# BROADWATER

# PRESSURE SEWERAGE SYSTEM
# DESIGN REPORT

FEBRUARY, 2012

PRESSURE SEWER SOLUTIONS P/L

Broadwater Pressure Sewerage System Design Report

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Richmond Valley Council

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## 1.0 EXECUTIVE SUMMARY

Richmond Valley Council (RVC) is providing sewerage services to the village of Broadwater located on the north coast of NSW. The sewerage scheme comprises a pressure sewerage system collecting wastewater from all properties within the scheme boundaries and discharging to the proposed sewage pumping station (SPS). Then a pressure sewer rising main will deliver sewage to the existing Evans Head Sewage Treatment Plant.

This report addresses all components of the works.

RVC have commissioned Pressure Sewer Solutions Pty Ltd to design the pressure sewer system, SPS and sewage rising main (SRM) components of the scheme.

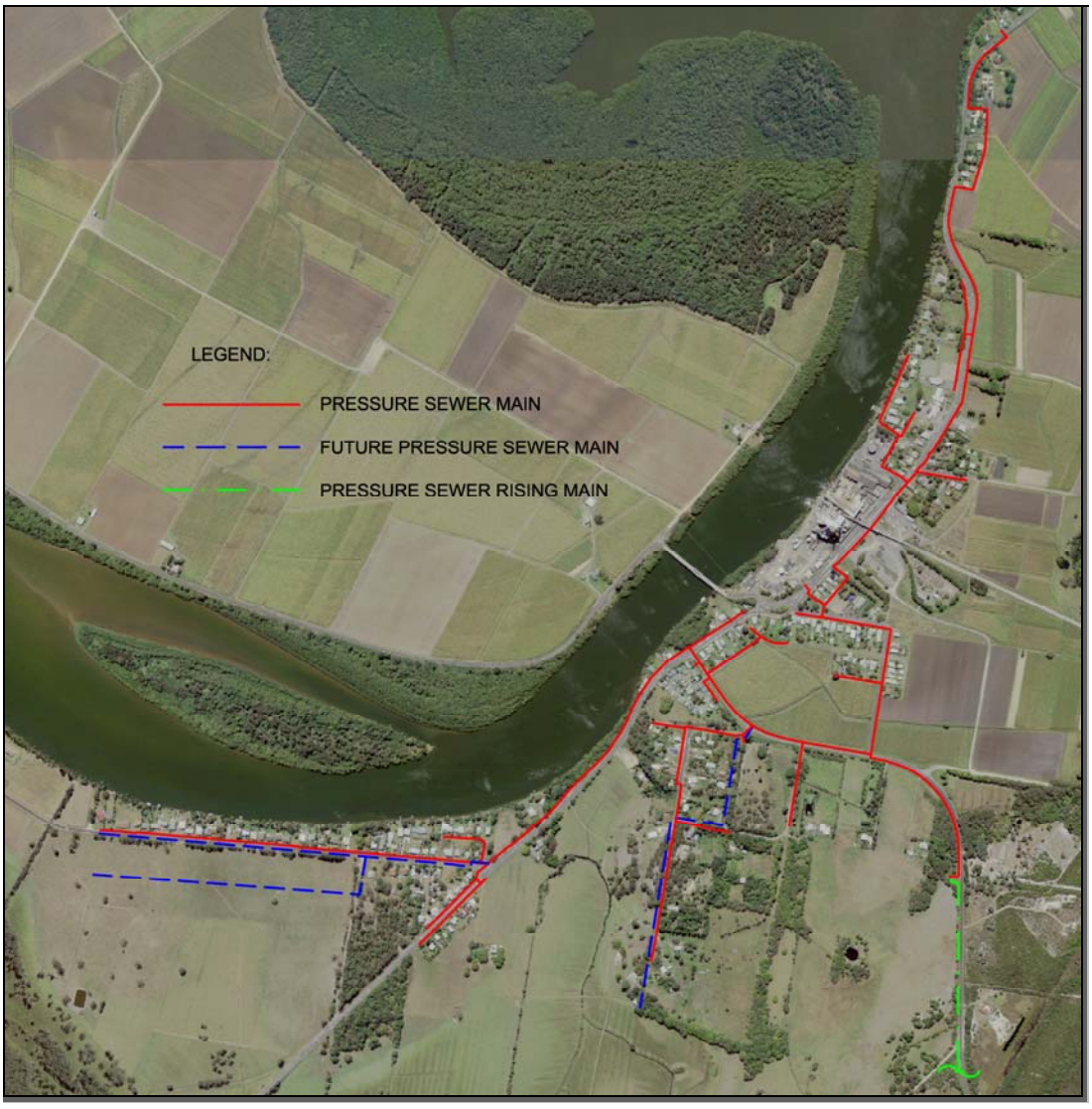



**Figure 1: Broadwater Village**

The Broadwater village is at the bank of Richmond River. Refer to Figure 2 for the scheme boundaries.

Existing, 50 Year and ultimate sewage loadings are required by RVC. The 50 year sewage loading of Equivalent Tenements has been accommodated within the design of the system. The design loadings are:-

- Existing Sewage Loadings = 286 ET's (Including vacant blocks)
- 50 Year Sewage Loadings = 558 ET's (at the year of 2061)
- Ultimate Sewage Loading = 712 ET's

The Broadwater pressure sewerage system design loadings are based upon the RVC 50 year loading projections.

Pressure sewerage systems consists of

- The common street main collection system, including pipework, valves, air valves, flushing points and ancillary fitments. Street mains shall be fusion welded polyethylene 40mm-140mm diameter. And rising main shall be 150mm PVC-O pipe.
- Boundary kits located at the boundary of each serviced lot. The boundary kits are the interface point between the street main system and the on property works.
- On Property works consisting of the pressure sewerage pump and pump well, pump out line to the boundary kit, control panel, control wiring and connection to electrical supply.
- Connection of the property sewer drainage to the pressure pump well and the decommissioning of the existing septic tank (or waste water treatment system) is the responsibility of the property owner.

The pressure sewerage system has been designed to perform satisfactorily with existing loads and project ultimate loads, with cleansing velocities achieved during normal operation and pressures within the system not exceeding the EOne recommended maximum pump operational discharge pressure.

## Pressure Sewerage System Design Concept

Each property will deliver sewage via a 40mm or 50mm polyethylene pressure pipe to the street mains (with various sizes of 50mm, 63mm, 75mm, 90mm, 110mm, 125mm and 140mm) and then to the Sewage Pumping Station (SPS) proposed location at Evans Head – Broadwater Road. Then the sewage will be discharged to the existing Evans Head Sewage Treatment Plant (STP) via a 150mm PVC-O rising main.

The design concept is to convey sewage to the SPS site minimising system detention time and pump discharge pressure while maximising operating velocity.

## Pump Selection

RVC has selected the EOne Extreme pressure sewer unit for the project.

## Hydraulic Analysis Outputs

The hydraulic analysis has been undertaken using a probability method to determine peak flow rates, pump head and flow velocities during existing and ultimate loading operational phases. The numbers of pumps operating simultaneously for any given probability is determined from total number of pumps connected and individual average pump operation durations based on pump-out flow rates and average inflow volumes for the critical period for the diurnal flow profile.

Performance of the system with regard to pump head is based on recommended pump operational head not being exceeded during a 10% probability event, with acceptable minimal exceedance risk for probabilities below 10%.

## Design parameters include:

1. EOne Extreme 60 m/h pressure sewer pump

2. 2.2 ep/et
3. 210 litres of sewage per person per day
4. 462 l/et/day
5. K = 0.15
6. Pipe – polyethylene PE100 PN16.
7. No I&I allowance
8. Pressure sewerage system Pipe :- Polyethylene PE100 PN16 with electro fusion joints.
9. SPS Inlet pipe: - 140mmØ inlet pipe connected to the pressure sewerage system at Evans Head – Broadwater Road SPS entry is Polyethylene PE100 PN16 with an ID = 114mm
10. SPS inlet level = RL9.46
11. Pressure Sewer Rising Main pipe:- DN150 PVC-O with an ID = 167.9mm
12. STP Inlet pipe:- DN150 inlet pipe connected to the pressure sewerage system at Treatment Works Road STP entry is PVC-O PN16 with an ID = 167.9mm
13. STP inlet level = RL12.0
14. Typical system hydraulic performance for 10 % Probability at 462 l/et/d is as follows:-

## Forecast sewage flow rate into the SPS for 10 % Probability at 462 l/et/d:-

- 50 Year lot number = 9.8 L/s (excluding wet weather flow allowance)
- Existing lot number = 5.3 L/s

## Forecast total dynamic head

The forecast system performance uses 10% probability with 462 l/D/ET.

| Litres Per ET Per Day | 50 Year Loadings | Existing Loading |
|---|---|---|
| 462 l/et/d | 34.9 m/h | 30.5 m/h |

## After Power Outage Flow

During a power outage the pumps in a system will not operate, but the pressure sewer collection wells may continue to fill. When the power is resumed, it is feasible that a large proportion of pumps may want to operate at once. The forecast peak flow to the SPS is 24.0 litres per second.

## Pressure monitoring

Monitoring pressure in the sewerage system spine mains is provided to give early notification to system operators of mains pressure increase. This may be symptomatic of mains partial obstructions which can progress to a full blockage if not addressed.

Pressure monitoring is not provided for this project however RVC may install at a later stage.

## System Flushing

A pressure sewerage system flushing program may be required to be undertaken in stages to allow lots to be progressively commissioned and avoid solids settlement within the piping system.

## Odour Control

The long system sewage retention times will require management of odour at the air valves and at the SPS. Three air valves are required throughout the system and have been provided with gas phase carbon canister to scrub odour at this release point. Sewage odour management in the liquid phase is managed at the SPS and therefore not a component of this commission.

## Mains Set-out

Pressure sewerage system mains have mostly been set-out on one side of the road which reduces the total lengths of street main pipe and effect of the RMS road (Pacific Highway).

The Pressure sewerage system is the last service to be installed, separation from other services in some locations throughout the village has been difficult to achieve and the main has been documented in a best fit position.

## Sewage Pumping Station and Sewage Rising Main

The pressure sewerage system discharges into the Broadwater Sewage Pumping Station pumping waste water to the Evans Head STP. The proposed sewage pumping station incorporates dual submersible electric sewage pumps in a concrete wet well.

The sewage pumping station is designed to comply with Richmond Valley Council requirements.

The sewage pumping station and rising main scope of work consists of:-

1. Broadwater Sewer Pumping Station includes two submersible centrifugal pumps mounted in a pump well, and includes inlet valves, outlet valves, inlet flow meter, automatic inlet valve and bypass line, electrical controls, float switches, monitoring equipment and valve pits

2. The installation includes pump well overflow pipes, conduits, and high level and low level vents.

3. Civil works includes ground works filling of site, entry and exit driveways, bunded concrete truck stand area, truck hardstand area and grass surface installation to earthwork banks.

4. A platform (road base) is included next to the pump station for future installation of an odour control facility, including conduits to future injection points.

5. Sewer rising main from the Broadwater sewage pumping station to the Evans Head STP, rising main to be 150mm PVC-O, 8,544m in length.

## Sewage Pump Performance

The sewage pumps are to be able to operate in the full range of operating conditions. The design bookend performances are based on:

1. Lowest operating head: new pipe to possible hydraulic condition were system hydraulic control point is the high point in the rising main at CH1869 downstream from the pumps. A pinch valve is proposed at CH2300, the downstream point of the high point to maintain a full pipe during normal operation.

2. Highest Operating Head: aged pipe with system pumping under pressure to the STP site 8544 m distance. With the pinch valve operating normally this is the typical operating condition.

The duty points for this pump range from:

- 27.7 L/s @ 43 m head minimum head conditions,

- 17.8L/s @ 52m head maximum head conditions

## SPS Overflow Protection

Overflow protection at the SPS is facilitated by automatic closure of the inlet valve in an emergency event. An emergency event includes activation of the high level alarm, power failure, or an alarm event that shuts down both sewage pumps. The SPS by-pass provision shall be provided at the sewage pumping station to allow the pressure sewerage systems flow to by-pass the SPS and discharge directly to the downstream STP receiving structure. This by-pass facility will provide service continuity during an emergency event and during maintenance of the sewage pumping station.

## 2.0 INTRODUCTION

Richmond Valley Council is providing sewerage services to the village of Broadwater. The sewerage servicing scheme comprises

- pressure sewerage system including street main collection system and on property equipment;
- sewage pumping station to be located on Evans Head – Broadwater Road at the east side of the village;
- pressure sewer rising main from SPS to existing Evans Head Sewage Treatment Plant.

RVC have commissioned Pressure Sewer Solutions Pty Ltd to design the pressure sewer system components of the scheme.

### 2.1 Pressure Sewer Solutions Pty Ltd Scope of Works

Scope of works for the pressure sewerage system is:-

**Table 1: Scope of Design Works – Pressure Sewerage System**

| Item No | Scope of Works | Responsibility |
|---|---|---|
| 1 | Pressure Sewer system detailed design | Brief by Richmond Valley Council |
| 2 | Street main design drawings for a pressure sewerage collection system to serve all properties indicated on the Pressure Sewer Solutions concept plan and the vacant entitlement lots. | Pressure Sewer Solutions P/L |
| 3 | Existing services - desktop identification | Pressure Sewer Solutions P/L |
| 4 | Existing services site identification | Pressure Sewer Solutions P/L / Ledonne Constructions |
| 5 | Development of a hydraulic analysis to confirm / determine the hydraulic performance parameters of the proposed system. | Pressure Sewer Solutions P/L |
| 6 | Installation standard details of systems components including pump units and property connection. | Pressure Sewer Solutions P/L |
| 7 | Details of expected flow rates that will discharge to the STP. | Pressure Sewer Solutions P/L |
| 8 | Pressure sewer street mains set out and mark-up | Richmond Valley Council / Pressure Sewer Solutions P/L |
| 9 | Documentation of street main collection system | Pressure Sewer Solutions P/L |
| 10 | Property audits<br>Meet with property owners and define locations of pressure sewer equipment on each property.<br>Identification of visual plumbing drainage | Pressure Sewer Solutions P/L |

| Item No | Scope of Works | Responsibility |
|---|---|---|
| | defects on the property. | |
| 11 | Property owners sign-off | Richmond Valley Council / Pressure Sewer Solutions P/L |
| 12 | Issue of property defect notices and supervision of defect correction. | Richmond Valley Council |
| 13 | Connection of the property sewer drainage to the pressure sewer unit | Property owner |
| 14 | SPS Design | Pressure Sewer Solutions P/L |
| 15 | SRM Design | Pressure Sewer Solutions P/L |
| 16 | Design Report | Pressure Sewer Solutions P/L |

Design documentation deliverables are summarised in Table 2

## Table 2: Design Documentation Deliverables

| Item Number | Design Deliverable Description | Overview And Purpose Of Document |
|---|---|---|
| 1 | Pressure Sewer System Street Main Plans | Construction of pressure sewerage system street mains including pipe sizes, set out, location of valves etc and construction details.<br>(Refer to Broadwater Transmittal Report Issue B for details.) |
| 2 | Property Plans | Locates pressure sewer unit, control panel, boundary kit, pressure discharge pipe, proposes a solution for property sewer connection to the pod and indicates if owner has signed-off locations.<br>(Refer to Broadwater Transmittal Report Issue B for details.) |
| 3 | Plumbing Reports | Individual Property Reports from site investigation such as fixture numbers and required plumbing upgrades / faults. |
| 4 | Design Report | Overviews the system design including design parameters, hydraulic analysis outputs and assumptions etc. |
| 5 | Property Audit Register | Schedule of property owners from Council data base overviews which properties have owner sign-off or “approved for construction” (c) and which still require owner’s approval (oa). |
| 6 | Property Audit Connections Schedule | Summary of information collected from site such as fixture numbers, calculated wastewater loadings, flood affected properties, holiday homes and recommended pressure sewer unit for each property. |
| 7 | Pre-Construction Property Photos | Photos of each property works locations. |

## 2.2 Pressure Sewerage System Description

Pressure sewerage systems consist of a network of pressure pipes and grinder pumps, which integrate to form a collection system. The pressure sewerage system comprises of a Pressure Sewer Unit installed at each property in the catchment discharging to a common collection system (Refer to Fig: 4). The pump units macerate the sewerage into fine watery slurry for discharge through a small diameter pipeline.

