BARKER RYAN STEWART

Urban Land Housing Group

Water Servicing Strategy

Lochinvar East

April 2021

ENGINEERING
PLANNING
SURVEYING
CERTIFICATION

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Project No.	PCB140046
Author	AM
Checked	DE
Approved	DE

Rev No.	Status	Date	Comments
A	Draft	17/03/2020	Draft issue for discussion
B	Draft	25/06/2020	HWC Comments
C	Draft	01/04/2021	HWC Comments

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1 Executive Summary

Development Background

This water servicing strategy has been prepared for the land located south of the New England Highway in the Lochinvar Urban Release Area. The subject land lies within the Maitland City Council local government area and is proposed to be developed into residential lots. The study area will comprise of approximately 3200 lots, a 2.5 ha commercial precinct and 1.5 ha of community park area. The R1 zoned land west of Station Lane, contributing an approximately1,320 lots, or Equivalent Tenements (ETs), has been considered in the study for the purposes of infrastructure sizing.

This strategy has been prepared in accordance with HWC requirements to prepare and analyse a proposed water supply network for the ultimate development within the study area. The water supply network has access to six points of connection to the existing reticulation network:

- 3 points of connection to the existing DN300 CICL water main along New England Highway, and
- 3 points of connection to the existing DN500 DICL water main traversing the subject site.

The results of the analysis have determined that portions of the study area will not achieve the minimum pressure head requirement of 20m due to elevation constraints. Two options have been considered in this water strategy report to ensure minimum pressure head of 20m is provided to all parts of the study area.

Servicing Options

- Option A: High-Level Reservoir provided at the highest elevation near to the study area. Provide two supply loops, with the high elevation zone being supplied by the High-Level Reservoir.
- Option B: Provide two supply loops, with the high elevation zone being supplied by a booster pump station and permanent standby generator. A permanent backup generator will be provided to maintain pump operation in the event of power outage.

Option B is the recommended option for this water supply network. It is recommended that the water supply system detailed in this report be adopted as the servicing strategy for the proposed development area.

2 Abbreviations

ADD	Average Day Demand
AHD	Australian Height Datum
CICL	Cast Iron Cement Lined
DICL	Ductile Iron Cement Lined
ET	Equivalent Tenement
FSL	Finished Surface Level
HWC	Hunter Water Corporation
NPV	Net Present Value
PVC-O	Oriented Polyvinyl Chloride
REF	Review of Environmental Factors
RL	Reduced Level
URA	Urban Release Area
WSA	Water Supply Code of Australia
WPS	Water Pumping Station

3 Background

Barker Ryan Stewart has been engaged by Lochinvar Ridge Pty Limited to prepare a water servicing strategy for residential development of land within the southern portion of the Lochinvar Urban Release area.

3.1 Study Area

The study area for this water servicing strategy is located in Lochinvar, approximately 11 kilometres north-west of the City of Maitland central business district. The study area is located on the southern side of the New England Highway Lochinvar and is bounded by Winders Lane to the East, the railway to the south and bisected by Station Lane. The study area covers a total land area of 99.58 ha and is shown in **Appendix B**.

The subject land gently inclines from the southern side of the New England Highway, terminating at a low ridge along Winders Lane which visually separates the southern portion of the site from the highway. The topography of the site generally falls to the west, sloping between 2° and 6°.

3.2 Planning Context

The subject land is zoned R1 General Residential and E3 Environmental Management under the Maitland Local Environmental Plan 2011. An overview of the subject site zoning is provided in **Appendix B**.

3.3 Development and Staging

The study area comprises five proposed residential developments which are subject of Development Applications or Approvals from Maitland City Council. These developments total 1,358 residential lots ranging in size from 600 to 1,500m^2, three 0.5 ha community park areas and a 2.5 ha commercial precinct. The study area includes a further 53 ha of residential zoned (R1) land without current development proposals. A summary of the proposed developments is provided in **Table 3.1** with an overview of the study area shown in **Appendix B**.

Table 3.1 - Lochinvar Developments

Development	Developer	Equivalent Tenements	Ancillary Development
Lochinvar Ridge	Lochinvar Ridge Pty Ltd	654	1.5 Ha community park area
Hereford Hill	McCloy Group	282	
Lochinvar Downs	Lochinvar Downs Pty Ltd	307	2.5 Ha commercial precinct
Arrowfield Estate	Robert Road Pty Ltd	97	
137 Station Lane	Hunter Land Pty Ltd	18	
South/East Station Lane	-	550	Currently not approved
West Station Lane	-	1359	Currently not approved

3.4 Projected Development in the Study Area

Development within the study area is expected to proceed incrementally from the New England Highway, Robert Road and Station Lane with an expected annual uptake of approximately 250ET.

Construction of early stages commenced in late 2020. A summary of development staging and timing is presented in **Table 3.2**.

The current area of development consists of five primary residential developments with a total of approximately 1,340 residential lots ranging in size from 600 to 1,500m². The current development area also includes 1.5 ha of community parkland and a 2.5 ha commercial precinct. Development within the study area is expected to continue for approximately eight years commencing in 2021.

Table 3.2 - Development Staging Summary

Year	ET	Stage Description
2021	276	Connection to DN500 trunk main and construction of pressure boosting station or construction of reservoir to be provided in first year.
2022	284	
2023	205	
2024	189	
2025	148	
2026	116	
2027	51	
2028	89	
2029+	1905	R1 zoned land at 78 Winders Lane, south of Lochinvar Ridge and west of Station Lane

3.5 Liaison with Hunter Water

Advise was sought from HWC regarding technical information required for preparation of the water supply model. In particular, the service head pressure of the existing water main infrastructure for servicing the local development area was advised by Hunter Water in April 2019:

> *"Based on the model the BWL and the TWL for Lochinvar 2 Reservoir are 71.5 (m AHD) and 79.0 (m AHD), respectively.*
> *Depends on the AIV, the region can be serviced from Four Mile Creek or Lochinvar 2, therefore the minimum HGL can be 71.5 m AHD at the Lochinvar 2.*
> *The maximum HGL along DN300 in New England Highway and north of the development is 78.5 (m AHD) and the maximum HGL along DN500 in the south pf the development is 78 (m AHD).*
>
> *Considering the BWL as the minimum HGL and at least 20 m residual pressure plus 1 m head-loss, the highest elevation can be serviced within the development is 50.5 m."*

Following revision of the proposed subdivision lot layout, further advice was provided by Hunter Water in January 2020:

> *"Based on a quick look, you should be able to service all lots in Stage 1 from the DN300 on New England Hwy. The highest serviceable level at 20m minimum pressure is approximately 52m.*
>
> *All stages beyond this would require a water pump station and the minimum pressure requirements are 25m on a peak day and 12m backup/failure pressure on a 95 percentile Peak Day Demand day.*
>
> *When the WPS is not operating on a 95th peak day there will be a backup HGL of approximately 74m, so you should be fine for a failure scenario for the higher lots in Stages 3, 5 and 6.*
> *Lots in Stages 9 and 10 will be below the minimum backup pressure, and this will need to be discussed in the strategy. If the number of lots is small, Hunter Water **may** consider this acceptable, in lieu of a permanent generator at the WPS site."*

4 Options Development

4.1 Points of Connection and Available Capacity

Six points of connection have been identified within the study area:

- DN300 CICL trunk water main located on the northern side of the New England Highway near Robert Road.
- DN300 CICL trunk water main located on the northern side of the New England Highway near the Hereford Hill development intersection at Windella Road.
- DN300 CICL trunk water main located on the northern side of the New England Highway near Lochinvar Ridge development at the entrance to "Airds of Lochinvar".
- DN500 DICL trunk water main using an existing DN250 offtake, approx. 400m west of Lochinvar 2 Reservoir.
- DN500 DICL trunk water main using an existing DN250 offtake, approx. 900m west of Lochinvar 2 Reservoir.
- DN500 DICL trunk water main using an existing DN250 offtake at Station Lane, approx. 1,800m west of Lochinvar 2 Reservoir.

A DN500 DICL Trunk Water main was constructed through the study area in 2016 as part of the Stage 3 of the Maitland North Rothbury Water Supply Upgrade. This trunk water main connects the Winders Lane Reservoir to the Rutherford Water supply system and is designed to provide water supply for the proposed development area.

4.2 Network Demand Requirements

The water supply network total demand requirements have been determined for the proposed developments detailed in **Table 3.1**, existing lots which will be serviced by the water supply network and potential future development of R1 zoned land within the Lochinvar Urban Release Area. The network will also service 2.5 ha of proposed commercial development, and 1.5 ha of irrigated community park area.

A summary of the water supply network water demand requirements is provided in **Table 4.1**.

Table 4.1 - Water Supply Network Requirements

Development	Demand	Comment
Residential		
Proposed lots	1358 ET	
Future Lot Allowance (Lochinvar East R1 zoned land)	550 ET	Proposed ET count taken from Parsons Brinkerhoff Lochinvar Water Supply Strategy August 2011
Future lot allowance (Lochinvar West R1 zoned land)	1359 ET	
Total	3267 ET	
Commercial	2.5 ha	
Irrigated Community Park Area	1.5 ha	

4.3 Design Water Demands

Infrastructure sizing for the local development area has been determined based on the demand requirements for the future developed site. Demands were calculated in accordance with WSA 03-2011-3.1 Water Supply Design Demands. **Table 4.2, Table 4.3** and **Table 4.4** below detail the calculation of supply demands.

Table 4.2 - Network Demand Calculations – Residential Development

	Value		Unit	WSA 03-2011-3.1 Reference
	Peak & Extreme Day Demand	**95% Peak Day Demand**		
Equivalent Tenements (ET's)	3182	3182		
Average Annual Consumption	285	285	kL/y/ET	Table 2.4(a)
Average Daily Flow	780.8	780.8	L/d/ET	
Average Daily Rate	0.009	0.009	L/s/ET	
PDF	2.25	1.8		Table 2.4(c) Table 2.4(i)
Peak Day	0.020	0.016	L/s/ET	
Diversity Factor	1.119	-		Clause 2.3.4.2(b)
Peak Day Demand	0.022	0.016	L/s/ET	
Diurnal Diversity Factor	1	-		Clause 2.3.4.7
Peak Hour Factor	2.02	2.02		Table 2.4(e), 8pm
Factored Peak Hour Demand	0.046	0.033	L/s/ET	
Factored Peak Hour Demand	150.14	107.35	L/s	

Table 4.3 - Network Demand Calculations - Commercial Development

	Value		Unit	WSA 03-2011-3.1 Reference
	Commercial Day Demand	**95% Commercial Day Demand**		
Area	2.5	2.5	ha	
Average Annual Consumption	4200	4200	kL/ha	Table 2.4(a)
Average Daily Flow	11506.8	11506.8	L/d/ha	
Average Daily Rate	0.133	0.133	L/s/ha	
PDF	1.6	1.52		Table 2.4(c) Table 2.4(i)
Peak Day Demand	0.213	0.202	L/s/ET	
Peak Hour Factor	1.9	1.9		Table 2.4(e)
Peak Hour Demand	0.405	0.385	L/s/ET	
Peak Hour Demand	1.012	0.961	L/s	

Table 4.4 - Network Demand Calculations – Irrigated community park area

	Value	Unit	Reference
	Parks Day Demand		
Area	1.5	ha	
Average Annual Consumption	250	kL/y/ha	Sydney Water[1]
Average Daily Flow	684.932	L/d/ha	
Average Daily Rate	0.008	L/s/ha	
PDF	1.6		Table 2.4(c)
Peak Day Demand	0.013	L/s/ha	
Peak Hour Factor	1.5		Table 2.4(e)
Peak Hour Demand	0.019	L/s/ha	
Peak Hour Demand	0.029	L/s	

[1]Sydney Water, *Best practice guidelines for holistic open space turf management in Sydney* (2011), Table 2.

EPANET was used to model the proposed water supply network using factored diurnal demands with hourly timesteps over a 24-hour period. Diurnal demands were calculated by applying the diurnal demand factors from the WSA code to the Peak Day Demands calculated in **Table 4.2**, **Table 4.3** and **Table 4.4**. The diurnal demand calculations used in EPANET modelling can be found in **Appendix C**.

5 Servicing Options

Two potable water servicing options have been considered in this servicing strategy, namely:

- Construction and connection of a High-Level reservoir
- Construction and installation of a booster pump station

The proposed water supply network was analysed using EPANET software utilising design demands and initial parameters detailed in Section 4 of this report. These options propose the use of PVC-O water mains of various sizes from DN100 to DN300 to service the study area.

Detailed lot layouts are not yet available for the R1 zoned land in the southern and western Station Lane areas. In these locations, the equivalent tenements (ET's) detailed in the 2011 Lochinvar Water Supply Servicing Strategy prepared by Parson Brinkerhoff have been adopted. Trunk infrastructure has been sized for the ultimate development. The proposed locations of the trunk infrastructure should be considered nominal.

5.1 Option A – High Level Reservoir

5.1.1 Technical Constraints

This option considers the construction of a high-level reservoir in or near the study area.

The highest area of residential zoned land within the study area has an elevation of approximately RL77.5m AHD within 78 Winders Lane. To satisfy Hunter Water's minimum service pressure requirement of 20m head, a high-level reservoir with a bottom water level of at least RL 97.5m AHD is required to supply the development of the elevated parts of the study area.

The topography of the surrounding land of the study area is not sufficiently elevated to enable the construction of a high-level reservoir land with a bottom water level of RL 97.5m AHD. The nearest land with an elevation of at least 97.5m AHD is approximately 5km south westerly from the study area.

Due to the remoteness from the study area of suitable elevated land for the construction of a high-level reservoir, this option will not be explored further.

5.2 Option B – Booster Pump

5.2.1 Technical Constraints

There are portions of the study area which cannot not achieve the Hunter Water minimum service pressure requirement of 20m head when connected to a reticulated water supply system due to the elevated nature of the land. To ensure that all parts of the study area can satisfy the minimum pressure requirements it is proposed split the network into low and high elevation supply systems. The supply loop for the high elevation zone will utilise a booster pump to provide a minimum 25m head to all properties in this elevated zone. **Figure 5.1** provides a diagrammatic illustration of the proposed high (pressure boosted) and low elevation (gravity supplied) networks.

A plan illustrating the affected lots is provided in Appendix B. A total of 1,624 ET's will be serviced by the boosted water supply network.

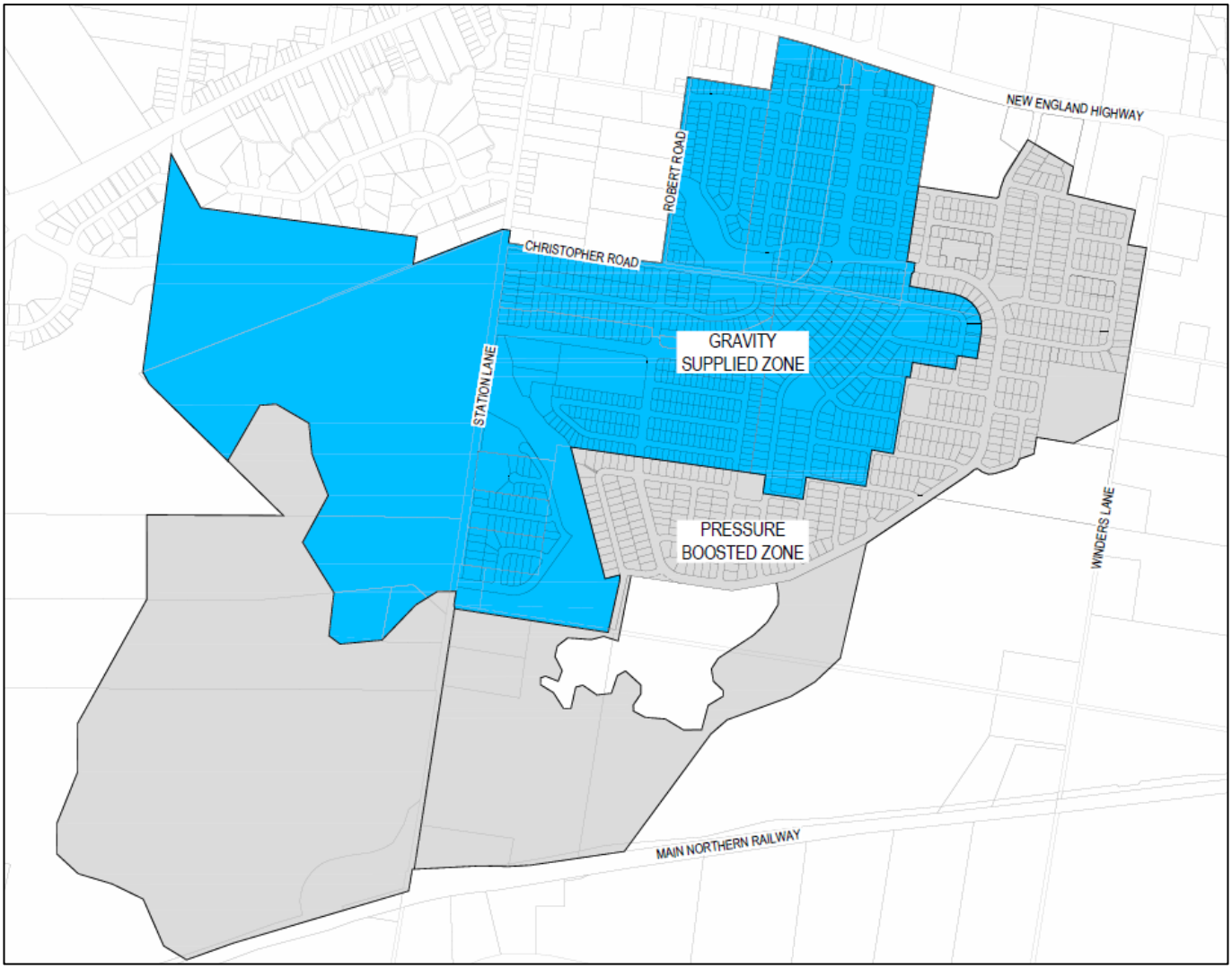

Figure 5.1 - Pressure boosted and gravity supplied zones.

