WIDE BAY water CORPORATION

2015 | Fraser Coast Sewerage Strategy

November 2015

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ABBREVIATIONS/DEFINITIONS

ADWF	Average Dry Weather Flow
AMTD	Adopted Middle Thread Distance - The distance in kilometres, measured along the middle of a watercourse that a specific point in the watercourse is from the watercourse's mouth or junction with the main watercourse.
AWTP	Advanced Water Treatment Plant
BOD	Biological Oxygen Demand
BNR	Biological Nutrient Removal
CCTV	Closed Circuit Television – used for capturing internal video of sewer pipe for condition assessment
COD	Chemical Oxygen Demand
DAF	Dissolved Air Floatation – A method of water and wastewater treatment
DEHP	Department Environment and Heritage Protection
DERM	Department of Resource Management – Publish a "Planning guideline for water Supply and Sewerage" which relates to all levels of infrastructure except source.
DEWS	Department of Energy and Water Supply (Formerly DERM)
DOC	Dissolved organic carbon
DN	Diameter (nominal) usually referring to a pipe size
ED	Equivalent Dwelling – A measure to quantify loading of individual properties. Typically a 3 bedroom house is considered as 1 ED.
Effluent	The liquid stream flowing from the treatment plant
EP	Equivalent Person - A measure to quantify loading of individual people
GIS	Geographical Information System
H	Head (usually expressed in m)
H_2S	Hydrogen Sulphide
HB	Hervey Bay township
IDEA(L)	Intermittently Decanted Extended Aeration (Lagoon)
I/I	Inflow/Infiltration terms used to describe storm water and groundwater entering a sewer system
IO	Inspection Opening
kL	kilolitres
L/s	Litres per Second
m	metres
MB	Maryborough township
MBR	Membrane Bioreactor
ML	Megalitres
ML/d	Megalitres per day
MSF	Maryborough Sugar Factory
N	Nitrogen
Non potable	Water that is not suitable for drinking because it does not meet ADWG
NPV	Nett Present Value

OESR	Office of Economic and Statistical Research (Formerly PIFU)
ORG	Overflow Relief Gully
ou	Odour Units
Potable	Water that is suitable for drinking. Typically has been treated and chlorinated.
P	Phosphorus
PAC	Powdered activated carbon
PIA	Priority Infrastructure Area
PWWF	Peak Wet Weather Flow (taken as 5xADWF)
Q	Flowrate (usually expressed in L/s)
Residual Pressure	That part of total pressure that is not used to overcome friction or gravity while forcing water through pipe, fittings fire hose and adaptors
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition
Sewage	Is a subset of wastewater which is contaminated with faeces or urine
Sewer	Pipes that transport sewage from customer to wastewater treatment plant
Sewerage system	The infrastructure to transport and treat sewage from customer to disposal
SOS	Standards of Service – This is a driver for infrastructure upgrades. This is the service level that is dictated by development guidelines, WSAA and DERM guidelines, legislation or WBWC's customer charter.
SPS	Sewage Pump Station
SS	Suspended Solids
TDS	Total Dissolved Solids
TkN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
TWL	Top Water Level
Wastewater	Any waste water containing contaminants
WBWC	Wide Bay Water Corporation – Water utility serving the Fraser Coast in Queensland
WQO	Water Quality Objectives
WSAA	Water Services Association of Australia– Recognised Authority for standards in Australia. Typically the standards cover pipe sizes up to 225mm only
WWTP	Wastewater Treatment Plant – For treating raw sewage to a quality suitable for discharge or reuse

EXECUTIVE SUMMARY

Wide Bay Water Corporation (WBWC) owns, operates and maintains the sewage collection, treatment, disposal and effluent reuse facilities on the Fraser Coast.

Population growth increases demand on the sewage treatment, collection and reuse systems. Capital expenditure on sewerage infrastructure is required as demand reaches the capacity of the existing system. This report focuses on the provision of sewerage infrastructure to accommodate anticipated growth to the year 2031 with some key source and treatment infrastructure identified to 2036.

This Sewerage Strategy examines:

– the disposal and beneficial reuse of effluent and biosolids, both by-products of the sewage treatment process

– sewage treatment capacity and future augmentation required to meet projected future treatment requirements

– gravity sewer, sewage pump station and rising main capacity to meet the projected future requirements

– Licencing requirements most notable being discharge quality limits.

To undertake the investigation and determine augmentation requirements, extended period simulation sewer models were updated and analysed using Infoworks CS sewer network modelling software. Simulation scenarios were developed using these hydraulic models to examine the impact of sewage projections to 2031. These models identify network failures under each planning horizon. They also verify that proposed augmentation works will meet the required standards of service.

The reuse and treatment components of the strategy were assessed and analysed using the aggregate sewage loading growth of all areas of each network.

Growth in the Fraser Coast

The projected sewage ED growth in the Fraser Coast region is presented in the table below. It is separated into the discrete sewerage catchment areas of the Fraser Coast.

Table 0-1: Projected Sewage Equivalent Dwellings (ED's)

Catchment	2011	2015	2016	2021	2026	2031	2036
Aubinville WWTP	11,085	11,509	11,615	12,061	12,522	13,007	13,590
Burrum Heads WWTP	951	1,053	1,079	1,201	1,337	1,358	1,418
Eli Creek WWTP	6,588	6,885	6,959	7,518	8,097	8,794	9,188
Howard WWTP	47	51	52	63	77	79	86
Nikenbah WWTP	6,975	7,506	7,638	8,327	9,264	10,407	11,322
Pulgul Creek WWTP	10,053	10,701	10,863	12,156	13,586	15,532	16,898
Toogoom WWTP	588	661	622	672	731	842	916
Torbanlea WWTP	136	139	140	143	145	149	156
Total Fraser Coast	**36,423**	**38,504**	**38,968**	**42,140**	**45,759**	**50,168**	**53,574**

Findings of the Report

Some of the significant findings of the report are;

- flow/ED
- the direction of the sewerage strategy is dependent on the direction of the effluent disposal strategy. The strategy assumes that a balanced approach of irrigation, discharge and flexibility for future higher purpose usage is deemed the most appropriate direction forward.
- several WWTP's will require capacity increases during the planning horizon. These include;
  - minor upgrade of Pulgul Creek WWTP in 2016 followed by a major upgrade in 2019
  - upgrade Aubinville WWTP 2026
  - upgrade Toogoom WWTP in 2030
  - upgrade Burrum Heads WWTP in 2033.
- increased discharge from the Pulgul outfall
- the aging sewerage network in Fraser Coast encourages inflow and infiltration into the sewerage system. This reduces the capacity of the existing sewers and places unnecessary hydraulic load on the WWTP's. It also leads to overflows from sewage pump stations. Condition inspection by CCTV, smoke and dye testing and rehabilitation works to rectify broken and leaking joint by relining will assist in the reduction of I/I. A program of $600k/annum has been established to address this issue.

Capital Expenditure Programme

The report identifies the cost of augmentation works to meet future growth conditions. The total capital expenditure to 2036 is $177m. The major investments (>$500k) are outlined in Table 0-2.

Table 0-2: Major Projects >$500k to 2036

Type	Year	Strategy ID	Description	Cost ($000's)
Effluent Reuse Land Purchase				
	2018	S194	Nikenbah Effluent Pump Station New for Transfer to Cassava 227L/S@91m	988
	2021	S197	Purchase and Development of 230Ha Plantations at Takura	5,290
	2032	S198	Purchase and Development of 430Ha Plantations Takura	9,890
Effluent Reuse Land Purchase Total				**16,168**
Effluent Reuse Plantation				
	2018	S191	320Ha Plantation Development at Cassava	4,160
Effluent Reuse Plantation Total				**4,160**
Effluent Reuse Pump Station				
	2018	S193	Cassava Plantation Irrigation Pump Station 227L/S@91m	988
Effluent Reuse Pump Station Total				**988**
Effluent Reuse Rising Main				
	2017-18	S163	Effluent Reuse - Pipeline Nikenbah WWTP to Cassava DN500 (17.1km)	13,885
Effluent Reuse Rising Main Total				**13,885**
Effluent Reuse Storage Lagoon				
	2032	S199	Takura Construction of 500ML Effluent Storage	3,500
Effluent Reuse Storage Lagoon Total				**3,500**
Sewage Treatment Plant				
	2016	S46	Pulgul Creek WWTP Upgrade Capacity Additional 0.9ML/Day (2,000ED)	6,000
	2019-21	S65	Pulgul Creek WWTP Upgrade Capacity Additional 4.5ML (10,000ED)	30,000
	2026-27	S48	Aubinville WWTP Upgrade Capacity Additional 2.25ML/Day (5,555ED)	16,667
	2028	S200	Aubinville WWTP Improve Effluent Quality 5.625ML/Day (12,500ED)	18,750
	2030	S47	Toogoom WWTP Upgrade Capacity To 625kl/Day	1,300
	2033	S45	Burrum Heads WWTP Upgrade Capacity By 200kl/Day	1,300
Sewage Treatment Plant Total				**74,017**
Sewer Gravity Main				
	2021	S34	Gravity Sewer New Doolong Flats DN300 2.3km	1,214
	2026	S30	Gravity Sewer New Doolong Flats DN225 1.1km	547
		S57	Gravity Sewer New St Helens Structure Plan DN300 1.2km	702
	2031	S166	Gravity Sewer New Eli Waters Structure Plan DN225 1.3km	888
	2036	S161	Gravity Main New Eli Structure Plan Sewer DN375 825m	706
Sewer Gravity Main Total				**4,057**
Sewer Outfall				
	2019	S195	Extend Pulgul Outfall 4.9km DN450 to Urangan Harbour	8,100
Sewer Outfall Total				**8,100**
Sewer Rising Main				
	2017	S32	Redirection And Upgrade APS02 Rising Main DN450 530m	548
	2021	S149	Sewer Rising Main New Nikenbah Structure Plan DN375 5km	2,000
		S158	Sewer Rising Main BHPS52 Augmentation DN225 2.2km	790
		S2	Sewer Rising Main EPS04 Augmentation DN525 1.7km	1,468

Type	Year	Strategy ID	Description	Cost ($000's)
	2026	S185	Sewer Rising Main Augmentation PS79 DN300 2.2km	986
		S11	Sewer Rising Main Duplication PS83 to Nikenbah WWTP DN450 6.9km	6,855
		S56	Sewer Rising Main New St Helens Structure Plan DN300 3.6km	1,586
	2031	S36	Sewer Rising Main New Grinstead Rd To Nikenbah WWTP DN450 5.3km	5,288
	2036	S59	Sewer Rising Main New St Helens Structure Plan DN225 1.6km	510
Sewer Rising Main Total				**20,030**
Total				**144,905**

Other capital projects less than $500k are totalised in Table 0-3 below.

Table 0-3: Projects <$500k to 2031 grouped by Project Type

Project Type	Cost ($000's)
Effluent Reuse Land Purchase	345
Effluent Reuse Storage Lagoon	760
Sewage Treatment Plant	100
Sewer Gravity Main	8,351
Sewer Pump Station	5,799
Sewer Rising Main	3,654
Grand Total	**19,009**

It should be noted that this report and the projected capital expenditure does not include operational projects, recurring projects or asset rehabilitation projects (apart from sewer lining projects to address I/I issues at a value of $12.6m to 2036).

Operation Expenditure Program

Throughout the course of meeting the objectives of the Sewerage Strategy, some additional planning studies have been identified and are listed in Table 0-4.

Table 0-4: OPEX Planning and Investigative Project Identified in the Sewerage Strategy

Year	Description	Cost ($000's)
2016	Investigate options for the reduction in Total Nitrogen and Total Phosphorus Suspended Solids at the Aubinville WWTP	60
2016	Investigate the reduction in Total Phosphorus at the Toogoom WWTP to meet licencing requirements	30
2016	Review SCADA system to determine user requirements and scope future works to augment SCADA system	20
2016	Creation of SCADA database for the storage of sewerage data for access by all users	30
2016	Investigate and produce a detailed planning report on the viability and timing of components in option H2(b)	80
2016	Investigate the economics of the Fraser Coast Reuse schemes in 2016 at a cost of $20k	20
2017	Investigate the impact of sewer rehabilitation to date on Infiltration	30
2017	Investigate feasibility of new WWTP located in Tinana	40
Total		**310**

Infrastructure Charges

An estimate of infrastructure charges to the 2036 timeframe across the entire Fraser Coast has been developed to allow comparison between projected costs and the amount recouped from developer charges.

The infrastructure costs over the period was restricted to projects that are considered headwork's and;

– benefit multiple land owners (generally sewers over DN150)

– are growth projects

– are required for reliability or standards of service

– Is not a replacement project.

All sewage pump stations and rising mains are considered headworks unless they only serve a single lot.

Based on a residential and non-residential sewage ED growth of 15070ED (to 2036) and a capital expenditure of $162m, the cost to provide water infrastructure to meet projected demands is estimated at $10,700/ED.

State Government currently caps developer charges in Queensland under the State Planning Regulatory Provisions (SPRP) at a maximum total charge of $28,000 for dwellings. Determining charges for non-residential development is more complex and based on floor area.

Currently the proportion of developer charges allocated to sewerage infrastructure is 21% (source: FCRC Management Policy - Table 1). This equates to approximately $4,788/ED using the current charge of $22,800 for a residential lot.

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1. INTRODUCTION

Previous sewerage infrastructure planning for the Fraser Coast network was undertaken on a city by city basis until 2014. The Wide Bay network included reports prepared by Cardno MBK: in 2001 the *Wide Bay Water Wastewater Transportation System Study* and the *Wide Bay Water Hervey Bay Wastewater Collection, Treatment and Disposal Planning Report* in 2003. The *Water and Wastewater Planning Strategies March 2004 Addendum* was subsequently prepared by WBWC as a result of higher than expected population growth and development in the Hervey Bay region.

Maryborough Water was integrated into Wide Bay Water Corporation in 2009, in the following year WBWC prepared the *Hervey Bay Waste Water Supply Strategy 2010* and after that the *Maryborough Waste Water Strategy 2010*.

Following the amalgamation of the Hervey Bay and Maryborough councils, WBWC took over the operations and maintenance of Maryborough Sewer Supply System.

Population growth and development continues to occur in the Fraser Coast region since those reports were adopted, new information and data has necessitated that the existing and projected waste water infrastructure needs of the area be reassessed in view of revised populations, waste water production figures and projected development sequencing.

This Sewerage Strategy's main objective is to evaluate the existing sewer network capacity to meet projected population forecasts and to identify infrastructure requirements to satisfactorily manage these demands to the year 2031 and the year 2050 for major infrastructure.

A major part of the investigation included the reassessment of the waste water requirements to those areas of the existing network that are developing at a rate significantly greater than was previously planned.

1.1 Study Area

The study area is consistent with the previous infrastructure planning reports and incorporates all the reticulated networks located within the Fraser Coast local government area controlled by Wide Bay Water Corporation. The study area consists of the Hervey Bay, Toogoom, Burrum Heads, Howard, Torbanlea and Maryborough.

The following figures show the extent of the trunk network servicing the Fraser Coast region.

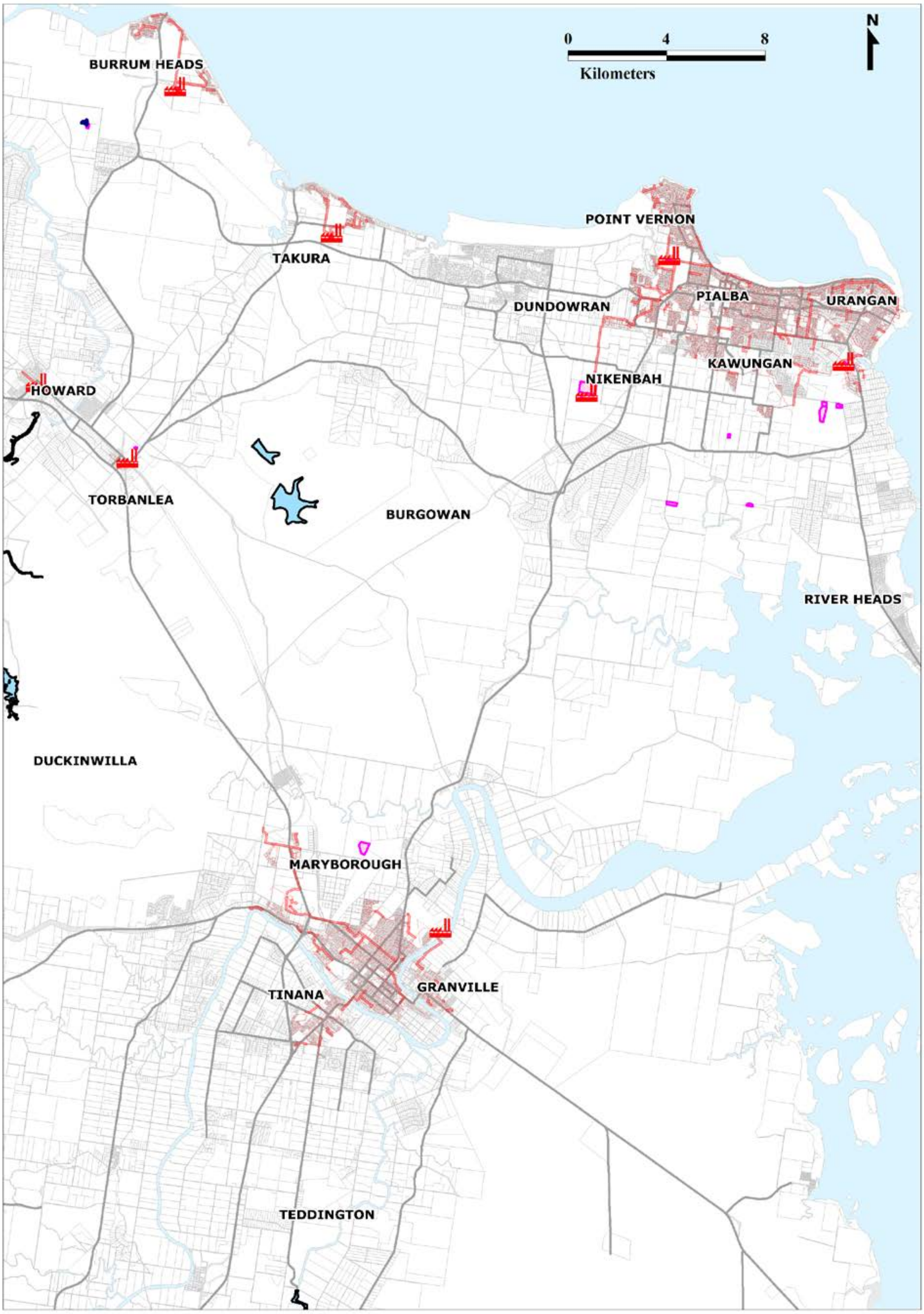


Figure 1-1: Map Depicting Study Area

2. OBJECTIVES

2.1 Objectives of the Study

The aim of this sewerage strategy is to review existing and projected population projections and sewer flows within the study area. This allows the development of a strategic infrastructure plan and the associated capital works program to the 2031 planning horizon and to 2066 for major infrastructure.

The primary objectives of this report are to:

- assess the existing sewage loads based on recently recorded flow data
- assess the projected sewage loads, up to 2031, using growth forecasts from the Office of Economic and Statistical Research (OESR, Queensland Treasury)
- evaluate the capacity of the sewerage system (gravity mains, sewage pump stations and rising mains) through sewerage network modelling for projected flows
- identify the capacity of the existing wastewater treatment plants and determine the most appropriate method of augmentation to meet licence conditions
- determine the most cost effective option for effluent disposal and reuse taking account of highest value use and likely future direction.
- identify any additional wastewater infrastructure required to deliver the desired Standards of Service (SOS)
- identify cost and timing of sewerage infrastructure identified in this Sewerage Strategy
- identify likely Developer Contributions costs based on the infrastructure identified in this Sewerage Strategy.

While not normally part of the sewerage strategy, an assessment of inflow and infiltration data is undertaken and used as a guide to determine the condition of the assets and provide guidance on relining programs.

2.2 Methodology

The methodology used to undertake this Sewerage Strategy included the following steps;

- **build** a population model, which is capable of determining existing equivalent dwelling (ED) population and predicting future populations for nominated development or planning horizons
- **review** the performance of the existing sewer network and identify areas which do not provide the adopted Standards of Service or the required assessment criteria
- **develop** sewer network models for the existing system and for each of the five (5) year planning horizons to the year 2031. Five yearly increments were chosen for the planning horizon to coincide with the National Census Survey Data.

- **produce** a capital works program until 2031 based on the results of the hydraulic modelling and determine the capital requirements associated with the various augmentation options developed
- **determine** any major infrastructure required to service the Fraser Coast region up to the year 2056

2.3 Standards and Guidelines

The Water Services Association of Australia (WSAA) is the main source of guidelines used in the water industry for sewerage collection systems. The guidelines are separated in several volumes to cover gravity sewers, sewage pump station and other types of sewerage systems (pressure, vacuum). Generally the guidelines are used for the reticulation system and are comprised of smaller sized sewers. For larger trunk mains WBWC refers to the DEWS (2015) Planning Guidelines for Water Supply and Sewerage. For environmental compliance at sewerage pump stations ERA63 from DEHP is used.

The applicable documents are listed below.

- WSA 02 – 2014 Gravity Sewerage Code – This code covers planning, design and construction of gravity sewer collection mains
- WSA 04 – 2005 Sewerage Pump Station Code – This code covers planning, design and construction of sewage pump stations and rising mains.
- WSA 05 – 2002 Sewer Inspection Reporting Code - This code covers condition reporting and assessment of sewer mains and is generally used in conjunction with CCTV footage.
- WSA 06 – 2008 Vacuum Sewerage Code - This code covers all planning, design and construction of vacuum sewer collection systems.
- WSA 07 – 2007 Pressure Sewerage Code - This code covers all planning, design and construction of presser sewer collection systems.
- DEWS (2015) Planning Guidelines for Water Supply and Sewerage Services - This guideline covers all planning, design and construction of trunk gravity sewer mains and sewage pump stations.
- ERA 63(3) Sewerage Pump Stations - This environmentally relevant activity covers pump station overflow reporting and as some design aspects of the sewage pump station to minimise the impact on the environment.

2.4 Standards of Service

A Statement of Corporate Intent 2015/16 has been adopted between Fraser Coast Regional Council and Wide Bay Water Corporation to identify the commercial relationship between the two entities and to ensure an acceptable standard of service is provided to all customers. This document sets the quantity, quality and reliability requirements of the scheme. The main requirements that affect the preparation of this report are as follows:

- total sewerage overflows per 100km/quarter < 10
- sewerage overflows on customer property per 1,000 connections/quarter < 5
- odour complaints per 1,000 connections/quarter < 10
- response/ reaction time to incidents < 1 Hour
- compliance with EPA Licence > 95%
- effluent reuse on land for 90% of the year > 90%

For technical and design components in this strategy the following assessment criteria is used.

- gravity mains are designed to meet PWWF at full pipe capacity. PDWF depth is not to exceed 60% of diameter.
- velocity in rising mains = 0.9m/s minimum to meet minimum scouring velocities.
- pump stations are designed to meet PPWF with one pump running. In larger pump stations the size of the pump is reduced requiring two pumps operating to meet PWWF.
- licence conditions for regulating discharge and effluent quality from WWTP’s. These requirements are site specific.

3. EXISTING SEWERAGE SYSTEMS

3.1 Fraser Coast Sewerage and Reuse Networks Overview

The Fraser Coast sewerage system consists of eight independent sewerage catchments, each with their own Wastewater Treatment Plant (WWTP) and effluent disposal facilities.

In Hervey Bay city there are three sewerage catchments comprising gravity mains, pump stations and rising mains. These are the Eli, Pulgul and Nikenbah catchments which transport raw sewage the Eli Creek, Pulgul and Nikenbah WWTP's for treatment.

3.1.1 Hervey Bay Sewerage and Reuse Overview

Treated effluent from Eli Creek and Nikenbah WWTP's is transferred to the 800ML effluent lagoon located at the Nikenbah WWTP site where it is stored for reuse. Excess flow from Eli Creek WWTP is discharged through the Eli Creek discharge point and flows into the ocean.

Effluent from the Pulgul Creek WWTP is transferred to the Pulgul 600ML effluent lagoon located on the Pulgul tree plantation site. Excess flow from Pulgul Creek WWTP is discharged from a discharge point located near the mouth of Pulgul Creek.

The schematic (Figure 3-1) outlines the sewage flow from collection to treatment and the disposal of effluent. Stored effluent from both effluent dams is used for the irrigation of tree plantations, turf farms and sugar cane plantations.

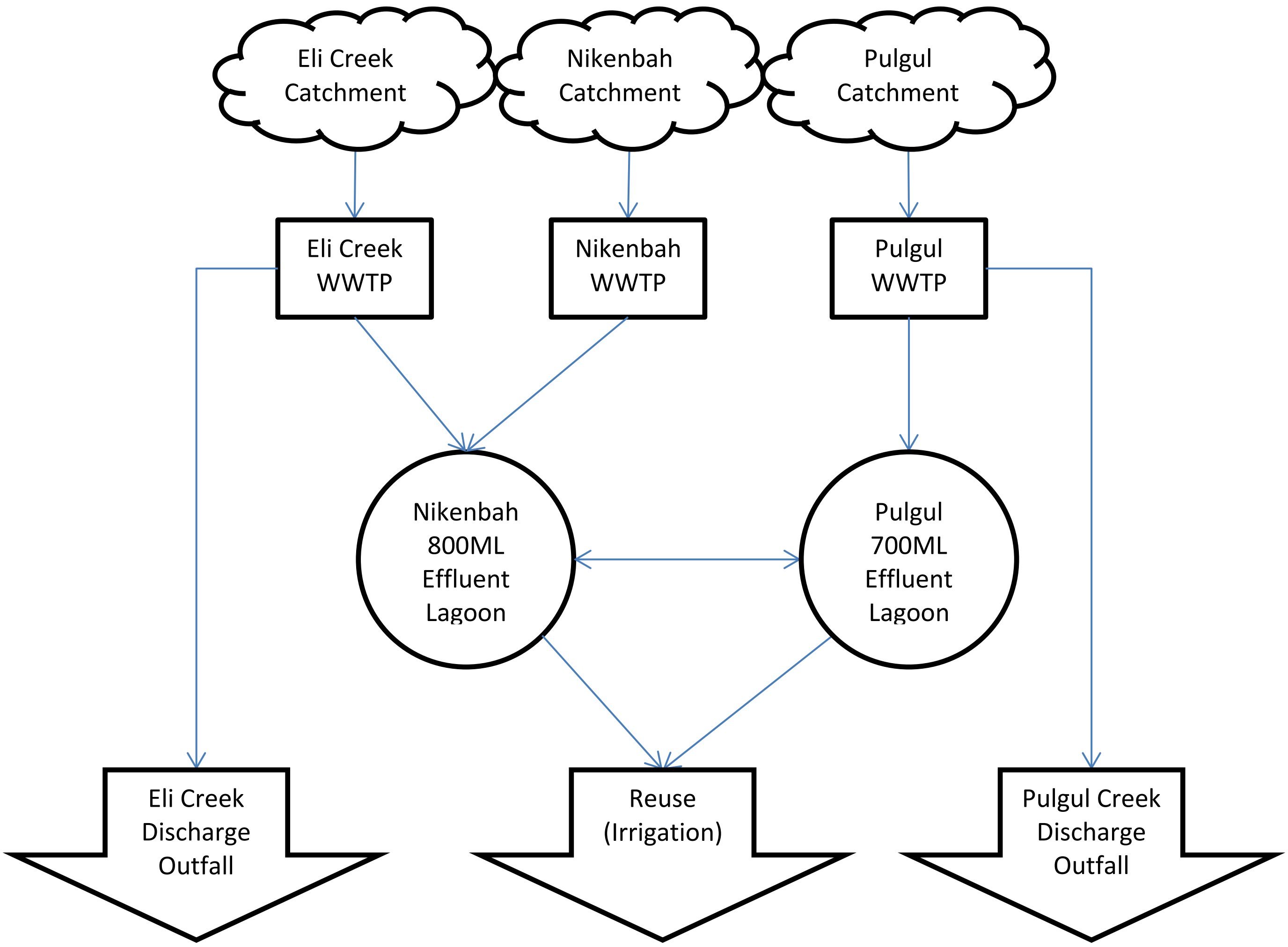


Figure 3-1: Hervey Bay Sewerage System Overview

3.1.2 Maryborough Sewerage and Reuse Overview

The Maryborough sewerage catchment consists of gravity mains, pump stations and rising mains which transport sewage to the Aubinville WWTP for treatment. Treated effluent is discharged to the Mary River or stored in a 700ML effluent lagoon located at St Helens. Effluent from this storage is used to irrigate cane farms in the local area. The plant is configured with a wet weather bypass that allows exceeding the plants hydraulic capacity of 5 x ADWF to be discharged directly to the Mary River after passing through coarse bar screens. There is also provision to discharge effluent directly from the plant when there is insufficient capacity in the 700ML effluent storage lagoon. The schematic in Figure 3-2 outlines the sewage flow from collection, through treatment to disposal.

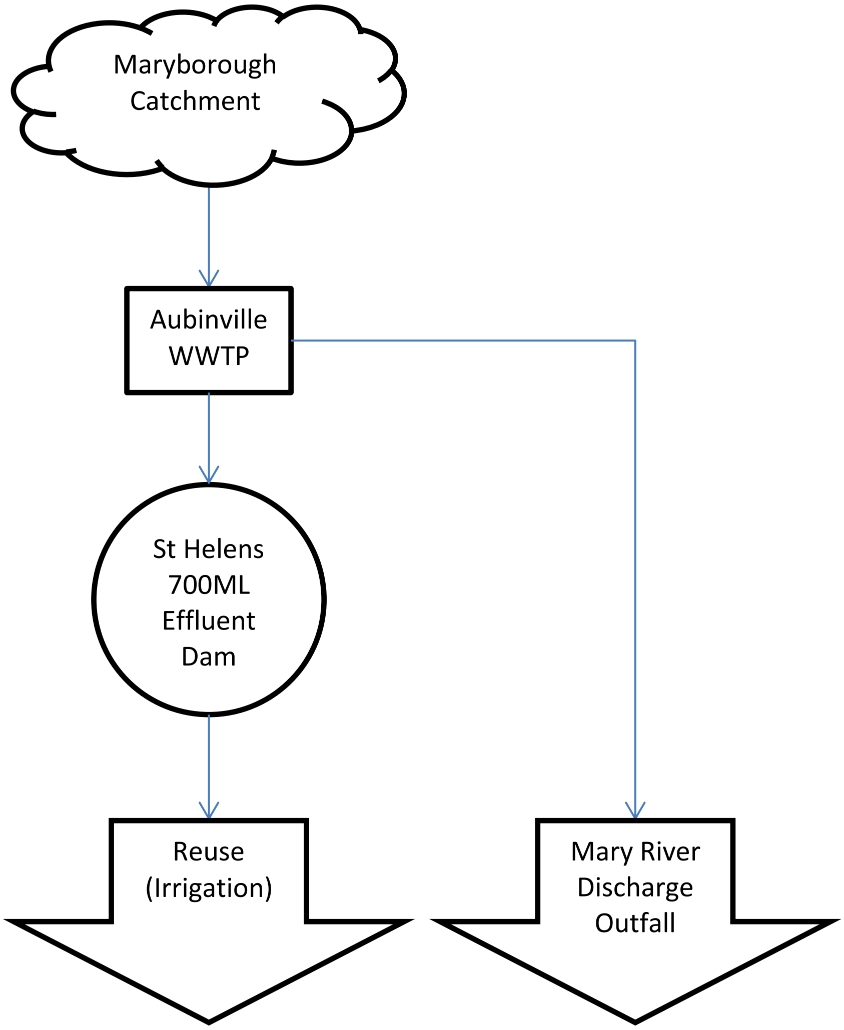


Figure 3-2: Maryborough Sewerage System Overview

3.1.3 Burrum Heads Sewerage and Reuse Overview

The Burrum Heads sewerage catchment consists of gravity sewer mains, pump stations and rising mains which transport sewage to the Burrum Heads WWTP for treatment. Treated effluent from this plant is stored in effluent lagoons on the WWTP site and transferred on a continuous basis to the Dreamtime Plantation site for irrigation use. The flow of sewage from collection to disposal is summarised in Figure 3-3. There is no discharge point from this WWTP.

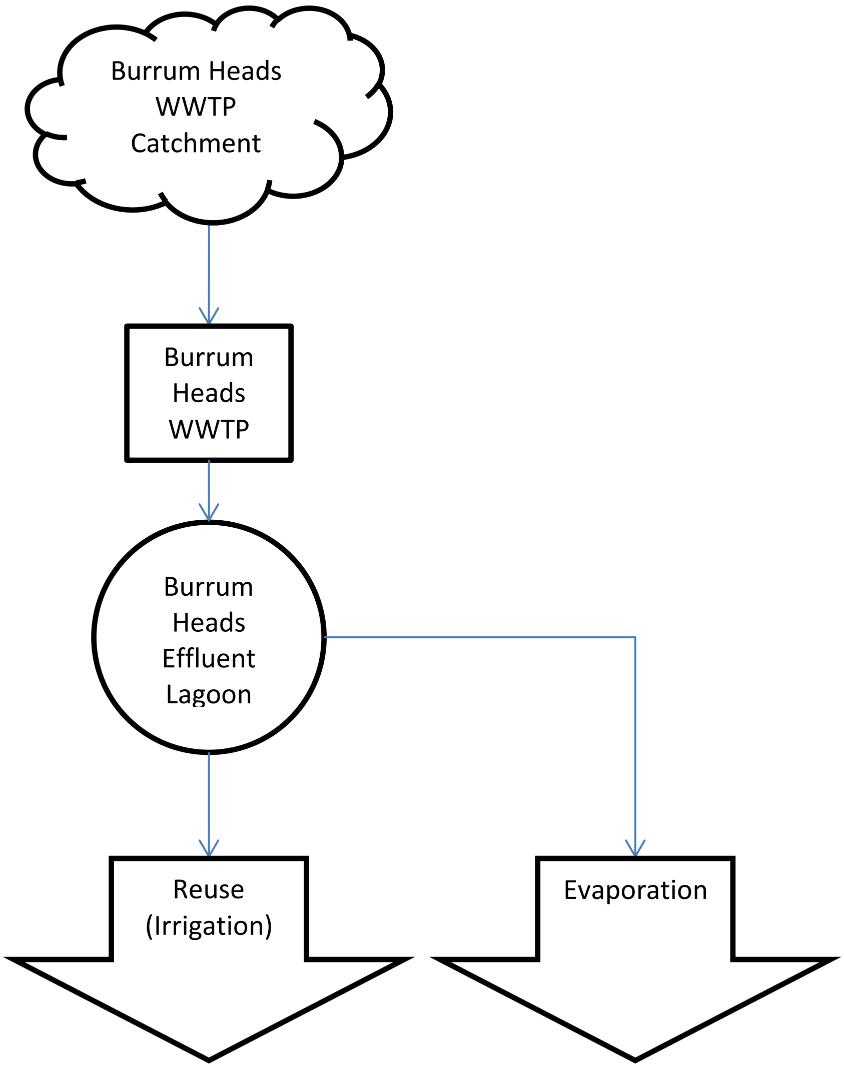


Figure 3-3: Burrum Heads Sewerage System Overview

3.1.4 Toogoom Sewerage and Reuse Overview

The Toogoom sewerage catchment consists of gravity mains, pump stations and rising mains which transport sewage to the Toogoom WWTP for treatment. Treated effluent is stored in effluent lagoons located on the WWTP site. The effluent is disposed by irrigation to the Toogoom Forest on the adjacent lot. Effluent is allowed to infiltrate into the underlying aquifer through the exfiltration lagoon.

The schematic in Figure 3-4 shows an overview of the Toogoom system.

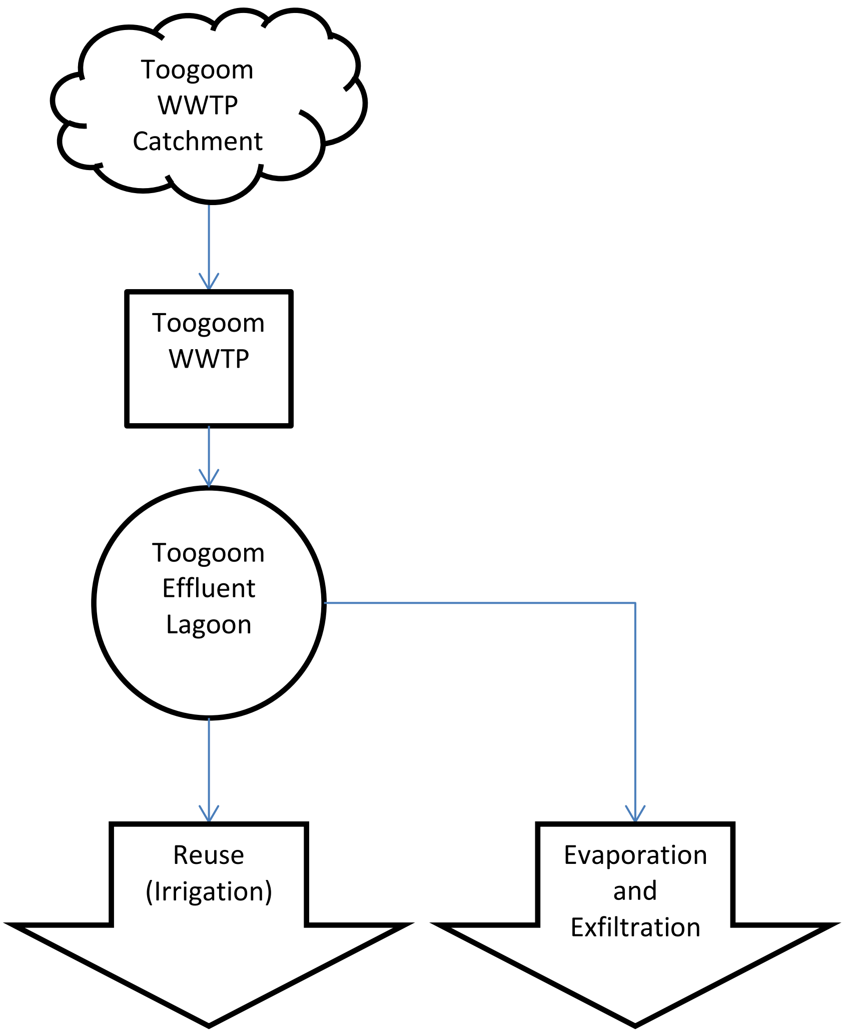


Figure 3-4: Toogoom Sewerage System Overview

3.1.5 Howard Sewerage and Reuse Overview

The sewerage catchment in Howard is serviced by a small network of gravity mains. Sewage is treated at the Howard WWTP and treated effluent is stored in an effluent lagoon located at the Burrum District golf course where it is used for irrigation. Excess flows are discharged into Maria Creek adjacent to the WWTP.

The schematic in Figure 3-5 shows the Howard sewerage system.

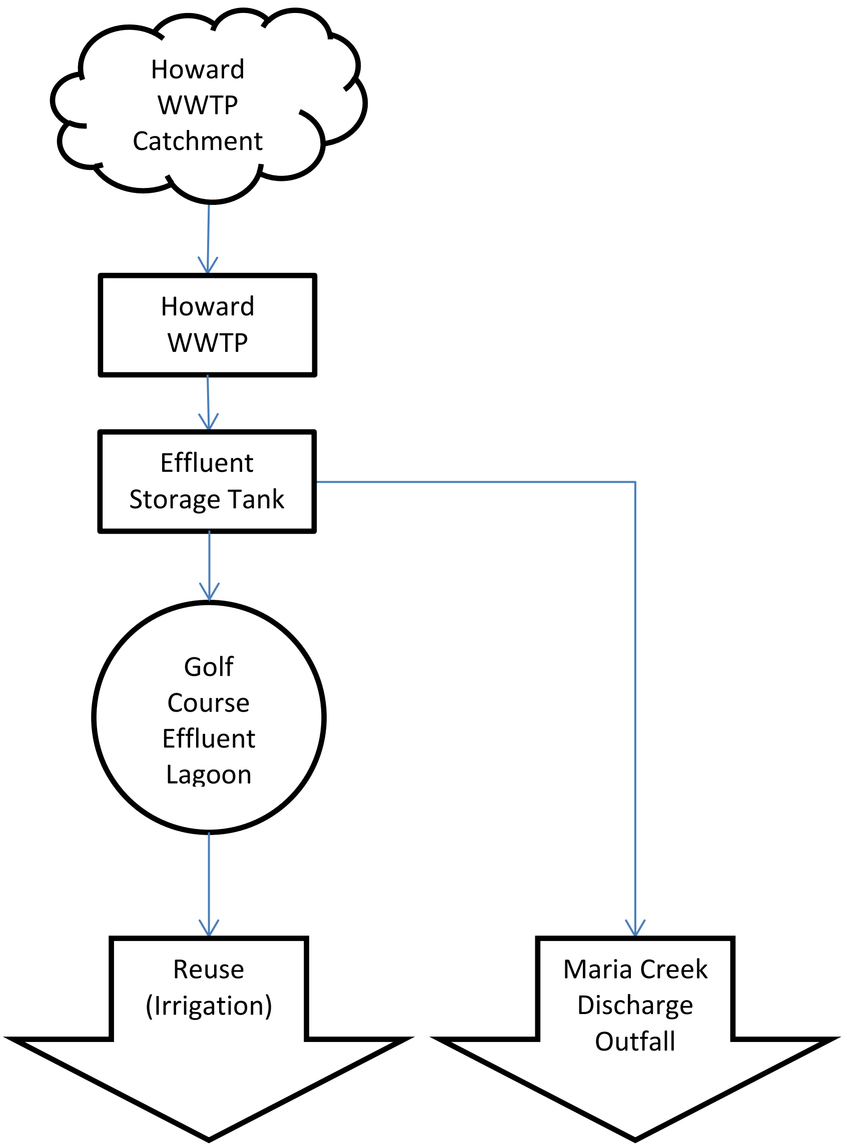


Figure 3-5: Howard Sewerage System Overview

3.1.6 Torbanlea Sewerage and Reuse Overview

Torbanlea has a small sewerage catchment comprising of gravity sewers, a pump station and rising main. Sewage is treated at the Torbanlea WWTP and the treated effluent is stored in an effluent lagoon located on the adjacent race course. Treated effluent is used to irrigate the Torbanlea recreational reserve and the nearby Torbanlea State School. There is no discharge point for this WWTP.

The schematic in Figure 3-6 shows an overview of the Torbanlea sewerage system.

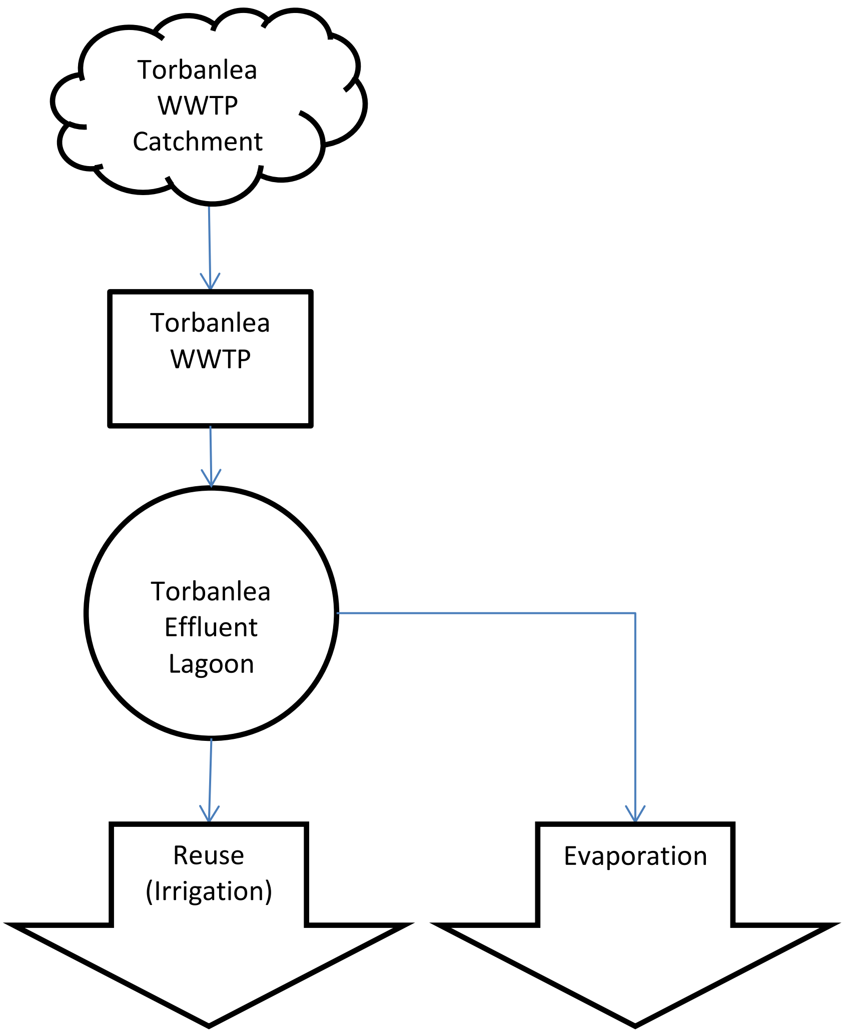


Figure 3-6: Torbanlea Sewerage System Overview

3.2 Fraser Coast Sewerage Catchments

There are eight separate sewerage system catchments in the Fraser Coast. Each one consists of sewerage gravity mains, sewage pump stations, rising mains, and treatment plant.

The catchments are;

– Eli Catchment

– Pulgul Catchment

– Nikenbah Catchment

– Aubinville Catchment

– Burrum Heads Catchment

– Toogoom Catchment

– Howard Catchment

– Torbanlea Catchment

Maps depicting these catchment areas are located in Appendix 4A.

Table 3-1 summarises the main attributes of each of these catchments.

Table 3-1 Catchment Area Summary

Catchment	Areas Serviced	Infrastructure	Serving	Makeup
Eli	– most of Pialba – Scarness – the north western area of Torquay and – the eastern strip of Point Vernon	A collection network consisting of 91.1km of sewer gravity mains, 10 pump stations and 5.8km of rising mains	6,900ED	mostly residential and commercial customers.
Pulgul	- Urangan - most of Torquay - Wondunna - most of Kawungan.	A collection network consisting of 162.2km of sewer gravity mains, 26 pump stations and 24.2km of rising mains	10,700ED	mainly residential customers although there are small commercial and industrial areas within its catchment
Nikenbah	-the western part of Point Vernon -Eli Waters -Augustus -Urraween -Dundowran industrial area and -the western part of Kawungan.	A collection network consisting of 142.5km of sewer gravity mains, 22 pump stations and 22.5km of rising mains. During some wet weather events sewage is diverted from the Nikenbah catchment into the Eli Creek catchment.	7,505ED	mainly residential and industrial customers and some major shopping centres (Stocklands)
Aubinville	- Granville - Tinana - CBD - Newtown Central and - Maryborough West.	A collection network consisting of 224.8km of sewer gravity mains, 33 pump stations and 27.6km of rising mains	11,510ED	made up of residential, commercial and industrial customers.
Burrum Heads	- Burrum Heads area	A collection network consisting of 23km of sewer gravity mains, 9 pump station and 8.8km of rising mains	1050ED	Mostly residential areas
Toogoom	- Toogoom area	A collection network consisting of 16.6km of sewer gravity mains, 9 pump station and 5.1km of rising mains	660ED	mostly residential customers
Howard	- Limited areas in Howard. Of the 162 lots, with an area less than 1,000m^2, only 22 are serviced with sewerage.	A collection network consisting of 600m of sewer gravity mains and 1.4km of rising	50ED	It services mostly commercial areas of Howard.
Torbanlea	- Torbanlea area	A collection network consisting of 3.5km of sewer gravity mains, 1 pump station and 0.6km of rising main	139ED	mostly residential customers.

3.3 Sewerage Trunk System

A sewer is defined as a trunk sewer based on the magnitude or function. For large sewer networks WSAA Gravity Sewerage code proposes that a trunk sewer is a sewer of DN750 or greater and connects to a branch sewer. Trunk sewers transport sewage to the treatment plant. For the Fraser Coast sewerage system gravity sewers DN300 or greater and all rising mains and sewage pump stations are considered trunk infrastructure.

3.3.1 Trunk Gravity Mains

Hervey Bay has 67.7km of trunk gravity mains, this includes Burrum Heads, Howard and Toogoom.

There is 45.5km of Sewer Gravity Main classified as Trunk infrastructure in Maryborough. The main trunk sewer to the Aubinville WWTP is a DN1050 gravity sewer and during wet weather events acts as an in-line storage facility to attenuate flows before reaching the treatment plant.

3.3.2 Pump Stations

Pump stations are an essential component in the sewerage collection system. They are used to lift sewage to higher sewers so that the sewage can continue its path to the treatment plant.

There are 110 sewage pump stations located across the Fraser Coast. They are distributed across the catchment areas as shown in Table 3-2. They range in size from very small (servicing just a few residential lots) to large (servicing the entire township). Generally small pump stations are located on the periphery of the catchments and get progressively larger as their catchment size increases as we near the WWTP. Refer to Appendix 5A for interrelationships between pump stations for each of the catchments.

Table 3-2: Fraser Coast Sewerage Pump Stations

Catchment	No of Pump Stations
Aubinville	33
Eli	10
Pulgul	26
Nikenbah	22
Burrum Heads	9
Toogoom	9
Torbanlea	1
Total	**110**

For a detailed data on all sewage pump stations in the Fraser Coast refer to Appendix 5A and Appendix 5B.

3.3.3 Rising Mains

There is over 89km of rising main associated with the existing sewage pump stations. Table 3-2 summarises the lengths of rising mains by diameter and location.

Table 3-3: Rising Main Lengths by Diameters and Location

	80	100	140	150	200	225	250	300	315	375	450
Burrum Heads	-	727	-	7,014	-	1,015	-	96	-	-	-
Dundowran	-	938	-	641	-	-	-	-	-	-	6,827
Hervey Bay	997	9,804	-	8,973	5,685	796	1,953	10,430	-	1,750	107
Maryborough	441	2,933	3	3,843	9,659	1,866	2,362	1,443	16	3,041	-
Toogoom	-	1,834	-	3,335	-	4	66	-	-	-	-
Torbanlea	-	587	-	0	-	-	-	-	-	-	-

Specific details on sewer rising mains can be found in Appendix 5A and Appendix 5B.

3.3.4 Overflow Management

3.3.4.1 System Storage

System storage is used to minimise the occurrence of unplanned releases of untreated sewage from the sewerage system. Alarms at sewage pump stations assist operators in identifying potential overflows early so that measures can be undertaken to eliminate the overflow or reduce the overflow on the environment. A secondary backup alarm, independent of the SCADA system, is also installed which alerts operators of potential overflows.

3.3.4.2 Designated Overflow Points

Where overflows are unavoidable designated discharge points are used to discharge or relieve sewage into the environment. In the majority of cases the overflow points are located at sewage pump stations, but there are some which are located at the most hydraulically disadvantaged location within the catchment.

Overflow discharge points at large sewage pump stations are registered with the Environment and Heritage Protection (EHP) which sets out reporting requirements and discharge conditions in accordance with ERA 63 (3) for sewage pump station overflows. The locations of the overflow points in Hervey Bay and Maryborough are shown in Appendix 4E.

3.4 Sewerage Treatment

3.4.1 Sewerage Treatment Plants

The Fraser Coast Sewerage system is serviced by eight treatment plants:

- Eli Creek WWTP
- Pulgul Creek WWTP
- Nikenbah WWTP
- Aubinville WWTP
- Burrum Heads WWTP
- Toogoom WWTP
- Howard WWTP
- Torbanlea WWTP

Each treatment plant is designed with two criteria; the biological treatment design capacity and the hydraulic design capacity. The biological treatment capacity is designed to reduce the biological oxygen demand in sewage through the facilitation of biological activity (aerobic, anaerobic or facultative). Time is required for the organics in the wastewater to be consumed by biological activity. Therefore each treatment facility must be constructed sufficiently large to allow this process to occur taking into account the incoming organic loading and the resulting organic loading desired (usually none).

Similarly the WWTP capacity needs to be sufficient to pass the volume of water coming in to the plant (hydraulic loading). Without sufficient hydraulic capacity a WWTP may not be able to satisfactorily treat sewage to the required BOD levels.

Generally WWTP's across the Fraser Coast are designed to meet 3xADWF for treatment and up to 5xADWF for hydraulic design. The treatment capacities of the Fraser Coast WWTP's are presented in Table 3-5. The current loadings are derived from historical flow data between 2010 and 2015. It does not take into account additional loading if all vacant dwellings and lots are occupied.

Table 3-4: Fraser Coast WWTP Capacities

	Hydraulic Capacity		Biological Capacity		Current Loading (2015)
	ED	ML/Day	ED	ML/Day	Ml/day
Nikenbah WWTP	10667	4.8	10667	4.8	2.9
Pulgul Creek WWTP	9720	4.4	9720	4.4	*4.9*
Eli Creek WWTP	10000	4.5	7500	3.2	2.7
Burrum Heads WWTP	1389	0.625	1042	0.469	0.31
Toogoom WWTP	833	0.375	1389	0.375	0.24
Torbanlea WWTP	138	0.062	115	0.052	0.043
Howard WWTP	40	0.024	40	0.018	*0.027*
Aubinville WWTP	12500	5.625	12500	5.625	4.5

3.4.2 Eli Creek WWTP

Eli Creek WWTP is located at Hythe Street in Pialba. The Eli Creek WWTP was the first treatment plant for Hervey Bay before the construction of the Pulgul Creek WWTP.

Currently the Eli Creek WWTP services approximately 6000ED (2.7Ml/day). The extent of the Eli Creek WWTP catchment area is presented in Appendix 4A.

All loads into Eli Creek WWTP are transferred by rising main from EPS04. This means that the flow loading to the treatment plant are intermittent and that the inlet works are a source of significant odour. To minimise the odour issues, the inlet works were covered and an activated carbon filter was installed in 2000.

The Eli Creek WWTP is a conventional trickling filter plant commissioned in 1969. The current plant's hydraulic design capacity is estimated to be 4.5ML/d under Average Dry Weather Flow (ADWF) which is estimated to be approximately 10,000ED. The Biological capacity has been estimated to be 7,500ED and is based on the treatment performance of the plant.

Historically there were issues with the plant being overloaded and planning required the installation of a new treatment plant. Odour studies at the time indicated a large buffer zone which is consistent with an overloaded treatment plant. This remained the case until the construction of Nikenbah WWTP, in 2010. At this time the load on Eli Creek WWTP reduced significantly to about half of its previous loading. The effluent quality improved as a result.

Given the proximity of the Eli Creek WWTP to existing residential properties and the history of associated odour complaints, coupled with the fact that the odour buffer around the plant effectively stymies development of adjacent residential land, the provision of additional capacity at the site has not been considered appropriate and a capacity ceiling of 10,000ED has been applied in the past. This philosophy has been carried forward in the options considered in this strategy report.

As part of a refurbishment of the inlet works in 2012, a new finer aperture screen was installed as well as repairs to concrete and refurbishment of the aeration system for the grit removal system. In 2012 new screens were installed and concrete works at the inlet works occurred.

The treatment process is described in Figure 3-8. The process commences at the inlet works where pumps are used to provide head for the process. Sewage is screened and grit is settled. Rags and grit are collected in bins to be disposed of. Three primary sedimentation tanks are used to reduce suspended solids before treatment in the two trickling filters. Flow continues to the Humus tanks where secondary clarification of the influent occurs. Chlorination of the effluent occurs before the effluent is stored in the local effluent storage lagoons or discharged to Eli Creek.

Sludge is collected from the primary sedimentation tanks and placed into a pair of primary digesters. The sludge is then placed in a secondary digester for further treatment and dewatering before dewatering by belt press and stockpiled for a minimum period of 6 months before reuse. Sludge drying beds are also available to dewater sludge from this process.

Excess sewage of effluent is discharged into the approved discharge point at Eli Creek. This discharge point is used regularly to manage inflows to the treatment plant.

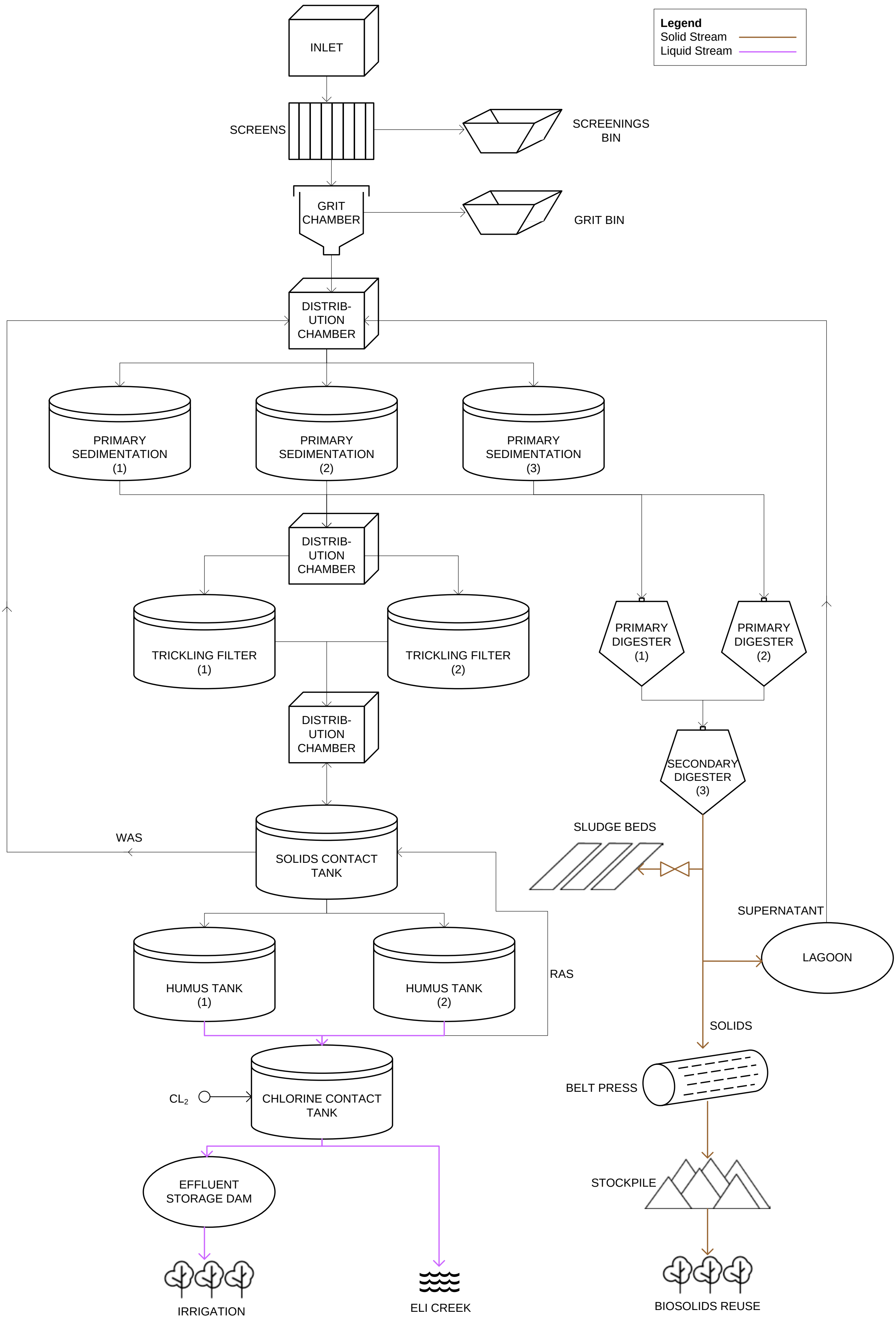


Figure 3-7: Eli Creek Process Flow Chart

Figure 3-9 plots the daily sewage inflows to the Eli Creek WWTP, the WWTP capacity and the Hervey Bay rainfall events over the period from November 2010 to March 2015. It can be seen that the impact of wet weather events is substantial with peaking factors of approximately 4.2 times the ADWF.