Gravity sewer pipes from the premises connect to a pressure sewerage tank containing a purpose built Grinder pump. In a completely pressurised collection system, all the piping downstream from the grinder pump will normally be under pressure (typically 60m total dynamic pressure or less). Pipe sizes will start at 40mm outside diameter PE100 PN16 polyethylene.

Polyethylene pipe is fully sealed by electrofusion welding at joints. Depending on the topography, size of the system and planned rate of buildout, appurtenances may include isolation valves, flushing points, air release valves at significant high points, and check and stop valves on the property boundaries at the junction of each property connection with the pressure sewerage main.

The piping system is hydraulically assessed using probability method and hydraulic grade line to determine pipe sizes required to maintain cleansing flow velocities and acceptable operating conditions.

Flushing points are provided at key locations and at regular intervals to facilitate maintenance when required. Installation of air valves are provided where necessary for the performance of the system but will be minimised to reduce the risk of odour escape. The system pipe sizes range from 40mm to 140mm PE100 PN 16 black polyethylene which is fully sealed by electrofusion welding of joints.

## 2.3 Project Definition

### 2.3.1 Pressure Sewage System Scheme Boundary and scope

The Broadwater village is at the bank of Richmond River. Refer to Figure 2 for the scheme boundaries.


**Figure 2: Broadwater Scheme Boundary**

### 2.3.2 Pressure Sewerage On-Property Works

The pressure sewerage system on property works comprises:

- Pressure sewer unit (PSU) pump and collection well with wastewater level sensor and high level alarm.
- PSU's are a mix of one and two pump units for all residential and commercial properties.
- Control Panel and interconnecting cabling, generally mounted on the wall of each property
- Power supply to the Control Panel
- 40mm pump out line (for one and two pump unit) extending to the Boundary kit
- Boundary Kit including check valve, test point and isolation valve.

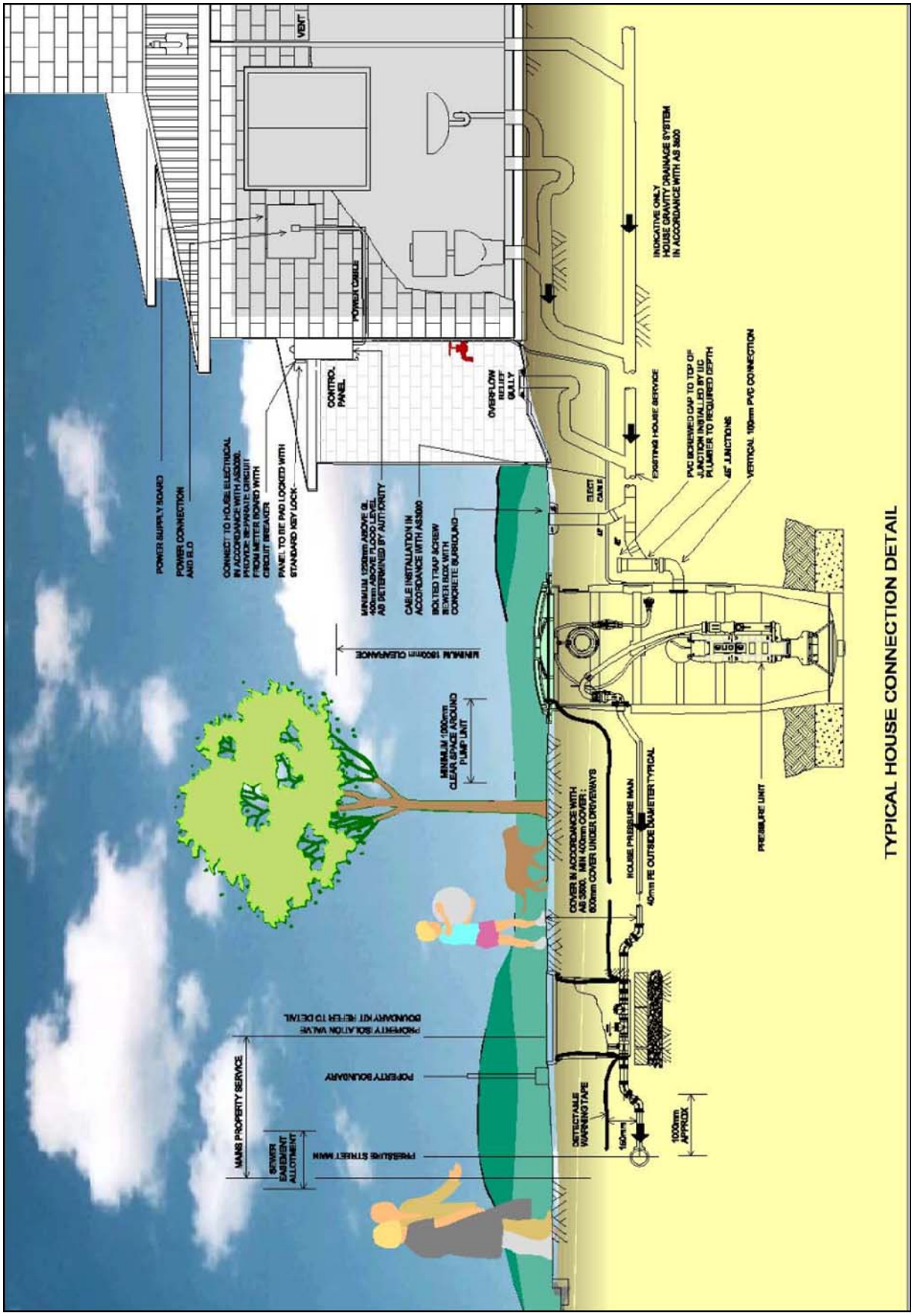



**Figure 3: Typical On Property Works Installation**

*Refer to Property Data Base for confirmation of pressure sewer system type: e.g. Simplex, Duplex or Quadruplex.

RVC pressure sewer policy defines their assets as indicated in Figure 4

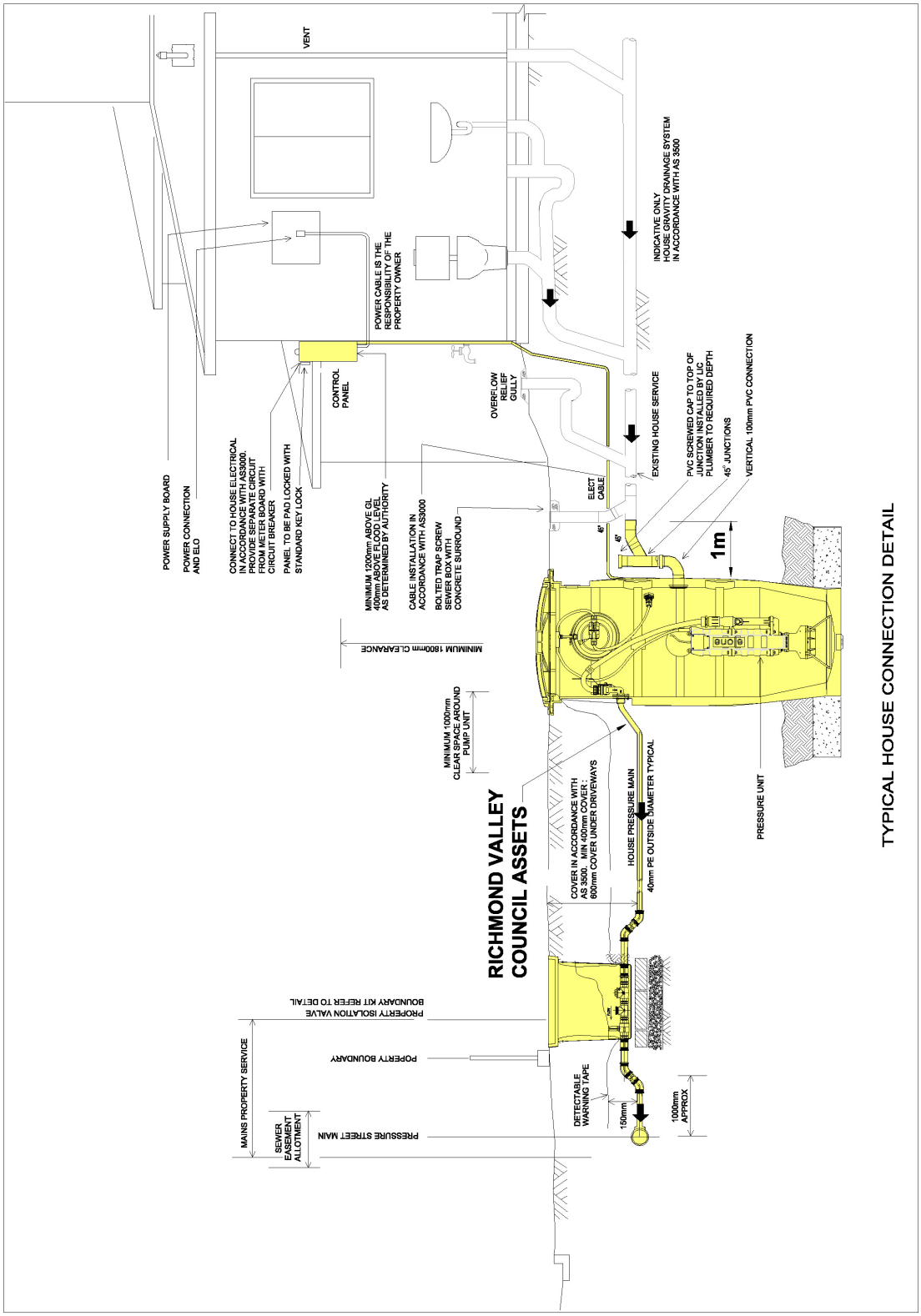



**Figure 4: RVC On-Property Pressure Sewer Assets**

# 3.0 PRESSURE SEWERAGE SYSTEM DESIGN

## 3.1 Design Methodology

The concept design for the pressure sewerage system was prepared by Pressure Sewer Solutions P/L as a component of the design and construction tender process for the Broadwater sewerage scheme. The concept design was then verified and detail design undertaken by Pressure Sewer Solutions P/L on behalf of Richmond Valley Council.

## 3.2 Design Objectives

The objectives of the design are:

- System to collect and convey all sewage from existing and future Broadwater facilities as briefed by RVC.
- Provide a sewer collection system acceptable to the community.
- All pressure sewer pumps shall operate within the recommended maximum operational pressure under 10% peak flow conditions.
- Cleansing velocities were achieved within all sections of the pressure sewerage mains
- Air valves are minimised within the system to reduce risk of odour escape.
- Achieve minimum disturbance to the environment, and minimum disturbance to the residents.
- To achieve a satisfactorily operating system under all forecast operating conditions.
- No odour detection by residents
- Elimination of, or minimal wet weather flows.
- Minimise maintenance and operation costs

## 3.3 Design Criteria

### Hydraulic Modelling

Design has been undertaken using a probability method to determine peak flow rates, pump head and flow velocities during existing and ultimate loading operational phases.

The probability modelling includes analysis of:

- Numbers of pumps operating simultaneously for any given probability is determined from total number of pumps connected and individual average pump operation durations based on pump-out flow rates and average inflow volumes for the critical period for the diurnal flow profile.
- Performance of the system with regard to pump head is based on recommended pump operational head not being exceeded during a 10% probability event, with acceptable minimal exceedance risk for probabilities below 10%.
- Acceptable performance of flow velocities in the system is based on achieving minimum velocities each day within the system for probabilities 1% and over. Cleansing velocities are acceptable in 50mm lines with flow from one operating pump and 63mm lines from 3 pumps.

Design Criteria adopted for the design of the Pressure Sewerage systems:-

**Table 3: Design Criteria**

| Item | Description |
|---|---|
| Pump Selection | Based on EONE 60m Pressure Sewer Pump: |
| Cleansing Velocity | - Optimum 0.6 m/s : Design minimum 0.4 m/s<br>- 50mm pipe – one pump connected |
| Hydraulic Modeling | Pump Head = 10% Probability - 3 hr peak diurnal flow<br>Velocity = 1% Probability - 3 hr peak diurnal flow |
| p/ET | 2.2 From Brief |
| Design L/p/d | 210 GHD Report May 2007 |
| L/p/d | 462 L/ET/d |
| Holiday Loadings | None |
| Planning Zones, Development areas and infill | As per council advise and Loading Drawings SK001 to SK012 |
| Wet Weather Design Allowance | Nil Allowance in pressure sewer design |
| Redundancy | N/A |
| Power outage Flows | Based on 24hr power outage for whole of Broadwater |
| Pressure Sewer Unit Storage | As required by RVC |
| System Pipe Material | Pressure sewerage system:- Polyethylene PE100 PN16 with electro fusion joints.<br>SPS Inlet pipe:- 140mmØ inlet pipe connected to the pressure sewerage system at Evans Head – Broadwater Road SPS entry is Polyethylene PE100 PN16 with an ID = 114mm.<br>Pressure Sewer Rising Main pipe:- DN150 PVC-O with an ID = 167.9mm.<br>STP Inlet pipe:- DN200 PVC inlet pipe connected to the pressure sewerage system at Treatment Works Road STP entry. |

## 3.4 Existing, Vacant and Future Lots

The existing ET's as defined in the hydraulic analysis allow for the existing lots plus the permanent caravan park loadings. The objective is to define the existing loads as an equivalent ET not the existing connected lots. Therefore to calibrate the existing ET's with the hydraulic analysis ET's the following requires consideration:-

- Hydraulic analysis = 260 ET
- Vacant Lots = 26 ET
- Total Caravan Park loading = 41 ET's (Included in Hydraulic analysis, Sunrise Caravan Park = 23 ET's, Stopover Caravan Park = 18 ET's)

As per GHD Report May 2007 (Revision A), council has confirmed that approximately 40kL/d of wastewater from the Sugar Mill will not be discharged to this new sewerage system.

The total existing loading for the Broadwater project = 286 ET

A full breakdown of existing, vacant and future sewage loadings accommodate in the Broadwater Pressure sewerage system design is provided on the following drawings:-

**Table 4: Existing, 50 Year and Ultimate Loading Drawings**

| Drawing Title | Drawing Number | Description |
|---|---|---|
| Broadwater Existing Loading | SK 001 | Sheet 1 of 4 |
| Broadwater Existing Loading | SK 002 | Sheet 2 of 4 |
| Broadwater Existing Loading | SK 003 | Sheet 3 of 4 |
| Broadwater Existing Loading | SK 004 | Sheet 4 of 4 |
| Broadwater 50 Year Loading | SK 005 | Sheet 1 of 4 |
| Broadwater 50 Year Loading | SK 006 | Sheet 2 of 4 |
| Broadwater 50 Year Loading | SK 007 | Sheet 3 of 4 |
| Broadwater 50 Year Loading | SK 008 | Sheet 4 of 4 |
| Broadwater Ultimate Loading | SK 009 | Sheet 1 of 4 |
| Broadwater Ultimate Loading | SK 010 | Sheet 2 of 4 |
| Broadwater Ultimate Loading | SK 011 | Sheet 3 of 4 |
| Broadwater Ultimate Loading | SK 012 | Sheet 4 of 4 |

## Table 5: Broadwater Sewerage Scheme – Existing Loadings

| EXISTING LOADINGS | | | | |
|---|---|---|---|---|
| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS | |
| Sunrise | 23 | 189 | 26 | |
| Stopover | 18 | | | |
| Total | 41 | | | TOTAL EXISTING ET'S= 256 |

| OTHER KEY SITES | | |
|---|---|---|
| Sugar Mill Northern Amenities | TOTAL ET= 1 | |
| Sugar Mill Central Amenities | TOTAL ET= 5 | |
| Sugar Mill Southern Amenities | TOTAL ET= 5 | |
| Hotel/Pub | TOTAL ET= 5 | |
| Motel | TOTAL ET= 5 | |
| Bowling Club | TOTAL ET= 3 | |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= 2 | |
| School | TOTAL ET= 3.6 | |
| | | TOTAL ET= 29.6 |
| ULTIMATE TOTAL LOTS = 223 | | ULTIMATE TOTAL ET= 286 |

The average daily flow allowance for each ET = 462 L/ET/d.