A Hunter Water requirement of pressure boosted systems is that all lots are serviced by a minimum 12m head for 95th percentile peak day demand in the event of pump failure. With a backup HGL of 74m AHD available in the distribution water network, the maximum elevation within the study area which satisfies this criterion is 62m AHD. To the south and west of the study area where the future lot layout is not known, a maximum serviceable elevation of 60m AHD was adopted to account for head loss within the water supply network.

There are three locations within the study area where this requirement cannot be achieved due to elevation constraints, as shown in **Figure 5.2**. In those parts of the study area without a proposed lot layout, the equivalent tenements (ET's) detailed in the 2011 Lochinvar Water Supply Servicing Strategy were adopted. A total of 439 ET's are impacted by insufficient backup pressure.

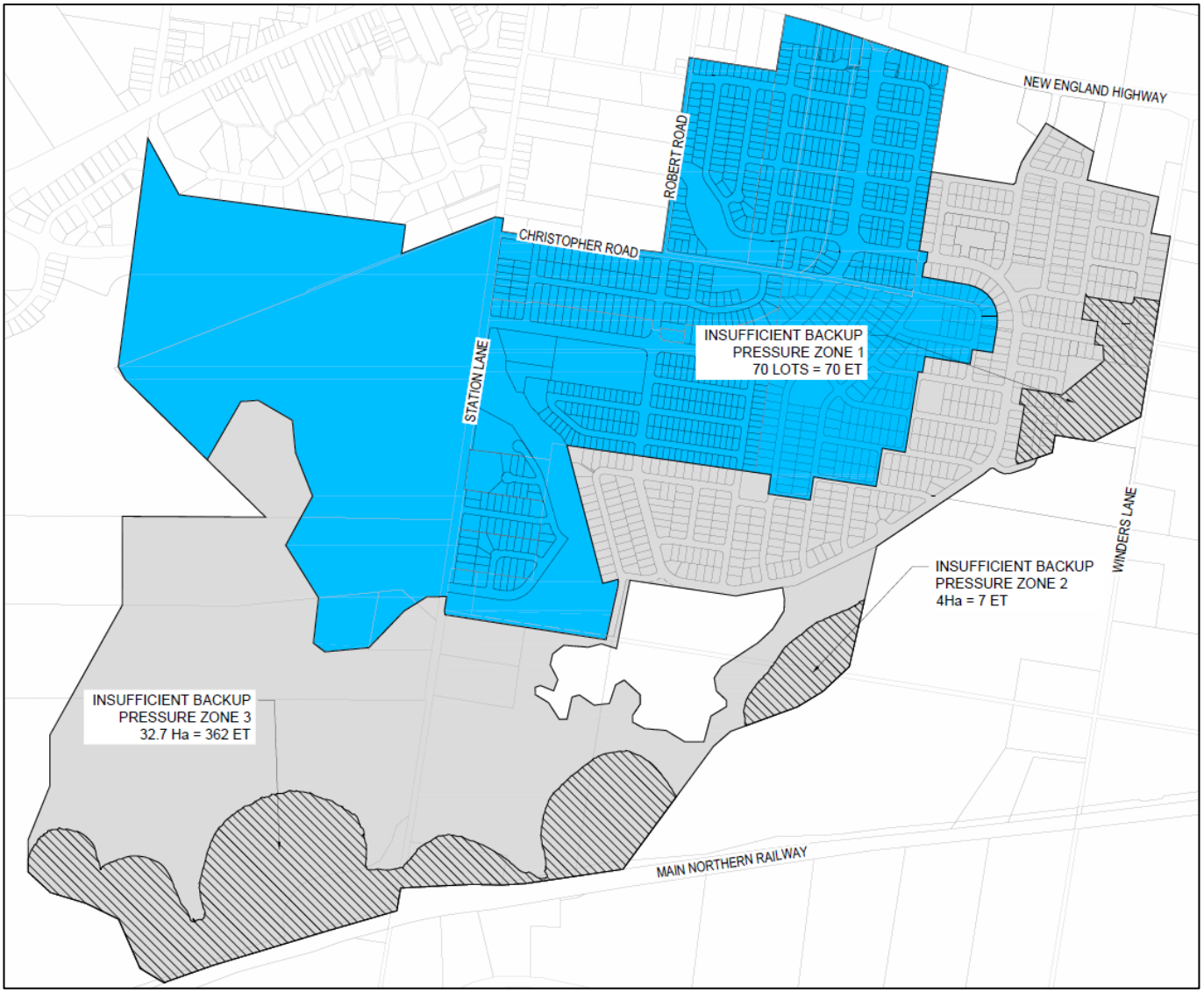

Figure 5.2 - Insufficient backup pressure zone

5.2.2 Community/Stakeholder Constraints

Connection to the existing DN300 trunk water main along the New England Highway may require an isolated temporary shutdown. The isolated temporary shutdown may affect a small number of properties which are serviced from this main. HWC's standard shutdown procedure will be followed to allow adequate notice to residents and coordinate shutdowns to off-peak usage times. All other watermain construction can be delivered without supply interruption to existing residents.

5.2.3 Environmental Constraints

Earthworks are to be carried out as part of the approved developments to create suitable building areas, with development consent being sought for these works. The proposed earthworks will not result in a detrimental impact to the site or surrounding lands.

No significant environmental constraints have been identified which will affect the construction and operation of the water supply network.

5.3 Water Demand Assessment

EPANET was used to model the Option B water supply network, using factored diurnal demands shown in Section 4.3 and Appendix C with hourly timesteps over a 24-hour period.

Ultimate development conditions were used as the basis for producing the EPANET model incorporating demands from adjacent developments. The ultimate pipe network was modelled using the proposed cadastral boundaries for the local development area. Proposed water main elevations were determined from Light Detection and Ranging (LIDAR) survey data, obtained from NSW Spatial Services. The water main network layout was designed in accordance with WSA 03.2011-3.1.

Proposed lots were represented in the network as nodes, with each node accounting for a maximum of 10 lots (10ET) within the area of approved developments. The commercial precinct and three community park areas were represented with one node each. Commercial and parkland diurnal demands were applied for these nodes as calculated in **Appendix C.** Computation within the southern and western sectors of the study area was modelled using representative ETs for each node.

Figure 5.3 is a screenshot of the water supply network modelled in EPANET.

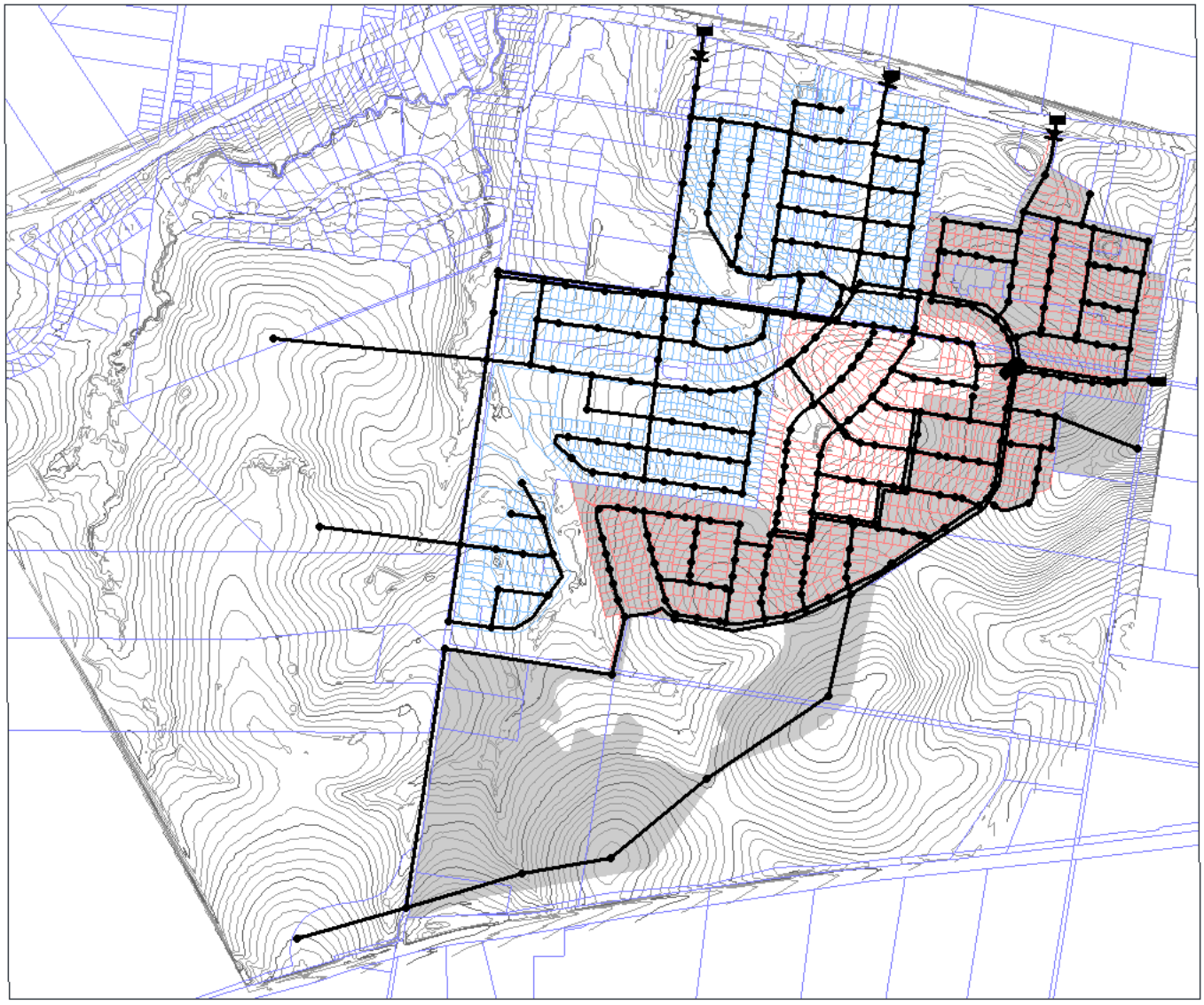

Figure 5.3 - EPANET water network model

5.3.1 Initial Parameters

Initial Parameters were adopted for the model in accordance with WSA 03.2011-3.1 and advice from HWC. A summary of the water supply boundary conditions is provided in **Table 5.1**.

Table 5.1 - Water supply boundary conditions

Water Supply Point	Hydraulic Pressure head
New England Highway DN300 CICL Trunk Main	72 m AHD
Lochinvar 2 Reservoir	74 m AHD

Losses due to pipe roughness were calculated during modelling using the Darcy-Weisbach formula. A Darcy-Weisbach coefficient of 0.4mm was adopted for all pipes, a conservative value selected to account for losses due to appurtenances and bends within the network.

5.3.2 Residual Pressure Requirements

The residual pressure requirements for the water supply network in accordance with WSA 03.2011-3.1 are summarised in **Table 5.2**.

Table 5.2 – Residual Pressure Requirements

Maximum	
All Applications	60m
Minimum	
Peak hour flow on a peak day	20m
Peak hour flow on extreme day	12m
Peak hour flow on 95th percentile peak day plus firefighting flow (at location of fire)	15m
Peak hour flow on 95th percentile peak day plus firefighting flow (at location other than fire)	3m
Booster pump station minimum pressure	25m
Peak hour flow on 95th percentile peak day in event of pump failure	12m

To check the system for firefighting capacity, several nodes deemed critical within the network were chosen for analysis as illustrated in **Figure 5.6**. The critical nodes were subject to a continuous outflow of 10L/s for residential lots and 20L/s for commercial developments in accordance with Hunter Water requirements. All other nodes were modelled with the 95th percentile factored peak day demands.

5.3.3 Booster Pump Station Requirements

Due to areas of low pressure in the development area, a booster pump was included in the model from the existing DN500 DICL trunk main to a DN300 trunk main. The booster pump station was located at the existing DN250 offtake from the DN500 trunk main, approx. 400m west of the Lochinvar 2 Reservoir as illustrated in **Figure 5.4**.

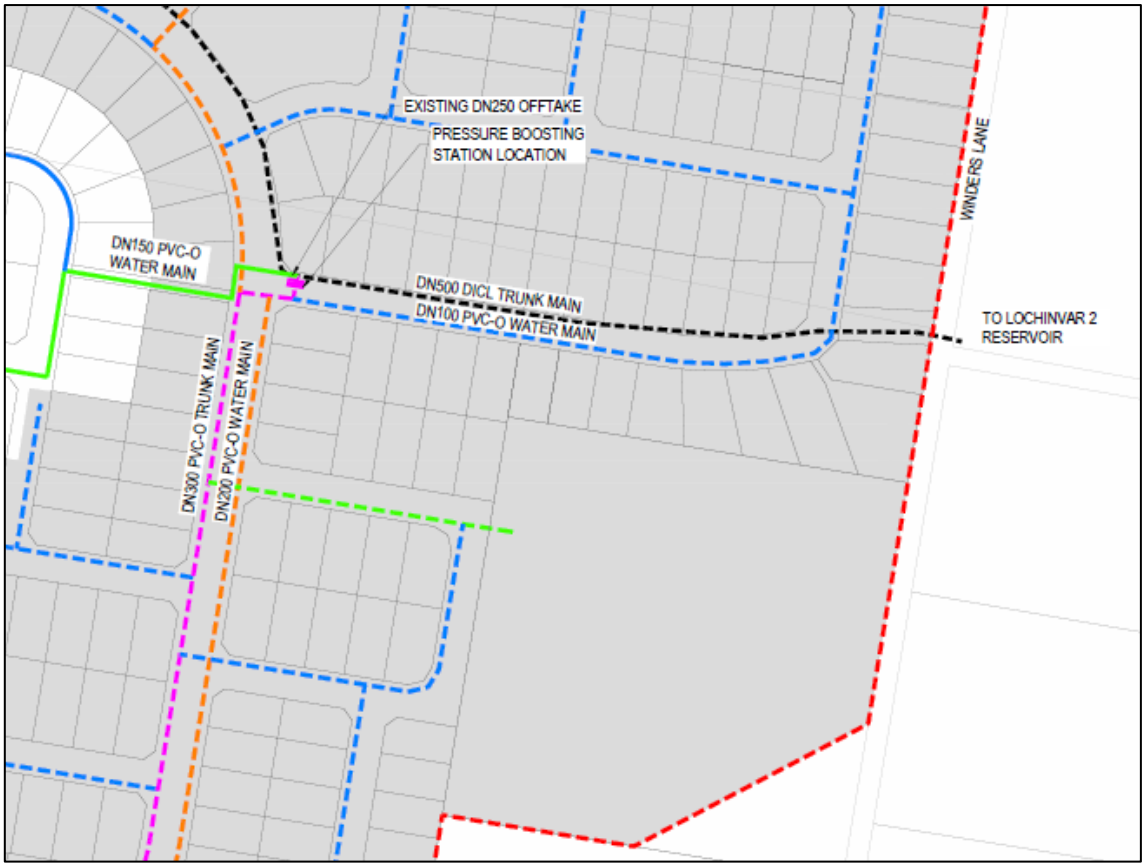

Figure 5.4 - Pressure boosting station location.

Flow requirements for the booster pump station were determined using the demand requirements calculated in Section 4.3. A summary of the pressure boosted zone water demands is presented in **Table 5.3**. Flow demands for the community park area within **Table 5.3** are for flow demands at 8pm, to coincide with the peak hour demand for residential development.

Table 5.3 - Booster pump station flow requirements

	Value		Unit
	Peak & Extreme Day Demand	**95% Peak Day Demand**	
Residential			
Factored Peak Hour Demand (8pm)	0.046	0.033	L/s/ET
Equivalent Tenements (ET's)	1624	1624	
Factored Peak Hour Demand	74.844	53.36	L/s
Community Park Area			
Factored Peak Hour Demand (8pm)	0.0109	0.0109	L/s/ha
Area	1.5	1.5	ha
Factored Peak Hour Demand	0.016	0.016	L/s
Total Peak Hour Demand	74.86	53.376	L/s
Booster Flow Requirement*	74.86	63.376	L/s

*** Booster flow requirement for 95% peak day demand includes 10L/s for firefighting flow.**

The highest serviced elevation within pressure boosted zone is 77.5m AHD, located within the adjacent R1 land within 78 Winders Lane. With a serviceable HGL from Lochinvar 2 Reservoir of 74m AHD and a minimum pressure requirement of 25m, the booster pump station is required to provide minimum 28.5m head during peak hour demand. A Grundfos HYDRO MPC E 3 CRNE 64-2-2 variable speed booster pump set was adopted for modelling and was implemented in the model using EPANET's multi point pump curve functionality. The variable speed pump curve is provided in **Figure 5.5**. A variable speed pump controller will be required with the pump set to reduce pressure during reduced flow.

