H2ONE

PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2018/990

Date: 12 SEP 2019

Queensland Government

57 Hamilton Street and 17 Weinam Street Redland Bay Qld 4165

Water Supply and Sewerage Network Capacity Assessment

FINAL Report V1 - 12 December, 2018

H2One Pty Ltd

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Joshua May	18064		12 December, 2018

Version	Date	Author	Reviewer
DRAFT - V1	11 December, 2018	D Colledge	J May
FINAL - V1	12 December, 2018	D Colledge	J May

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1 INTRODUCTION

1.1 Background

A mid-rise, residential aged care building, on 57 Hamilton Street and 17 Weinam Street, Redland Bay QLD 4165, is currently in the planning phase of the Development Application (DA) process. The development's land-use type and density is planned for 188 x 1 bed aged care units.

The development site is located within the Weinam Creek Priority Development Area (PDA), which is managed by the Minister for Economic Development Queensland (MEDQ), in consultation with Redland City Council (RCC). To support the DA for the proposed development, a water supply and sewerage network capacity assessment was undertaken to determine if the site's additional loading will impact system performance and trigger the need for infrastructure upgrades.

H2One Pty Ltd was engaged by *Palm Lake Works* to undertake the assessment in accordance with RCC's Design Standards; *South East Queensland Water Supply and Sewerage Design and Construction Code* (SEQ WS&S D&C Code) (2013). The results of the completed network capacity assessments are presented in this report.

1.2 Objectives

The objectives of the project were as follows.

1. Assess the capacity of existing gravity mains, pressure mains, pumps, wet well and emergency storage for the relevant sewer catchment (Sewage Pump Station (SPS) 90).

   Note MEDQ and RCC have yet to complete the water supply and sewer network planning study to determine the impact of additional loading from the increased population density associated with the Weinam Creek PDA. The proposed density for the subject site is similar to the preliminary planning demands for the Weinam Creek PDA, but is above RCC's Local Government Infrastructure Plan (LGIP) planning densities. Therefore, in consultation with RCC, the adopted approach was to assess the following scenarios.

   - Existing planning horizon (2016), based on LGIP planning densities.
   - Ultimate planning horizon (2036), based on the new Weinam Creek PDA planning densities.

2. Assess standard flow and fire flow capacity of the relevant water supply network (Heinemann Low Level Zone (LLZ)).

   Note the proposed water supply connection will be located within the Boundary Street District Metered Area (DMA 202), which is outside the Weinam Creek PDA water supply boundary. The consideration of the Weinam Creek PDA planning demands was therefore only required for the sewer capacity assessment.

3. Determine infrastructure upgrades necessary to achieve RCC's minimum design standards, where system performance failures have occurred due to the additional loading of the subject site; and
4. Prepare a network capacity assessment report.

1.3 Sewerage Catchment System

The development site is located within the SPS 90 sewerage catchment, with a connection proposed on the diameter nominal (DN) 150 gravity main adjacent to the eastern property boundary, at the intersection of Weinam Street and Hamilton Street. The development's sewage outfall will continue north via a DN225 gravity line, and discharge to SPS 90, approximately 260 m downstream of the

subject site. SPS 90 is duty/assist and discharges to the downstream gravity network within the SPS 67 catchment, which ultimately discharges to the Victoria Point Sewage Treatment Plant (STP) pump station.

SPS 90 currently services an estimated 1,600 EP, which is projected to increase to a maximum of 6,180 EP at the Ultimate planning horizon (2036), with the inclusion of the preliminary Weinam Creek PDA planning densities. Note this is an increase from the LGIP 2036 planning density of approximately 2,320 EP.

Refer to Appendices 1 and 2 for an overview of the development site location and relevant sewer catchment.

1.4 Water Supply Zone

The development site is located within the Boundary Street DMA (DMA 202), which is supplied by a flow modulated Pressure Reducing Valve (PRV), with a maximum pressure setting of 44 m. The Heinemann water supply tanks (*Heinemann RES 2 and 3*) service the catchment via a trunk system of DN600, DN375, DN300 and DN200 mains along Heinemann Road, Giles Road, Boundary Street and Main Street.

The development's proposed water connection will be located on the DN100 along Hamilton Street, which extends south from the DN150 main along Peel Street, Redland Bay. This DN100 is on the water supply catchment boundary of the Boundary Street DMA and Weinam Creek PDA, separated by a closed valve on the corner of Weinam Street and Hamilton Street.

Refer to Appendix 3 for an overview of site location and relevant water supply system.

1.5 Demand Assessment

A demand assessment of the development was undertaken to determine the approximate water and sewage demand loading attributed to the proposed land use type and density. This was calculated using RCC's adopted Equivalent Tenement (ET) unit rates and average "per capita" demand for potable water and sewage (230L/EP/day and 210 L/EP/day respectively).

Table 1 shows a summary of the development's demand estimation.

Table 1. Estimated demands for the proposed development

Site Land Use and Density	Demand Rate	ET	EP	Water (kL/day)	Sewage (kL/day)
188 x 1 bed aged care unit.	0.31 ET/Unit	58.3	157.4	36.2	33.0

Note: Based on 2.7 ET to EP conversion

The LGIP and Weinam Creek PDA planning demands allocated to the subject site are presented below in Table 2. The 2016 demands were removed from the sewer hydraulic model, and replaced with 157.4 EP, for the post-development scenario. The 2036 planning horizon however, was unchanged as the proposed site density is below the projected demands for the Weinam Creek PDA. The below figures were advised by RCC or sourced from the LGIP hydraulic model.

Table 2. LGIP sewage demands (EP) removed from the hydraulic model

Address	Node ID	2016 LGIP (EP)	2036 Weinam Creek PDA (EP)
57 Hamilton St, Redland Bay	48005	24.8	78.8
17 Weinam St, Redland Bay	48071	0.0	77.4
	TOTAL	**24.8**	**156.2**

Note 1: The 2016 demands were sourced from RCC's LGIP Infrastructure Demand Model (IDM) and the 2036 demands were sourced from the preliminary Weinam Creek PDA planning densities.

Note 2: The water supply LGIP demands (for the site) were allocated within the Weinam Creek PDA, i.e. outside the Boundary Street DMA. Therefore, these demands were not removed from the model for the assessment.

2 METHODOLOGY

2.1 Desired Standards of Service

The design standards of the "*South East Queensland Water Supply and Sewerage Design and Construction Code*" (2013) were utilised for the assessments. A summary of the most relevant requirements are as follows.

Table 3. SEQ WS&S D&C Code provisions relevant to the analysis

	Provision	Specification
Sewerage	ET to EP conversion factor	2.7
	Average Dry Weather Flow (ADWF)	210 L/EP/day
	Peak Wet Weather Flow (PWWF)	5 x ADWF
	Single pump capacity	C1 x ADWF (L/s) where; C1 = 3.5 to 5.0 C1 = 15 x $(EP)^{-0.1587}$
	Pump station operational storage (m^3)	0.9 x Q / N where; Q = Single pump capacity (L/s) N = Number of pump starts per hour, where N = 12 for duty pump motor < 100 kW N = 8 for duty pump motor 100 – 200 kW N = 5 for duty pump motor > 200 kW
	Pump station emergency storage (m^3)	4 hours ADWF
	Total pump station capacity (L/s)	PWWF
	Maximum depth of gravity flow (proposed system)	75% pipe diameter
	Maximum depth of gravity flow (existing system)	1.0 m below manhole level
	Maximum rising main flow velocity	3.0 m/s
Water Supply	ET to EP conversion factor	2.7
	Average Day Demand	230 L/EP/day
	Maximum pipe velocity (WSA)	2.5 m/s
	Maximum head loss (WSA)	5 m head/km for <=DN150 3 m head/km >=DN200
	Minimum service pressure	22 m at the property boundary
	Maximum service pressure	55 m
	Minimum fire flow network pressure	12 m at 2/3 peak hour demand (res)
	Fire flow	15 L/s (res)
	Hazen Williams pipe friction co-efficient	<= 150 diameter, 100 >150 <300 diameter, 110

2.2 Sewerage Network Assessment

The methodology adopted for the hydraulic capacity assessment of the sewer network is as follows.