## Table 6: Broadwater Sewerage Scheme – 50 Year Loadings

| EXISTING LOADINGS | | | | |
|---|---|---|---|---|
| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS | |
| Sunrise | 23 | 189 | 26 | |
| Stopover | 18 | | | |
| Total | 41 | | | TOTAL EXISTING ET'S= 256 |

| 50 YEARS LOADING ALLOWANCES | | | | |
|---|---|---|---|---|
| EXTRA OVER FUTURE LAND RELEASES (RESIDENTIAL) (ET'S) | EXTRA OVER EXISTING SINGLE LOTS (ET'S) | EXTRA OVER VACANT LOTS (ET'S) | FUTURE SINGLE LOTS (ET'S) | |
| 184 | 21 | 20.5 | 11 | TOTAL 50 YEARS EXTRA OVER ET'S= 236.5 |

| OTHER KEY SITES | | |
|---|---|---|
| Sugar Mill Northern Amenities | TOTAL ET= 1 | |
| Sugar Mill Central Amenities | TOTAL ET= 5 | |
| Sugar Mill Southern Amenities | TOTAL ET= 5 | |
| Hotel/Pub | TOTAL ET= 5 | |
| Motel | TOTAL ET= 5 | |
| Bowling Club | TOTAL ET= 3 | |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= 2 | |
| School | TOTAL ET= 5.5 | |
| Village Industrial (Sugar Mill) | TOTAL ET= 34 | |
| | | TOTAL ET= 65.5 |

| | |
|---|---|
| ULTIMATE TOTAL LOTS = 237 | ULTIMATE TOTAL ET= 558 |

The average daily flow allowance for each ET = 462 L/ET/d.

## Table 7: Broadwater Sewerage Scheme – Ultimate Loadings

| EXISTING LOADINGS | | | | |
|---|---|---|---|---|
| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS | |
| Sunrise | 23 | 186 | 26 | |
| Stopover | 18 | | | |
| Total | 41 | | | TOTAL EXISTING ET'S= 253 |

| ULTIMATE LOADING ALLOWANCES | | | | |
|---|---|---|---|---|
| EXTRA OVER FUTURE LAND RELEASES (RESIDENTIAL) (ET'S) | EXTRA OVER EXISTING SINGLE LOTS (ET'S) | EXTRA OVER VACANT LOTS (ET'S) | FUTURE SINGLE LOTS (ET'S) | |
| 259 | 43 | 21.2 | 9.8 | TOTAL ULTIMATE EXTRA OVER ET'S= 333.0 |

| OTHER KEY SITES | | |
|---|---|---|
| Sugar Mill | TOTAL ET= 37.3 | |
| Hotel/Pub & Motel | TOTAL ET= 10.5 | |
| Bowling Club | TOTAL ET= 3.6 | |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= 6 | |
| School | TOTAL ET= 5.5 | |
| Village Industrial (Sugar Mill) | TOTAL ET= 34 | |
| 195 Pacific Highway (Sugar Mill) | TOTAL ET= 5.5 | |
| Service Station (171-173 Pacific Hwy) | TOTAL ET= 11.8 | |
| Service Station (7-9 Pacific Hwy) | TOTAL ET= 11.8 | |
| | | TOTAL ET= 126 |

| | |
|---|---|
| ULTIMATE TOTAL LOTS = 237 | ULTIMATE TOTAL ET= 712 |

The average daily flow allowance for each ET = 462 L/ET/d.

### 3.5 Pressure Sewerage System Concept Design

A typical pressure sewerage concept design solution for Broadwater was documented with two pressure system spine mains joining at the intersection of MacDonald Street and George Street, then discharging to the SPS. The static lift within the Broadwater pressure sewerage system is not excessive, with most of the town flat with some undulating and low laying areas. The distance from the furthest pump to the proposed SPS is approximately 2.55km, and the friction losses within this length of pipework is generally within the range of the EOne 60m pressure sewer pumps. A hydraulic model was prepared for evaluation of the peak and non-peak flows.

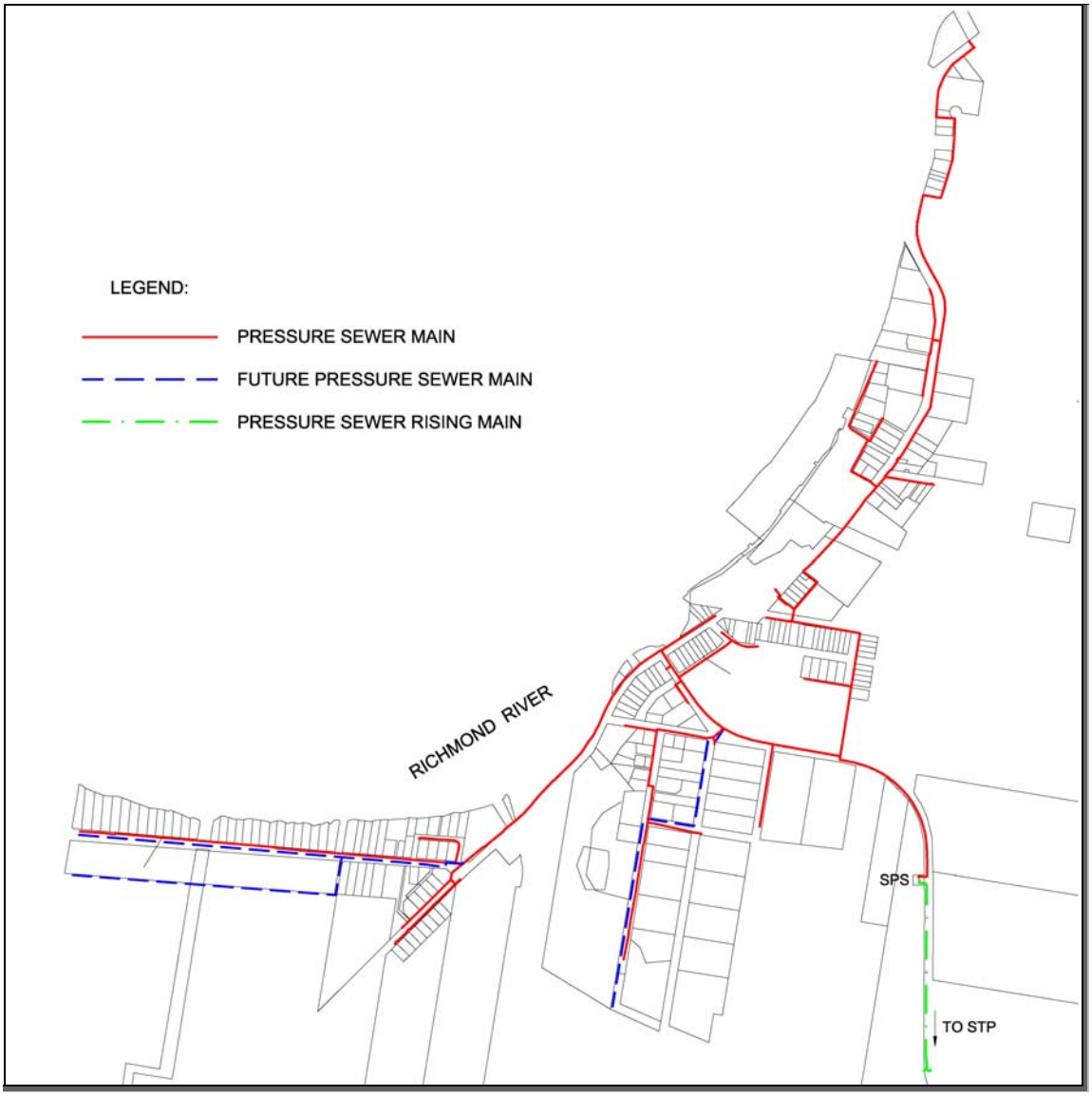



**Figure 5: Approved Concept Design**

## 3.6 System Hydraulic Model

The Broadwater hydraulic analysis outputs are provided in Appendix A.

This system has been designed using design parameters detailed in Section 3.3

Pressure Sewer Solutions has developed an in house hydraulic design tool in conjunction with the University of New South Wales Water Research Laboratory.

During the development of the pressure sewer design methodology there have been several rudimentary design tools developed by pump suppliers, and several different computer modelling software infrastructure packages adapted to design pressure sewer. The initial pump suppliers design tool was and still is based on field data collected from 12 pump units in a 1969 test installation. This information was then statistically extrapolated for larger systems.

The design tools have become more sophisticated as the pressure sewer industry has expanded and a need developed for more accurate prediction of cleansing flow velocities and dynamic pump head.

The modelling of a pressure sewer system has eight principle variables:

1. Probability of flow event e.g. 1%, 5%, 10% or 20% etc.
2. Existing and ultimate system loadings
3. Volume of waste water per pump unit
4. Diurnal Flow pattern critical peak duration and flow proportion
5. Pressure Sewer Unit pump out rate
6. Buoyancy Head events
7. K factors adopted
8. Pipe sizes and material.

The flows within the pressure sewer system for any contributing number of pumps can be predicted using a probability model with the inputs of average volume per pump unit, duration of subject period, and pump out rate (based on the pump curve of the selected pressure pump unit). In conjunction with the University of New South Wales Pressure Sewer Solutions developed a mathematical probability based model populated with the project specific variables. The model used by Pressure Sewer Solution will iterate through the range of system operating scenarios to consolidate a solution. Pressure Sewer Solutions hydraulic model has been extensively calibrated against years of project field data and the design methodology has been proven to accurately predict system flow frequency, behaviour and performance.

The Pressure Sewer Solutions Design tool assesses flows based on pump performance curves matched to dynamic head determined from the system Hydraulic grade line. The primary task lies in determining the peak flow rate in each pipe segment during low and peak occupancy periods. Once this has been determined, the calculation of friction head in each segment, the static head for each grinder pump, and the resulting total dynamic head for each grinder pump.

Establishing pressure sewer mains levels including the downstream discharge point water level are also input to the model.

Understanding the potential for buoyancy head events to detrimentally affect system performance and pump longevity is also a design consideration integrated into Pressure Sewer Solutions Hydraulic modelling tool. This enables strategic air management and value engineering pipeline profiles for location and number of air valves.

This method was developed specifically for semi positive displacement pumps operating characteristics with their near vertical Head vs Quantity (HQ) performance curve. Pressure Sewer Solutions also gave consideration to lower property sewage discharge rates.

In addition to evaluating the peak flow condition; it is also necessary to determine retention times under the initial low flow condition to evaluate the need for odour control.

## 3.7 System Hydraulic Model Outputs

The Broadwater hydraulic analysis outputs are provided in Appendix A.

This system has been designed using design parameters detailed in Section 3.3

System hydraulic performance for 10 % Probability at 462 l/et/d is as follows:-

Forecast sewage flow rate into the SPS:-

- 50 Year lot number = 9.8 l/s
- Existing lot number = 5.3 l/s

Forecast total dynamic head

The forecast system performance uses 10% probability with 462 L/D/ET. (Refer to Hydraulic output table for all Zone TDH).

- 50 Year lot number = 34.9 m/h @ Zone 8
- Existing lot number = 30.5 m/h @ Zone 29

Forecast spine main velocities (Refer to Hydraulic output table for all zone velocities).

- 50 Year lot number = 1.2 m/s
- Existing lot number = 1.1 m/s

## 3.8 System Performance Outputs

Once the preferred design solution was established a detailed hydraulic model was undertaken to determine the systems normal operation. (Refer to appendix A for hydraulic outputs).

## 3.9 Maximum Desirable TDH

Design is integrally associated with knowledge of the pumps being used. The prime example of this is the maximum total dynamic head (TDH) that is chosen in the design process. Even though some model semi positive displacement grinder pumps can lift to over 100m the total dynamic head is restricted to a maximum of 55 - 60m TDH. Constant operation of the pumps over 60m TDH causes the operational life of the stator to diminish rapidly. The design of the system must give due consideration to the nature and characteristics of the pumping units connected. The pipe sizing determined by the hydraulic modelling is designed to ensure the pump longevity is not reduced by frequent operation above the recommended pump performance maximum.

**MAXIMUM PUMP DYNAMIC HEAD DISTRIBUTION**

| Pressure Range (m Head) | Number of units in range |
|---|---|
| >=0 <10 | 10 |
| >=10 <20 | 160 |
| >=20 <30 | 186.2 |
| >=30 <40 | 200.8 |
| >=40 <50 | 0 |
| >=50 <60 | 0 |
| >=60 <70 | 0 |
| >=70 | 0 |
| Total Pump Units | 557 |

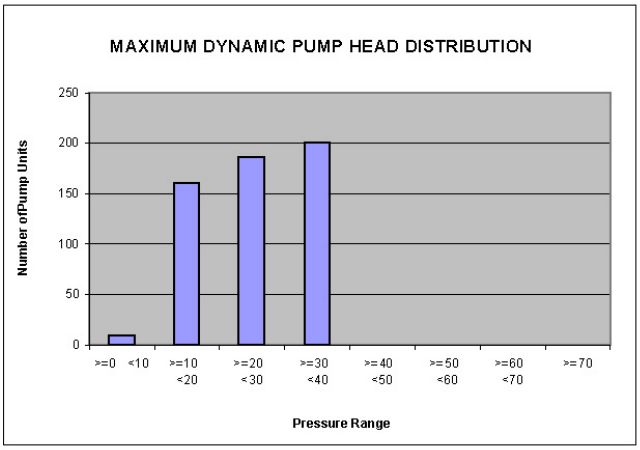



**Figure 6: 10% Probability Pump Discharge Pressure 50 Year Connected ET's**

## 3.10 Velocities

Minimum desirable cleansing flow velocity is 0.6m/s. The pipe zones larger than 50mm and 63mm are designed to achieve these flows in all sections of the main at regular intervals to minimise flushing requirements. Where 50mm pipes have only one pump connected the maximum flow velocity will be under 0.6 m/s. Empirical data from many existing systems has demonstrated satisfactory performance in 50mm lines with only one operating pump connected and 63mm lines with 3 operating pumps connected.