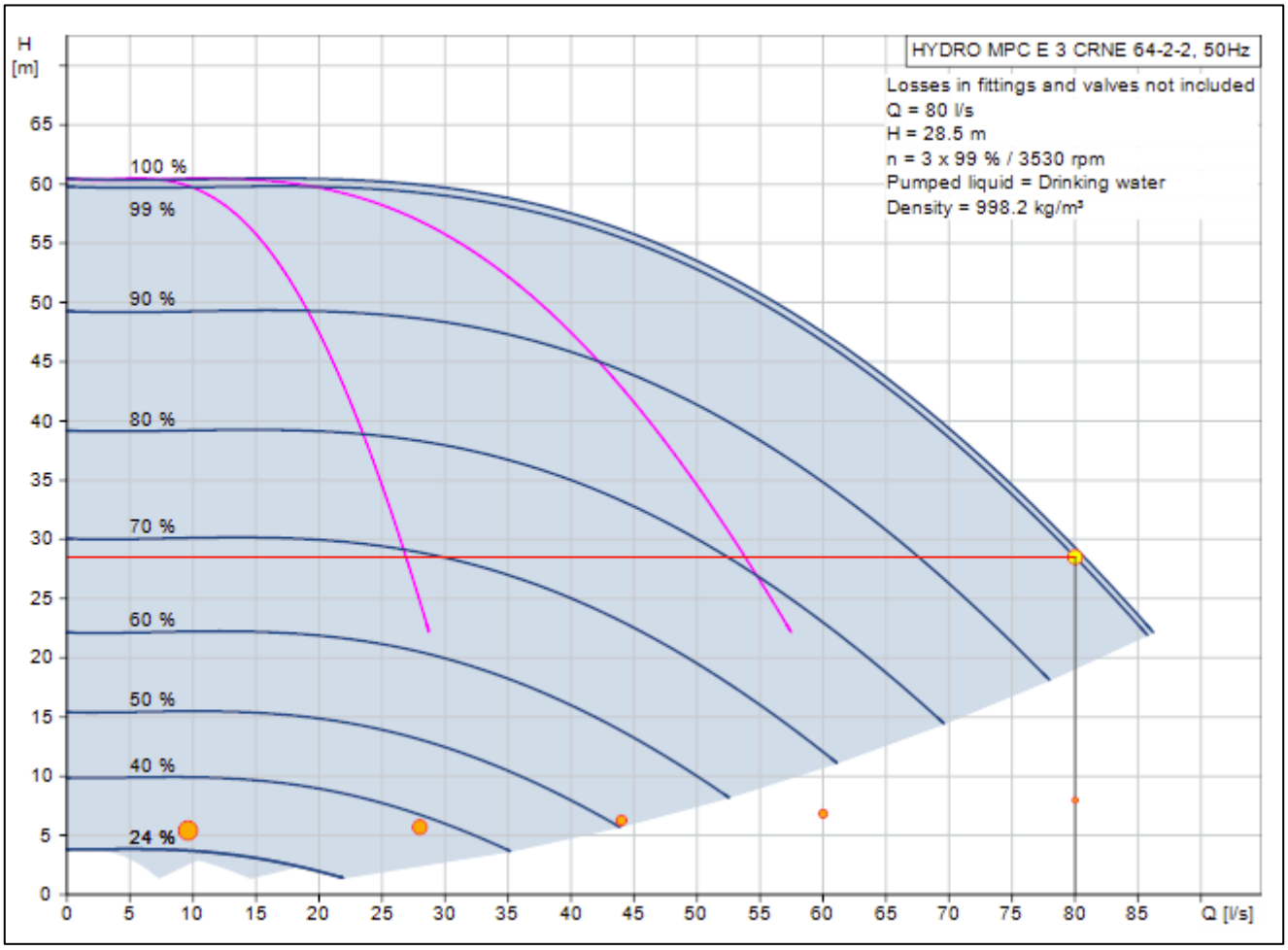

Figure 5.5 - Pressure Booster Pump Curve

5.3.4 Fire Flow Assessment

To check the system for firefighting capacity, several nodes deemed critical within the network were chosen for analysis as illustrated in **Figure 5.6**. The critical nodes were subject to a continuous outflow of 10L/s for residential lots and 20L/s for commercial developments, in accordance with Hunter Water requirements, and all other nodes were modelled with the 95th percentile factored peak hour demands.

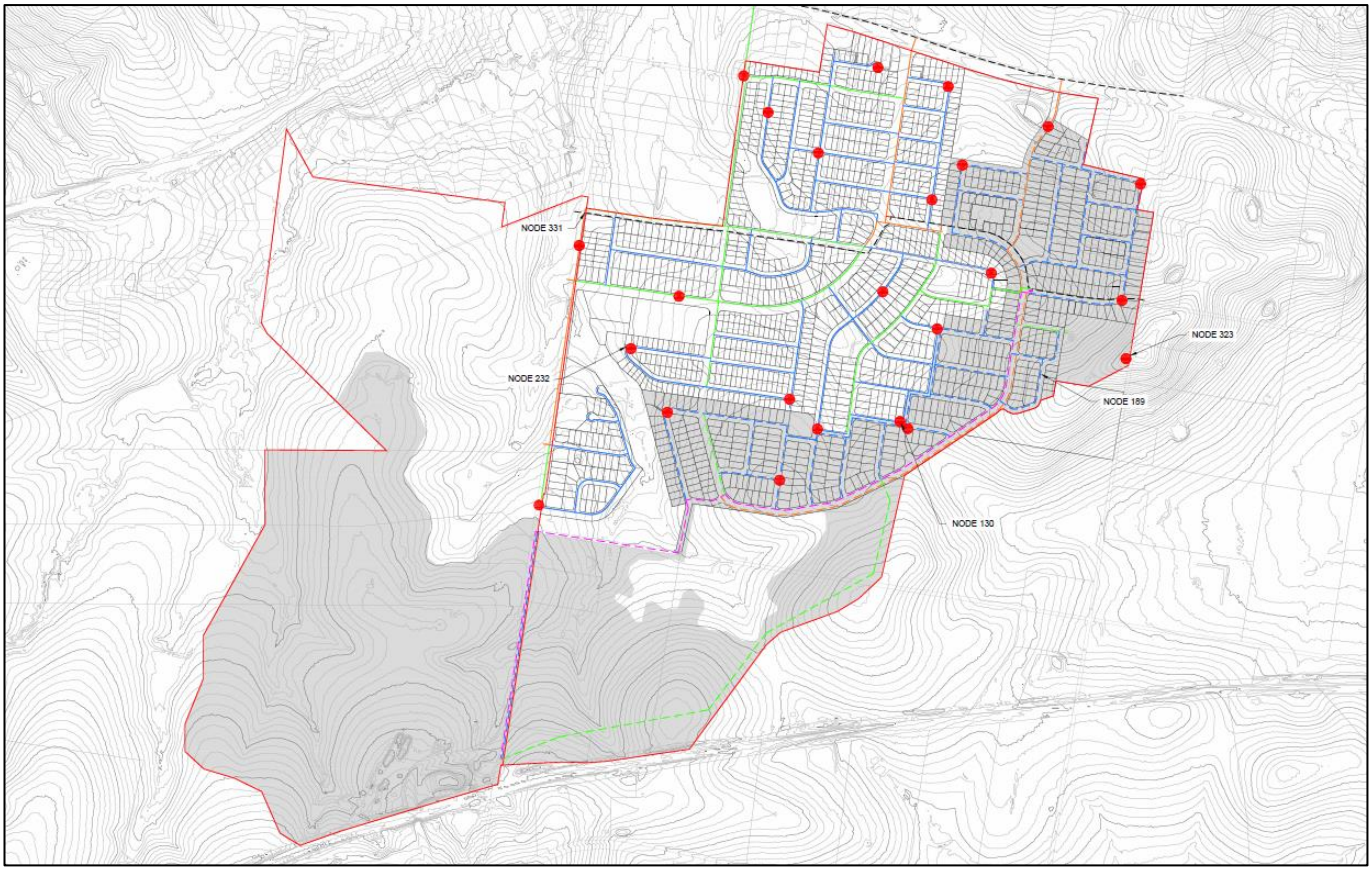

Figure 5.6 - Fire flow assessment locations shown as red spots.

All fire flow assessments confirmed a minimum pressure of 12m is maintained at all points throughout the network. A summary of the critical fire flow modelling results is presented in **Table 5.4**.

Table 5.4 - Fire flow assessment results

	Pressure (m)	Node	Location
Pressure at Node	24.96	323	78 Winders Lane
Minimum Pressure in System	28.56	189	East Lochinvar Ridge

5.3.5 Peak Demand Assessment

EPANET modelling was undertaken for the water supply network using peak day demands calculated in Section **Error! Reference source not found.**. A summary of the modelling results is presented in **Table 5.5**.

Table 5.5 – Peak hour demand assessment results

	Pressure (m)	Node	Location
Gravity Supplied Zone			
Maximum Pressure	39.92	331	West Lochinvar Downs
Minimum Pressure	20.79	130	Central Lochinvar Ridge
Pressure Boosted Zone			
Maximum Pressure	58.67	232	Southwest Lochinvar Ridge
Minimum Pressure	25.34	323	78 Winders Lane

The modelled results shown in **Table 5.5** indicate HWC minimum and maximum pressure requirements are satisfied during peak day demands. Minimum pressure within the pressure boosted zone was observed at node 323, which represents the R1 zoned land at 78 Winders Lane.

5.3.6 **Security of Supply Assessment**

The water supply network was assessed for security of supply in the event of one of three independent system failures:

5.3.6.1 Isolation of the DN500 trunk main

To maintain security of supply, three connections to the existing DN300 CICL the New England Highway are proposed. These points of connection will be controlled using non return valves during normal operation and will service the water supply network in the event of supply disruption. The DN500 trunk main is the sole point of connection for the boosted supply zone. In the event of failure this entire zone will be without water.

5.3.6.2 Isolation of the Reservoir

To maintain security of supply, three connections to the existing DN300 CICL the New England Highway are proposed. These points of connection will be controlled using non return valves during normal operation and will service the water supply network in the event of supply disruption from the Lochinvar 2 reservoir.

In the event of reservoir failure, HWC require a minimum of 12m pressure to all impacted properties during 95th percentile peak day demand. The maximum elevation which can satisfy this requirement without boosted supply in the study site is 60m AHD.

During 95th Percentile peak Day Demand, the minimum pressure observed was 2.07m AHD. **Figure 5.7** below illustrates this scenario, with the blue nodes receiving below 20m pressure and red nodes receiving below 12m pressure.

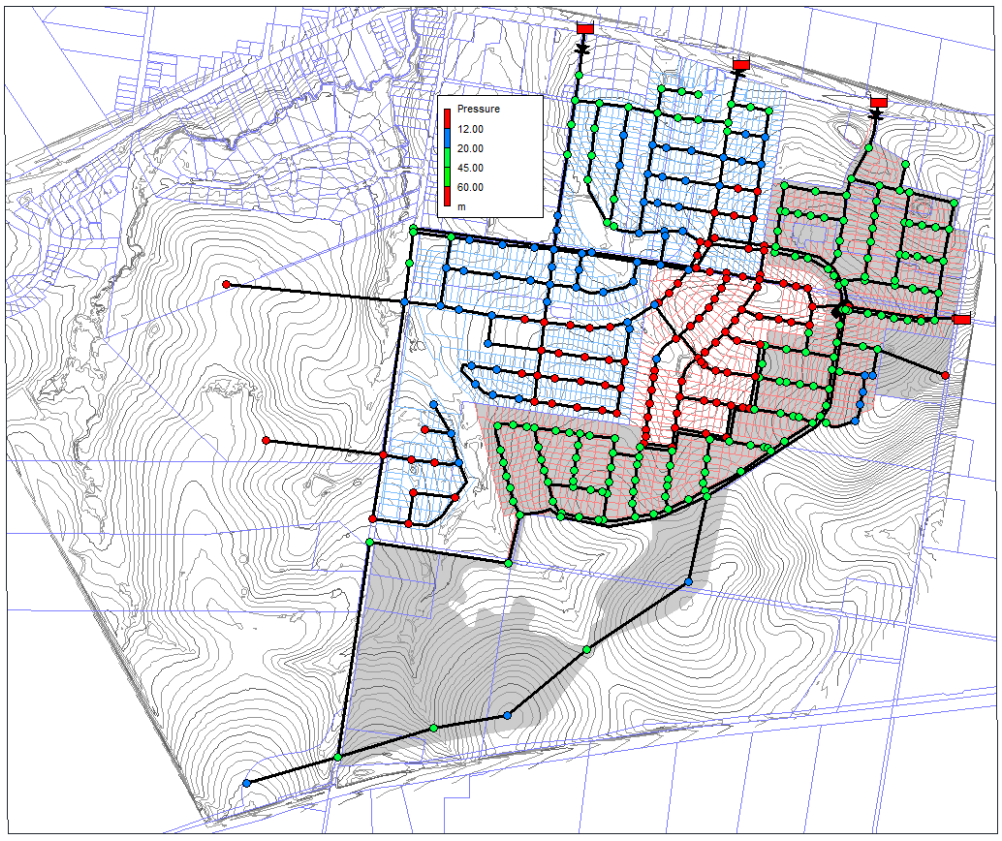

Figure 5.7 - EPANET water network - Reservoir isolation

5.3.6.3 Failure of the booster station

In the event of booster station failure, HWC require a minimum of 12m pressure to all impacted properties during 95th percentile peak day demand. The maximum elevation which can satisfy this requirement in the study site is 62m AHD.

To assess the impact of booster station failure, the pump was bypassed in the model by a DN250 watermain to simulate standard pressure supply from the DN500 trunk main. **Figure 5.8** below illustrates this failure scenario, with the blue nodes receiving below 20m pressure and red nodes receiving below 12m pressure. A total of 439 ET's within the study area and the R1 zoned land west of Station Lane are impacted by insufficient backup pressure.

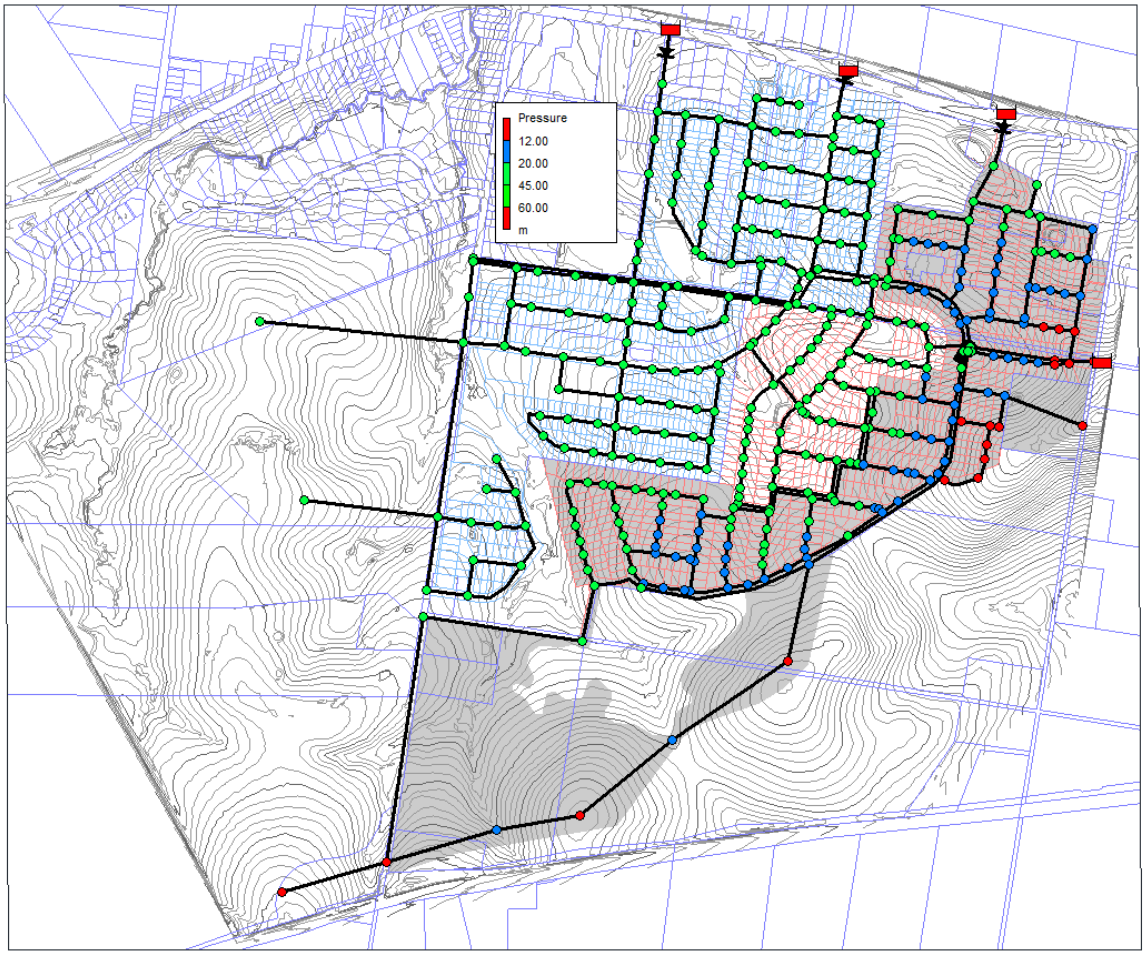

Figure 5.8 - EPANET water network - booster station failure

5.3.6.4 Failure of the single feed trunk mains from the booster station

Water supply from the booster station to the boosted water supply network uses a single feed DN300 trunk watermain. To assess security of supply, the model was analysed with sections of this watermain closed to simulate isolation during 95th percentile peak hour demand. In these events a 2 DN200 supply main is utilised as a bypass.

In this analysis, the maximum velocity observed within the DN200 water main was 1.5m/s, and the minimum pressure observed was 22.98m AHD in the R1 zoned land west of Station Lane. These results are deemed adequate for security of supply in the event of short-term isolation of the DN300 trunk main.