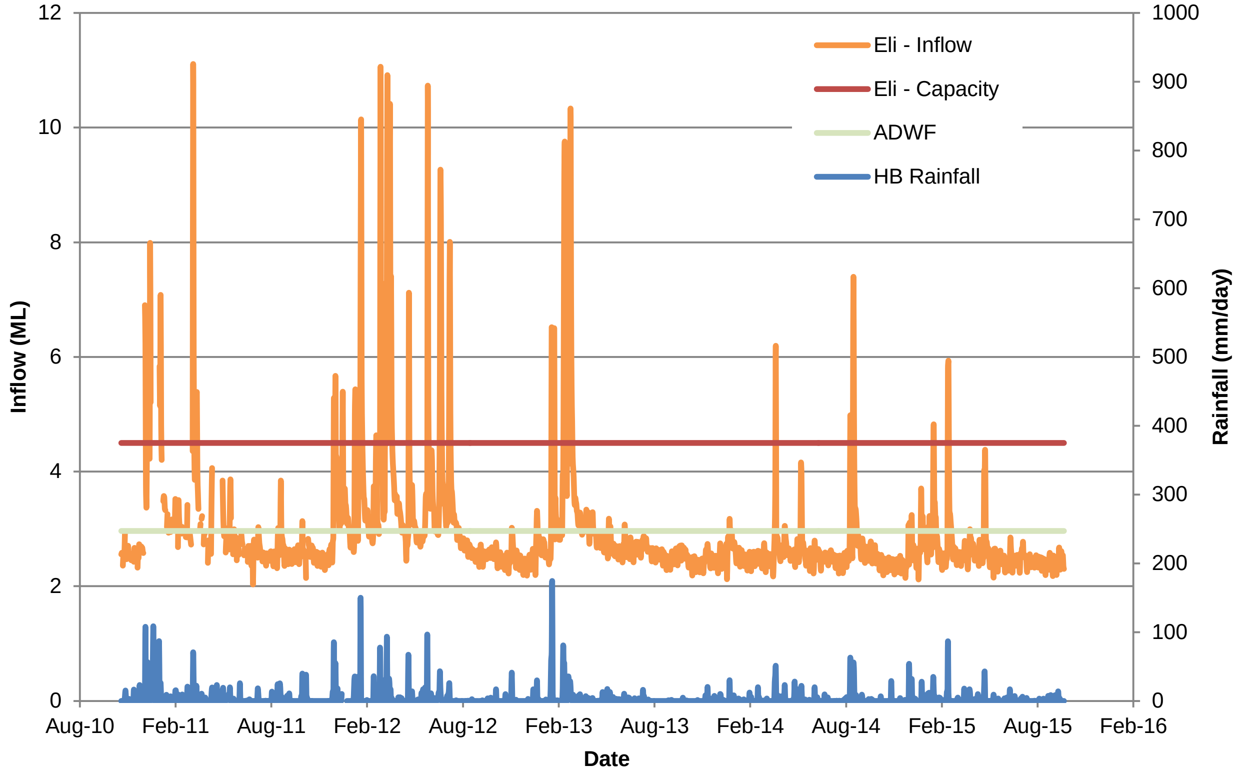


Figure 3-8: Eli Creek WWTP Historical Inflows, Capacity and Rainfall

3.4.2.1 Effluent Release to Eli Creek

The operating licence for Eli Creek WWTP stipulates that daily releases during periods of no rainfall shall not exceed 2.75ML/day and during periods of wet weather shall not exceed 6ML/day.

Total nitrogen and total phosphorus are not permitted to exceed 10 tonnes and 2.5 tonnes respectively. WBWC has a licenced outfall from Eli Creek WWTP to Eli Creek. The mass load released to waters is summarised in Table 3-5. Notably no discharge to waters from the Eli Creek WWTP occurred in 2013/14.

Table 3-5 Eli Creek WWTP Mass Loads Released to Waters

Year	TN(kg)	TP(kg)
2010/11	20257	4252
2011/12	19252	4060
2012/13	11275	2244
2013/14	0	0
2014/15	3720	1239

A report by frc environmental (2006) indicated that the impact of mass nutrient discharge from the Eli Creek WWTP had a minimal impact on the Eli Creek eco system and that the floral and faunal communities were affected by unrelated factors (frc, 2006). Clause C2.7 of the licence requires that a minimum of 90% ADWF shall be reused per annum.

The effluent discharge quality limits for discharge to waters is stipulated in the EPA licence for this WWTP. The effluent quality limits for release to waters is available in Appendix 6A.

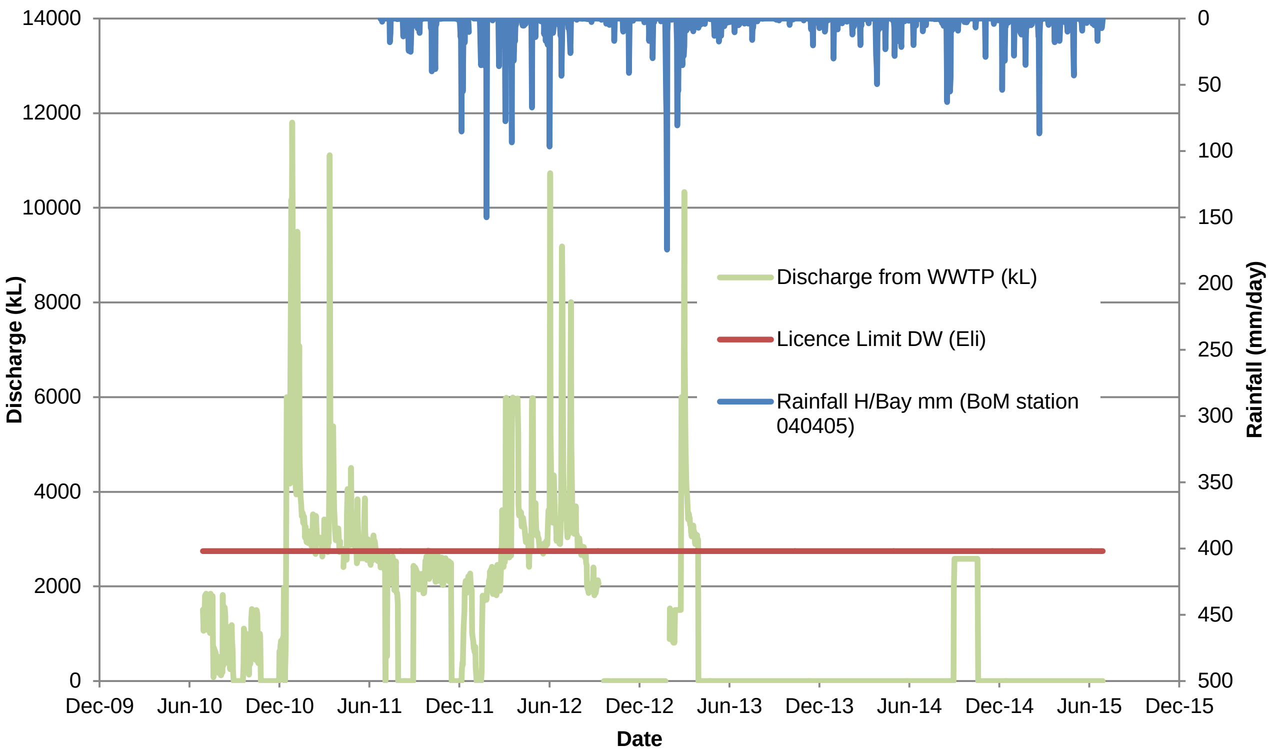


Figure 3-9: Eli Creek WWTP - Historical Discharge to Waters

3.4.2.2 Effluent Release to Land

Effluent is transferred to Nikenbah effluent storage lagoon for irrigation use under the reuse scheme and is discussed in more detail in Section 4 of this report. Effluent is also used to irrigate the Hervey Bay golf course. Figure 3-11 depicts the effluent available for reuse from the Eli Creek WWTP. It can be seen that there has been a marked increase in effluent demand associated with the lower rainfall after 2013.

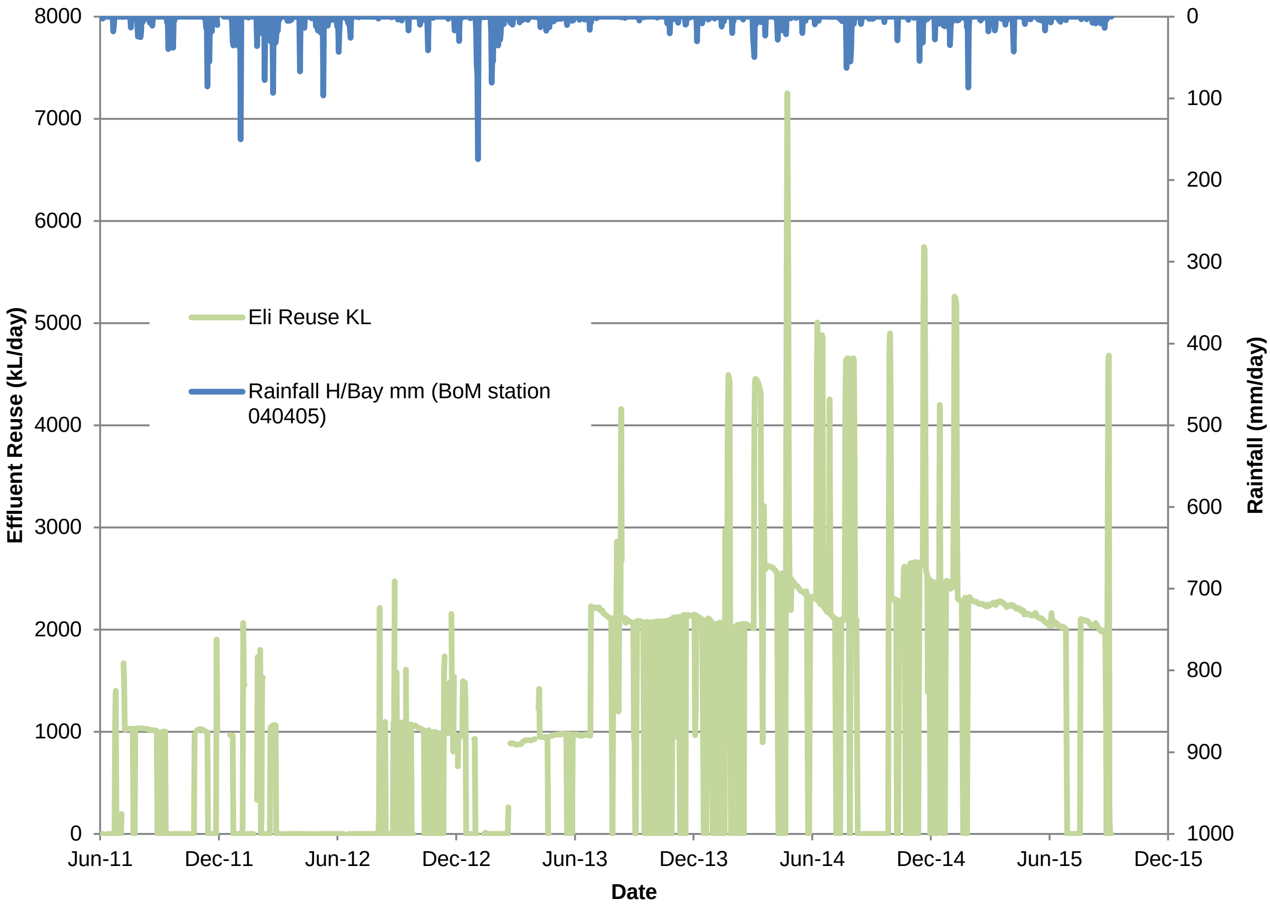


Figure 3-10: Eli Creek WWTP Historical Discharge for Reuse

The effluent quality limits for land disposal are stipulated in the EPA licence for this WWTP which is contained in Appendix 6A.

The historical percentage of ADWF reused is summarised in Table 3-6. The figures in the table are a combination of both the Eli Creek and Nikenbah Reuse.

Table 3-6: Eli Creek and Nikenbah (Combined) Percentage Effluent Reuse

Year	% ADWF Reused (%)	Total Volume reused Eli Creek WWTP only (ML/annum)
2010/11	93	413
2011/12	86	385
2012/13	110	715
2013/14	100	940
2014/15	95	844

3.4.3 Pulgul Creek WWTP

The Pulgul Creek WWTP is located on Cicada Lane approximately 250m west of Booral Road and approximately 1.2km north of Hervey Bay Airport. It is one of the main WWTP's servicing the Hervey Bay township. It is surrounded by vegetation on the western side of the plant with a sporting facility approximately 150m north of the plant. Industrial areas are located to the south and east approximately 300m from the facility. There is a low lying area that runs west to east through the south of the property that discharges into Pulgul Creek. Access is via an all-weather single lane bitumen road which joins Booral Road. The catchment currently services approximately 10,000ED (4.5Ml/day). The extent of the Pulgul Creek WWTP catchment area is presented in Appendix 4A.

There are two process trains at Pulgul, an oxidation ditch and an IDEAL plant.

In 1984 the first treatment train was constructed at the Pulgul Creek WWTP site. It consisted of an oxidation ditch type extended aeration activated sludge plant bioreactor with secondary clarifiers. The original design capacity of this plant was 8,000EP and 230L/EP/day (1.84ML/day ADWF). This is equivalent of 4,089ED.

The second train was constructed in 1991 and consisted of an Intermittently Decanted Extended Aeration Lagoon (IDEAL). This treatment train was designed with a capacity of 8,000EP and 250L/EP/day (2ML/day ADWF). This is equivalent of 4,444ED.

The combined treatment capacity at this time was 3.84ML/day (or 8,533ED).

A Bathurst Box lagoon was installed to treat tankered waste at the site. The sludge from this process is transferred to the anaerobic sludge lagoon.

Augmentation in 2001/2 provided another chlorine contact tank, sludge thickening, aerobic digestion and dewatering for the plant.

In 2003 screens and grit removal facilities were installed on the plant.

In 2006 the oxidation ditch was augmented by replacing the Kesner Brush Aerators with floor mounted diffusers to provide a capacity of 8,900ED. This capacity increase was never realised. A second chlorine contact tank was also constructed at this time.

Modelling of the oxidation ditch using a spread sheet developed by GHD estimated the treatment capacity of this treatment train at 1.6ML/day ADWF. Modelling of the IDEAL treatment train also undertaken by GHD in 2011 concluded that this plant was capable of treating 3.7ML/day ADWF provided that the IDEAL treatment train was operating without short-circuiting. According to GHD (2011) the Pulgul Creek WWTP is capable of a combined capacity around 5.3ML/d under ADWF.

WBWC has reviewed the capacity and estimates that the treatment capacity of this plant is 4.4ML/day (9,720ED). For the purposes of this strategy report the current capacity of the treatment plant of 4.4ML/day has been adopted.

The treatment process is described in Figure 3-12. Sewage is received at the inlet works where it is distributed between the IDEAL and Oxidation Ditch process trains.

The oxidation ditch process train is an activated sludge process where sewage is aerated before it is clarified in a pair of secondary clarifier tanks. Clarified effluent is chlorinated and either transferred to the Pulgul effluent storage lagoon or discharged to Pulgul Creek the onsite Pulgul lagoon.

The IDEAL process train treats sewage through a series of aeration, settling and decanting phases. The effluent from this process is chlorinated and discharged directly into the onsite Pulgul lagoon. From here it is either transferred to the effluent storage lagoon at the Pulgul plantation or discharged to Pulgul Creek.

Waste activated sludge from both the IDEAL and the Oxidation ditch is transferred to a gravity drainage deck for thickening before transferring to the aerobic digester for stabilisation. Once treated the solids are dewatered using a belt filter press and stockpiled for a minimum of 6 months before being reused as a soil conditioner.

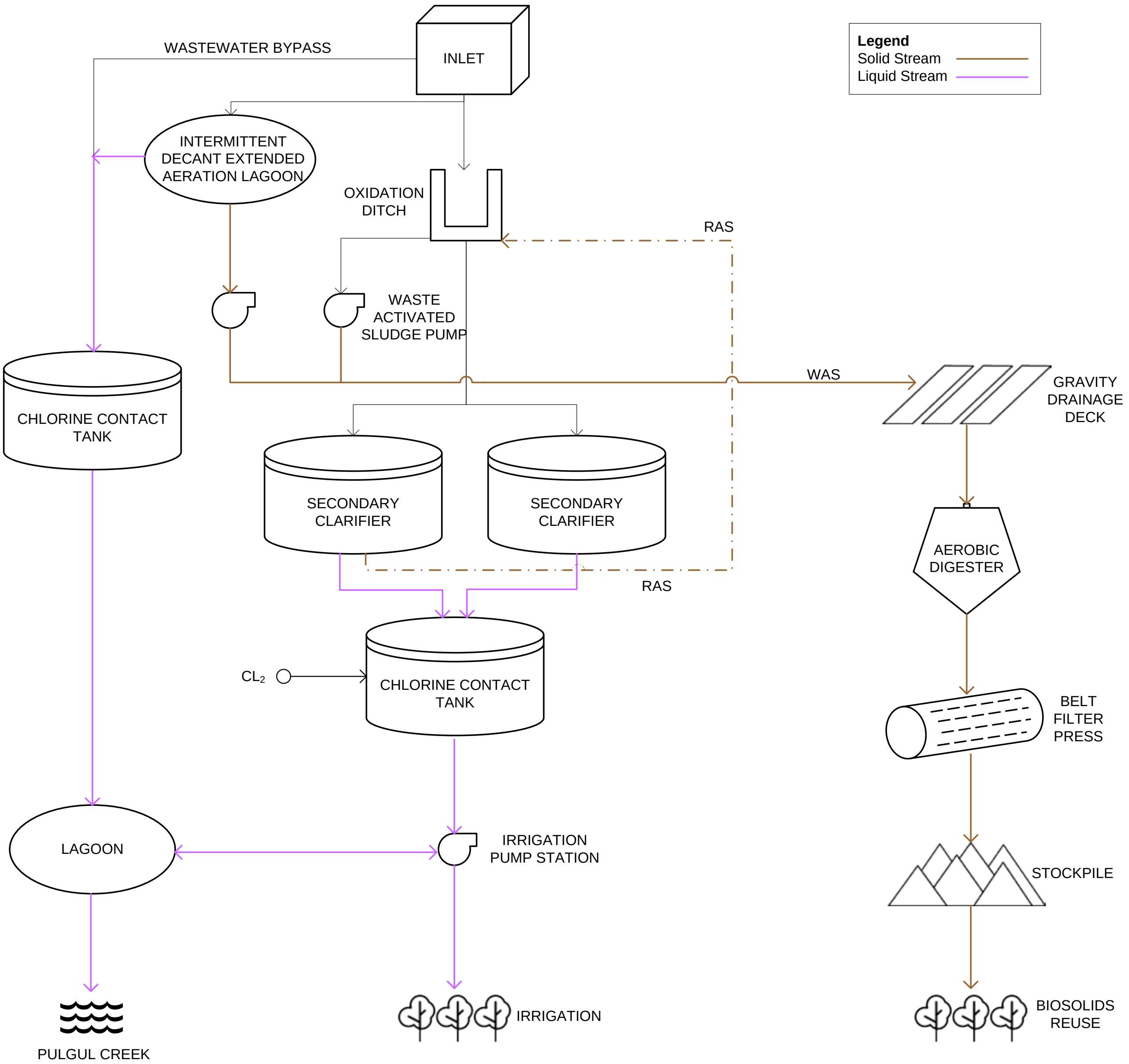


Figure 3-11: Pulgul Creek WWTP Process Flow Diagram

Figure 3-13 shows the historical inflows and rainfall at the Pulgul Creek WWTP. It appears that from August 2014 that the inflows to the treatment plant have decreased significantly. The graph shows the drop is approximately 1ML/day. Investigation of this discrepancy revealed that the one of the two flow meters used for determining flows into the treatment plant had not been functioning since August 2014.The treatment plant is considered to be at capacity.

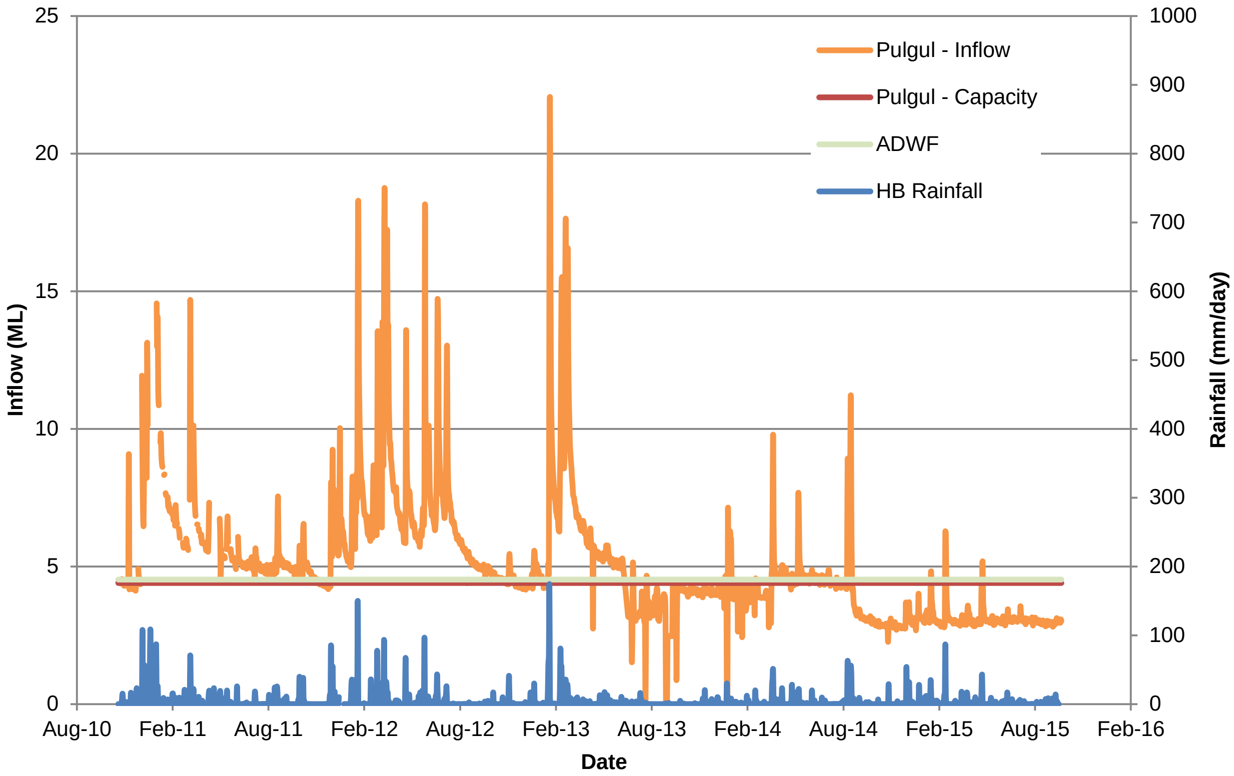


Figure 3-12: Pulgul Creek WWTP Historical Inflows, Capacity and Rainfall

Between August 2010 and August 2013, there is a high correlation between sewage inflows to the plant and rainfall events. This indicates that there is a high amount of inflow and infiltration. The PWWF ranges between 4 and 5 at this treatment plant.

3.4.3.1 Effluent Release to Pulgul Creek

The licenced discharge point for the Pulgul Creek WWTP is Pulgul Creek. The licence permits a discharge into Pulgul Creek of 2.0ML/day during dry weather flow (<1mm/day rainfall). The maximum single day discharge is 6.0ML during a wet weather periods under the licence.

Clause C2.7 of the licence conditions stipulates that 90% of ADWF must be reused each year.

In terms of nutrient loading the mass of Total Nitrogen and mass of Total Phosphorus permitted to be discharged to waters are 10 tonnes per year and 2.5 tonnes per year respectively. Table 3-5 summarises the mass load discharged to waters over the past five years.

Table 3-7 Pulgul Creek WWTP Mass Loads Released to Waters

Year	TN(kg)	TP(kg)
2010/11	4497	3266
2011/12	5366	3115
2012/13	5067	2045
2013/14	0	0
2014/15	0	0

The minimum effluent quality for waterway releases is stipulated under the EPA licence for this WWTP and is included in Appendix 6A.

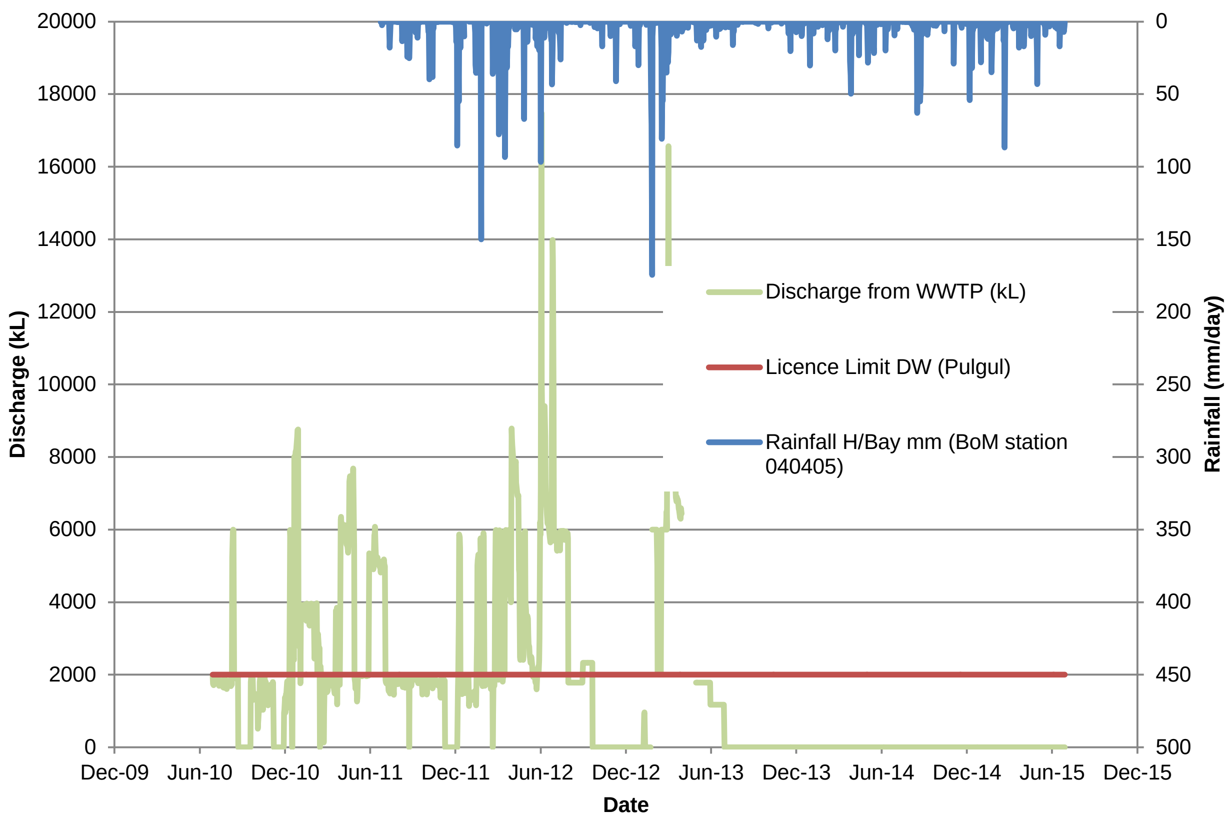


Figure 3-13: Pulgul Creek WWTP Discharge to Waters

3.4.3.2 Effluent Release to Land

Effluent is transferred to Pulgul effluent storage lagoon for irrigation under the reuse scheme and is discussed in more detail in Section 4 of this report. Figure 3-15 depicts the effluent available for reuse from the Pulgul Creek WWTP.

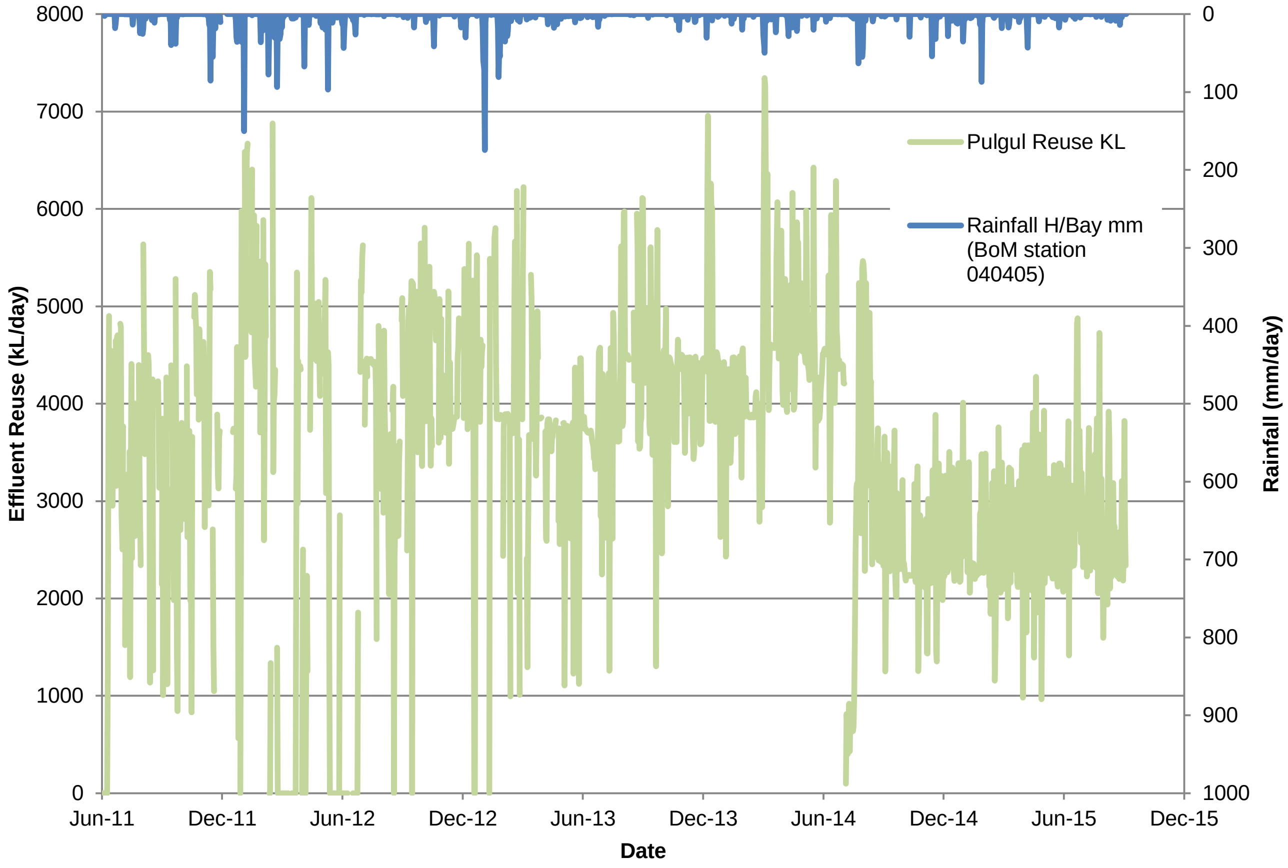


Figure 3-14: Pulgul Creek WWTP Historical Discharge for Reuse

The EPA licence for Pulgul Creek WWTP sets out the effluent quality limits and is included in Appendix 6A.

The historical percentage of ADWF reused from the Pulgul Creek WWTP is summarised in Table 3-6.

Table 3-8 Pulgul Creek WWTP Percentage Effluent Reuse

Year	% ADWF Reused (%)
2010/11	80
2011/12	83
2012/13	89
2013/14	108
2014/15	89

3.4.4 Nikenbah WWTP

The Nikenbah WWTP is located on Piggford Ln 6.3km south west of the Pialba GPO. It services a current catchment of approximately 7,000ED (3.2Ml/day). The extent of the Nikenbah WWTP catchment area is presented in Appendix 4A.

Nikenbah WWTP was commissioned in 2010 and uses Biological Nutrient Removal and Membrane Bioreactor technologies to treat sewage from the Nikenbah catchment. The Nikenbah WWTP has an ADWF design capacity of 4.8ML/d.

Figure 3-18 shows the treatment process at the Nikenbah WWTP. Sewage at the inlet works is screened and degritted. The screenings and grit are collected in bins for disposal.

The treatment continues to a balance tank to buffer peaks from the inflow and provide a constant flow through the treatment plant. Sewage is then treated through a series of anoxic and anaerobic chambers. Treatment continues through two aerobic chambers before micro filtration. Effluent is chlorinated and stored in the Nikenbah effluent storage lagoon for reuse.

Waste sludge is extracted from the filters and treated in a digester. After treatment the sludge is dewatered in a belt filter press and the dewatered solids are stockpiled on site for a minimum period of 6 months before being reused.

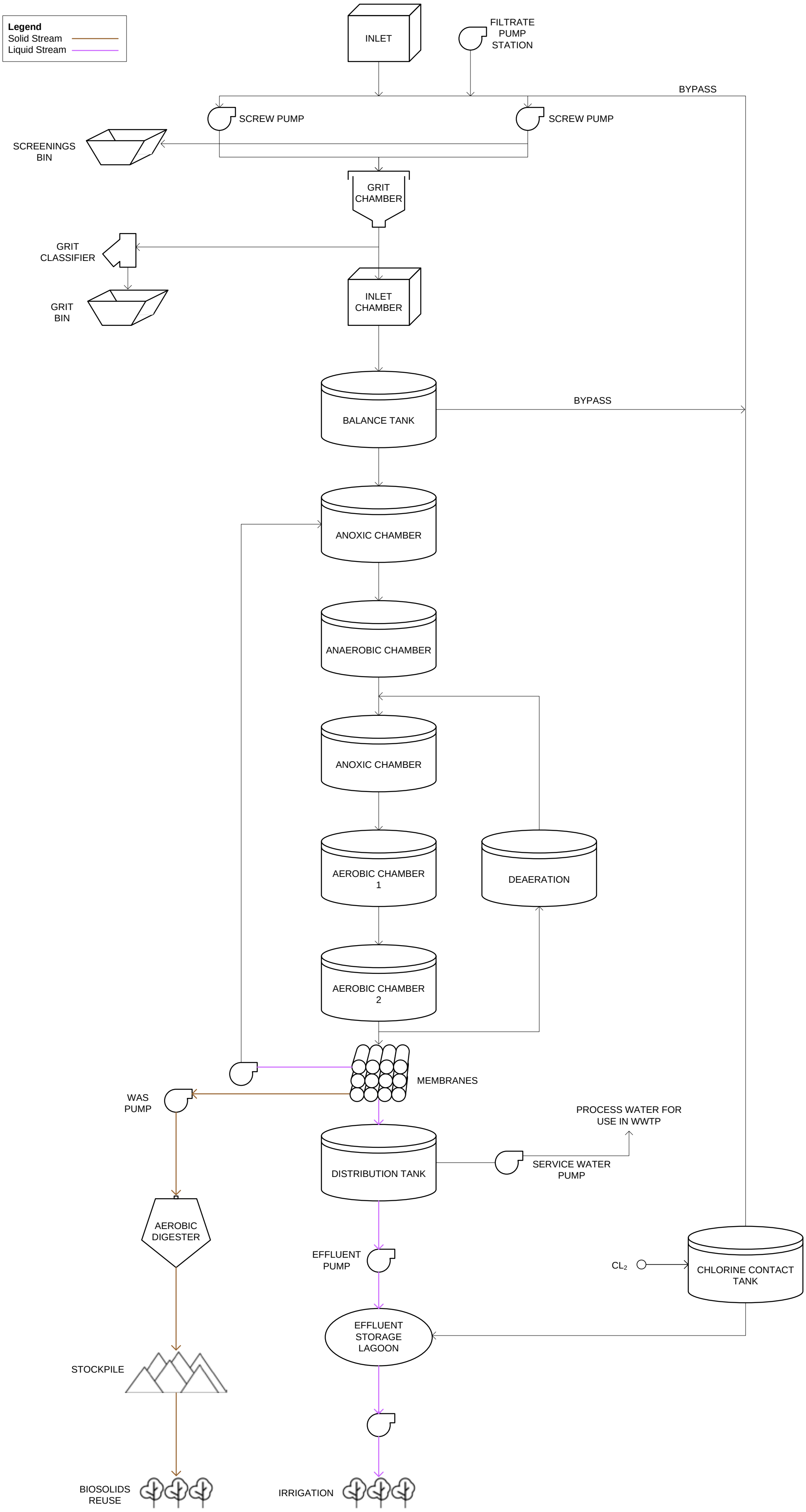


Figure 3-15: Nikenbah WWTP - Process Flow Diagram

Figure 3-17 plots the historical inflows, WWTP capacity and rainfall for the period from 2010 to 2015. It shows that there appears to be sufficient capacity at this WWTP to meet the current sewage treatment requirements.

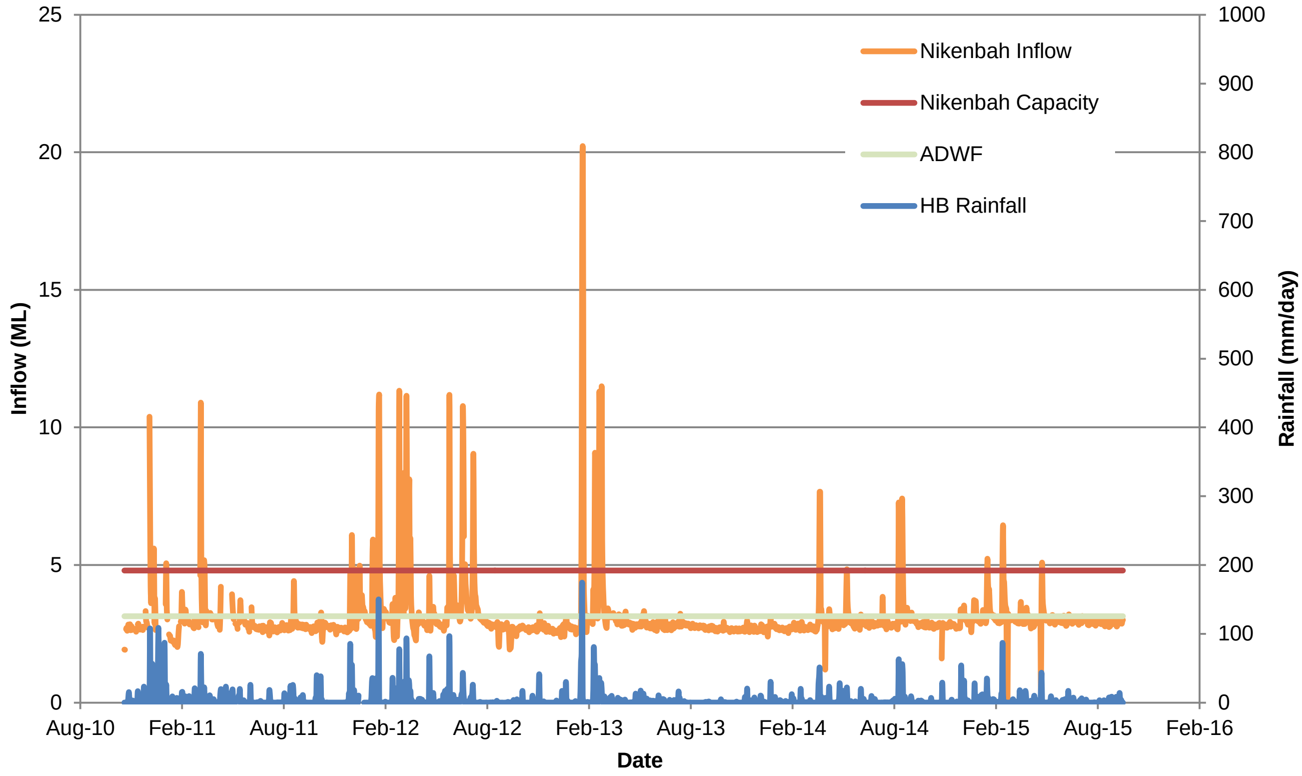


Figure 3-16: Nikenbah WWTP Historical Inflows, Capacity and Rainfall

3.4.4.1 Effluent Release to Waters

Nikenbah WWTP is located inland and does not currently have access to a water outfall therefore the licence does not allow discharge of contaminants to any receiving waters. The Licence only allows for discharge to land for irrigation purposes.

3.4.4.2 Effluent Release to Land

Discharge of effluent to land for irrigation purposes is permitted so long as the effluent meets the quality limits detailed in the EPA licence for this WWTP. The limits are available in Appendix 6A.

3.4.5 Aubinville WWTP

Aubinville WWTP is located north east of Maryborough CBD within 300m of the suburb of Aubinville and is immediately adjacent to the Mary River. The WWTP currently services 11,100ED (5ML/day). The extent of the Aubinville WWTP catchment area is included in Appendix 4A.

According to the available documentation the plant has a nominal design capacity of 30,000EP at 275L/EP/day (8.25ML/day) with a nominal wet weather treatment capacity of 3 x Average Dry Weather Flow (ADWF) and a nominal design hydraulic capacity of 5 x ADWF. The WWTP either discharges to the Mary River with the discharge location being approximately 33.2km from the river mouth in the Great Sandy Straits at River Heads or to the effluent reuse lagoon for irrigation use.

The WWTP was initially constructed during the 1940's, and was subsequently augmented in 1976 to trickling filter activated sludge process to meet the growing demands.

In July 2009 Wide Bay Water Corporation became the Successor at Law of the Aubinville WWTP. Since then WBWC has been investigating and reviewing the WWTP's performance and has implemented measures to improve performance and environmental compliance at the plant.

The raw sewage load is predominantly domestic in origin. Recently all septic and grease trap waste from Maryborough have been transported to Pulgul Creek WWTP for treatment but it is proposed that this waste be treated in the digesters at Aubinville WWTP into the future.

Inflow to the plant is received from a DN900 gravity sewer, a DN600 gravity sewer and a DN250 rising main from APS010 in Granville. These mains discharge into a lift pump station adjacent to the inlet works. There are three pumps installed in the lift station with manual duty selection. The capacity of the inlet works is insufficient to operate the three pumps simultaneously. This is due to the configuration of the inlet works, where surcharging of the vortex grit removal chamber occurs. The capacity of only two pumps operating in parallel is insufficient to meet the wet weather flows entering the lift station and as a result wet weather bypass at the plant is utilised.

There are two automatic (weir) overflow bypasses built into the plant. Each incorporates a coarse screen and discharges screened sewage directly to the Mary River. One is on the DN900 trunk gravity main before it reaches the lift pump station within the plant and was installed around 2003. The other is within the lift pump station wet well structure immediately adjacent to the Inlet Works. Both of these bypasses are unmetered and historically overflows to the bypasses have not been reported to the EPA.

The plant configuration beyond the inlet works, where screening and grit removal occurs, is primary clarifiers (PC) followed by rock media biological trickling filtration (BTF) in-series with two parallel activated sludge reactors (AS). Secondary sedimentation beyond the AS reactors is carried out in two final clarifiers (FC). The plant configuration is unusual as these two entirely different systems are usually operated in parallel. Waste Activated Sludge (WAS) from the activated sludge reactors is thickened and transferred to a digester for stabilisation. The stabilised sludge is dewatered and stockpiled at the St Helen's effluent storage lagoon site.

Figure 3-18 describes the treatment process.

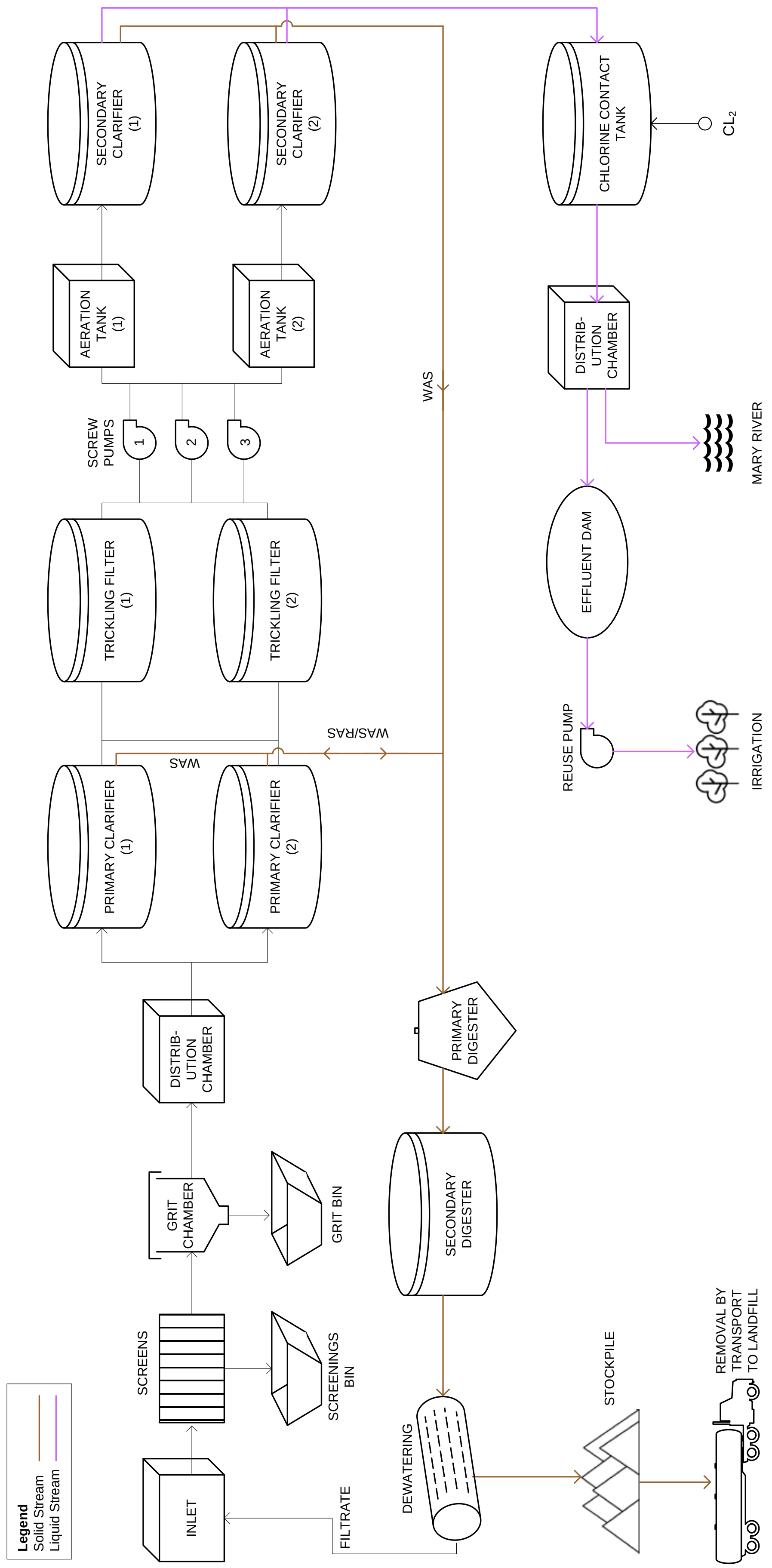


Figure 3-17: Aubinville WWTP - Process Flow Diagram

Figure 3-19 illustrates the historical inflows to the Aubinville WWTP. The data shows a decline in amplitude after August 2012 where the average inflow is approximately 3ML/day. A portable flow meter was used for one week between 15/7/14 and 21/7/14. This, albeit, small measurement period concluded that the average flow to the plant was 4.5ML/day. This figure is consistent with the theoretical flowrate based on the estimated ED's and is also representative of data prior to August 2012. Therefore it is concluded that the data between August 2012 and May 2015 is not reliable.

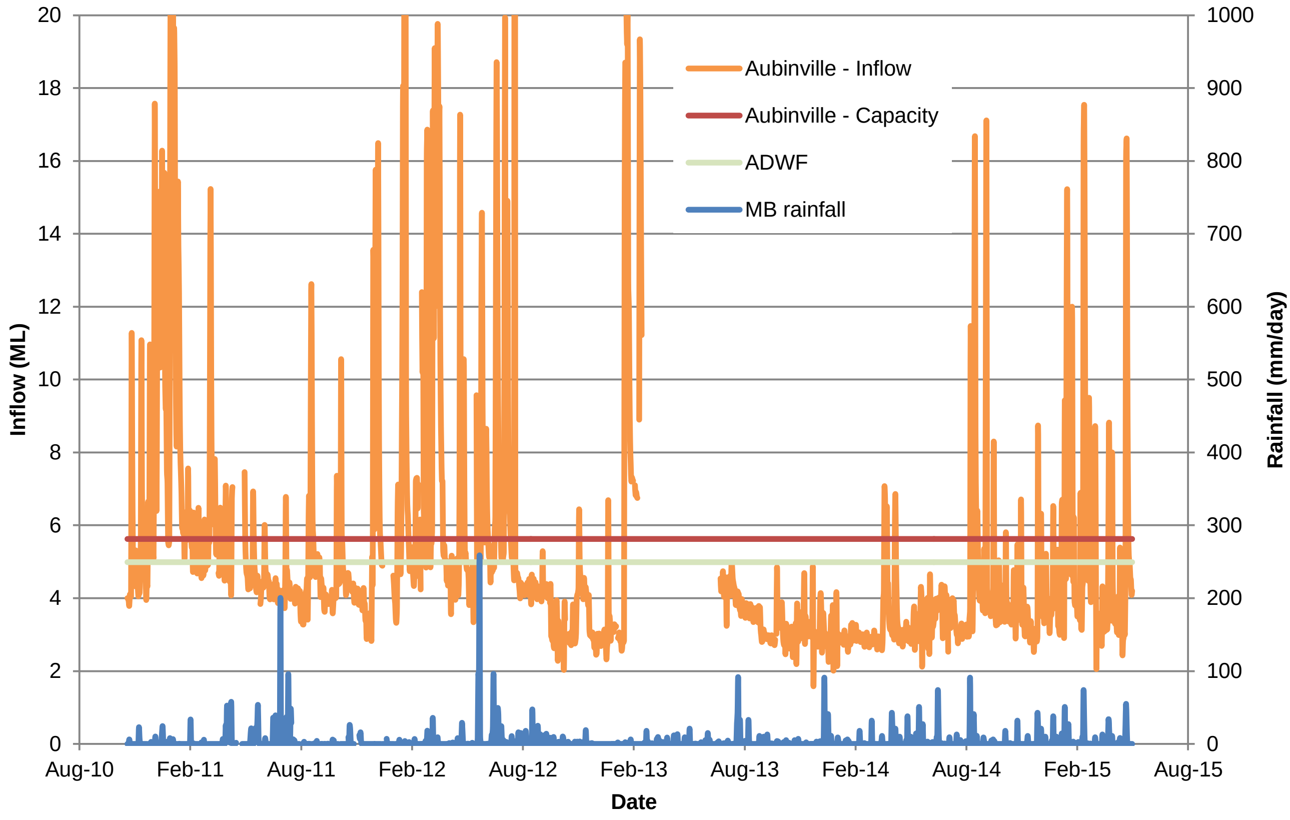


Figure 3-18: Aubinville WWTP Historical Inflows, Capacity and Rainfall

3.4.5.1 Effluent Release to Mary River

The licenced discharge point for Aubinville WWTP is the Mary River at approximately 300m north east of Booker St (33.2km AMTD). The maximum release volume permitted under the licence is 10ML during dry weather and 50ML on a wet weather day. Figure 3-20 illustrates the historical discharge volumes to the Mary River from 2010 to present.

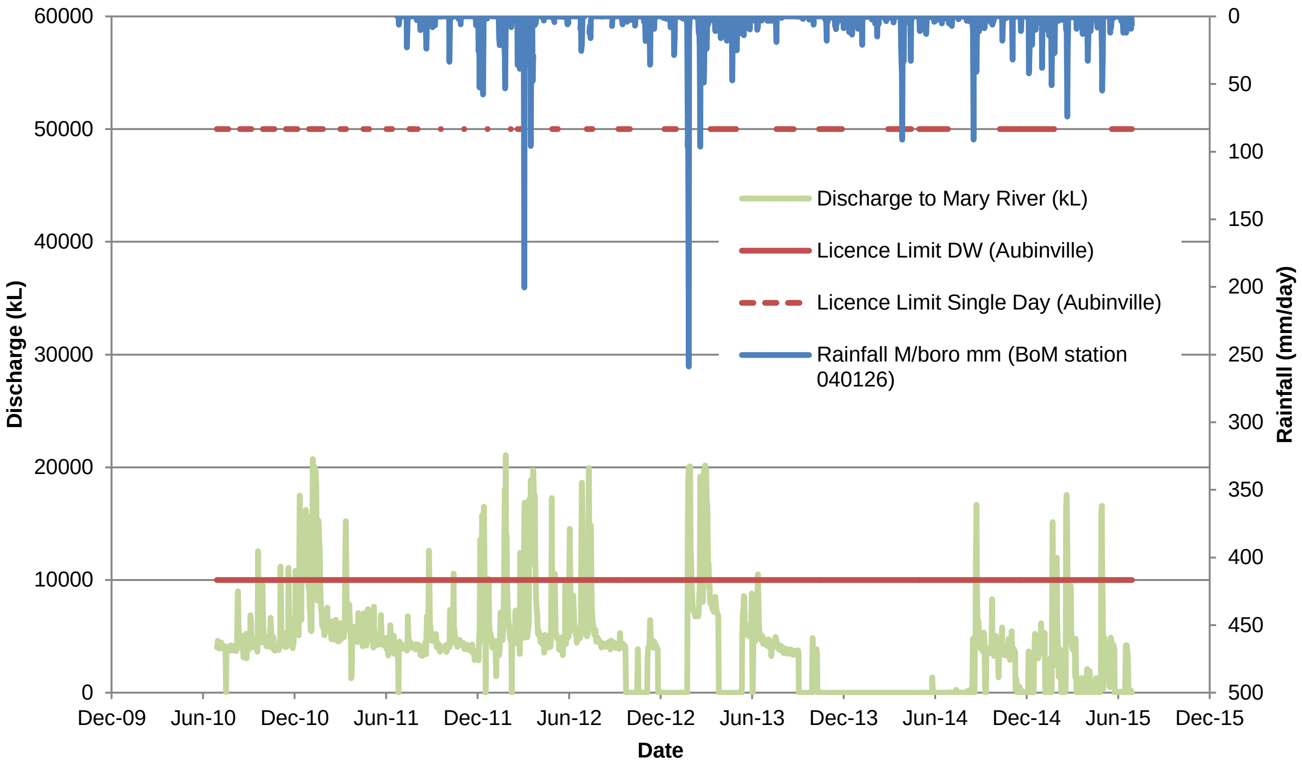


Figure 3-19: Aubinville WWTP Discharge to Mary River

The quality release limits under the licence are included in Appendix 6A.

An amended licence is expected in the coming year and it is likely that the amended licence will not define volumetric discharge limits. Instead it is expected that the discharge to the Mary River will be triggered by the flow in the Mary River. Discharging from the WWTP during high river flow periods (greater than 23.15m^3/s) allows better dispersion of discharges. The request for amended licence also includes the facility to discharge from the 700ML effluent reservoir at St Helens (when river flows are greater than 46.3m^3/s). This will allow the reduction in stored effluent during wet weather events and reduce the amount of discharge during periods where the flow in the Mary River is low.

3.4.5.2 Effluent Release to Land

Any effluent released to land is required to meet certain quality limits. These limits are defined in the environmental licence for the Aubinville WWTP and are included in Appendix 6A.

Discharge to land includes irrigation of existing cane farms and WBWC's tree plantation. It is estimated that the amount of effluent reused from Aubinville is approximately 40-50% (Water Strategies, 2014). Figure 3-21 depicts the effluent available for reuse from the Aubinville WWTP.

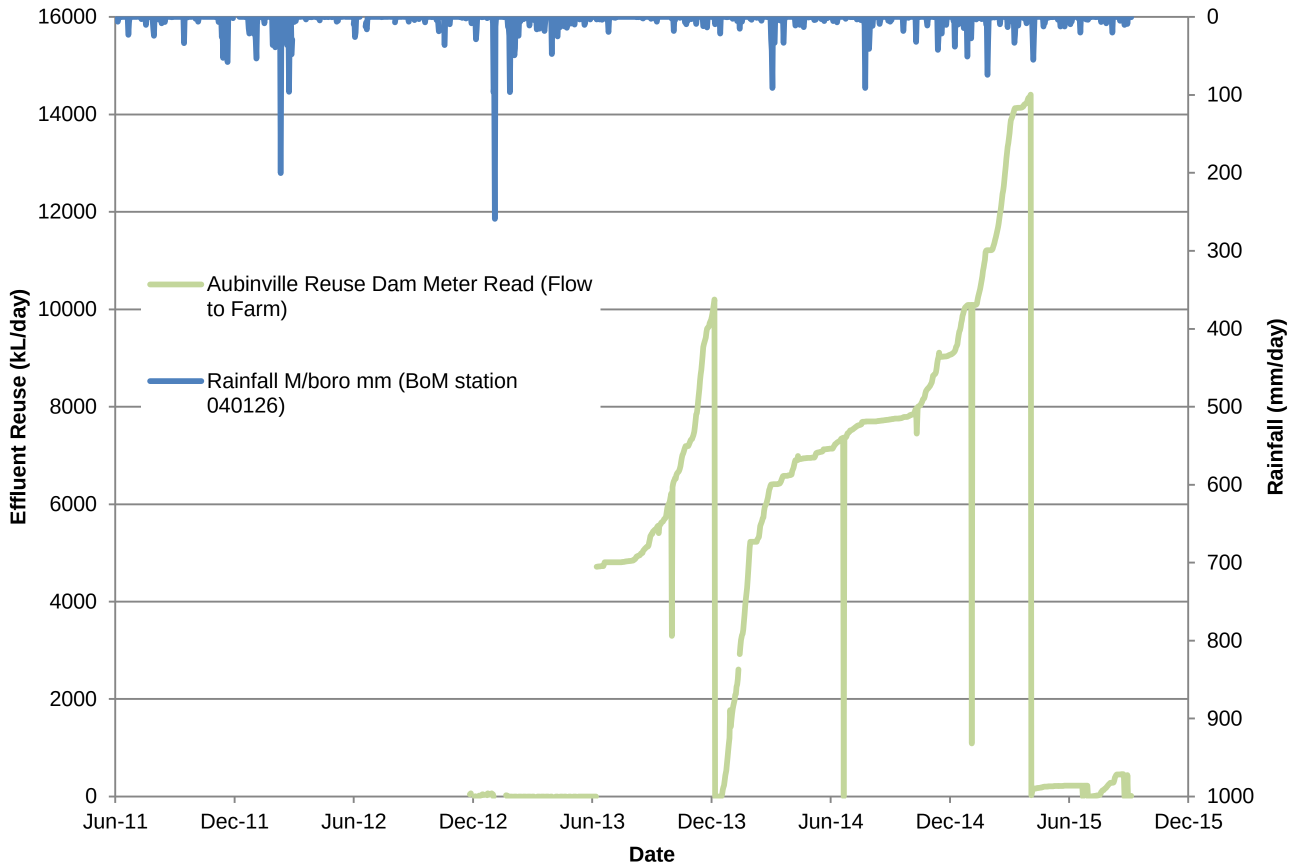


Figure 3-20: Aubinville WWTP Effluent Reuse to Land

3.4.6 Burrum Heads WWTP

The Burrum Heads WWTP is located on Road 181 (extension of Bushnell Rd) and approximately 1km west of existing beach side residential areas. The WWTP currently services approximately 950ED (430kL/day). The extent of the Burrum Heads WWTP catchment area is presented in Appendix 4A.