**MAXIMUM FLOW VELOCITIES**

| Flow L/s | metres of pipework in range |
|---|---|
| >=0 <0.3 | 0 |
| >=0.3 <0.6 | 2161 |
| >=0.6 <0.9 | 5980 |
| >=0.9 <1.2 | 2170 |
| >=1.2 <1.5 | 120 |
| >=1.5 <1.8 | 0 |
| >=1.8 <2.1 | 0 |
| >=2.1 | 0 |
| Total m Pipe | 10431 |

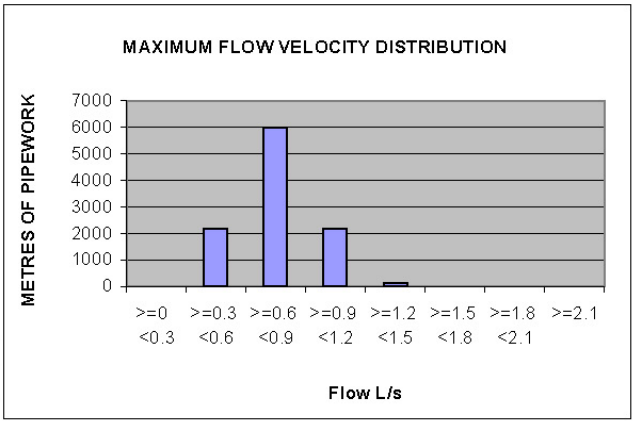



**Figure 7: 1% Probability Maximum Flow Velocity 50 Year Connected ET's**

## 3.11 Odour Control and Septicity

The introduction of a Pressure sewerage system at Broadwater is expected to generate significant concentrations of hydrogen sulphide (H2S). It should be understood that the operating flow and detention times of a Pressure sewerage system is highly variable, therefore the generation of sulphides and H2S is also variable. H2S levels measured at similar projects (and predicted for Broadwater) are consistently greater than 100 ppm at the systems discharge.

The odour detection threshold of hydrogen sulphide is 0.0005ppm therefore it is likely that if not managed fugitive emissions occurring near residential dwellings may result in odour complaints.

Also of importance is the potential for concrete and metallic assets corrosion through sulphuric acid attack at the systems discharge point. The presence of high H2S concentrations combined with high relative humidity and bacteria can lead to the production of sulphuric acid and the subsequent onset of this corrosion. It is recommended receiving concrete chambers and ancillary equipment incorporate corrosion protection.

Refer to the following examples of H2S and sulphide levels measured from two operating Pressure sewerage system. The Cabonne Council system of Cudal has been in operation for approx. 3 years and incorporates approx. 240 connections and a long sewage transfer main (therefore long average retention time of ~8.5 hours) to the STP ponds. The odour is managed at the air valves with carbon canister scrubbers. The system does not incorporate and chemical dosing. Note the peak H2S of 200ppm and in the two week monitoring period the H2S was above 100ppm on 15 occasions.

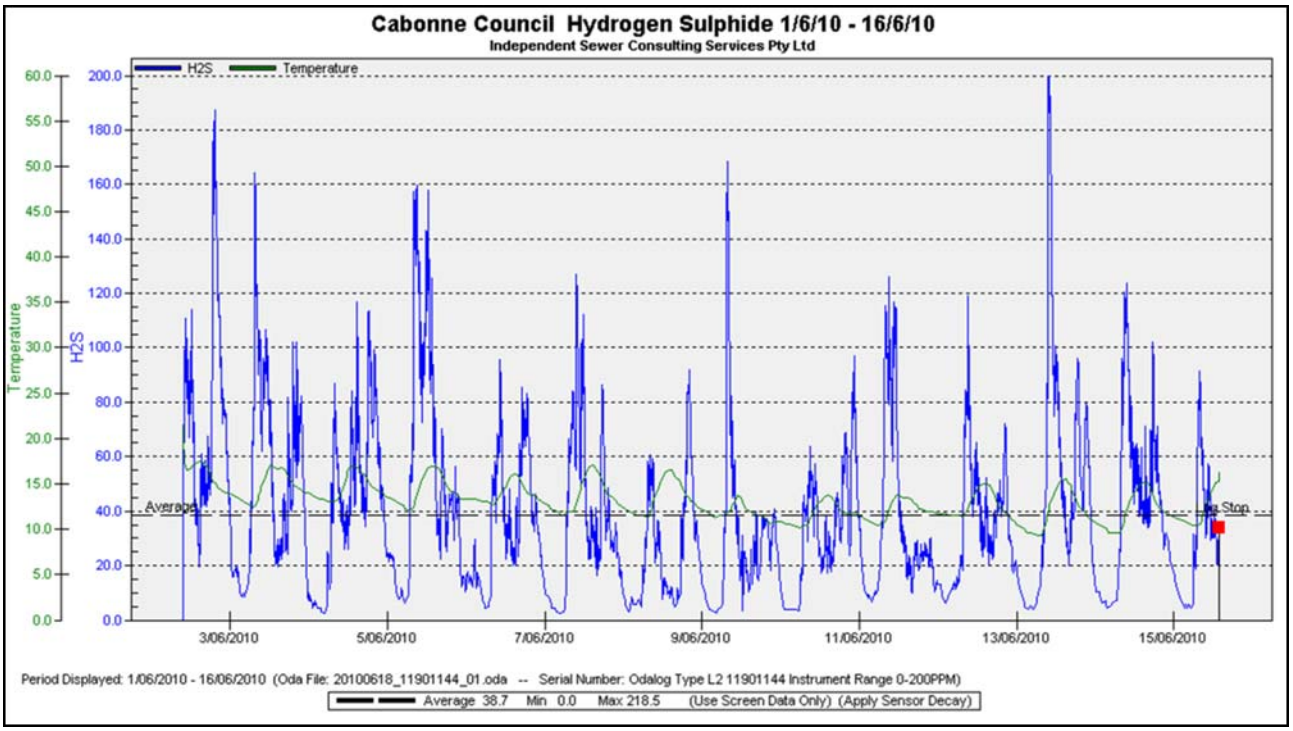



**Figure 8: Cabonne Pressure Sewerage System H2S Logging at STP Discharge Chamber**

The Narrabri system has been in operation for approximately 10 years. This chart has been included to demonstrate the measured PH, temperature and dissolved sulphides.

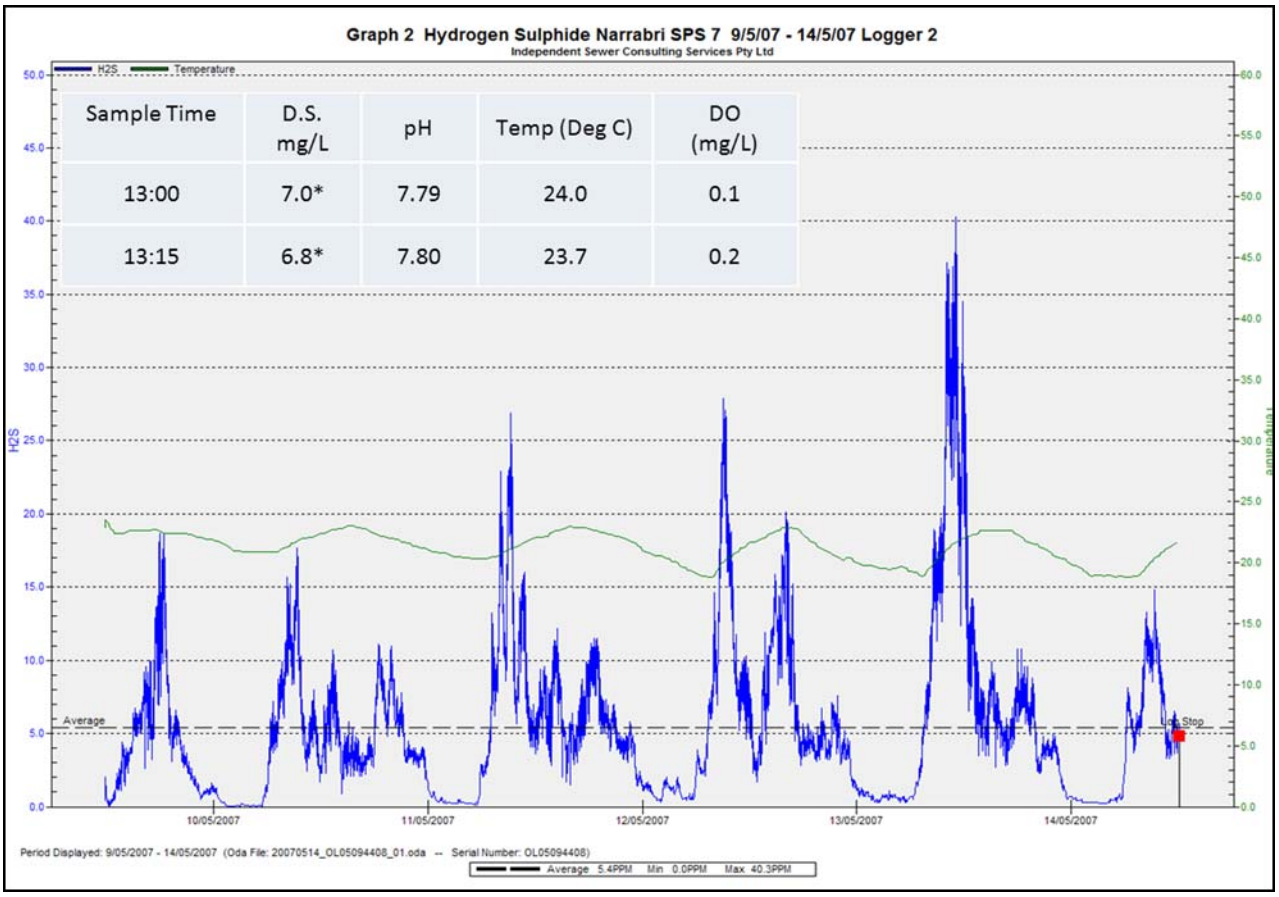



**Figure 9: Pressure Sewerage System H2S and Dissolved Sulphides Logging**

Odour management recommendations for the Broadwater Pressure sewerage system is based upon the following-

1. Recognising the issue by monitoring parameters and performance of similar system (as above).
2. Calculation of average forecast retention times. The maximum retention time calculated for the existing loadings and at the furthest pipe branch (Zone 46) is 12.95 hours discharging to the sewage pumping station. The retention time proportionally reduces as the properties progressively connect closer to the downstream SPS. The sewage retention time to the STP is 64 hours. It is generally accepted that above 4 – 6 hours sewage retention time may result in air release H2S concentrations that require management.
3. Where possible locating air valves with separation from residential houses.
4. Air valves to include carbon canister odour scrubbers to treat the small foul air volumes expected to discharge at each air valve point. It is not possible to model odour plume behavior due to the low volumes and irregular discharge patterns.
5. Liquid phase treatment is required at the sewage pumping station.

The Broadwater Pressure sewerage system incorporates 3 air valves (including 2 on future mains) with locations determined from the design plans:-