6 Options Review

6.1 Infrastructure Description

The proposed network will comprise PVC-O PN16 water main pipe, ranging in size from DN100 to DN300. Standard Ductile Iron appurtenances are proposed and will be located in accordance with WSA 03.2011-3.1.

A pressure booster pump capable of delivering 80L/s at 28.5m pressure is required for this development. For the purpose of this strategy, a Grundfos Hydro MPC E3 CRNE 64-2-2 booster pump has been considered for energy calculations. The pump requires a variable speed controller to reduce the pressure within the boosted network during periods of reduced flow. A non-return valve is proposed at the connections to the existing DN300 CICL trunk main in the New England Highway to isolate the boosted zone. The water network layout can be found in **Appendix B.**

To mitigate the risk of booster pump failure as detailed in Section 5.3.6.3, a permanent generator at the location of the booster pump station is required. The generator will be sized to sufficiently power the booster pump for the peak hour flow on a 95th percentile peak day.

6.2 Financial Criteria

6.2.1 Capital and Replacement Cost

Capital cost estimates were calculated using HWC's *Estimating Guidelines V3.4* spreadsheet. The cost estimate included design and construction of all reticulation water mains and the water pump station including backup generator. The following site parameters were adopted as defaults for cost estimating:

- Project classification: A (New Subdivision)
- Terrain: B (Hilly)
- No trenching under powerlines
- No excavation close to services
- No tree removal required
- Rock excavation not quantified

A breakdown of the capital cost estimate is presented in **Table 6.1**. A detailed breakdown of the cost estimate can be found within **Appendix E**.

Table 6.1 - Capital Cost Estimate

B.	**PRE-CONSTRUCTION COST (Table 10)**	
	Design	$751,648.82
	Project Management of Design	$166,329.76
	Sub Total (B1)	$917,978.59
	Preconstruction contingency (30% of B1)	$275,393.58
	TOTAL PRE-CONSTRUCTION COST (B)	$1,193,372.16
C.	**CONSTRUCTION COST**	
	Total Estimated Contract Award Sum (A)	$7,516,488.22
	Construction Management (Table 11)	$676,483.94
	Sub Total (C1)	$8,192,972.16
	Construction contingency (Table 12) (30% of C1)	$2,457,891.65
	TOTAL CONSTRUCTION COST (C)	$10,650,863.81
	TOTAL PRELIMINARY PROJECT ESTIMATE (B+C) (Preliminary Estimate)	$11,844,235.98

6.2.2 Operating Cost

The operating cost of the proposed boosting pump station has been calculated in accordance with HWC's Operating and Maintenance Cost Estimating Guideline. A breakdown of the operating cost estimate is presented in **Table 6.2**.

Table 6.2 - Booster Pump Operating Cost

Parameter	Value	Units
Pump Type	Grundfos Hydro MPC E3 CRNE 64-2-2	
Design Flowrate (PHF)	80	L/s
Design Pressure Head Increase	28.5	m
Energy Usage	69,426	kWh/year
HWC Electricity Prices (2020/21)	38.0	c/kWh
Annual Operating Cost (2020/21)	26,381.88	$
Lifecycle	15	Years
Discount Rate	7	%
Lifecycle Cost	266,665.80	$
Discounted Cashflow Sensitivity @ 4%	4	%
Lifecycle Cost	319,705.80	$
Discounted Cashflow Sensitivity @ 10%	10	%
Lifecycle Cost	227,044.60	$

6.2.3 Maintenance Cost

The maintenance cost of the proposed water network has been calculated in accordance with HWC's Operating and Maintenance Cost Estimating Guideline.

Table 6.3 - Water Network Maintenance Costs

Pipe Diameter	Cost ($/km)	Length (km)	Cost/year ($)
DN100	800	17.188	13,750.40
DN150	520	6.587	3,425.24
DN200	520	3.313	1,722.76
DN250	520	0.215	111.80
DN300	520	2.610	1,357.20
Total			**20,367.40**

The maintenance cost of the proposed water pump station has been calculated in accordance with HWC's Operating and Maintenance Cost Estimating Guideline.

Table 6.4 - Water Pump Station Maintenance Cost

Power Consumption (MWh/year)	69.426
Maintenance Cost ($/MWh/year) (Variable Speed)	200
Cost/year ($)	13,885.20

6.3 Social Impact

The proposed water network will have minimal negative social impact on both existing and future residents in the Lochinvar region once established. The installation of the diesel backup generator will require a waterproof, above ground structure with a similar appearance to an electrical substation. During operation of the backup generator minor noise and exhaust fume odour could be expected.

Construction of the water network and the development as a whole will be staged so that existing development will not be significantly impacted by the construction of future stages of the network (i.e., impeded access, excess noise and vibration etc). Works will be conducted under an approved Construction Management Plan (CMP).

6.4 Environmental Impact

The study area is currently modified pasture with planted windbreaks, gardens, and dams. Generally, fauna habitat is limited due to a lack of structural complexity. There is no significant vegetation or hollow bearing trees located within the area of the approved subdivisions. The impact assessment concluded that the proposal will not have a significant impact on any locally occurring EECs, threatened flora or fauna species, or migratory species.
Recommendations have been made to minimise localised impacts on biodiversity as a result of the development; these include:

- Trees having potential habitat hollows should be 'soft felled' by an experienced machine operator and attended by a suitably experienced fauna ecologist to ensure the safety of any fauna occupying hollows.
- Best practice erosion and sedimentation control methods should be adopted, enforced, and maintained throughout any earthworks during the construction phase to avoid having a negative impact on water quality downstream.

An Aboriginal Heritage Due Diligence Assessment was undertaken for part of the study area by Archaeological Risk Assessment Services (ARAS) to identify and assess likely Aboriginal heritage potential and provide appropriate risk management advice.
Several Aboriginal sites have been identified in the study area, with all sites considered to be of low scientific significance and have low archaeological significance. A total of four (4) Potential Archaeological Deposits (PADS) were identified as part of the assessment. These areas are of medium archaeological significance, due to their landscape setting, condition, and content.
Based on the current archaeological evidence, there are no objections to any future development proposal proceeding on scientific significance grounds. An Aboriginal Heritage Impact Permit (AHIP) has been issued under Section 90 of the National Parks and Wildlife Act 1974 by NSW Planning, Industry & Environment for the site.

Option B requires the provision of an on-site standby diesel-powered generator at the location of the booster pump station. During operation, the generator will generate noise and exhaust fumes which may impact local residents. To mitigate these impacts, the lockable generator housing will be insulated with noise absorption and deadening material, subject to HWC approval. The generator exhaust will be configured in a fashion such that exhaust fumes are projected upwards clear of pedestrians. While the impact of odour and noise on nearby residents will be moderate, the frequency of generator operation will be infrequent.
The generator will store diesel in an on-site fuel tank, which poses a risk of pollution in the event of leakage or spillage. The enclosure is to incorporate a bund to collect diesel fuel spillage or engine oil spillage.

6.5 Technical Assessment

6.5.1 Option A - High Level Reservoir

The high-level reservoir option has been rejected due to the lack of nearby elevated land which could accommodate the reservoir. This option will not be investigated further.

6.5.2 Option B – Pressure Booster Pump & Generator

6.5.2.1 Performance

The network has been designed and modelled to ensure all customers will achieve adequate pressure in accordance with HWC's guidelines. The pressure booster pump will have a variable speed controller to ensure water pressure within the network is within an acceptable range.

6.5.2.2 System Reliability

The network will be reliant on the performance of the booster pump, the performance of the emergency generator and a constant water supply from the DN500 trunk main to provide adequate pressure to lots within the pressure zone.

6.5.2.3 Flexibility and Adaptability

The network has been designed and sized to connect with adjacent developments to improve flexibility and adaptability.

6.5.2.4 Maintainability

The network is designed for standard materials in accordance with the WSA code and HWC approved suppliers for nominal maintainability. The on-side generator will require regular servicing and maintenance in accordance with HWC's maintenance schedule. The generator will require an on-site fuel tank and bunding, and diesel will need to be replenished when in use or replaced when stored for extended periods of time. The feed pump will require regular servicing in accordance with HWC's maintenance schedule.

6.5.2.5 Security of Supply

The network will be supplied by the DN500 trunk main, which is fed from two reservoirs for security of supply. The water supply network has been designed to minimise the number of single feed mains and duplicate them where necessary. The onsite generator will ensure security of supply to lots within the pressure boosted zone in the event of power outage.

7 Recommended Option

A water supply network was designed in accordance with HWC's design specifications to provide water to the proposed residential lots within the study area. Due to elevation constraints, there are portions of the proposed development which cannot not achieve the Hunter Water minimum service pressure requirement of 20m head by connection to existing trunk main infrastructure.
Two supply options were considered in this water strategy report:

- **Option A:** Provide a High-Level Reservoir to service the elevated portions of the study area.
- **Option B:** Provide two supply loops, with the high elevation zone being supplied by a booster pump station and permanent standby generator.

Option B is the recommended option for this water supply network. It is recommended that the water supply system detailed in this report be adopted as the servicing strategy for the proposed development area.

8 References

Chenery, N, Cupitt, P, Wynn, J. (2011), *Lochinvar Water Supply Servicing Strategy*, Parsons Brinkerhoff, Newcastle.

Grundfos (2021), *HYDRO MPC E 3 CRNE 64-2-2*, Website: https://product-selection.grundfos.com/products/hydro-mpc/hydro-mpc-e/hydro-mpc-e-3-crne-64-2-2-99734986, Last accessed 17th March 2021.

Hunter Water Corporation (2008), *Water and Sewer Design Manual Section 5 – Water Pumping Stations*, Hunter Water Corporation, Newcastle.

Hunter Water Corporation (2011), *Water and Sewer Design Manual Section 7 – Tank/Reservoir Standards*, Hunter Water Corporation, Newcastle.

Sydney Water (2011), *Best practice guidelines for holistic open space turf management in Sydney, Sydney Water, Sydney*.

Water Services Association of Australia (2011), *Water Supply Code of Australia WSA 03-2011-3.1 – Hunter Water Edition Version* 2, Water Services Association of Australia, Sydney.

Appendix A – HWC Correspondence

Angus Macleod

From: Kai Woodham <kai.woodham@hunterwater.com.au>
Sent: Wednesday, 24 April 2019 7:56 AM
To: Angus Macleod
Subject: FW: HWC ref 2017-969 - Water Supply Strategy - GIS plan and details

Categories: M-Files

Angus,

Based on the model the BWL and the TWL) for Lochinvar 2 Reservoir are 71.5 (m AD) and 79.0 (m AD), respectively.
Depends on the AIV, the region can be serviced from Four Mile Creek or Lochinvar 2, therefore the minimum HGL can be 71.5 m AD at the Lochinvar 2.
The maximum HGL along DN300 in New England Highway and north of the development is 78.5 (m AD) and the maximum HGL along DN500 in the south pf the development is 78 (m AD).

Considering the BWL as the minimum HGL and at least 20 m residual pressure plus 1 m head-loss, the highest elevation can be serviced within the development is 50.5 m.

Cheers,

From: Angus Macleod [mailto:amacleod@pcbnsw.com.au]
Sent: Monday, 11 March 2019 11:34 AM
To: Barry Calderwood <barry.calderwood@hunterwater.com.au>
Subject: HWC ref 2017-969 - Water Supply Strategy - GIS plan and details

Hi Barry,

I'm currently working on the water servicing strategy for the proposed 146 lot subdivision at Lochinvar (2017-969).
Could you please provide the GIS plan showing the existing water mains?
Also, if you could provide pipe details and the service head pressure, that would be great.

Thanks,

Angus Macleod
Undergraduate Civil Engineer
email: amacleod@pcbnsw.com.au
phone: (02) 4934 3026

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East Maitland 2323

PO Box 729, Newcastle 2300

Ph (02) 4934 3026
Email admin@pcbnsw.com.au

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Angus Macleod

From: Wesley Jones <wesley.jones@hunterwater.com.au>
Sent: Thursday, 9 January 2020 4:45 PM
To: Angus Macleod
Cc: David England; Chris Barker; Barry Calderwood
Subject: RE: 2017-969 Water Servicing Strategy - Service Pressures

Categories: M-Files

Hi Angus,

Based on a quick look, you should be able to service all lots in Stage 1 from the DN300 on New England Hwy. The highest serviceable level at 20m minimum pressure is approximately 52m.

All stages beyond this would require a water pump station and the minimum pressure requirements are 25m on a peak day and 12m backup/failure pressure on a 95 percentile Peak Day Demand day.

When the WPS is not operating on a 95th peak day there will be a backup HGL of approximately 74m, so you should be fine for a failure scenario for the higher lots in Stages 3, 5 and 6.
Lots in Stages 9 and 10 will be below the minimum backup pressure, and this will need to be discussed in the strategy. If the number of lots is small, Hunter Water **may** consider this acceptable, in lieu of a permanent generator at the WPS site.

Please let me know if you need any additional information to assist with the servicing strategy.

Regards,
Wes

Wesley Jones
Development Services Engineer | Hunter Water Corporation
36 Honeysuckle Drive Newcastle NSW 2300 | PO BOX 5171 HRMC NSW 2310
T 02 4979 9676 | Twitter: @hunterwater
wesley.jones@hunterwater.com.au | hunterwater.com.au
Please consider the environment before printing this email

From: Angus Macleod [mailto:amacleod@pcbnsw.com.au]
Sent: Thursday, 9 January 2020 3:43 PM
To: Wesley Jones <wesley.jones@hunterwater.com.au>
Cc: David England <dengland@pcbnsw.com.au>
Subject: 2017-969 Water Servicing Strategy - Service Pressures

Hi Wesley,

As discussed I'm currently working on the proposed 113 lot subdivision in Lochinvar (2017/969). Could you please advise the design service pressures for the DN300 watermain along New England Highway, and in the DN500 trunk main to the south of the site? Previous advice from HWC is attached for reference.

The first phase of this development concerns stages 1-7 (subdivision plan attached). Our current intention for this first phase is to have this development supplied by the DN300 main along New England Highway, with security of supply provided by the development to the west. However, we are unable to achieve adequate pressure for the highest lots in these stages based on the advice provided to us by HWC last year. It may be necessary for us to connect to the DN500 trunk main and construct a booster pump in the first phase, with the booster adequately sized to supply the future stages.

Could you also advise what the minimum pressure requirement is (if any) for lots serviced by a boosted network, if the booster pump fails? We have proposed lots within stage 9 which may be affected by this due to their elevation.

Kind regards,

Angus Macleod
Graduate Civil Engineer
E: amacleod@pcbnsw.com.au
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Table 1 – Review of Lochinvar East Water Servicing Strategy - 2017-969