The plant was constructed in 2001 to replace facultative ponds system. The ponds were lined and are now used as effluent storage lagoons. The plant has been in operation since 2004.

The Burrum Heads WWTP has a hydraulic capacity of 625kL/d. It is an Intermittently Decanted Extended Aeration (IDEA) wastewater treatment plant. The raw sewage enters the treatment plant from three sewerage pump stations located within the residential areas of Burrum Heads. Once at the treatment plant raw sewage is screened to remove rags and other objects that might be harmful to the treatment equipment.

The treatment commences in the aerobic/anoxic tank where aeration (aeration phase) occurs followed by a settling period (anoxic phase) to encourage nitrification.

The treatment continues in the Intermittent Aeration Tank (IAT) where aeration occurs intermittently followed by a settling period. After the settling is complete effluent is decanted from the IAT and chlorinated before being stored in the effluent storage lagoons.

Activated sludge is transferred back to the AAT to assist in the treatment process. Waste sludge from the IAT process is removed to the sludge thickening lagoon.

Supernatant from the sludge thickening process is returned to the AAT at the head of the treatment process.

A schematic of the process flow is represented in Figure 3-22.

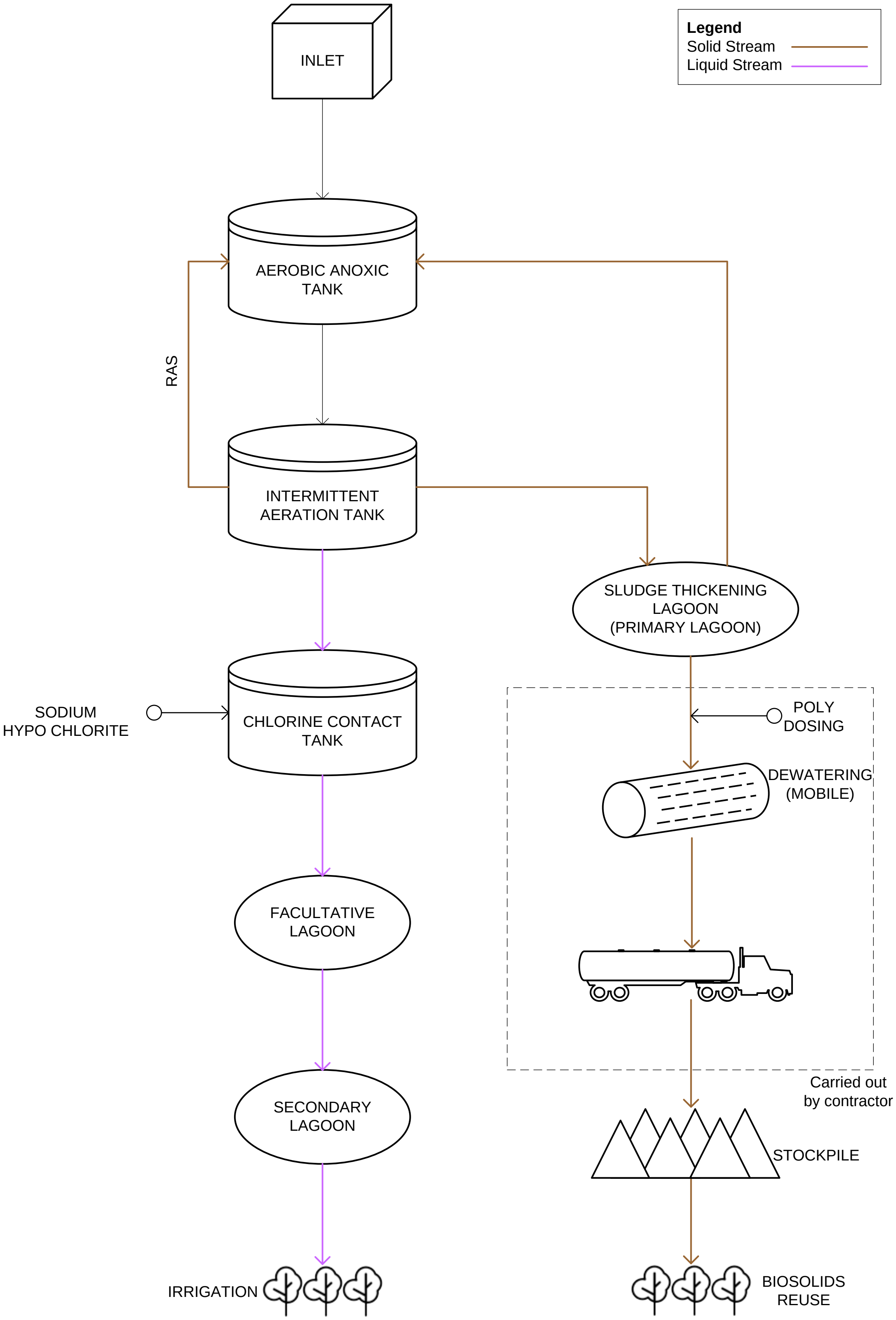


Figure 3-21: Burrum Heads WWTP - Process Flow Diagram

The sewage inflows at the Burrum Heads WWTP are shown in Figure 3-23. The historical data spans the period from 2010 to 2015. It can be seen that the plant capacity is exceeded from time to time particularly during periods of prolonged or intense rainfall. During dry weather events and smaller wet weather events the capacity of the treatment plant is not exceeded.

Inflows to the plant are affected by holiday seasons and increased population during these periods.

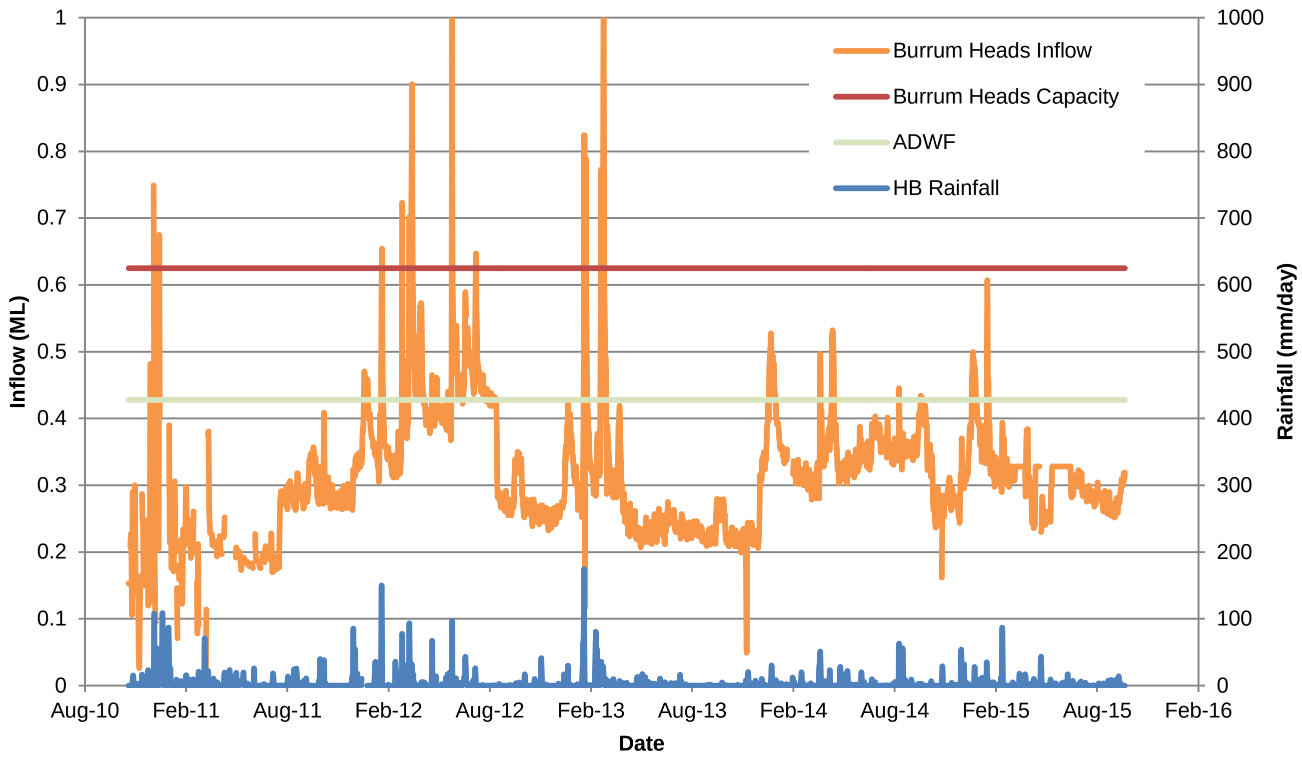


Figure 3-22: Burrum Heads WWTP Historical Inflows, Capacity and Rainfall

3.4.6.1 Effluent Release to Waters

The licence for Burrum Heads WWTP does not allow for effluent discharge release to waters. The licence only allows effluent discharge to land for irrigation.

3.4.6.2 Effluent Release to Land

Treated effluent from this plant is stored in an onsite effluent storage lagoon and used for land irrigation at the Dreamtime plantation as required. The amount of treated effluent permitted to be released to land or to wet weather storage is 0.65ML/day ADWF and a maximum release during wet weather of 3.25ML.

Figure 3-24 shows the volume of effluent reused from the Burrum Heads WWTP. While the graph appears to show that the licence limits are regularly reached for discharge to land, the figures are the volumes transferred between the Burrum WWTP site and the Dreamtime effluent storage lagoon and therefore are not necessarily the volume of water discharged to land.

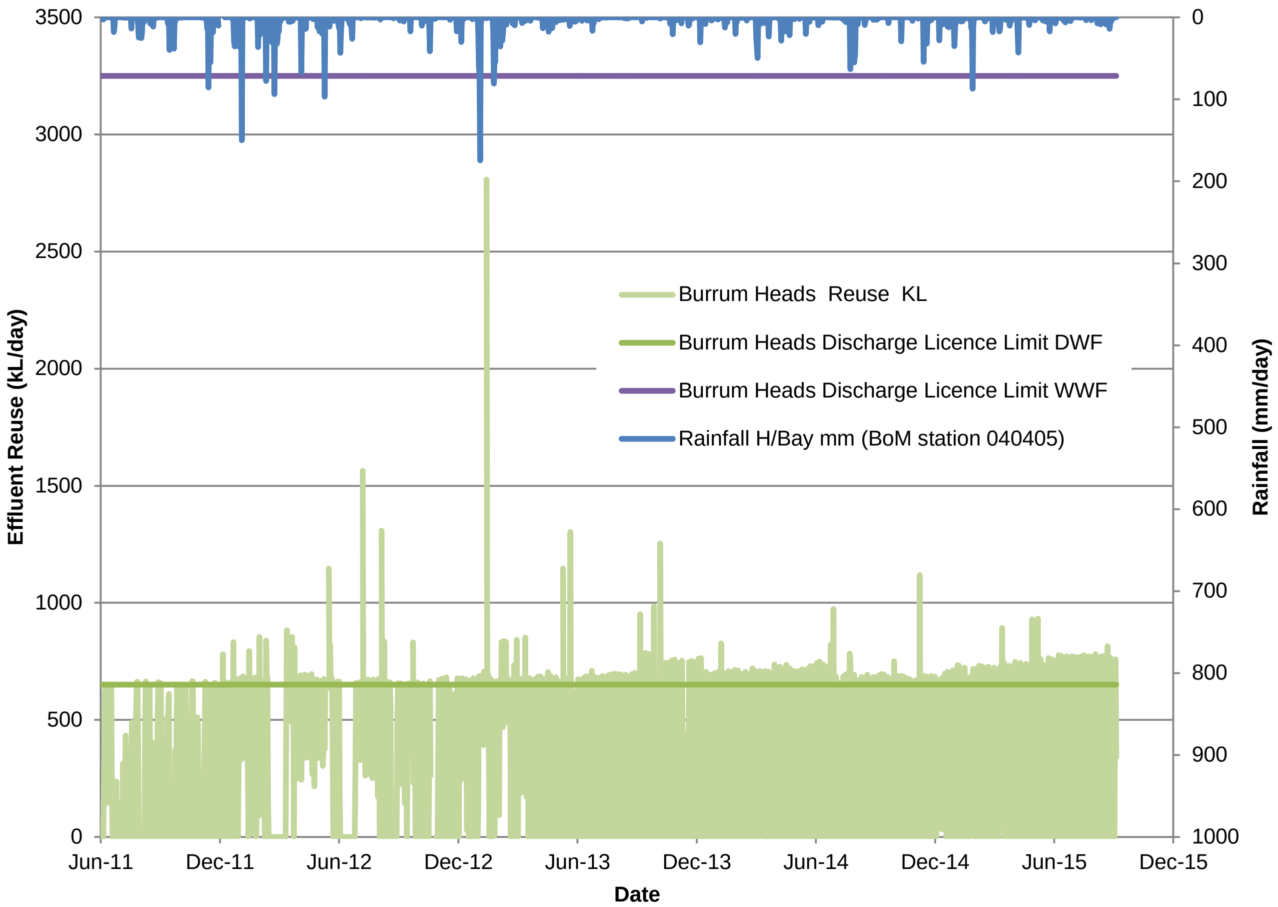


Figure 3-23: Burrum Heads Effluent Reuse

The release limits for the key contaminants to land are included in Appendix 6A.

3.4.7 Toogoom WWTP

The Toogoom WWTP is located on Morris Rd some 600m south west of the nearest residential properties. The WWTP currently services approximately 590ED (approx. 270kL/day). The extent of the Toogoom WWTP catchment area is presented in Appendix 4A.

This plant was constructed in 2001 to replace facultative lagoons that were operating since 1984.

The Toogoom WWTP has a hydraulic capacity of 375kL/d. The treatment process is a combination of an aerobic/anoxic tank and an intermittent aeration tank.

Raw sewerage enters the treatment plant through a number of rising mains from the main residential areas of Toogoom. The inlet works consist of a flow meter and screens to remove rags and other objects harmful to the treatment equipment. Treatment begins in an aerobic/anoxic tank where activated sludge is mixed (aerobic phase) with the influent and allowed to settle (anoxic phase). The mixed liquor is transferred to the intermittent aeration tank (IAT) where it is aerated and allowed to settle. To enhance denitrification short burst of aeration are used during the settling phase.

When the level reaches the decant level, effluent is decanted into the chlorine contact tank. Once chlorinated the effluent is transferred to the exfiltration ponds.

Chlorinated effluent is transferred to the exfiltration ponds or to the filter banks for effluent reuse on the adjacent tree plantation. Effluent is discharged into groundwater through a process of exfiltration in the lagoon beds. It is recognised that this practice may compromise the aquifer around the plant and therefore the corporation undertakes regular assessment of the depth and quality of the aquifer.

Sludge is removed from the IAT and transferred to a geofabric bag for dewatering. If the volume of sludge is higher than the capacity of the geofabric bag then sludge is transferred to the sludge lagoon.

A process flow chart of the Toogoom WWTP is represented in Figure 3-25.

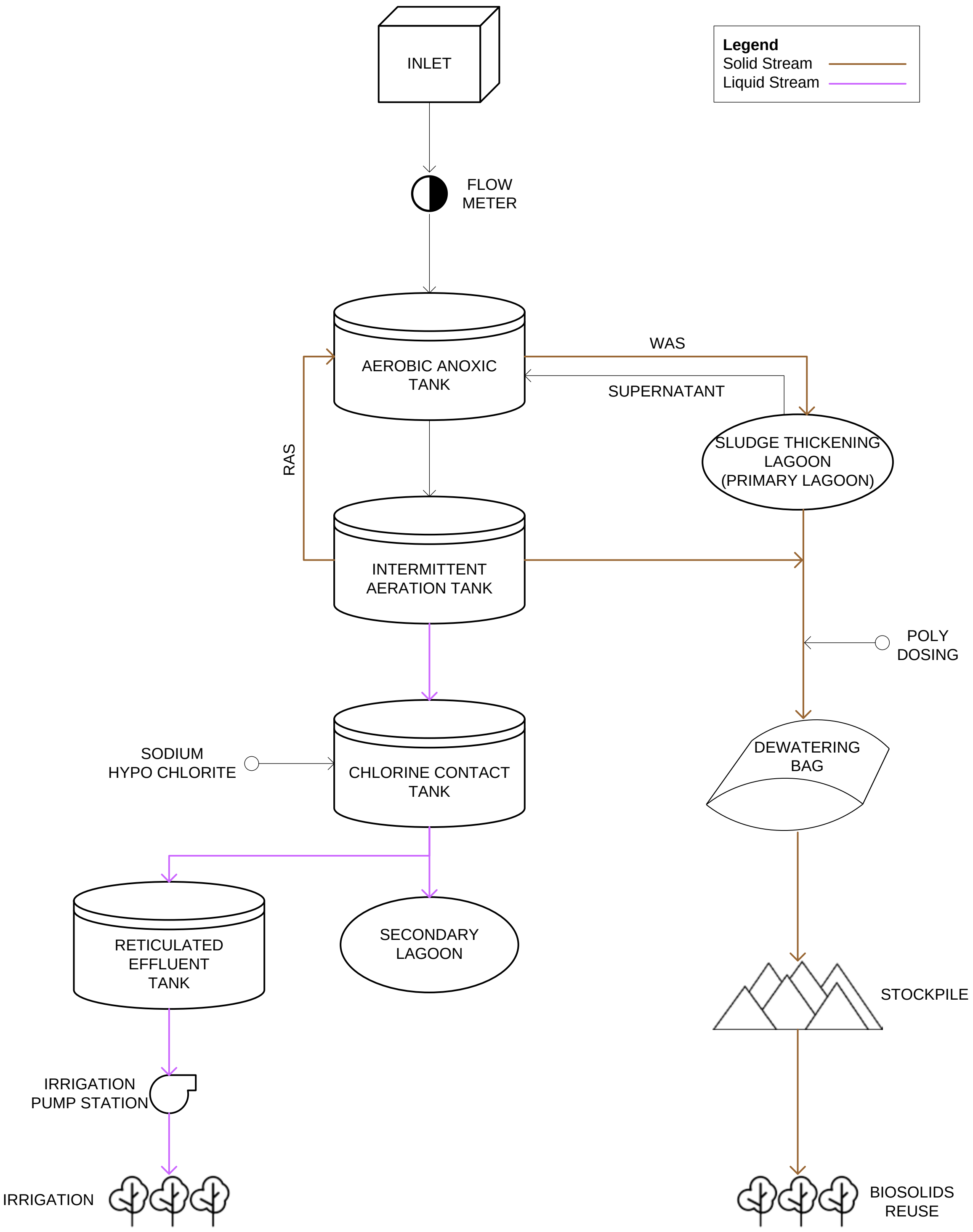


Figure 3-24: Toogoom WWTP Process Flow Chart

The historical sewage inflows to the Toogoom WWTP and the plant capacity and rainfall data are shown in Figure 3-26. No data was available between December 2013 and October 2014. Generally the plant is operating under its capacity.

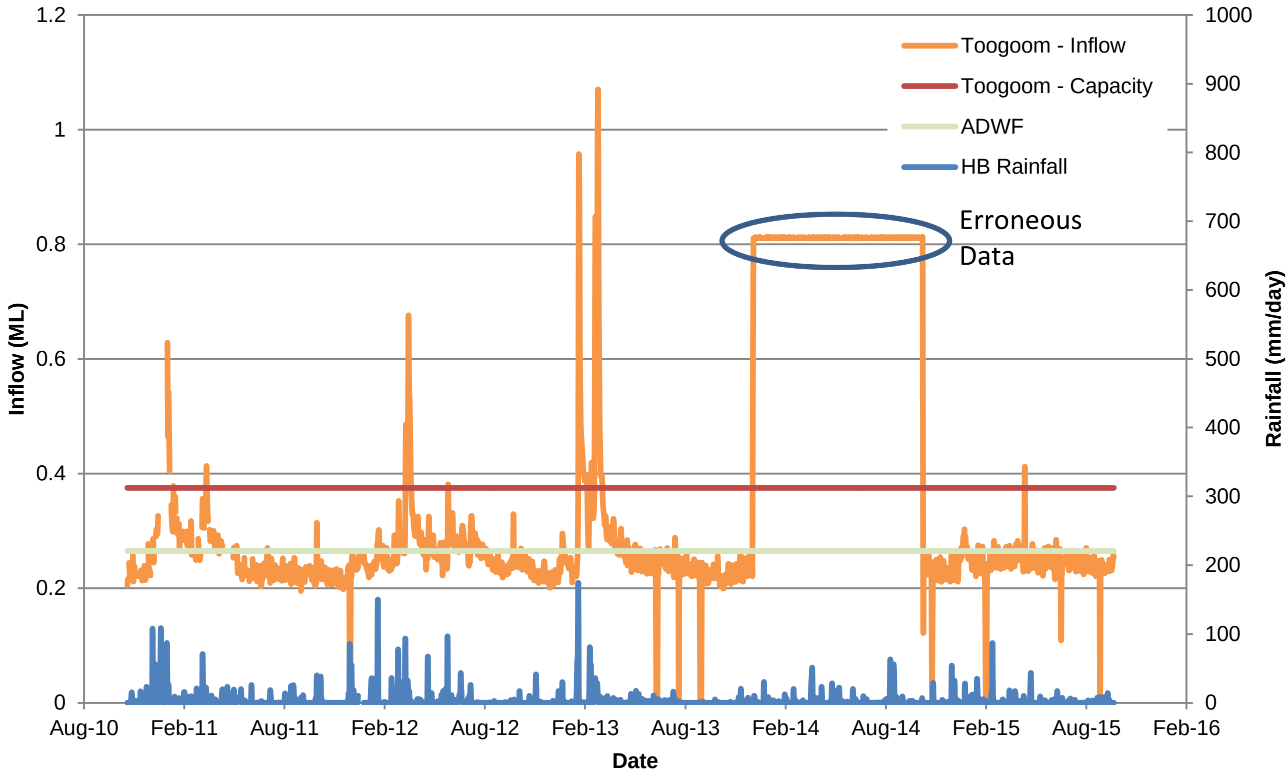


Figure 3-25: Toogoom WWTP Historical Inflows, Capacity and Rainfalls

3.4.7.1 Effluent Release to Waters

The licence does not allow discharge to surface water but permits discharge to ground water. The sandy subsurface of the effluent storage lagoons provide a discharge point into the underlying ground water by exfiltration. The licence allows a dry weather discharge (exfiltration) of 0.15ML/day and a maximum exfiltration of 0.75ML/day during wet weather periods. Figure 3-27 shows the historical estimated exfiltration from the Toogoom effluent storage lagoons. It can be seen that the licence limits were exceeded twice between 2012 and 2013.

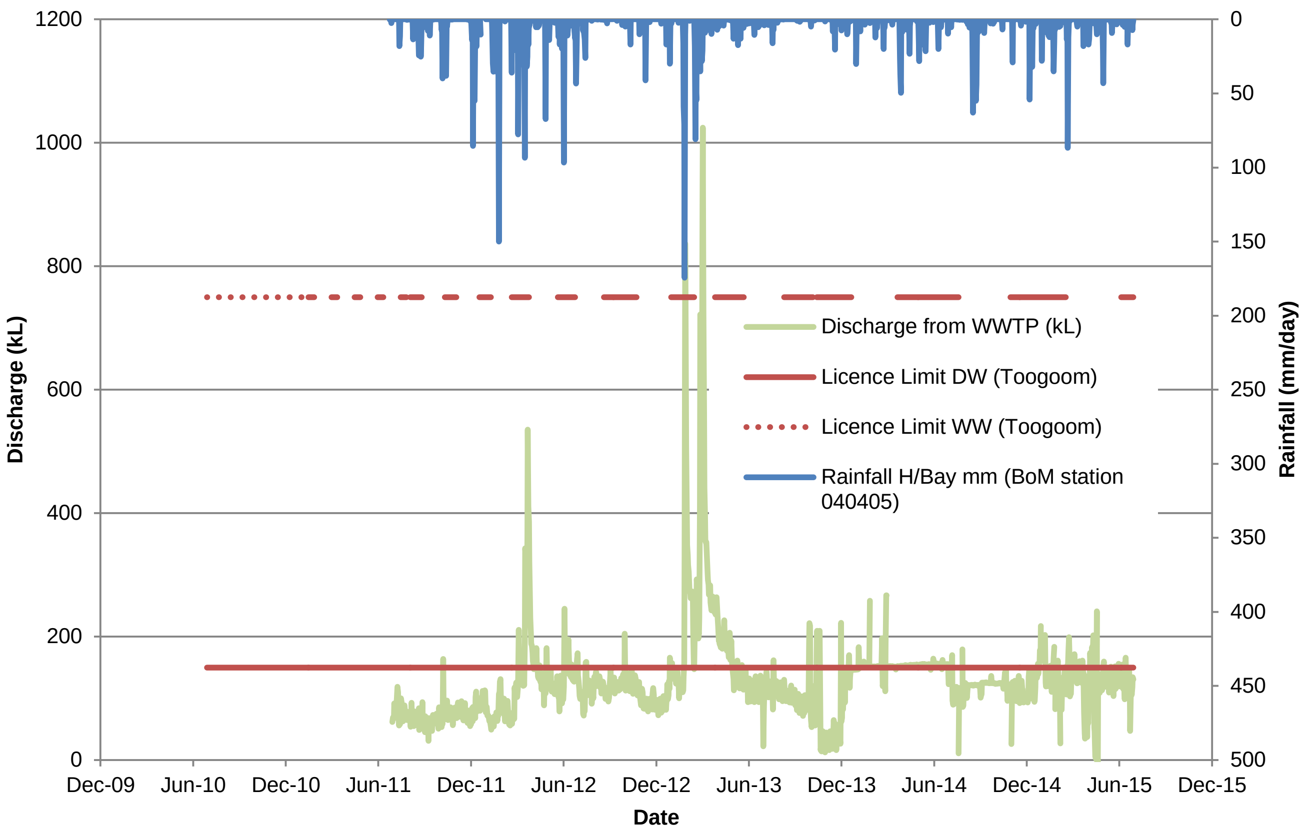


Figure 3-26: Toogoom Estimated discharge to through exfiltration

3.4.7.2 Effluent Release to Land

Figure 3-28 shows the effluent available to be reused from the Toogoom WWTP. It can be seen that there is a general slight downward trend on the available effluent. The cause of this phenomenon is uncertain without further investigation.

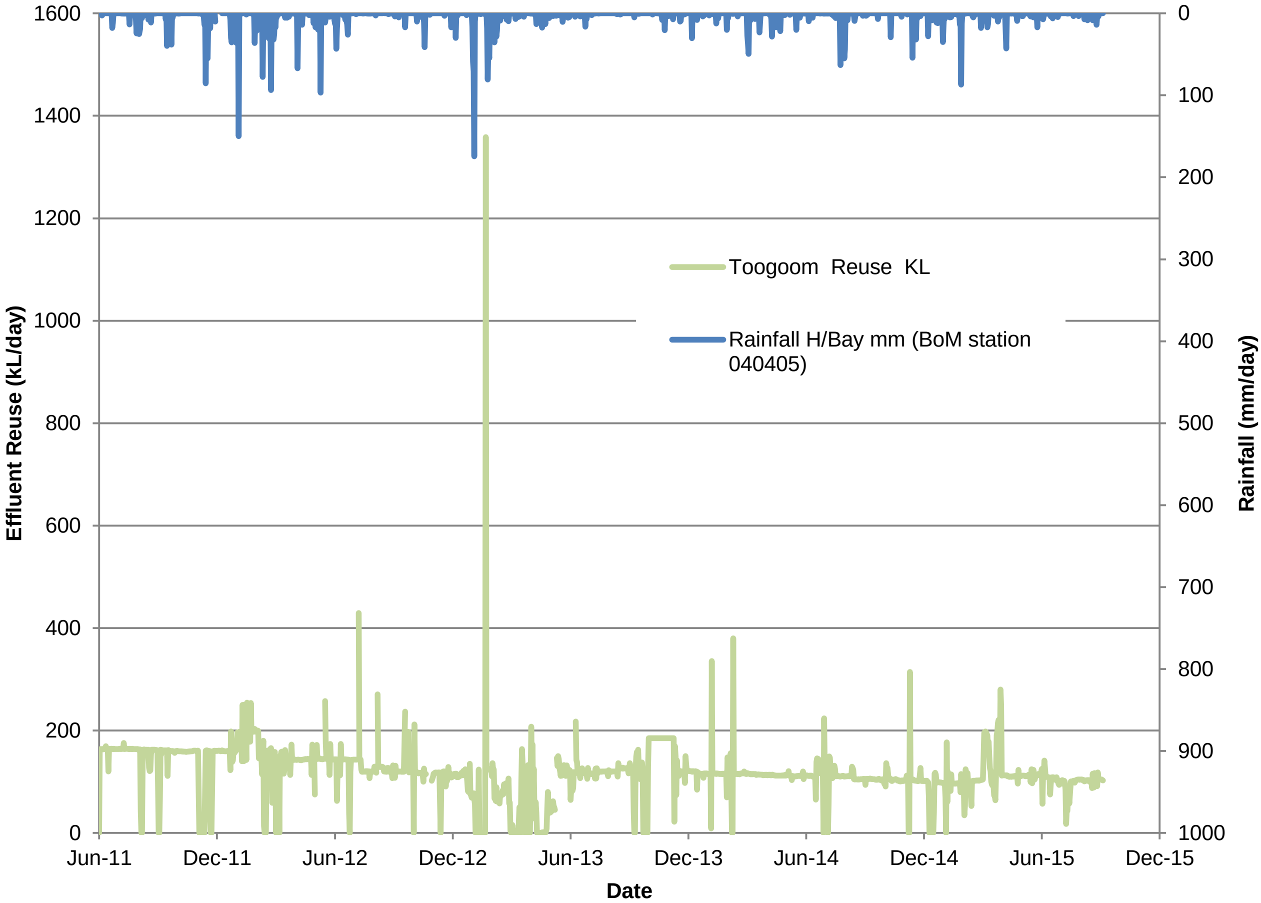


Figure 3-27: Toogoom Effluent Reuse

The historical total reuse volumes for Toogoom WWTP are shown in Table 3-9.

Table 3-9: Toogoom WWTP Effluent Reuse

Year	Total Volume reused Toogoom WWTP (ML/annum)
2011/12	51.7
2012/13	38.8
2013/14	42
2014/15	40.5

3.4.8 Howard WWTP

The Howard WWTP is located at the oval in Steley St. It is located in close proximity to many of the local commercial lots in Howard. The extent of the Howard WWTP catchment area is presented in Appendix 4A.

The Howard WWTP is an “Enviroflow” Trickling Filter package and was constructed in 1991. The plant’s design capacity is 24kL/d or the equivalent of 53ED and is currently loaded to its full capacity. Since 2010, no further connections have been permitted.

It consists of three primary sedimentation tanks to remove sediment from the raw wastewater influent stream. Treatment continues through two trickling filters before being chlorinated and pumped to a storage pond at the local golf course for irrigation use by the golf course.

The configuration of the plant is such that the sedimentation tank and trickling filters can be used in parallel or in series. Parallel use can be used during high loading periods to allow a greater amount of influent to be treated. Operating the WWTP in this manner affects the quality of the effluent. Operating the WWTP in series produce better quality effluent, however it does decrease the treatment capacity. The latter is the normal operating procedure.

The highest quality effluent is preferred because the effluent is used for direct irrigation purposes. The irrigation area including the effluent storage pond is not controlled by WBWC.

The overflow point for the Howard WWTP is the nearby Maria Creek. Discharge into this water way is not desirable due to the low dilution achieved at the upper end of this tributary where the discharge point is located.

Any additional load into the treatment plant would require large capital outlays to increase the capacity of the treatment plant and the associated works required to meet discharge licensing requirements.

The process flow is represented in Figure 3-29.

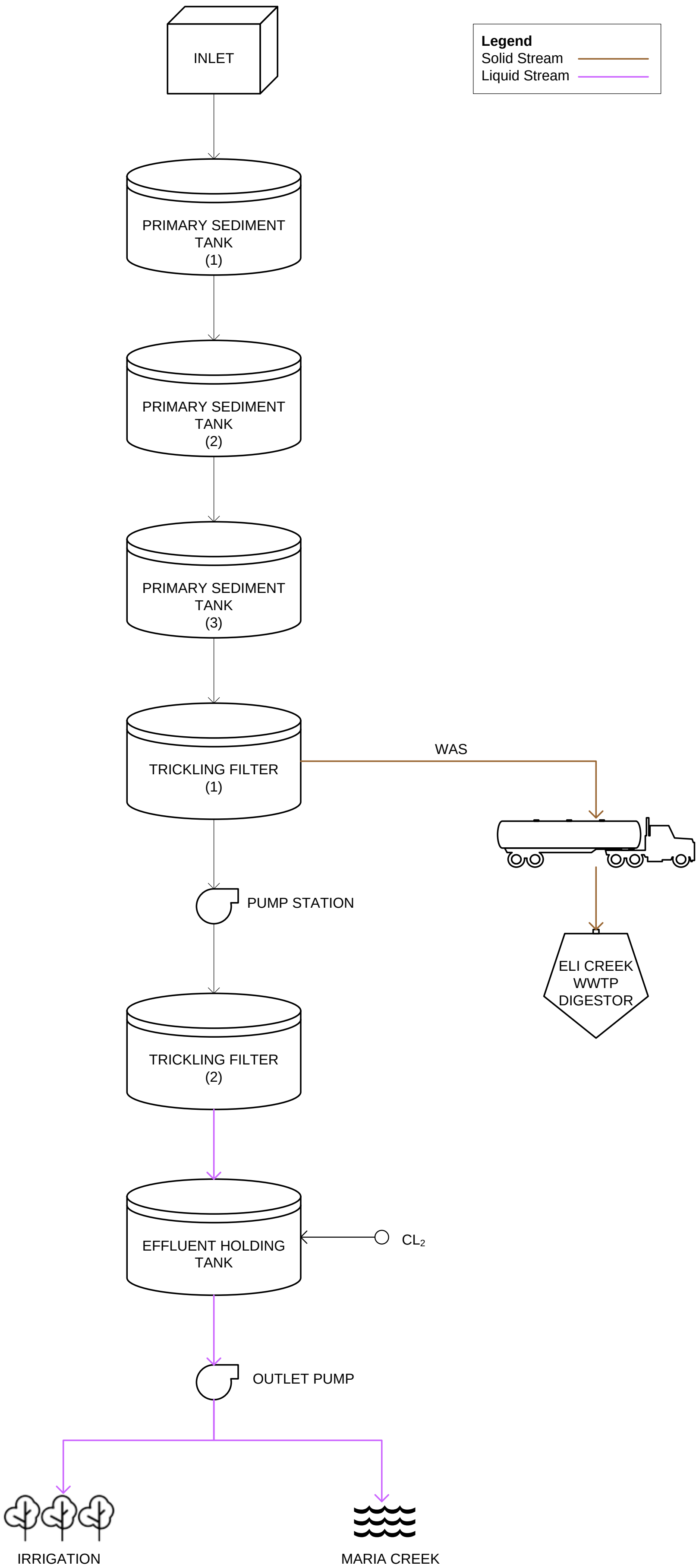


Figure 3-28: Howard Process Flow Chart

The historical sewage inflows and WWTP capacity and rainfall are shown in Figure 3-30.The capacity of the treatment plant is regularly exceeded at Howard. Even so, the Howard WWTP and sewerage collection system are beyond economic expansion and it is unlikely that any extensions or capacity upgrades to the WWTP will be made in the future unless external funding is made available for such a project.

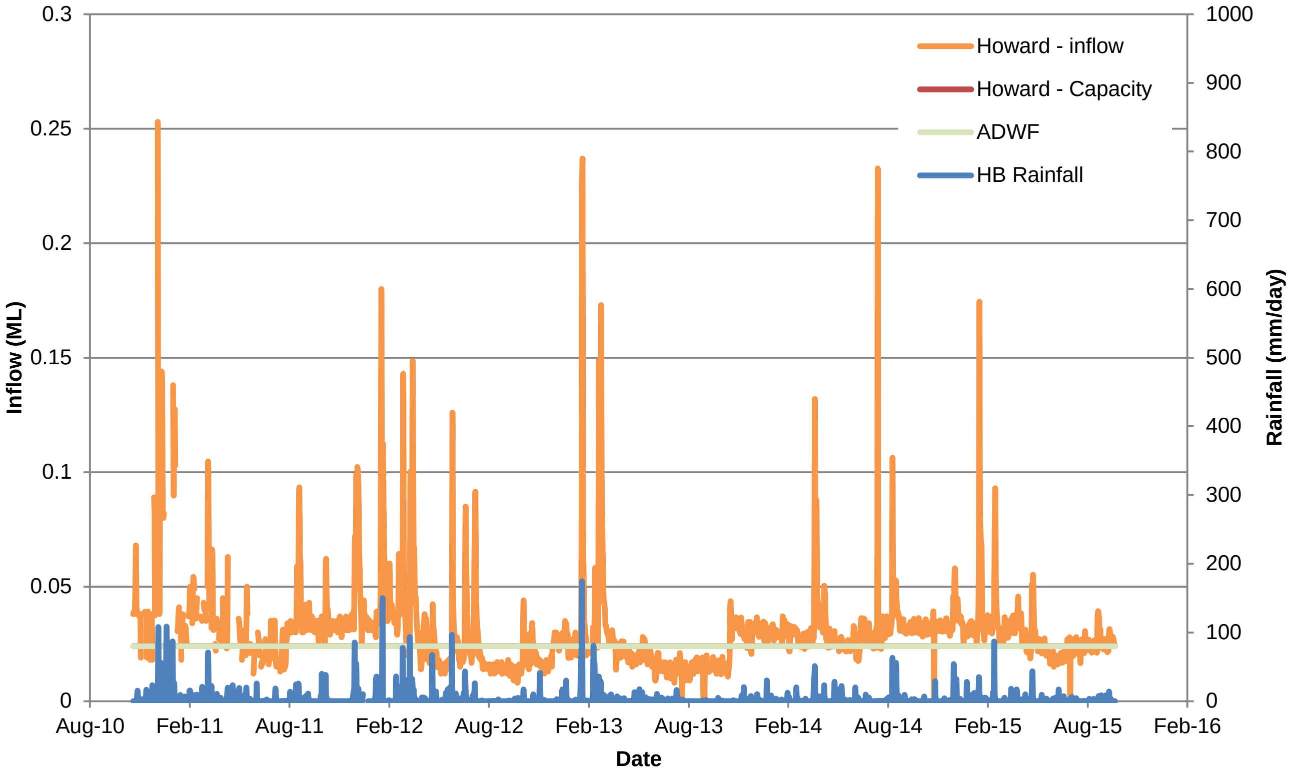


Figure 3-29: Howard WWTP Historical Inflows, Capacity and Rainfall

3.4.8.1 Effluent Release to Maria Creek

The Licenced release point for the Howard WWTP is Maria Creek. The ADWF permitted under the licence to be discharged into Maria Creek is 51.8kL/day but only permitted when there is flow in Maria Creek.

Appendix 6A includes the minimum effluent quality for water release points from this WWTP.

The Historical discharges to Maria Creek between 2010 and 2015 are shown in Figure 3-31. It can be seen that discharges occasionally occur, but licence limits have not been exceeded to date.

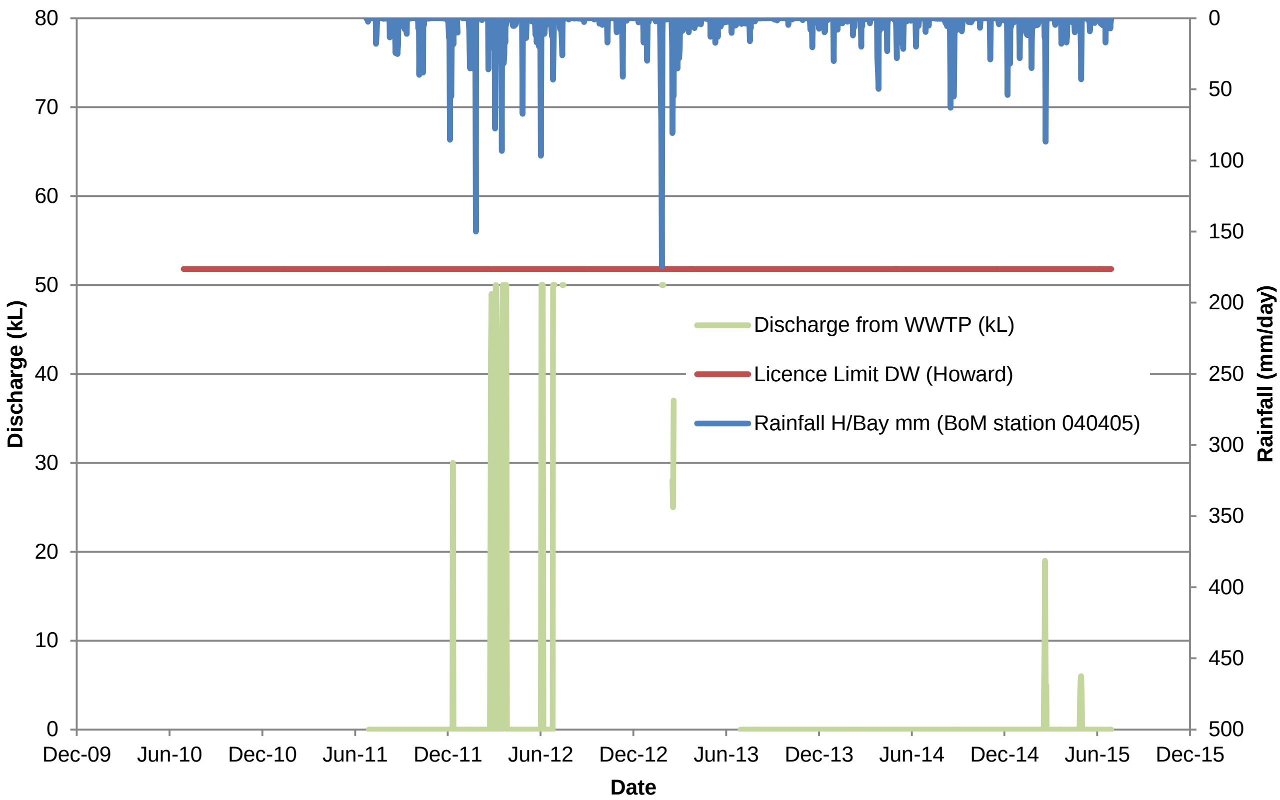


Figure 3-30: Howard WWTP Historical Discharge to Waters

3.4.8.2 Effluent Release to Land

Figure 3-32 depicts the effluent reuse at the Howard WWTP. The historical data spans from 2010 to 2015. It can be seen that the effluent reuse from this WWTP averages approximately 20kl/day.

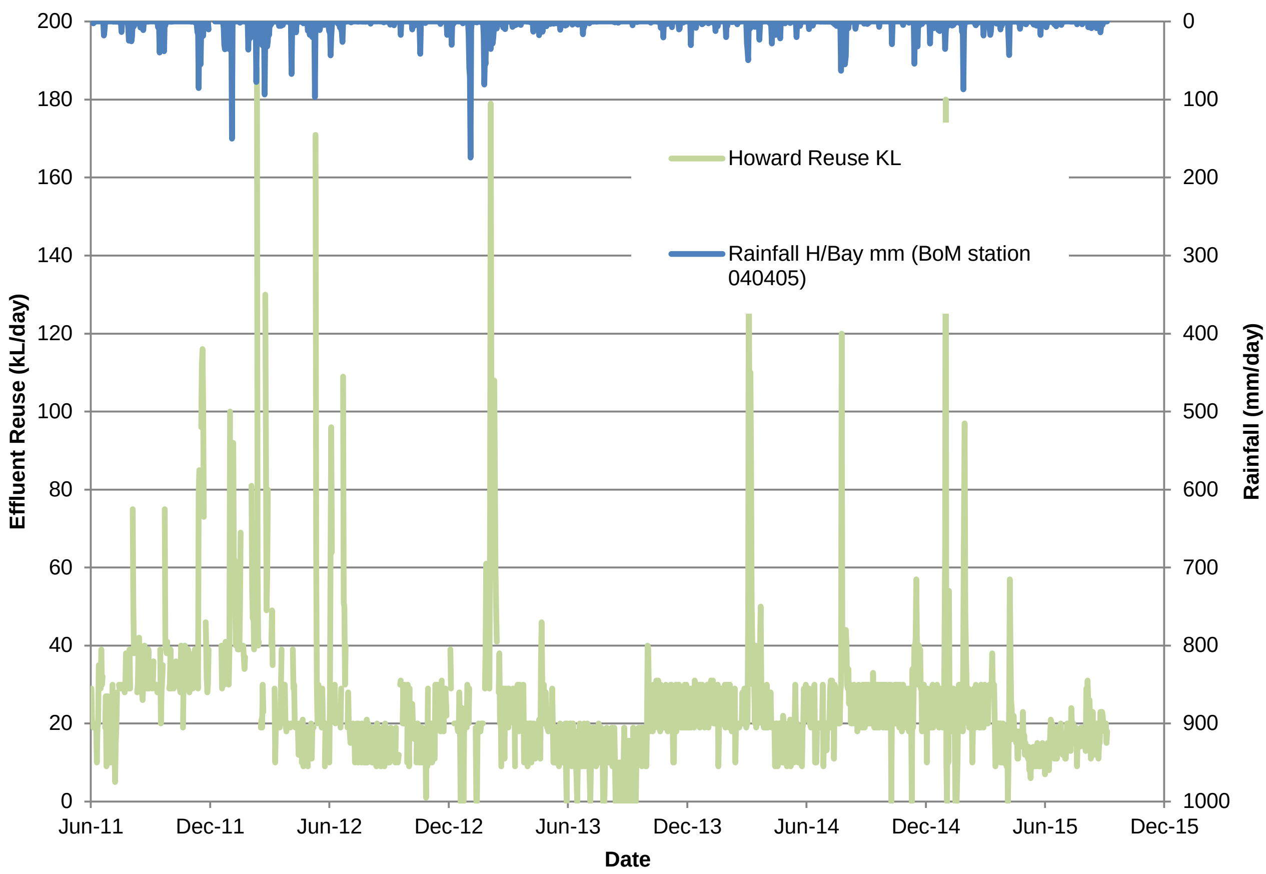


Figure 3-31: Howard WWTP Effluent Reuse

Release to land is required to meet certain quality criteria and limits that are defined in the environmental licence for this WWTP. Appendix 6A includes the minimum effluent quality for land release from this WWTP.

3.4.9 Torbanlea WWTP

Torbanlea WWTP is located at the corner of Burgowan Rd and Torbanlea Pialba Rd. It is situated on the outskirts of town but is adjacent to residential areas and a sporting facility and racecourse. The WWTP currently services approximately 138ED (62kL/day) and is at capacity. The extent of the Torbanlea WWTP catchment area is presented in Appendix 4A.

The Torbanlea WWTP is an Intermittently Decanted Extended Aeration (IDEA) package plant and was commissioned in 1994. The plant's design capacity is 62kL/d or approximately 138ED. It was designed with the provision for an upgrade to 100kL/day.

Influent enters the treatment process through the inlet works where screens are installed. Raw sewage is then treated in the aeration tank. The process involves intermittently aerating, settling and decanting the sewage. The decanted water is chlorinated stored in a 6.3ML lagoon for irrigation use of a 6Ha grassed area within the neighbouring Torbanlea Racecourse property.

The process also forms sludge in the aeration tank. This sludge is removed to a sludge tanks where it is allowed to thicken. The thickened sludge is then placed in a geofabric bag for dewatering. This dried sludge is periodically removed from the site. Removing sludge from the plant by tanker is an odorous process and is undertaken under favourable wind conditions and time of day as to minimise odour complaints.

Figure 3-33 shows the treatment process flow.

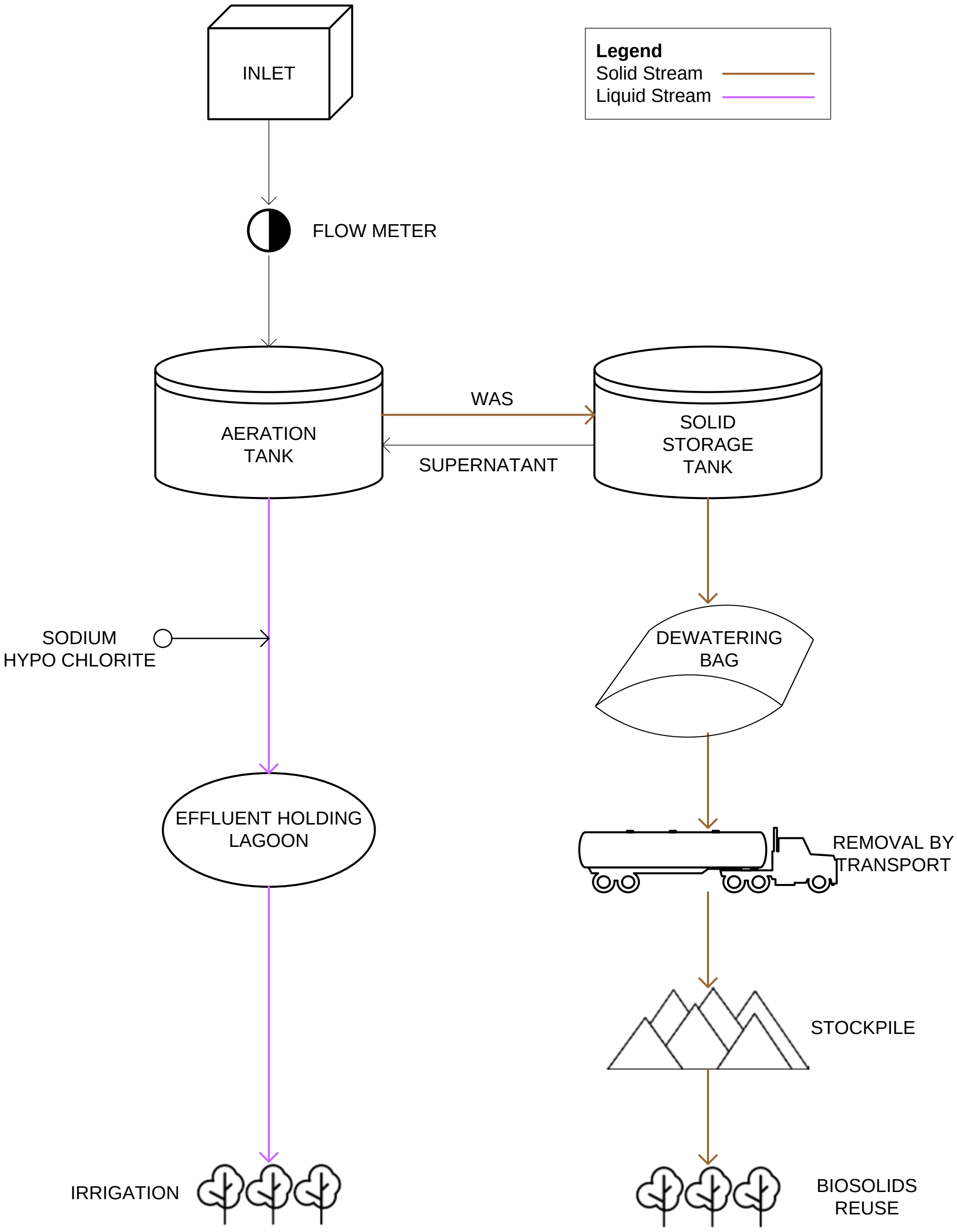


Figure 3-32: Torbanlea Process Flow Chart

Figure 3-34 represents the historical inflow to the Torbanlea WWTP and rain fall events for the period from November 2010 to March 2015. It can be seen that the inflows are responsive to rainfall events and generally shows a PWWF factor of 4.7 times ADWF, but has on occasion reached 7.8 times ADWF.

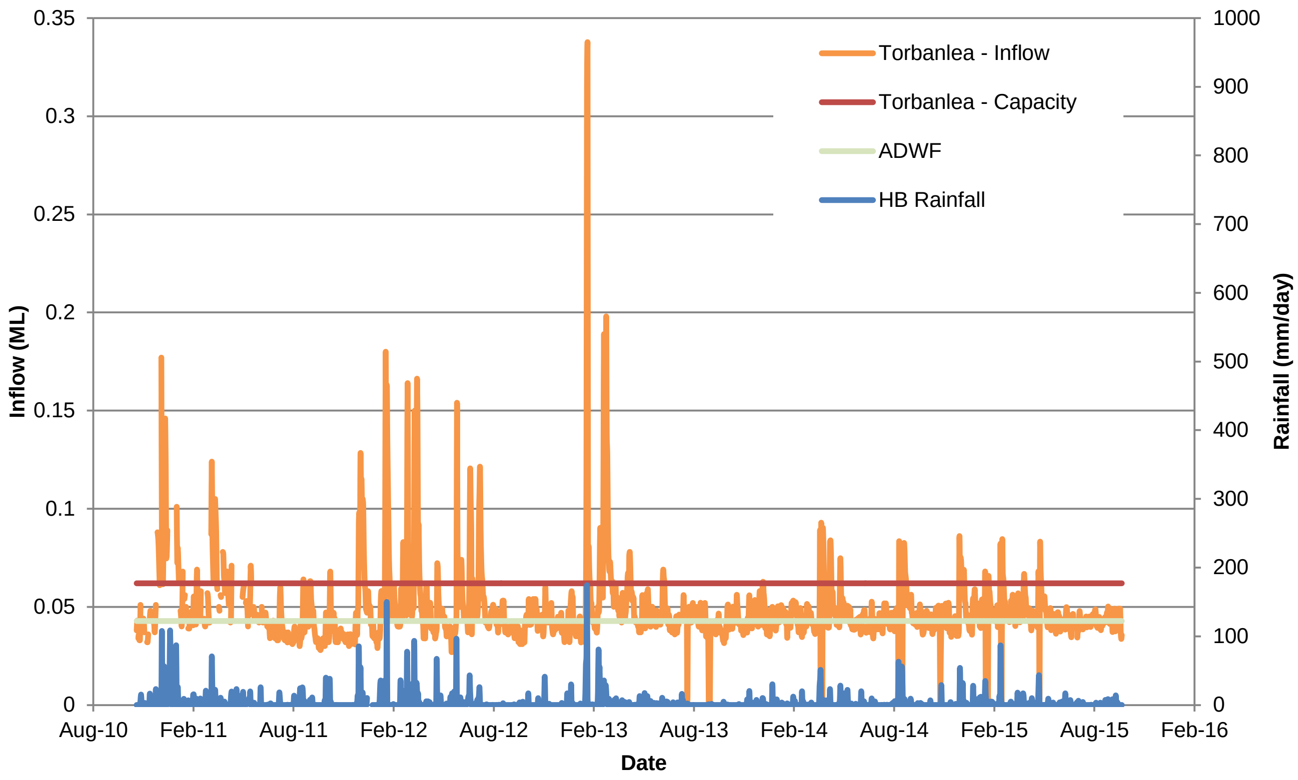


Figure 3-33: Torbanlea WWTP Historical Inflows, Capacity and Rainfall

3.4.9.1 Effluent Release to Waters

The licence does not allow for any discharge to waters from the Torbanlea WWTP. All discharges from this WWTP are to land for irrigation purposes.

3.4.9.2 Effluent Release to Land

Effluent reuse data was not available for this WWTP however it is understood that this plant achieves 100% reuse between irrigation and evaporation. The effluent quality parameters required under the licence are included in Appendix 6A.

3.4.10 Odours

On occasion WBWC receives complaints regarding odours emanating from WWTP's. The complaints may be due to plant upset conditions or if the wind direction is unfavourable or if there is odour producing works occurring at the WWTP.

A summary of the number of odour related complaints in each WWTP catchment is shown in Table 3-3.

Table 3-10: Number of Odour Complaints by WWTP Catchment 9/8/13 to 28/10/15

WWTP	No. Complaints
Aubinville WWTP	14
Burrum Heads WWTP	2
Eli Creek WWTP	67
Nikenbah WWTP	1
Pulgul Creek WWTP	17
Toogoom WWTP	1
Torbanlea WWTP	1
Total	**103**

WBWC employs the use of buffer zones to manage odour and minimise the impact to surrounding areas and sensitive receptors.

3.4.10.1 WWTP Buffer Zones

Delays in transferring sewage to treatment plants can cause the sewage to become septic and release odorous gases. Typically the release of gases occurs where sewage is aged because

– sewage is transferred a long distance

– sewage is detained for extended periods of time in pump stations

– sewage is detained for extended periods of time in rising mains

– sewage quality contains high sulphide content which is easily converted to odorous gases such as H2S through biological and chemical reactions. This is particularly relevant where there may be sea water intrusion into the sewer system.

In 2012 WBWC reviewed the sewerage buffer distances at all its WWTP's in the Fraser Coast. The assessment was, in part, based on;

– the Victorian EPA "Recommended Buffer Distances for Industrial Residual Air Emissions" produced in 1990

– The Ecoaccess "Guideline – Odour Impact Assessment from Developments" produced by the Queensland Government in 2004 which refers back to the Victorian guidelines and

– Air emission modelling work carried out at all the major wastewater treatment plants with the exception of the Nikenbah WWTP.

The Victorian Guidelines provide guidance on buffer distances based on the size of the plant as reproduced in Table 3-4.

Table 3-11: Buffer distances recommended by EPA Victoria 1990 guidelines

EP/ED		Buffer distances (m)			
EP		<1000	<5000	<20000	<50000
ED	2.4	<415	<2083	<8333	<20833
Mechanical Biological wastewater plants		**100**	**200**	**300**	**400**

Reproduced from EPA Victoria, 1990, "Recommended Buffer Distances for Industrial Residual Air Emissions"

Table 3-4 is used where no location specific modelling data is available. Where emission modelling was undertaken, the results and recommendations from the odour modelling assessment were used to derive a suitable buffer distance measured from the WWTP.

It was generally found that the odour studies coincided with the Victorian EPA guidelines reasonably well.

In a small number of cases where WBWC own the land surrounding the WWTP, the buffer was extended to incorporate the property boundary.

The adopted WWTP Odour buffer zones are included in Appendix 6B.

4. EXISTING REUSE SCHEMES

Effluent and biosolids are two by products of the wastewater treatment process. Both are valuable resources because they contain high nutrient levels. This makes them especially valuable to farmers and irrigators to enhance soils and improved crop yield.