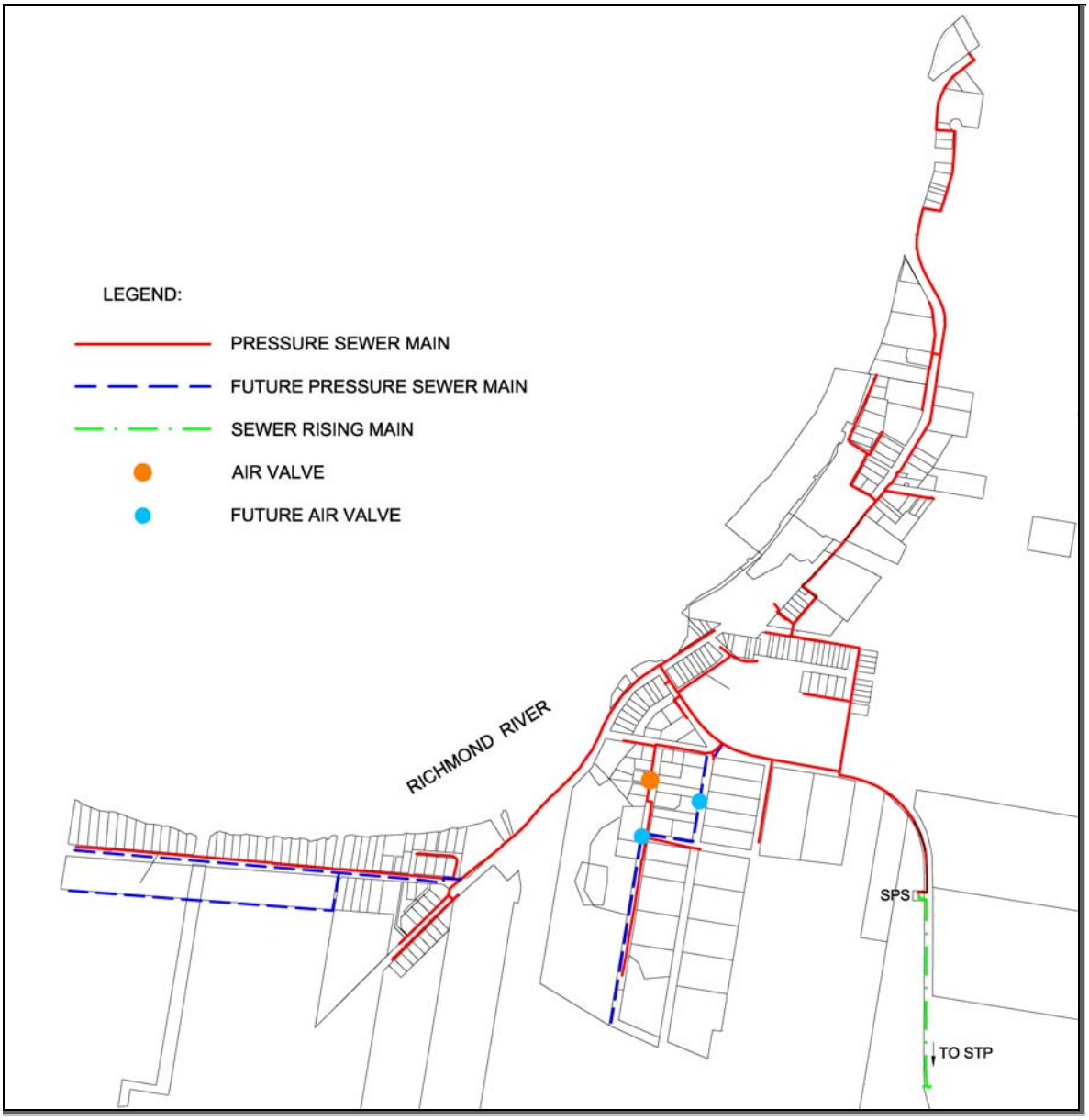



**Figure 10: Air Valves Locations**

The recommended air valve design as follows:-

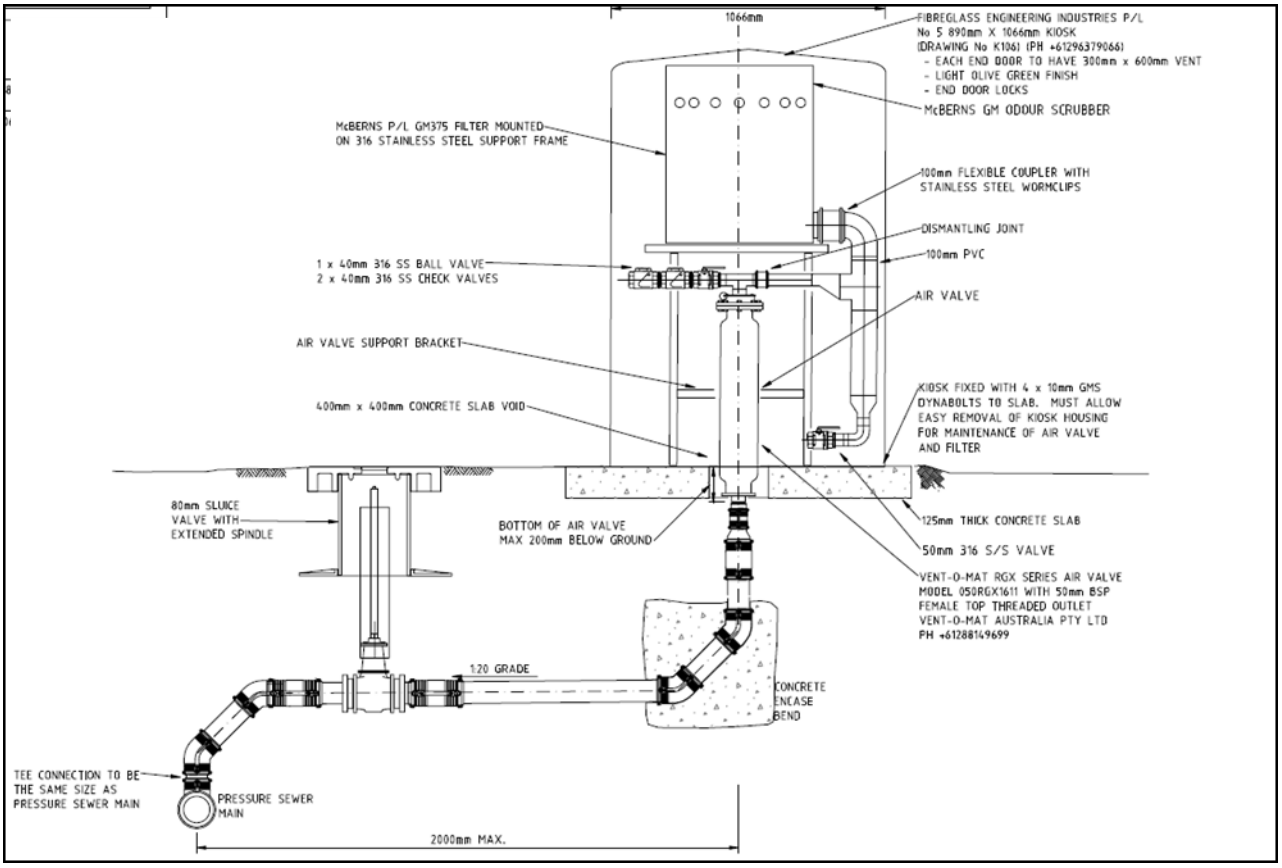



**Figure 11: Proposed Air Valve Configuration**

## 3.12 Power Outage Flow Management Strategy

During a power outage the pumps in a system will not operate, but the pressure sewer collection wells may continue to fill. When the power is resumed, it is feasible that a large proportion of pumps may want to operate at once. The power outage peak sewage flow to the pressure sewage pumping station is reliant upon a number of variables such as the number of occupied dwelling and time of year, the duration of the electricity outage and time of day when the electricity is off. It is therefore not possible with any certainty to forecast the peak sewage flow or volume.

When the power returns after a power outage a significant number of pumps may attempt to operate simultaneously. This will cause the head loss due to friction to rise significantly. A number of pumps in the system could see a backpressure high enough to cause the overload protectors to automatically trip in a few seconds.

While these pumps are “off-line” other pumps in the system would be able to empty their tanks. After a period of approximately 1-5 minutes, the group that tripped off due to overload would reset and restart. The system backpressure would have been reduced and the group would be able to pump down normally. This process would repeat itself automatically under the influence of each unit’s own internal protector, until restoring the system to normal operation.

Refer to report Section 4 for full details of the SPS by-Pass operation which may occur during after power outage flows.

The table below shows the theoretical maximum discharge flows after an extended power outage.

| | Power Outage Flow L/s |
|---|---|
| Ultimate Connected Loading | 24 L/s |

## 3.13 Pumps below the 1:100 year Flood Level

During the Broadwater property design and audit process each owner was asked if their property experienced flooding or surface water ponding after heavy rain. 178 properties were nominated as affected. The detailed results have been documented as a component of the Property Audit Connections Schedule.

The property plans and the Property Audit Connections Schedule document where ponding surface water is apparent or the property owner has nominated a location but the information appears inconsistent and may be considered unreliable. However this information was taken into consideration when locating the PSU on the property.

Where grinder pumps are installed below a nominated flood level it is recommended the following precautions be implemented when constructing the on-property works.

- The vent at the top of the pump must be sealed to stop the ingress of water into the tank.
- A vent is installed from the tank to a level above the 1:100 year flood level. It is recommended that this be attached to the building.
- The control panel's lowest point is to be located at least 400mm above the 1:100 year flood level, whilst in a location that will allow it to be accessed safely when required.
- The above installation methodology is dependent upon each properties house sewerage overflow relief gully termination point being above the flood level.

## 3.14 Pressure Sewer Mains Set-out

Due to the wide road reserve and the RMS road the pressure sewerage system mains have mostly been set-out on both sides of Pacific Highway. This direction increases the total lengths of street main pipe however significantly reduces the number of road crossings and pipe under the carriageway. Generally if the lot widths are the same or narrower than the road reserve it is more cost effective to locate mains on both sides of the road.

In other streets mains have been positioned to one side of the road however some pavement will require removal and replacement due to the narrow road reserve.

The mains have generally been set-out in compliance with RVC requirements. Given the Pressure sewerage system is the last service to be installed, separation from other services in some locations throughout the village has been difficult to achieve and the main has been documented in a best fit position.

Co-ordination has also been undertaken with the existing paths however the available verge has resulted in the pressure sewer main being located in varied allocations.

Pressure sewer mains generally cross roads at 90 deg.

## 3.15 Wet Weather Flows and Pressure Sewerage System

Although the design intent is to eliminate stormwater infiltration in the pressure sewer system it is possible for wet weather flows to occur. If illegal downpipe connections are made to the sewer, or existing defects in the house drainage systems are not rectified, stormwater ingress and infiltration will occur and increase flows in the collection system. While the pressure sewerage system is not designed to cater for these flows, the system is capable of delivering increased wet weather flow to the STP. The STP inlet capacity should accommodate capacity for this event. Pressure sewerage system wet weather flow allowance is based on traditional gravity system factor adjusted for pressure sewerage applications.

In pressure sewerage systems no infiltration can occur in the street mains or property pump out lines because they are under pressure. The only portion of the collection system capable of allowing stormwater inflow and infiltration (I&I) is the house drainage collection pipework.

Research was undertaken to assess a suitable percentage wet weather flow to allow for the on property house drainage systems, as a proportion of the standard allowance for traditional gravity systems.

An acceptable standard criterion in the design of a gravity sewerage system is to allow a fixed "Storm Allowance" per property or a multiple of ADWF or a fixed I&I flow per property such as the PWD allowance of 0.058 l/s per property. Based upon the Pressure sewerage system features an I&I allowance to the STP considered suitable is recommended to be 25% of the normal gravity system allowance. Therefore (0.058 x 0.25) x 237(ultimate lots) = 3.4 L/s wet weather allowance flow to the STP.

## 3.16 Pressure Sewer Unit Selection Criteria

The agreed PSU selection criteria is as follows

1 – One standalone house or dwelling = 1 simplex PSU.

2 – Three to six units or townhouses = 2 pump Duplex EOne unit

3 – Quad unit to a maximum of approx. 16,000 litres per day.

EOne PSU storage capacities

| Tank Volumes | EOne Simplex 2010ip (Litres) | EOne Simplex Squat 2012ip (Litres) | EOne Duplex 2120ip (Litres) | EOne Quad Unit (Litres) |
|---|---|---|---|---|
| Total Volume | 718 | 984 | 1264 | 3502 |
| On – off | 32 | 41 | 54 | 174 |
| On – alarm | 153 | 393 | 307 | 705 |
| Alarm - full | 453 | 457 | 748 | 2050 |
| On = full | 606 | 850 | 1055 | 2755 |

(Average project litres per ET per day = 420 litres)

The option of using and Eone squat tank was considered because of the increased On – Full storage volume of 850 litres, however RVC did not consider the 244 litres gained justified the additional cost.

For the Broadwater Pressure sewerage system the PSU type is as follows

**Table 8: Broadwater Pressure Sewer Unit Selection**

| No. | Property Address | Description | PSU Type |
|---|---|---|---|
| 1 | 1-5 Pacific Highway | Stopover Caravan Park Amenities and Permanent PU | Duplex |
| 2 | 117 Pacific Highway | Sugar Milling Co-Op Ltd Central Amenities | Duplex |
| 3 | 74-92 Pacific Highway | Sunrise Caravan Park PU 1 & PU 3 | Duplex |
| 4 | 117 Pacific Highway | Sugar Milling Co-Op Ltd Southern Amenities | Quadraplex |
| 5 | 74-92 Pacific Highway | Sunrise Caravan Park PU 2 | Quadraplex |
| 6 | 175-187 Pacific Highway | Hotel / Motel | Quadraplex |
| 7 | Other one standalone house or dwelling | | SImplex |

## 3.17 Pressure Sewer Unit Depth

During the Broadwater property designs process the requirement for deeper than normal PSU tanks were reviewed and determined as not required. However on occasions during the construction process a small number of properties do require deeper tanks to achieve grade from the property sewer connections. Deeper non-standard pressure sewer units can be obtained from EOne. Please be aware that it is Pressure Sewer Solutions P/L recommendation that for occupational safety reasons when using a deeper than standard tank all connection (except the house sewer) MUST NOT be deeper in the tank from surface level than a standard tank. The typical EOne tank extension will not achieve the above and therefore not an appropriate detail. All connections should rise to prevent the need for an operator to reach deep into the tank to access components.

## 3.18 Pump Trip Out Performance

The EOne pump programmed to operate in trip-out mode as follows:-

1. Pump activates & if downstream pressure is at shut-off (cannot pump into main) it will trip-out.
2. The pump will automatically re-start after 30 minutes & again trip-out if downstream pressure remains high.
3. The pump will automatically re-start after 30 minutes a further 3 times.
4. After the 4th re-start attempt (2 hours) the pump will attempt re-start after 60 minutes a further 6 occasions.

5. If the pump doesn't successfully start after 4x30 minute & 6x60 minute delayed attempts it will shut-down & operator intervention will be required to assess the problem & re-start the pump.

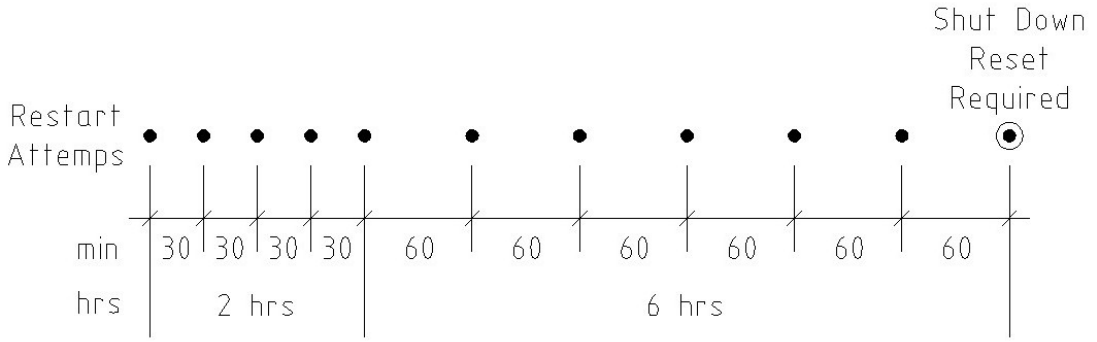



**Figure 12: EOne Pump Trip-out & Re-starts Performance**

## 3.19 Caravan Park Connections

Waste from caravan park amenities discharging into Pressure Sewer Units (PSU) has been found to be problematic at some caravan park locations due to solids and sanitary napkins blocking the inlet of pumps. Consideration by RVC was given to the use of a dry basket arrestor installed as a component of the property sewer upstream of the pressure sewer unit. This is intended to prevent solids entering the tank and therefore a blockage becomes the caravan park owner's responsibility.

It is also worth noting that when a pump in a quad PSU fails the alarm will not activate until a high water level event, therefore the system operator and property owner will not know of a pump failure until a second pump fails.

## 3.20 Design Rules

At the commencement of the design process RVC pressure sewer policies and the project technical specification were reviewed and a set of property design and audit rules were established. These rules were documented by Pressure Sewer Solutions P/L and reviewed by RVC and Public Works for correctness.

# 4.0 BROADWATER SEWER PUMPING STATION AND RISING MAIN

## 4.1 Overview

The pressure sewer system discharges into the Broadwater sewage Pumping Station pumping waste water to the Evans Head STP. The proposed sewage pumping station is a dual submersible electric sewage pumps in a wet well.

The sewage pumping station is designed to comply with Richmond Valley Council requirements.

The sewage pumping station and rising main scope of work consists of:-

6. Broadwater sewage Pumping Station includes two submersible centrifugal pumps mounted in a pump well, and includes inlet valves, outlet valves, inlet flow meter, automatic inlet valve and bypass line, electrical controls, float switches, monitoring equipment and valve pits

7. The installation includes pump well overflow pipes, conduits, and high level and low level vents.

8. Civil works includes ground works filling of site, entry and exit driveways, bunded concrete truck stand area, truck hardstand area and grass surface installation to earthwork banks.

9. A platform (road base) is included next to the pump station for future installation of an odour control facility, including conduits to future injection points.

10. Sewer rising main from the Broadwater sewage pumping station to the Evans Head STP, rising main to be 150mm PVC-O, 8,544m in length.

Sewage Pump Performance

The selected submersible sewage pumps are suitable for the range of operating conditions that may be experienced during the operation design life.

## 4.2 Design Development

The primary brief for the Sewage Pumping Station and Rising Main was the Design and Construct Tender design issued by Richmond Valley Council.

During the design process there were several revisions to the brief and modifications to the design including the following:-

### 4.2.1 Design Loadings

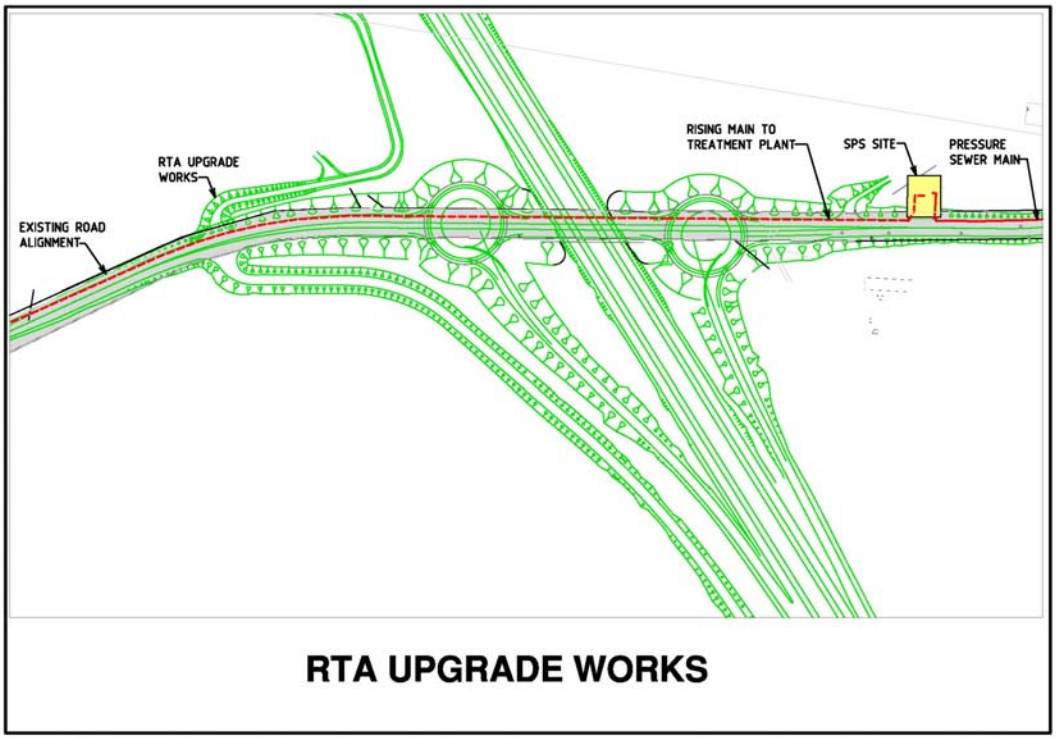
At tender stage the design loadings were based on the GHD report (Broadwater Sewerage Scheme Detail Design – Design Options Report, May 2007 Revision A). The loadings have been named 25 year future population growth although this is not numerically correct. During the design development stage the design loadings were increased to a future 50 year projected growth. The increase in projected future loadings increased the sewage pump capacity, and the size of the proposed sewage rising main. The design flow for the sewage pumps increased from 8.5 L/s 25 year loading to 14 L/s for 50 year future loading. (Value engineering increased the design flow to 18L/s to suit the selected rising main size). Refer to Clause 3.4 Existing, Vacant and Future lots for Hydraulic loadings details.