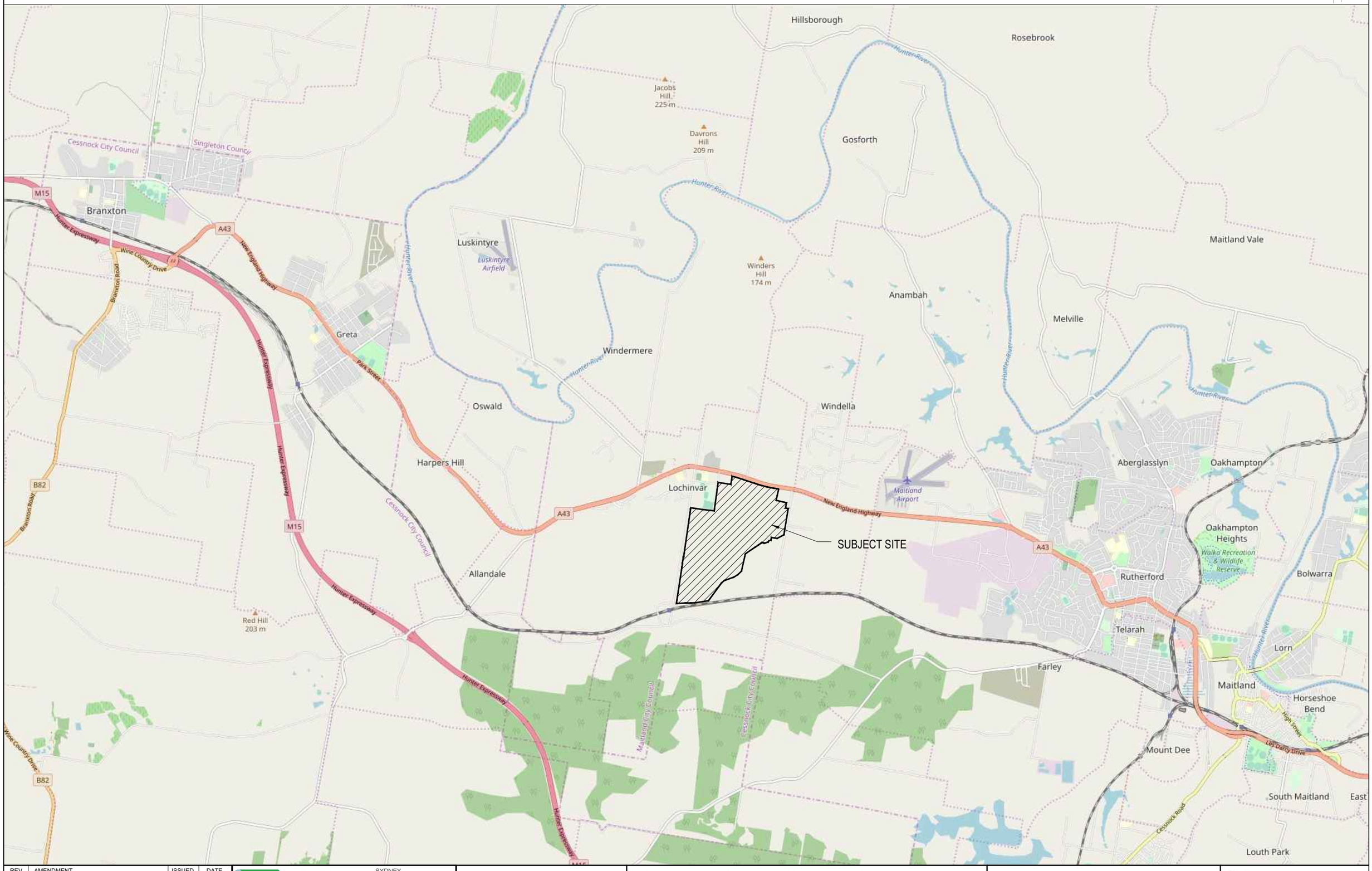
STATUS	Item	Reviewer Name	Page	Section	Hunter Water Comment	Consultant Response	Hunter Water Response	Consultant Response
CLOSED OUT	1	Ali Binesh	2	1.5	Please correct the typo mistake on Line 3 section 1.5-Extra parenthesis	Corrected.	Accepted	
CLOSED OUT	2	Ali Binesh		GENERAL	Please correct the units from AD to standard AHD	Corrected.	Accepted	
CLOSED OUT	3	Ali Binesh	3	2.2	Please confirm the necessity of having section 2.2.	Removed.	Accepted	
CLOSED OUT	4	Ali Binesh	7	3.4	Please correct the pipe type. Its PVC-O	Corrected.	Accepted	
OPEN (CONSULTANT)	5	Ali Binesh		GENERAL	The highest node(s) to assess the model has not been properly demonstrated on map or report. Please provide it using map on Appendix.	A EPANET snapshot showing node elevations has provided in appendix D.	Highest residential zoned land in 78 Winders Lane is 77.5m RL. **Boosting pressure from the WPS may need to be reviewed and increased prior to development of this site.**	Amended. 77.5m adopted as the highest servicable node within the study area.
OPEN (CONSULTANT)	6	Ali Binesh	5	3.2.1	Please clearly demonstrate how many lots wouldn't recive minimum require pressure during the system failure.	Provided, please refer section 3.1.1.	Please refer to total number of lots, not this development and potential lots (even if it is an estimate on adjacent development).	Amended.
OPEN (CONSULTANT)	7	Ali Binesh		GENERAL	Please demonstrate the security supply based on DN 300 across Northern bourndary. As DN500 is feeding from the reservior in East of the study area and system failure should be investigated by shutting down of this pipe. Please check the nessecity of having a descent size connecting DN 300 and DN 500 for the system failure.	Provided, please refer section 3.3.6. Insufficient backup pressure within the pressure boosted zone occurs due to the booster pump becoming inactive in the event of DN500 shutdown. Please note this analysis does not assess the capacity of the existing DN300 to supply existing and proposed water demands.	Pretty much there! There are three failure scenarios to investigate independently, not together; 1. Isolation of the DN500 watermain (no lots should receive less than 20m presssure as this could be a medium-term impact). 2. Failure of the booster station. 3. Failure of the single feed trunk mains from the booster to south - **resolve with duplication in the DRL for single feed sections.**	Provided, refer section 5.3.6.
CLOSED OUT	8	jarrod wynn		GENERAL	at this stage do we get them to look at the NPV of a RES to service all lots in lieu of a WPS or do we have adequate storage in this area based on "regional" development in the area? As I understand there is far more houses to go in here.		WPS required regardless for this area. A reservoir is generally considered when there is a large number of customers on the boosted zone and/or when a significant number of customers do not receive backup presssure during power failure (Wes). Refer to Item 6 for determination on lot count during WPS failure.	
CLOSED OUT	9	B Calderwood		Appendix D	The Water Servicing Overall Plan DRL should include watermains greater than DN 100 in adjacent development sites. It should also show the DN500.	Adopted. Scope of report and analysis now includes all proposed developments between Station Lane, Winders Lane, Highway and Christopher Road.	Accepted	
CLOSED OUT	10	B Calderwood	8	3.4	The HLZ is to be zoned rather than managed by reflux valves	Adopted. HLZ mains are on separate zoned loop independent of gravity supplied mains.	Accepted	
CLOSED OUT	11	B Calderwood			Estimate the number of lots impacted by option A	Provided, please refer section 3.2.1	Accepted	

OPEN (CONSULTANT)	12	B Calderwood			Provide comparison of options and more detail on costs and number of lots impacted.	Report has been amended to focus on only two options, generator vs no generator. The HWC cost estimate tool output has been provided in appendix E. Number of lots impacted has been detailed in section 3.1.1	No cost analysis/comparison provided on generator option. What are the cost implications?	Amended, costing now incldued using the HWC cost estimating spreadsheet.
CLOSED OUT	13	B Calderwood			You have not nominated a preferred Option for pump failure	Provided, please refer to Section 5.	Accepted	
CLOSED OUT	14	B Calderwood			Lot layout and HLZ boundary results in a lot of deadend watermains. More link mains along side streets and adjusting high level boundary in some areas should reduce the number of deadends. Probably worth contacing HW to discuss the boundary of the HLZ in more detail.	Water network has been revised to remove dead ends and provide link mains. HLZ mains are on separate zoned loop independent of gravity supplied mains.	Accepted	
CLOSED OUT	15	Wes Jones	2	1.3	Remove unneccesary information - paragraphs 2,3 and 5.	Paragraphs removed.	Accepted	
CLOSED OUT	16	Wes Jones	7	3.3.2	How has 30 L/s been calculated for the WPS? There is no lot and demand breakdown.	Now detailed in Table 3.3, and demand breakdowns shown in Table 2.1.	Accepted	
CLOSED OUT	17	Wes Jones	7	3.3.3	Provide water demand breakdown for all developments, with standard zone and WPS zone separated. Is the 54L/s maximum demand for 95th day inclusive of the 10L/s fireflow or not? Provide more clarity. Minimum WPS flows should also be included for input to design phase.	Water demands for all developments provided in section 2.3, and breakdown for WPS zone shown in table 3.3. Minimum WPS flows were considered to ensure maximum pressure not exceeded within the network.	Accepted	
OPEN (CONSULTANT)	18	Wes Jones		App B	Subject site should include all adjacent development areas to Station Lane	Adopted. Scope of report and analysis now includes all proposed developments between Station Lane, Winders Lane, Highway and Christopher Road.	Land (east of Station Lane) currently zoned residential has not been included in the report. Provide plan on how this may be serviced from the booster station. Refer to MCC LEP and include all zoned URA land.	Amended, this has now been considered within the strategy.
CLOSED OUT	19	Wes Jones		App D	Show indicative DRL within adjacent developments, for pipe sizes DN150 and greater.	Provided, please refer Appendix E	Accepted	
CLOSED OUT	20	Wes Jones		App D	Show WPS mains in different line type for clarity.	Amended, pressure boosted mains now shown in dashed linestyle	Accepted	
CLOSED OUT	21	Wes Jones		App D	Potential for land in the southwest corner of this development below 50m to be serviced from the low pressure zone via Hunter Land.	In an effort to reduce dead end mains, land in southwest corner has been included wholly in WPS zone.	Accepted	
CLOSED OUT	22	Wes Jones		App D	How does the WPS service potential lots within the R1 zoned land at 78 Winders Lane?	Amended. R1 zoned land was previously excluded from analysis. Now has been considered for estimated 40 lots, supplied by boosted main to west.	Accepted	

OPEN (CONSULTANT)	23	Wes Jones		General	Has the pipes in the boosted zone been sized for future distribution to the R1 zoned land to the south towards the railway line?	No, the scope of this analysis was for all developments to Station Lane in the south. It is assumed that any development south of the subject site will be supplied by mains along Station Lane, from the existing 250 offtake from the DN500 trunk main.	Please provide more detail - are you suggesting that a second booster may be required? The previous regional strategy included all Lochinvar lots above 50m in the one boosted zone as this would be the most cost effective. Is there future scope for upgrading the WPS to provide for all lots in the Lochinvar URA high level elevations?	Revised, the strategy now allows for R1 zoned land south toward the railway and west of station lane for lots above 50m within the boosted supply network.
OPEN (CONSULTANT)	24	Wes Jones	7	3.3.2	Demonstrate that highest elevation within the WPS zone receives the minimum 25m pressure. A quick calc suggests minimum pressures below 25m.	Detailed in section 3.3.3. Highest elevation within adjacent R1 zoned land (78 Winders Lane) nominated as 70m AHD. HGL from Lochinvar 2 is 74m, so to achieve minimum 25m pressure, 21m boosted pressure provided from WPS.	As above, elevations up to 77.5m are found in 78 Winders Lane.	Amended.
OPEN (CONSULTANT)	25	Wes Jones	14	4.4	Environmental impact should discuss construction and operating issues related to the water network, not land clearing. What are the impacts on adjacent residents from having a generator on site - noise, odour, chemical storage, etc?			Amended, refer section 6.4.
OPEN (CONSULTANT)	26	Wes Jones	14	4.5.1 and 4.5.2	Re-word Performance and Security of Supply sections. Performance is for normal operation ie all lots receive service pressures within HWC ranges, Security of supply is for the effects of watermain, power and other outages.			Amended, refer section 6.5.
OPEN (CONSULTANT)	27	Wes Jones	15	4.5.2	Maintainability - what increased maintenance may be required for a generator - bunding, fuel delivery, maintenance runs, etc.			Amended, refer section 6.5.2.4.
OPEN (CONSULTANT)	28	Wes Jones	General		Please include a breif comment on the third option for security of supply - high level reservoir. This should be mentioned for future clarity but can be discounted due to cost and there being no suitable elevations/sites within the URA			Amended. The previous option A (no action for areas of insufficient pressure) was deemed infeasible due to the large number of lots which would be impacted, so has been removed from the strategy. Option A now considers a high level reservoir and backup generator, and option B considers a boosted water supply station.
CLOSED OUT	29							
CLOSED OUT	30							
CLOSED OUT	31							
CLOSED OUT	32							
CLOSED OUT	33							

Appendix B – Exhibits

A3



REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
HUNTER
P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

Client:

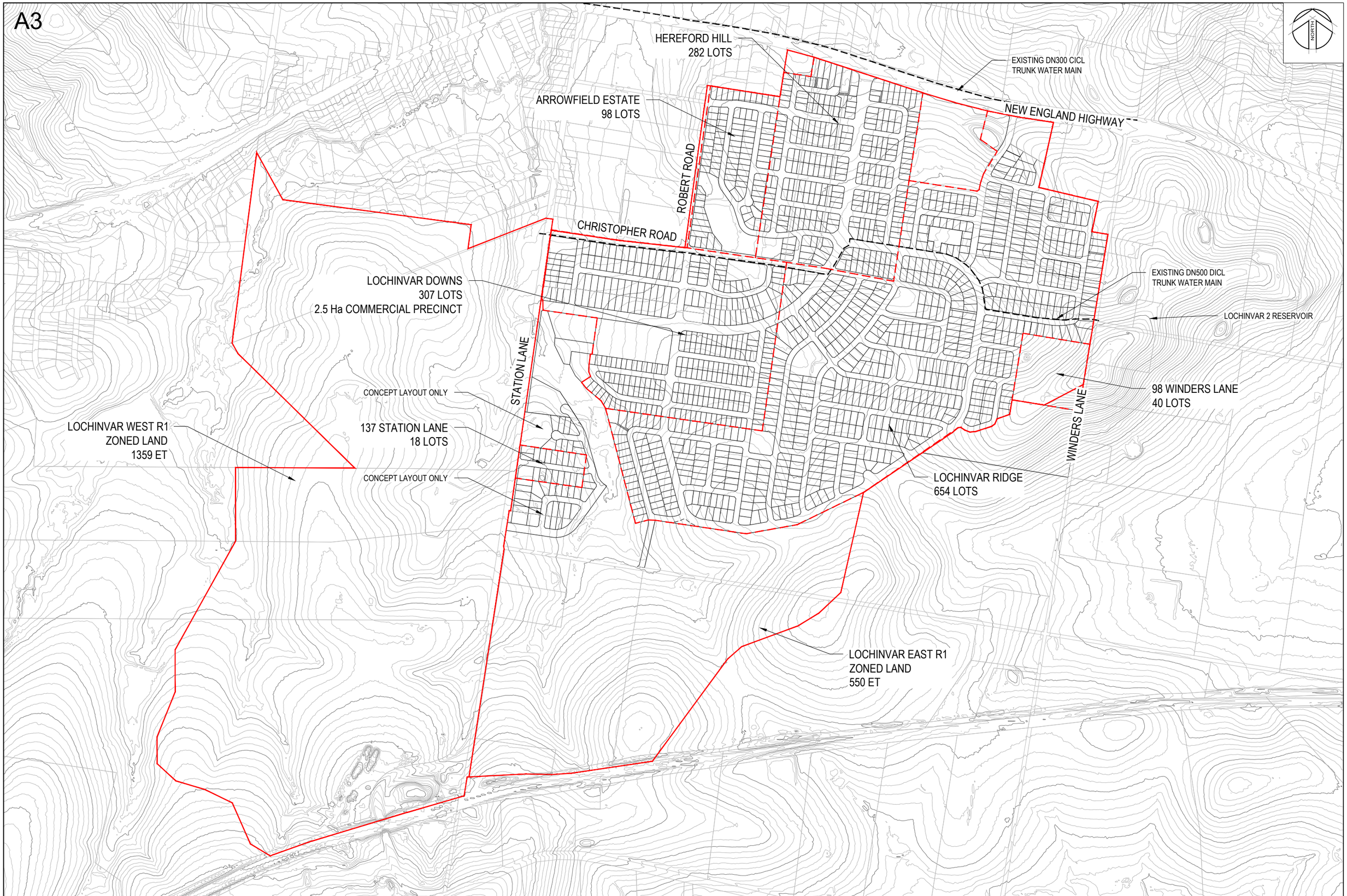
URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
LOCALITY PLAN

Designed: AM
Drawn: AM
Checked: DE
Scales: Plan
Datum: A.H.D

Plan No.
EXHIBIT A
File Ref. 179477
REV. C

A3



REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
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Client:

URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
DEVELOPMENT SITE OVERVIEW

Designed: AM
Drawn: AM
Checked: DE

Scales: Plan

Datum: A.H.D

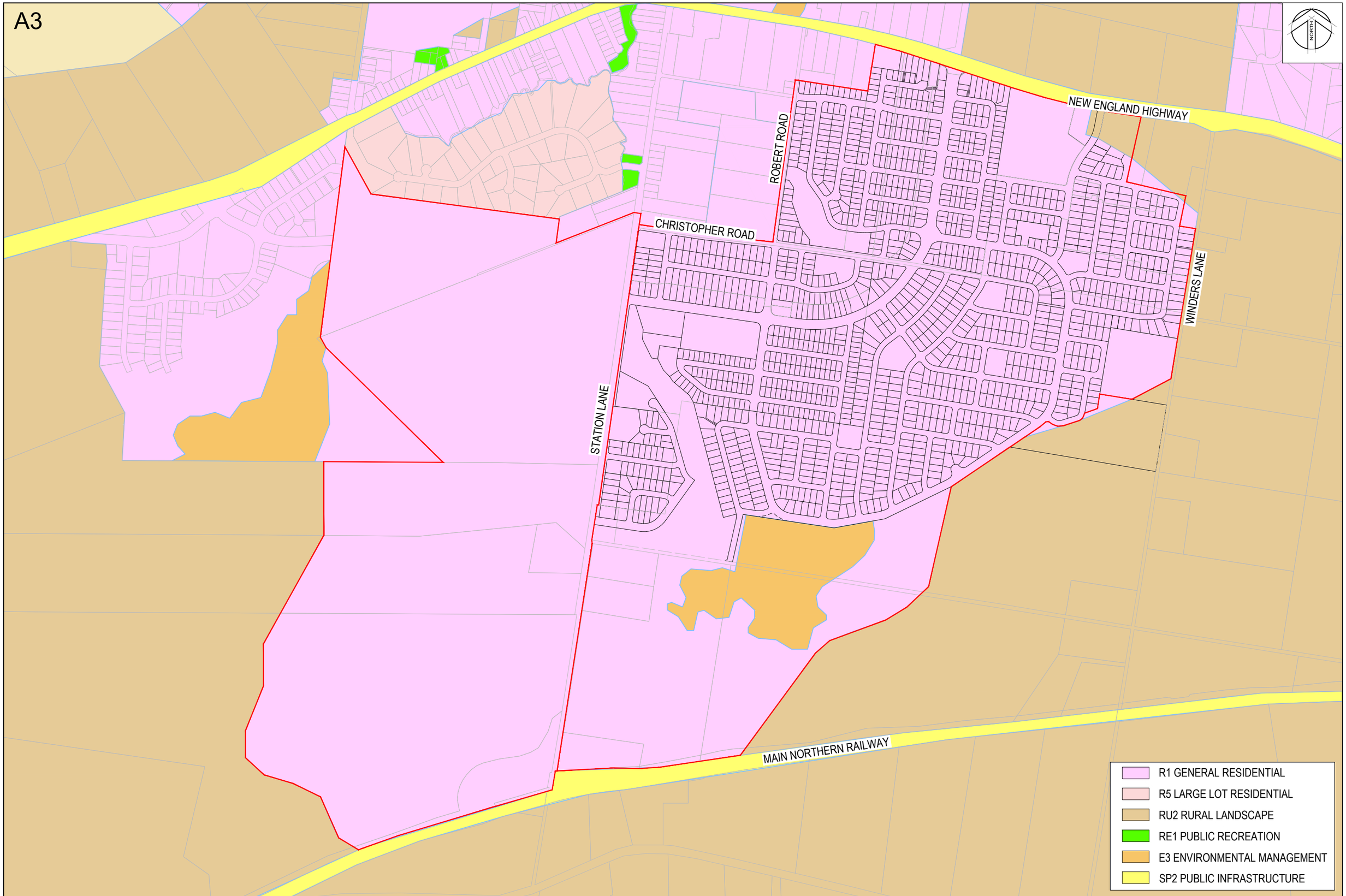
Plan No.