The properties that make them valuable to farmers also makes them a hazard to the environment. High nutrient loading in waterways can lead to outbreaks of blue green algae. Other quality issues in effluent such as dissolved oxygen and suspended solids can also impact on the health of receiving waters. For this reason there are very strict environmental conditions on the use of effluent and biosolids.

WBWC's current strategy is to reuse 90% of effluent during ADWF across most of its reuse schemes. In the cases where the WWTP does not have a suitable outfall for the disposal of effluent the requirement is higher at 100% reuse. The locations where 100% effluent reuse is imposed under the WBWC licencing conditions are the Nikenbah, Burrum Heads and Torbanlea WWTP's. These targets are stipulated in the environmental licences for each of the WWTP's.

Effluent is used for various purposes including the irrigation of

– WBWC owned tree plantations,
– Golf courses,
– Sugar cane plantation,
– Turf,
– Sporting fields.

The largest user of Effluent in the Fraser Coast is WBWC where the effluent is used to irrigate tree plantations. Other effluent usage on the Fraser Coast is through the irrigation of cane, turf and the supply of effluent water to contractors through standpipes. To service these customers, WBWC has developed a number of effluent reuse schemes and associated pipeline networks to facilitate the transfer of effluent from WWTP to customers.

Biosolids are reused as a soil additive adding vital carbon and nutrients to the soil. Biosolids are mostly used on tree plantations and cane plantations where they are mixed with the existing soil. WBWC is currently the only user of biosolids, although at least one farmer in Maryborough has indicated an interest in using WBWC biosolids on his cane plantation.

4.1 Effluent Reuse

4.1.1.1 Irrigation Sites

WBWC owned property where tree plantations exist or other available effluent reuse sites totals 1404Ha in area.

Table 4-1: WBWC Owned Plantations

Scheme	Owner	Description	Total site area (Ha)	Irrigation Type	Irrigation area (Ha)	Estimated Irrigation Consumption (ML/Annum)	Estimated Usage (ML/annum)
Pulgul	WBWC	Dual Retic	5	Dual Retic	5	3	15
	WBWC	Pulgul Pasture	50	Plantation	50	5	250
	WBWC	Pulgul Plantation	390.4	Plantation	177	5	885
	WBWC	Bunya Plantation	152	Plantation	110	5	550
	WBWC	Sports Fields (Pulgul)	9	Sports Fields	9	3	27
	WBWC	Hebblewhite	120	Plantation	100	5	500
Eli/Nikenbah	WBWC	Vanderwolf	211	Plantation	65	5	325
Aubinville	WBWC	Aubinville Plantation	7	Plantation	7	5	35
	WBWC	Hebberman Plantation	267	Cane	195	1.7	332
Burrum Heads	WBWC	Dreamtime Cane	30.4	Cane	30.4	1.7	51
	WBWC	Dreamtime Plantation	175.4	Plantation	32	5	160
Toogoom	WBWC	Toogoom Plantation	17	Plantation	7	5	35
TOTAL			**1434.2**		**787**		**3165**

With the exception of the 4 Mile Plantation, the majority of the plantations are hardwood tree plantations grown for the purpose of resale.

There are also a number of privately owned irrigation sites.

Table 4-2: Privately Owned Irrigation Sites

Scheme	Owner	Description	Total site area (Ha)	Irrigation Type	Irrigation area (Ha)	Estimated Irrigation Consumption (ML/Annum)	Estimated Usage (ML/annum)
Eli/ Nikenbah	Private	Golf course	50	Golf Course	50	3.5	175
	Private	Cane Farms	536.8	Cane	536.8	1.7	912.56
Howard	Private	Golf course	16.7	Golf Course	16.7	3	50.1
Torbanlea	Private	Racecourse	11.9	Sports Fields	11.9	3	35.7
	Private	State School	1.5	Sports Fields	1.5	3	4.5
	Private	Active Riders Area (proposed)	1.6	Sports Fields	1.6	3	4.8
Pulgul	Private	Cane Farms	95.6	Cane	95.6	1.7	162.52
	Private	Turf Farm	60	Turf	58.1	3.5	203.35
Aubinville	Private	Cane Farms	509.5	Cane	509.5	1.7	866.15
TOTAL					**1281.7**		**2415**

The locations of the irrigation sites are shown in Figure 4-5, Figure 4-7, Figure 4-10 and Figure 4-13.

4.1.1.2 Irrigation Odour Buffers

In 2012 WBWC assessed the buffer zones surrounding all WWTP and WBWC owned irrigation sites. The report recommended the adoption of the Victorian EPA guidelines for odour buffer distances as summarised in Table 3-4.

The table recommends different odour buffers for different irrigation types.

- 200m buffer for spray irrigation and
- 50m for flood irrigation.

WBWC adopted 50m for all effluent storage dams and drip irrigation sites. Which make up the majority of the WBWC owned sites, although the recent acquisition of the Hebberman site is likely to be irrigated using central pivot irrigators and would be subject to the larger buffer zone.

The adopted buffer zones surrounding the existing WBWC plantation and effluent dams and lagoons are illustrated in Appendix 6B.

Table 4-3: Buffer distances recommended by EPA Victoria 1990 guidelines

EP/ED			Buffer distances (m)			
EP			<1000	<5000	<20000	<50000
ED		2.4	<415	<2083	<8333	<20833
Disposal Areas for secondary treated Effluent						
a)	by spray irrigation		**200**	**200**	**200**	**200**
b)	by flood irrigation		**50**	**50**	**50**	**50**

Reproduced from EPA Victoria, 1990, “Recommended Buffer Distances for Industrial Residual Air Emissions”

4.1.2 Effluent Reuse

The Fraser Coast reuses most of its effluent from its WWTP’s. The existing environmental licences for these treatment plants generally nominate between 90% and 100% of ADWF reuse requirements for effluent from the treatment plants. There is generally allowance for discharges to waterways (where available).

Monitoring of the irrigation system is facilitated through the IRRINET and IRRWISE monitoring systems.

There are six effluent reuse schemes in operation across the Fraser Coast. The schemes are;

- Hervey Bay Effluent Reuse Scheme which uses effluent from the three major WWTPs of Nikenbah, Eli Creek and Pulgul.
- Maryborough Effluent Reuse Scheme which uses effluent from the Aubinville WWTP.
- Burrum Heads Reuse Scheme which uses effluent from the Burrum Heads WWTP
- Toogoom Effluent Reuse Scheme which uses effluent from the Toogoom WWTP
- Howard Effluent Reuse Scheme which uses effluent from the Howard WWTP an
- Torbanlea Effluent Reuse Scheme which uses the effluent from the Torbanlea WWTP.

Over the last 21 years. WBWC has reused approximately 46,000ML of effluent through irrigation of WBWC owned plantations and third party irrigators (WBWC, 2015).

Figure 4-1 summarises the total annual effluent reuse from 1994 to 2015. Rainfall has a major impact on the amount of effluent reuse in any single year. The weather has a large impact on WBWC’s ability to meet licence requirements with regards to effluent reuse. On wet years it is unlikely that WBWC can meet its licence conditions as was demonstrated in 2010/11 where 44% was reused as a result of the elongated wet period.

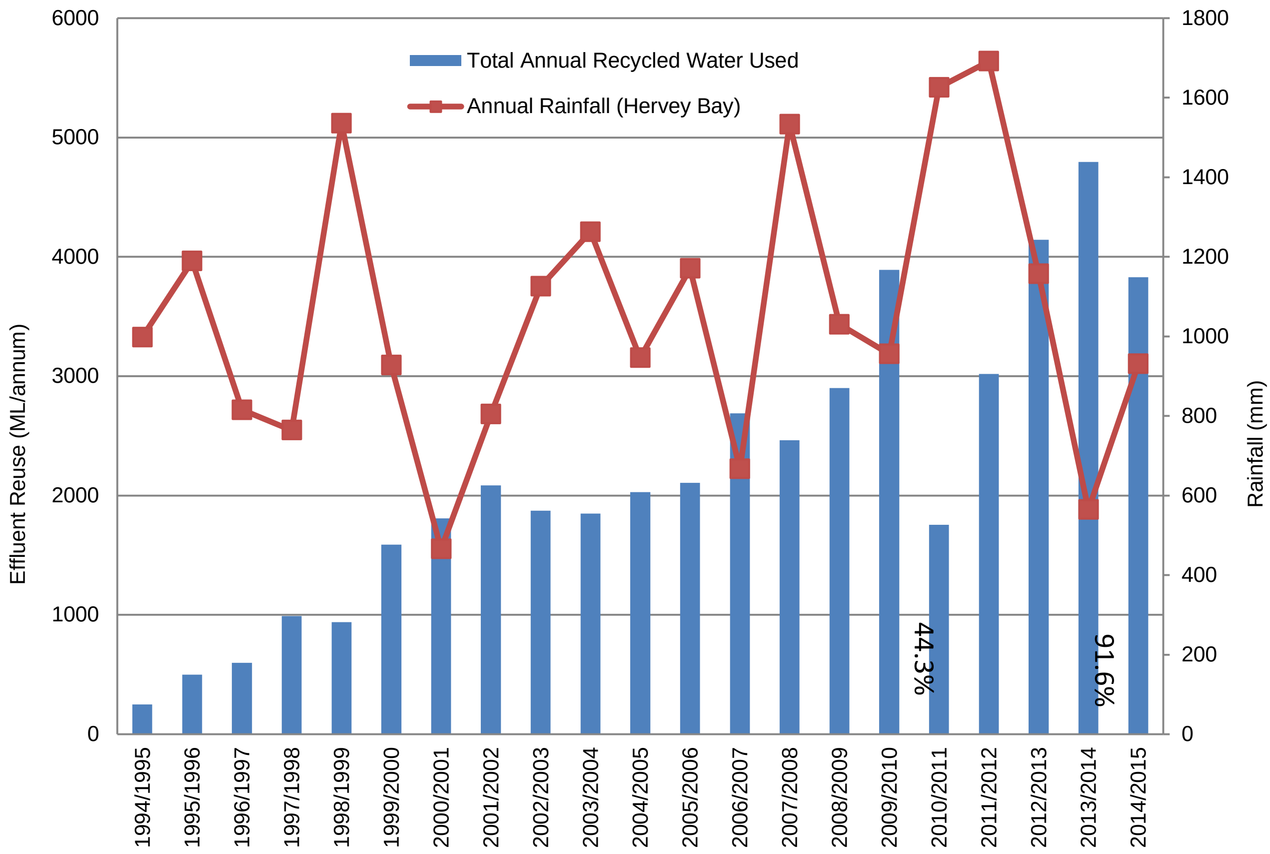


Figure 4-1: Historical Annual Effluent Reuse vs Rainfall

The Reuse Annual Report for 2015 reports that in 2014/15 92% reuse was achieved. A summary of the key figures is replicated in Table 4-4.

Table 4-4: Fraser Coast Effluent Reuse Statistics 2014/15

Treatment Plant	Inflow (Ml)	Annual ADWF (Ml)	Reuse (Ml)	Discharge (Ml)	%Reuse of ADWF
Aubinville	1611	975	733	857	75%
Pulgul	1215	1114	1215	0	109%
Nikenbah & Eli Creek	2074	1974	1801	126	91%
Burrum Heads	120	114	120	0	106%
Toogoom	88	86	39	42	46%
Torbanlea	17	15	13	0	84%
Howard	12	11	9	64	117%
TOTAL	5137	4289	3930	1089	91.6%

Source: WBWC Reuse Annual Report (2015)

4.1.3 Effluent Reuse Standards

The Water Supply (Safety and Reliability) Act 2008 provides the regulatory framework for using recycled water. The corresponding Public Health amendment Regulation includes details about water quality monitoring requirements for class A+, A, B, C and D recycled water.

4.1.4 Hervey Bay Effluent Reuse Scheme

The Hervey Bay Effluent Reuse Scheme consists of effluent from the Eli Creek, Nikenbah and Pulgul Creek WWTP's. Since the effluent systems from these WWTP's are interconnected it is appropriate to consider them as a single scheme although Pulgul is isolated from the Eli Creek and Nikenbah systems.

Effluent from the Pulgul Creek WWTP plant is transferred to the 600ML Pulgul effluent storage dam located on Pulgul farm (Booral Rd) through 3.2km, DN225 effluent main.

Effluent from the Pulgul effluent storage lagoon is used to irrigate the Pulgul farm and provides irrigation water to the dual reticulation system in Ellengowan Industrial and airport precinct.

Effluent from the wastewater treatment processes at both Nikenbah and Eli Creek WWTP's is stored in the 800ML effluent storage lagoon located adjacent to the Nikenbah WWTP. Effluent from the Eli Creek WWTP is transferred to Nikenbah Effluent storage lagoon through 7.5km of DN300 effluent main.

During the dry season (May to October) Nikenbah Effluent Storage lagoon is filled to 100% FSL for the upcoming irrigation season. When full, effluent is transferred to Pulgul, Bunya and Vanderwolf Effluent Storage Dams. During the irrigation season between November and April the storage will drop as the inflow is lower than the irrigation demand.

The scheme consists of pump stations at both Nikenbah and Pulgul. These pumps distribute the effluent to customers through 30km of distribution and reticulation mains.

The effluent reuse scheme and associated reuse irrigation areas are shown in Figure 4-5.

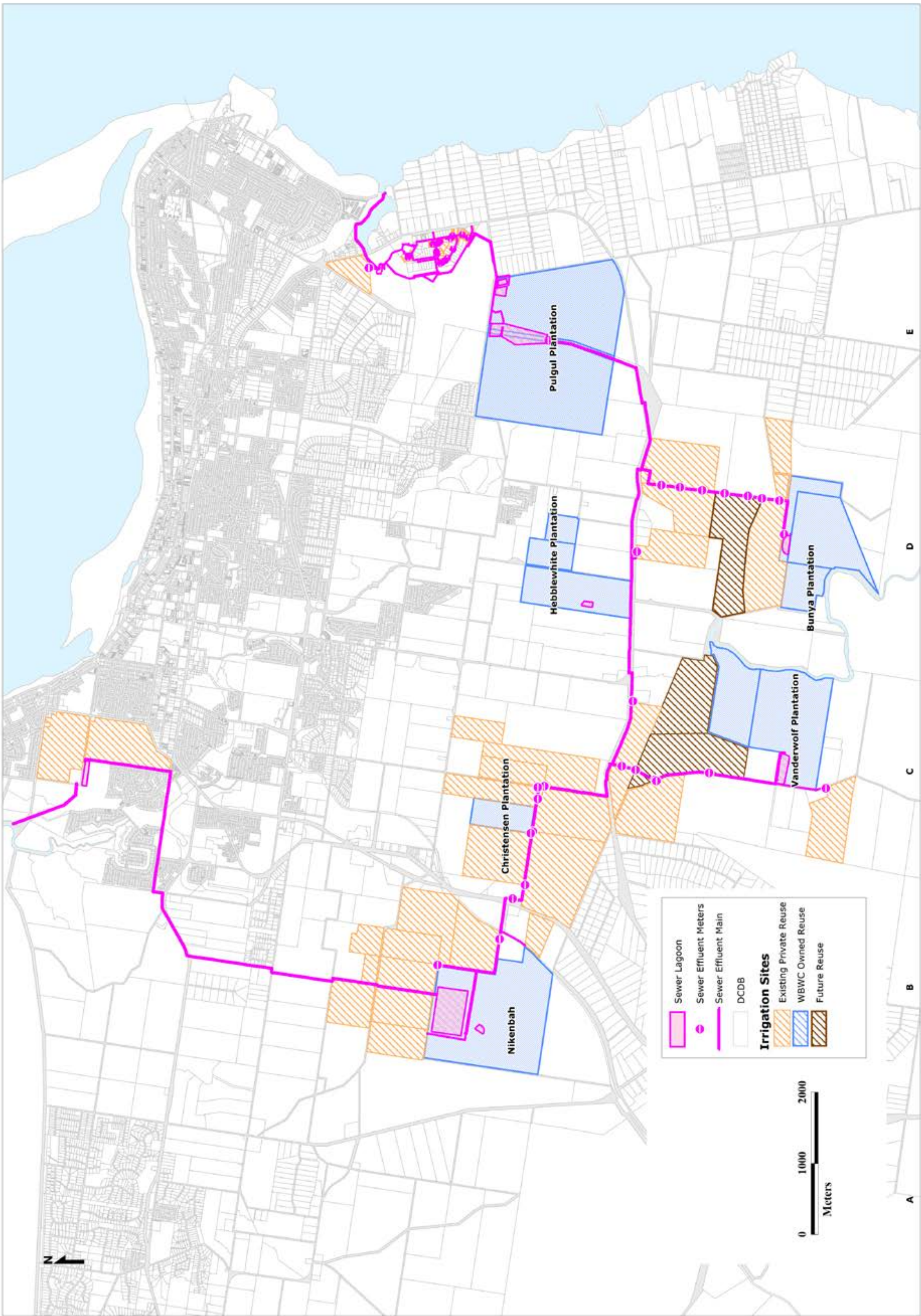
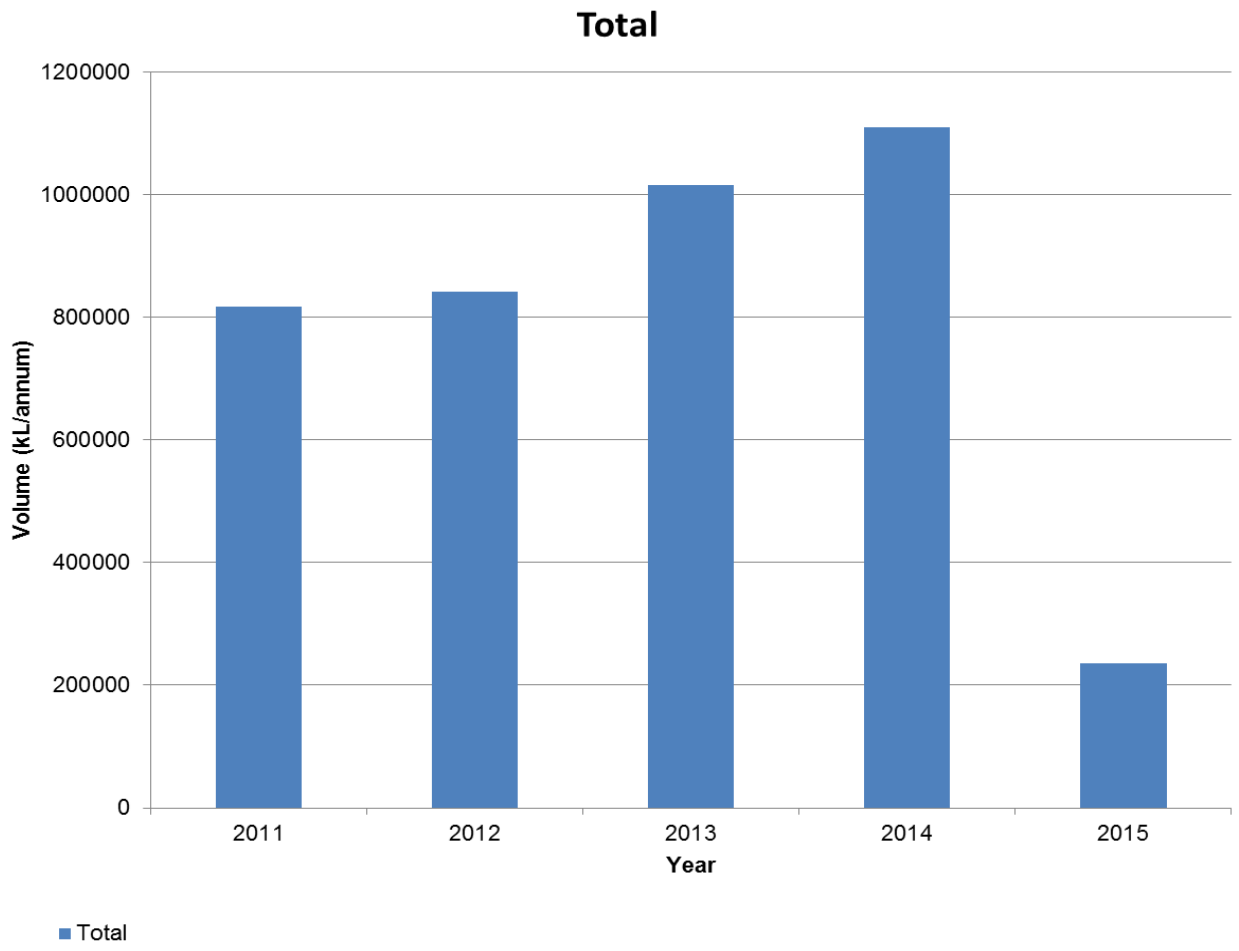


Figure 4-2: Hervey Bay Effluent Reuse Scheme

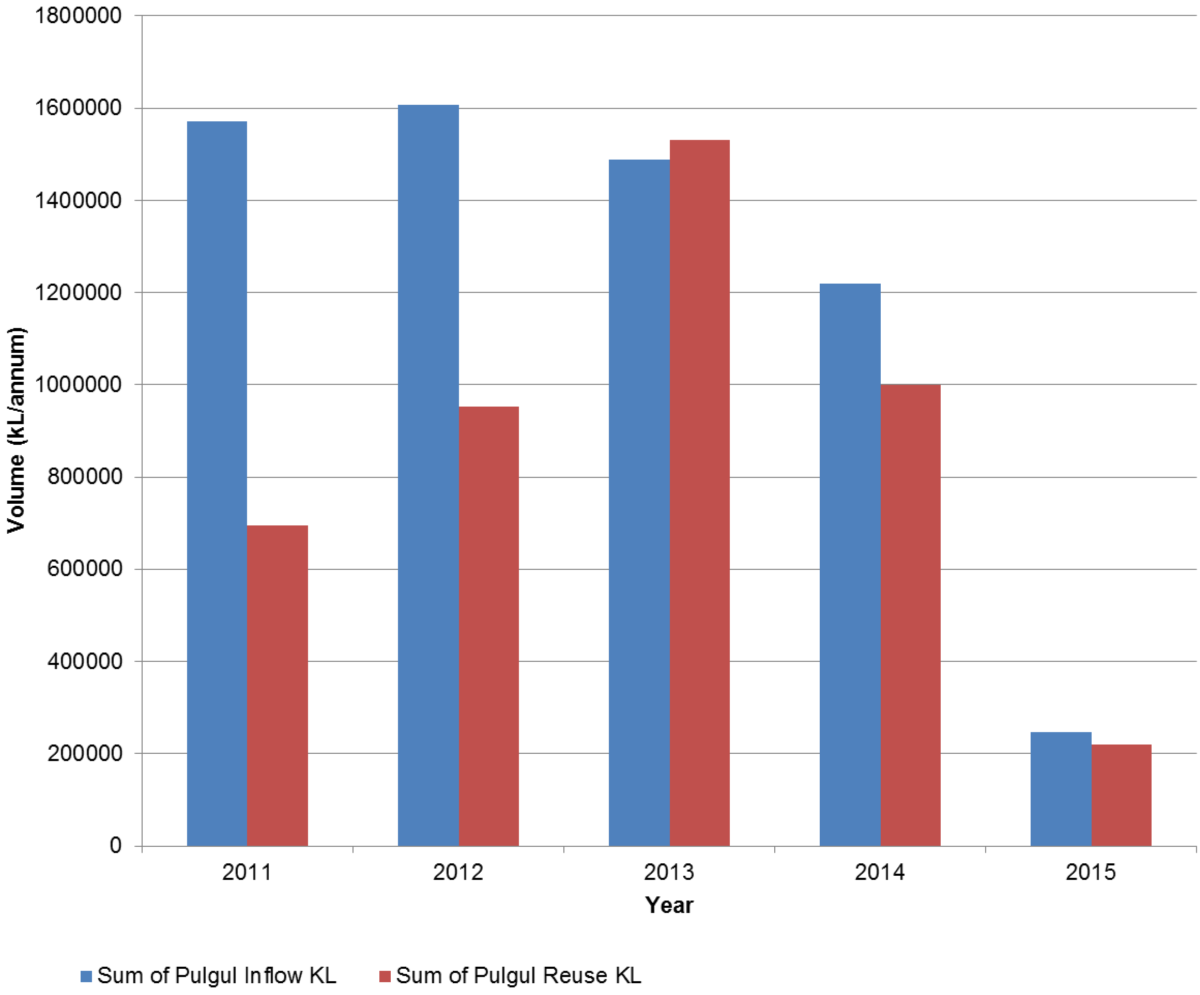
Figure 4-2 shows the inflow to the Nikenbah WWTP. No data was available for the effluent reuse from this treatment plant however it is understood that this treatment plant generally achieves 100% effluent reuse.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-3: Nikenbah Effluent Reuse Inflow Vs Reuse

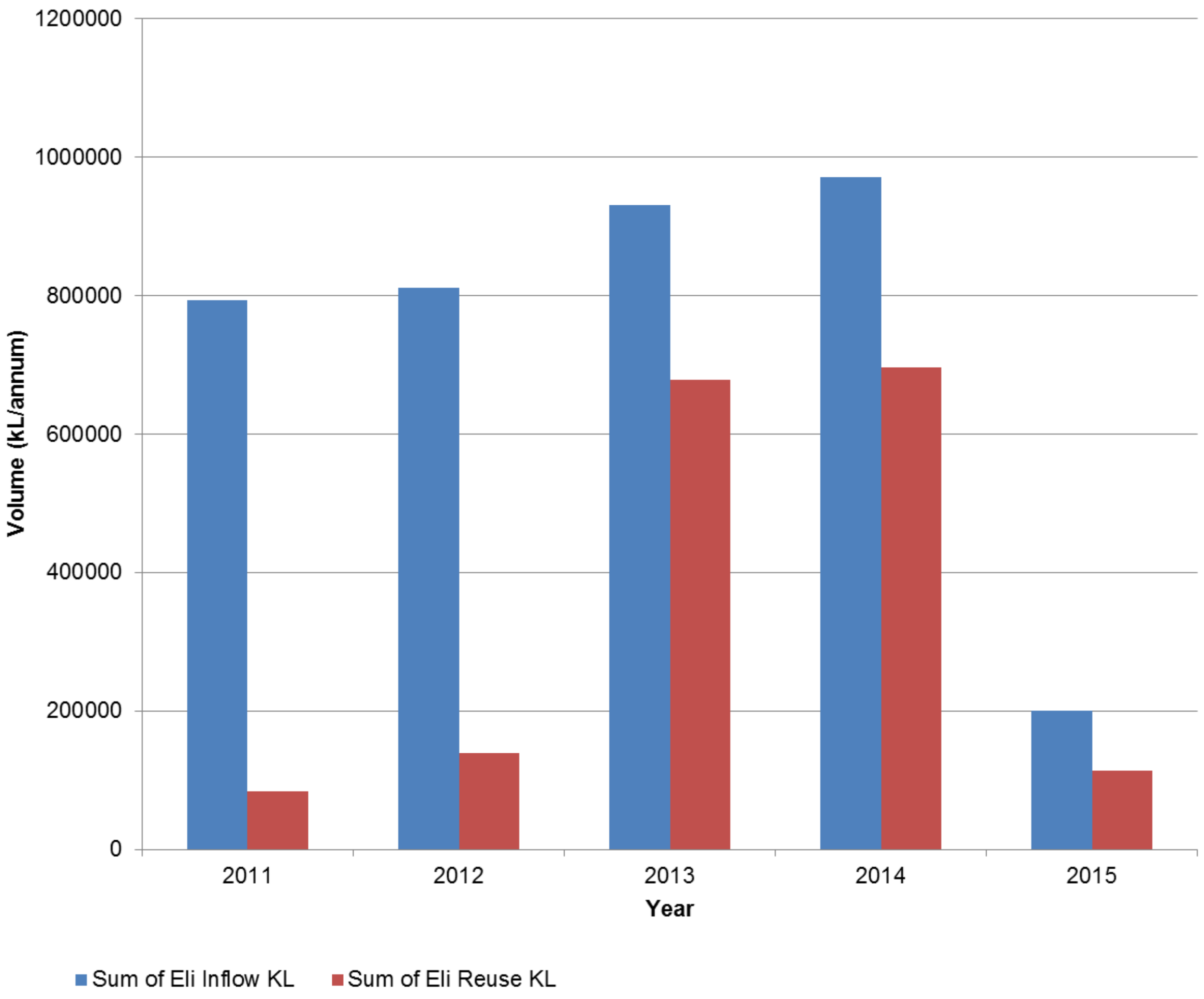
Effluent reuse from Pulgul is shown in Figure 4-3. It can be seen that in 2013 the reuse exceeded the inflows.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-4: Pulgul Effluent Reuse Inflow Vs Reuse

The effluent reuse from the Eli Creek WWTP is shown in Figure 4-4. During wet years in 2010/11 and 2011/12 it can be seen that the effluent usage was low in contrast to the figures in Pulgul over the same period.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-5: Eli Creek Effluent Reuse Inflow Vs Reuse

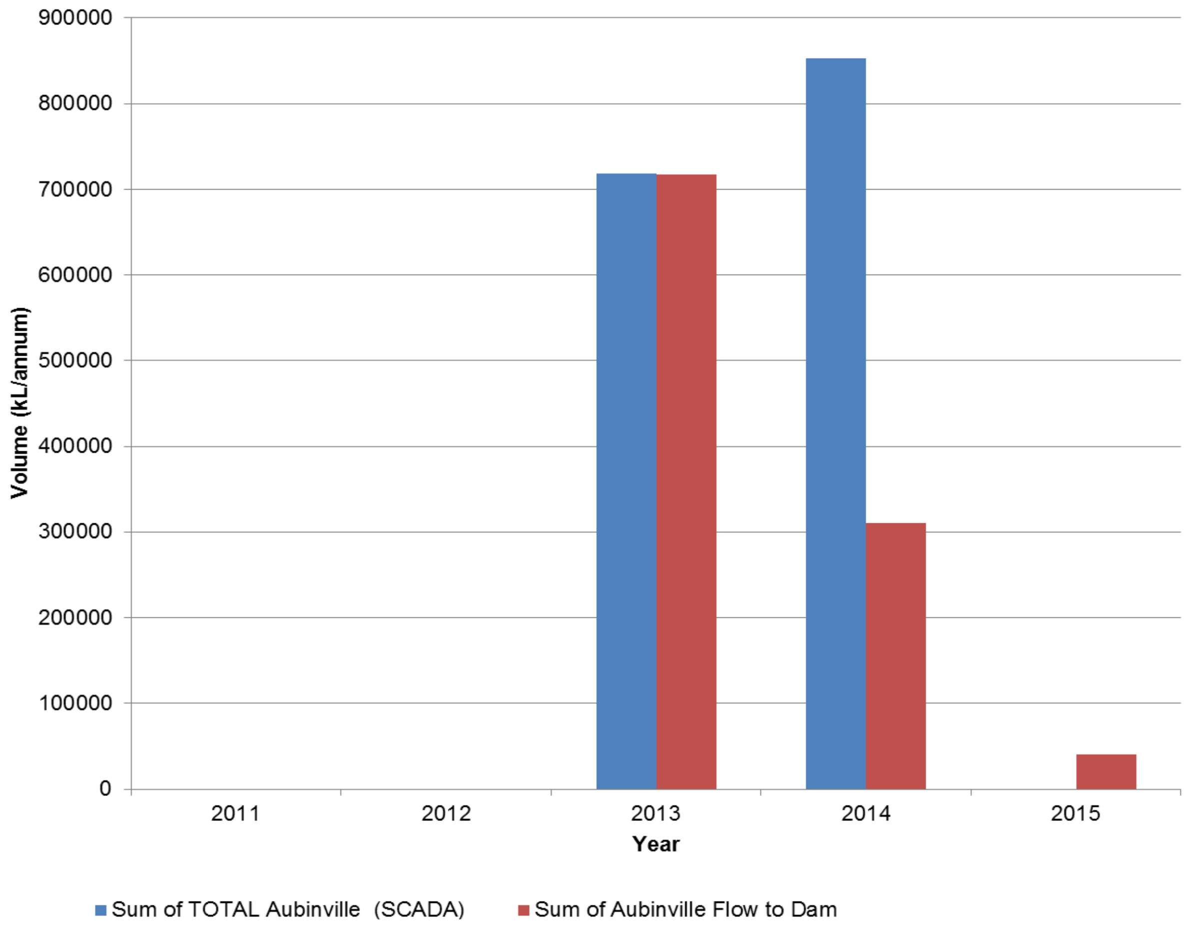
The discrepancy between the inflow and the is explained because the effluent reuse figures from the Hervey Bay golf course were not included in the reuse figures at this site. It is estimated that the usage at the golf course averages 20ML/month or 240ML/annum.

4.1.5 Aubinville

The Aubinville reuse scheme consists of 5.5km of rising main transferring effluent from the Aubinville WWTP to the 700ML effluent storage dam located on 1SP147568. From this location a pump station consisting of 1 pump is used to transfer effluent through 12.1km of effluent reticulation mains to customers on an on an “as demanded” basis. The effluent reuse scheme and associated reuse irrigation areas are shown in Figure 4-7.

Effluent reuse in this scheme has historically been used primarily for the irrigation of cane plantations by central pivot irrigators and travelling irrigators.

The Aubinville reuse scheme serves an irrigation area of 694ha with an effluent allocation of 4,220ML/annum. This area includes nine irrigated farms. The largest irrigation allocation was the Hebberman farm (with an allocation of 3,000ML/annum), however the Hebberman farm ceased farming cane and as a result effluent usage was also reduced. The recent acquisition of 4 Mile plantation by WBWC (from Hebberman) in 2013/14 has maintained maximum potential irrigation in the area. WBWC also irrigates an existing tree plantation located at the Aubinville WWTP. The size of the tree plantation is 7Ha.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-6: Aubinville Effluent Reuse Inflow vs Reuse

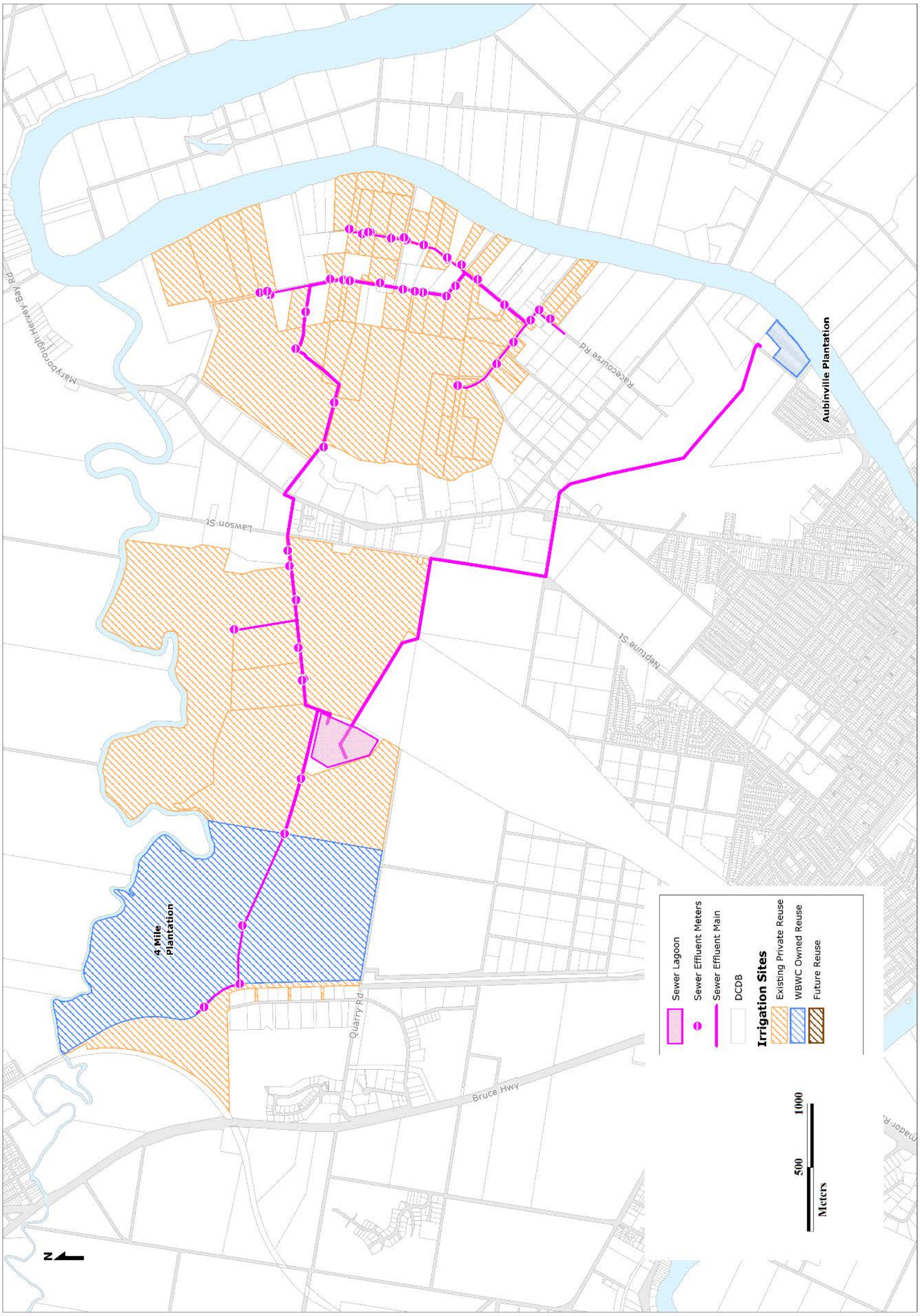


Figure 4-7: Maryborough Effluent Reuse Scheme

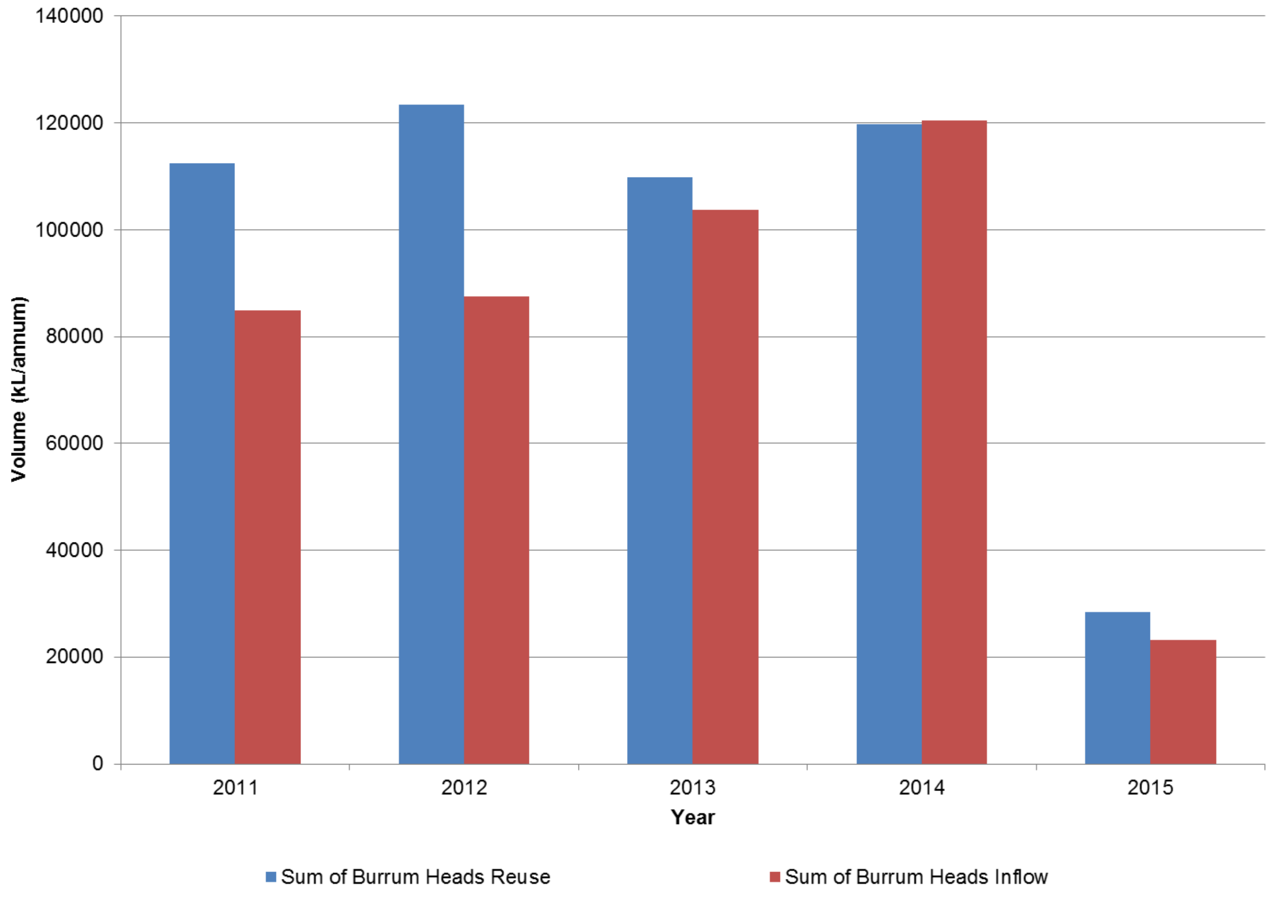
4.1.6 Burrum Heads

Prior to 2010, effluent from The Burrum Heads WWTP was disposed of through evaporation and exfiltration into the sandy ground underlying the polishing ponds at the Burrum Heads WWTP site. The purchase of a cane farm on Fisher Rd in 2009 and the subsequent installation of pipework and pump station in 2010, allowed 100% of effluent to be used for irrigation at this site. The scheme involves the transfer of effluent from The Burrum Heads WWTP to the plantation site on Fisher Rd. Irrigation consists of 175Ha of cane plantation with the potential for 80ha to be used for hardwood plantation.

Figure 4-10 shows the extent of the effluent reuse scheme. It includes 6.5km of effluent mains and a pump station and effluent storage lagoon located at the Burrum Heads WWTP site. There are two effluent storage lagoons. The primary lagoon is 4.14ML and the secondary lagoon is 12.3ML.

WBWC are currently the only users of effluent from this scheme.

Based on irrigation demand of 4.5ML/Ha/annum, then this site has the potential to dispose up to 788ML of effluent per annum. Figure 4-8 shows the inflow to the Burrum Heads WWTP vs the reuse. It can be seen that the inflow is less than the reuse. This is probably due to meter error but none the less it can be seen that the current annual effluent reuse is approximately 120ML/annum indicating that the Dreamtime plantation can dispose of effluent from the Burrum Heads WWTP well into the future.



Note that 2015 only contains 3 months of data at the time of graph production.

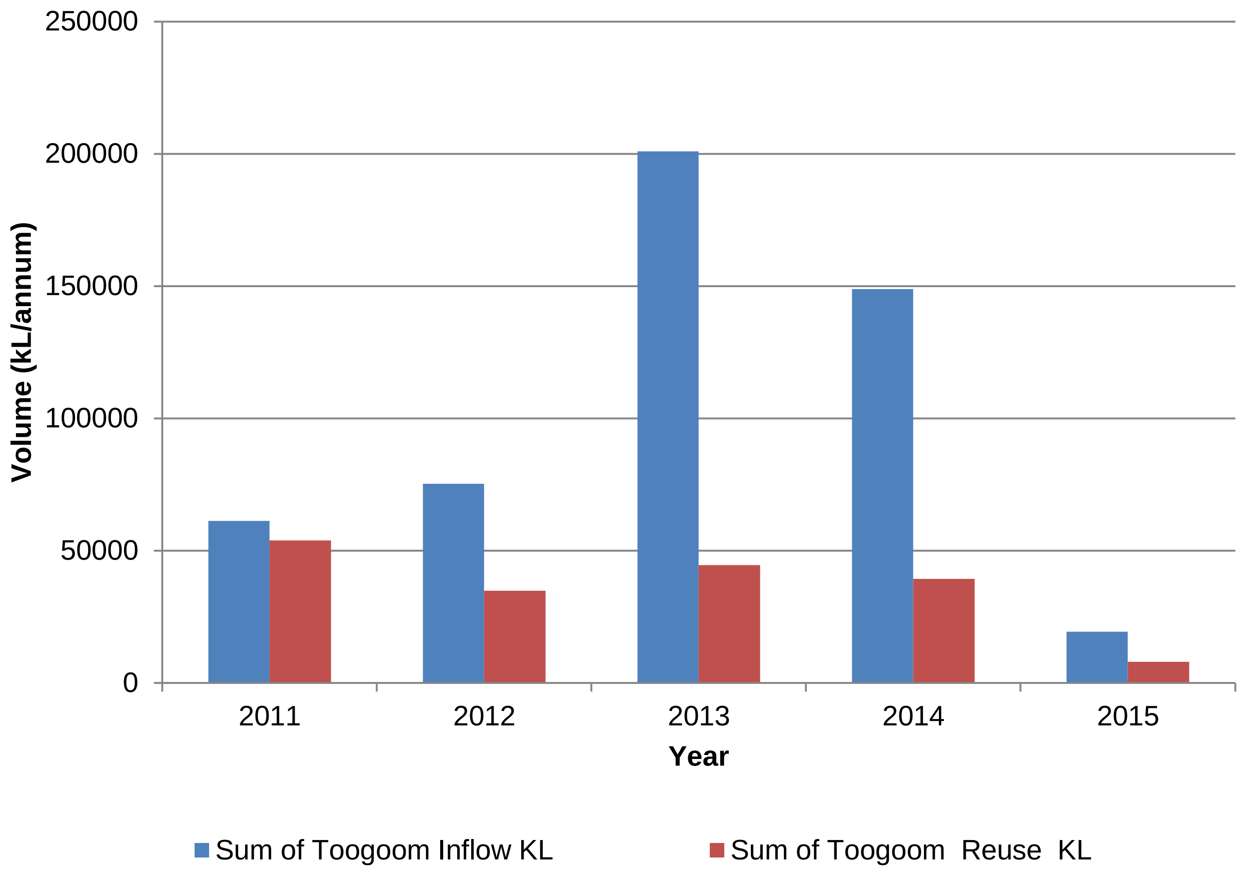
Figure 4-8: Burrum Heads Inflow Vs Reuse

4.1.7 Toogoom

Prior to 2010, effluent from the Toogoom WWTP was discharged directly into polishing ponds and exfiltrates into the ground water system. Since WBWC purchased the adjacent lot effluent has been used to irrigate an established tree plantation on this lot minimising effluent releases by exfiltration at the effluent storage dam.

The scheme is comprised of 545m of effluent mains, and a pump station and effluent storage dam located on the Toogoom WWTP site. There are two effluent storage lagoons sized 1.9ML (primary lagoon) and 3.6ML (secondary lagoon). Figure 4-10 shows the extent of the effluent reuse scheme in Toogoom. WBWC are currently the only user of effluent from the Toogoom Scheme.

The current irrigation area is approximately 7ha. Although the site is approximately 17.1ha the additional land is a creek and its immediate catchment. Therefore there is no opportunity to expand the irrigation scheme at this location and any future irrigation land required will need to be sourced elsewhere. Figure 4-9 shows the sewage inflow to Toogoom WWTP and the effluent reuse from this treatment plant. It can be seen that the current level of reuse is approximately 40ML/annum which is in line with the current level of irrigation available.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-9: Toogoom WWTP Inflow Vs Reuse

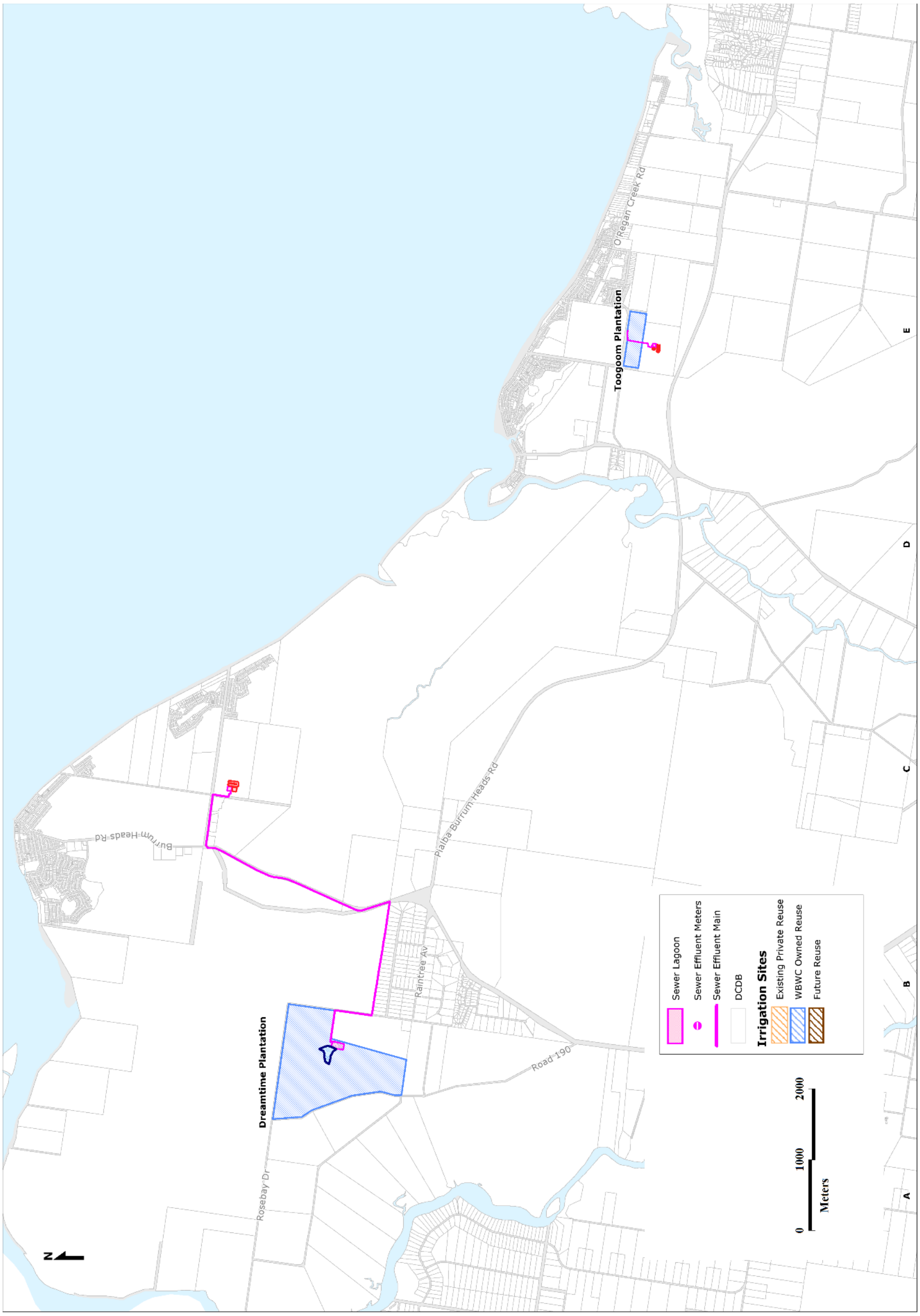


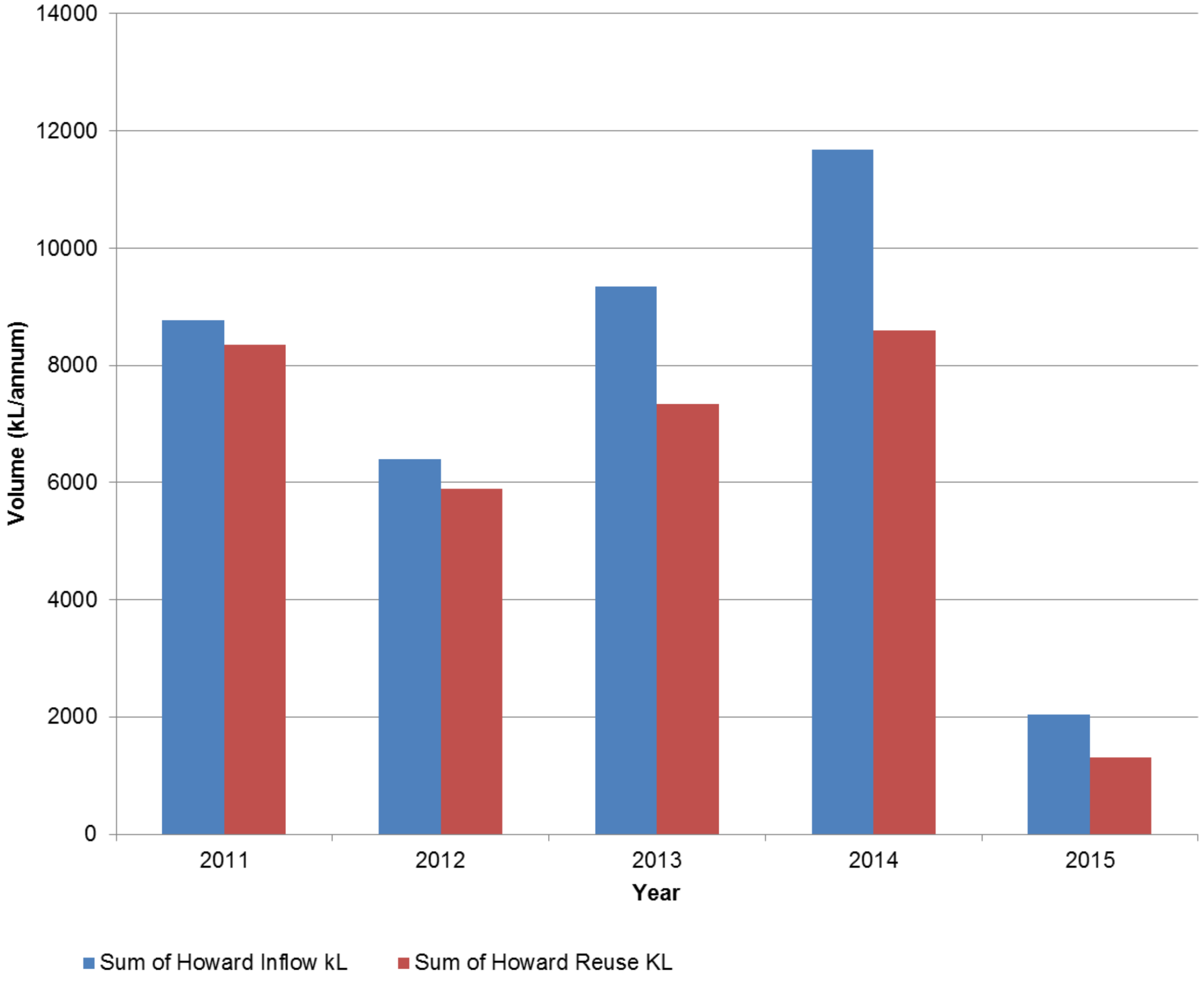
Figure 4-10: Burrum Heads and Toogoom Effluent Reuse Scheme

4.1.8 Howard

The Howard effluent scheme consists of a pump at the Howard WWTP which transfers effluent to the Burrum District Golf Course effluent lagoon. The capacity of the system is approximately 24kl/day. The effluent reuse system is shown in Figure 4-13.

At present the Howard treated effluent is used for the irrigation of the Burrum District Golf Course, with 100% reuse. There are no plans to extend the sewerage area in Howard in the foreseeable future, however a report has been completed in 2015 outlining the costs of providing sewerage to Howard. The report also includes options for disposal of effluent if the township is provided with sewerage.

Figure 4-11 shows the Howard WWTP inflow and effluent reuse. It can be seen that the majority of the inflow is reused. The differences between the inflow and effluent reuse are due to discharges during wet weather events.



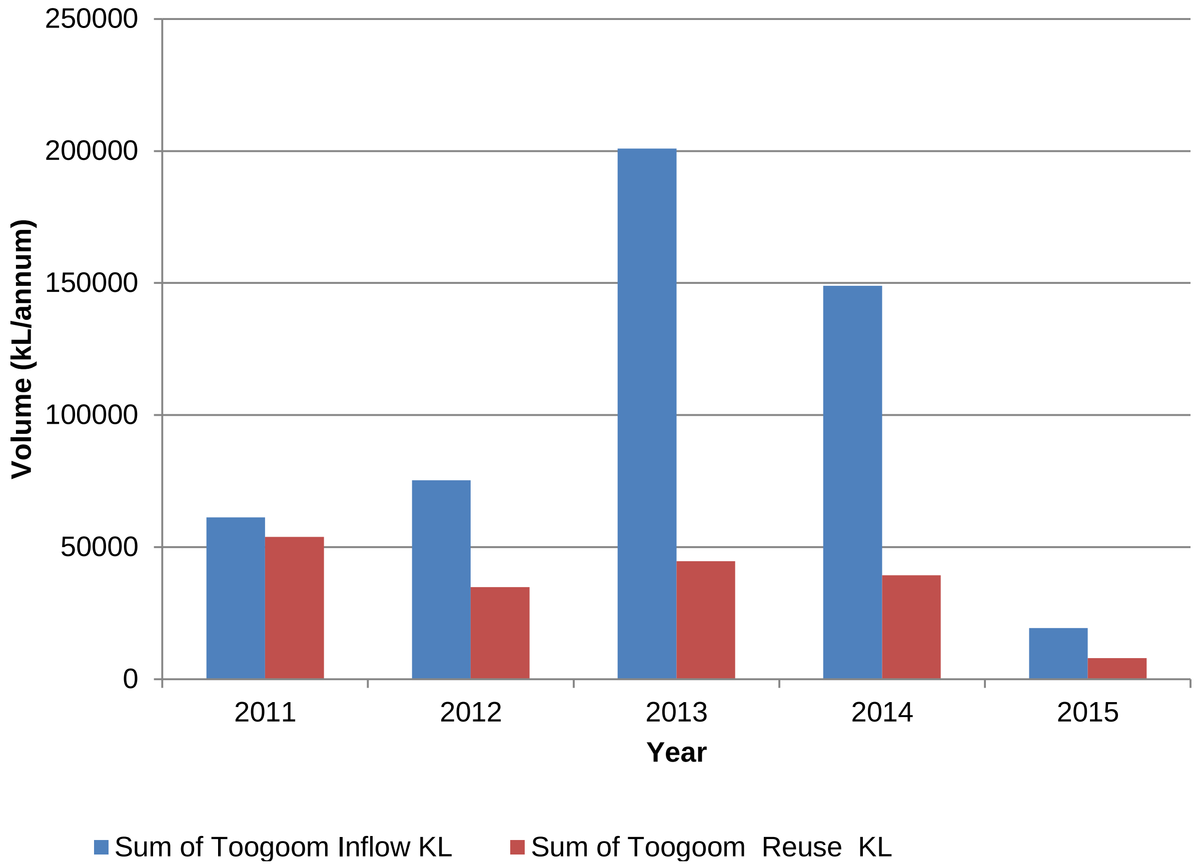
Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-11: Howard WWTP Inflow vs Reuse

4.1.9 Torbanlea

Treated effluent from the Torbanlea WWTP is used for irrigation of the local racecourse and nearby school. The scheme is quite small and localised. The irrigation network is made up of 2.2km of pipework, 1 pump station and a small effluent lagoon (7.92ML). Figure 4-13 shows the extent of the reuse scheme.

The WWTP inflows and the effluent reuse figures have been plotted for the period between 2011 and 2015 and are shown in Figure 4-12. There is no discharge to waters at this site and therefore reuse must be 100% indicating that there are discrepancies in the data.