### 4.2.2 Pump Platform finished levels.

At tender stage the design and construct tender documentation showed a pump platform level of 7.3. At tender a level of 6.3 was proposed by Pressure Sewer Solutions P/L to provide a balanced cut and fill quantities on the site. RVC subsequently directed the pump platform level to be 7.5. The level of the pump platform was reviewed in the context of the proposed future RMS bypass road design.

### 4.2.3 RMS Bypass Highway proposed design.

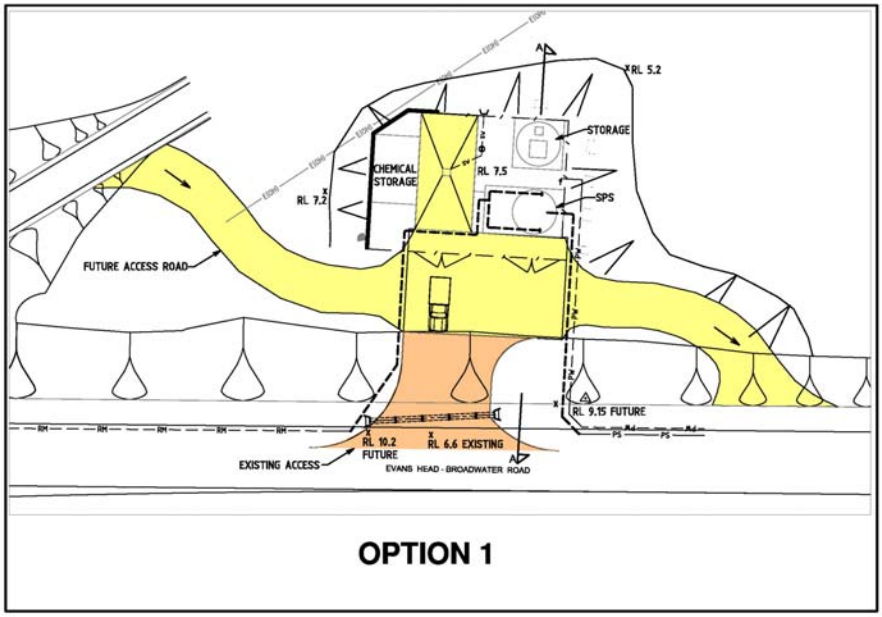
During design development RVC issued a proposed RMS (Formally RTA) bypass road that affects the future levels of the road at the pumping station.



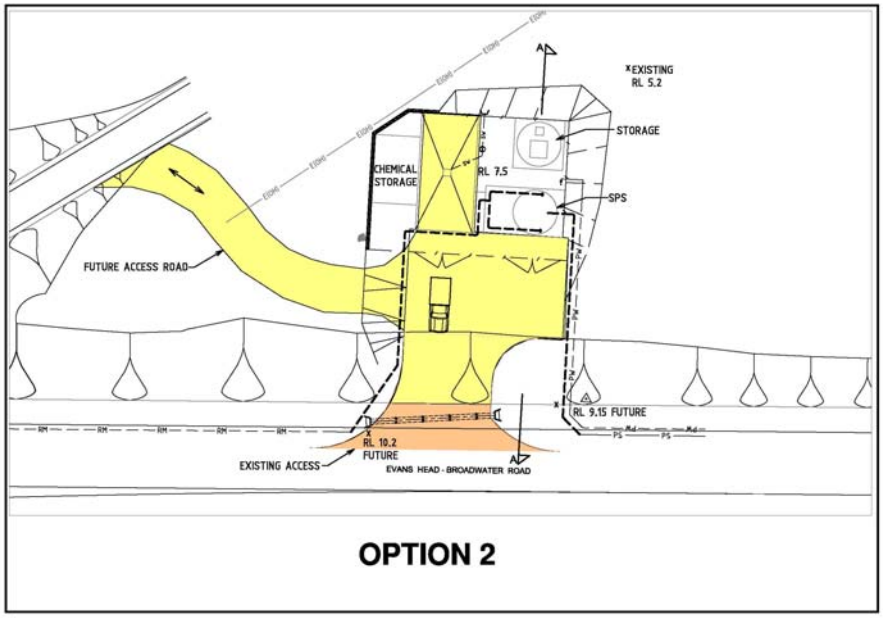

RMS UPGRADE WORKS

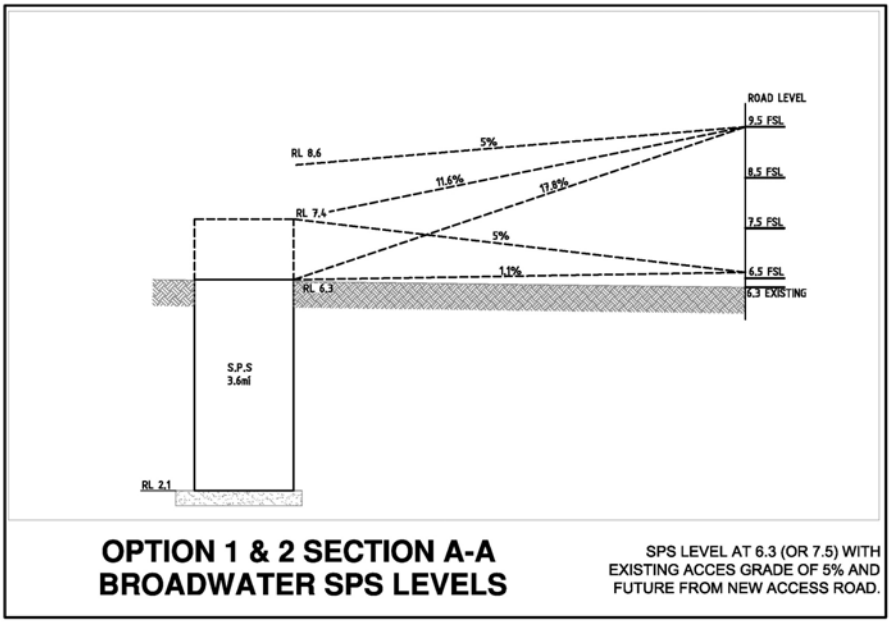
The future Broadwater Evans Head Road levels at the pumping station are raised by 2-3 meters and will affect the entry and exit driveways. If the road levels are raised the entry and exit road will exceed the maximum gradients specified by RVC of 8%. Options considered included:

1. A future entry road from a proposed side road to the west of the site, and an exit road extending to the east at a grade to meet the future road levels

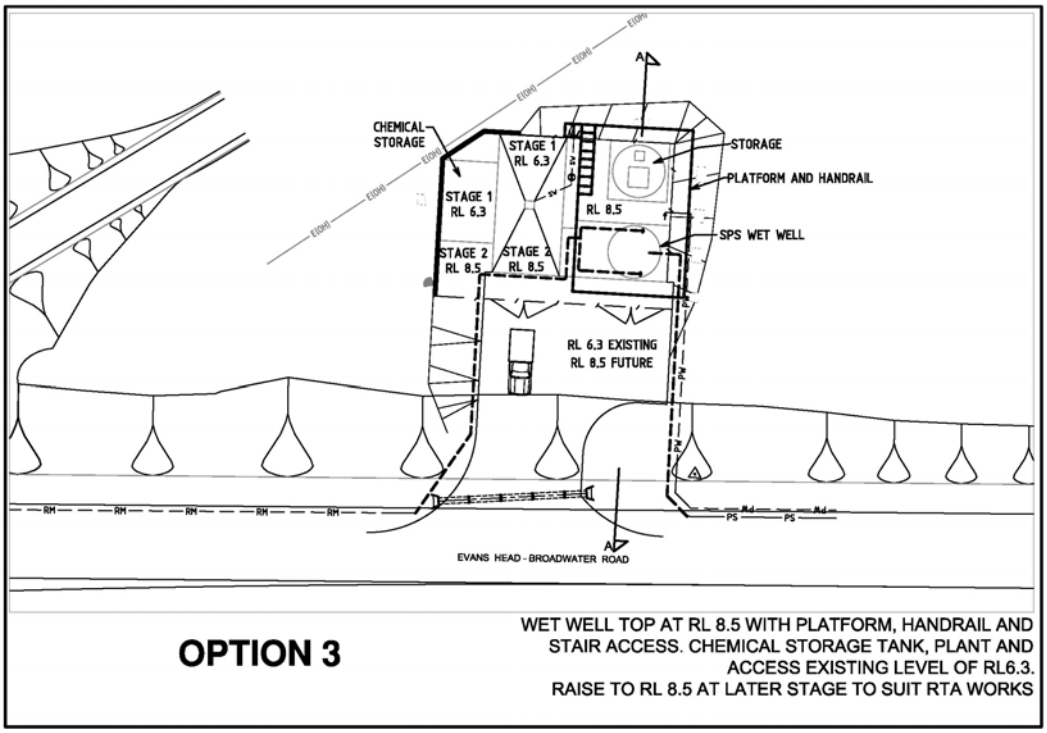


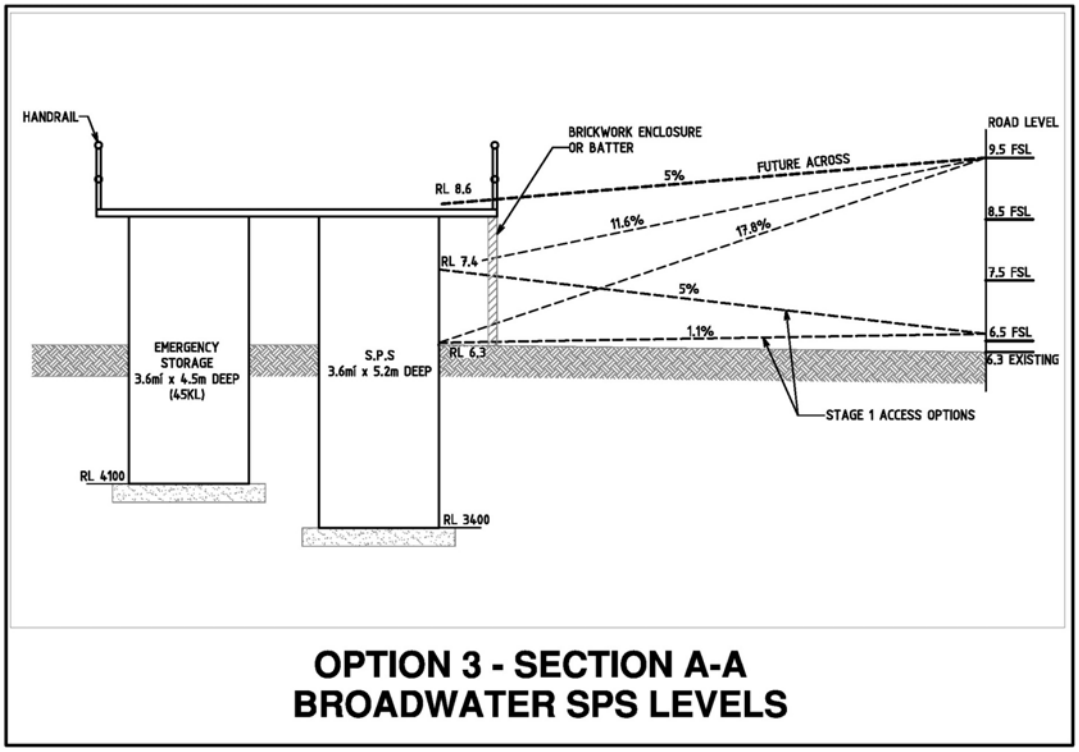

2. Existing entry from the Broadwater-Evens Head Road and a future entry and exit road from a proposed side road to the west, and provision of a truck turning platform at the SPS.



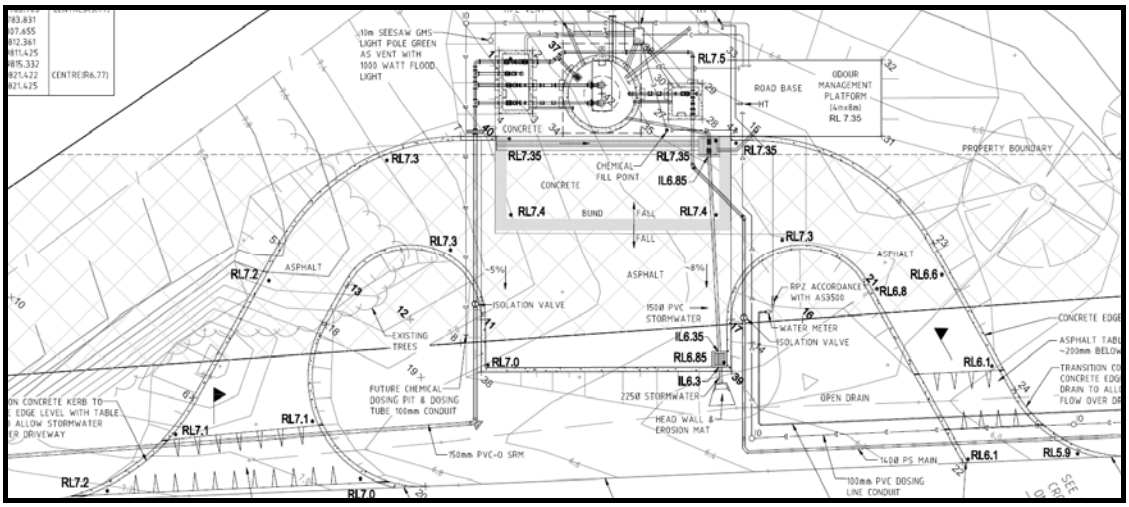



3. Raising the SPS platform to RL 8.5 to facilitate future entry and exit roads to the future proposed new road levels in Broadwater Evans Head Road.






RVC directed design solution was to site the SPS at RL 7.5, and to provide an entry and exit road to the existing Broadwater Evans Head Road levels, and change the entry and exit roads when the by-pass is constructed in the future.




**Selected SPS Entry and Exit Driveway Option**

### 4.2.4 SPS Driveway Entry and Exit Turning Radius

The entry and exit driveway turning radius parameters are as follows:-

| Item No | Access Driveway | Parameters Selected |
|---|---|---|
| 1 | Specification Standard | Austroads Design Vehicle and Turning Path Templates 2006. |
| 2 | Entry Driveway | Vehicle 8.8 metre service vehicle<br>Driveway radius = 12.5 metres<br>Turning speed = 0 – 5 km/h |
| 3 | Exit Driveway (Left-hand turn only) | Vehicle 8.8 metre service vehicle<br>Driveway radius = 9.0 metres<br>Turning speed = Mandatory stop 0 – 5 km/h |
| 4 | Internal Manoeuvring | Vehicle 8.8 metre service vehicle<br>Driveway radius = 9.0 metres<br>Turning speed = Mandatory stop 0 – 5 km/h |

### 4.2.5 Sewage Rising Main Sizing and Material.

At tender the nominated rising main was nominated as 100mm PVC-O. During the Early Contractor Involvement period RVC and Pressure Sewer Solutions P/L agreed on an alternate material, 125mm HDPE. These sizes were based on the original design sewage loadings and a sewage pump duty = 8.5 L/s. A progressive cavity pump was also specified in the Tender documents.