EXHIBIT B

File Ref.
179477

REV.
C

A3



REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
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Client:

URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
ZONING PLAN

Designed: AM
Drawn: AM
Checked: DE

Scales: Plan

Datum: A.H.D

Plan No.
EXHIBIT C
File Ref.
179477
REV.
C

A3

REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
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HUNTER
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Client:

URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
AERIAL IMAGERY PLAN

Designed: AM
Drawn: AM
Checked: DE

Scales: Plan

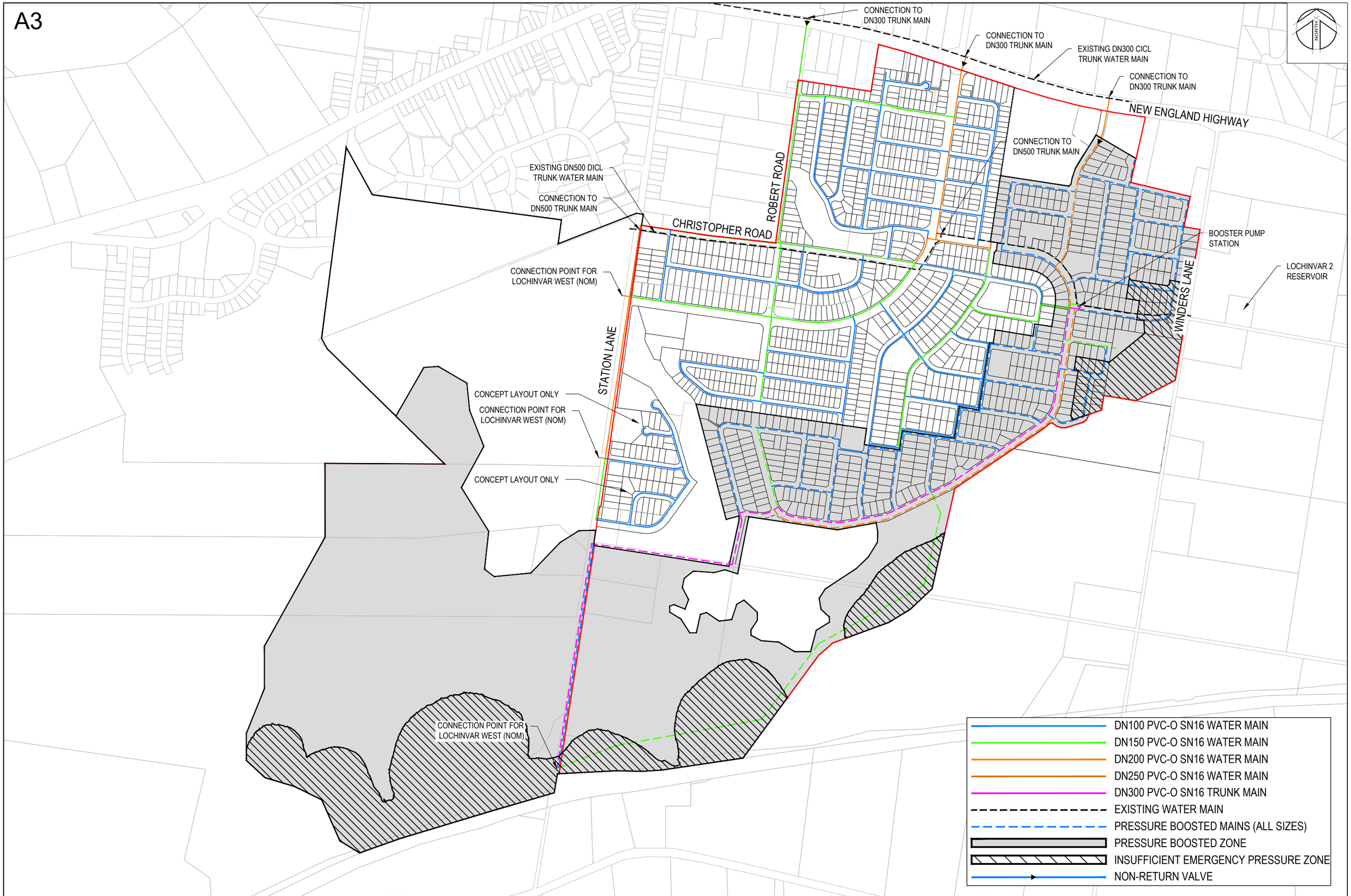
Datum: A.H.D

Plan No.
EXHIBIT D

File Ref.
179477

REV.
C

A3



REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION

SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
HUNTER
P: 02 4966 8388
ABN: 26 134 067 842
barkerryanstewart.com.au
mail@barkerryanstewart.com.au

Client:

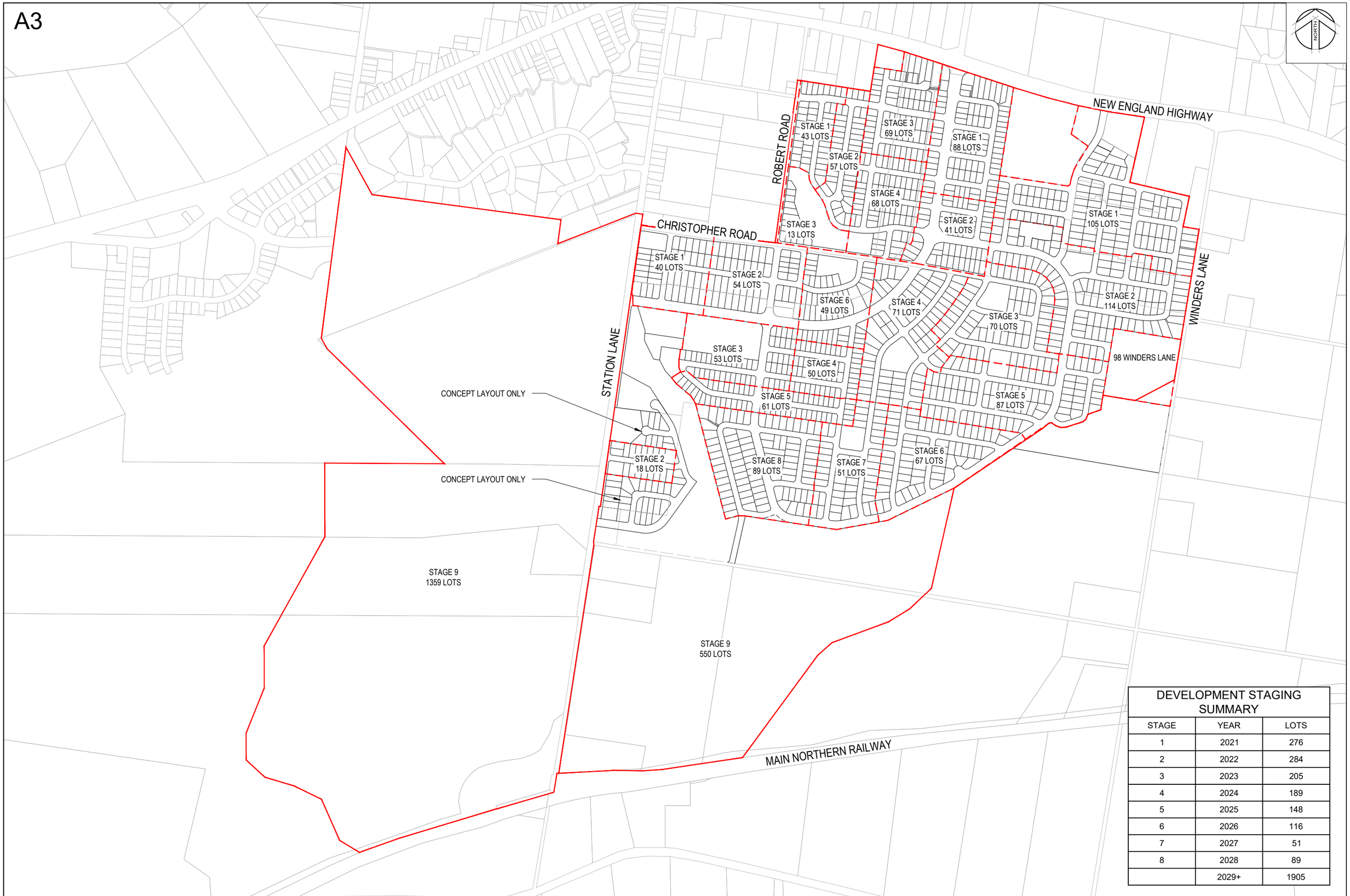
URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
WATER NETWORK PLAN

Designed: AM
Drawn: AM
Checked: DE
Scales: Plan
Datum: A.H.D

Plan No.
EXHIBIT E
File Ref.
179477
REV.
C

A3



DEVELOPMENT STAGING SUMMARY		
STAGE	YEAR	LOTS
1	2021	276
2	2022	284
3	2023	205
4	2024	189
5	2025	148
6	2026	116
7	2027	51
8	2028	89
	2029+	1905

REV	AMENDMENT	ISSUED	DATE
C	EXPANDED SCOPE	AM	17/03/21

BARKER RYAN STEWART
TOTAL PROJECT SOLUTIONS
PLANNING - PROJECT MANAGEMENT - ENGINEERING - CERTIFICATION
SYDNEY
P: 02 9659 0005
CENTRAL COAST
P: 02 4325 5255
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Client:

URBAN LAND & HOUSING GROUP

LOCHINVAR EAST WATER SERVICING STRATEGY
HWC REF 2017-969
DEVELOPMENT STAGING

Designed: AM
Drawn: AM
Checked: DE

Scales: Plan

Datum: A.H.D

Plan No.

EXHIBIT F

File Ref. 179477

REV. C

Appendix C – Diurnal Demand Calculations

Factored Peak Demand (L/s/ET) = ADD x PDF x DF x DDF
Factored 96th Percentile Demand (L/s/ET) = ADD x 95F x DDF

Where:

ADD = Average Day Demand (L/s/ET)
PDF = Peak Day Factor
DF = Diversity Factor
95F = 95th Percentile Factor
DDF = Diurnal Demand Factor

Table C.1 – Residential Diurnal Demands

Time	Domestic Peak & Extreme Day Diurnal Demand Factors	DPED Factored Peak Demand	95th Percentile Factored Demand
		L/s/ET	L/s/ET
0:00	0.48	0.0110	0.0078
1:00	0.42	0.0096	0.0068
2:00	0.37	0.0084	0.0060
3:00	0.38	0.0087	0.0062
4:00	0.27	0.0062	0.0044
5:00	0.29	0.0066	0.0047
6:00	0.40	0.0091	0.0065
7:00	0.81	0.0185	0.0132
8:00	1.19	0.0271	0.0194
9:00	1.33	0.0303	0.0216
10:00	1.28	0.0292	0.0208
11:00	1.16	0.0265	0.0189
12:00	1.07	0.0244	0.0174
13:00	0.98	0.0224	0.0159
14:00	0.93	0.0212	0.0151
15:00	0.97	0.0221	0.0158
16:00	0.99	0.0226	0.0161
17:00	1.24	0.0283	0.0202
18:00	1.55	0.0354	0.0252
19:00	1.84	0.0420	0.0299
20:00	2.02	0.0461	0.0329
21:00	1.86	0.0424	0.0303
22:00	1.29	0.0294	0.0210
23:00	0.83	0.0189	0.0135

Table C.2 – Commercial Diurnal Demands

Time	Commercial Factor	Commercial Factored Peak Demand	95th Percentile Factored Demand
		L/s/ET	L/s/ET
0:00	0.18	0.0384	0.0364
1:00	0.11	0.0234	0.0223
2:00	0.11	0.0234	0.0223
3:00	0.15	0.0320	0.0304
4:00	0.19	0.0405	0.0385
5:00	0.23	0.0490	0.0466
6:00	0.51	0.1087	0.1032
7:00	1.80	0.3836	0.3644
8:00	1.82	0.3878	0.3684
9:00	1.85	0.3942	0.3745
10:00	1.85	0.3942	0.3745
11:00	1.85	0.3942	0.3745
12:00	1.89	0.4027	0.3826
13:00	1.90	0.4049	0.3846
14:00	1.88	0.4006	0.3806
15:00	1.85	0.3942	0.3745
16:00	1.75	0.3729	0.3543
17:00	1.50	0.3196	0.3037
18:00	0.75	0.1598	0.1518
19:00	0.48	0.1023	0.0972
20:00	0.39	0.0831	0.0789
21:00	0.30	0.0639	0.0607
22:00	0.26	0.0554	0.0526
23:00	0.23	0.0490	0.0466

Table C.3 – Irrigated Community Park Area Diurnal Demands

Time	Parks & Gardens Factor	Park Area Factored Peak Demand
		L/s/ET
0:00	0.18	0.0023
1:00	0.11	0.0014
2:00	0.11	0.0014
3:00	0.22	0.0028
4:00	0.64	0.0081
5:00	0.98	0.0124
6:00	1.25	0.0159
7:00	1.37	0.0174
8:00	1.45	0.0184
9:00	1.50	0.0190
10:00	1.50	0.0190
11:00	1.50	0.0190
12:00	1.50	0.0190
13:00	1.50	0.0190
14:00	1.50	0.0190
15:00	1.48	0.0188
16:00	1.44	0.0183
17:00	1.35	0.0171
18:00	1.22	0.0155
19:00	1.04	0.0132
20:00	0.86	0.0109
21:00	0.64	0.0081
22:00	0.43	0.0055
23:00	0.23	0.0029