1. RCC's latest LGIP Mike Urban SWMM hydraulic model (*VP72.3.8.3*) was adopted for the 2016 analysis. At the time the study was undertaken, RCC's Mike Urban model was being developed

with only the 2016 LGIP planning horizon operational. The assessment of the 2036 planning horizon, with the preliminary Weinam Creek PDA demands, was therefore undertaken using RCC's H2OMap SWMM LGIP hydraulic model, developed in 2016. A comparison of the 2016 planning horizon results, for each model, showed similar results with the aggregate PWWF loading for the SPS 90 catchment being similar (refer Appendix 4 for results comparison). It was therefore considered appropriate to adopt the use of both models for this study.

2. For the 2016 post-development scenario, the subject site's estimated demand (157.4 EP) was placed into the model on manhole *48067*, and relevant LGIP demands removed as per Section 1.5 of this report. The subject site loading for the 2036 scenario was not altered and remained as per the planning densities developed for the Weinam Creek PDA. This was due to the proposed development being almost identical to the preliminary Weinam Creek PDA planning density estimations.
3. The pump capacity of SPS 90 was assessed by running the model at PWWF and determining whether wet well levels operated within the stand-by pump start/stop settings from acceptable pump cycles. If the pump station could not maintain acceptable levels and surcharging occurred, capacity upgrades were investigated until design standards were achieved.
4. The wet well operational storage of SPS 90 was subsequently evaluated by comparing the required operational storage capacity, pre- and post-development, against wet well volumes between duty pump start/stop levels.

   If the wet well's operational storage volume was above the minimum requirement, compliance was achieved. If it was below the minimum requirement, upgrades were investigated until design standards were achieved.
5. The flow depth of gravity mains was assessed from the proposed connection point to SPS 90, at pre- and post-development PWWF. To avoid surcharging from unrelated issues downstream, pumps were deactivated from the model and gravity mains discharged directly to a wet well outlet.

   If flow depths could not be maintained within RCC specifications, pipe augmentations were investigated until design standards were achieved.
6. The emergency storage capacity of the SPS 90 catchment was assessed by determining the ADWF retention time, pre- and post-development. This was achieved by priming the hydraulic model with ADWF and simulating a pump shutdown at the duty pump start level. Using the SPS 90 wet well depth profiles, the time duration from pump shutdown to the overflow event was used to determine the sewage retention time.

   If the overflow event occurred at a duration beyond 4 hours, compliance was achieved. If it was below 4 hours, compliance was not achieved and storage upgrades were investigated.
7. Modelling results were verified and findings reported.

2.3 Water Supply Network Assessment

The methodology adopted for the water supply network capacity assessment is as follows.

1. RCC's latest Mike Urban LGIP water supply hydraulic model (*IDM_Rev16*) was adopted for the hydraulic analysis. For the post-development scenarios, the estimated site demands and diurnal patterns were placed into the model on node *J11494*.

2. For all planning horizons, a detailed 1 x Maximum Day (MD) standard flow analysis was undertaken on the property connection and surrounding network, for both pre- and post-development scenarios. Any deficiencies in the network were investigated and appropriate solutions determined.

   Note: An assessment on the capacity of the water supply tanks (Heinemann Rd LLZ) was not undertaken, as the development's additional loading (157 EP at the ultimate planning horizon) was considered negligible for the existing storage capacity, in excess of 20 ML storage.

3. Residential (15 L/s) and commercial (30 L/s) fire flow allocation was applied to the surrounding network as per the RCC's MapInfo fire flow map "*FF_Mainland*". Hydrants surrounding the site were allocated 30 L/s fire flow, due to the site being adjacent to commercial properties and higher than 3 storeys, as per RCC's design standards.

4. A detailed fire flow analysis was undertaken on the nearest hydrants directly servicing the site, and all hydrants within the local network. This was completed for both pre- and post-development scenarios, with a 1 x MD event. Any deficiencies in the network were investigated and appropriate solutions determined.

5. Modelling results were verified and findings reported.

3 RESULTS

3.1 Sewerage Network Assessment

3.1.1 Pump/s

A pump capacity assessment was undertaken on SPS 90, as per the methodology described in Section 2.2 of this report. The analysis identified that the pump station was not adversely impacted by the subject site's loading and performed within RCC requirements, at the 2016 planning horizon with LGIP demands.

However, for the 2036 planning horizon with Weinam Creek PDA planning demands, the pump station was unable to maintain upstream PWWF and an overflow occurred. It is estimated that the proposed 2036 LGIP upgrade of SPS 90 will need to be increased from 50 L/s to 75 L/s combined flow, in order to maintain upstream PWWF. Further investigation is required by RCC to determine timing of the pump station augmentation and the relevant impact on downstream infrastructure.

As the proposed development density is almost identical to the preliminary Weinam Creek PDA planning demands, the site did not trigger nor exacerbate the pump deficiency. It is recommended RCC disregards this infrastructure upgrade for the development assessment of the subject site.

Refer to Appendix 5 for detailed pump capacity modelling results.

3.1.2 Wet Well/s

An assessment on the operational storage capacity of the SPS 90 wet well was undertaken, as per the methodology described in Section 2.2 of this report. Table 4 below shows a summary of results and Appendix 6 presents detailed calculations.

Table 4. Operational storage capacity results

Planning Horizon	Capacity Available (kL)	Capacity Required (kL)	Difference (kL)
2016	1.7	1.5	+0.2
2036	1.7	4.2	-2.5

The results in the above table demonstrate that there is sufficient operational storage to incorporate the site's additional loading with the 2016 LGIP catchment demands. However, the 2036 planning horizon, with the Weinam Creek PDA planning demands, presented a 2.5 kL operational storage deficiency. Further investigation is required by RCC to determine timing of the storage augmentation due to the increase in catchment demands from the Weinam Creek PDA.

As the proposed development density is almost identical to the preliminary Weinam Creek PDA planning demands, the site did not trigger nor exacerbate the storage deficiency. It is recommended RCC disregards this infrastructure upgrade for the development assessment of the subject site.

3.1.3 Gravity Main/s

As per the methodology described in Section 2.2 of this report, gravity pipe flow depths were assessed against RCC's minimum requirement (1.0 m below manhole level), from site connection to SPS 90. The analysis identified that there is sufficient capacity to incorporate the site's additional loading and gravity main upgrades are not required to service the development.

Refer to Appendix 7 for detailed modelling results and gravity main profiles.

3.1.4 Emergency Storage

An emergency storage capacity assessment was undertaken on the SPS 90 catchment, as per the methodology described in Section 2.2 of this report. Based on an overflow level of RL -2.3 m, which

was sourced from both the Mike Urban and H2OMap SWMM models, the analysis identified a sewage retention time of approximately 33 minutes and 20 minutes, at the 2016 and 2036 planning horizons, respectively. The site is estimated to have increased the 2016 retention time requirement by 2 minutes.

This demonstrates that the SPS 90 catchment may have an existing emergency storage deficiency that was neither triggered nor significantly exacerbated by the subject site. However, the overflow level presented in both hydraulic models appears to be low and potentially incorrect. It is therefore recommended that RCC confirms the overflow level with 'as constructed' drawings and validates modellings results shown in this report. Refer to Appendix 8 for modelling results pre- and post-development.

3.2 Water Supply Network Assessment

3.2.1 Fire Flow

As per the methodology described in Section 2.3 of this report, a detailed fire flow network analysis was undertaken on the 2017 and Ultimate planning horizons, with the inclusion of the estimated development demands.

The closest hydrant (*H127*) servicing the site was allocated 30L/s as per RCC's MapInfo fire flow map, which requires the commercial fire rating to service the police station, adjacent to the site at 60 Hamilton Street, Redland Bay. The 2017 planning horizon showed a peak hour standard flow and fire flow residual pressure of 44.9 m and 1.5 m, respectively. The fire flow minimum pressure was below the 12 m requirement, therefore further modelling was undertaken to resolve accordingly.