The design loading was increased to 50 year and pump design flow increased to 14L/s. A value engineering analysis was undertaken comparing:

1. Pipe Size
2. Pipe Material
3. Flow Rates
4. Pump Type (Progressive cavity and centrifugal)

The analysis considered the material derating factors, available pipe sizes, projected future loadings and installation cost.

The most cost effective solution was a 150mm PVC-O rising main, providing for future ultimate loadings beyond the 50 year design life, and offering cost advantages. The 150mm pipe size necessitated increasing the pump flow rate to 19L/s to achieve cleansing velocities in the rising main. It also facilitated the use of centrifugal duty stand-by pumps which is the clear preference of RVC.

### 4.2.6 Emergency Storage.

During tender stage RVC specified providing eight hours emergency dry weather storage at the sewage pumping station.

This requirement was reviewed with RVC with the option of providing an automatic inlet shut off valve on the inlet to the pumping station and provision of an automatic by-pass. The automatic

shut-off valve closed on pump fault, or high level in the sewage pumping station, preventing surcharge at the pumping station site. Under this emergency operating condition the system would go into automatic by-pass, with the pressure sewer pumps able to pump directly into the sewage rising main and to the Evens Head STP, thus maintaining sewer service to the township.

The pressure sewerage system has an inherent 24 hour emergency storage (for single residential dwelling) within the pressure sewer unit tanks located on each property.

Considering the emergency storage provided at the pressure sewer units, and the inclusion of an automatic shut-off valve on the inlet of the pumping station, RVC directed a reduction in storage volume from 8 hours ADWF to 2 hours ADWF at 50 year loadings (21,560 litres). The design of the sewage pumping station is 3.6m diameter, and the 2 hours storage is achieved within the pump well without the need for an external storage tank.

RVC adopted the 2 hour storage provision within the wet well, and requested the design include a nominated location for an emergency storage tank if RVC decide to install emergency storage in the future (no connection piping to be provided). A location for the installation of a future emergency overflow storage tank is nominated on the sewage pumping station design drawings. An emergency relief line from the pumping station is provided at high level in the pump well discharging at the location of the possible future emergency storage tank.

The 2 hour storage provision does not allow for any wet weather flows.

During peak times, wastewater inflow to the sewage pumping station will be more than double the average (at 6 – 8 l/s over 1 peak hour), therefore at peak discharge from the Broadwater pressure sewerage system the sewage pumping station emergency storage may only provide less than one hour response time. With I & I flow the inflow to the sewage pumping station is forecast to be 14 - 16 litres per second and will therefore only provide 20 minutes storage.

The above storage times are based upon the actuator controlled isolation valve failing therefore requiring operator intervention to manually by-pass the sewage pumping station.

Sewer Pumping Station emergency storage and pressure sewer system storage comparison:-

1. Existing Lots ADWF = 1.54 l/s
2. 50 Year Loadings ADWF = 3.0 l/s

Required and Available Wastewater Storage

| Item No | | Number of Residential Lots (Used to calculate pressure sewer unit storage Volume) | 8 Hours ADWF Litres Storage Required | 4 Hours ADWF Litres Storage Required | 2 Hours ADWF Litres Storage Required | 1 Hours ADWF Litres Storage Required | 0 Hours ADWF Litres Storage Required | Storage Volume Available in Pressure Sewerage System (Storage Between Pump-On to Overflow Level) |
|---|---|---|---|---|---|---|---|---|
| 1 | Existing Loading = 288 ET | 221 | 44,352 | 22,176 | 11,100 | 5,550 | 0 | 133,926 |
| 2 | 50 Year Loading = 560 ET | 455 | 86,240 | 43,120 | 21,560 | 10,780 | 0 | 275,730 |

### 4.2.7 RVC SPS Design Requirement 'must haves'.

RVC issued a minimum design requirement list as follows:

1. Concrete wet well including benching and external ballast sized for 50 year loadings, coated with Luxepoxy STL.
2. Valve pit coated with Luxepoxy STL.
3. Concrete emergency overflow storage including benching and external ballast coated with Luxepoxy STL, 8hrs storage at ADWF for 50 year loadings.
4. Aluminum covers for the wet well, valve put and emergency storage as per spec clause 5.6.1.
5. Access ladders for wet well, and emergency storage as per spec clause 5.6.1.
6. Step irons in the valve pit.
7. Polyethylene safety net for wet well, and emergency storage as per spec clause 5.6.1. (RVC amended this requirement and specified the use of Mc Burns covers with void protection).
8. Centrifugal pumps for 50 year loadings.
9. Inlet and outlet electromagnetic flow meters for future flow paced dosing with conduits to the SCA. (RVC amended requirement to a single inlet flow meter).
10. Inlet control valve and actuator on the pump station inlet line.
11. SCA by CHCC and programming by IPower Solutions.
12. Vent and odour filter.
13. Chemical dosing line x dia from the future dosing area to 150m upstream of the incoming pressure line.
14. Chemical dosing line x dia from future dosing area to the pump station rising main.
15. Potable water services from Broadwater to the pump station with water also available to future dosing area.
16. Spare electrical conduits to future dosing area from SCA and both flow meters.
17. Chemical unloading bund area for future chemical trucks.
18. Unloading point for chemical.

These requirements were included in the Broadwater sewage pump station design. It is noted the final design solution includes an external emergency storage tank hardstand area allowance.

### 4.2.8 Proposed Rising Main Water Crossing Details

The sewage rising main water crossings were reviewed by the Fisheries Permit and the following advice received. :-

## Broadwater – Evans Head Rising Main: Proposed culvert crossing arrangements

| Crossing Reference | Pipeline Chainage | Known OPP | Culvert/pipe arrangement | Acceptable crossing technique as per Fisheries requirements | Ledonne Proposed Crossing technique |
|---|---|---|---|---|---|
| B1 | 596 | N | 2 x 1850x850 box culverts | Trenching in front of headwall | Underbore to avoid wetlands or trenching in front of headwall pending water levels at the time |
| B2 | 709 | N | 2 x 600 dia pipes w/ headwall | Trenching in front of headwall | Underbore to avoid wetlands or trenching in front of headwall pending water levels at the time |
| B3 | 1616 | N | Single 300 dia pipe | Trenching in front of headwall | Trenching between pit & road |
| B4 | 2258 | N | Single 450 dia pipe | Cross pipeline over, attached to or behind headwall | Trenching between headwall & road |
| B5 | 2741 | N | Single 450 dia pipe | Trenching in front of headwall | Trenching between headwall & road |
| B6 | 4173 | Y | 6 x 750 dia pipes w/ headwall | Underboring to avoid OPP habitat | Underboring to avoid OPP habitat |
| B7 | 4588 | N | 2 x 600 dia pipes w/ headwall | Trenching in front of headwall | Move line from 1.5m off bitumen, to 1.2m off bitumen, and trench between headwall & road |
| B8 | 4987 | Y | 2 x 600 dia pipes w/ headwall | Cross pipeline over, attached to or behind headwall | Trenching between headwall & road |
| B9 | 6690 | N | 4 x 600 dia pipes w/ headwall | Trenching in front of headwall | Trenching in front of headwall |

When trenching between headwall and road:

- A RC vertical extension of the existing headwall will be installed if required for scour protection and provision of cover to the pipe;
- if there is insufficient cover to the pipe, a RC 'capping' slab will be formed above the pipe, for the length of the headwall , and tied into the headwall extension.

The design of the rising main included the requested design features at these crossings, including trenching headwalls and underbores at critical locations.

### 4.2.9 Odour Control and septicity

Odour control was reviewed during the design development process by Independent Sewer Consulting Services Pty Ltd. Retention times within the pressure sewer system are greater than 16 hours with existing loading conditions and elevated hydrogen sulphide levels are expected to be present at the discharge.

Retention times in the rising main from Broadwater Sewage Pumping Station to the Evans Head STP are also high, especially during the initial existing loading operation.

An odour report was commissioned by RVC recommending dosing at the sewer pumping station, upstream and downstream, to control odours and septicity. The location of the Broadwater SPS was assessed and RDC are not proceeding with the installation of the odour control treatment at this stage. The site is to include a flat platform area adjacent to the SPS for future installation of odour control if RVC deems it's required. The construction of the pumping station is to include the

provision of dosing conduits, a bunded truck stand area for chemical delivery, and valved drainage pits to the area.

Corrosion protection is required at the Broadwater Pumping Station and at receiving structures in the system. Odour control is recommended to be provided at automatic air release valves.

## 4.3 Sewage Pump Design Performance Requirements

Sewage Pumps are to be have design flow point = 18L/s. Rising main to be 150mm PVC-O pipe 8544m Long.

The sewage pumps are to be able to operate in the full range of possible operating conditions. The design bookend performances are based on:

1. Lowest operating head: new pipe to possible hydraulic condition were system hydraulic control point is the high point in the rising main at CH1869 downstream from the pumps. A pinch valve is proposed at CH2300, the downstream of the high point to maintain a full pipe during normal operation.

2. Highest Operating Head: aged pipe with system pumping under pressure to the STP site 8544 m distance. With the pinch valve operating normally this is the typical operating condition.

| Pump Design Minimum Flow | 18 L/s | Pump flow design is based on achieving cleansing flow |
|---|---|---|
| Minimum Pump Head | 43m head | New pipe 'k' factor = 0.1, hydraulic control to high point in rising main |
| Maximum Pump Head | 53m Head | Old pipe 'k' factor = 0.3, pump to STP |

The selected pumps are : Xylem NP 3171 SH 3~274.

The duty points for this pump range from:

- 27.7 L/s @ 43 m head minimum head conditions,
- 17.8L/s @ 52m head maximum head conditions

Refer to attachment for Sewage Pump technical Details

## 4.4 Broadwater Sewage Pumping Station Operation Strategy

### 4.4.1 Overview

Sewage is collected from the Broadwater village using a pressure sewerage system and discharges into the proposed sewage pumping station. Overflow protection at the SPS is facilitated by automatic closure of the inlet valve in an emergency event. An emergency event includes activation of the high level alarm, power failure, or an alarm event that shuts down both sewage pumps. The SPS by-pass provision shall be provided at the sewage pumping station to allow the pressure sewerage systems flow to by-pass the SPS and discharge directly to the

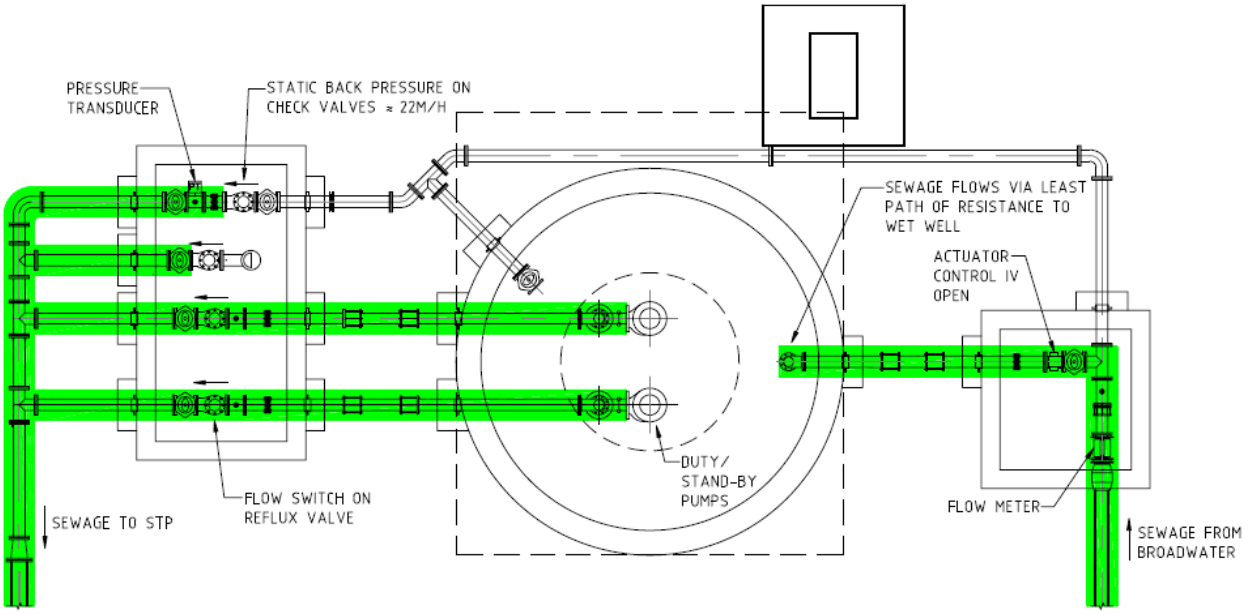
downstream STP receiving structure. This by-pass facility will provide service continuity during an emergency event and during maintenance of the sewage pumping station.

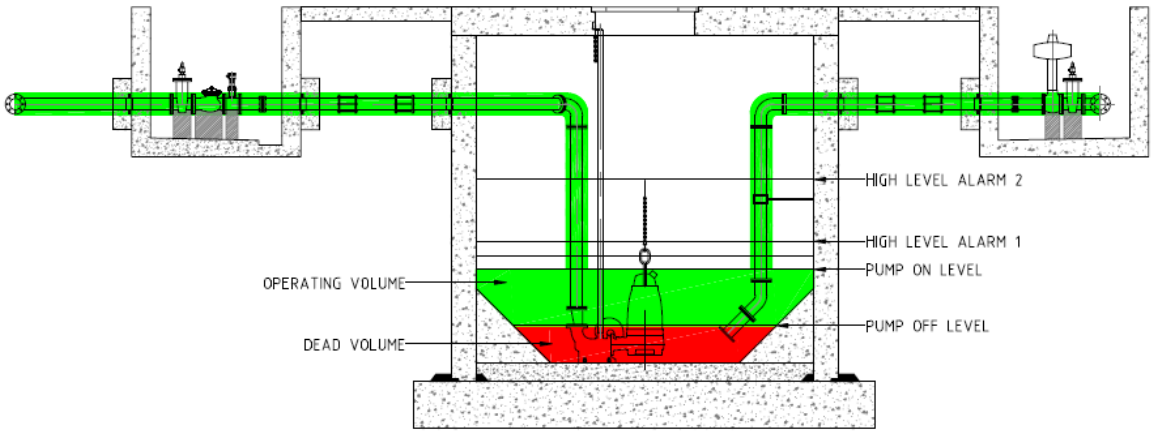
The SPS by-pass arrangement will provide satisfactory short term performance. In this mode of operation, cleansing velocities are not achieved in the sewage rising main, and prolonged operation in this mode will increase risk of rising main blockage. During peak loading some of the pressure sewer pumps will experience higher operating pressure and may trip out on overload for short period of time. The pressure sewer pumps are designed to automatically reset in this event and the system will return to normal operation.

During events where the SPS is required to be shut down, the sewage pumping station actuator controlled isolation inlet valve shall close. The pressure sewerage collection network is a closed pipe system and no overflow shall occur in the collection system.

### 4.4.2 Normal Operation

Sewage from the Broadwater village flows into the sewage pumping station wet well via the open actuator controlled isolation valve. The pumps operating as duty / stand-by discharge sewage via the rising main into the Evens Head STP. Back pressure on the by-pass check valve prevents it from opening and allowing sewage to by-pass the sewage pumping station.



Normal Operation

### 4.4.3 By-Pass Mode

The actuator controlled isolation valve located at the inlet to the sewage pumping station is normally open (Actuator valve is to fail closed on power failure or system fault there-by directing sewage to by-pass the pumping station).