Attachment D – EPANET Water Modelling

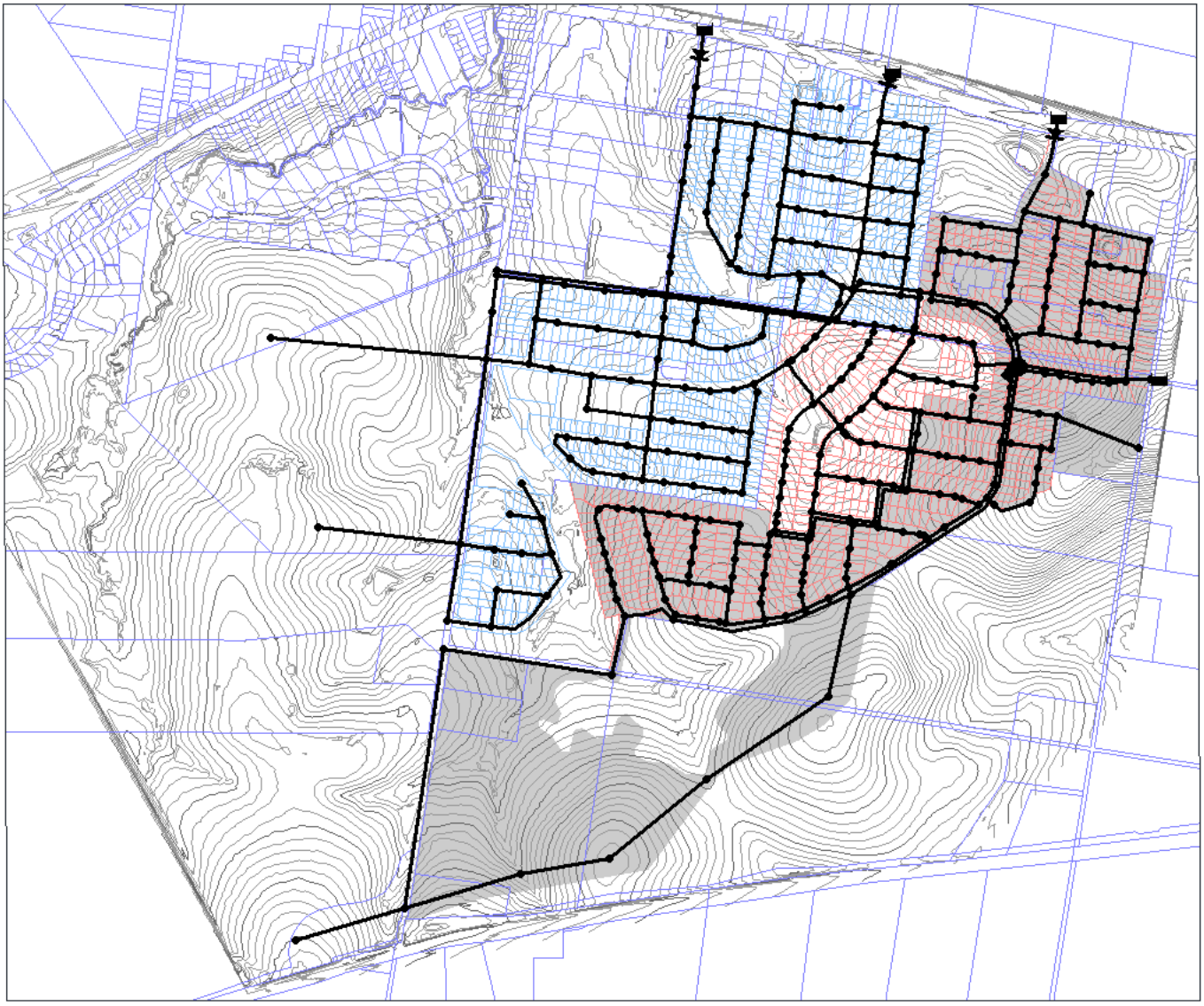

Figure D1- EPANET model overview

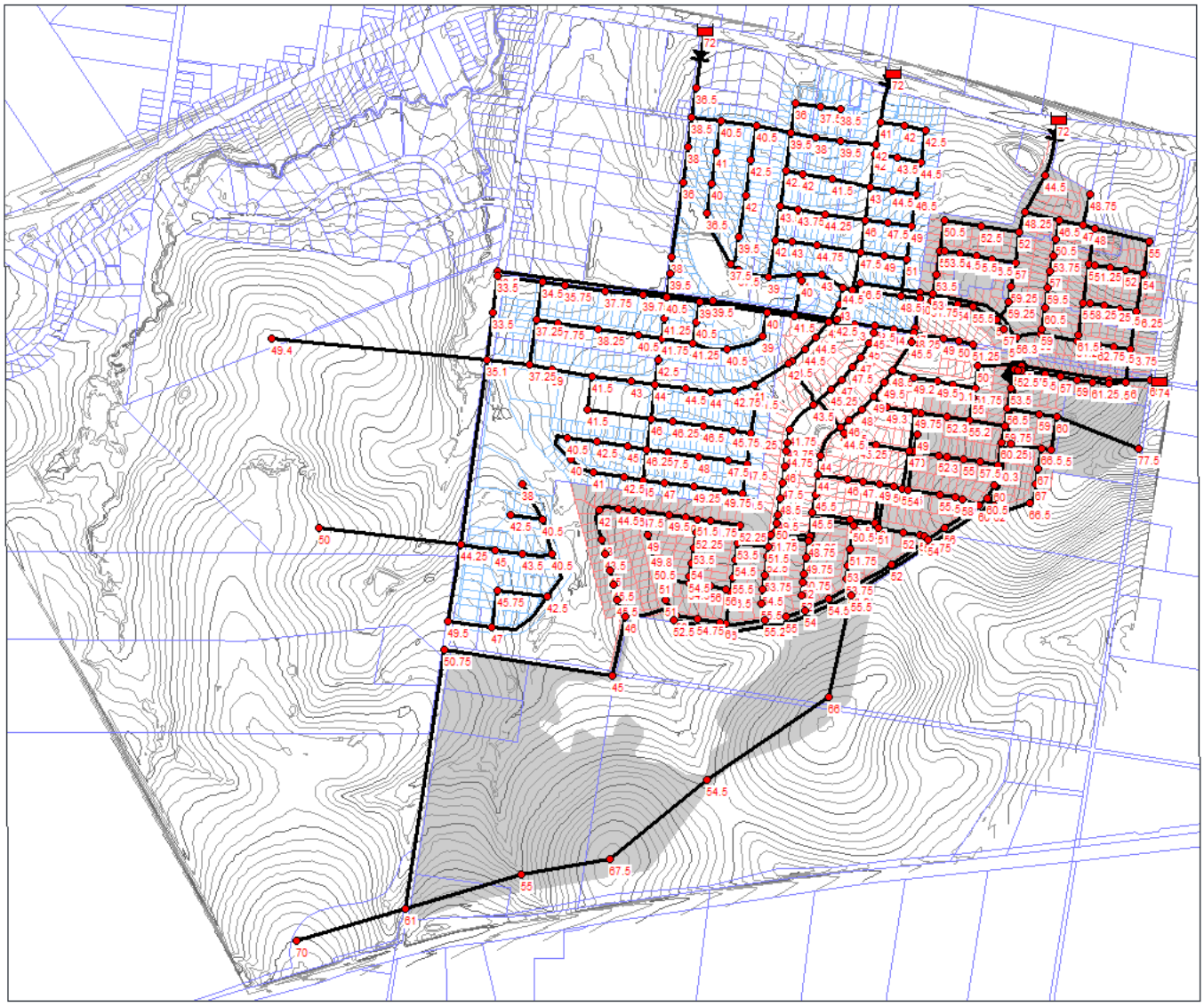

Figure D2 – EPANET node elevations

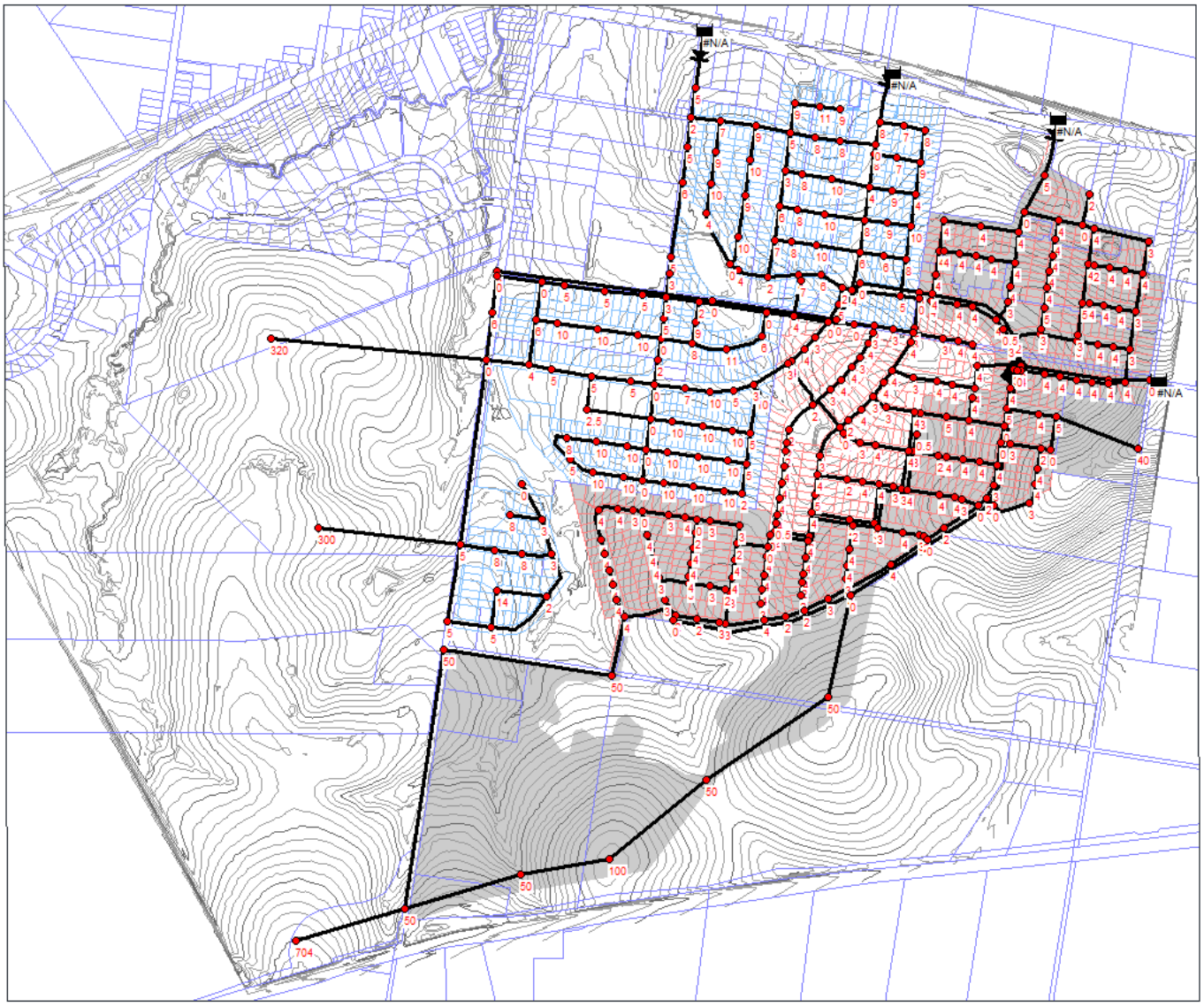

Figure D3 - EPANET node equivalent tenements

Attachment E – Pipeline and Pump Station Estimating Guidelines Output

ESTIMATING SHEET

PROJECT DESCRIPTION:

Date Priced: 07-Apr-2021

Date Cost Tables updated: 24-Oct-2018

Item No.	Item Description	Qty	Unit	Rate $/Unit	Amount $	Application of Schedule of Rates	Capital Project Estimate	
							Code	WBS
HW0001	All work not included elsewhere in this schedule	Item	Lump Sum	$ 142,752.00	$ 142,752.00	**Payment**: Maximum of 10% shall be due each month until 70% of the amount has been paid. Remainder at Practical Completion.	**Delivery**	
HW0002	Site Establishment <Insert Max $>	Item	Lump Sum	$ 85,000.00	$ 85,000.00	**Payment**: 100% after completion.		
HW0003	Site Disestablishment <Insert Min $>	Item	Lump Sum	$ 85,000.00	$ 85,000.00	**Payment**: 100% after completion.		
HW0004	Preparation and implementation of the Construction EMP	Item	Lump Sum	$ 32,200.00	$ 32,200.00	**Payment**: Maximum of 30% on submission of complying Construction EMP, then 10% per month up to maximum of 80%. Remainder at Practical Completion. **Submit:** Construction EMP.		
HW0005	Preparation and implementation of the Safety Management Plan.	Item	Lump Sum	$ 69,200.00	$ 69,200.00	**Payment**: Maximum of 30% on submission of complying plan, then 10% per month up to maximum of 80%. Remainder at Practical Completion. **Submit:** Safety Management Plan.		
HW0006	Preparation and implementation of the Traffic Control Plan.	Item	Lump Sum	$ 18,000.00	$ 18,000.00	**Payment**: Maximum of 30% on submission of complying Traffic Control Plan, then 10% per month up to maximum of 80%. Remainder at Practical Completion.		
HW0007	Preparation and Implementation of Quality Management Plan	Item	Lump Sum	$ 77,144.71	$ 77,144.71	**Payment**: Maximum of 30% on submission of complying Quality Management Plan, then 10% per month up to maximum of 80%. Remainder at Practical Completion.		
HW0008	Community Consultation	Item	Lump Sum	$ -	$ -	**Payment**: 10% per month up to maximum of 70%. Remainder at Practical Completion.		

Water Pipeline - Reticulation - section will be present if one or more reticulation watermains are specified

Item	Construction of Reticulation Watermains	Qty	Unit	Rate $/Unit	Amount $	Application of Schedule of Rates	Code	WBS
HWW001	Service Location	Item	Lump Sum	$ 20,115.68	$ 20,115.68	**Payment**: Maximum of 10% shall be due each month until 70% of the amount has been paid. Remainder at Practical Completion.	**Delivery**	
HWW002	Supply all valves and flowmeters	Item	Lump Sum		$ -	**Payment:** Percentage of valves and flowmeters supplied. **Submit:** Relevant Quality Records including Compliance Certificates.		
HWW003	Supply all fittings	Item	Lump Sum		$ -	**Payment**: Percentage of fittings supplied. **Submit:** Relevant Quality Records including Compliance Certificates.		
HWW004	Supply all pipes materials including detector tape, pipe protection wrapping, rubber rings and lubricant for following pipe sizes:					**Measurement:** Actual metres (effective length) of pipe delivered to site. **Submit:** Relevant Quality Records including Compliance Certificates. Note: Limits of Accuracy to be inserted for each pipe size.		
20AVSS	Nominal DN100 PVC pipe	17188	m	$ 17.77	$ 305,344.82			
20FVSS	Nominal DN150 PVC pipe	6587	m	$ 35.53	$ 234,036.11			
214VSS	Nominal DN200 PVC pipe	3313	m	$ 58.52	$ 193,876.76			
219VSS	Nominal DN250 PVC pipe	215	m	$ 72.63	$ 15,614.91			
HWW005	Clear, excavate, lay, join, bed, backfill & test pipelines (installation). Up to **1.5 m depth** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation up to and including 1.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWW006	Clear, excavate, lay, join, bed, backfill & test pipelines (installation). Nominal depth **>1.5m to 3.0m** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation > 1.5m to and including 3.0m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
20AV0B	Nominal DN100 PVC (Trench type B)	17188	m	$ 149.40	$ 2,567,887.20			
20FV0B	Nominal DN150 PVC (Trench type B)	6587	m	$ 169.40	$ 1,115,837.80			
214V0B	Nominal DN200 PVC (Trench type B)	3313	m	$ 190.40	$ 630,795.20			
219V0B	Nominal DN250 PVC (Trench type B)	215	m	$ 213.95	$ 45,999.25			
HWW007	Clear, excavate, lay, join, bed, backfill & test pipelines (installation). Nominal depth **>3.0m to 4.5m** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation > 3.0m to and including 4.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWW008	Clear, excavate, lay, join, bed, backfill & test pipelines (installation). Nominal depth **> 4.5m** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation > 4.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWW009	Supply additional service connection pipe and fittings and install	Item	Lump Sum		$ -	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HWW010	Extra over rate for installation for Additional compaction		m3	$ 33.63		**Measurement:** Cubic metres of additional compaction based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW011	Excavate below specified design depth where directed including disposal of excess excavated material		m3	$ 70.80		**Measurement:** Cubic metres of excavation directed based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW012	Extra over rate for installation to Supply & place & compact non cohesive material		m3			**Measurement:** Cubic metres of non cohesive material based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW013	Extra over rate for installation for supply, place and compact stabilised sand cement (14:1) backfill		m3	$ 265.50		**Measurement:** Cubic metres of stabilised sand cement based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW014	Extra over rate for installation for supply, place and compact aggregate		m3			**Measurement:** Cubic metres of aggregate based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW015	Supply & place ballast			$ 91.80		**Measurement:** Actual tonnes placed as directed. **Submit:** Relevant Quality Records including certified weighbridge dockets. **Limits of Accuracy:** <To be inserted>.		
HWW016	External Dewatering of trench including establishment and disestablishment (Contingent Item)		m			**Measurement**: Length of pipeline for which external dewatering is agreed with the Superintendent and provided, measured along the axis of the pipeline between the first and last spear point. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW017	Supply and place treated timber piling for pipe support		m			**Measurement**: Actual metres from pipe invert to toe of pile. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW018	Road / creek crossings					**Measurement**: Length in metres of casing installed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW018.01	NEH 3	50	m	$ 868.69	$ 43,434.50			

HWW018.02	NEH 1	50	m	$ 936.05	$ 46,802.50			
HWW018.03	NEH 2	50	m	$ 936.05	$ 46,802.50			
HWW019	Extra over rate for installation of trenchless technique under existing rail line		m			**Measurement**: Length in metres of casing installed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW020	Supply & installation of river crossing includes supply of MSCL pipe, welding, weld testing, 150mm concrete encasement, mobilisation & demobilisation of dredge, excavation, disposal of excavated material, backfilling, lay, bed & test:					**Measurement**: Length in metres of casing installed. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. *Note: Consider other milestone retentions.* **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW021	Supply and installation of pipe aerial creek crossing including supply of MSCL pipe with protection coating, internal and external welding, testing of welds. For the following MSCL pipe sizes:					**Measurement**: Length in metres of crossing installed in accordance with design. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. *Note: Consider other milestone retentions.* **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW022	Bulkheads and Trenchstops in accordance with WSAA drawing WAT-1209		Each			**Payment**: Number of bulkheads & trenchstops constructed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW023	Supply and Install valve pits (excluding valves and fittings)	0	Each	$ -	$ -	**Payment**: Number of valve pits constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW024	Flow Relief Structures		Each			**Payment:** Number of flow relief structures constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW025	EMPTY							
HWW026	Supply and install structure to house flowmeter (excluding cost of flowmeter).		Each			**Payment:** Number of structures constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWW027	Preparation of line sheets	27303	m	$ 1.16	$ 31,671.48	**Measurement**: Length of pipelines constructed as per design. **Limits of Accuracy:** <To be inserted>.		
HWW028	Acceptance testing - reticulation main	27088	m	$ 8.49	$ 229,917.53	**Measurement:** Length of pipelines constructed as per design. **Submit:** Staisfactory test records **Limits of Accuracy:** <To be inserted>.		
HWW029	**Miscellaneous**							
HWW000	***Sub Total***				$5,528,136			

Water Pipeline - Trunk - section will be present if one or more trunk watermains are specified