The first option was to modify the valve arrangement between the Boundary Street DMA and Weinam Creek PDA (DMA 106), at the intersection of Hamilton Street and Weinam Street, i.e. move the closed valve west to reposition the site hydrant into DMA 106. This approach however did not resolve the peak hour minimum pressure deficiency and system upgrades were subsequently investigated.

Modelling determined that a DN150 upgrade of the existing DN100 (110 m) running west to east along Hamilton Street, from the intersection of Pitt Street and Hamilton Street, resolved the minimum pressure failure across all planning horizons. The modelling results below show modelling results with consideration of the recommended DN150 upgrade.

Table 5. Fire flow network modelling results (DN150 upgrade included)

		Planning Horizon			
Scenario		**2017 (Post)**	**2017 (Pre)**	**Ultimate (Post)**	**Ultimate (Pre)**
Peak Hour	Site hydrant (H127) min. pressure (m)	25.0	23.8	16.5	16.4
	Network hydrant min. pressure (m)	-116.8	-118.8	-115.2	-108.7
	Network hydrant min. pressure node ID	J11745			
	Network hydrants no. failures	5	5	5	5
	Network hydrant min. pressure (m)	-121.7	-121.6	-121.9	-120.3
	Network hydrant min. pressure node ID	J11745			
	Network hydrants no. failures	4	4	4	4

Note 1: Results based on peak hour at 9 am and 2/3 peak hour at 6 am.

Note 2: Post-development results show higher network pressures due to the flow modulated PRV increasing the supply pressure with the increased flow rate.

The above results demonstrate that the network performed within RCC's minimum design standards, with exception to a small number of minimum pressure peak hour and 2/3 peak hour failures, which were unrelated to the proposed DN150 upgrade.

Further investigation revealed that the minimum pressure failures were due to insufficient network connectivity and occurred at both pre- and post-development. This demonstrates that these deficiencies are an existing planning issue that was not triggered by the proposed development.

With exception to the recommended 110 m, DN150 pipe upgrade on Hamilton Street, no further infrastructure upgrades are required to service the subject site for fire flow.

3.2.2 Standard Flow

As per the methodology described in Section 2.3 of this report, a detailed standard flow network analysis was undertaken on the 2017 and Ultimate planning horizons, with the inclusion of the estimated development demands and proposed DN150 upgrade along Hamilton Street.

Table 6. Standard flow network modelling results (DN150 upgrade included)

	Planning Horizon			
Provision	**2017 (Post)**	**2017 (Pre)**	**Ultimate (Post)**	**Ultimate (Pre)**
Connection point (J11494) min. pressure (m)	45.5	44.7	47.5	48.0
Network min. pressure (m)	29.3	27.4	31.5	31.8
Network min. pressure node ID	202CMP			
Network no. failures	0	0	0	0
Max. pipe velocity (m/s)	0.5	0.5	0.8	0.8

Note: The flow modulated PRV (ID: PRV202) resulted in higher residual pressure during the higher flow/demand scenarios.

The above results demonstrate that the network performed within RCC's specifications across all planning horizons. Infrastructure upgrades are therefore not required to service the proposed development.

4 CONCLUSION

A mid-rise, residential aged care building, on 57 Hamilton Street and 17 Weinam Street, Redland Bay QLD, is currently in the planning phase of the Development Application (DA) process. The development's land-use type and density is planned for 188 x 1 bed aged care units.

The development site is located within the Weinam Creek Priority Development Area (PDA), which is managed by the Minister for Economic Development Queensland (MEDQ), in consultation with Redland City Council (RCC). To support the DA for the proposed development, a water supply and sewerage network capacity assessment was undertaken to determine if the site's additional loading will impact system performance and trigger the need for infrastructure upgrades. This included an assessment of the relevant sewer catchment (SPS 90) with the increase in planning demands from the Weinam Creek PDA.

The analysis identified the following water supply and sewer infrastructure upgrades to adequately service the proposed development and preliminary Weinam Creek PDA planning densities.

Water Supply

- At the 2017 planning horizon, upgrade the existing DN100 along Hamilton Street to a DN150 (110 m), to provide adequate commercial fire flow service pressure to hydrant H127. Note this upgrade is an existing deficiency that was not triggered by the site, the 30 L/s fire flow is required to service the existing police station at 60 Hamilton Street, Redland Bay, in addition to the proposed development. This therefore demonstrates that it's an existing planning issue that should be investigated further by RCC.

Sewer

- At the 2017 planning horizon with LGIP planning demands, potentially upgrade the SPS 90 emergency storage capacity to achieve 4 hours ADWF retention time. The hydraulic model showed a minimum ADWF retention time of 20 minutes, which is well below the 4 hour ADWF design standard. However, it is recommended that RCC confirms the overflow level with as constructed drawings, as both hydraulic models presented a very low level (RL -2.3 m) which is potentially incorrect.

  Note this deficiency also occurred at the pre-development scenario, with the subject site contributing negligible ADWF to the shortfall. This therefore demonstrates that it's an existing planning issue that should be investigated by RCC.

- At the 2036 planning horizon with Weinam Creek PDA planning demands, potentially upgrade SPS 90 to a combined flow of 75 L/s and wet well operational storage of 4.2 kL.

  Note these deficiencies were again unrelated to the subject site and were required to service the preliminary Weinam Creek PDA planning densities. This therefore demonstrates that it's an existing planning issue that should be investigated further by RCC.

In summary, it is recommended that RCC considers the following for the assessment of the proposed development on 57 Hamilton Street and 17 Weinam Street, Redland Bay QLD.

- RCC approves the water supply and sewer connections for the proposed development, without conditioning additional obligations to the client.
- RCC initiates a detailed water supply and sewer infrastructure planning study to determine the impact of the preliminary Weinam Creek PDA planning densities. This should include confirmation of the overflow level for the SPS 90 catchment and validation of the emergency storage modelling results presented in this report.

- Where possible, further validate the modelling results presented in this report with available SCADA monitoring data, e.g. SPS 90 pump run times.

Detailed modelling results, calculations and system plans can be observed in Appendices 1 through 8.

5 REFERENCE LIST

RCC. (2013). *SEQ Water Supply and Sewerage Design and Construction Code*. Redland Bay, QLD

6 APPENDICES

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H2ONE PM:	J May

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No.	REVISION	APPROVED
A	ORIGINAL ISSUE - 11 DEC 2018	

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HEIGHT: AHD

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Metres

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PROJECT NO: 1809252
FILE REF:
CAD FILE:

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17 Weinam St and 57 Hamilton St Redland Bay, QLD 4165 Water Supply and Sewerage Network Capacity Assessment