Note that 2015 only contains 3 months of data at the time of graph production.

Figure 4-12: Torbanlea WWTP Inflow Vs Reuse

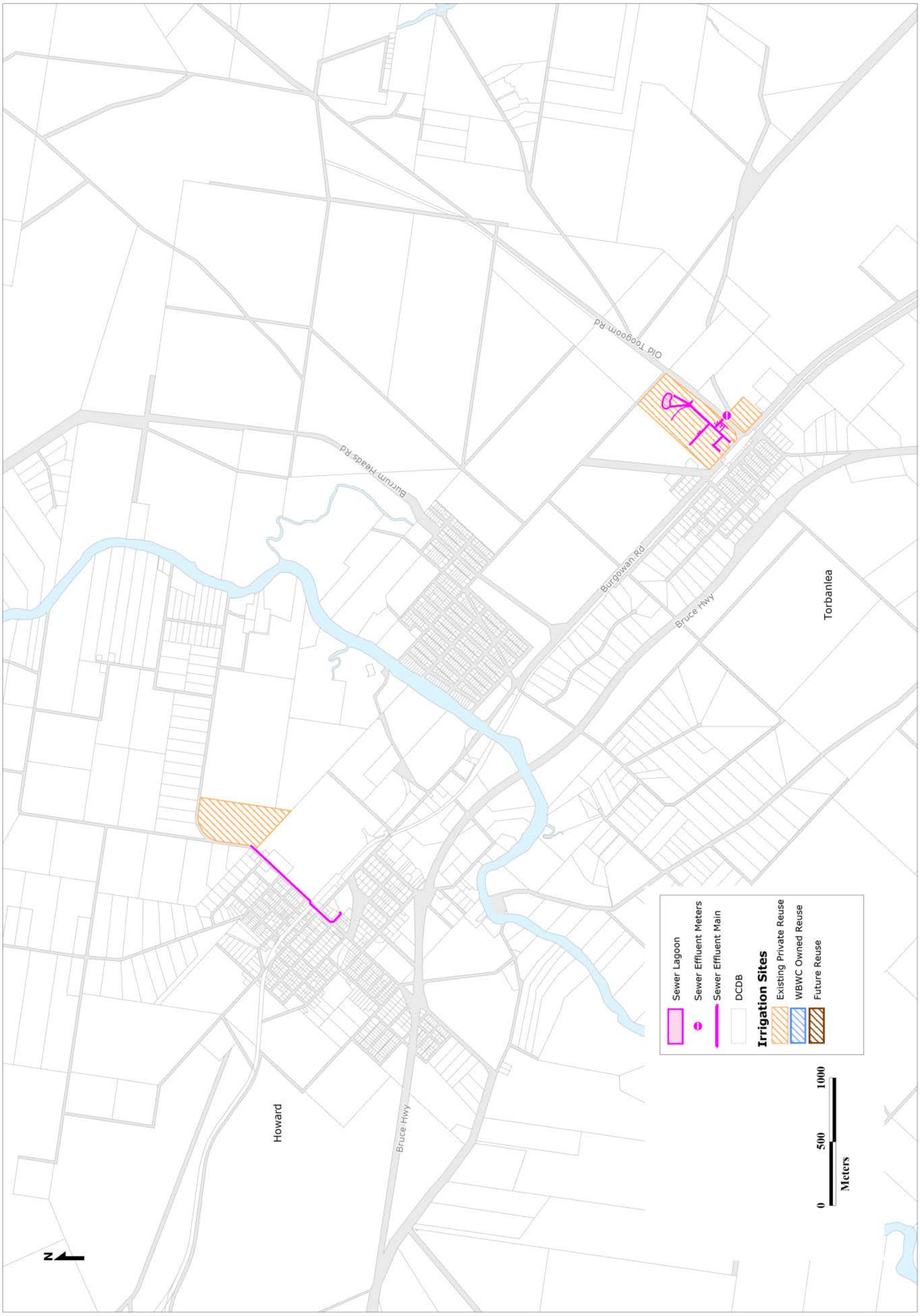


Figure 4-13: Howard and Torbanlea Effluent Reuse Scheme

4.2 Biosolids Reuse

Biosolids are also reused on the Fraser coast. To date most of biosolids produced are stockpiled for stabilisation and reused as a soil conditioner and fertiliser for WBWC tree plantations. A small amount is used to fertilise cane plantations in Maryborough but the availability of sufficient volumes of biosolids to meet demand has limited the widespread use on cane plantations and other food crop industries.

Historically the removal of biosolids was handled by an external contractor who held the licence to sample biosolids; transport biosolids from WWTP's, spread and incorporate the biosolids into the ground. To undertake this task twice a year the total cost of the operation was on average in excess of $243,000 for Hervey Bay. Limitations were placed on this arrangement such as wet weather conditions, schedules and availability for the company to undertake the process when WBWC required it. Maryborough's biosolids were disposed of to landfill with an average annual cost of $230,000.

In August 2014, WBWC obtained approval to take over this activity in its entirety. A local Contractor has been engaged, following a tender process, to transport the biosolids from the WWTP's to appropriate licensed beneficial reuse sites. WBWC staff collect samples of the biosolids and soil samples of the receiving sites with the same being sent to a NATA Accredited Laboratory for analysis. Upon receiving the results of the analyses an appropriate spreading rate is determined.

During 2014/15 biosolids were removed from the Eli Creek, Pulgul Creek and Nikenbah WWTP's twice, in September/October 2014 and March 2015.

The table below indicated the quantities:

Table 4-5: Volume of Biosolids Removed from Fraser Coast WWTP's

Site	Biosolids Quantity (m^3)
Eli Creek WWTP	720
Pulgul Creek WWTP	1,946
Nikenbah WWTP	2,232
Aubinville WWTP	1,800
Total (m^3)	**6,705**

It is expected that as processes are refined, future biosolids spread will see further financial savings as processes become more efficient with better management of the biosolids pads to reduce water ponding.

4.2.1 Biosolids Reuse Standards

Biosolids are classed using two classifications.

- Contamination Grade
- Stabilisation Grade

The contamination grade is a measure of the contaminant concentrations in the biosolids. contaminants include such things as heavy metal concentrations, DDT levels and others as outlined in Table 3.1 of "Use and Disposal of Biosolids Products" (NSWEPA, 2000)

The stabilisation grade is a measure of the pathogenic activity, odour reduction and vector attraction. Grade A stabilisation requires that biosolids undertake thermal treatment to "kill off" any pathogens. No odour or vector would be evident in so classed biosolids. Grade B stabilisation is generally achievable through stockpiling and aerating biosolids for a 6 month period of time.

The use of biosolids as either unrestricted use or restricted use can only be determined if both the contaminant and stabilisation grades are determined. Sampling and testing occurs before reuse of biosolids to ensure that the biosolids meet the required stability and contamination grades.

4.2.2 Hervey Bay

Biosolids are stored at the Pulgul, Eli Creek and Nikenbah WWTP until they have achieved stabilisation grade. After a period of six months the biosolids are tested to ensure that contamination grade is achieved and a contractor transports the biosolids from the WWTP directly to the reuse site. This may be at any of the approved reuse sites. Generally the transportation costs are quite high so the reuse site is generally close to the location of the treatment plant.

Approximately 6,705m^3 of biosolids was produced in 2014/15 from these treatment plants and beneficially reused on WBWC owned plantations as a soil conditioner.

4.2.3 Aubinville

Biosolids from the Aubinville WWTP are dewatered on site using a centrifuge and stockpiled on site until sufficient solids are available for transportation by road. Up until recently the biosolids were disposed of to the land fill site at Maryborough and then at the Granville land fill site. The Fraser Coast Regional Council advised WBWC in 2012 that biosolids would no longer be accepted at their landfill sites and that alternative disposal strategy must be found. A new biosolids storage area is currently being designed and constructed at the 700ML effluent dam site at St Helens. This location is ideally suited to cane farmers who wish to use biosolids as a soil conditioner to improve the productivity of the farms. Until the time that the biosolids storage area is complete, biosolids are transported to the Nikenbah WWTP for stockpiling.

There is currently approximately 465dry tonnes of biosolids produced at Aubinville WWTP on an annual basis (GHD, 2011). The actual biosolids figures for 2014/15 were 632m^3 transported to Nikenbah and 1,175m^3 transported to the 4 Mile plantation in Maryborough.

4.2.4 Toogoom

Waste sludge is dewatered using geofabric bags at this site. Periodically the biosolids are removed from this site and transported to Nikenbah for storage or reused at Dreamtime plantation site.

4.2.5 Burrum Heads

Sludge waste from this plant is taken to Eli Creek sludge lagoon and subsequently dewatered.

4.2.6 Howard

Biosolids are not reused from this site. The waste sludge produced from the treatment process is transported to the Bathurst Box at the Pulgul Creek WWTP.

4.2.7 Torbanlea

Sludge is removed by tanker to the Pulgul Creek WWTP Bathurst box where it is treated dewatered and stockpiled for reuse at any of the approved reuse sites.

5. POPULATION PROJECTIONS AND SEWER DEMAND

An Equivalent Dwelling (ED) model has been used to date as the basis for infrastructure planning in Fraser Coast. An ED is defined as the measure to quantify the sewage load generated by a single residential dwelling (typically a 3 bedroom dwelling is considered 1ED).

Each property within the proposed sewered areas was assigned an ED load for the following planning horizons:

- 2016
- 2021
- 2026
- 2031
- 2036

Note that the planning horizons were adopted to align with the Hervey Bay Population Model which formed the basis of demand forecasts in PSP4 and which was benchmarked against the most recent Census data in 2011.

5.1 Demand Types

For modelling purposes demand types have been simplified into two categories, residential and non-residential types;

- Residential demand typically encompasses all residential development including low, medium and high density residential development;
- Non-residential development typically includes commercial, industrial, educational, sporting, recreational and health related premises.

Many areas in the Fraser Coast have a mix of the two categories.

5.2 Potential Development Areas

The growth areas are largely dictated by developers and influenced by the Planning Scheme. The Planning Scheme indicates what development can occur within town areas through zoning plans. It further explores future development areas through the establishment of Land Use Structure Plans.

Within the next 20 years the Planning Scheme for Hervey Bay provides for the foreshore of Urangan, Pialba, Scarness and Torquay to evolve into High and Medium Density development areas due to the proximity of facilities and beach access. Industrial areas in Pialba, Lower Mountain Road and the Airport Industrial Estate will also develop steadily to meet the increasing demand for services from residential growth and major commercial nodes are planned to develop at the Pialba precinct and Urangan.

The planning scheme for Maryborough allows for expansion of residential areas in Tinana and Granville, and some infill in Maryborough Central. Growth in non-residential development has been provided for in the North Maryborough area.

The planning scheme also makes allowance for growth in structure plan areas. The structure plan areas that have not already been mentioned are the Eli Waters Structure Plan Area (between Dundowran and Mariners Cove) and the Nikenbah Structure Plan Area (area south of the Kawungan ridgeline).

Detailed information on the planning scheme is available on the Fraser Coast Regional Council website but the major development areas are briefly described in the following pages.

More detailed plans of each area can be found in Appendix 3.

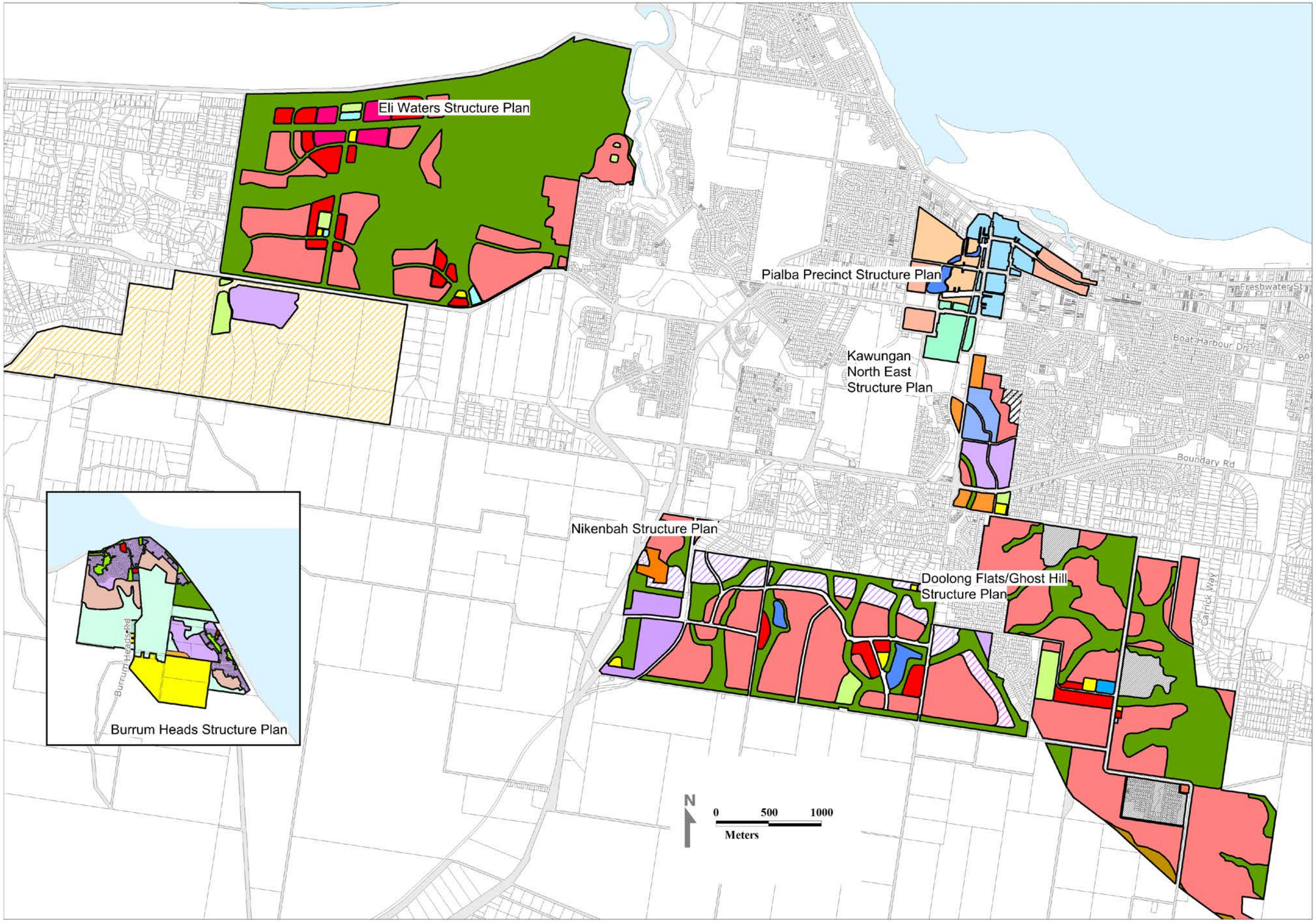


Figure 5-1: Hervey Bay Development Plan Overview

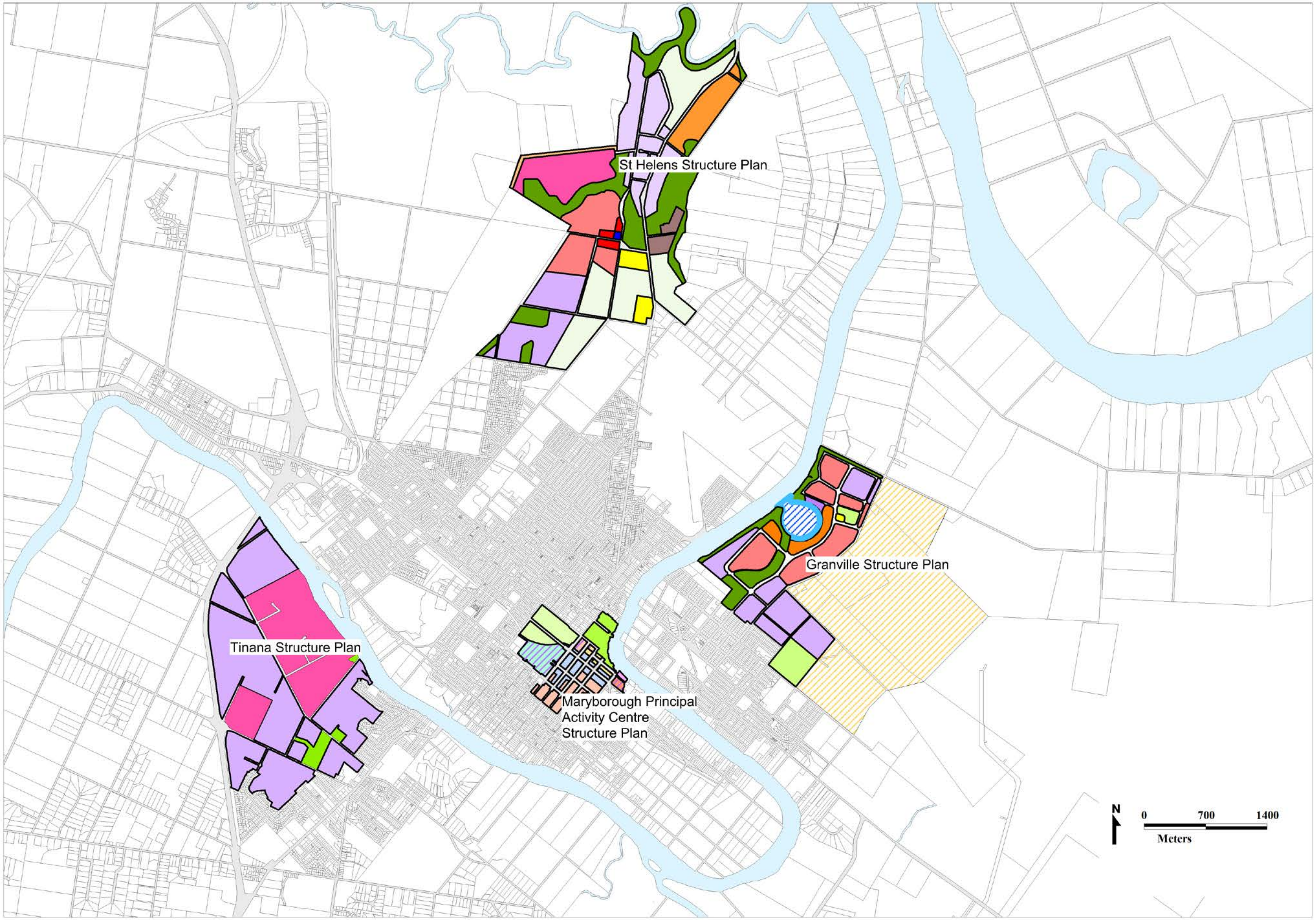


Figure 5-2: Maryborough Development Plan Overview

HB – Nikenbah

This predominantly greenfield site is located on the southern side of the ridge. The area is approximately 445Ha in size and bound by the Ghost Hill ridgeline and existing residential subdivision in the north and east; Chapel Rd and Maggs Hill Rd in the south, and; the road reserves of Aalborg Rd North, Maryborough-Hervey Bay Rd and Scrub Hill Rd in the west.

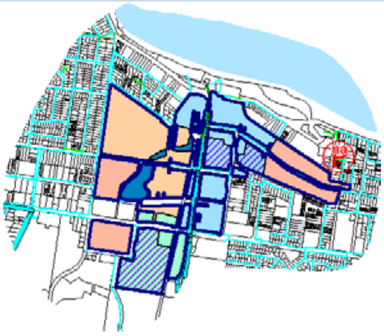
The area is proposed for predominantly residential development with some industrial development along the Maryborough-Hervey Bay Rd. It has a potential yield of approximately 3,860ED. A sports precinct has been proposed for the area to the south of the Nikenbah structure plan and the development of this precinct would encourage growth in the Nikenbah area.

HB - Eli Waters

Eli Waters is located in the predominantly greenfield area between the coastal foreshore of Dundowran Beach in the north, the emerging Eli Waters residential community in the east; Lower Mountain Rd in the south; and Ansons Rd and Dundowran Rd in the west. There is a large area of land to the south of Pialba – Burrum Heads Rd classed as "further investigation" area in the Fraser Coast Planning Scheme. This area has been excluded from any analysis in this strategy. It is estimated that the potential ED yield for the remaining area is approximately 4,570. This is made up of mixed density residential and medium density residential with some tourist precincts and associated commercial land use.

HB - Pialba Precinct

The Pialba Precinct is located around the existing Pialba commercial area in Hervey Bay. This is an already established area and hence the development in this area is by way of densification and higher use of existing facilities. The estimated additional ED yield is approximately 800ED.

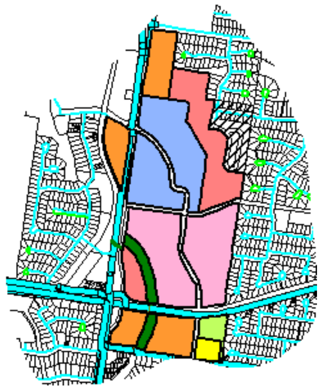


HB – Doolong Flats/ Ghost Hill

This predominantly greenfield area consists of approximately 528Ha of undeveloped land stretching between Doolong Rd, Doolong South Rd, the Ghost Hill ridgeline and the existing Kawungan development to the west. The estimated ED yield is approximately 5,390, consisting mainly of residential areas, with a small commercial centre.

HB – Kawungan North East

This predominantly greenfield area consists of approximately 67.2Ha of undeveloped land stretching between McLiver St, existing development in the east, Main St in the west and Doolong Rd in the south. The estimated ED yield is approximately 1,400ED, consisting mainly of residential areas, with a commercial centre to the south. The area is proposed for large commercial development buffered by residential areas.



Burrum Heads

There is potential for growth in Burrum Heads and significant interest from developers on further development in the area. It is estimated that there could be up to an additional 1,520ED developed in the area. This land is made up of mostly residential areas.

HB - Infill development

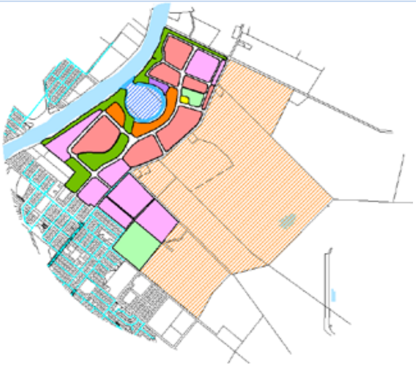
Infill development is expected to continue throughout the Hervey Bay area and includes increased densification by redevelopment as well as through subdivision. It is estimated that infill development could account for approximately 20% of growth in the area.

MB - Tinana

Tinana has one of the highest potential for residential growth in Maryborough. While some of the areas are below the Q100 flood level there is suitable land for development located to the west of Gympie Rd and east of Bruce Highway. Most of the area is zoned residential. There is potentially about 5,310ED at full yield, although this is not likely to be realised because significant fill would be required to achieve a minimum level to meet flood level requirements.

MB - Granville

Proposals for Granville Harbour development indicate that the initial component of the site could accommodate 2,650ED. While this development is in preliminary stages it is included in this strategy for completeness. It is proposed for a major marina area, surrounded by residential and commercial land.



MB - St Helens

St Helens has recently had several large development proposals. Hibiscus Gardens is one such development and is located at the north eastern part of St Helens. There is the potential for approximately 2,890 ED's to be developed in this area and would be mostly residential development in the south and large areas of industrial development to the north.

MB – Maryborough Principal Activity Centre

This area is predominantly the Maryborough CBD and includes densification and significant open space and community purposes. There is a large emphasis on heritage and maintaining its historical and cultural features. The estimated yield from this area is 560ED above the existing loading.

MB – Infill

Infill development is expected to continue throughout the Maryborough area and includes increased densification by redevelopment as well as through subdivision. It is estimated that infill development could account for approximately 20% of growth in the area.

The development is assumed to occur in the sequence shown in Table 5-1. Often this can change depending on the developer, other commitments, economic viability and political direction. The sequencing was formulated through discussions with the development and planning sections of the FCRC, who have also indicated that development sequencing is developer driven.

The assumptions made are consistent with the growth forecast for the Fraser Coast. The actual location of that growth may have an impact on infrastructure delivery and timing. It will be necessary to review the development sequencing on a regular basis with the view of updating the capital expenditure timings.

Table 5-1: Development Area Potential ED Yields

Development Area	2011	2016	2021	2026	2031	2036	2041	2046	*Ultimate*
Nikenbah					233	1442	2651	3860	*3860*
Eli Waters			883	1367	2727	4099	4555	4568	*4568*
Pialba CBD Precinct	120	265	330	500	530	600	650	700	*800*
Doolong Flats/Ghost Hill	210	646	1032	1681	2969	3777	4596	5387	*5387*
Kawungan NE		104	163	347	754	969	1184	1402	*1402*
Burrum Heads	60	136	197	303	441	801	1161	1515	*1515*
Tinana	20	202	425	679	903	2353	3803	5310	*5310*
Granville				850	1700	2654	2654	2654	*2654*
St Helens				481	963	1444	1926	2407	*2889*
Maryborough Principal Activity Centre (CBD)						186	372	560	*560*

5.3 Existing and Projected ED Demand

Existing and projected residential demands were taken from the Hervey Bay City Population Model which is benchmarked against the State Governments Office Economic and Statistical Research (OESR) Medium Series population projection. An allowance has been made within the Model for the City's tourist population which will create an additional demand for accommodation and associated infrastructure.

Existing and projected Non Residential demand was estimated from a consideration of the development potential under the current zoning provisions, site and building constraints under the Planning Scheme, and current metered consumption. Where current metered demand exceeds projected ultimate demand from the above analysis, the current metered demand and hence the ED loading to the sewer has been assumed to remain constant throughout the planning period. Growth in Non-Residential demand was assumed to follow the estimated OESR forecast growth in population.

The Residential and Non-Residential ED's were then applied to existing sewered properties from the rates database to determine the existing ED sewerage loads in the Model. The results were then compared with records of major WWTP's to determine their validity.

Potential exists for further development within the land currently zoned for development at Howard and Torbanlea but there are no plans to extend the sewered areas.

Maryborough has a current residential population of approximately 27,217 and based on the Queensland Treasury's Office of Economic and Statistical Research (OESR) Maryborough will continue to grow at 0.8% per annum which is consistent with previous PIFU Medium Series Growth Projections. This growth forecast has been used throughout the report.

The 2011 Wide Bay Burnett Regional Plan (WBBRP) proposes to double the population of Maryborough over the planning period, however the Plan provides no economic drivers to support this population growth. For the purposes of this report no provision beyond the OESR forecasts has been made in the Demand Model.

To calculate existing and projected Non Residential demand the existing water consumption was evaluated and appropriate factors for discharge to sewer were applied to the development.

5.4 Existing ED Demand

The existing ED's are shown in Table 5-2.

Table 5-2: Existing ED's

WWTP Catchment	Res ED (2015)	Non Res ED (2015)	Total ED
Aubinville WWTP	9,024	2,484	11,509
Burrum Heads WWTP	912	141	1,053
Eli Creek WWTP	4,461	2,424	6,885
Howard WWTP	19	32	51
Nikenbah WWTP	6,424	1,081	7,506
Pulgul Creek WWTP	7,982	2,718	10,701
Toogoom WWTP	655	6	661
Torbanlea WWTP	128	11	139
Total	**29,606**	**8,898**	**38,504**

5.5 Future ED Demand

The forecast projected ED's are tabulated in Table 5-3.

Table 5-3: Projected ED Figures for Fraser Coast by Sewerage Catchment Areas

Catchment	2011	2015	2016	2021	2026	2031	2036
Aubinville WWTP	11,085	11,509	11,615	12,061	12,522	13,007	13,590
Burrum Heads WWTP	951	1,053	1,079	1,201	1,337	1,358	1,418
Eli Creek WWTP	6,588	6,885	6,959	7,518	8,097	8,794	9,188
Howard WWTP	47	51	52	63	77	79	86
Nikenbah WWTP	6,975	7,506	7,638	8,327	9,264	10,407	11,322
Pulgul Creek WWTP	10,053	10,701	10,863	12,156	13,586	15,532	16,898
Toogoom WWTP	588	661	622	672	731	842	916
Torbanlea WWTP	136	139	140	143	145	149	156
Total Fraser Coast	**36,423**	**38,504**	**38,968**	**42,140**	**45,759**	**50,168**	**53,574**

Demand is dependent upon the number of equivalent dwellings (ED's) either existing or permitted under the planning scheme for a particular area. Over the planning period it is forecast that residential and non-residential development in Hervey Bay and Maryborough will increase by approximately 2.4% and 0.8% annually.

5.6 Demand Allocation

An analysis of the ADWF from each WWTP was carried out using the existing ED's to calculate a theoretical flow/ED for each of the WWTP catchments. The assessment allowed for a percentage of vacant dwellings in each catchment.

Table 5-4: Determination of Flow/ED

	ED in Catchment (2014)	ADWF (Historical 2014)	Flow/ED (Historical ADWF 2014)	Assumed vacancy rate	Adjusted ADWF
Aubinville WWTP	11,085	4,472	392	10%	431
Burrum Heads WWTP	951	307	299	20%	358
Eli Creek WWTP	6,588	2,663	391	10%	430
Howard WWTP	47	27	549	5%	576
Nikenbah WWTP	6,975	2,847	386	10%	425
Pulgul Creek WWTP	10,053	4,894	464	10%	511
Toogoom WWTP	588	243	379	10%	416
Torbanlea WWTP	136	43	309	10%	340

It can be seen that the adjusted ADWF per ED varies across the different catchments. The smaller catchments have a higher variation than the larger catchments. This is due to a smaller base population and could also be due to higher visitor numbers as might be experienced at Burrum Heads. For the major centres the figures are approximately 10% different from previously adopted flow/ED of 450L/ED/day. Therefore it is considered appropriate to maintain a flow figure for design of 450L/ED/day for the Fraser Coast.

In future strategies consideration might be given to adopting different flow/ED for major centres and minor centres.

5.7 Peaking Factors

Previous strategies have applied a PWWF factor of 5 x ADWF to model diurnal patterns. WBWC used a diurnal peaking factor of 1.9 resulting in a peak wet weather flow (during maximum hour) of 9.5 x ADWF. This significantly over estimates the peak load on the sewerage system and does not give an accurate representation of PWWF (refer to Figure 5-3). Another approach was adopted for this strategy. All the factors in the diurnal curve were increased by four, this allows the average area under the curve to equal 5 x ADWF. This allows flows from Inflow and Infiltration (I/I) to be captured while still representing typical sewerage diurnal inflow patterns from residential and non-residential sources.

This process was applied to both the residential and non-residential demand curves.

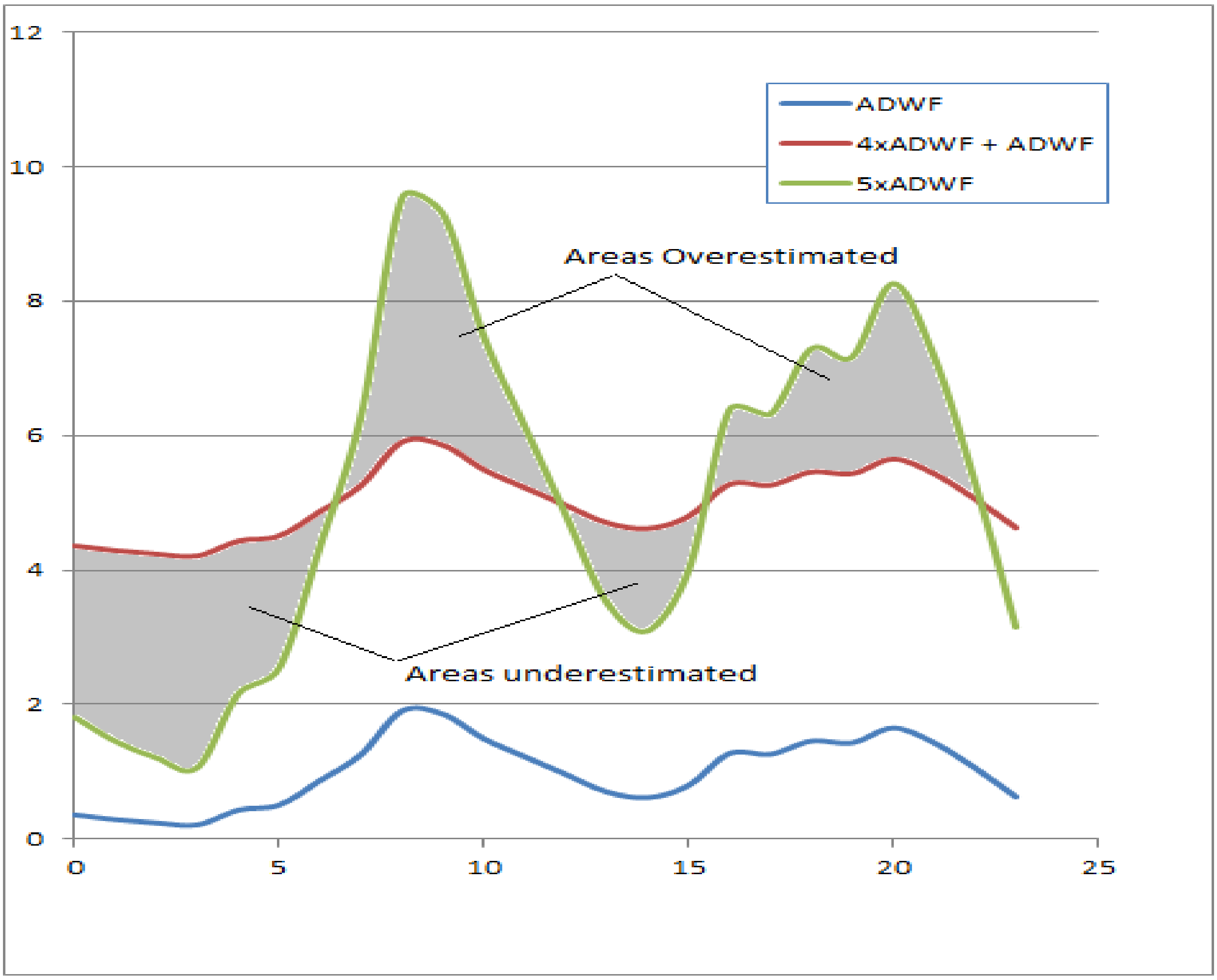


Figure 5-3: Selection of PWWF Factor for Modelling

5.8 Adopted Diurnal Profiles

Diurnal profiles are used in modelling to simulate the variation in flows produced during a typical dry and wet weather day. It varies during the day but typically;

– Residential curves have two peaks, one in the morning and one in the evening.

– Non-residential curves are flatter and typically start in the morning and can continue to well into the night depending on the land usage type.

Figure 5-4 shows the adopted curves used in modelling in the report.

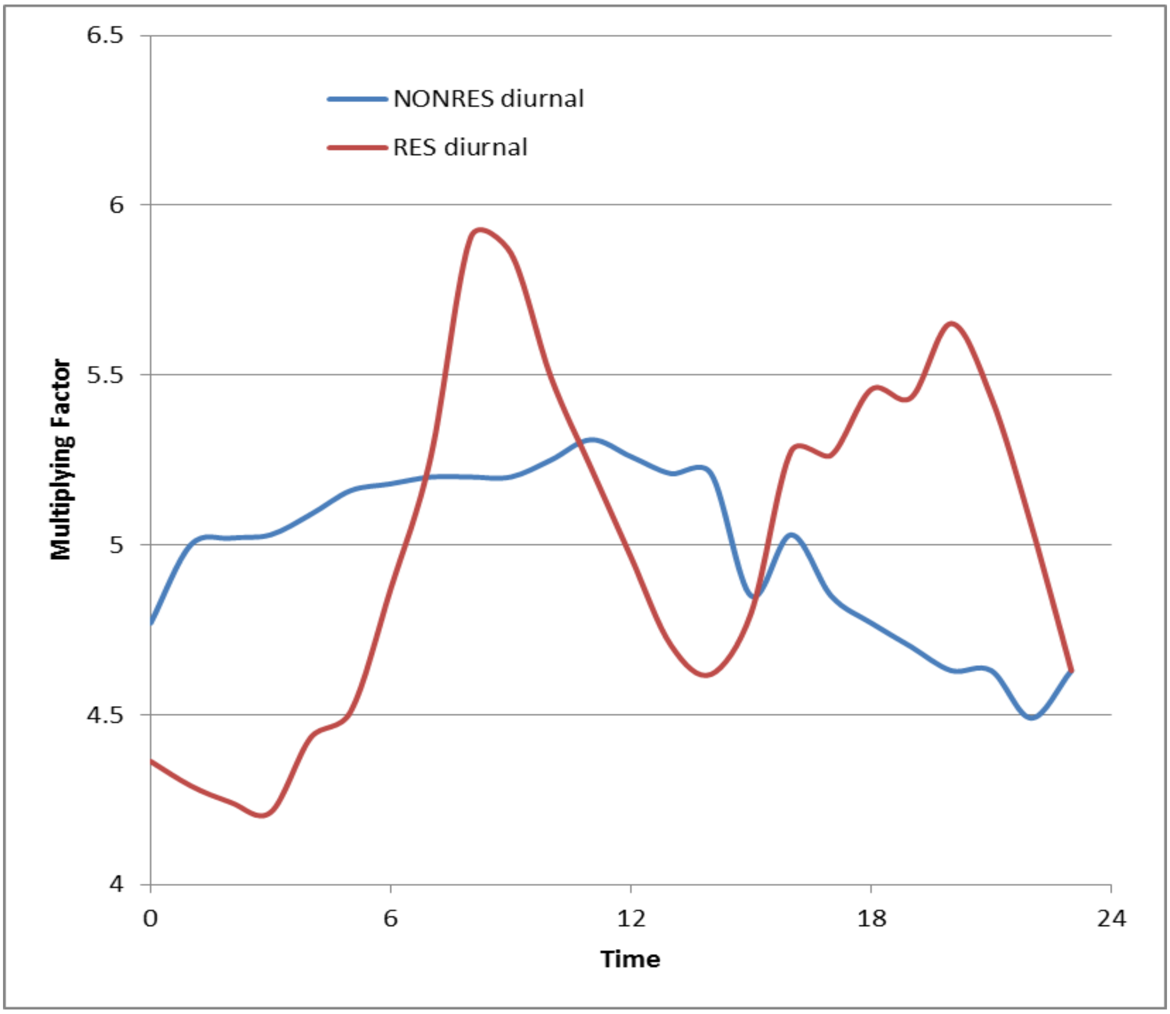


Figure 5-4: Diurnal Curves used in Modelling

6. SYSTEM REVIEW AND ASSESSMENT

6.1 Reuse

6.1.1 Current Strategy

WBWC has over the last decade maximised the reuse of effluent generated from the Hervey Bay Region becoming a national leader in the field. WBWC provides effluent for irrigation to a variety of users including cane and turf farms, golf courses, sports fields and its own tree plantations.

The reuse scheme has grown from a necessity to meet regulatory licence conditions and the demand created from existing customers.

The existing reuse strategy principles are to:

- achieve beneficial reuse of treated effluent to meet licencing requirements from both qualitative and quantitative perspectives
- provide adequate storage and irrigation land to minimise dry weather discharge into the World Heritage Listed Great Sandy Straights
- encourage any commercial use or enterprise that generates revenue and achieves the above two points
- promote WBWC sustainability objectives (environmental and financial) that align with the above.

With the expected population growth in the Fraser Coast, effluent production will increase and methods for its disposal that are both socially responsible and sustainable must be sought.

Based on current approved operational budget in 2015/16 of $1.5m, the operating cost of the effluent reuse schemes is approximately $270/ML (based on reuse of 5580ML/annum). A study is required to determine the cost of providing effluent to the Fraser Coast

RECOMMENDATION: Investigate the economics of the Fraser Coast Reuse schemes in 2016 at a cost of $20k.

6.1.2 Key Considerations

The main objective of effluent reuse has been to focus on opportunities for beneficial reuse taking the following issues into consideration:

- Population growth and increasing volumes of recycled water
- Market demand for recycled water
- Community perception and support
- Sustainable irrigation application rates
- Acquisition of land by WBWC for further expansion
- Capital costs and return on investment

The final key element of the strategy will be to ensure that pricing of this valuable resource is both responsible and sustainable. Commercial buyers of effluent need to be paying fair market value if WBWC wants to shift from simply disposing effluent to a profitable income stream through the recognition of effluent and biosolids and a valuable resource.

6.1.3 Effluent Availability

The predicted total annual volumes of effluent produced by the 8 WWTP's owned by WBWC based on estimated ED Projection figures (refer to Table 6-1).

Table 6-1: Estimated ED Projections, Inflow and Volumes of Effluent Reuse Water

Reuse Avail (ML/annum)	2016	2021	2026	2031	2036
Aubinville WWTP	1,545	1,605	1,666	1,731	1,808
Burrum Heads WWTP	177	197	220	223	233
Eli Creek WWTP	926	1,000	1,077	1,170	1,222
Howard WWTP*	8.5	10.3	12.6	13.0	14.1
Nikenbah WWTP	1,255	1,368	1,522	1,709	1,860
Pulgul Creek WWTP	1,445	1,617	1,808	2,066	2,248
Toogoom WWTP	83	89	97	112	122
Torbanlea WWTP	23	24	24	24	26

* Howard WWTP receives up to an additional 10 ML/a from the Howard Water Treatment Plant as part of the treatment process

The percentage of effluent or waste water collected and disposed of varies each year depending on rainfall. In 2014/15, approximately 91.6% of the effluent produced in the Fraser Coast was disposed of in a beneficial way, satisfying our EPA licence conditions (WBWC, 2015).

6.1.4 Land Availability

Application rates are determined by soil type, climatic conditions, crop species and sustainability issues such as Salinity and leaching of soil nutrients.

Regardless of the type of land use, a maximum of 5ML/Ha/annum is the recommended irrigation application rate to avoid soil degradation.

Based on these rates an equivalent disposal area can be calculated for each of the planning horizons. These are shown in Table 6-2.

It is important to have an understanding of the quantity of land needed and the best way that it can be utilised. WBWC has undertaken extensive trials on a number of crop types and tree species using reuse water, and has established set up and operational costs for each type. The strategy for the future is to maximise the economic return from the crop or crops grown by the corporation using the most efficient and secure methods.

Table 6-2: Equivalent Land required for Effluent Disposal

Fraser Coast	2016	2021	2026	2031	2036
Reuse Avail (ML/annum)	5407.5	5853.5	6367.5	6988.5	7472.5
Current Equivalent Plantation Area (Ha)	1116				
Additional Plantation Area Required (Ha)	*0*	*55*	*158*	*282*	*379*

6.1.5 Storage Capacity

The current diversity in application, distribution and usage requires WBWC to hold storage capacity of approximately six months' supply in any one year. Table 6-3 shows the predicted storage requirements for Hervey Bay Region under the current Water Reuse scheme. A detailed Water Balance Model is recommended for development as a priority to clearly identify the required water storage and land requirements for the developing community.

Table 6-3: Predicted Storage Requirements

Fraser Coast	2016	2021	2026	2031	2036
Reuse Avail (ML/annum)	5407.5	5853.5	6367.5	6988.5	7472.5
Current Dam Storage(ML)	2575				
Additional Dam Storage Required (ML)	*129*	*352*	*609*	*919*	*1161*

6.1.6 Effluent Balance Model and Results

A water balance model was developed for the Hervey Bay System to assist in the decision making process and provide information on a number of different scenarios.

The model uses historical climate data and applies these historical events into future demand scenarios to determine the land or storage required to achieve a set amount of overflow (in line with current discharge licences).

It was also used to determine the impact of rainfall on a reuse system and the works required to produce a cost effective and reliable balance between land required, storages required and discharge to the environment required.

The Model was set up to

– meet minimum 90% ADWF reuse more than 9/10 years

– dam overflow action plans are required less than 1/20 years.

– Does allow for discharges over the 6ML limits at Eli and Pulgul (which all would have to be reported)… On average these discharges account for approximately 1/3 of the total discharge

The Graph in Figure 6-1 shows the output from the model. It can be seen that at the projected rates of growth in the significant land and storage volumes will be required into the future. It also shows that the current level of land area available is slightly less than that required to meet the 90% reuse target 90%.

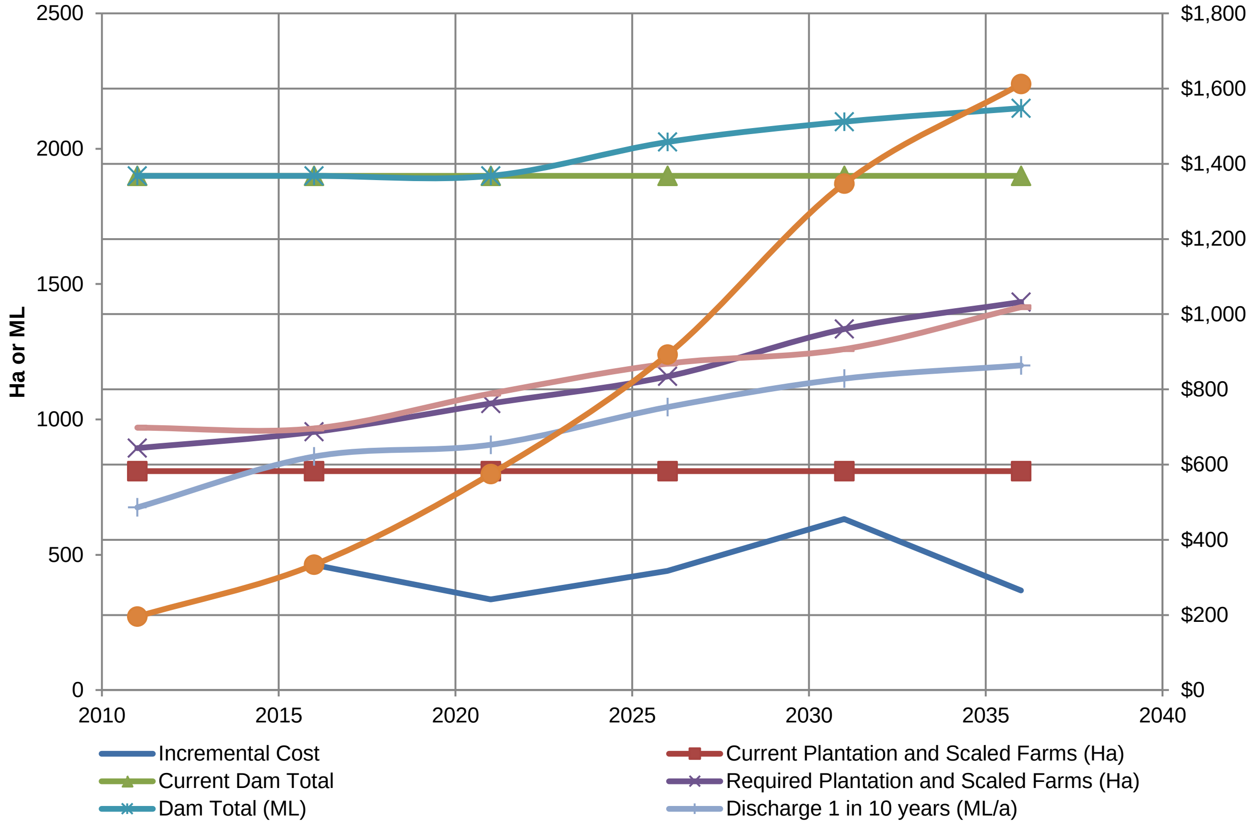


Figure 6-1: Water Balance Model Results Hervey Bay - Projected Land, Storage and Costs

6.1.7 Assessment of Strategic Reuse Options

Several options are available for the disposal of effluent and biosolids into the future. They include;

- reuse effluent and biosolids for irrigation and agriculture
- discharge to receiving waters of Hervey Bay and the Mary River
- direct/Indirect Potable Reuse
- third pipeline (dual reticulation) systems
- a combination of these options (as is the current strategy)

Determining the strategy for the disposal of treatment by-products is the starting point for the development of a new sewerage strategy. It will provide guidance for upgrades and deciding treatment options for future WWTP's in the Fraser Coast.

In 2011 Water Strategies Pty Ltd were commissioned by WBWC to produce a Fraser Coast Reuse Strategy which investigates some of the more promising options for effluent reuse into the future. While the report by Water Strategies was never finalised nor adopted by WBWC a draft report was produced and forms the basis of this section of the strategy. It should be recognised that further detailed study and planning will be required prior to committing funds to any of the options outlined in this section.

The estimated income from the tree plantations is based on figures in the Water Strategies (2012) report. The report estimates that a return of $53k can be achieved in an 18 year timeframe. This figure is adopted for use in the NPV's. No supporting evidence was able to be found to substantiate these returns. The risk is that the returns are not achievable because of factors outside of WBWC control such as fire, pests and/or disease.

Note that all NPV's in this section use a WACC of 6.25%.

6.1.7.1 Option H1 Cassava Development – Expand the irrigation to Cassava

This option continues along the direction of achieving reuse through irrigation to 90-100%. It involves transferring effluent from Nikenbah to the Cassava site for storage and reuse on new plantations to be established on the site and in other locations.

Land requirements

While there is a large amount of land surrounding the Cassava Dams, the report is clear that no irrigation should occur to the south of Cassava Dam No. 1 The area to the south of Cassava Dam No.1 forms part of the catchment area for Cassava Dam No. 1 and may pose a potential risk of contamination to the Hervey Bay Water supply source. Therefore the available land for is limited to areas north of Cassava Dam No. 1. The available irrigation area at Cassava is approximately 319Ha. Table 6-4 shows the required land for irrigation under this option. Clearly there is insufficient land available at the Cassava site and therefore other areas will need to be sought for disposal of effluent. The report indicates that there may be some cane land available to the north west of Cassava and some areas between Cassava and Nikenbah which might be suitable for purchase and development into tree plantations.

Table 6-4: Option HB1 - Land requirements for irrigation

REQUIRED	2017	2026	2031
Cane		80	950
Plantation's	320	320	750
TOTAL	*320*	*400*	*1700*
POTENTIAL LAND			
Cassava	320	320	320
Area west of Nikenbah		330	330
Area east of Nikenbah			100
Area to north west Cassava			950
TOTAL	*320*	*650*	*1700*

Storage Requirements

This strategy proposes the use of Cassava Dam N0.2 (FSL volume of 426Ml). An additional 500Ml storage has also been identified to service new plantation areas between Nikenbah and Cassava.

Infrastructure requirements

- A 17.1km DN750 pipeline and pump station (234L/s @ 34m – 120kW) between Nikenbah WWTP and Cassava Plantation. The report identified two DN600 to be installed 10 years apart. This has been modified to one DN750.
- A 11.1km DN525 pipeline and pump station (220L/s @ 40m – 125kW) between Cassava and new irrigation areas to the north west of Cassava
- A 5.1km DN450 pipeline and pump station (100L/s @ 7m – 10kW)between Nikenbah and new irrigation areas along Booral Rd

The strategy reported an upgrade to both Pulgul and Nikenbah WWTP's. A study by WBWC (2015) indicates that it may be possible to transfer load from one WWTP catchment to another and defer the costly upgrades of one of the treatment plants. Refer to Section 6.2.1 for further details. The upgrades are modified from the report accordingly.

- Upgrade of Pulgul Creek WWTP by 4.5Ml/day through the installation of a WWTP train similar to the membrane technology used at Nikenbah.
- Upgrade Pulgul outfall 1.3km DN500 in 2019

The costs in the report have been revised to reflect present day figures.

Costs

Table 6-5: Option H1 Estimated Costs

Description	Year	Cost ($000)
Nikenbah to Cassava (DN750 17.1km)	2017	19,785
Pump Station at Nikenbah (234L/s @ 34m)	2017	675
Pump Station at Cassava (234L/s @ 34m)	2017	675
Cassava Dam No. 2 Improvements	2017	200
Cassava Irrigation Area Development (320Ha)	2017	4,160
New Storage between Nikenbah and Cassava (500ML)	2017	3,500
Upgrade Pulgul Creek WWTP (4.5Ml)	2019	30,000
Upgrade Pulgul Outfall DN500 1.3km	2019	1,100
Acquisition and development of new land for Plantations (330Ha)	2026	7,590
Acquisition and development of new land for Plantations (100Ha)	2028	2,300
New DN450 Pipeline (5.1km) Nikenbah to Cane Farms along Booral Rd	2028	3,983
New Pump Station Nikenbah to Booral Rd (100L/s @ 7m)	2028	109
Pipeline to new Cane Farms (NW of Cassava)	2029	9,013
New Pump Station to Cane Farms (NW of Cassava)	2029	675
Acquisition and development new land for Plantations (420Ha)	2031	9,660
Total		**93,424**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 750Ha of plantations in this scenario yield approximately $40m.

The NPV for this option is $51.4m.

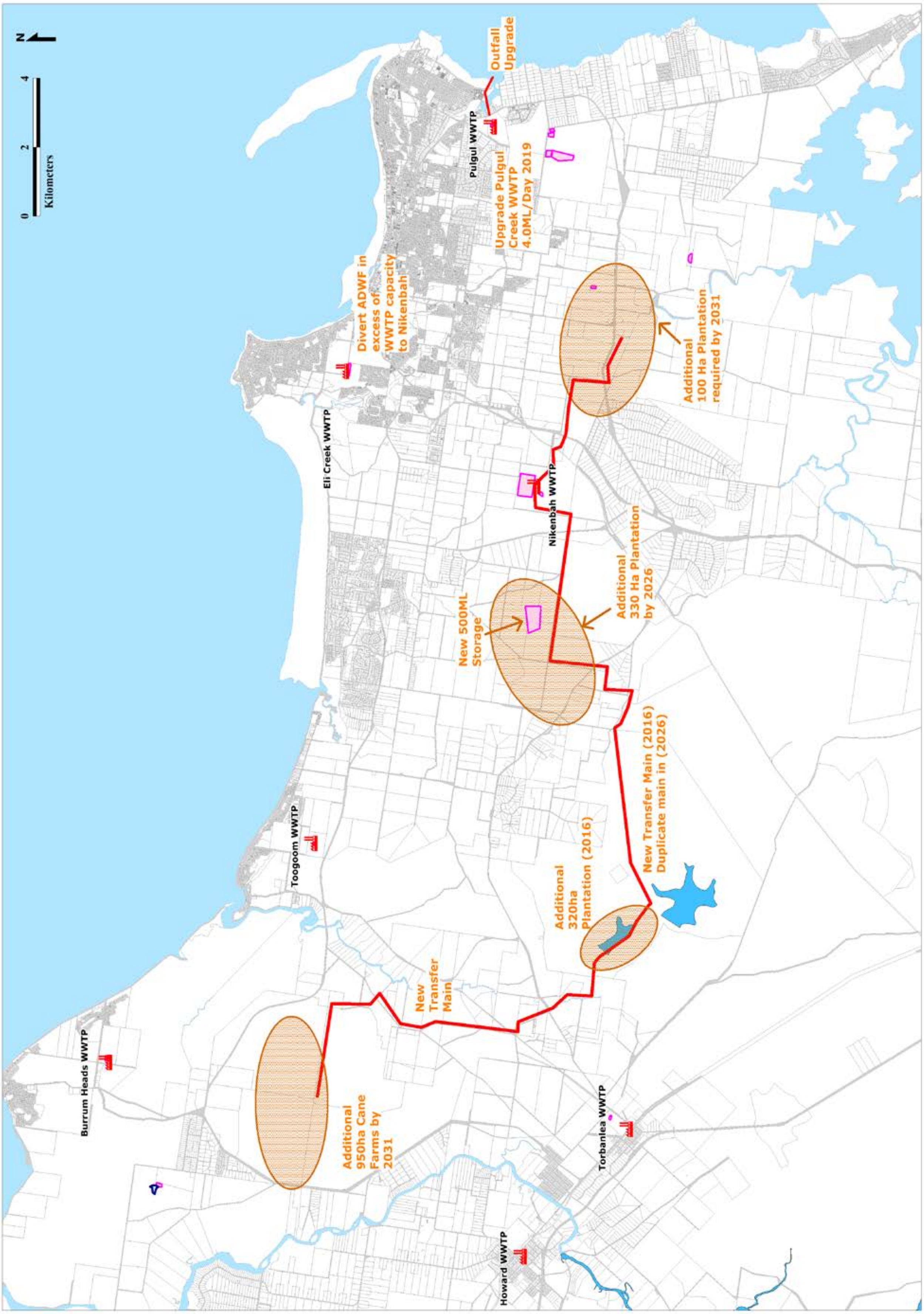


Figure 6-2: Option H1 Develop Cassava

6.1.7.2 Option H2 Increasing Discharge to Receiving Waters

Two sub options were considered here;

- Option H2(a) involves replacing the existing Pulgul Creek WWTP with a 9.0ML/day WWTP. Discharge is to the Pulgul outfall with an improved treatment process treating sewage to a better effluent quality.
- Option H2(b) involves the addition of a 4.5Ml/day treatment train at Pulgul Creek WWTP and diverting all sewage inflows to it. All effluent from this treatment train would be disposed through the Pulgul outfall. Any additional flows are treated by the existing Pulgul Creek WWTP and disposed of through irrigation.

OPTION H2(a)

Option H2(a) upgrades the existing Pulgul Creek WWTP (increase capacity to 9ML/day) and meet required quality standards for discharge through the Pulgul Creek discharge point. This option investigates discharging as much effluent as possible to the Pulgul Creek discharge outfall. This option requires amendment to the current discharge licence.

Land requirements

While most of the additional effluent associated with growth in the Hervey Bay area would be discharged into Pulgul Creek, there is still an amount of additional land that will be required to meet our licencing requirements in other areas of Hervey Bay.

Table 6-6 shows the required land for irrigation under this option. The report recommends using Cassava to obtain the additional land required for irrigation.

Table 6-6: Option H2a - Land requirements for irrigation

REQUIRED	2017	2021	2031
Plantation's			170
TOTAL			*170*
POTENTIAL LAND			
Cassava			170
TOTAL			*170*

Storage Requirements

This strategy proposes the use of Cassava Dam N0.2 (FSL volume of 426Ml) as an effluent storage lagoon for the Cassava Plantation. No other storage is required under this option.

Infrastructure requirements

– A 17.1km DN300 pipeline and pump station (40L/s @ 59m – 35kW) between Nikenbah WWTP and Cassava Plantation.

The upgrades of the treatment plants reported an upgrade to both Pulgul and Nikenbah. A study by WBWC (2015) indicates that it may be possible to transfer load from one WWTP catchment to another and defer the costly upgrades of one of the treatment plants. Refer to Section 6.2.1 for further details. The upgrades are modified from the report accordingly.

– Upgrade of Pulgul Creek WWTP to 9Ml/day through the installation of two WWTP trains similar to the membrane technology used at Nikenbah.

– Upgrade Pulgul outfall 4.9km DN600

The costs in the report have been revised to reflect present day figures.

Costs

Table 6-7: Option H2(a) Estimated Costs

Description	Year	Cost ($000)
Upgrade Pulgul Creek WWTP (9Ml)	2019	60,000
Upgrade Pulgul Outfall DN600 4.9km	2019	16,400
Outfall pump station (521L/s @ 19m)	2019	675
Nikenbah to Cassava pipeline (DN300 17.1km)	2026	7,268
Pump station at Nikenbah (40L/s @ 59m)	2026	295
Pump station at Cassava (40L/s @ 59m)	2026	295
Cassava Dam No. 2 Improvements	2026	200
Cassava Irrigation Area Development (170Ha)	2026	2,210
Total		**87,342**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 750Ha of plantations in this scenario yield $9m.