Item	Construction of Trunk Mains	Qty	Unit	Rate $/Unit	Amount $	Application of Schedule of Rates	Code	WBS
HWT001	Service Location	Item	Lump Sum	$ 3,915.00	$ 3,915.00	**Payment**: Maximum of 10% shall be due each month until 70% of the amount has been paid. Remainder at Practical Completion.	**Delivery**	
HWT002	Supply all valves and flowmeters	Item	Lump Sum		$ -	**Payment**: Percentage of valves and flowmeters supplied. **Submit:** Relevant Quality Records including Compliance Certificates.		
HWT003	Supply all fittings	Item	Lump Sum		$ -	**Payment**: Percentage of fittings supplied. **Submit:** Relevant Quality Records including Compliance Certificates.		
HWT004	Supply all pipes materials, including detector tape, pipe protection wrapping, rubber rings and lubricant for following pipe sizes:					**Measurement**: Actual metres (effective length) of pipe delivered to site. **Submit:** Relevant Quality Records including Compliance Certificates. *Note: Limits of Accuracy to be inserted for each pipe size.*		
31EVSS	Nominal DN300 PVC pipe	2610	m	$ 100.84	$ 263,198.93			
HWT005	Clear, excavate, lay, join, bed, backfill & test reticulation pipelines (installation). Up to **1.5 m depth** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation up to and including 1.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWT006	Clear, excavate, lay, join, bed, backfill & test					**Measurement:** Actual metres of pipe installed to design depth of excavation >		
31EV0B	Nominal DN300 PVC (Trench type B)	2610	m	$ 236.10	$ 616,221.00			
HWT007	Clear, excavate, lay, join, bed, backfill & test reticulation pipelines (installation). Nominal depth **>3.0m to 4.5m** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation > 3.0m to and including 4.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWT008	Clear, excavate, lay, join, bed, backfill & test reticulation pipelines (installation). Nominal depth **> 4.5m** to invert in OTR.					**Measurement:** Actual metres of pipe installed to design depth of excavation > 4.5m. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. **Submit:** Relevant Quality Records including as constructed lengths, levels and coordinates. **Limits of Accuracy:** <To be inserted>.		
HWT009	EMPTY							
HWT010	Extra over rate for installation for Additional compaction.		m3	$ 42.75		**Measurement:** Cubic metres of additional compaction based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT011	Excavate below specified design depth where directed including disposal of excess excavated material		m3	$ 90.00		**Measurement:** Cubic metres of excavation directed based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT012	Extra over rate for installation for supply & place compact non cohesive material		m3			**Measurement:** Cubic metres of non cohesive material based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT013	Extra over rate for installation for supply, place and compact stabilised sand cement (14:1) backfill		m3	$ 337.50		**Measurement:** Cubic metres of stabilised sand cement based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT014	Extra over rate for installation for Supply, place and compact aggregate		m3			**Measurement:** Cubic metres of aggregate based on thickness by length by Minimum Trench Width. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT015	Supply & place ballast		tonnes	$ 91.80		**Measurement:** Actual tonnes placed as directed. **Submit:** Relevant Quality Records including certified weighbridge dockets. **Limits of Accuracy:** <To be inserted>.		
HWT016	External Dewatering of trench including establishment and disestablishment (Contingent Item)		m			**Measurement**: **Measurement**: Length of pipeline for which external dewatering is agreed with the Superintendent and provided, measured along the axis of the pipeline between the first and last spear point. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT017	Supply and place treated timber piling for pipe support		m			**Measurement:** Actual metres from pipe invert to toe of pile. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT018	Road / creek crossings					**Measurement:** Length in metres of casing installed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		

HWT019	Extra over rate for installation of trenchless technique under existing rail line		m			**Measurement:** Length in metres of casing installed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT020	Supply & installation of river crossing includes supply of MSCL pipe, welding, weld testing, 150mm concrete encasement, mobilisation & demobilisation of dredge, excavation, disposal of excavated material, backfilling, lay, bed & test:					**Measurement:** Length in metres of casing installed. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. *Note: Consider other milestone retentions.* **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT021	Supply and installation of pipe aerial creek crossing including supply of MSCL pipe with protection coating, internal and external welding, testing of welds. For the following MSCL pipe sizes:					**Measurement:** Length in metres of crossing installed in accordance with design. **Retention:** 10% <or other appropriate percentage> until satisfactory testing. *Note: Consider other milestone retentions.* **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT022	Bulkheads and Trenchstops in accordance with WSAA drawing WAT-1209		Each			**Payment:** Number of bulkheads & trenchstops constructed. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT023	Supply and Install valve pits excluding cost of valves and fittings	0	Each	$ -	$ -	**Payment:** Number of valve pits constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT024	Flow Relief Structures		Each			**Payment:** Number of flow relief structures constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT025	EMPTY							
HWT026	Supply and install structure to house flowmeter (excluding cost of flowmeter).	Item	Lump Sum		$ -	**Payment:** Number of structures constructed. **Retention:** <To be determined>. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HWT027	Preparation of line sheets	2610	m	$ 1.16	$ 3,027.60	**Measurement**: Length of pipelines constructed as per design. **Limits of Accuracy:** <To be inserted>.		
HWT028	Acceptance testing - trunk main	2610	m	$ 12.40	$ 32,364.00	**Measurement:** Length of pipelines constructed as per design. **Submit:** Staisfactory test records **Limits of Accuracy:** <To be inserted>.		
HWT029	**Miscellaneous**							
HWT000	***Sub Total***				$918,727			

Grundfos Hydro MPC E3 CRNE 64-2-2

Item	*Pump Station - Name*	Qty	Unit	Rate $/Unit	Amount $	Application of Schedule of Rates	Code	WBS
HW0601	**Grundfos Hydro MPC E3 CRNE 64-2-2 2.4m dia 2 Pump(s)**						**Delivery**	
	Clear, excavate & backfill in OTR conditions, supply & construct pipework, 1.5m deep pump pit, tread plate, ancillary metal work & fittings. Supply & place formwork, reinforcement, concrete, valve & pump supports, thrust blocks, valve pit covers.	Item	Lump Sum	$ 81,680.00	$ 81,680.00	**Payment**: <Insert appropriate percentages to reflect the value of work at key milestones eg excavation, pump well, metalwork etc>. **Submit:** Relevant Quality Records.		
HW0602	**Pumps for Pumping Stations** - Supply and install pumps and associated fittings, connection to pipework, testing and commissioning.	2	Lump Sum	$ 7,000.00	$ 14,000.00	**Payment**: <Insert appropriate percentages for key milestones eg installation, precommissioning, commissioning>. **Submit:** Relevant Quality Records including those for pump test.		
HW0603	**Pumping Station Electricals**							
HW0603.01	Pit and Conduit System	Item	Lump Sum	$ 3,875.00	$ 3,875.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.02	LV Station Power Supply	Item	Lump Sum	$ 6,120.00	$ 6,120.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.03	Station By-Pass arrangements	Item	Lump Sum		$ -	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.04	Electrical Demolition works	Item	Lump Sum		$ -	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.05	Switchboard	Item	Lump Sum	$ 68,000.00	$ 68,000.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.06	PLC / Telemetry Hardware	Item	Lump Sum	$ 16,120.00	$ 16,120.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.07	PLC / Telemetry / Scada Engineering and Software Development	Item	Lump Sum	$ 31,720.00	$ 31,720.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.08	Stainless Steel Generator Box Cable Tray & Metering Box	Item	Lump Sum	$ -	$ -	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.09	Building Services (Electrical)	Item	Lump Sum	$ -	$ -	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.10	Pressure Transmitter/Gauge Board	Item	Lump Sum	$ 11,875.00	$ 11,875.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0603.11	Installation/Cabling (Electrical)	Item	Lump Sum	$ 11,987.00	$ 11,987.00	**Payment**: Percentage of work completed. **Submit:** Relevant Quality Records.		
HW0604	Odour Control							
HW0605	Empty							
HW0606	**Service Location**	Item	Lump Sum	$ 460.80	$ 460.80	**Payment**: Maximum of 10% shall be due each month until 70% of the amount has been paid. Remainder at Practical Completion.		
HW0607	**Excavation below design depth** including disposal of excavated material (Contingent Item)		m3	$ 80.00		**Measurement**: Cubic metres excavated based on thickness of excavation by design cross section of the structure for which excavation has been undertaken. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0608	Extra over Civil Works for **excavation in rock**:		m3	$ 120.00		**Measurement**: Actual cubic metres of rock excavated within the design dimensions of the structure. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0609	**Cut and fill earthworks** including compaction:		m3	$ 38.00		**Measurement**: Actual cubic metres of earthworks completed in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0610	**Supply & place ballast** (Contingent Item)		tonne	$ 91.80		**Measurement**: Actual tonnes placed as directed. **Submit:** Relevant Quality Records including certified weighbridge dockets. **Limits of Accuracy:** <To be inserted>.		
HW0611	**Import and place select fill** including compaction <may be Contingent Item>		m3	$ 75.00		**Measurement**: Actual cubic metres placed as directed by the Superintendent or placed in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0612	Construct access road and hardstand							
HW0612.01	Prepare subgrade		m2	$ 4.20		**Measurement**: Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0612.02	Supply, place and compact 150mm thick basecourse		m2	$ 37.00		**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0612.03	Supply, place and compact 200mm thick basecourse		m2	$ 47.00		**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		
HW0612.04	Supply, place and compact 250mm thick basecourse		m2	$ 58.00		**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.		

HW0612.05	Supply, place and compact two coat bitumen seal		m2	$ 31.00		**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.
HW0612.06	Supply, place and compact 30mm thick asphalt bitumen seal		m2	$ 40.00		**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.
HW0612.07	Concrete kerb & gutter	0	m	$ 128.00	$ -	**Measurement:** Actual metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.
HW0612.08	Concrete driveway	0	m2	$ 198.00	$ -	**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.
HW0613	Supply all plant, material and labour to undertake the following Piling works:					
HW0613.01	Treated timber mini piles		m			**Measurement:** Actual metres in accordance with the design. **Submit:** Relevant Quality Records. **Limits of Accuracy:** <To be inserted>.
HW0613.02	Reinforced concrete bored piles	Item	Lump Sum		$ -	**Payment:** Percentage of work completed. <Consider % payments at milestones> **Submit:** Relevant Quality Records.
HW0614	Supply all plant, material and labour to undertake the following Retaining Wall works:					**Measurement:** Actual square metres in accordance with the design. **Submit:** Relevant Quality Records.
HW0614.01	Timber(Koppers Log) up to 1.5m high		m2	$ 380.00		**Limits of Accuracy**: <To be inserted>.
HW0614.02	Concrete Keystone up to 1m high		m2	$ 510.00		**Limits of Accuracy**: <To be inserted>.
HW0614.03	Concrete Keystone between 1m and 3m high		m2	$ 750.00		**Limits of Accuracy**: <To be inserted>.
HW0614.04	Concrete Keystone greater than 3m high		m2	$ 750.00		**Limits of Accuracy**: <To be inserted>.
HW0614.05	Concrete Crib Block up to 2m high		m2	$ 840.00		**Limits of Accuracy**: <To be inserted>.
HW0614.06	Concrete Crib Block between 2m and 3m high		m2	$ 890.00		**Limits of Accuracy**: <To be inserted>.
HW0615	Acid sulphate soil					
HW0615.01	Initial testing for acid sulphate soils and prepare and submit report	5	per test	$ 140.00	$ 700.00	**Submit:** Result for each test. **Limits of Accuracy:** <To be inserted>
HW0615.02	Establish treatment facility	Item	Lump Sum		$ -	**Payment**: 100% after completion of treatment facility.
HW0615.03	Handling, treatment and testing of acid sulphate soils		m3	$ 112.50		**Measurement:** Cubic metres within the design cross section of the structure for which excavation has been undertaken. **Submit:** Test results confirming satisfactory treatment. **Limits of Accuracy:** <To be inserted>
HW0615.04	Disposal off site of acid sulphate soil		tonne	$ 198.00		**Measurement:** Tonnes transported from the site. **Submit:** Weighbridge dockets. **Limits of Accuracy:** <To be inserted>
HW0616	Series Pump Pit Structure	Item	Lump Sum		$ -	**Payment:** <Insert appropriate percentages to reflect the value of work at key milestones eg excavation, reinforced concrete, metalwork etc>. **Submit:** Relevant Quality Records.
HW0617	Supply and Install valve pit concrete formwork, reinforced concrete complete with aluminium tread plate covers and including excavation and backfill	Item	Lump Sum	$ -	$ -	**Payment**: <Insert appropriate percentages to reflect the value of work at key milestones eg excavation, reinforced concrete, metalwork etc>. **Submit:** Relevant Quality Records.
HW0618	Supply and install pipework items inside valve pit	Item	Lump Sum	$ -	$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0619	Supply and Install additional pipe Items outside station	Item	Lump Sum	$ -	$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0620	Supply and install pipework items inside station	Item	Lump Sum	$ -	$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0621	Supply and install Type 2 or 4 flow relief structures in accordance with Drgs SCP-502 and SCP-505	Item	Lump Sum		$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0622	Supply and install emergency storage structures		L/m			**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0623	Supply and install fan forced ventilation	Item	Lump Sum		$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0624	Supply and install Soil Bed Filter	Item	Lump Sum		$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0625	Supply and Install Strainers	Item	Lump Sum		$ -	**Payment**: Valued at percentage of work completed. Retention of 20% <or other percentage> until satisfactory testing. **Submit:** Relevant Quality Records.
HW0626	Supply and Install Series Bypass	Item	Lump Sum		$ -	**Payment**: Valued at percentage of work completed up to 80%. Remainder at Practical Completion. **Submit:** Relevant Quality Records.
HW0627	Landscaping	Item	Lump Sum	$ -	$ -	**Payment:** 100% at completion. **Submit:** Relevant Quality Records.
HW0628	**Miscellaneous**					
HW0628.01	Diesel Backup Generator and Controller	1	Each	$ 50,000.00	$ 50,000.00	
HW0629	Preparation and submission of Operation and Maintenance Information	Item	Lump Sum	$ 4,800.00	$ 4,800.00	**Payment:** 100% at Practical Completion. **Submit:** Complying Work As Constructed Information.
HW0630	Pre commissioning and commissioning	Item	Lump Sum	$ 8,000.00	$ 8,000.00	**Payment**: 50% at completion of satisfactory precommissioning. Remainder at Practical Completion. **Submit:** Relevant Quality Records.
HW0631	Preparation and submission of Work as Constructed Information	Item	Lump Sum	$ 7,200.00	$ 7,200.00	**Payment:** 100% at Practical Completion. **Submit:** Complying Work As Constructed Information.
HW6WP	***Sub Total***				$316,538	

Item No.	Item Description	Qty	Unit		Amount $	Application of Schedule of Rates	Capital Project Estimate Code	WBS
HW0009	Restoration - Pipelines:					**Payment**: 100% after completion.	**Delivery**	
HW0009.01	Concrete kerb & gutter	0	m	$ 128.00	$ -	**Measurement**: Lineal metres restored within Minimum Trench Width. **Limits of Accuracy:** <To be inserted>.		
HW0009.02	Concrete driveway	0	m2	$ 198.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		
HW0009.03	Exposed aggregate & stamped driveway	0	m2	$ 256.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		
HW0009.04	Concrete footpath	0	m2	$ 178.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		
HW0009.05	Bitumen footpath	0	m2	$ 144.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		
HW0009.06	Gravel pavement	0	m2	$ 80.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		
HW0009.07	Bitumen pavement	0	m2	$ 238.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>		

HW0009.08	AC pavement	0	m2	$ 328.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>
HW0009.09	Pavers	0	m2	$ 178.00	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>
HW0009.10	Turf	0	m2	$ 12.60	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>
HW0009.11	Grass seeding	0	m2	$ 7.90	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>
HW0009.12	Hydromulch	0	m2	$ 9.60	$ -	**Measurement**: Square metres restored based on actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>
HW0010	Extra over item for Excavation in rock and disposal of excess excavated material		m3			**Measurement**: Cubic metres excavated based on thickness of rock by actual length by Minimum Trench Width. **Limits of Accuracy:** <To be inserted>.
HW0011	Acid sulphate soil					
HW0011.01	Initial testing for acid sulphate soils and prepare and submit report		per test			**Submit**: Result for each test. **Limits of Accuracy:** <To be inserted>.
HW0011.02	Establish treatment facility		Item			**Payment**: 100% after completion of treatment facility.
HW0011.03	Handling, treatment and testing of acid sulphate soils		m3			**Measurement**: Cubic metres excavated based on thickness of ASS by actual length by Minimum Trench Width. **Submit:** Test results confirming satisfactory treatment. **Limits of Accuracy:** <To be inserted>
HW0011.04	Disposal off site of acid sulphate soil		tonne			**Measurement**: Tonnes transported from the site. **Submit:** Weighbridge dockets. **Limits of Accuracy:** <To be inserted>
HW0012	Preconstruction record					
HW0012.01	Photographic	Item	Lump Sum		$ -	**Payment**: 70% on submission of the Photographic record. Remainder at Practical Completion.
HW0012.02	Video	Item	Lump Sum		$ -	**Payment**: 70% on submission of the Video record. Remainder at Practical Completion.
HW0012.03	CCTV	Item	Lump Sum		$ -	**Payment**: 70% on submission of the CCTV record. Remainder at Practical Completion.
HW0013	Work as Constructed Information <Insert Min $>	Item	Lump Sum	$ 243,790.95	$ 243,790.95	**Payment**: 100% at Practical Completion.

A.	**TOTAL ESTIMATED CONTRACT AWARD SUM**	$ 7,516,488.22

B.	**PRE-CONSTRUCTION COST (Table 10)**	
HW0016	Design	$ 751,648.82
HW0017	Project Management of Design	$ 166,329.76
HW0018	Land Matters	$ -
HW0024	Community Consultation	
	Sub Total(B1)	$ 917,978.59
	Pre construction contingency (30% of B1)	$ 275,393.58
	TOTAL PRE-CONSTRUCTION COST (B)	$ 1,193,372.16

C.	**CONSTRUCTION COST**		
	Total Estimated Contract Award Sum (A)		$ 7,516,488.22
HW0019	Principal Supplied Pipe (as applicable)		$ -
HW0020	Principal Supplied Valves and Flowmeters (as applicable)		$ -
HW0021	Principal Supplied Fittings (as applicable)		$ -
HW0022	Pump Station HV Power Supply		$ -
HW0023	Construction Management (Table 11)		$ 676,483.94
	Sub Total (C1)		$ 8,192,972.16
	Construction contingency (Table 12) (30% of C1)	Preliminary Estimate	$ 2,457,891.65
	TOTAL CONSTRUCTION COST (C)		$ 10,650,863.81

	TOTAL PRELIMINARY PROJECT ESTIMATE (B+C) (Preliminary Estimate)	$ 11,844,235.98

Development

Delivery

Total Cost