Appendix 1. Development site and SPS 90 sewer catchment

DEC, 2018
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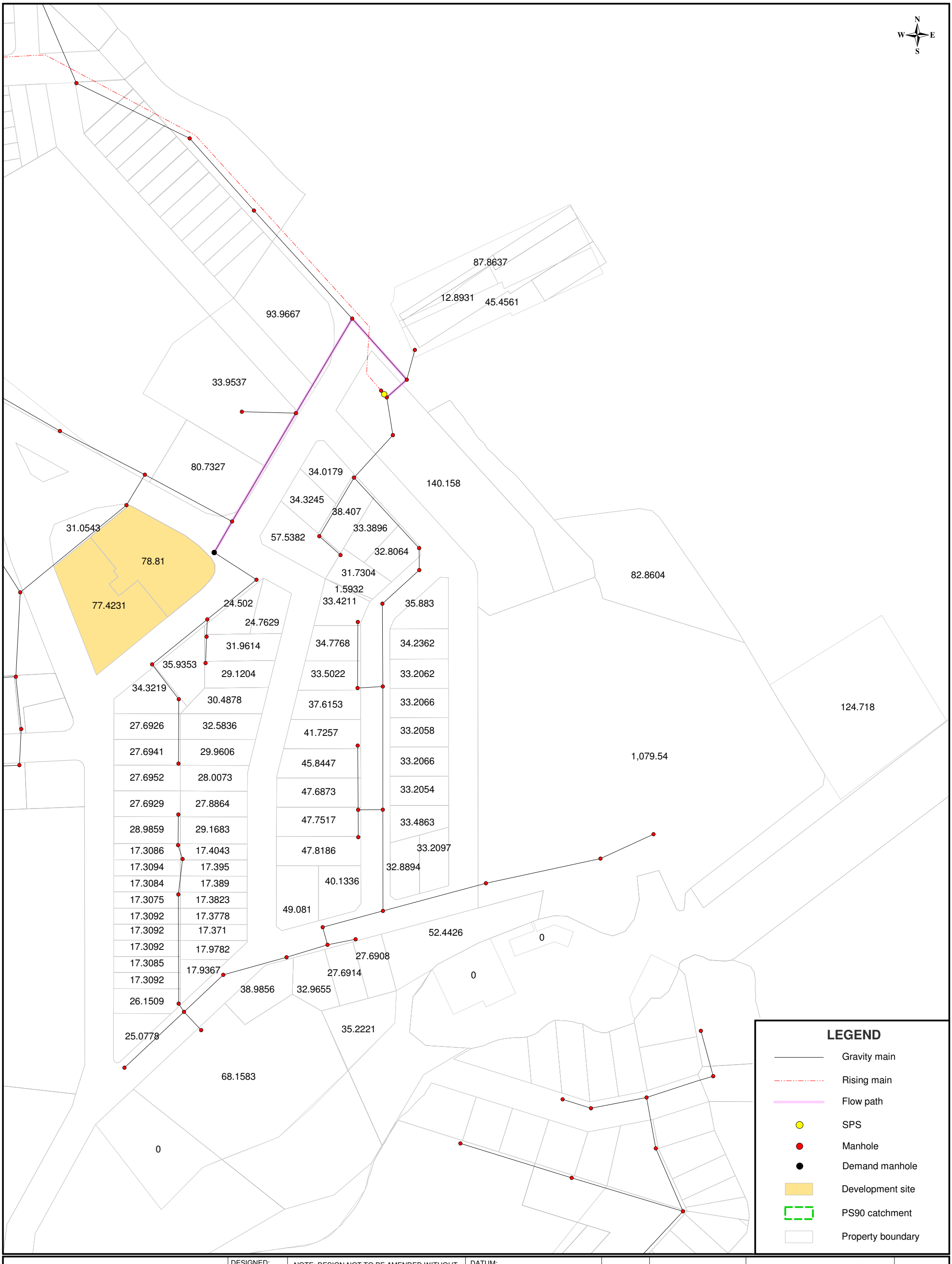

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Appendix 2. Prelim. Weinam Creek PDA demands within the SPS 90 catchment

DEC, 2018
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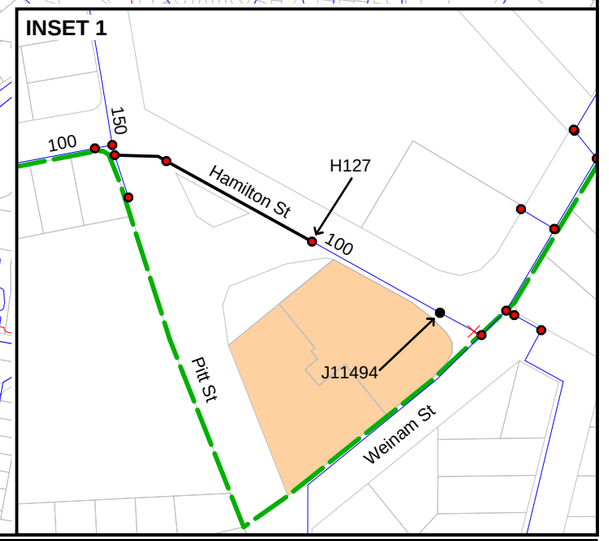
LEGEND

- Trunk main
- Retic main
- Recommended DN150
- Reservoir
- Hydrant
- Demand node
- PRV
- Closed valve
- Area analysed
- Development site
- Property boundary

N
W E
S

375
300
600
600
600
200
150
Refer INSET 1
HEINEMANN RES 2
HEINEMANN RES 3

INSET 1



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Metres

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Appendix 3. Development site and Heinemann LLZ water supply system