The NPV for this option is $64.35m.

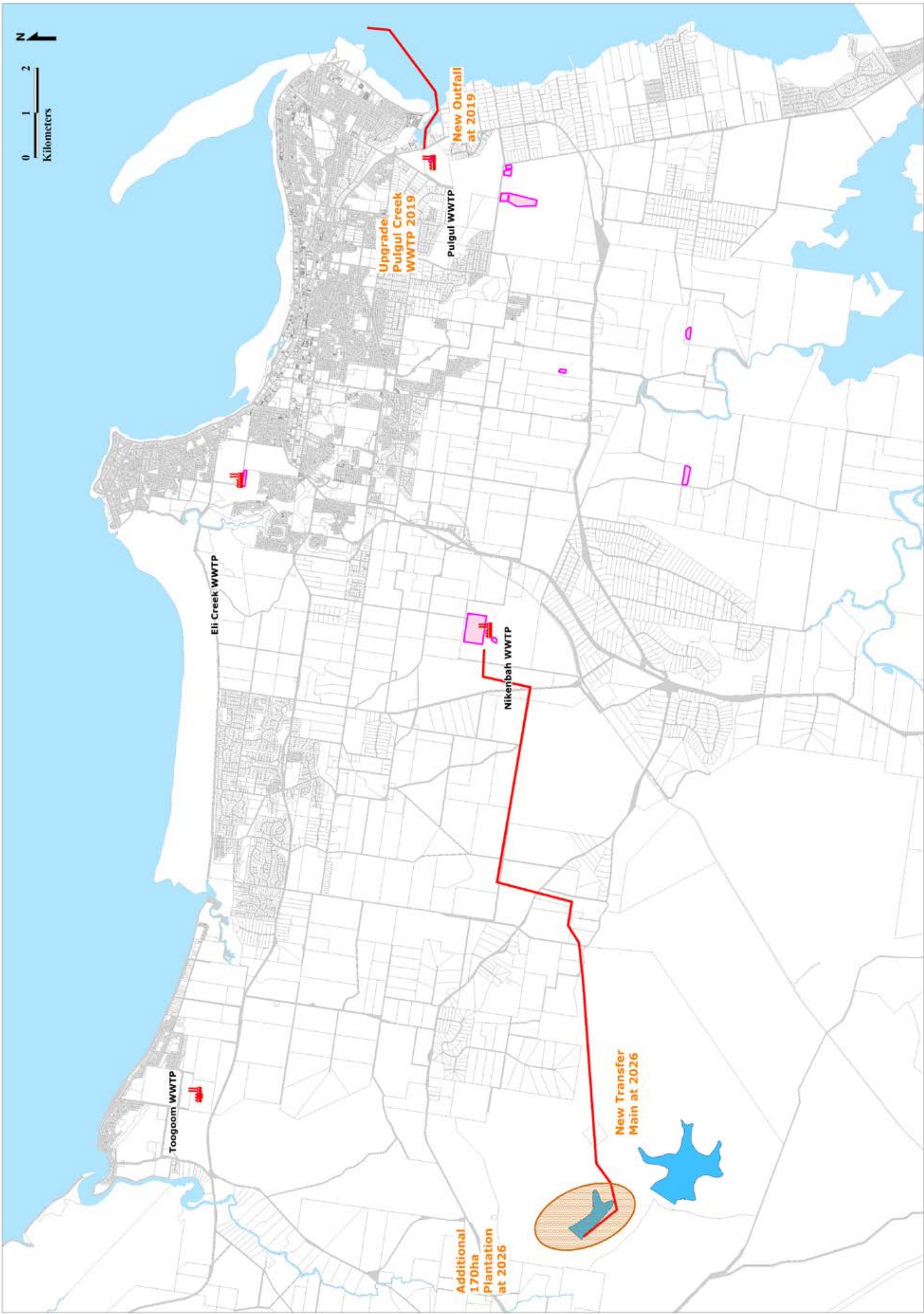


Figure 6-3: Option H2(a)

OPTION H2(b)

Option H2(b) involves a smaller new plant at Pulgul (4.5ML/day). All of the effluent from this plant would be discharged through the Pulgul Creek discharge point. The existing plant (4.4Ml/day) would be used to treat any surplus sewage over 4.5ML/day and its effluent would be used for irrigation only.

This option is a hybrid of increased discharge from the Pulgul Creek outfall and reuse by irrigation. It requires renegotiation of the existing discharge licence with the DERM. It also requires the development of Cassava plantation and additional land for future irrigation purposes.

Land requirements

Table 6-8 shows the required land for irrigation under this option. Clearly there is insufficient land available at the Cassava site and therefore other areas will need to be sought for disposal of effluent. The report indicates that there may be land available

Table 6-8: Option H2(b) - Land requirements for irrigation

REQUIRED	**2017**	**2021**	**2031**
Cane			
Plantation's	320	550	980
TOTAL	*320*	*550*	*980*
POTENTIAL LAND			
Cassava	320	320	320
Area West of Nikenbah		230	660
TOTAL	*320*	*550*	*980*

Storage Requirements

This strategy proposes the use of Cassava Dam No. 2 (FSL volume of 426ML). An additional 500ML storage has also been included to service new irrigation areas between Cassava and Nikenbah WWTP.

Infrastructure requirements

– A 17.1km DN500 pipeline and pump station (227L/s @ 91m – 290kW) between Nikenbah WWTP and Cassava Plantation.

The upgrades of the treatment plants reported an upgrade to both Pulgul and Nikenbah. A study by WBWC (2015) indicates that it may be possible to transfer load from one WWTP catchment to another and defer the costly upgrades of one of the treatment plants. Refer to Section 6.2.1 for further details. The upgrades are modified from the report accordingly.

– Upgrade of Pulgul Creek WWTP by 4.5Ml/day through the installation of a WWTP train similar to the membrane technology used at Nikenbah.

– Upgrade Pulgul outfall with 4.9km (DN450) extended past the Urangan Harbour into waters up to 10m deep

– New outfall pump station 232L/s@17m (55kW)

The costs in the report have been revised to reflect present day figures.

Costs

Table 6-9: Option H2(b) Estimated Infrastructure Costs

Description	Year	Cost ($000)
Cassava Irrigation Area Development (320Ha)	2018	4,160
Cassava Dam No. 2 Improvements	2018	200
Nikenbah to Cassava DN500 17.1km	2018	13,885
Pump station at Nikenbah (227L/s @ 91m)	2018	988
Pump Station at Cassava (227L/s @ 91m)	2018	988
Upgrade Pulgul Creek WWTP (4.5Ml)	2019	30,000
Upgrade Pulgul Outfall (DN450 4.9km)	2019	8,100
New Outfall pump station (232L/s@17m)	2019	457
Acquisition and development new land for plantations between Nikenbah and Cassava (230Ha)	2021	5,290
Acquisition and development new land for plantations between Nikenbah and Cassava (430Ha)	2031	9,890
New Storage between Nikenbah and Cassava (500ML)	2031	3,500
Total		**77,458**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 980Ha of plantations in this scenario yield approximately $52m.

The NPV for this option is $44.67m.

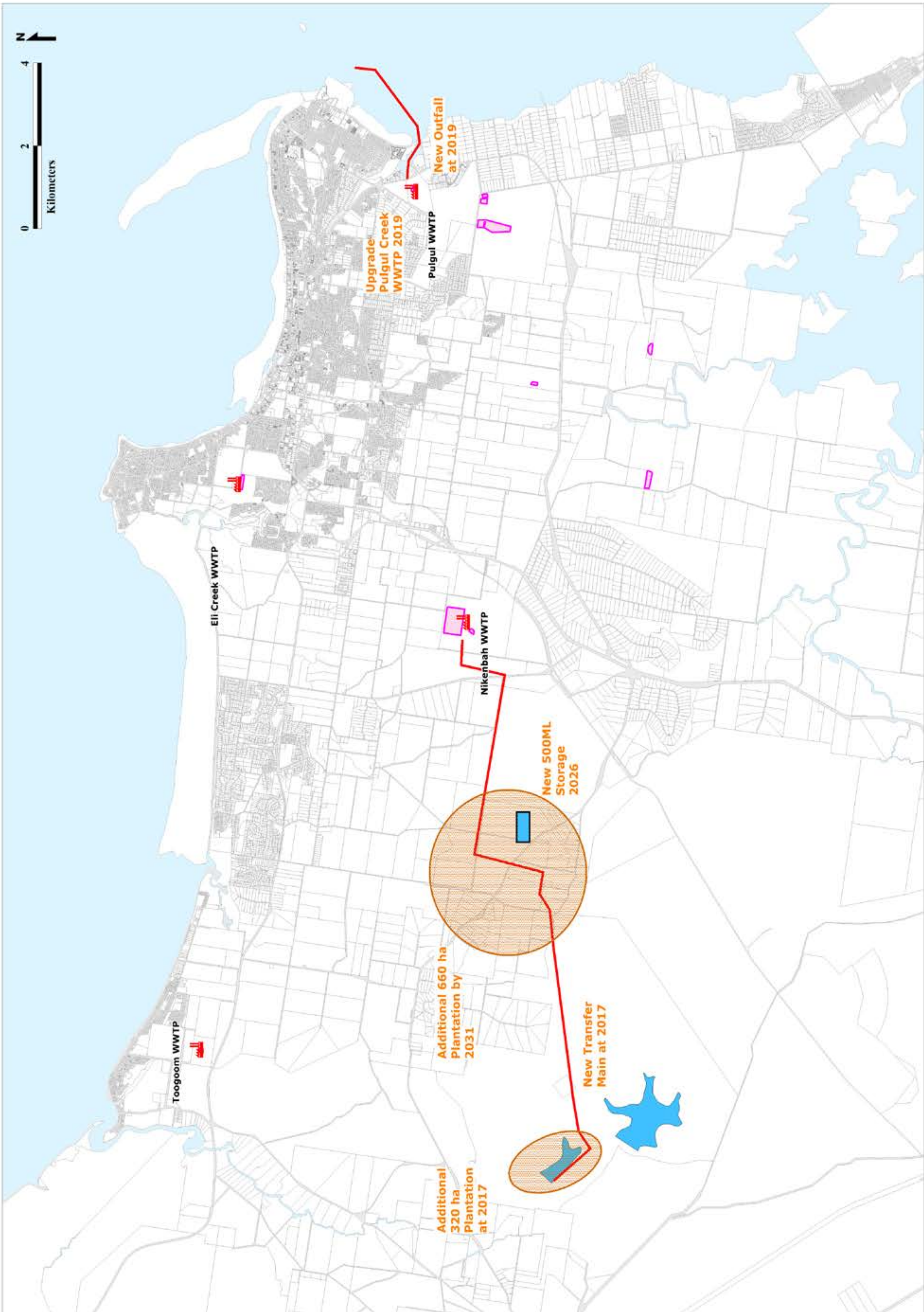


Figure 6-4: Option H2(b)

6.1.7.3 Option H3 Potable Reuse Options

Option 3 considers potable reuse to dispose of effluent. Stage 1 includes the installation of an advanced water treatment plant (AWTP) at Nikenbah and a new pipeline to Cassava Dam. After 5 years of community consultation and proving, process and quality monitoring and upon community acceptance, the water could be injected into the Hervey Bay water supply system by injection into Cassava Dam or Lake Lenthall (indirect potable reuse).

Another alternative could be to dispose of the water through the Eli Creek Discharge point until the process is proven at which point the effluent could be injected directly into the reticulation system (direct potable reuse). This would involve a new pipeline, but does not provide the same beneficial reuse as the Cassava option and is likely to receive less public support.

There are two options considered;

- Option H3(a) considers potable reuse and disposal of effluent through maximising discharges at Pulgul Creek.
- Option H3(b) considers potable reuse and disposal of effluent by maximising effluent reuse for irrigation.

OPTION H3(a)

Option H3(a) involves a new plant at Pulgul (4.5ML/day). All of the effluent from this plant would be discharged through the Pulgul Creek discharge point. The existing plant (4.4Ml/day) would be used to treat any surplus sewage over 4.5ML/day and its effluent would be used for irrigation only. This option will require renegotiation of discharge licence with DERM.

Land requirements

Table 6-10 shows the required land for irrigation under this option. There is sufficient land available at Cassava to use for irrigation.

Table 6-10: Option H3(a) - Land Requirements for Irrigation

REQUIRED	2017	2021	2031
Cane			
Plantation's	270	270	270
TOTAL	*270*	*270*	*270*
POTENTIAL LAND			
Cassava	270	270	270
TOTAL	*270*	*270*	*270*

Storage Requirements

This strategy proposes the use of Cassava Dam No. 2 (FSL volume of 426Ml). The report suggests that wet lands might be considered as additional treatment for potable water injection into Cassava Dam. The preferred option is irrigate plantations or crops while the system is proven.

Infrastructure Requirements

- A 17.1km DN375 pipeline and pump station (56L/s @ 64m – 60kW) between Nikenbah WWTP and Cassava Plantation.

The upgrades of the treatment plants reported an upgrade to both Pulgul and Nikenbah. A study by WBWC (2015) indicates that it may be possible to transfer load from one WWTP catchment to another and defer the costly upgrades of one of the treatment plants. Refer to Section 6.2.1 for further details. The upgrades are modified from the report accordingly.

- Upgrade of Pulgul Creek WWTP by 4.5Ml/day through the installation of a WWTP train similar to the membrane technology used at Nikenbah.

- Upgrade Pulgul outfall with 4.9km (DN450) extended past the Urangan Harbour into waters up to 10m deep

- New Outfall pump station 232L/s@17m (55kW)

The infrastructure required is shown in Figure 6-5.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-11: Option H3(a) Estimated Infrastructure Costs

Description	Year	Cost ($000)
Nikenbah to Cassava DN375 17.1km	2017	10,157
Pump Station at Nikenbah (56L/s @ 64m)	2017	457
Pump Station at Cassava (56L/s @ 64m)	2017	457
Cassava Irrigation Area Development (270Ha)	2017	3,510
Cassava Dam No. 2 Improvements	2017	200
Upgrade Pulgul Creek WWTP (4.5Ml)	2019	30,000
Upgrade Pulgul Outfall DN450 4.9km	2019	8,100
New Outfall Pump Station (232L/s@17m)	2019	457
AWTP at Nikenbah (4.5ML/day)	2026	38,100
Total		**91,438**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 270Ha of plantations in this scenario yield approximately $14.3m.

The NPV for this option is $57.72m.

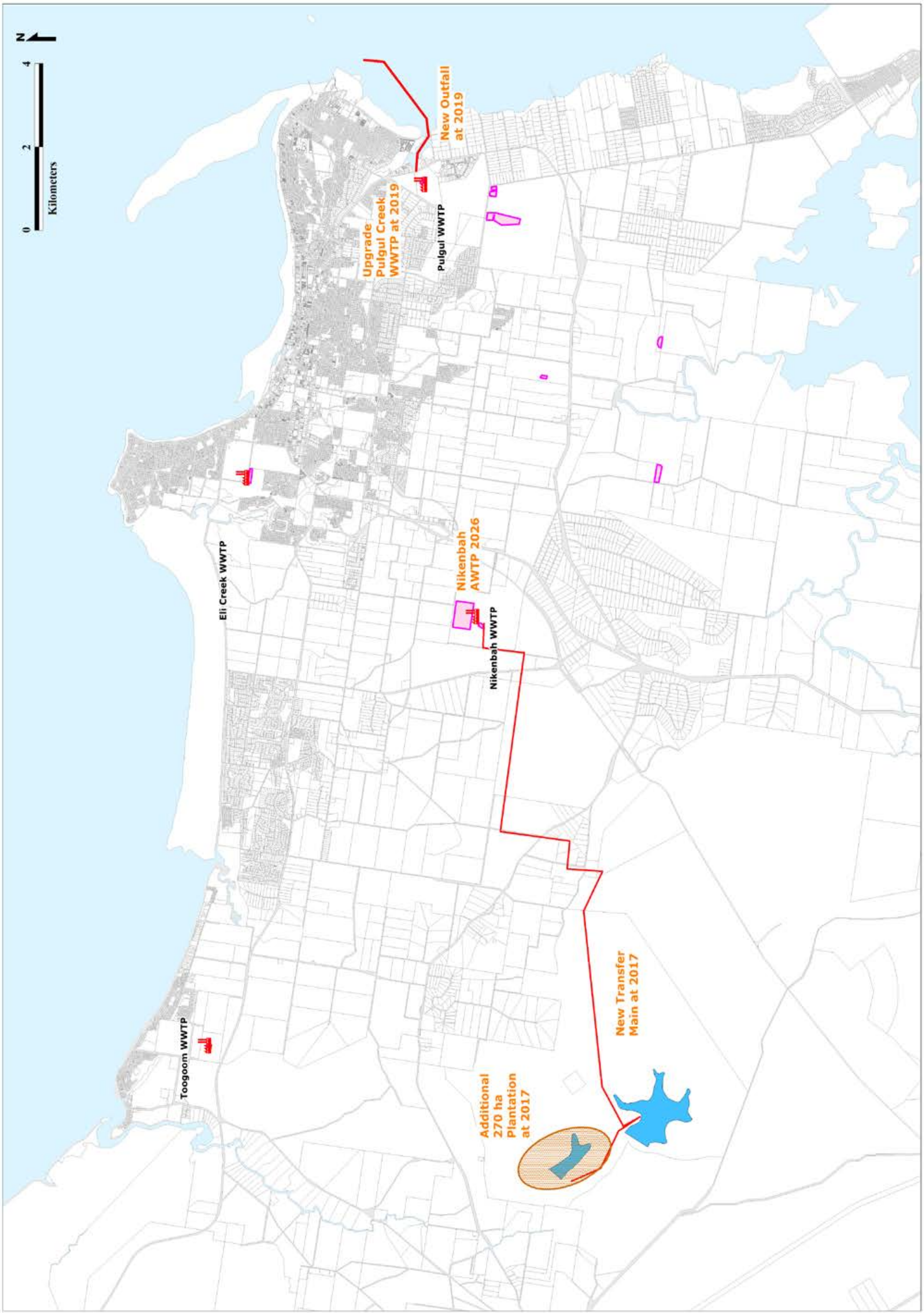


Figure 6-5: Option H3(a)

OPTION H3(b)

Option H3(b) is similar to option H3(a) except that in this option the amount of irrigation is maximised. This option requires more land but there is less emphasis on ocean outfalls and therefore a more favourable option from a beneficial reuse perspective.

Land requirements

Table 6-12 shows the required land for irrigation under this option. It can be seen that there is insufficient land available at Cassava to meet full irrigation requirements. Therefore other land needs to be sought and developed for irrigation purposes.

Table 6-12: Option H3(b) - Land Requirements for Irrigation

REQUIRED	**2017**	**2021**	**2031**
Cane			
Plantation's	370	650	870
TOTAL	*370*	*650*	*870*
POTENTIAL LAND			
Cassava*	320	320	320
Plantations area west of Nikenbah	50	330	550
TOTAL	*270*	*650*	*870*

* There may be more land available at cassava due to the higher quality of water used for irrigation in this option and the reduced risk of contaminating the Hervey Bay Water supply system

Storage Requirements

This strategy proposes the use of Cassava Dam No. 2 (FSL volume of 426Ml). The report suggests that wet lands might be considered as additional treatment for potable water injection into Cassava Dam. The preferred option is irrigate plantations or crops. In addition a new 200ML storage will be required to service the new plantation sites west of Nikenbah.

Infrastructure Requirements

- A 17.1km DN375 pipeline and pump station (56L/s @ 64m – 60kW) between Nikenbah WWTP and Cassava Plantation (AWTP).
- A 17.1km DN600 pipeline and pump station (202L/s @ 65m – 185kW) between Nikenbah WWTP and Cassava Plantation (Effluent Main).

The upgrades of the treatment plants reported an upgrade to both Pulgul and Nikenbah. A study by WBWC (2015) indicates that it may be possible to transfer load from one WWTP catchment to another and defer the costly upgrades of one of the treatment plants. Refer to Section 6.2.1 for further details. The upgrades are modified from the report accordingly.

– Upgrade of Pulgul Creek WWTP by 4.5Ml/day through the installation of a WWTP train similar to the membrane technology used at Nikenbah.

– Upgrade Pulgul outfall with 1.3km (DN375)

The infrastructure required is shown in Figure 6-6.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-13: Option H3(b) Estimated Infrastructure Costs

Description	Year	Cost ($000)
Cassava Irrigation Area Development (320Ha)	2017	4,160
Cassava Dam No. 2 Improvements	2017	200
Nikenbah to Cassava DN600 17.1km	2017	17,220
Pump Station at Nikenbah (202L/s @ 65m)	2017	791
Pump Station at Cassava (202L/s @ 65m)	2017	791
Acquisition and Development of new Plantation area west of Nikenbah (50Ha)	2017	1,150
Upgrade Pulgul Creek WWTP (4.5Ml)	2019	30,000
Upgrade Pulgul Outfall 1.3km DN375	2019	1,100
Acquisition and Development of new Plantation area west of Nikenbah (280Ha)	2021	6,440
Nikenbah AWTP (4ML/day)	2026	38,100
Nikenbah to Cassava DN375 17.1km	2026	10,157
AWTP pump station (56L/s @ 64m)	2026	345
Acquisition and Development of new Plantation area west of Nikenbah (220Ha)	2031	5,060
New Storage (200ML) to service area west of Nikenbah	2031	1,400
Total		**116,914**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 870Ha of plantations in this scenario yield approximately $46m.

The NPV for this option is $65.77m.

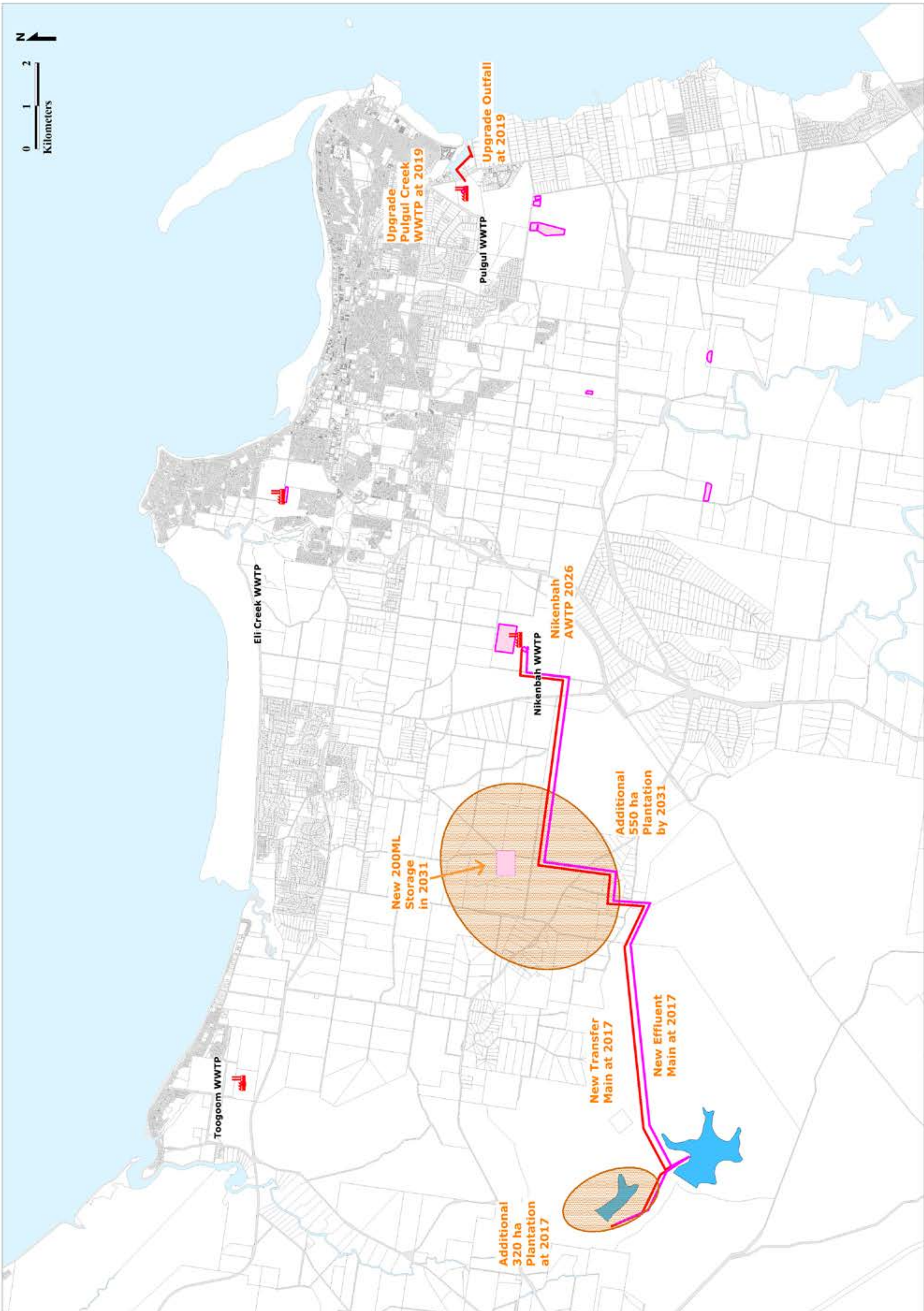


Figure 6-6: Option H3(b)

6.1.7.4 Option H4 No Reuse Option

This option involves improving the effluent quality at all of the WWTP's so that 100% discharge to receiving waters can be achieved. It is expected that upgrading all treatment plants to 3mg/L Total Nitrogen and <1mg/L Total Phosphorus or better will be required to discharge effluent into the Bay. This option requires major infrastructure works on the treatment plants and ocean outfalls. The option also involves selling all of the existing effluent reuse plantations that are owned by WBWC. This means that existing effluent customers would no longer be serviced.

Negotiation with DERM would be required to amend discharge licences to allow this option to occur.

It is unlike that this option would be adopted because it abandons an income stream (effluent supply) and a large amount of existing pipeline, pump station and dam infrastructure.

Infrastructure Requirements

The infrastructure upgrades under this option are mainly at the WWTP's to achieve effluent quality suitable for discharge into the Bay. The proposed discharge point is at the Pulgul Creek discharge point.

- Upgrade of Pulgul Creek WWTP to 9Ml/day.
- Upgrade of Nikenbah WWTP to 9Ml/day.
- Upgrade Pulgul outfall with 1.3km (DN375)
- Transfer main from Eli Creek WWTP to Nikenbah WWTP
- Transfer main from Nikenbah WWTP to Pulgul outfall (existing main could be used in short term).

The infrastructure required is shown in Figure 6-7.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-14: Option H4 Estimated Infrastructure Costs

Description	Year	Cost ($000)
Pulgul Creek WWTP Upgrade (9ML/day) – N3/P1	2019	60,000
Upgrade Pulgul Outfall 5.6km DN900	2019	25,200
Pulgul Outfall Pump Station (1200L/s @ 19m)	2019	1,075
Pipeline Eli Creek WWTP to Nikenbah WWTP DN500 7.9km	2031	6,415
Pump station at Eli Creek WWTP (318L/s @ 51m)	2031	894
Nikenbah WWTP Upgrade existing quality – N3/P1	2031	3,500
Nikenbah WWTP New Treatment Train – N3/P1	2031	42,300
Pipeline from Nikenbah to Pulgul Outfall	2031	19,804
Nikenbah discharge Pump Station	2031	1,309
Total		**160,497**

Income

It is estimated that the sales of all the existing plantations would be approximately $22m (Water Strategies Ltd, 2012). It is expected that this income would be realised in 2031.

The NPV for this option is $87.5m.

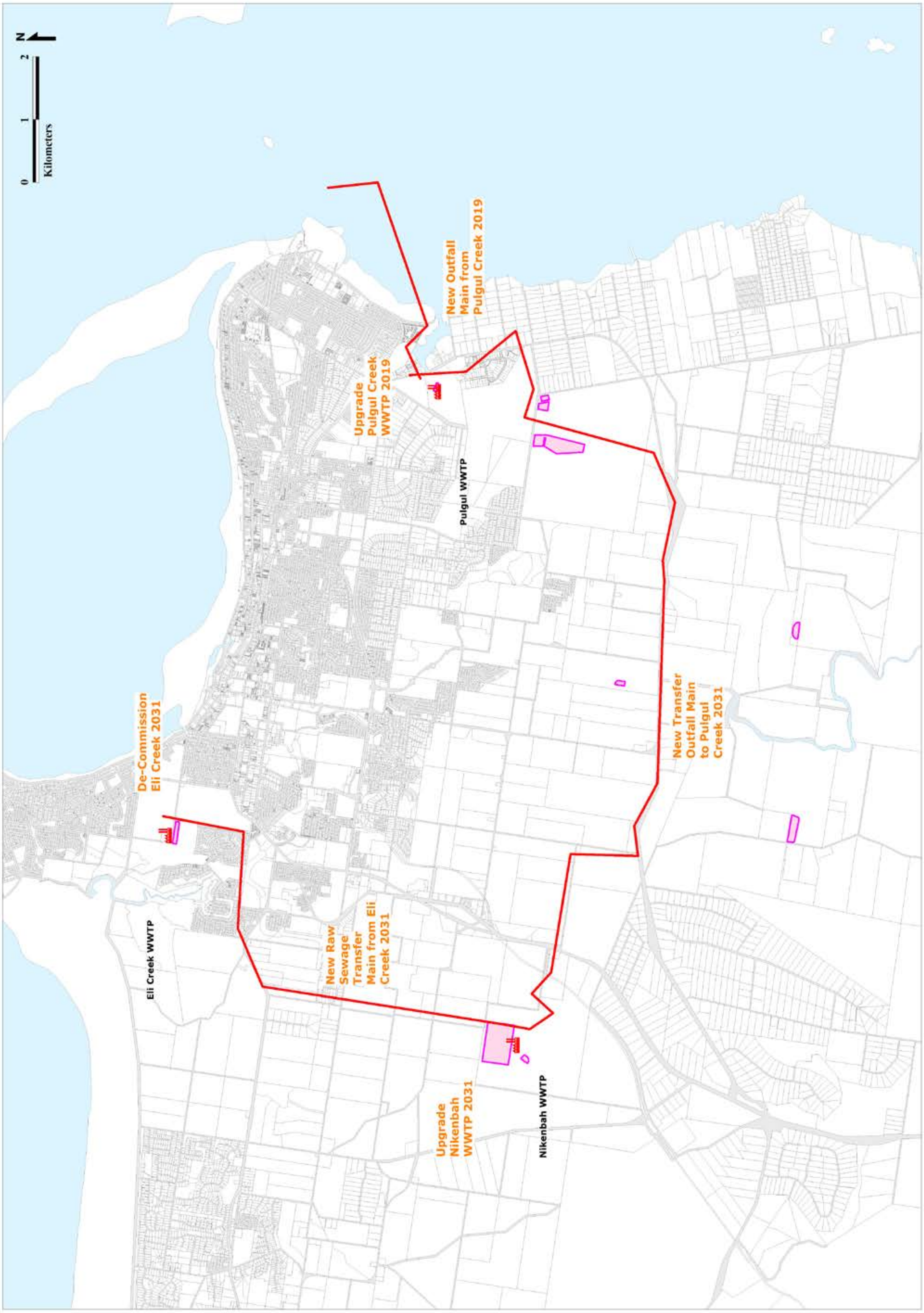


Figure 6-7: Option H4

6.1.7.5 Option H5 Dual Reticulation

Providing effluent reuse to existing properties is not economically viable. In new developments, developers may contribute to the third pipe costs but the cost of supplying infrastructure to service these pockets of development will be borne by WBWC.

Water Strategies (2011) estimates that the average cost of servicing a new development will be $3,000 per lot. $1,000 per lot is assumed to be the cost of providing the reticulation to the development and the other $2,000 is for the establishment of distribution systems, pump stations, treatment and storages.

Assuming that existing areas are to be serviced. It is estimated that to service Hervey Bay will cost approximately $63m and Maryborough is likely to cost $31m. The estimated income stream based on an effluent sale price of $0.3/kL is shown in Table 6-15. The estimated income assumes that all available effluent will be used.

Table 6-15: Option H4 Estimated Income

	2011	2016	2021	2026	2031
Available Effluent (ML/annum)	5,517	5,872	6,373	6,928	7,613
Estimated Income ($m/annum)	1.6	1.8	1.9	2.1	2.3

The payback period of this option would be in excess of 40 years.

6.1.7.6 Option M1 Link the Maryborough and Hervey Bay systems together

Option M1 involves interconnecting the Maryborough and Hervey Bay effluent reuse systems and servicing plantations along the route.

Land requirements

Table 6-16 shows the required land for irrigation under this option.

Table 6-16: Option M1 - Land Requirements for Irrigation

REQUIRED	2017	2021	2031
Plantation's	293	293	293
TOTAL	*293*	*293*	*293*
POTENTIAL LAND			
Plantations area between Hervey Bay and Maryborough	293	293	293
TOTAL	*293*	*293*	*293*

Storage Requirements

This option does not propose any additional storage but instead makes use of the existing storages for maximum efficiency. The report indicates that the addition of 200ML of storage in this option would decrease the amount of irrigation land required to 238Ha. The reduction in area from 293Ha to 238Ha of 55Ha equates to approximately $1.3m (at a rate of $23k/Ha) to acquire and develop an irrigation site. This compares to $1.4m to establish a 200ML storage at $7k/ML.

Infrastructure Requirements

– A 24.3km DN375 pipeline and pump station (106L/s @ 67m – 100kW) between St Helens effluent storage lagoon and Nikenbah effluent storage lagoon.

The infrastructure required is shown in Figure 6-8.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-17: Option M1 Estimated Infrastructure Costs

Description	Year	Cost ($000)
Upgrade Aubinville WWTP (Additional Treatment 2.5Ml/day)	2026	16,667
Upgrade Aubinville WWTP (Quality Improvement 5.625Ml/day)	2026	18,750
Pipeline link to Nikenbah (24.3km DN375)	2017	14,434
St Helens Effluent Storage Pump Station (106L/s@67m)	2017	537
Land acquisition and Plantation Development (between HB and MB) (293Ha)	2017	6,739
Total		**57,127**

Income

It is estimated that from plantations, an income over and 18 year lifespan is $53,000/Ha (Water Strategies, 2012). Using this as a basis and realising 293Ha of plantations in this scenario yield approximately $15.5m.

The NPV for this option is $31.78m.

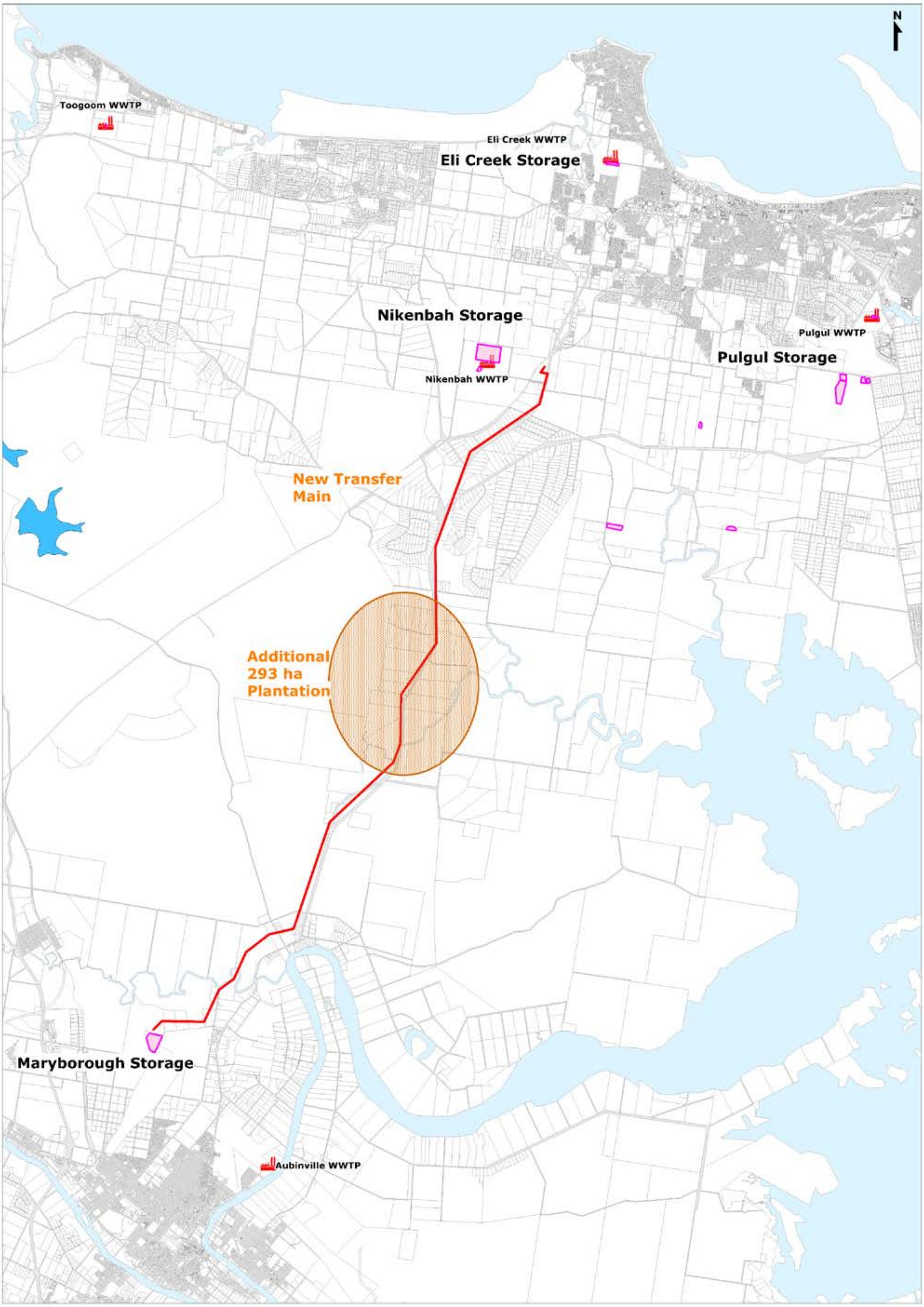


Figure 6-8: Option M1

6.1.7.7 Option M2 Extend Effluent Scheme to MSF Cane Plantations

Option M2 involves the addition of additional cane customers on the effluent reuse scheme. It relies on Maryborough Sugar Factory (MSF) using effluent for growing cane and so usage of effluent will be seasonal and dependent on weather conditions.

One of the greatest advantages of this option is that land used for irrigation would be owned by a third party and there would be no costs associated with land purchase or land upkeep required from WBWC.

Land requirements

Table 6-18 shows the required land for irrigation under this option.

Table 6-18: Option M2 Land Requirements for Irrigation

REQUIRED	**2017**	**2021**	**2031**
Cane	720	720	720
TOTAL	*720*	*720*	*720*
POTENTIAL LAND			
Maryborough Sugar	720	720	720
TOTAL	*720*	*720*	*720*

Storage Requirements

This option requires the installation of an effluent storage lagoon at the MSF site. The size of the storage is 500ML.

Infrastructure Requirements

– A 4.7km DN450 pipeline and pump station (180L/s @ 35m – 100kW) between Aubinville WWTP and a new effluent storage lagoon at the MSF site.

The infrastructure required is shown in Figure 6-9.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-19: Option M2 Estimated Infrastructure Costs

Description	Year	Cost ($000)
Upgrade Aubinville WWTP (Additional Treatment 2.5Ml/day)	2026	16,667
Upgrade Aubinville WWTP (Quality Improvement 5.625Ml/day)	2026	18,750
Pipeline from Aubinville WWTP to MSF site (4.7km DN450)	2017	4,671
Aubinville WWTP Pump Station (180L/s@35m)	2017	537
Effluent Storage lagoon (500ML)	2017	3,500
Total		**44,124**

The NPV for this option is $25.89m.

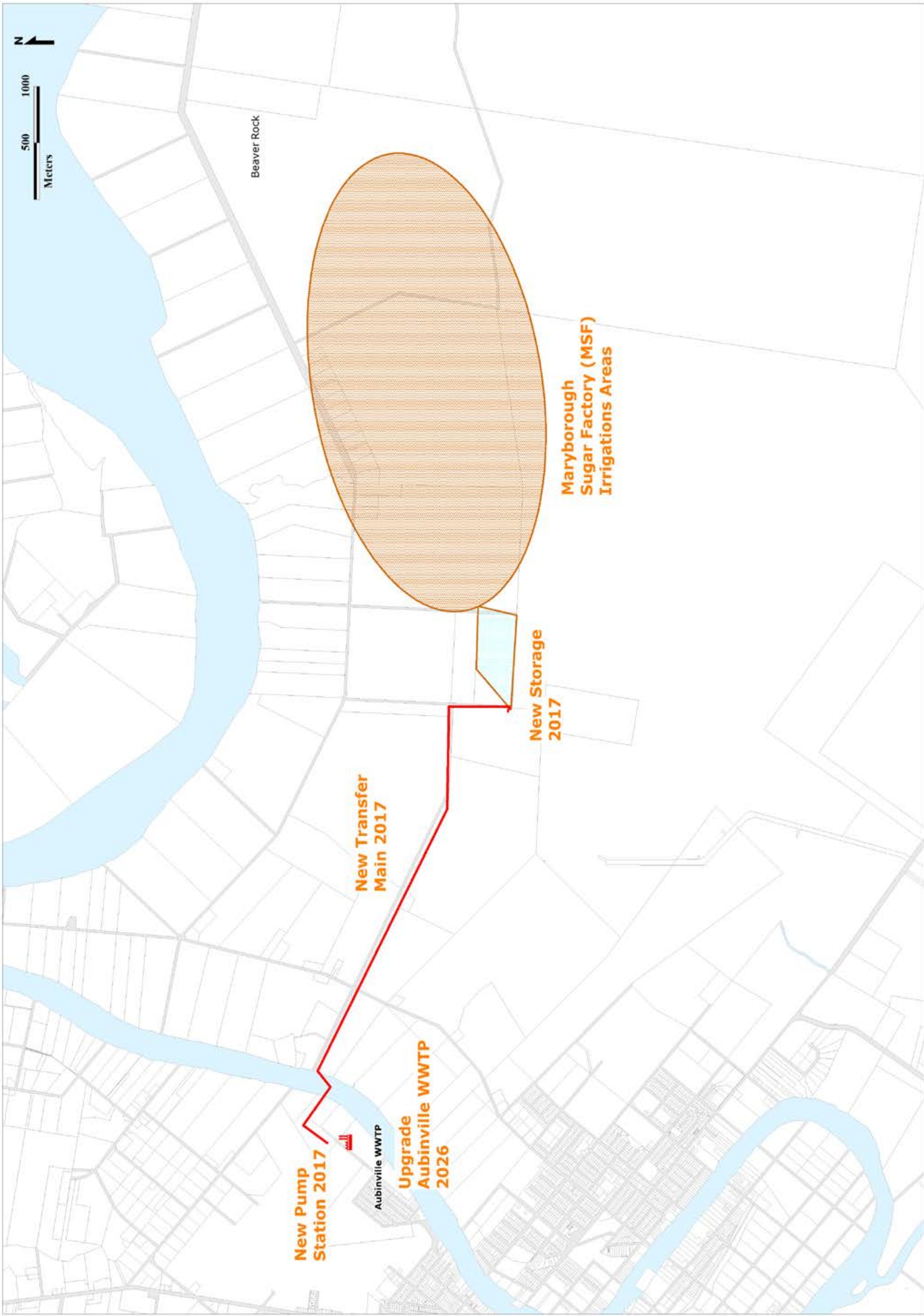


Figure 6-9: Option M2

6.1.7.8 Option M3 Upgrade the Aubinville WWTP and continue discharging to the Mary River

Option M3 involves upgrading the Aubinville WWTP so that the Quality is suitable for discharge to the Mary River. This option would require negotiation of a discharge licence with DERM. It also requires upgrading of the treatment plant to improve treatment quality and capacity.

The existing irrigation sites are maintained in this option and any excess flow is discharged to the Mary River through the existing outfall.

Costs

The costs in the report have been revised to reflect present day figures.

Table 6-20: Option M3 Estimated Infrastructure Costs

Description	Year	Cost ($000)
Upgrade Aubinville WWTP (Additional Treatment 2.5Ml/day)	2026	16,667
Upgrade Aubinville WWTP (Quality Improvement 5.625Ml/day)	2026	18,750
Total		**35,417**

The NPV for this option is $18.2m.

6.1.7.9 Minor Centres

The assessment at Burrum Heads was that an additional 4Ha of cane plantation was required in 2031 to meet the 90% reuse. Additional irrigation area is available at the Dreamtime plantation site and is sufficient to meet future requirements.

Toogoom will require further irrigation areas into 2031 (nominally 20Ha). The report indicates that there is little/no land available which would be suitable for irrigation near the Toogoom WWTP. An option in the report is to pipe the effluent to Cassava Dam. Another option may exist, which is to pipe the effluent to the Dreamtime plantation and combine the Burrum Heads and Toogoom Effluent Reuse Schemes.

Howard. There are no plans to increase the capacity of the Howard WWTP and hence the effluent discharge volumes should remain constant.

Torbanlea does not require any upgrades in the future. There are no plans to increase the sewerage supply area in this location.

6.1.7.10 Comparison of Options

The options summary and costs are included below in Table 6-21 for comparison.

Table 6-21: Comparison of Reuse Options

Option	Description	Capex	NPV
H1	Cassava Development Expand the irrigation to Cassava	93.4	51.4
H2(a)	This option involves replacing the existing Pulgul Creek WWTP with a 9.0ML/day WWTP. Discharge is to the Pulgul outfall	87.3	64.3
H2(b)	This option involves the addition of a 4.5Ml/day treatment train at Pulgul Creek WWTP and diverting all sewage inflows to it. All effluent from this treatment train would be disposed through the Pulgul outfall. Any additional flows are treated by the existing Pulgul Creek WWTP and disposed of through irrigation	77.5	44.7
H3(a)	This option considers potable reuse and disposal of effluent through maximising discharges at Pulgul Creek	91.4	57.7
H3(b)	This option considers potable reuse and disposal of effluent by maximising effluent reuse for irrigation	116.9	65.8
H4	This option considers “No Reuse” as a strategy	160.5	95.8
H5	Dual Reticulation		
M1	Link the Maryborough and Hervey Bay systems together	57.1	31.8
M2	Extend the supply to Maryborough Sugar Factory Farms to Achieve 90% reuse	44.1	25.9
M3	Upgrade the Aubinville WWTP and continue discharging to the Mary River	35.4	18.2

6.1.7.11 Preferred Option

For the Hervey Bay reuse scheme the preferred option is H2(b). This option has the smallest capital costs and NPV based on capital costs. It also provides the best flexibility as it;

- Provides for additional irrigation (beneficial reuse)
- Provides a connection between Nikenbah and Cassava (potential indirect reuse at a later date)
- Improved water quality to discharge into receiving waters at Pulgul.

Therefore Option H2(b) is the recommended option for Hervey Bay. The option allows for a pipeline to Cassava, upgrading of the Pulgul Creek WWTP and extension of the outfall at Pulgul. While the costings were revised, the component timings were taken directly from the Water Strategies (2011) draft report.

A detailed planning study will be required using the preferred option as a base scenario but investigating factors such as;

– An increase in the discharge licence at Pulgul Creek WWTP. An increase to 8.3ML/day (from the current 2ML/day) would have the impact of postponing any requirements for additional irrigation at Cassava by approximately 15 years. Dispersion modelling of the Pulgul outfall is currently being undertaken and preliminary results indicate that sufficient dispersion can be achieved with an 8.3ML to 9ML discharge rate.

– An alternative to the proposed new plant at Pulgul might be to increase the capacity of the existing plant to 8.3ML at around $25-30m (similar cost to a new 4.5ML/day plant proposed).

The detailed planning study will determine the scope and timing of works prior to any expenditure under this option.

In Maryborough the preferred option is M3 which allows for better effluent quality to allow continued discharge into the Mary River, while maintaining existing beneficial reuse. This option provides the smallest capital costs while maintaining existing beneficial reuse of effluent.

RECOMMENDATION: Carry out a detailed planning report on the viability and timing of components in option H2(b) in 2016 at a cost of $80k.

RECOMMENDATION: Adopt H2(b) as the direction for effluent reuse at the Hervey Bay effluent reuse scheme at a total Capital cost of $77.5m at timings shown in Table 6-9.

RECOMMENDATION: Adopt M3 as the direction for effluent reuse at the Maryborough effluent reuse scheme at a cost of $35.4m at timings shown in Table 6-20.

6.1.8 Biosolids Disposal and Management

Previous reports for the disposal and storage of biosolids indicated that biosolids should be temporarily stored at WWTP sites of Eli Creek WWTP and Pulgul Creek WWTP site. Biosolids would be dewatered at these sites and stored in sealed skip bins until transported to the Nikenbah WWTP for storage.

6.2 Sewerage Treatment

The Fraser Coast WWTP's are expected to treat all of the sewage produced from the existing residential and industrial customers as well as the treatment of sewage produced as new land is developed into residential and commercial or industrial areas. The expected development areas were outlined in Section 5. Table 6-22 summarises the projected WWTP catchment ED over the planning horizon to 2031.

Table 6-22: Projected ED for each WWTP Catchment

WWTP	2016	2021	2026	2031	2036
Aubinville WWTP	11,615	12,061	12,522	13,007	13,590
Burrum Heads WWTP	1,079	1,201	1,337	1,358	1,418
Eli Creek WWTP	6,959	7,518	8,097	8,794	9,188
Howard WWTP*	53	53	53	53	86
Nikenbah WWTP	7,638	8,327	9,264	10,407	11,322
Pulgul Creek WWTP	10,863	12,156	13,586	15,532	16,898
Toogoom WWTP	622	672	731	842	916
Torbanlea WWTP	140	143	145	149	156

* The Howard WWTP is not expected to be upgraded in the planning horizon although the township is expected to grow over the same period.

Table 6-23 shows the capacity of each of the WWTP's and the projected demand in 2036. It can be seen that Pulgul, Aubinville and Toogoom WWTP's will require upgrading within the 2031 planning horizon. It also shows that Nikenbah WWTP (if considered individually) and Burrum Heads WWTP will require upgrading before 2036.

Table 6-23: Fraser Coast WWTP Capacities

	Hydraulic Capacity		Biological Capacity		Projected 2036
	ED	ML/Day	ED	ML/Day	Ml/day
Nikenbah WWTP	10,667	4.8	10,667	4.8	**5.095**
Pulgul Creek WWTP	9,720	4.4	9,720	4.4	**7.604**
Eli Creek WWTP	10,000	4.5	7,500	3.2	4.135
Burrum Heads WWTP	1,389	0.625	1,042	0.625	**0.638**
Toogoom WWTP	833	0.375	1,389	0.375	**0.412**
Torbanlea WWTP	138	0.062	115	0.052	0.049
Howard WWTP	40	0.024	40	0.018	0.024
Aubinville	12,500	5.625	12,500	5.625	**6.116**

6.2.1 Hervey Bay

The Hervey Bay sewerage system consists of three separate sewerage systems, the Nikenbah catchment, Eli Catchment and the Pulgul catchment. The three catchments are adjacent to one another and when considering upgrades to treatment plants it is beneficial to consider all three catchments together.

6.2.1.1 Capacity for Growth

The Pulgul Creek WWTP is currently at capacity and will require a capacity upgrade in the near future. Figure 6-10 shows the projected loading on the WWTP over the planning horizon. Its current capacity is 4.4Ml/day and its current load is in excess of this figure already.

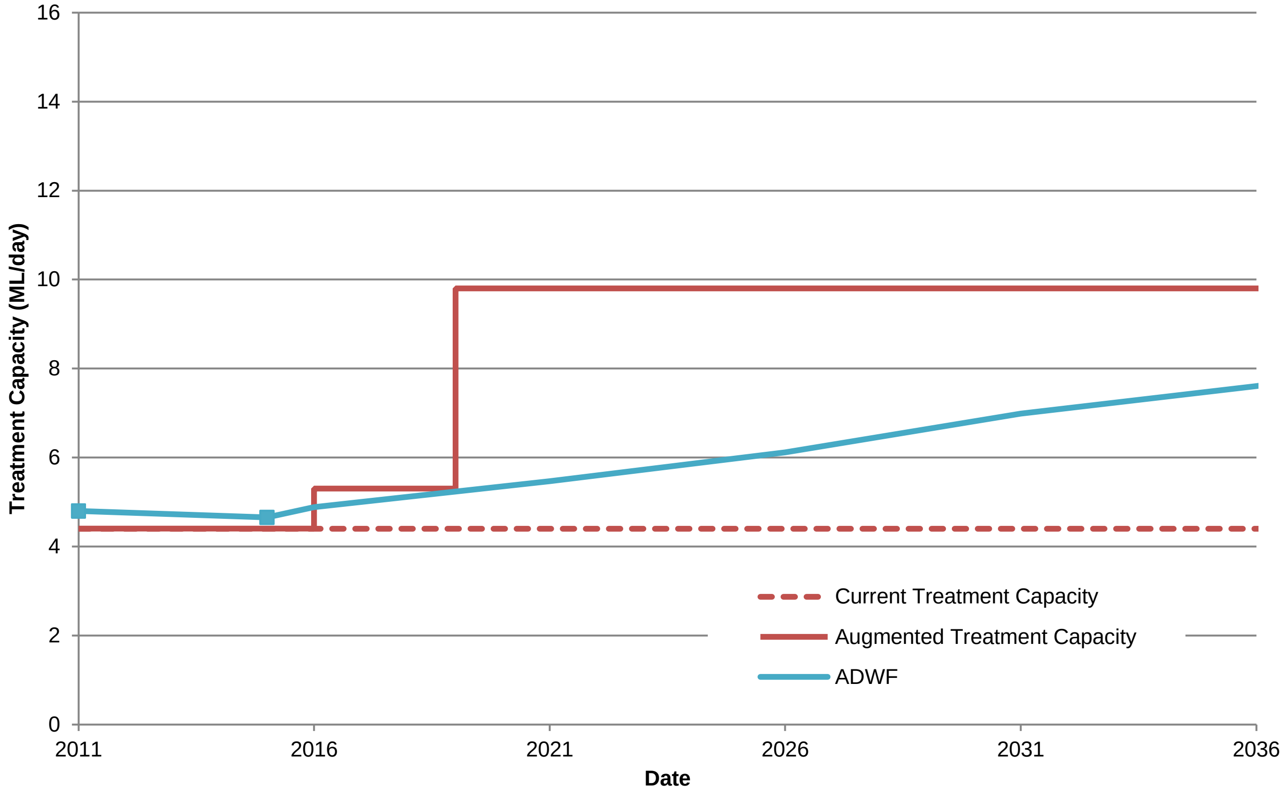


Figure 6-10: Pulgul Creek WWTP Capacity

The required works are to

– Carry out a minor (2,000ED) upgrade to the treatment plant immediately (2016) at a cost of $6m.

– Carry out a 10,000ED upgrade to the Pulgul Creek WWTP in 2019 at a cost of $30m.

The Nikenbah WWTP has a design capacity of 10,666 ED (4.8ML/day) and the catchment will exceed the capacity of the WWTP in 2032. The WWTP has been designed in a modular configuration so that additional treatment process trains can be added cost effectively. Two additional treatment trains of 10,666ED (4.8ML) have been proposed at Nikenbah, the first being required in 2032 based on current load projections.

Figure 6-11 shows the current WWTP load projections along with the augmented capacity.

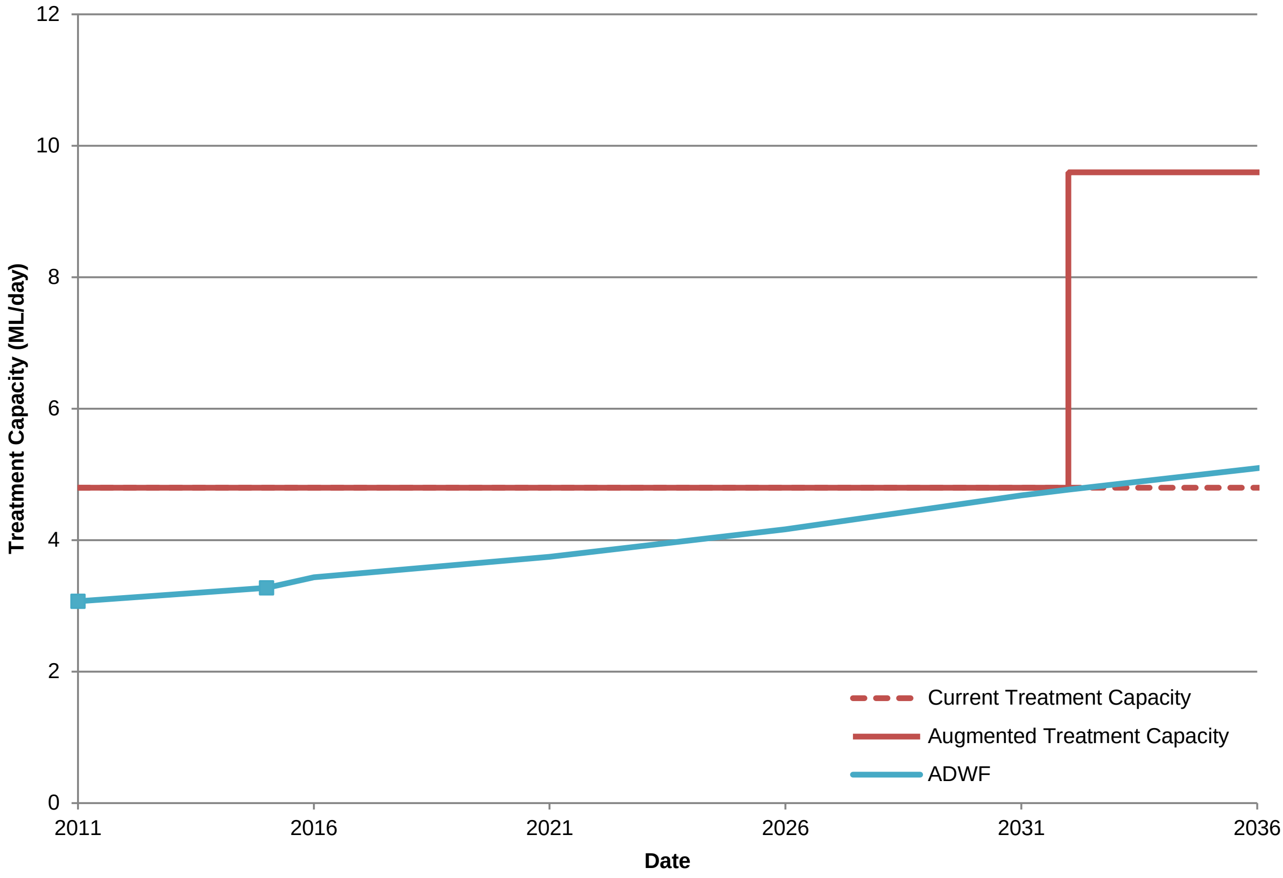


Figure 6-11: Nikenbah WWTP Capacity

When Eli Creek WWTP again reaches its design capacity (by 2046), there will be a need to transfer loads from the Eli Catchment to an augmented Nikenbah WWTP. This can be achieved by development of a balance tank at Eli that will receive flows from PS4 and then distributes the flow between Eli Creek and Nikenbah WWTP's.

Figure 6-12 shows the projected load on the Eli Creek WWTP and plant capacity. It can be seen that the WWTP does not reach its treatment capacity based on the projected sewerage demands over the planning period and therefore no upgrades are required to this treatment plant in the planning horizon.

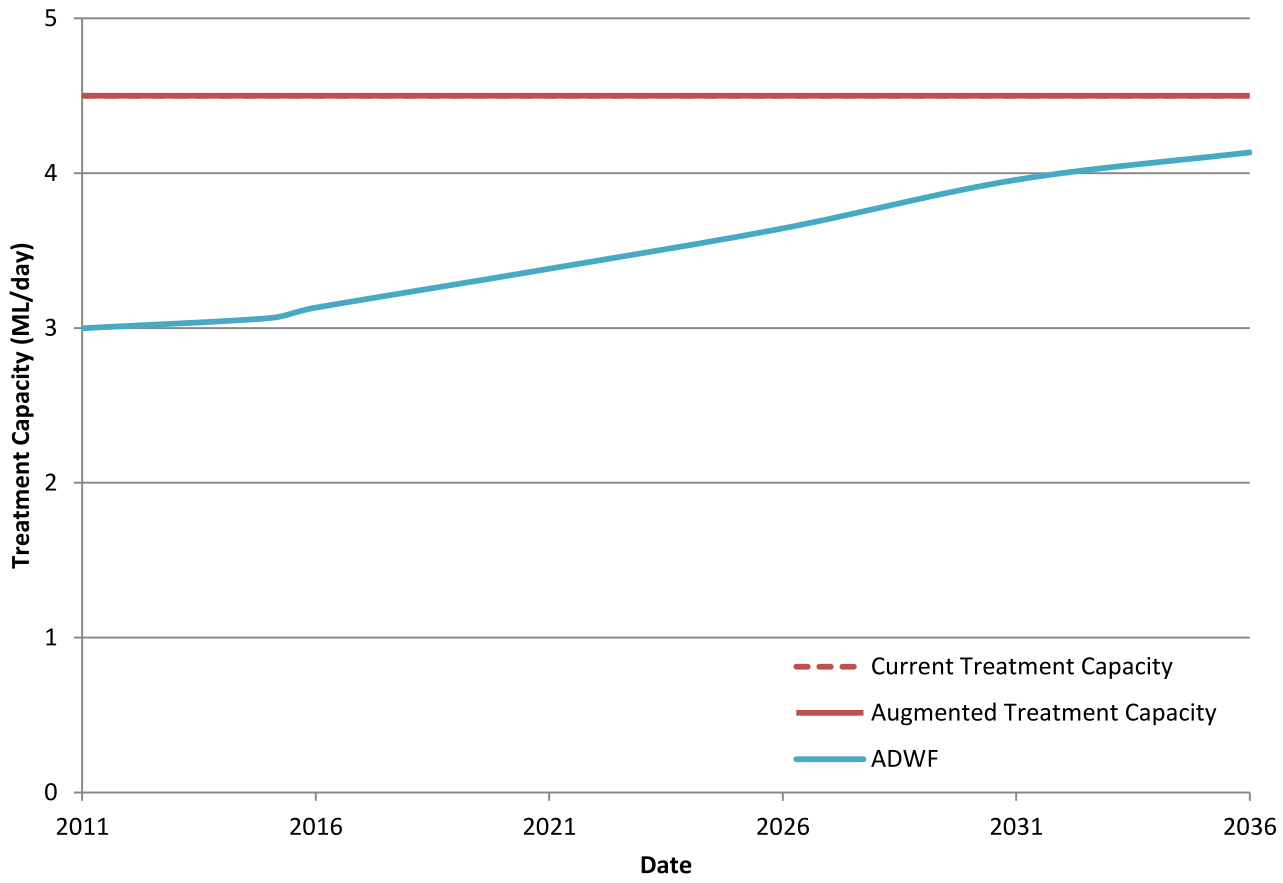


Figure 6-12: Eli Creek WWTP Capacity

If the three WWTP's in Hervey Bay are considered separately it can be seen that Pulgul Creek WWTP will require upgrading immediately, Nikenbah WWTP will require upgrading in 2032 while Eli Creek does not require a hydraulic upgrade within the planning horizon.

Since the three catchments are located adjacent to one another there is opportunity to divert sewage flows from one catchment to the other in order to maximise the usage of the Hervey Bay WWTP's prior to upgrading.

WBWC (2014) produced a draft report titled "Hervey Bay WWTP Catchments – Modifying Catchment Boundaries – Financial Assessment" on the modification of WWTP catchment boundaries in Hervey Bay.

Table 6-24 shows the capacity and projected ED loading on the Nikenbah and Pulgul Creek WWTP's.

Table 6-24: Pulgul and Nikenbah WWTP Catchment ED's and Capacity (source: WBWC 2014)

Catchment	ED 2016	ED 2021	ED 2026	ED 2031	ED 2036
Eli Creek WWTP Catchment	6,959	7,518	8,097	8,794	9,188
Pulgul Creek WWTP Catchment	10,863	12,156	13,586	15,532	16,898
Nikenbah WWTP (Within PIA)	7,638	8,327	9,264	10,407	11,322
Total (Nikenbah and Pulgul)	18,501	20,483	22,850	25,939	28,220
Capacity (Nikenbah and Pulgul)	*20,667*	*20,667*	*20,667*	*20,667*	*20,667*
Upgrade at Pulgul	*2,000*	*10,000*			
Adjusted Capacity (Nikenbah and Pulgul)	*20,667*	*22,667*	*30,667*	*30,667*	*30,667*

The capacity of the system is reached in 2022 and therefore additional capacity will be required.

Four options were presented in the report.

Option 1 – This option involves treating each of the WWTP catchments in isolation. An upgrade of the Pulgul Creek WWTP in 2019 would be required to meet growth within the catchment. The Nikenbah WWTP would need to be upgraded in 2030 to meet the growth in its catchment. The NPV for this option is $39.1m.

Option 2 – This option involves a minor upgrade to the Pulgul Creek WWTP (additional 2,000ED to a total capacity of 12,000ED). Transfer sewage (3,350ED) from the Pulgul catchment to the Nikenbah catchment via the Eli catchment. Under this scenario Pulgul Creek WWTP's load would be maintained below 12,000ED until 2036 at which time an upgrade to this treatment plant would occur. This option involves diverting sewage from PS06 to the Nikenbah catchment. It also requires upgrading the capacity of PS05 and the capacity and rising main at PS83. An upgrade of the Nikenbah WWTP would need to occur in 2020. The NPV for this option was $35.3m. Figure 6-13 shows the extent of the infrastructure required under this option.

Figure 6-13: Combined Catchment Option 2

Option 3 – This option involves diverting sewage from the Pulgul catchment to the Nikenbah catchment and upgrading the Nikenbah WWTP as required. Two sub options were considered here.

- Option 3a – Uses the existing infrastructure within the Pulgul and Eli Creek catchments as much as possible to convey sewage from the Pulgul catchment to the Nikenbah catchment.
- Option 3b – redirects a few of the key pump stations in the Pulgul catchment directly to the Nikenbah WWTP.

Option 3a involves the same upgrades as option 2 but after 2036 further sewage would be diverted from the Pulgul catchment to the Nikenbah catchment. To facilitate this option PS08 and PS09 would be redirected to PS06 and diverted to the Nikenbah catchment via the Eli Creek catchment. In addition PS14 will need to be diverted to the Nikenbah catchment after 2035. The NPV of this option is $35.5m. Figure 6-14 shows the extent of the infrastructure required under this option. This option relies on upgrading a large extent of infrastructure within built up areas

Option 3b involves the use of Nikenbah as the primary treatment site. It involves diversion of some of Pulgul catchment to the Nikenbah catchment. This option redirects PPS79 to Nikenbah WWTP via the future development area identified under the Nikenbah Structure Plan area. Figure 6-15 shows the extent of the works. The NPV for this option is $39.3m. This option is the highest capital cost option because it involves a larger scope of works (particularly the rising main from PPS79). Regardless, this option has the advantage of passing through the future Nikenbah Structure Plan area. Any infrastructure installed could be used in the future for the Nikenbah area.

Figure 6-14: Combined Catchment Option 3a

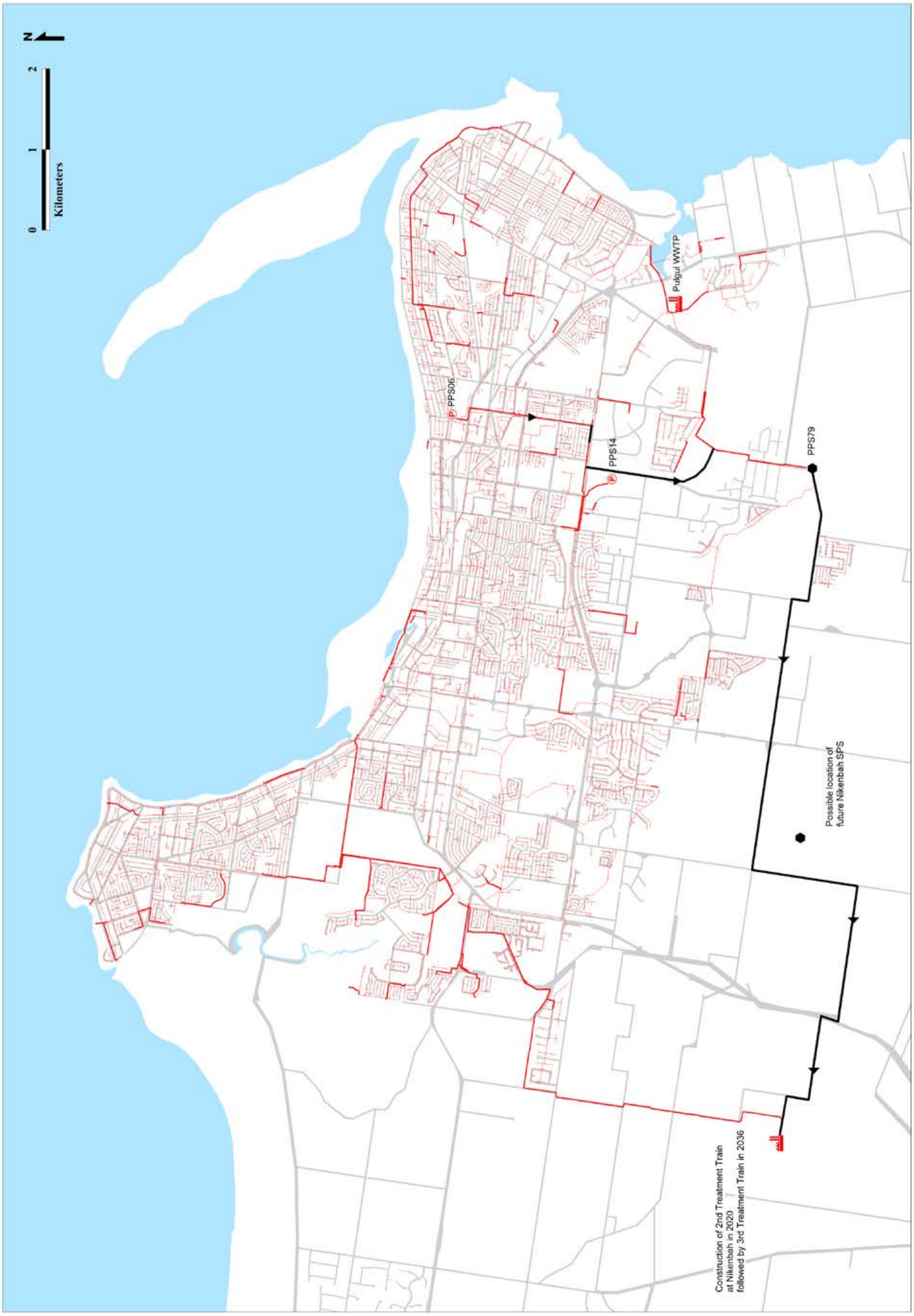


Figure 6-15: Combined Catchment Option 3b

Option 4 – This option involves upgrading the Pulgul Creek WWTP to 22,000ED, while diverting sewage from the Nikenbah catchment to the Pulgul catchment. To facilitate this option EPS23 will need to be diverted to the Nikenbah catchment. In addition a new SPS will need to be constructed on Nissen St to divert sewage back to EPS23. An upgrade of EPS23 will be required to facilitate the additional load from the new SPS. The NPV of this option is $32.8m. Refer to Figure 6-16 for full extent of infrastructure works required in this option.

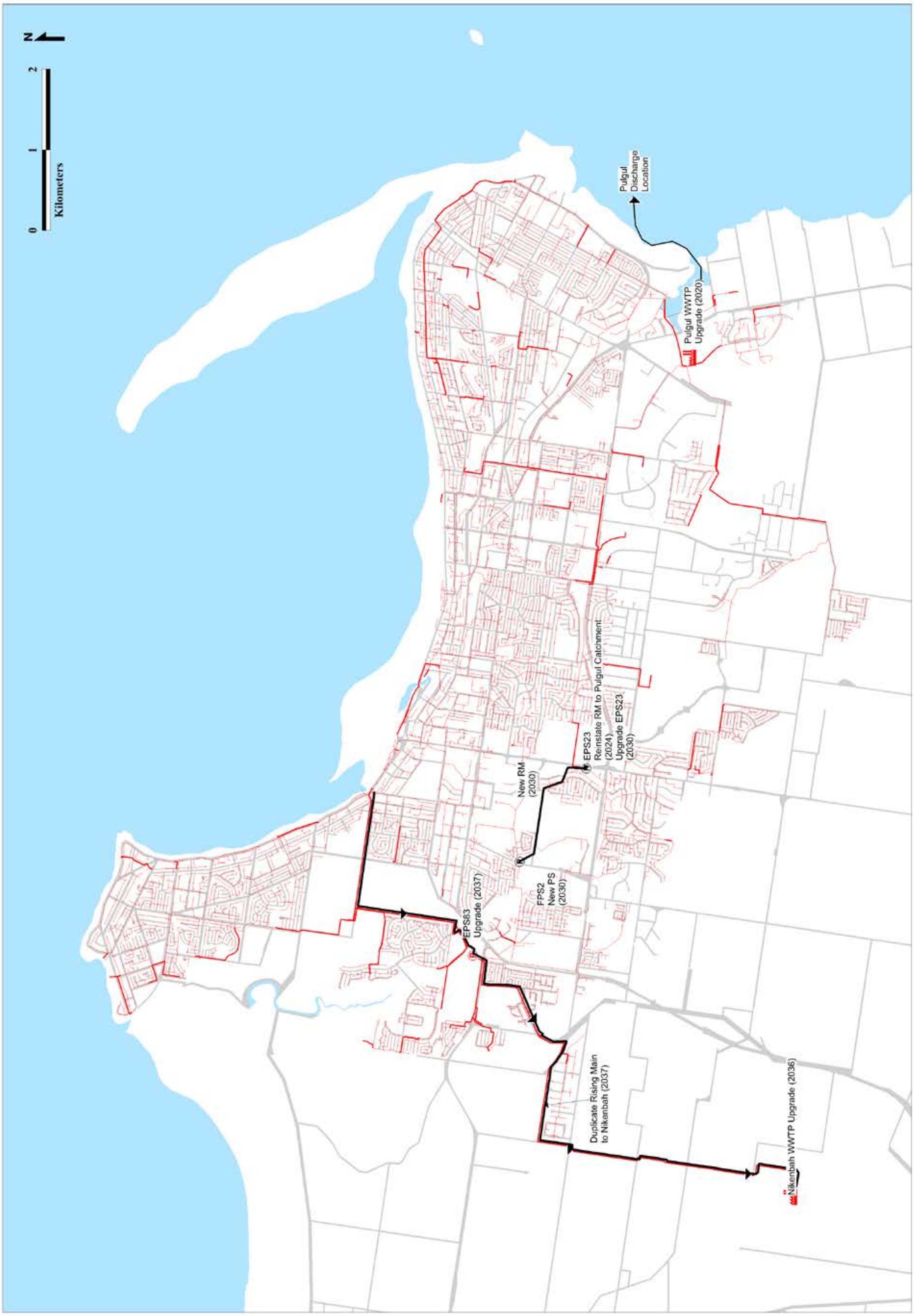


Figure 6-16: Combined Catchment Option 4

A comparison of the options is included in Table 6-26.

Table 6-25: Comparison of Options

Option	NPV ($m)	Advantages	Disadvantages
Option 1 – Upgrade Pulgul Creek WWTP and upgrade Nikenbah WWTP	39.1	– Maintains segregation of catchments. – Large additional capacity if any development boom occurs	– High initial capex – Inefficient use of infrastructure
Option 2 – Transfer sewage from Pulgul to Nikenbah by diverting PPS06, PPS08 and PPS09 (Upgrade Nikenbah WWTP upgrade first and Pulgul later)	35.3	– Makes use of existing infrastructure	– No access to outfall – Upgrades required in built up area along esplanade
Option 3a – Transfer sewage from Pulgul to Nikenbah by diverting PPS06, PPS08 and PPS09, PPS14 and new SPS at Emerald Park Way (FPS1) (Upgrade Nikenbah WWTP only)	35.5	– Makes use of existing infrastructure – Nikenbah is remote to development	– No access to outfall – Upgrades required in built up area along esplanade
Option 3b – Transfer sewage from Pulgul to Nikenbah by diverting PPS79, PPS14 and PPS06 (Upgrade Nikenbah WWTP only)	39.3	– Provides some infrastructure to service Nikenbah Structure Plan area	– High initial capex – No access to outfall
Option 4 – Divert sewage from Nikenbah to Pulgul Catchment through diversion of EPS23 and a new pump station on Nissen St (FPS2) (Upgrade Pulgul Creek WWTP first and then Nikenbah WWTP)	32.8	– Lowest Capex cost of options – Provides treatment near good outfall	– Requires and additional SPS – Pulgul is close to existing residential areas

Option 4 provides the most economical option and has several benefits over the other options.

– Pulgul has an existing licenced waterway outfall. It is proposed to increase the volume on the outfall licence limit to 6ML/day ADWF (currently 2ML/day ADW).

– This option defers the expensive upgrades required to EPS83 and its rising main.

For these reasons Option 4 is the preferred option. This option is also complimentary to option H2(b) in Section 6.1.7.

RECOMMENDATION: Adopt Option 4 and upgrade Pulgul Creek WWTP and divert EPS23 into the Pulgul catchment in 2019.

6.2.1.2 Eli Creek WWTP

6.2.1.2.1 Effluent Quality

The effluent quality produced at the Eli Creek WWTP is shown in Figure 6-17. Samples were taken at the outlet of the treatment plant. The data spans 2013 to 2015 and identifies the sampled levels of suspended solids, BOD, Total Nitrogen and Total Phosphorus.

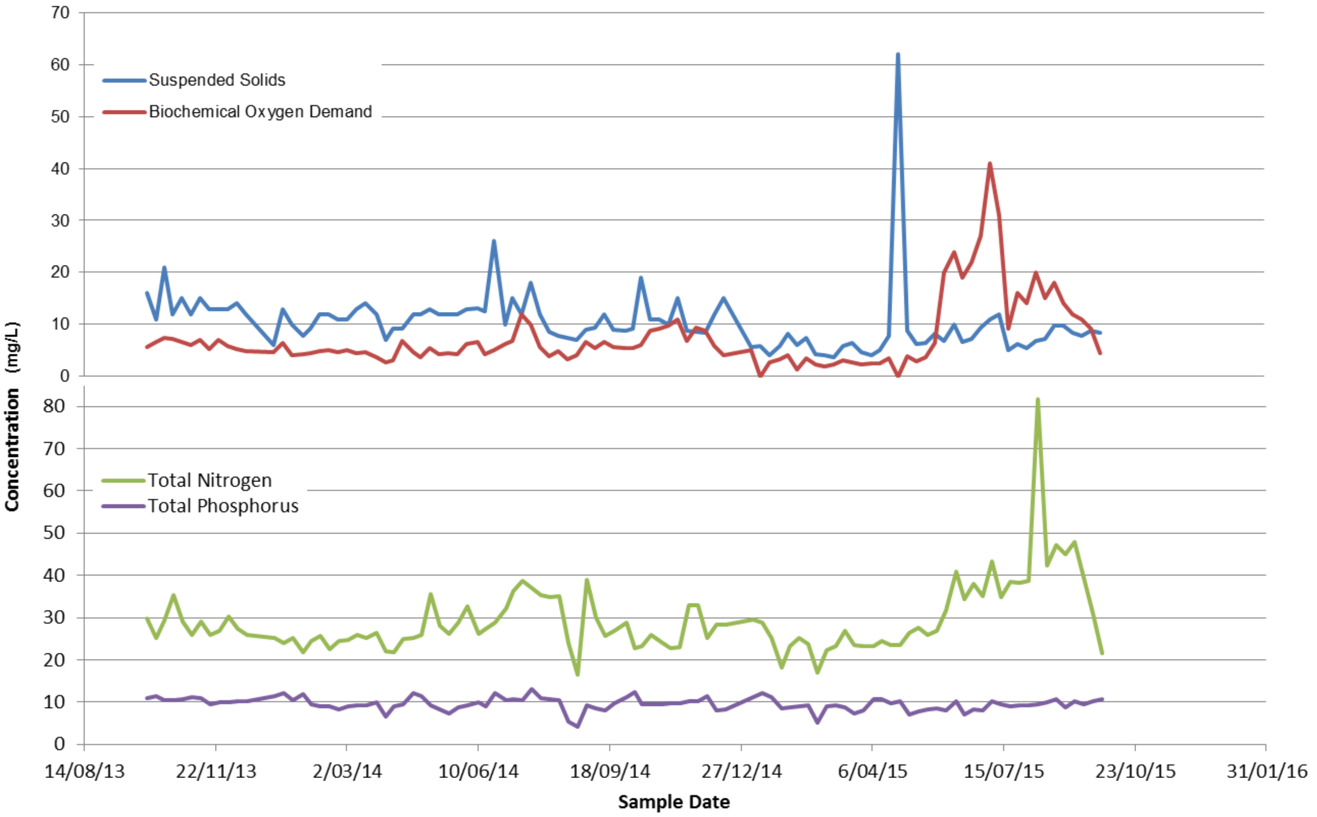


Figure 6-17: Eli Creek WWTP Effluent Quality – 2013 to 2015

The data shows some elevated readings in Nitrogen levels between June 2015 and September 2015. This may be due to replacement of trickling filter arms which occurred during that time. The occasional spikes that are shown in the graph could be due poor sampling technique and may not be necessarily representative of the output quality of the plant.

6.2.1.2.2 Discharges to the Environment

Whilst licence conditions are generally met, Eli Creek WWTP does have hydraulic limitations during wet weather events and overflows from the plant do occur through the Eli Creek outfall during such events.

Environmental licence allows discharge to receiving waters (Eli Creek) and land. Eli Creek flows into Wide Bay which also has stringent water quality objectives according to the Environmental Protection (Water) Policy 2009.

The current environmental licence has limits on nutrient mass loads (rolling), daily discharge volume and daily nutrient release limits as well as a reuse volume requirement that 90% ADWF is irrigated to land. It also has a requirement for tide based release. During dry years, WBWC generally meets its licence requirements but during wet years much more difficulty arises in meeting these.

During higher periods of rainfall, a number of sewage pump stations are diverted from the Nikenbah catchment to Eli Creek WWTP, to reduce the flow to the Nikenbah WWTP. Nikenbah does not have defined receiving water under its discharge licence.

Discharge to Receiving Waters

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA*	1.4	12	5.4	15	9.28	35	41
Suspended Solids (mg/L)	NA*	3.6	15	9.4	25	13	45	62
Dissolved Oxygen (mg/L)	2	2.4	NS*	3.8	NS*	4.8	NS*	6.7
pH (pH units)	6.5	6.4	NS*	6.9	NS*	7.1	8.5	7.4
E. Coli (CFU/100mL)	NA*	2	150	21	600	63	NS*	2200
Total Phosphorus (mg/L)	NA*	4.23	NS*	9.52	NS*	10.7	NS*	13.2
Total Nitrogen (mg/L)	NA*	16.4	NS*	26.9	NS*	35.2	NS*	81.6

6.2.1.2.3 Odour Buffers

The Eli Creek WWTP is located between Eli Water residential area to the south and south west and Martin Street residential area to the north.

The prevailing wind direction is south east for the majority of the year which generally does not affect any residential areas, however north easterly winds could be expected at 4.1m/s at times between 1pm and 6pm. In these cases odour complaints could be received from the residential area to the south and south west.

A study by PAE Holmes (2012) indicates that the 2.5ou contour was exceeded at a number of sensitive receptors under maximum emission rates (i.e. plant upset conditions). Under these conditions approximately 28 properties were within the 2.5ou contour. Under normal operating conditions adverse impacts were not expected. The report concluded that the WBWC adopted buffer of 400m for the Eli Creek WWTP appeared to be reasonable.

6.2.1.2.4 Reuse

Discharge to Land

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA*	1.4	12	5.4	15	9.28	35	41
E. Coli (CFU/100mL)	NA*	2	150	21	600	63	NS*	2200
pH (pH units)	6.5	6.4	NS*	6.9	9.5	7.1	NS*	7.4
Total Dissolved Salts (mg/L)	NA*	711	NS*	1384	NS*	1469	1560	1595
Sodium Absorption Ratio (SAR)	NA*		NS*		NS*		NS*	
Total Nitrogen (mg/L)	NA*	16.4	NS*	26.9	NS*	35.2	NS*	81.6
Total Phosphorus (mg/L)	NA*	4.23	NS*	9.52	NS*	10.7	NS*	13.2

6.2.1.3 Pulgul Creek WWTP

6.2.1.3.1 Capacity for Growth

Even with the transfer of EPS23 to Nikenbah WWTP in 2010, the Pulgul Creek WWTP is operating over its capacity based on current ED loads entering the plant. The plant is hydraulically limited in its current configuration.

Figure 6-10 showed the projected loads on the plant and the urgency of augmentation to meet future demands. Commencement of planning for the next augmentation should commence in 2019 as it is likely that commissioning a new WWTP could take 3 years (bringing completion to 2022).

– Carry out a minor (2,000ED) upgrade to the treatment plant immediately

– Carry out a major upgrade (10,000ED) upgrade to the Pulgul Creek WWTP.

RECOMMENDATION: Minor upgrade to Pulgul Creek WWTP (2,000ED) in 2016 at a cost of $6m.

RECOMMENDATION: Major upgrade to the Pulgul Creek WWTP (10,000ED) commencing in 2019 at a cost of $30m.

6.2.1.3.2 Effluent Quality

The effluent quality produced at the Eli Creek WWTP is shown in Figure 6-18. Samples were taken at the outlet of the treatment plant. The data spans 2013 to 2015 and identifies the sampled levels of suspended solids, BOD, Total Nitrogen and Total Phosphorus.

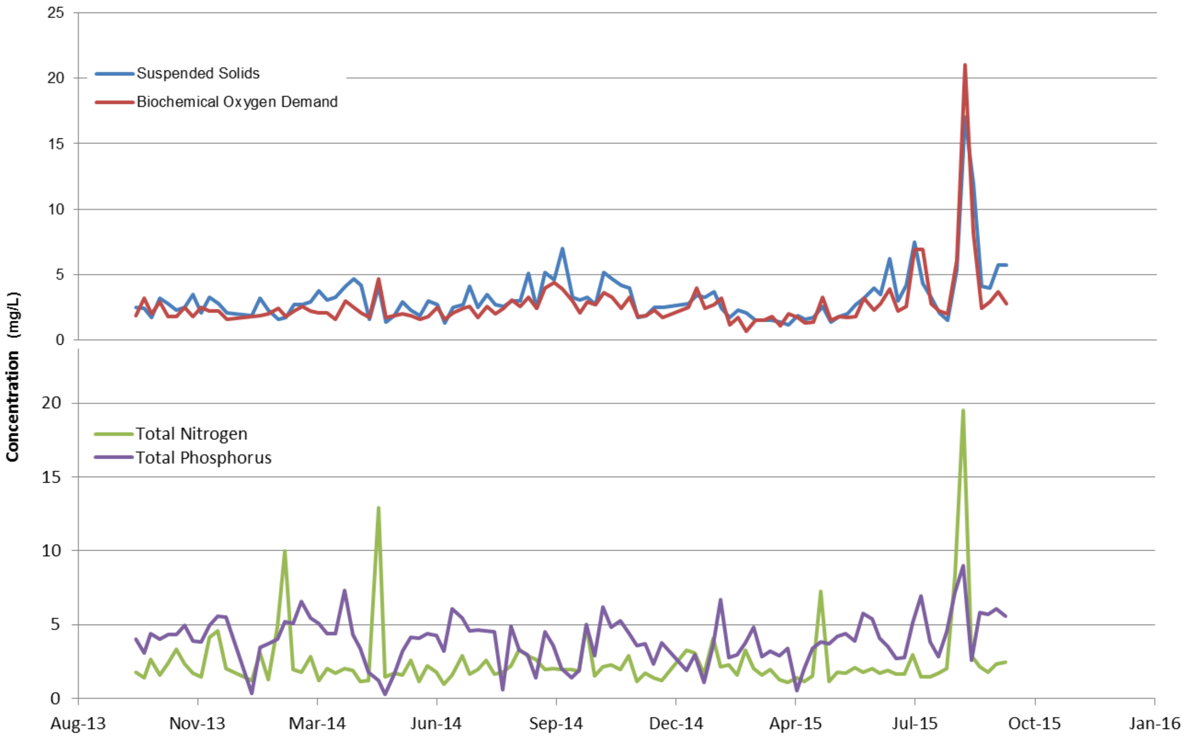


Figure 6-18 Pulgul Creek WWTP Effluent Quality 2013 to 2015

The quality from this treatment plant is generally good. On occasions spikes in the effluent quality data are experienced and may be due to poor sampling techniques and not necessarily representative poor quality effluent from this plant.

6.2.1.3.3 Discharges to the Environment

Discharge to Receiving Waters

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA*	0.7	12	2.2	15	2.2	35	21
Suspended Solids (mg/L)	NA*	1.2	15	2.8	25	4.1	45	17
Dissolved Oxygen (mg/L)	2	1.8	NS*	5	NS*	5.3	NS*	6.1
pH (pH units)	6.5	6.5	NS*	6.9	NS*	7	8.5	7.1
E. Coli (CFU/100mL)	NA*	2	150	20	600	38	NS*	190
Total Phosphorus (mg/L)	NA*	0.258	7	4.03	NS*	5.12	10	8.97
Total Nitrogen (mg/L)	NA*	0.984	10	1.93	NS*	2.88	15	19.5

The effluent quality from the Pulgul Creek WWTP generally meets the requirements for discharge into the receiving waters. However if additional (above the licence limits) then it is likely that the effluent quality may need to be improved.

A study and associated modelling is currently being undertaken to determine if additional discharge can be achieved at the outfall. The outcome of this study will determine what if any treatment upgrades will be required to discharge larger quantities to the Pulgul Creek outfall.

6.2.1.3.4 Odour Buffers

The odour buffer for Pulgul creek WWTP is 400m from the outer footprint of the existing WWTP. The Buffer extends over Walker St to the west and encapsulates some of the existing residential areas. Restrictions to development have been posed through the planning scheme, but the affected areas are also within the Urangan Structure Plan area which is currently under development through the Fraser Coast Regional Council.

6.2.1.3.5 Reuse

Discharge to Land

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA*	0.7	12	2.2	15	3.1	35	21
E. Coli (CFU/100mL)	NA*	2	150	20	600	38	NS*	190
pH (pH units)	6.5	6.5	NS*	6.9	NS*	7	8.5	7.1
Total Dissolved Salts (mg/L)	NA*	711	NS*	864	NS*	969	1560	1207
Sodium Absorption Ratio (SAR)								
Total Nitrogen (mg/L)	NA*	0.984	10	1.93	NS*	2.88	15	19.5
Total Phosphorus (mg/L)	NA*	0.258	7	4.03	NS*	5.12	10	8.97

Most of the effluent produced during dry weather periods is beneficially reused through irrigation. This is expected to continue while the demand for effluent exists. During wet weather periods discharges are expected to continue into Pulgul Creek.

6.2.1.4 Nikenbah WWTP

6.2.1.4.1 Capacity for Growth

Nikenbah WWTP has a capacity of 4.8ML/day. It is expected that Nikenbah will need to be upgraded in 2032 if considered in isolation. However if the Hervey bay system is considered as one system (refer Section 6.2.1) then upgrade to the Nikenbah WWTP is not required until after the 2036 planning horizon.

6.2.1.4.2 Effluent Quality

Sampling is undertaken at the outlet of the treatment process. Sampling records for suspended solids, BOD, Total Nitrogen and Total Phosphorus is shown for the period from 2013 to 2015 in Figure 6-19.

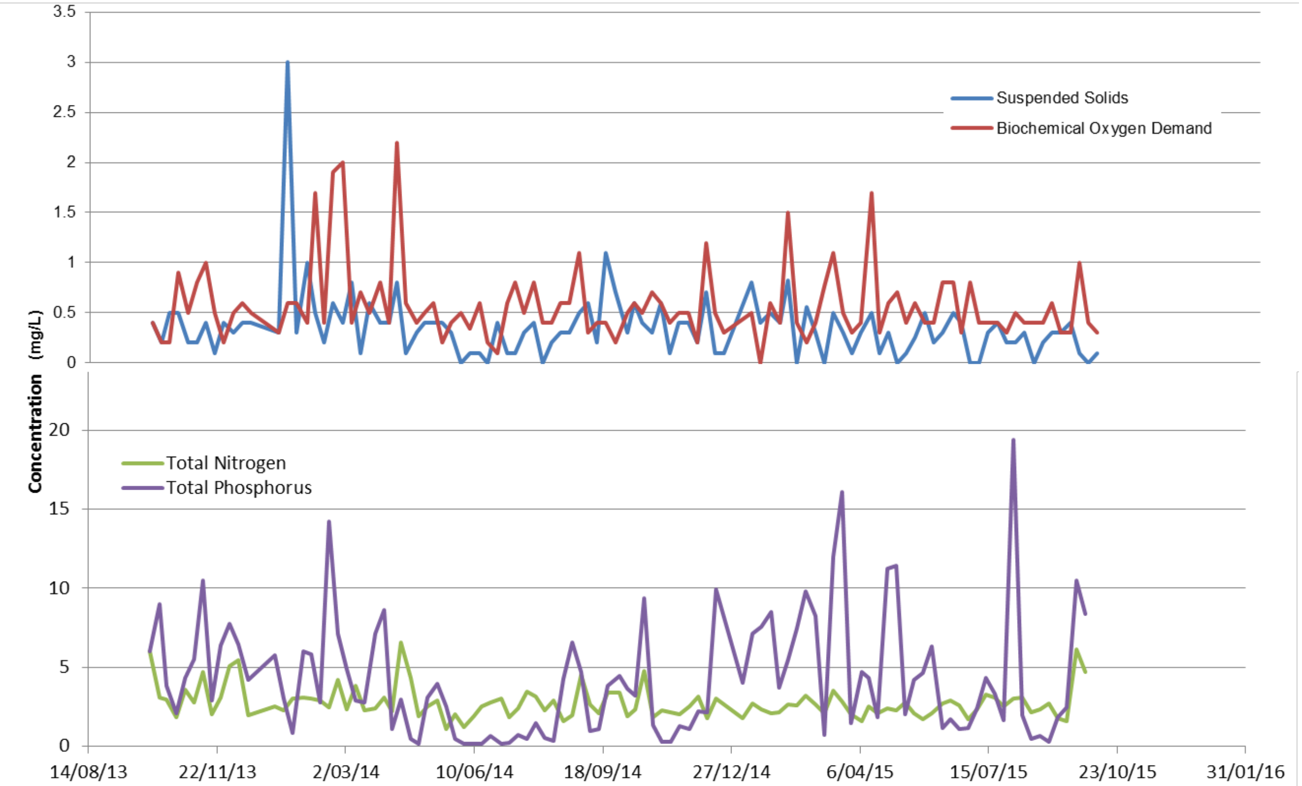


Figure 6-19: Nikenbah WWTP Effluent Quality 2013 to 2015

The Nikenbah WWTP achieves good quality effluent. While the Total Phosphorus can be a bit erratic, it is generally below the 10mg/L concentration.

6.2.1.4.3 Discharges to the Environment

The Nikenbah WWTP has some regulatory constraints. It does not have a licenced outfall to receiving waters and therefore all of the effluent produced at this site to be disposed through irrigation.

During high flow events, bypass is achieved from the inlet works to a chlorine contact tank and then sent directly to the 850ML reuse dam.

Future growth would need to consider sufficient land area for irrigation (Hervey Bay reuse scheme) and storage ability for reuse including options available when all the reuse storages are near capacity.

6.2.1.4.4 Odour Buffers

The odour buffer encompasses the full extent of the Nikenbah WWTP parcel of land. There is sufficient buffer to meet the needs of the current and future treatment trains at this site.

6.2.1.4.5 Reuse

Discharge to Land

Parameter	min		50 Percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual
BOD(mg/L)	NS	0.1	10	0.5	20	2.2
Suspended Solids (mg/L)	NS	0.1	5	0.3	10	3
E Coli (organisms per 100mL)	NS	2	NS	14	10	110
pH (pH units)	6.5	6.5	NS	7.1	8.5	7.4
Sodium Absorption Ratio	NS		NS		1560	
Total Nitrogen (mg/L)	NS	1.06	NS	2.54	NS	6.56
Total Phosphorus (mg/L)	NS	0.143	NS	3.21	NS	19.4

Possible anomalies in sampling may have caused the high E.coli sample in the above table.

6.2.2 Aubinville WWTP

6.2.2.1 Capacity for growth

The Aubinville WWTP has sufficient capacity to meet demand until the 2026 planning horizon at the assumed growth rates (refer to Figure 6-20). Therefore a capacity augmentation will be required in 2026 to allow the continued growth in the Aubinville WWTP catchment. An augmentation of 2.5Ml or approximately 5,600ED will provide sufficient growth at this WWTP to beyond 2070.

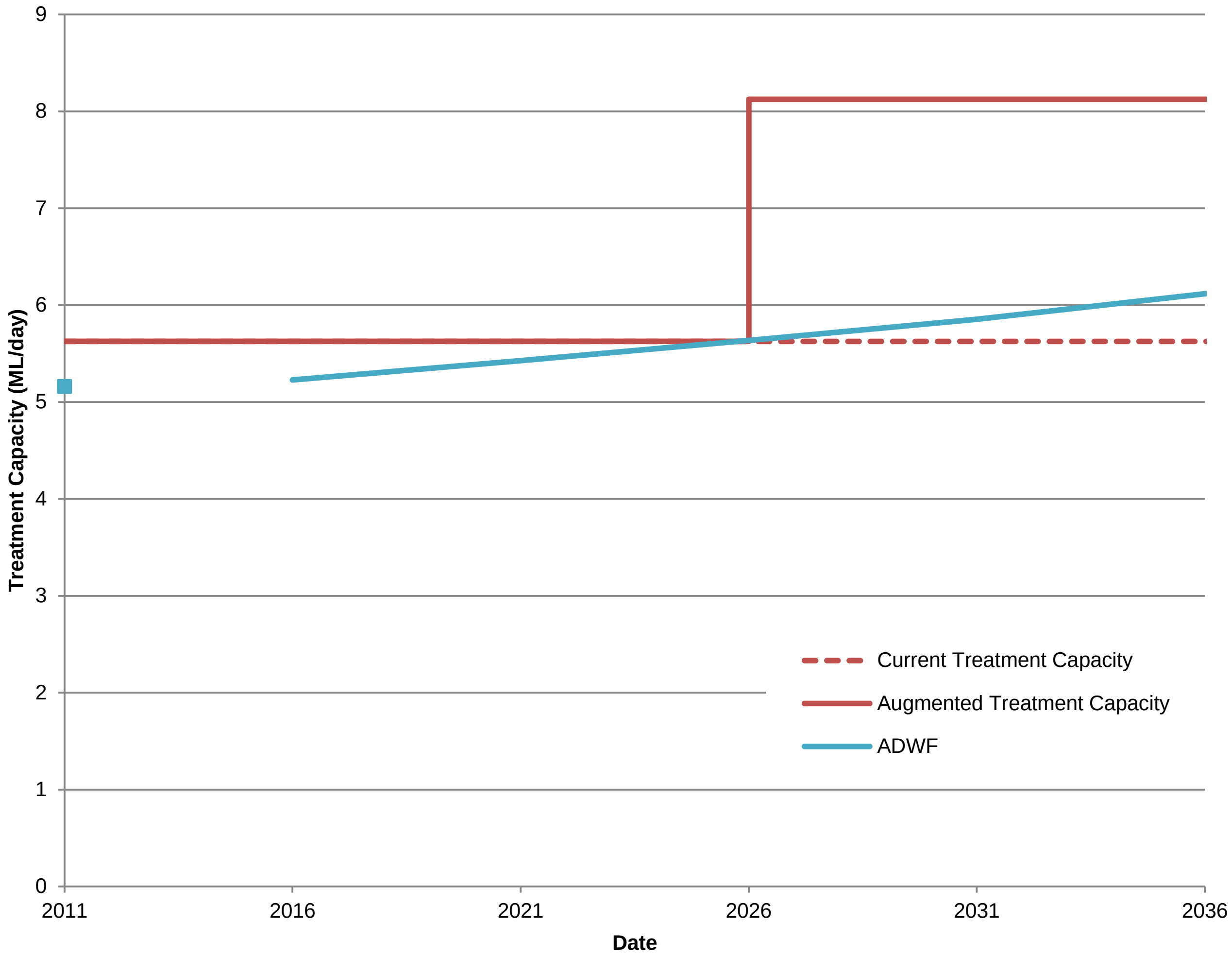


Figure 6-20: Aubinville WWTP Demand Projection 2031

This WWTP has the capacity to treat wet weather flows of 3 x ADWF but based on the hydraulic capacity of the final clarifiers it will be able to handle 4 x ADWF until around 2020. It is currently hydraulically overloaded at 5 x ADWF.

At flows greater than 4 x ADWF by passing the WWTP is required. The bypass directs raw sewage directly into the Mary River discharge point. The amount of sewage lost during PWWF events is a concern. The hydraulic capacity of the inlet works and the WWTP final clarifiers limits the capacity of the plant to treat wet weather flows and results in overflows to the Mary River through the by-passes.

Any options for upgrading the Aubinville WWTP need to be investigated with a view towards maximising the life of the existing infrastructure. At the same time a concerted effort needs to be made to reduce wet weather flows entering the plant. The reduction in wet weather flows is discussed in Section 6.4.2).

A planning report has been prepared for the augmentation of the inlet works including new screen and vortex grit chamber.

RECOMMENDATION: Augment the treatment capacity of the Aubinville WWTP in 2025 by 2.5ML/day (to 8.25ML/day) at an estimated cost of $17m.

6.2.2.2 Effluent Quality

One of the key issues at this treatment plant is the effluent quality. The Aubinville WWTP cannot meet its current nutrient (Nitrogen and Phosphorus) removal limits for discharge to receiving waters (refer to Table 6-26). The table shows that the 80 percentile are not met for discharge to the environment. Figure 3-20 discussed previously that the discharge to the Mary River occurs on a relatively frequent basis.

The Total Nitrogen, Total Phosphorus, Suspended Solids and BOD historical data from 2013 to 2015 are graphing in Figure 6-21. The monitoring sites are located in accordance with the licencing requirements and taken at the outlet of the treatment plant.

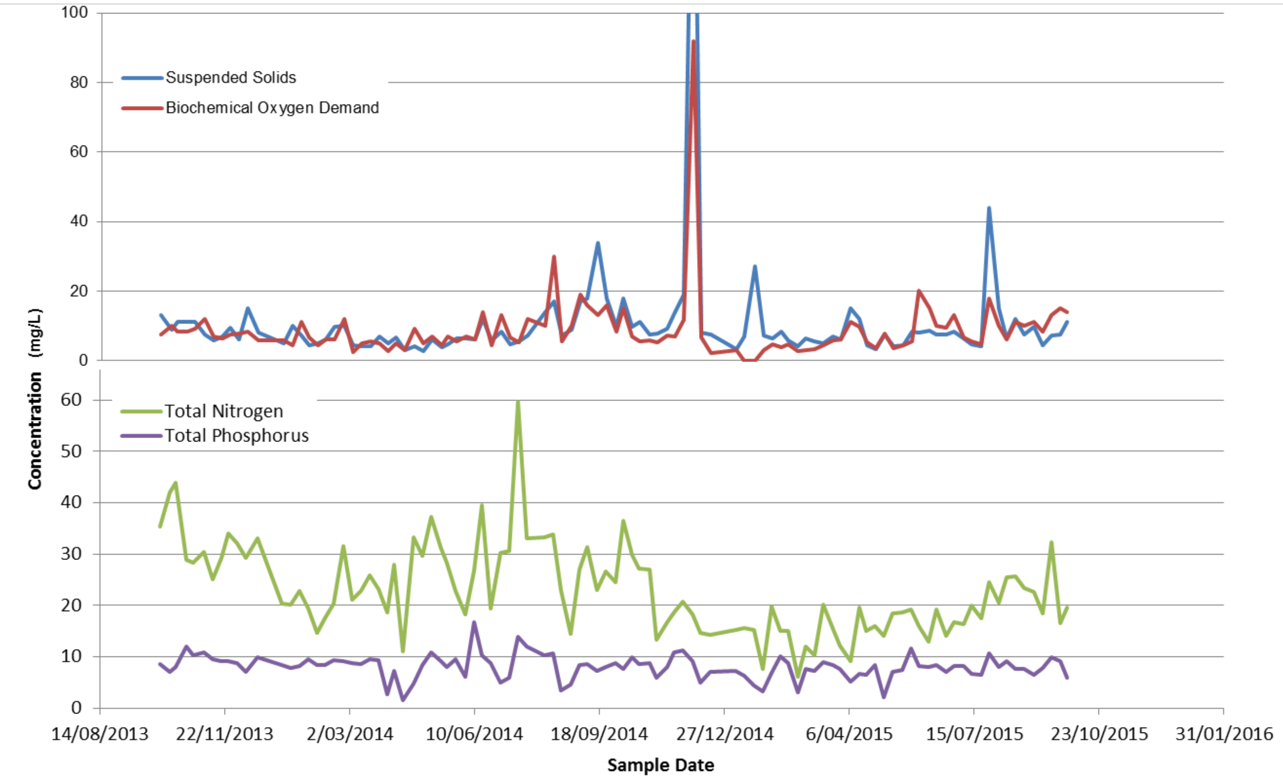


Figure 6-21: Aubinville WWTP Effluent Quality

6.2.2.3 Discharges to Environment

The proposed 2015 licence conditions (currently under negotiation with the EPA) indicate that discharge from the Aubinville WWTP to the Mary River at current effluent quality leaving the plant is unlikely to continue for much longer. WBWC is currently under negotiations to revise the discharge regime so that discharges are based on the flow in the Mary River. Licence re-negotiations include allowance to discharge from the treatment plant and the reuse dam when flow in the Mary River is greater than 25.13m^3/s.

Table 6-26: Aubinville WWTP Effluent Quality vs Discharge to Water Limits

Parameter	min		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual
BOD(mg/L)	NA	2.2	15	11.48	20	92
Suspended Solids (mg/L)	NA	2.8	25	11	30	180
pH (pH units)	6.5	6.5	NA	7.3	8.5	7.5
Dissolved Oxygen (mg/L)	2	4.6	NA	6.5	NA	8
Residual Chlorine (mg/L)	0.3	0.02	NA	0.15	0.7	7.6
Faecal Coliforms (faecal coliforms organisms per 100mL)	NA		NA		1000	
Total Nitrogen (mg/L)	NA	6.17	5	30.26	10	59.6
Total Phosphorus (mg/L)	NA	1.53	1	9.52	2	16.7

It is likely that most monitoring results occur during periods of dry weather flow when discharge to the environment is not required, however if WBWC continues to discharge to the Mary River then improvements to effluent quality parameters of Total Nitrogen and Total Phosphorus are required.

Discharge licencing negotiations are currently being undertaken to move away from a nutrient limit based licence approach to a river volume flow approach. If these renegotiations are successful then it may be possible that no treatment quality upgrades will be required at this treatment plant. None the less a capacity upgrade will be required within the planning horizon and it is expected that the capacity upgrade will use industry best practice for treatment and have an associated quality improvement with it.

RECOMMENDATION: Investigate options for the reduction in Total Nitrogen and Total Phosphorus Suspended Solids at the Aubinville WWTP in 2016 at an estimated cost of $60k.

RECOMMENDATION: Effluent quality upgrade at Aubinville WWTP (5.625Ml/day) in 2028 at a cost of $18.75m.

6.2.2.4 Odour Buffer

An odour modelling study carried out by Pacific Environment Limited (2014) indicated that the 2.5ou contour was slightly larger than the 400m odour buffer adopted. There are 31 existing dwellings within the 400m buffer. There are an additional 27 dwellings within the 2.5ou contour.

Odour complaints are monitored and managed by WBWC. In this area four complaints have been received over the past two years. The majority of complaints are received from dwellings within the adopted 400m odour buffer of the plant and are related to odours generated during the biosolids removal process from the WWTP site. One dwelling is located less than 50m from the dewatered sludge storage area. Future planning for the plant will need to address this issue. The remainder of the dwellings are to the south west in the Aubinville subdivision. Proposed developments in this area are located further than the 400m buffer and the 2.5ou contour. For this reason the 400m buffer was adopted for this WWTP. The extent of the odour contour is contained in Appendix 6B.

6.2.2.5 Reuse

The table below shows the current licence requirements and the statistical effluent quality data for the past two years. With the exception of suspended solids and BOD reading in December 2014, the licence conditions are generally met for discharge to land.

Discharge to Land

Parameter	min		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual
BOD(mg/L)	NA	2.2	15	6.85	20	92
Suspended Solids (mg/L)	NA	2.8	25	11	30	180
pH (pH units)	6.5	6.5	NA	7.3	NA	7.5
Dissolved Oxygen (mg/L)	2	4.6	NA	6.5	9	8
Residual Chlorine (mg/L)	3	0.02	NA	0.15	NA	7.6
Faecal Coliforms (faecal coliforms organisms per 100mL)	NA		NA		0.7	
Dissolved Solids Salts (mg/L)	NA	479	NA	479	1000	830
Sodium Absorption Ratio	NA		NA		1560	
Total Nitrogen (mg/L)	NA	6.17	NA	30.26	NA	59.6
Total Phosphorus (mg/L)	NA	1.53	NA	1.53	NA	16.7

Table 6-27 shows the additional land and storage requirements for the Aubinville Reuse scheme. It shows that by 2036, 115ha of additional irrigation land might be required and that an addition 204ML of storage will also be required. The estimated costs for additional land and development into an irrigation site along with additional storage are $2.6m and $1.4m.

Table 6-27: Aubinville WWTP Effluent Reuse Land and Storage Requirements

	2016	2021	2026	2031	2036
Reuse Avail (ML/annum)	1545	1605	1666	1731	1808
Current Equivalent Plantation Area (Ha)	247				
Additional Plantation Area Required (Ha)	*62*	*74*	*87*	*100*	*115*
Current Dam Storage(ML)	700				
Additional Dam Storage Required (ML)	*73*	*103*	*133*	*166*	*204*

Upgrading the existing plant and concentrating on effluent reuse to manage effluent from the plant may not be the most cost-effective solution to wastewater management in Maryborough. Augmentation of the plant to meet environmental requirements for discharge to the Mary River may well be a more cost effective solution in the longer term. Any additional process units should be located no closer to the existing residences in Aubinville.

Section 6.1.7 investigated future reuse options for Maryborough and concluded irrigation areas should be continued as they are but Aubinville WWTP should be upgraded to allow further and more frequent discharge to the Mary River. The recent acquisition of the Hebberman farm at 4 Mile has allowed the expansion of the irrigation area in Maryborough. This together with a renegotiated licence for discharge and management of effluent storage lagoon levels will mean that effluent can be managed through the planning period.

6.2.3 Burrum Heads WWTP

6.2.3.1 Capacity for Growth

Burrum Heads WWTP has a nominal capacity of 1,087ED and is a hybrid version of the Intermittently Decanted Extended Aeration (IDEA) treatment process.

The original design basis of 250L/EP/day is equivalent to an ADWF of 625kL/day. Records of recent inflow to the WWTP suggest that hydraulically there is adequate capacity at the plant until 2036 and that recent work on reducing inflow and infiltration is actually reducing inflows to the plant. Aeration was upgraded at this treatment plant to allow the biological treatment capacity to match the hydraulic capacity.

From the Hervey Bay Population Model the estimated ED load on the Burrum Heads WWTP is 1079ED (2016) which may be above the nominal 1,050ED biological capacity of the plant. There is a need to determine the actual influent quality to more accurately predict the timing (and hence capital requirements) of an augmentation at the WWTP. However, if hydraulic loads were determined to be the controlling factor, then an upgrade would not be required until 2033 (refer to Figure 6-22).

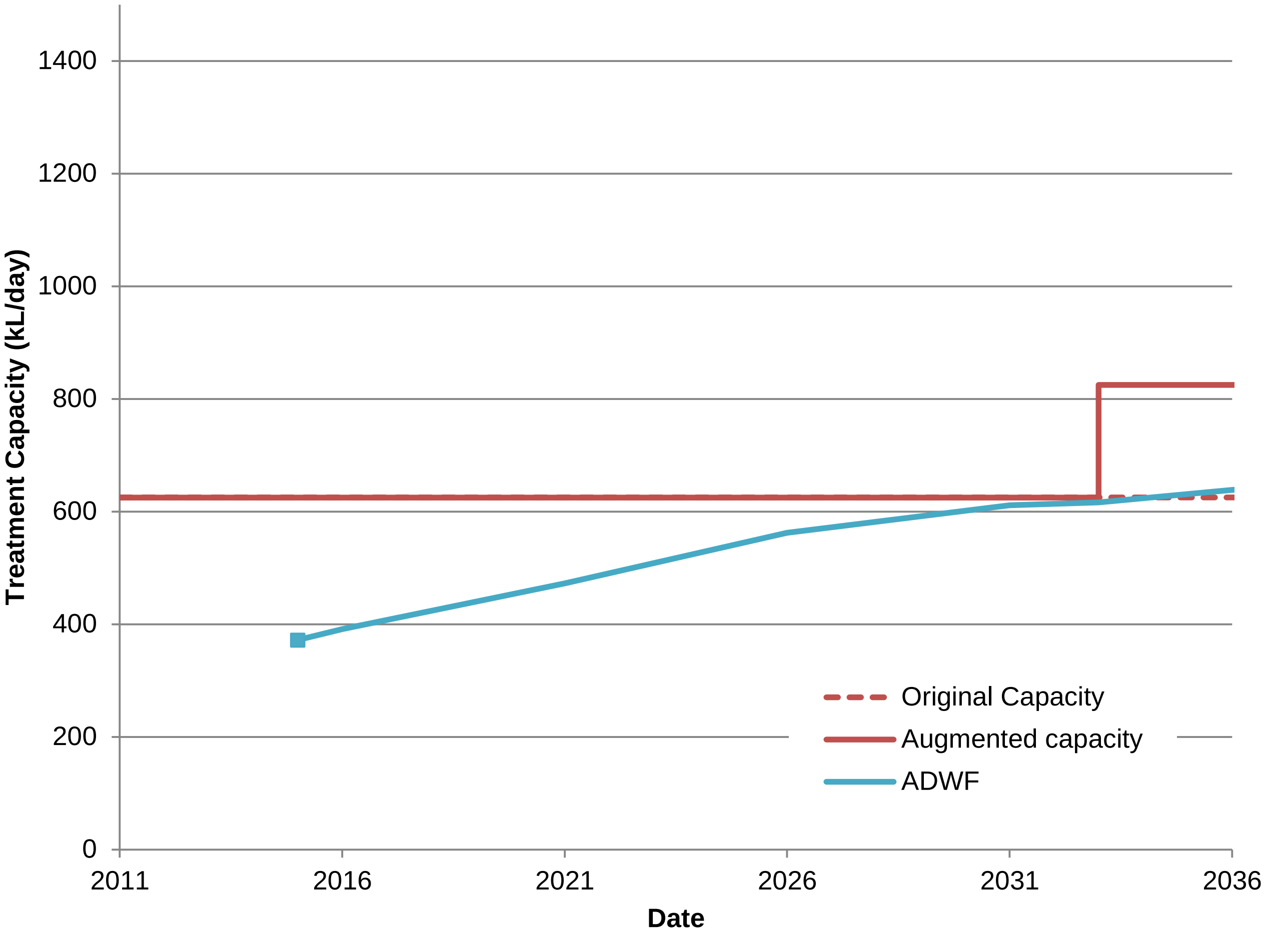


Figure 6-22: Burrum Heads WWTP Capacity

It should also be noted that the flow per ED in Burrum Heads appears to be considerably less than average flows per ED in Hervey Bay; although this could be associated with low occupancy rates (holiday houses). Noticeable flow peaks of around 25-30% of plant inflow coincide with the school holiday periods. This is likely to be associated with tourist loadings and the return of non-resident population to holiday houses during the holiday periods.

Projections for the Burrum Heads WWTP indicate that they will increase from an estimated 1079ED (2016) to 1,418 ED in 2036. At this time the hydraulic capacity of the WWTP is exceeded and therefore capacity upgrades will be required. It should be noted that these projections could increase significantly if the full potential of development occurs at Burrum Heads and would impact on the timing of any upgrade works.

RECOMMENDATION: Upgrade Burrum Heads WWTP by 200kl/day in 2033 at a cost of $1.3m.

6.2.3.2 Effluent Quality

The Total Nitrogen, Total Phosphorus, Suspended Solids and BOD historical data from 2013 to 2015 are graphing in Figure 6-23. The monitoring sites are located in accordance with the licencing requirements and taken at the outlet of the treatment plant.