ORIGINAL ISSUE DATE: DEC, 2018
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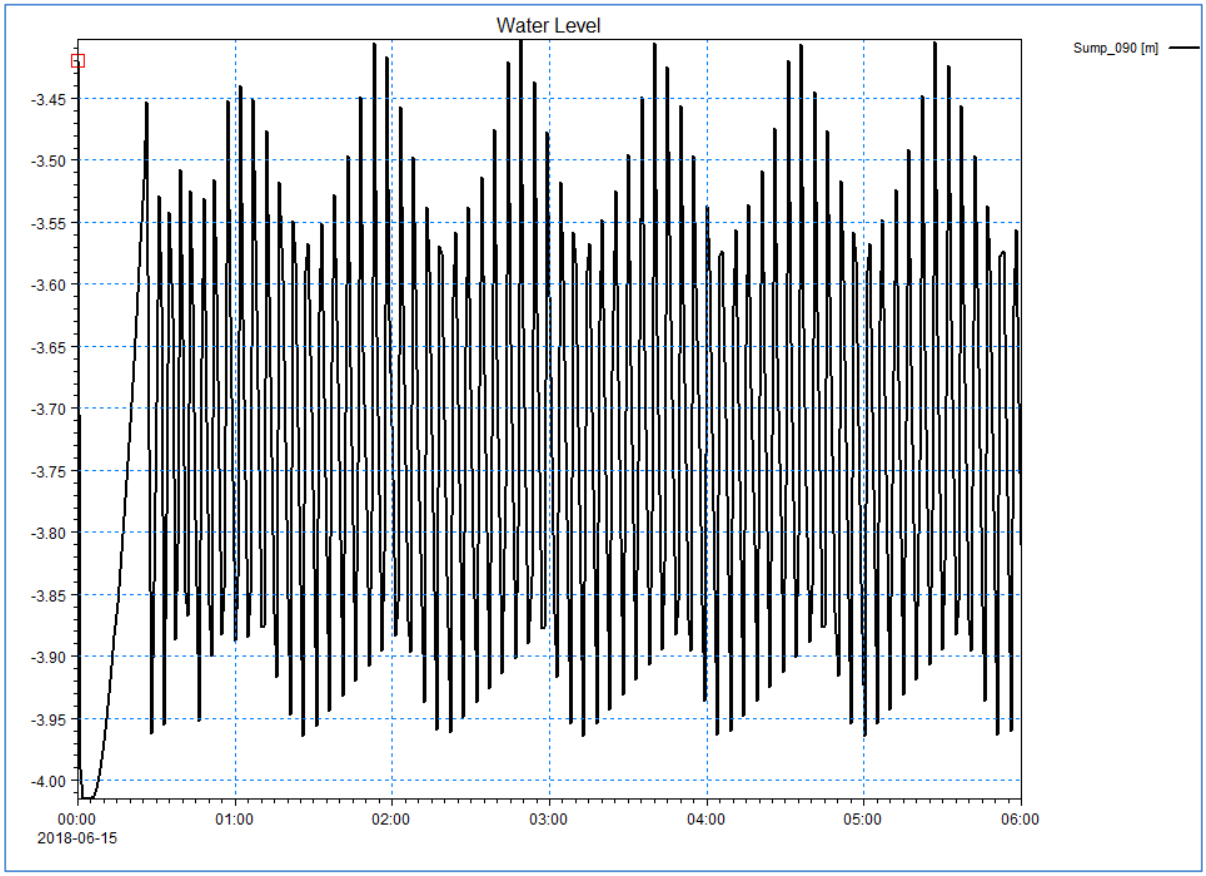
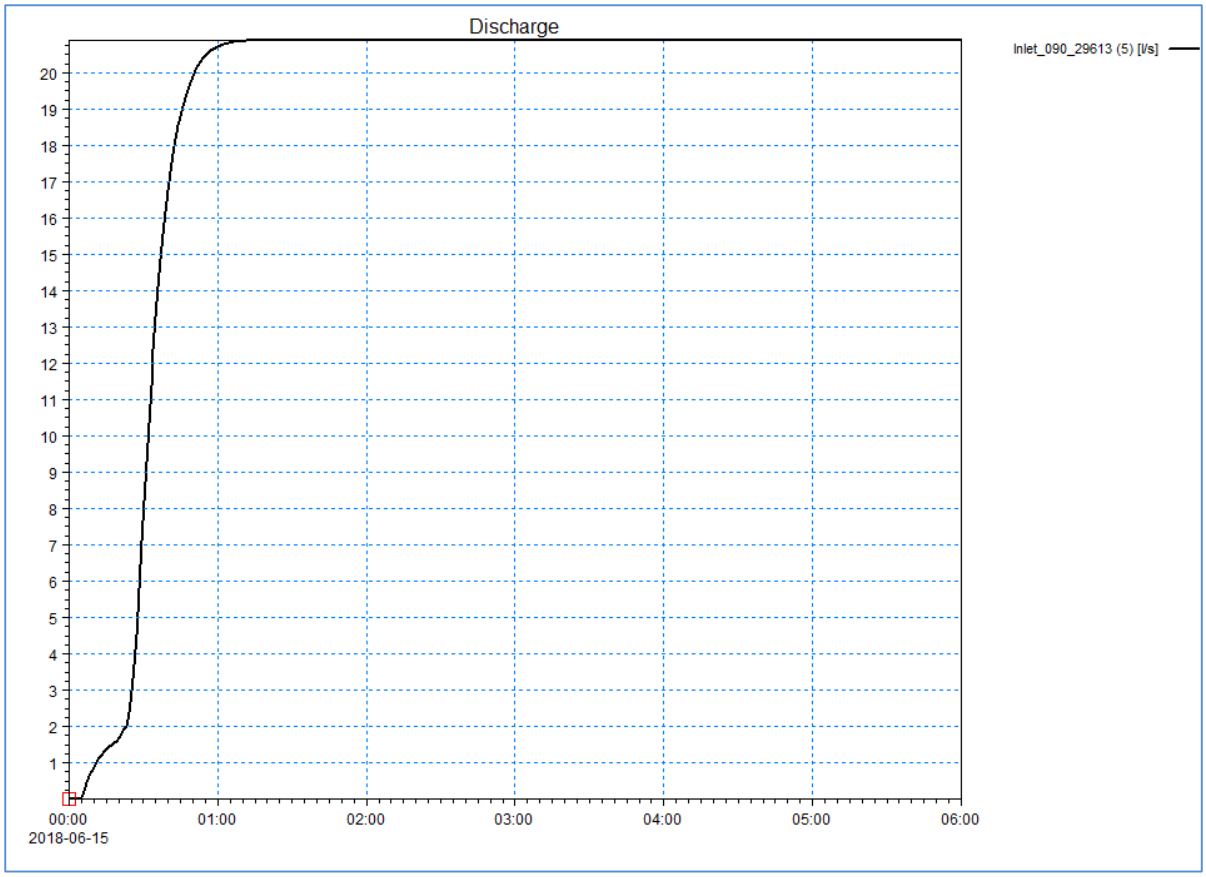
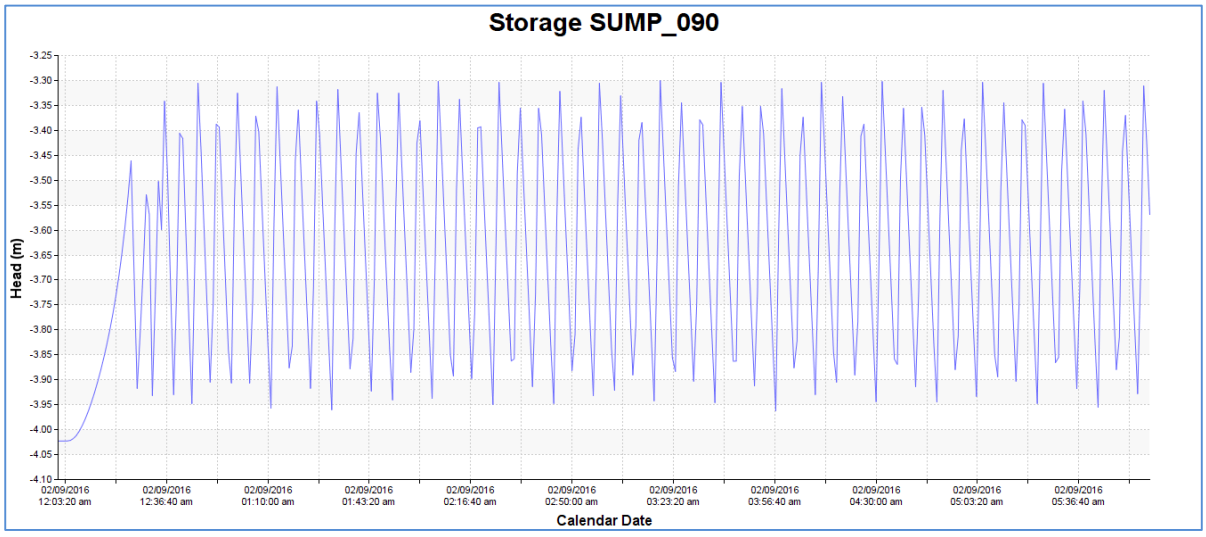
Appendix 4. Mike Urban and H2OMap SWMM model validation results

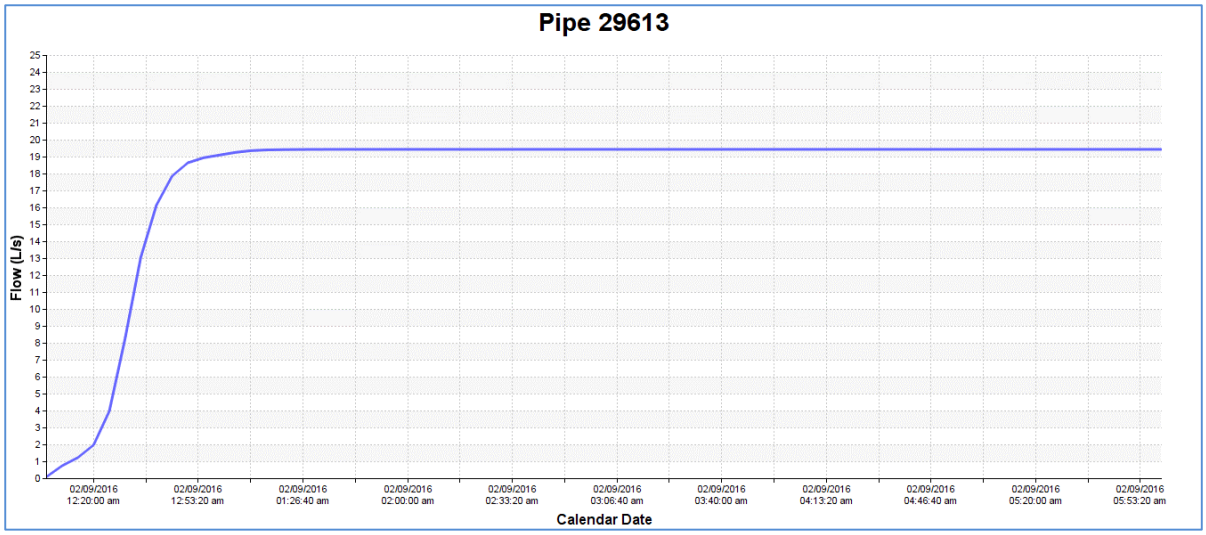
2016 PWWF LGIP, Mike URBAN





2016 PWWF LGIP, H2OMap SWMM

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22
23
24
25
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02/09/2016 12:53:20 am
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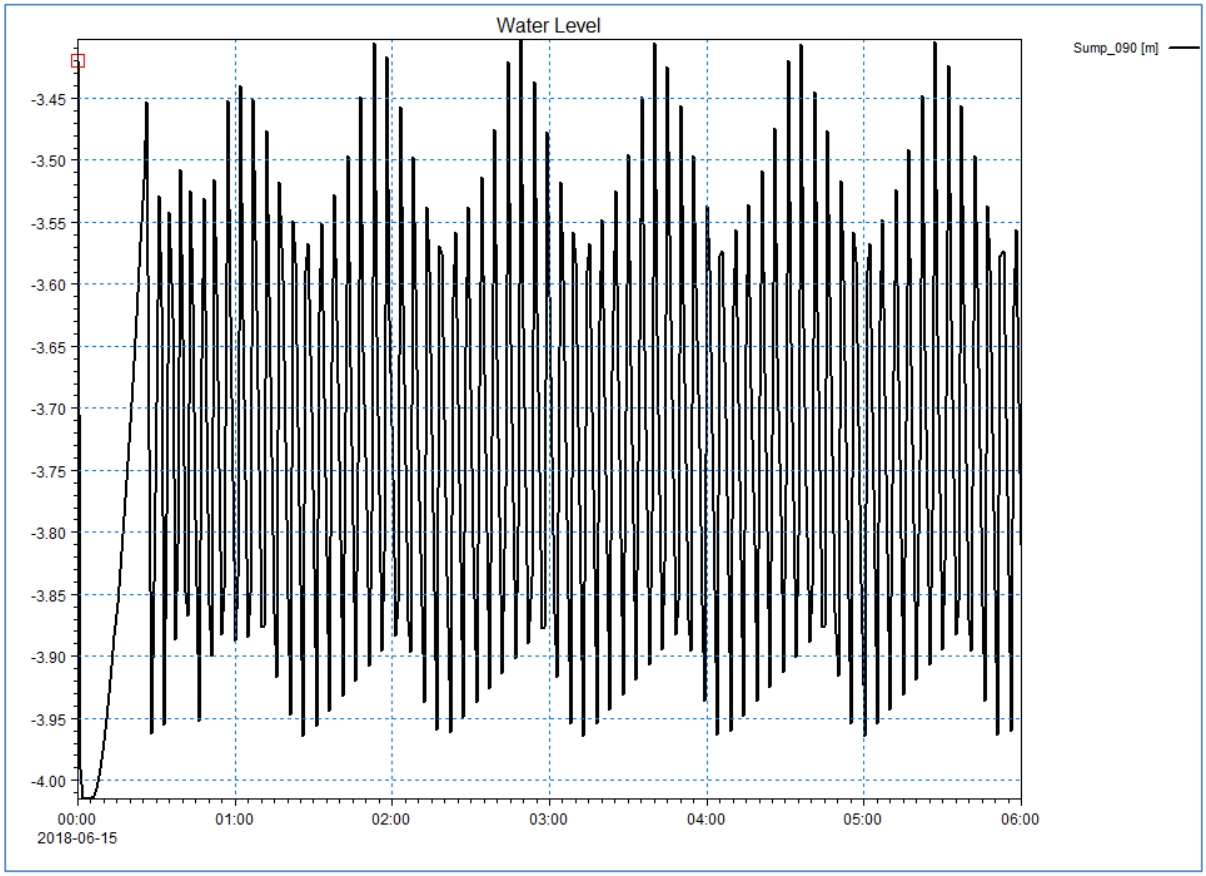
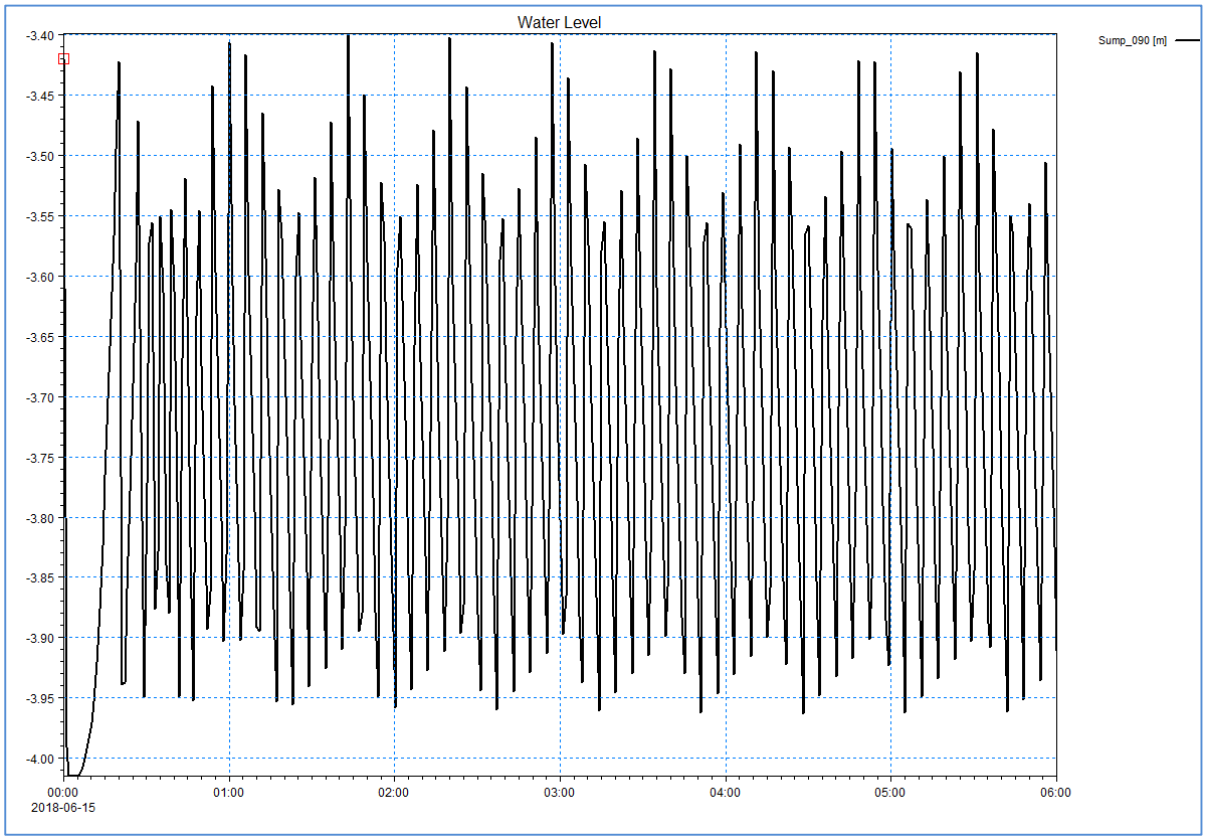
Calendar Date

Appendix 5. Pump capacity assessment results

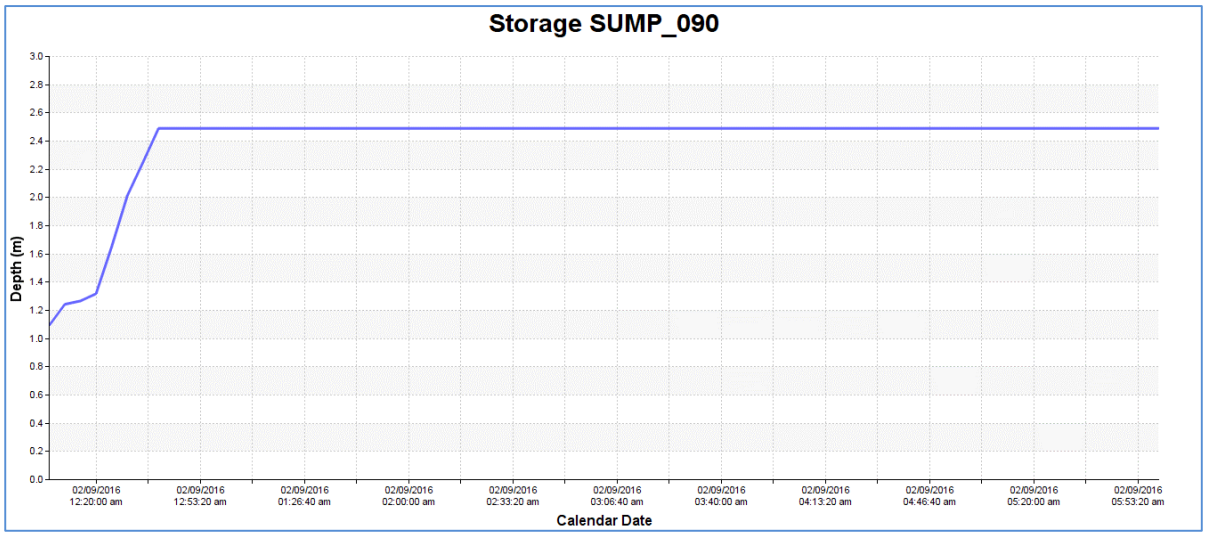
2016, SPS 90 Pre-develop.