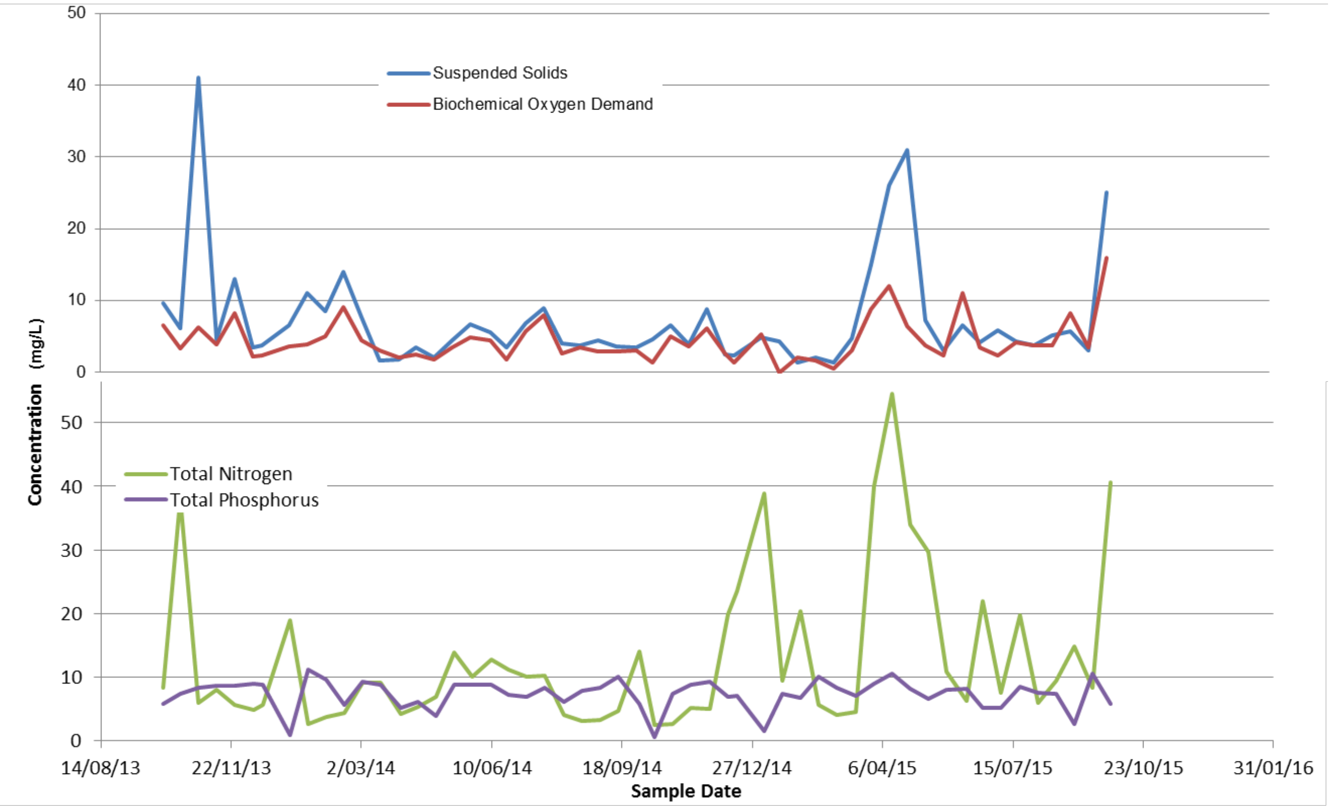


Figure 6-23: Burrum Heads WWTP Effluent Quality 2013 to 2015

The Total Nitrogen parameter is erratic at this treatment plant and the Total Phosphorus is elevated. The other quality parameters are reasonably consistent.

6.2.3.3 Discharges to the Environment

The environmental discharge licence only allows discharge to land for irrigation at this site.

6.2.3.4 Odour Buffers

The existing odour buffer at this plant encompasses some area to the north (site of a dam) and does not impact of any residential areas. It is expected that any expansion of this site will occur to the south of the existing plant and thus will not negatively impact the residential areas.

6.2.3.5 Reuse

All effluent from this treatment plant is used at the Dreamtime irrigation site. Further upgrades to this site include the purchase of an additional pivot irrigator to allow another 7ML of reuse to occur over a 55hr period.

Table 6-28: Burrum Heads Effluent Reuse Land and Storage Requirements

Burrum Heads WWTP	2016	2021	2026	2031	2036
Reuse Avail (ML/annum)	177	197	220	223	233
Current Equivalent Plantation Area (Ha)	42				
Additional Plantation Area Required (Ha)	*0*	*0*	*2*	*2*	*4*
Current Dam Storage(ML)	57				
Additional Dam Storage Required (ML)	*31*	*41*	*53*	*54*	*59*

There is an additional 4Ha of irrigation land required at Burrum Heads to meet the requirements under this planning horizon and an additional 60ML of storage required.

Discharge to Land

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NS*	0.54	12	3.6	15	6.26	35	16
E. Coli (CFU/100mL)	NS*		150		600		NS*	
pH (pH units)	6.5	5.9	NS*	6.8	NS*	7	8.5	7.5
Suspended Solids (mg/L)	NS*	1.3	15	4.6	25	8.68	45	41
Dissolved Oxygen (mg/L)	2	1.6	NS*	2.5	NS*	4.16	NS*	5.8
Electrical Conductivity (µS/cm)	NS*	1015	NS*	1250	NS*	1358	2000	1605
Sodium Absorption Ratio (SAR)	NS*		NS*		NS*		NS*	
Total Nitrogen (mg/L)	NS*	2.48	10	8.29	NS*	19.82	20	54.6
Total Phosphorus (mg/L)	NS*	0.588	10	7.82	NS*	8.84	12	11.1

Sludge is dewatered by contractors and taken to Nikenbah WWTP stockpiling until stabilisation grade is achieved. Future growth would need to ensure biosolids storage capacity at Nikenbah is maintained.

A proposal has been made for WBWC to purchase its own dewatering trailer for use at Burrum Heads, Toogoom, Howard and Torbanlea.

RECOMMENDATION: Purchase dewatering trailer for use at minor centres in 2017 at a cost of $100k.

RECOMMENDATION: Construct additional 60ML effluent storage lagoon at Burrum Heads at an estimated cost of $420 in 2036.

6.2.4 Toogoom WWTP

6.2.4.1 Capacity for Growth

Toogoom WWTP has a nominal capacity of 625ED (Based on 2.4EP/ED) and the design is a hybrid version of the Intermittently Decanted Extended Aeration (IDEA) treatment process.

The original design was based on 250L/EP/day is equivalent to an ADWF of 375kL/day. Records of recent inflow to the WWTP suggest that hydraulically there is adequate capacity at the plant for some time to come and that recent work on inflow and infiltration is actually reducing inflows to the plant. Aeration was improved at this site in 2012 and has addressed any previous treatment deficiencies.

From the Population Model the estimated ED load on the Toogoom WWTP is expected to be 412kL/day ADWF at 2036. Therefore an upgrade of this treatment plant will be required in 2030 to meet projected demands (refer to Figure 6-24).

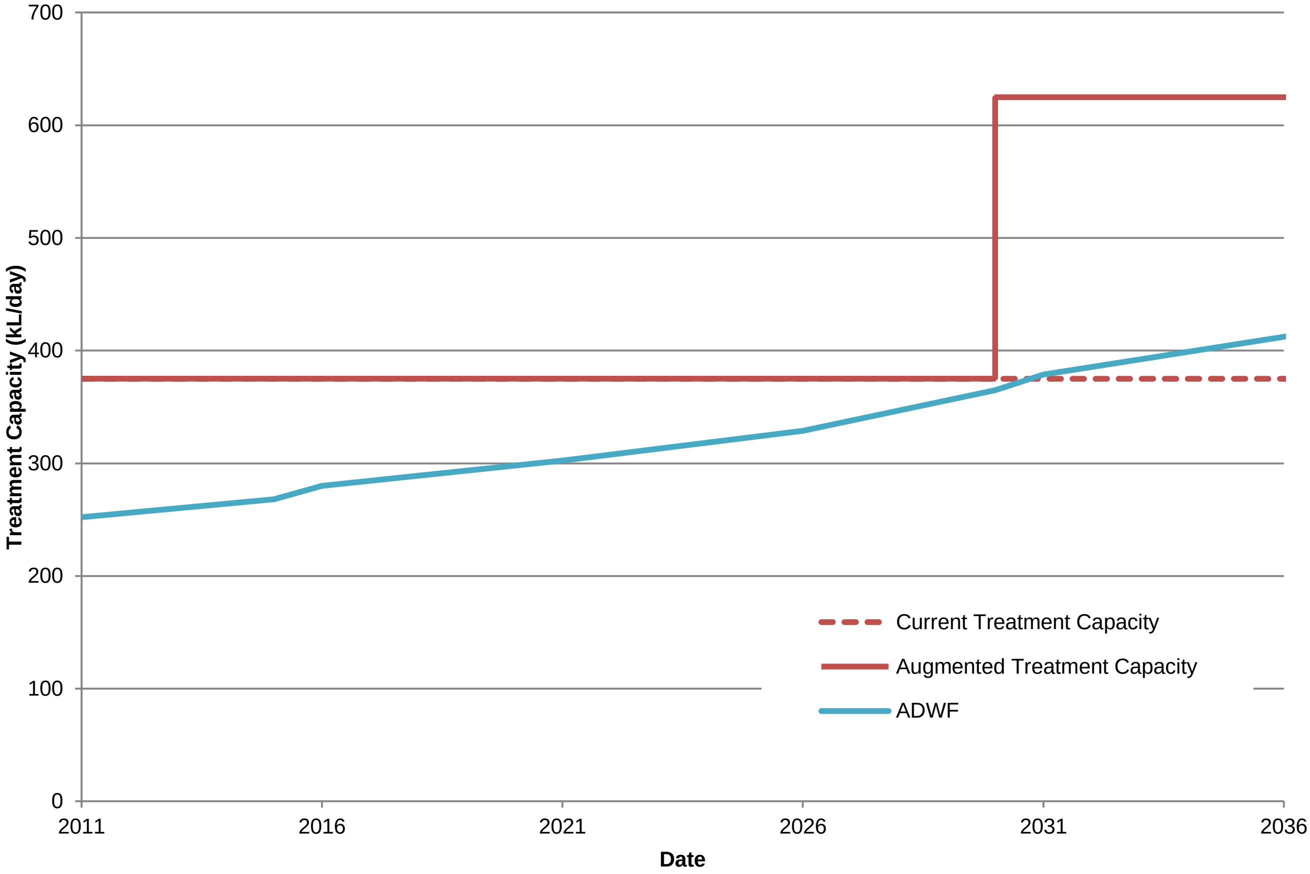


Figure 6-24: Toogoom WWTP Capacity

The plant will have capacity for the projected development in Toogoom until 2030 at which stage a capacity augmentation at the plant will be required. If it is assumed that growth at Toogoom will increase beyond what is provided for in the Planning Scheme then it is likely that a duplication of the plant in stages as per the existing plant design would be appropriate. .

RECOMMENDATION: Upgrade Toogoom WWTP to a total capacity of 625kL/day in 2030 at an estimated cost of $1.3m.

6.2.4.2 Effluent Quality

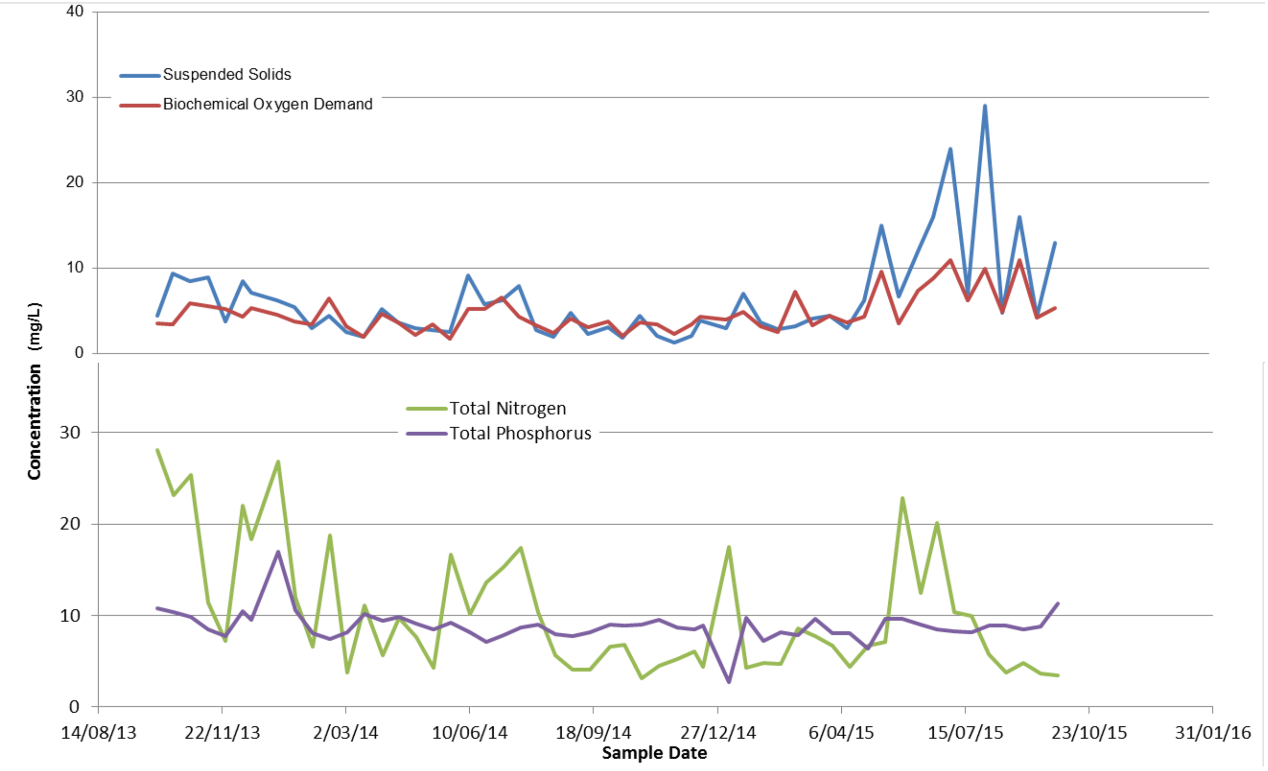


Figure 6-25: Toogoom WWTP Effluent Quality 2013 to 2015

6.2.4.3 Discharges to the Environment

The environmental licence allows discharge to land and exfiltration to groundwater from the existing exfiltration lagoons. The licence limit for discharge to groundwater is 0.15ML on a dry weather day and 0.75ML on a wet weather day. During periods of prolonged wet weather the water table rises meaning exfiltration is no longer possible and the lagoons are at risk of overflowing.

The average daily inflow in 2013/2014 was 257kL/day, meaning an average of 107kL of water needs to be reused daily.

Table 6-29: Toogoom Effluent Quality vs Exfiltration to Environment Parameters (Samples taken 2013-2015)

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA	1.8	NA	4.2	10	5.78	20	11
Suspended Solids (mg/L)	NA	1.3	NA	4.5	10	8.5	30	29
pH (pH units)	6.5	6.3	NA	6.8	NA	7	8.5	7.3
Dissolved Oxygen (mg/L)	2	2	NA	2.7	NA	3.9	NA	5.3
Electrical Conductivity (mS/cm)	NA	720	NA	830	NA	884	1300	965
Total Nitrogen (mg/L)	NA	3.16	10	7.23	NA	17.12	20	28.1
Total Phosphorus (mg/L)	NA	2.71	10	8.81	NA	9.636	12	17
E. Coli (CFU/100mL)	NA		150		600		N/A	

The effluent quality results show that there are failures in maintaining Total Nitrogen and Phosphorus below the licenced maximum amounts. However as can be seen in Table 6-28 the 50 percentile requirements are met and the maximum figures could be a result of irregular operation of the plant or an external factor during the sample collection.

6.2.4.4 Odour Buffers

A 200m buffer zone is used at the Toogoom WWTP. It is measured from the boundary of the property. This is in accordance with the Victorian guidelines for odour buffers for a WWTP of this size. Any future expansion of the plant is likely to be to the south of the existing plant and therefore the existing buffer will be sufficient to meet the odour requirements of this plant.

No modifications to the buffer zone are required under this strategy.

6.2.4.5 Reuse

Current reuse land area is 7ha adjacent to WWTP. Future growth would need to consider additional land area for irrigation for reuse.

The future land use and storage requirements are summarised in Table 6-29. It can be seen that additional land for irrigation will be required and additional storage will be needed into the future also.

Table 6-30: Toogoom WWTP Reuse Land and Storage Requirements

Toogoom WWTP	2016	2021	2026	2031	2036
Reuse Avail (ML/annum)	28	34	42	57	67
Current Equivalent Plantation Area (Ha)	7				
Additional Plantation Area Required (Ha)	*0*	*0*	*1*	*4*	*6*
Current Dam Storage(ML)	20				
Additional Dam Storage Required (ML)*	*0*	*0*	*1*	*8*	*13*

* allows for exfiltration of 55ML/annum from the Toogoom effluent storage lagoons

Even allowing for exfiltration of 55Ml/annum, additional storage (13ML) and land for irrigation (6Ha) will be required by 2036.

Table 6-30 shows the discharge licence limits and the statistical data over the past two years from 2013 to 2015.

Table 6-31: Toogoom Effluent Quality vs Discharge to Land Parameters (Samples taken 2013-2015)

	min		50 Percentile		80 percentile		max	
Parameter	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**
5-day BOD (mg/L)	NA	1.8	NA	4.2	10	5.78	20	11
Suspended Solids (mg/L)	NA	1.3	NA	4.5	10	8.5	30	29
pH (pH units)	6.5	6.3	NA	6.8	NA	7	8.5	7.3
Dissolved Oxygen (mg/L)	2	6.3	NA	2.7	NA	3.9	NA	5.3
E. Coli (CFU/100mL)	NA		150		600		NA	
Electrical Conductivity(mS/cm)	NA	720	NA	830	NA	884	1300	965
Sodium Absorption Ratio	NA		NA		NA		NA	
Total Nitrogen (mg/L)	NA	3.16	10	7.23	NA	17.12	20	28.1
Total Phosphorus (mg/L)	NA	2.71	5	8.81	NA	9.636	10	17

The Total Phosphorus and Total Nitrogen maximum results do not meet the licencing requirements for discharge to land. As discussed in previous sections this may just be due to a sampling error or an external influence during sampling. Of more concern is that for disposal to land the 50 percentile limit under the licence has been exceeded during the past two years.

Should WBWC continue to irrigate using this effluent then measures should be undertaken to improve the level of total Phosphorus in the effluent.

The current method of dewatering wasted solids is through a geofabric bag located on a cement storage pad. Future growth would also need to consider options for solids management. Investigations are currently underway into the feasibility of a mobile dewatering unit. Even so, sludge would need to be stored onsite until dewatering facilities were made available. It is likely that a sludge tank would be needed to be installed on site to store sludge until dewatered.

RECOMMENDATION: Purchase/Lease additional land (nominally 15Ha) suitable for effluent reuse in 2026 at a cost of $345k.

RECOMMENDATION: Install new storage at Toogoom WWTP (nominally 20ML) in 2026 at a cost of $140k.

RECOMMENDATION: Investigate the reduction in Total Phosphorus at the Toogoom WWTP to meet licencing requirements in 2016 at an estimated cost of $30k.

6.2.5 Howard WWTP

6.2.5.1 Capacity for Growth

The capacity of the WWTP is 24kL/day. There are no plans to increase the sewered area in Howard and as such the capacity of the system is capped at 24kL/day. A report prepared by Water Strategies in 2015 examines the costs associated with sewering Howard. This report was undertaken as a result of public pressure on Fraser Coast Regional Council to provide sewerage services to the existing Howard township.

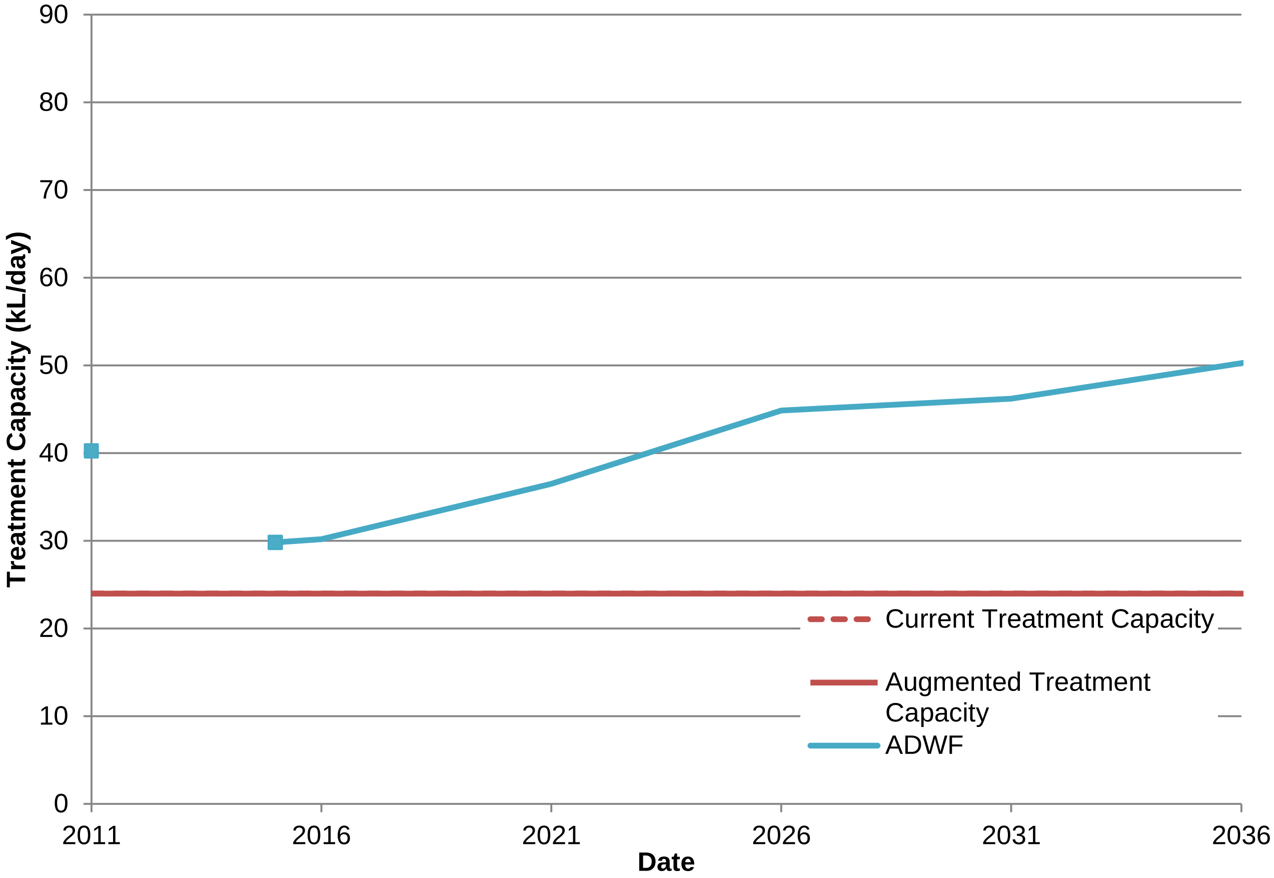


Figure 6-26: Howard WWTP Capacity

The current ED load is estimated at 47ED compared with a design capacity of 42ED. Redevelopment of existing sewered land in Howard has the potential to increase the load on the WWTP to 75ED. Policy to date has been not to allow any additional connections to the Howard WWTP but it is unknown whether the same would be able to be applied to a redevelopment of existing sewered properties within the catchment. The Hervey Bay Population Model predicts that Howard is expected to grow from a population of 1,502 in 2006 to an ultimate population of 3,069 around 2031. With this population growth there will be a demand for increased commercial services which will by their nature need to be connected to the WWTP.

Currently there is no capacity available at the Howard WWTP for any additional connections.

There has been local media interest in expanding the Howard sewerage system recently, however the cost to do so has been estimated at $4.91m for a gravity sewerage system solution (Water Strategies, 2015). In addition the cost of treatment and disposal are $16.4m.

6.2.5.2 Effluent Quality

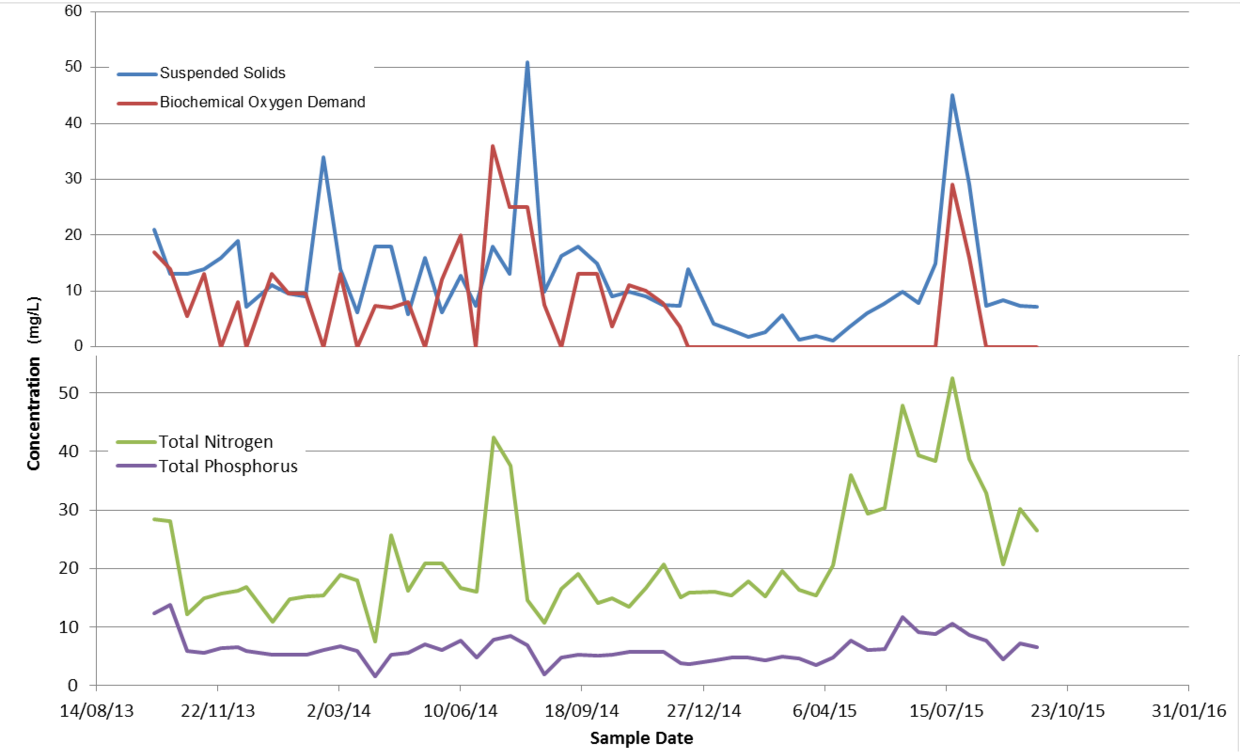


Figure 6-27: Howard WWTP Effluent Quality

The effluent quality in Figure 6-27 shows that the quality is lower during the winter period. This could be due to lower biological activity during these times. The total Nitrogen from this plant is high during some periods of the year.

6.2.5.3 Discharges to the Environment

The Howard WWTP has an environmental licence that allows it to discharge to water (Maria Creek) and land, but only when there is flow in Maria Creek which is an ephemeral creek. The flow in the Creek is very short-lived and may not correspond with the increased flow to the plant during times of rainfall.

Discharge to Water

	min		50 Percentile		80 percentile		max	
Parameter	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**
5-day BOD (mg/L)	NA*	3.6	15	12	20	16.8	20	36
Suspended Solids (mg/L)	NA*	1.1	18	9.6	25	16.18	30	51
Dissolved Oxygen (mg/L)	2	2.8	NS*	6.4	NS*	7	NA	10.9
pH (pH units)	6.5	6.2	NS*	7.7	NS*	8.4	8.5	9.3
E. Coli (CFU/100mL)	NA*		150		600		N/A	
Total Phosphorus (mg/L)	NA*	1.47	NS*	5.72	NS*	7.582	12	13.7
Total Nitrogen (mg/L)	NA*	7.44	NS*	12	NS*	29.84	20	52.6

6.2.5.4 Odour Buffers

The buffer zone for this treatment plant is 100m from the centre of the plant, in accordance with the Victorian guidelines for WWTP's of this size. The buffer encompasses several public venues and commercial outlets including the bottle shop, real estate agent, medical centre, markets and museum as well as several residences. Ideally the buffer zone is free of any public activity including commercial properties and public venues.

Despite this there have been no odour complaints registered over the past two years from this WWTP.

Therefore no changes are proposed to the buffer zone at Howard.

6.2.5.5 Reuse

The only user of effluent from this WWTP is the Burrum District Golf course. The Table below compares the statistical effluent quality parameters against the licence requirement for discharge to land.

Discharge to Land

	min		50 Percentile		80 percentile		max	
Parameter	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**	**Licence**	**Actual**
5-day BOD (mg/L)	NA*	3.6	12	12	15	16.8	35	36
E. Coli (CFU/100mL)	NA*		150		600		NS*	
pH (pH units)	6.5	6.2	NS*	7.7	9.5	8.4	NS*	9.3
Dissolved Salts (mg/L)	NA*	445	NS*	874	NS*	1038.8	1560	1822
Sodium Absorption Ratio	NA*		NS*		NS*		NS*	
Total Nitrogen (mg/L)	NA*	7.44	NS*	12	NS*	29.84	NS*	52.6
Total Phosphorus (mg/L)	NA*	1.47	NS*	5.72	NS*	7.582	NS*	13.7

The BOD levels are a cause for concern as they do not meet the 80th percentile required under the licence for effluent discharge on land. Of concern also is the high level of dissolved salts. These values exceed the maximum allowed under the licence, but more importantly elevated salt levels may make the effluent unsuitable for irrigation of the golf course. The salinity of effluent needs to be monitored to ensure that potable water does not need to be mixed with the effluent to provide a dissolved salt level consistent with use on a golf course.

RECOMMENDATION: Monitor the dissolved salts (salinity) levels of the effluent against maximum suitable for golf course irrigation.

RECOMMENDATION: Investigate options for reducing the salinity levels and BOD levels at this WWTP at a cost of $30k in 2017.

6.2.6 Torbanlea WWTP

6.2.6.1 Capacity for Growth

The plant is near capacity. There is also no provision for additional capacity to be provided at the WWTP unless a development application is lodged and headworks charges are levied to fund an expansion of the plant. Connection of existing dwellings will add additional load to the plant but provide no mechanism to recover the costs associated with the provision of additional wastewater treatment capacity at the plant.

There is little forecast growth in Torbanlea contributing to the WWTP under the Fraser Coast ED model. Additional demand on the sewerage system will likely come from sewer extensions to existing houses by way of sewer extensions. The forecast growth is shown in Figure 6-28 showing that the minimal growth in area will be able to be hydraulically sustained by this WWTP.

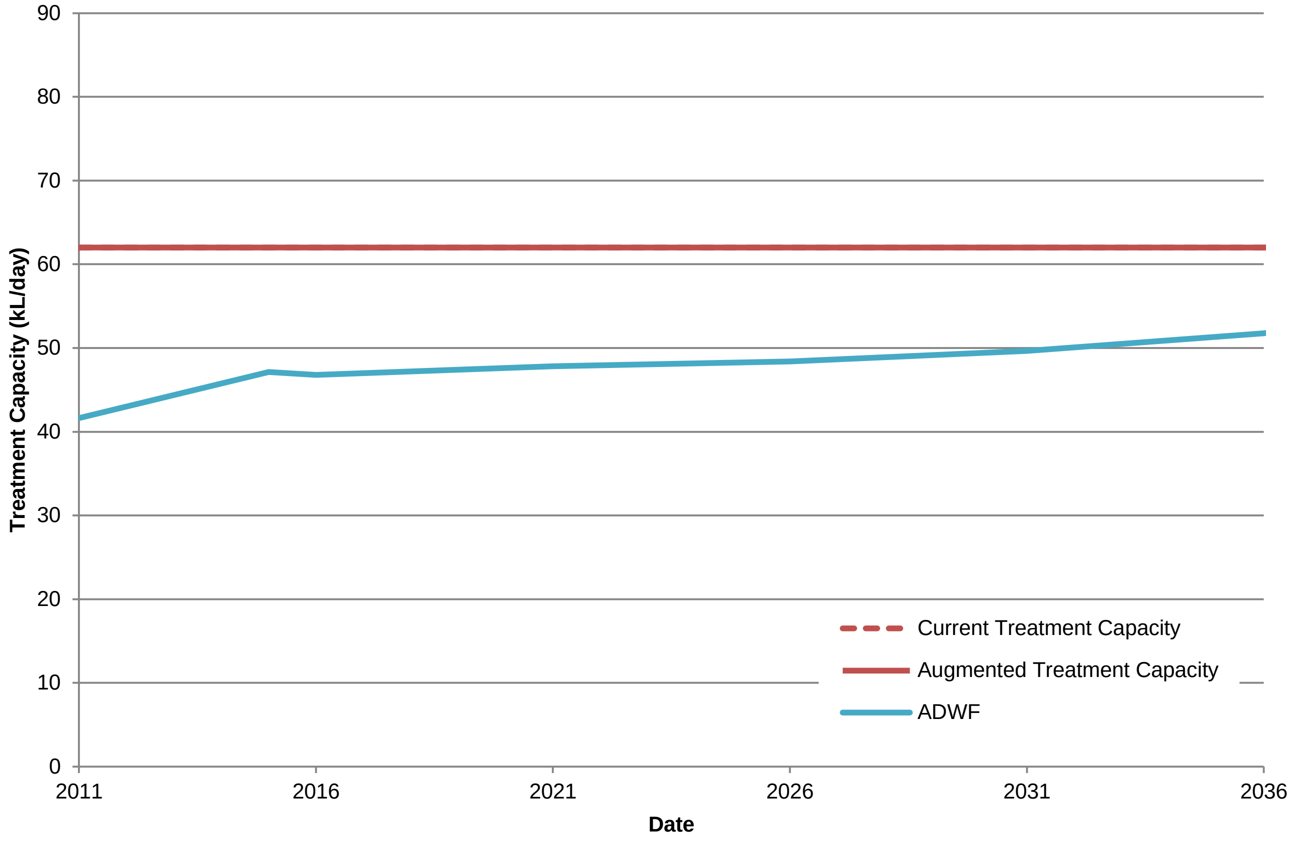


Figure 6-28: Torbanlea WWTP Capacity

6.2.6.2 Effluent Quality

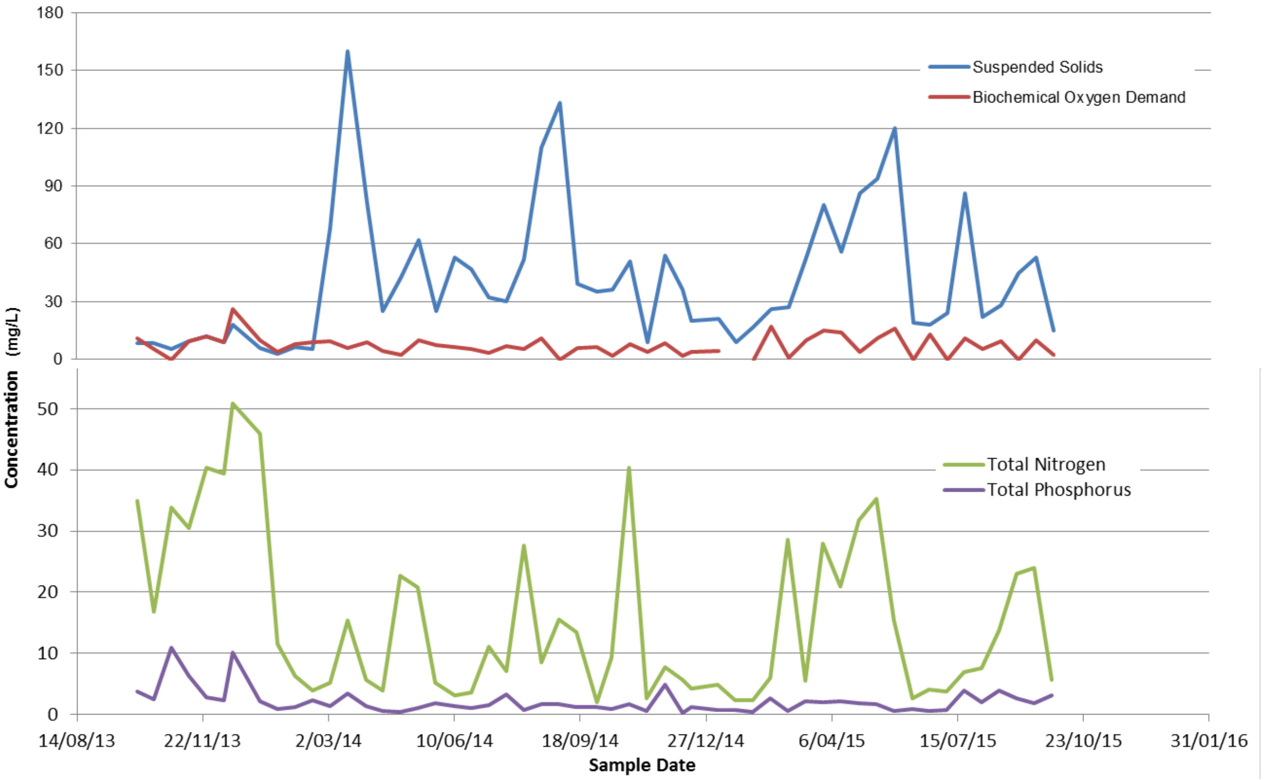


Figure 6-29: Torbanlea Effluent Quality (2013 – 2015)

The quality of effluent produced at this plant is erratic and elevated in terms of suspended solids and Total Nitrogen.

6.2.6.3 Discharges to the Environment

The Environmental licence for Torbanlea WWTP does not allow discharge to receiving waters and all effluent is stored and reused at adjacent sites to the WWTP.

6.2.6.4 Odour Buffers

The buffer zone for this WWTP is 100m and is consistent with the Victorian guidelines for WWTP's of this size. There are two residential lots that are partially within the buffer zone. One complaint from the local hotel was received over the past two years but it is known that previous complaints have been made with regards to odour from this WWTP and in particular during biosolids removal. Revised biosolids management procedures were introduced at this treatment plant which has reduced the number and frequency of complaints.

6.2.6.5 Reuse

Current reuse is dependent only on 3rd party users (race track and school ovals). This poses a risk in that WBWC does not have control over how much effluent is used at any given time. Education and customer management are assisting in reducing this risk. Current CCT is too small for the plant to achieve sufficient contact time in CCT therefore monitoring samples are taken along pipe to reuse dam. This needs to be upgraded to provide better chlorine contact time.

Table 6-32: Torbanlea Effluent Quality Performance

Parameter	min		50 Percentile		80 percentile		max	
	Licence	Actual	Licence	Actual	Licence	Actual	Licence	Actual
5-day BOD (mg/L)	NA*	0.78	12	7.75	15	11	35	26
E. Coli (CFU/100mL)	NA*		150		600		NS*	
pH (pH units)	6.5	2.9	NS*	4	9.5	4.86	NS*	6
Dissolved Salts (mg/L)	NA*	483	NS*	694	NS*	745.8	1560	843
Sodium Absorption Ratio	NA*		NS*		NS*		NS*	
Total Nitrogen (mg/L)	NA*	1.95	NS*	7.75	NS*	28.32	NS*	50.9
Total Phosphorus (mg/L)	NA*	0.269	NS*	1.62	NS*	2.746	NS*	10.9

While the Nitrogen levels are quite high fortunately the licence does not stipulate limits on this for discharge to land. Some quality improvements would be required if the licence is changed to include limits on Suspended Solids and Total Nitrogen.

Sludge is dewatered on site through a geofabric bag (similar to Toogoom). In the past the management of these geofabric bags, particularly when removing biosolids have led to significant odour generation. The proposed mobile dewatering unit will enable dewatering on site and removal of biosolids with minimal odour generation.

6.3 Sewerage Trunk

6.3.1 Pump Stations

An assessment of the pump station capacities across the Fraser Coast was undertaken for the current and projected sewage loads. The assessment identifies the capacity deficiencies at individual sewage pump stations throughout the planning period. The assessments are included in Appendix 5A and Appendix 5B.

From the analyses 21 existing pump stations required upgrading and 16 new sewage pump stations will need to be constructed within the planning horizon. A summary of these are presented in Table 6-32.

Table 6-33: New Pump Stations and Augmentations Required

Strategy ID	SPS	(N)ew / (E)xisting	Currently Adopted Discharge (L/s)	Currently Adopted Head (m)	Current Station Power (KW)	Year for replacement	Future Discharge (L/s)	Future Head (m)	Future Power Rating	SPS Upgrade Cost Estimate ($000)
Aubinville WWTP									(kW)	
S185	APS09	E	4.9	8.0	0.5	2016	7.1	9.3	0.8	19
S187	APS10	E	30.0	21.4	7.9	2016	45.2	23.9	13.2	75
S186	APS13	E	15.0	24.0	4.4	2016	66.6	47.7	39.0	118
S61	S61 (FMB30)	N	#N/A	#N/A	#N/A	2016	76.0	12.5	13.3	206
S60	S60	N	#N/A	#N/A	#N/A	2031	69.0	13.0	12.6	206
S62	S62 (FMB29)	N	#N/A	#N/A	#N/A	2036	105	35.0	51.5	340
S53	S53 (FMB09)	N	#N/A	#N/A	#N/A	2026	2.6	10.0	0.4	124
S51	S51 (FMB09a)	N	#N/A	#N/A	#N/A	2026	20.4	15.0	4.3	154
S22	S22 (FMB09b)	N	#N/A	#N/A	#N/A	2026	10.0	9.0	1.3	138
S55	S55 (FMB15)	N	#N/A	#N/A	#N/A	2036	5.2	10.5	0.8	124
S54	S54 (FMB19)	N	#N/A	#N/A	#N/A	2027	8.7	13.0	1.6	138
Burrum Heads WWTP										
S169	BHPS50	E	4.0	12.0	0.6	2016	15.1	23.6	4.4	45
S168	BHPS53	E	4.5	5.0	0.3	2016	28.7	67.4	23.7	95
S25	BHPS55	E	19.0	35.0	8.2	2021	21.7	40.1	10.7	62
Eli Creek WWTP										
S171	EPS04	E	105.0	22.9	29.5	2016	241.6	36.5	108.1	181
S172	EPS13	E	4.0	20.0	1.0	2016	7.7	6.7	0.6	19
S16	EPS05	E	100.0	7.5	9.2	2016	200.0	11.2	27.5	95
S176	EPS22	E	9.7	32.5	3.9	2023	12.6	38.4	5.9	62
S173	EPS46	E	8.0	12.0	1.2	0	7.9	12.2	1.2	32
S174	EPS66	E	5.4	9.8	0.6	0	15.3	18.2	3.4	45
S15	EPS73	E	13.5	10.0	1.7	2016	18.1	13.9	3.1	45
S43	EPS83	E	184.0	41.4	93.4	2016	312.8	61.0	234.0	259
S177	PPS84	E	8.5	20.0	2.1	2031	10.7	23.2	3.0	45
S181	PPS06	E	73.0	32.0	28.6	2021	125.1	40.2	61.7	143
	PPS49	E	6.7	10.0	0.8	0	8.1	13.5	1.3	32
S178	PPS70	E	2.0	22.0	0.5	2016	2.7	31.0	1.0	21
S44	PPS79	E	33.0	30.6	12.4	2026	91.9	79.3	89.4	168
Nikenbah WWTP										
S49	S49	N	#N/A	#N/A	#N/A	2031	103.0	37.0	53.4	340
S160	S160	N	#N/A	#N/A	#N/A	2036	57.0	7.0	5.6	177
S162	S162	N	#N/A	#N/A	#N/A	2033	26.0	16.0	5.8	177
S167	S167	N	#N/A	#N/A	#N/A	2031	6.0	5.0	0.4	124
S130a	S130a	N	#N/A	#N/A	#N/A	2033	36.9	13.0	6.7	177
S84	S84	N	#N/A	#N/A	#N/A	2021	86.0	22.0	26.5	249
S85	S85	N	#N/A	#N/A	#N/A	2036	15.3	12.0	2.6	154
S130	S130	N	#N/A	#N/A	#N/A	2036	7.2	14.0	1.4	138
Toogoom WWTP										
S170	TGMPS17	E	6.1	20.5	1.5	2016	8.8	15.5	1.7	32
S180	TGMPS44	E	17.5	15.0	3.2	2021	20.8	18.3	4.7	45

In addition several pump stations will be removed as a result of diverting sewage from one catchment to another.

PPS84 (S177) and EPS22 (S176) on the Kawungan Ridgeline will be able to gravitate into the Pulgul catchment once the Doolong Flats gravity sewers are installed in 2016 and 2021 respectively. At these times the pump stations will be decommissioned.

In accordance with Section 6.2.1.1, PPS23 (S201) is to be diverted into the Pulgul catchment after Pulgul Creek WWTP has been upgraded (10,000ED) in 2022. In addition a new sewage pump station (S203) and associated rising main (S204) will be required on Nissen St to divert additional sewage from the Nikenbah catchment will need to occur in 2030. This new pump station would direct sewage to PPS23. At this time an upgrade to PPS23 (S202) will be required.

RECOMMENDATION: Upgrade sewage pump stations in accordance with schedule in Table 6-32.

RECOMMENDATION: Divert PPS84 into the Pulgul Catchment in 2018 at a cost of $50k.

RECOMMENDATION: Divert PPS22 into the Pulgul Catchment in 2023 at a cost of $50k.

RECOMMENDATION: Divert PPS23 to Pulgul Catchment in 2022 at a cost of $50k.

RECOMMENDATION: Construct a new sewage pump station (Nissen St) and associated rising main in 2030 at a cost of $490k.

RECOMMENDATION: Upgrade PPS23 in 2030 at a cost of $175k.

6.3.2 Rising Mains

Assessment of the velocity through rising mains was also undertaken for each of the pump stations. WSAA code recommends an absolute minimum velocity of 0.9m/s, a minimum velocity of 1.5m/s and a maximum velocity of 3.5m/s. At 3.5m/s energy costs become significant so for the purposes of this Strategy an upper limit of 1.5m/s was used as an upper limit.

Table 6-34: Fraser Coast Projected Rising Main Upgrades

Rising Main Strategy ID	Associated Sewage Pump Station	Adopted Discharge 2031 (L/s)	Velocity existing Rising Main (m/s)	Existing Rising Main Diameter (m)	Year for replacement	Future Rising Main Diameter (mm)	Velocity new Rising Main (m/s)	Notes
Aubinville WWTP								
S24	APS13	63.9	2.0	200	2018	300	0.904	
S32	APS02	158.4	2.2	300	2017	450	0.996	
Burrum Heads WWTP								
S158	BHPS52	29.7	1.7	150	2017	225	0.747	
S26	BHPS55	20.9	2.6	100	2016	150	1.183	
Eli Creek WWTP								
S2	EPS04	231.4	2.1	375	2021	500	1.179	Pump upgrade has Deferred RM to 2021
S11	EPS83	288.6	1.8	450	2027	600	1.021	
S44	PPS79	71	4.0	150	2026	300	1.004	

RECOMMENDATION: Upgrade Sewer rising mains in accordance with the schedule in Table 6-33.

6.4 Sewerage Collection

6.4.1 Network Modelling

The wastewater network was assessed using the commercially available sewerage network modelling software, Infoworks CS. In all 8 models were created for the sewerage strategy, one for each of the sewerage catchments.

The models were created using a combination of physical and dynamic data. The physical data such as pipe sizes, grades, elevations, pump station dimensions, and rising main information were gathered from the WBWC Geographic Information System (GIS), while the dynamic data such as pump flow rates, inflows to WWTP and pump controls were determined from the WBWC telemetry system (SCADA). Future loading projections were determined from the ED demand model.

As the population data relies both on residential and non-residential, an average of each profile at each particular planning horizon was calculated and applied to each subcatchment. This profile enables a proportion of flow per ED to be estimated per hour in a 24 hour period for all of the models.

The networks were modelled using an extended time simulation over a period of three days. These were conducted over the projected planning horizon in 5 yearly increments to 2031. The 2031 scenario was assessed and any deficiencies in the system were identified and addressed. The model illustrated where sewage overflows/surcharging occurred in the network (i.e. at a manhole or pump station wet well). The modelled overflows are generally caused by a lack of capacity of the gravity main, pump station or rising main. In these cases the deficiency was rectified with larger gravity mains or new pumps or rising mains. If additional capacity was not provided, the magnitude of overflows would increase in the next planning increment. New overflows became apparent at each subsequent modelling iteration. The logic was that the pump/rising main was unable to keep up with the upstream flows and needed to be upgraded.

The intermediate increments were then assessed starting with 2016 through to 2026. As increased sewage loading occurred, augmentation to the network was required. When this occurred the 2031 infrastructure previously identified was applied to the model. Using this methodology reduces the risk of upgrading the same section of main multiple times throughout the planning horizon.

The required capital expenditure to the gravity collection system, pump stations and rising mains are located in Appendix 1. Plans showing the location of these upgrades are included in Appendix 2.

6.4.2 I/I Assessment

Gravity sewerage reticulation systems have historically been designed for a Peak Wet Weather Flow (PWWF) of five times the Average Dry Weather Flow (ADWF) entering the system. This design guideline is consistent with the DEWS (2015) Planning Guidelines for Water Supply and Sewerage.

The PWWF flow factor allows for inflows that result from inflow and infiltration (I/I) into the sewerage system. Groundwater infiltration and stormwater inflow are sources additional flow. Inflow is apparent in flow data as it reflects an increase in sewage flows during a rain event. The stormwater enters through direct connections of rooves into the sewer, other illegal connections and broken manholes. In the case of Infiltration, ground water is allowed into the sewerage system through leaking joints or cracks, drawing down groundwater levels. The recession curve continues for a much longer period of time after the rainfall event and is usually quite distinct. Infiltration into the sewer is related to the height of the water table and in coastal areas can be influenced by tidal ranges/intrusion. Infiltration enters the system due to infrastructure integrity and/or poor construction techniques.

The additional volume of stormwater entering the reticulation system places additional demands on the system. It is required to be pumped and stored within the system, and at the WWTP it adds significant volumes to be treated. From the perspective of irrigation and effluent reuse it results in additional storage requirements and irrigation facilities to dispose of the treated effluent.

Reduction of inflow and infiltration into the system to a manageable level is the only economical and environmentally viable solution. Simply over-sizing infrastructure to handle the inflows does not address the root cause of the problem. Major inflow and infiltration sources need to be located and eliminated. As inflow and infiltration occurs across the entire system it will be necessary to implement a planned and structured approach that will quantify the problem so that future capital works programs can be developed. A combination of CCTV, smoke and dye testing, and property by property inspections will be required.

It is recommended that a detailed assessment of I/I and the development of a structured approach to I/I reduction in the Fraser Coast be given a high priority. To enable this relevant data needs able to be retrieved from the SCADA system. There is an amount of work required to change the current polling system to a 4G system which would allow real time tracking of sewer pump stations and cumulative flow data to be collected and stored at a central SCADA database. It has been estimated that the cost for these works would be of the order $$$?

Effective management and administration of an inflow and infiltration program is resource intensive. Field investigation and repairs are only part of the work. Collation of data, engineering of solutions, development of remedial and capital works programs, assigning priorities, defect notifications to property owners, follow up inspections, follow up notices and progress reporting are but some of the administrative functions necessary to support such an undertaking. Effective delivery requires a dedicated position for a person with an engineering background to develop and deliver the program which is likely to take several years.

A schedule has been prepared that tracks when a sewer catchment was last cleaned and closed circuit television (CCTV) imagery is taken. They are then scheduled for a new clean and CCTV based on pipe material. Clay and concrete pipes are most likely to fail and allow infiltration therefore is checked every 5 years, while the rest of the pipes are checked every 10years. During the CCTV process any defects are flagged. These defects are then checked and categorised based on how easily they would allow groundwater to infiltrate the sewer. Lengths of main are analysed from manhole to manhole and repairs are categorised into either patching or re-lining. Sections requiring re-lining are added to a capital works program that allocates $300,000 a year for re-linings with the priority on the list being based on severity and number of defects.

Currently WBWC has a recurrent budget of $600k/annum to target areas with high infiltration in Maryborough and Hervey Bay. The rehabilitation of these sewer mains is being undertaken by;

- Spirally wound PVC lining and
- Close fitting thermoplastic lining

The spirally wound PVC is a method where a strip of PVC is spirally wound into a pipe and interlocked using proprietary locking mechanisms.

The close fitting thermoplastic lining is a technique where a deformed PVC liner is drawn down the host pipe. Once they are in place heat is applied to reshape the liner to the full diameter of the host pipe.

RECOMMENDATION: Review SCADA system to determine user requirements and scope future works to augment SCADA system at a cost of $20k in 2016.

RECOMMENDATION: Creation of SCADA database for the storage of sewerage data for access by all users at a cost of $30k in 2016.

RECOMMENDATION: Review the I/I program to assess the effectiveness of rehabilitation works to date at a cost of $30k in 2017.

7. 20 YEAR CAPITAL WORKS PROGRAM

The detailed 20 year program is included in Appendix 1. The total program to 2036 is $177m.

Table 7-1: Capex Program to 2036

Year	Proposed CAPEX ($000's)
2016	7,747
2017	9,779
2018	13,238
2019	19,157
2020	16,296
2021	18,410
2022	650
2023	888
2024	1,334
2025	1,258
2026	19,679
2027	10,738
2028	19,350
2029	600
2030	2,971
2031	8,424
2032	13,990
2033	2,713
2034	600
2035	600
2036	8,092
Total	**176,514**

Some operational planning projects have been identified during the process of preparing this report. These projects are investigative by nature and require some assessment and optioneering prior to a decision being made on capital expenditure. These types of projects are deemed operational and are identified for inclusion in the operational budgets.

Table 7-2: Operational Expenditure Program to 2036

Year	Description	Cost ($000's)
2016	Investigate options for the reduction in Total Nitrogen and Total Phosphorus Suspended Solids at the Aubinville WWTP	60
2016	Investigate the reduction in Total Phosphorus at the Toogoom WWTP to meet licencing requirements	30
2016	Review SCADA system to determine user requirements and scope future works to augment SCADA system	20
2016	Creation of SCADA database for the storage of sewerage data for access by all users	30
2016	Investigate and produce a detailed planning report on the viability and timing of components in option H2(b)	80
2016	Investigate the economics of the Fraser Coast Reuse schemes in 2016 at a cost of $20k	20
2017	Investigate the impact of sewer rehabilitation to date on Infiltration	30
2017	Investigate feasibility of new WWTP located in Tinana	40
Total		**310**

The following graph shows the forecast expenditure over the 2016-2036 period identified in this report. There is significant expenditure in some of the years.

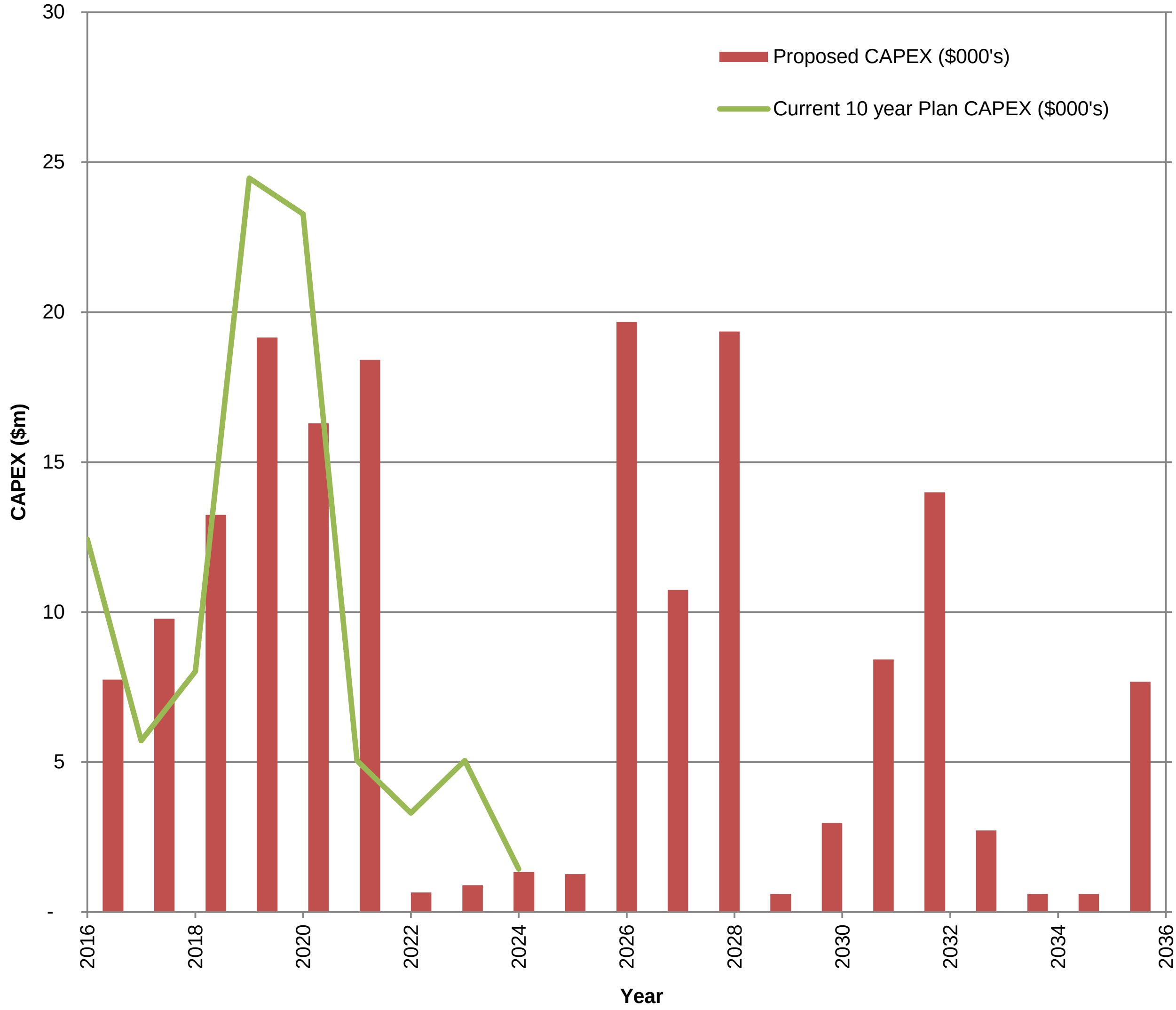


Figure 7-1: Capex Expenditure Identified in this Report

7.1 Impact on Infrastructure Charges

An estimate of infrastructure charges to the 2036 timeframe across the entire Fraser Coast has been developed to allow comparison between projected costs and the amount recouped from developer charges.

The infrastructure costs over the period was restricted to projects that are considered headwork's and;

- benefit multiple land owners (generally sewers over DN150)
- are growth projects
- are required for reliability or standards of service
- Is not a replacement project.

All sewage pump stations and rising mains are considered headworks unless they only serve a single lot.

Based on a residential and non-residential sewage ED growth of 15070ED (to 2036) and a capital expenditure of $162m, the cost to provide water infrastructure to meet projected demands is estimated at $10,700/ED.

State Government currently caps developer charges in Queensland under the State Planning Regulatory Provisions (SPRP) at a maximum total charge of $28,000 for dwellings. Determining charges for non-residential development is more complex and based on floor area.

Currently the proportion of developer charges allocated to sewerage infrastructure is 21% (source: FCRC Management Policy - Table 1). This equates to approximately $4,788/ED using the current charge of $22,800 for a residential lot.

8. CONCLUSIONS

The development of a Sewerage Strategy for WBWC has provided the basis of a capital development programme covering the period to 2036.

A capital investment programme valued at $177m will be required to the year 2036 and includes some major upgrades to the Pulgul and Aubinville WWTP's. Major expenditure is also proposed for the effluent reuse scheme to incorporate Cassava into the scheme.

May assumptions are made in the preparation of the Sewerage Strategy including projected sewage loadings, demands per property and the likely sequencing of development activity in the Fraser Coast. These factors change from time to time and require periodical review.

9. RECOMMENDATIONS

The following recommendations are made with respect to this report:

1. That the WBWC Board adopts the Fraser Coast Sewerage Strategy Report 2015 as the basis for partial development of a Capital Works Programme for the period to 2036.

2. That the WBWC Board notes the required expenditure of $177m for capital investment and $310k for investigations and planning studies to the year 2036.

3. That this Sewerage Strategy report be reviewed every five years, as a minimum, to address any changes to water demand, population growth rates and development sequencing.

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