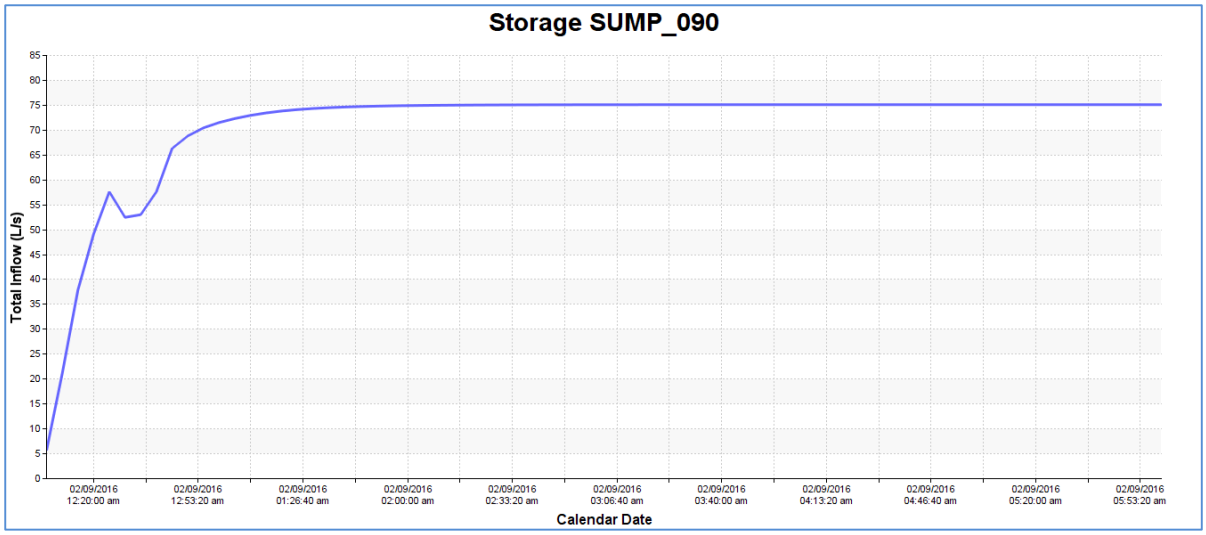


2016, SPS 90 Post-develop.



2036, SPS 90 Weinam Creek PDA




Storage SUMP_090
Total Inflow (L/s)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
02/09/2016 12:20:00 am
02/09/2016 12:53:20 am
02/09/2016 01:26:40 am
02/09/2016 02:00:00 am
02/09/2016 02:33:20 am
02/09/2016 03:06:40 am
02/09/2016 03:40:00 am
02/09/2016 04:13:20 am
02/09/2016 04:46:40 am
02/09/2016 05:20:00 am
02/09/2016 05:53:20 am
Calendar Date

Appendix 6. Operational storage capacity assessment results

		2016 (LGIP)	2036 (Weinam Creek PDA)
Single Pump Capacity Required	C1	4.6	3.8
	ADWF (L/s)	4.2	15.0
	Pump Arrangement	Duty / Assist	Duty / Assist
Storage Capacity Required	Duty Flow (L/s)	19.3	56.4
	Duty Head (m)	-	-
	Pump Efficiency (%)	-	-
	Duty Power (kW)	<100 kW	<100 kW
	No. pump starts (n)	12.0	12.0
	Volume (kL)	1.45	4.23
Storage Capacity Available	Duty Start (RL m)	-3.42	-3.42
	Duty Stop (RL m)	-3.96	-3.96
	Duty Height (m)	0.54	0.54
	WW Diam. (m)	2.00	2.00
	Volume (kL)	1.70	1.70
OUTCOME	**Difference (kL)**	+0.24	-2.53
	Pass / Fail	Pass	Fail

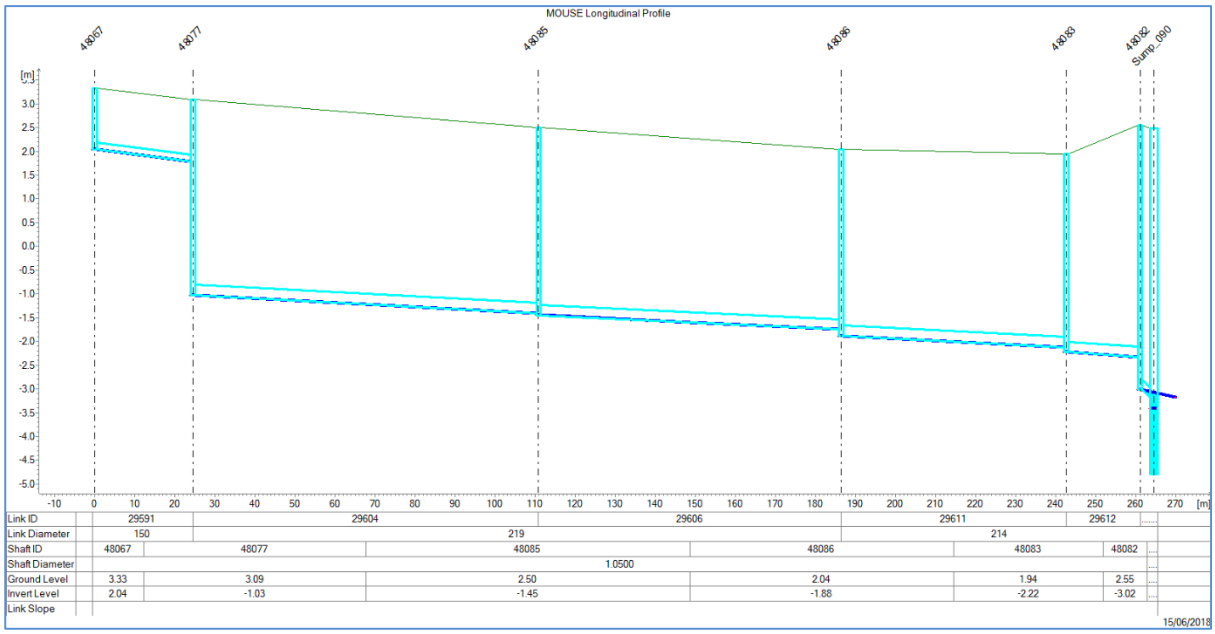
Note 1: Wet well and pump details were sourced from RCC's LGIP report and models. The 2036 scenario considers the increase in population density from the Weinam Creek PDA.

Note 2: Duty pump power (kW) was assumed at less than 100 kW.

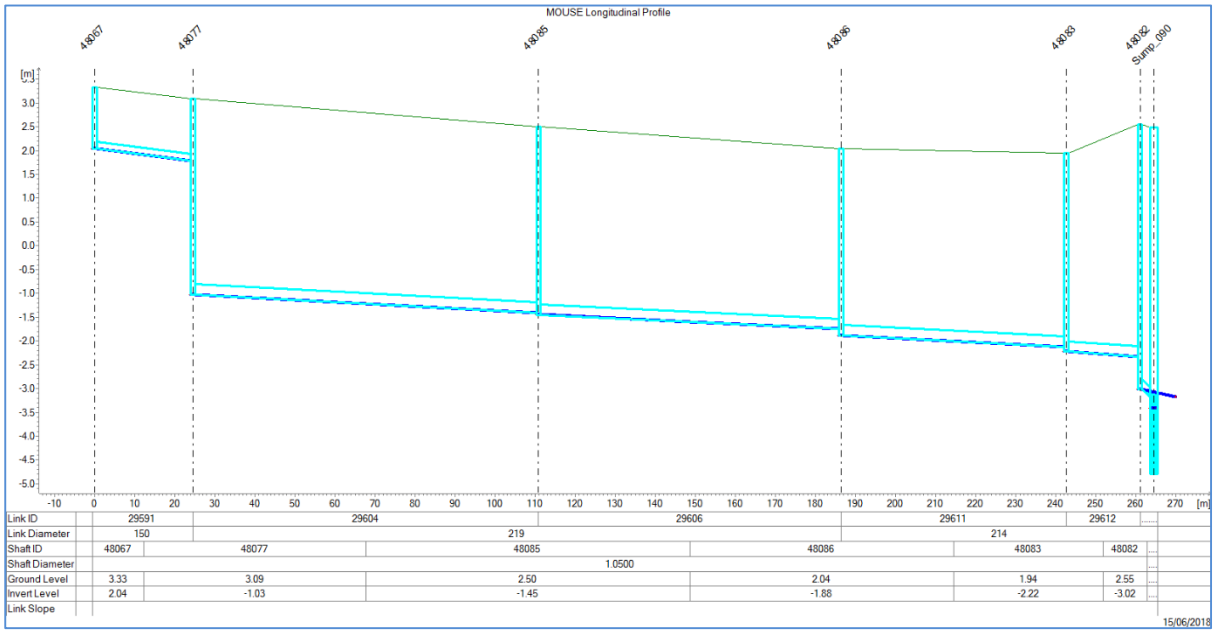
Note 3: The proposed development contributed 0.09 kL towards the storage requirement.

Appendix 7. Gravity main flow depth capacity assessment results

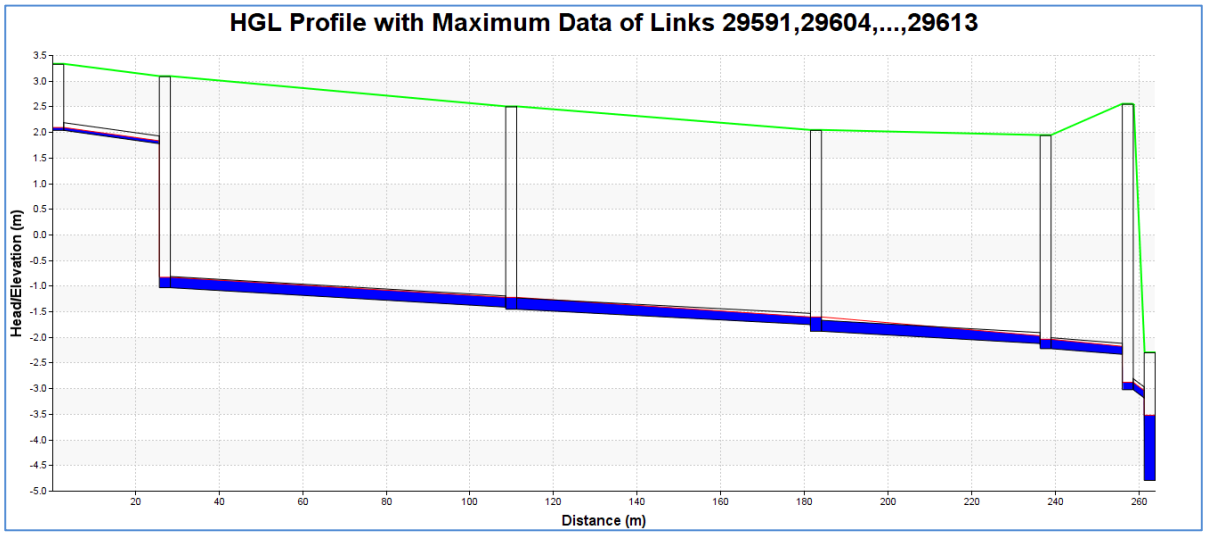
2016 LGIP, Pre-development



2016 LGIP, Post-development

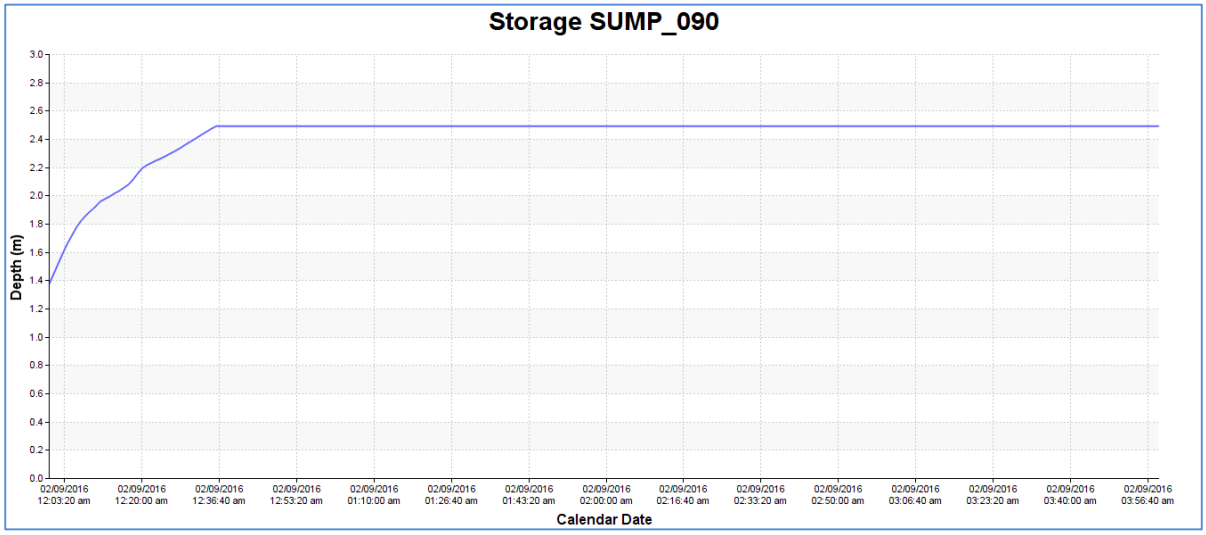


2036 Weinam Creek PDA

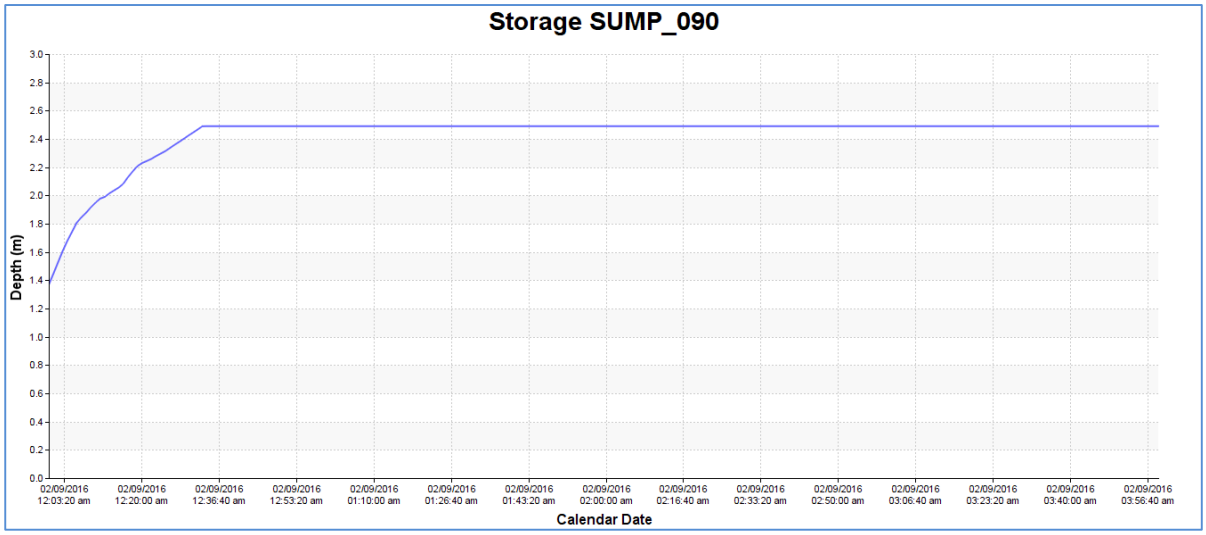


Appendix 8. Emergency storage capacity assessment results

2016 LGIP, Pre-development (35M)



2016 LGIP, Post-development (33M)



2036 Weinam Creek PDA (20M)