The actuator controlled valve closes and the system operates in By-Pass in the following events:-

1. High Level Wet Well Alarm when sewage pumps are operating or not operating. Alarm may be due to pump failure or high after power outage flow from the Broadwater pressure sewerage system. Sewerage pumps are turned off prior to actuator valve closing

2. Power Failure at the sewage pumping station

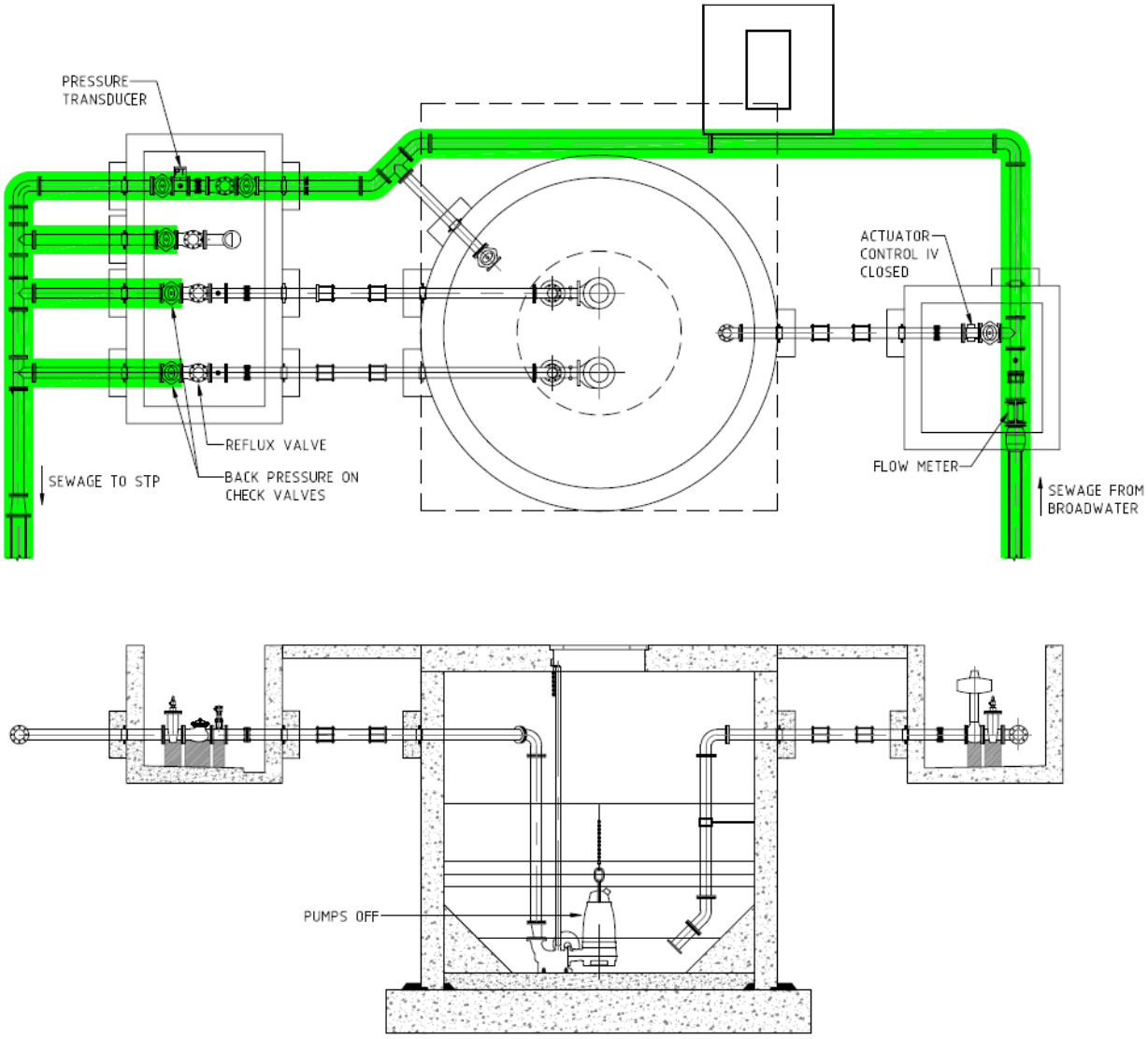
3. Both Pumps fail

4. High Pressure in SRM when pumps off (Greater than 30m)

5. Pump 1 or 2 enabled and discharge check valve flow switch indicates No Flow. Pumps stop and Actuator closes

6. Operator via Telemetry system or manually closes actuator valve

In this mode the individual pressure sewer pumps are pumping directly to the STP via the rising main. The increase in pump head on the pressure sewer pumps is not significant because of the large size of the rising main from the sewage pumping station to the STP and pumps will operate within their normal pressure head operating range. This mode of operation is suitable for short periods, (up to several daysIn this mode however cleansing velocities are not achieved in the sewage rising main.




### 4.4.4 System Returning to Normal Operation

Returning the sewage pumps into operation when the sewage pumping station is in By-Pass mode of operation must be controlled considering the following:-

1. The sewage pumping station pumps are not to operate simultaneously with the by-pass operating to avoid the pumps operating in the zone of instability (pump discharge combining with by-pass flow may result in high discharge pressure). (SW to discuss making the PT a control instrument and allowing the pumps to run and be shut-down on high pressure)

2. Sewage pumps turning on and off within short periods, therefore hunting to find its performance point.

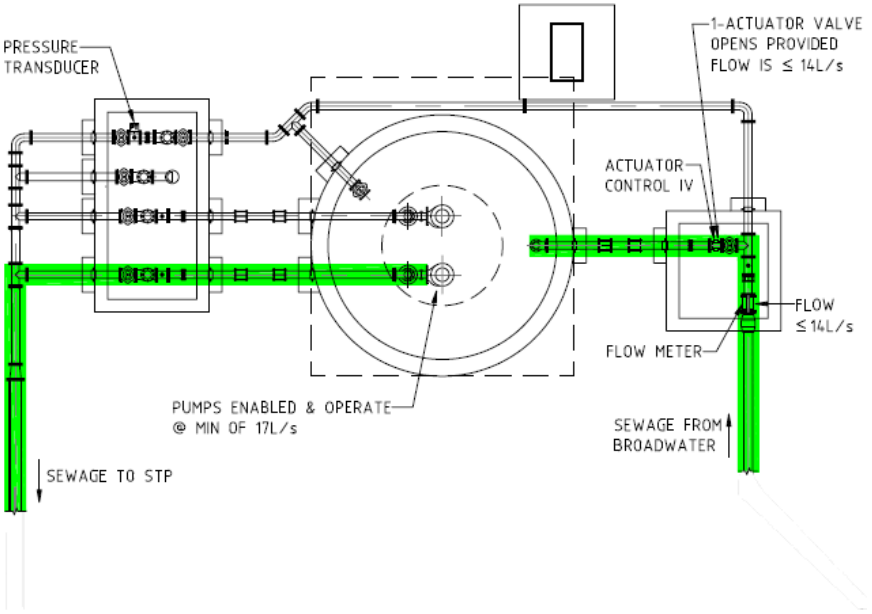
Actuator Valve Opens in the Following Events.

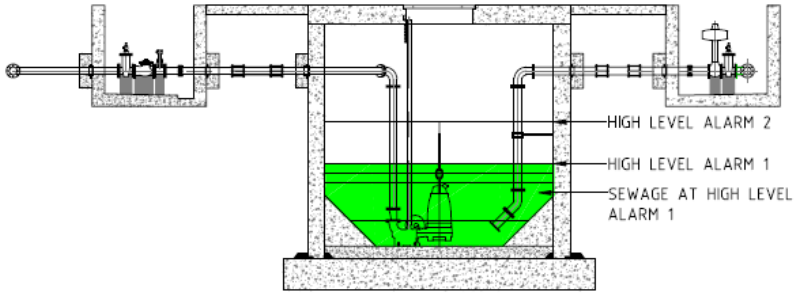
1. Wetwell Sewage Volume At High Level Alarm Level 1:- When the Inlet Flow meter indicates less than 14 l/s the inlet actuator isolation valve opens and the sewer pumps operate (~ 18 l/s). If the sewage level in the wetwell increases to High Alarm Level 2 the

system returns to by-pass operation and alarm is indicated. Manual operator intervention is required to return system to normal operation.

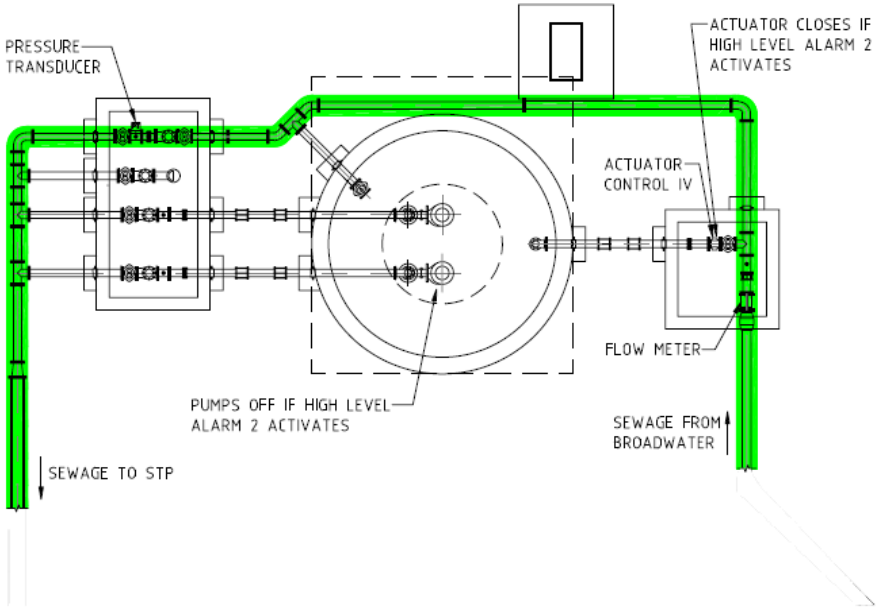
2. Power Return to Sewage Pumping Station:- Actuator controlled valve opens and the sewer pumps operate (~ 18 l/s). When pump-off level is achieved the system returns to normal operation. Should sewage in the wetwell activate high Alarm Level 1, then operating mode as "Wetwell sewage volume at high level alarm level 1" above will operate.

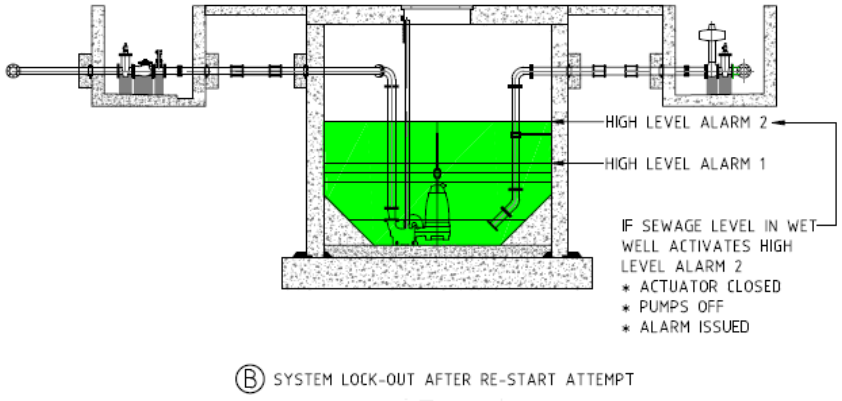
3. Both Sewage Pumps Fail:- Operator intervention required to return system to normal operation.




Ⓐ STATUS: * ACTUATOR VALVED CLOSED & HIGH SEWAGE LEVEL 1
* ACTUATOR OPENS PROVIDED FLOW ≤ 14L/s FOR 10mins
* PUMPS ENABLED & OPERATE



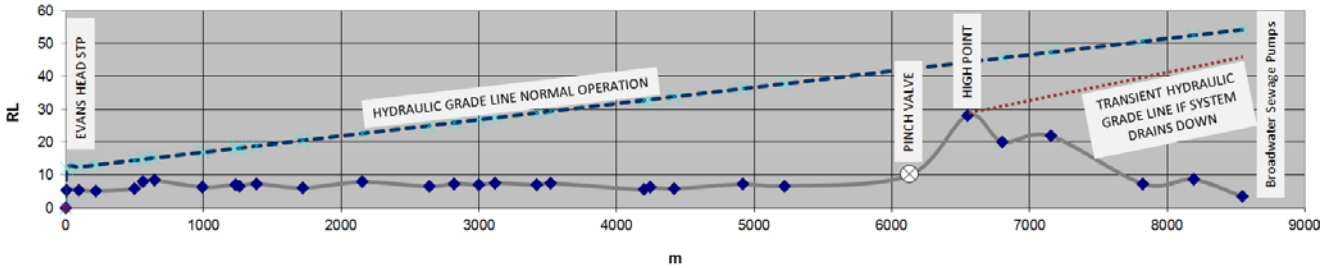

Return to normal operation

## 4.5 Sewage Rising Main Operation

The sewage rising main extends from the Broadwater Sewage Pumping Station to the Evans Head Sewage Treatment plant. The rising main is proposed to be 150mm PVC-O, and is 8544 m in length. The rising main is to include scour points and air valves required for the correct operation of the system.

The profile of the rising main includes a high point at CH1869 from the Broadwater Pump Station. When not operating in normal mode with pipe full the high point becomes an intermediate hydraulic control. The sewage pumps are selected to operate satisfactorily if they operate with the rising main drained down after an operation cycle, or after maintenance.

A pinch valve has been included in the rising main downstream of the high point at CH2300, to provide consistent operating conditions during normal mode. The pinch valve will prevent the rising main draining down after a pump cycled, maintaining constant operating conditions for the sewage pumps. Preventing the rising main from draining down will prevent the constant ingress and egress of air from the air valve located at the high point in the systems, and will reduce risk of odour emissions.




Functional Section : Rising Main Pinch Valve

To commission the Pinch valve the charge line needs to be pressured to a set point above the line operating pressure. Flotech advised this should be 3 bar however because the sleeve is handmade it is not exact specification and will require determination at the commissioning stage. Pressure gauges have been detailed up and downstream of the Pinch valve. The gauges also assist operators to confirm the pinch valve is working. When the pumps are off the valve upstream SRM pressure will be approx. 18.73 M/H, and the downstream pressure will be approx. 2.2 m/h. When the pumps are operating and the valve is open both gauges will read the same. Flotech can assist with commissioning the pinch valve.

A water hammer analysis was undertaken on the performance of the rising main and selected sewage pumps. Refer to attachment for water hammer report

## 4.6 Statutory Requirements

All work shall be carried out in accordance with Australian Standards and Regulatory Authorities requirements having jurisdiction over the works or associated work affecting the installation requirements, and in accordance with manufacturers recommendations and instructions including but not limited to the following:-

- Sewerage Code of Australia
- AS/NZS 4130 – polyethylene pipes for pressure applications.
- AS/NZS 4129 – Fittings for polyethylene piper for pressure applications.
- AS2033 – Installation of polyethylene pipe systems.
- RVC requirements for retention and restoration of vegetation and restoration of surface structures and roads and other hard and soft surface finishes.
- RVC Engineering Standards.
- Australian Standards relevant to the works.

## 5.0 GLOSSARY

| | |
|---|---|
| WWTP | Waste Water Treatment Plant |
| LPS | Low Pressure Sewer |
| RVC | Richmond Valley Council |
| PSS | Pressure Sewer Solutions |
| STP | Sewage Treatment Plant |
| HDPE | High Density Polyethylene |
| PE | Polyethylene |
| Ha | Hectare |
| ADDWF | Average Daily Dry Weather Flow |
| ADWWF | Average Daily Wet Weather Flow |
| ADWF | Average Dry Weather Flow |
| RM | Rising Main |
| SPS | Sewage pumping Station |
| KPI | Key Performance Indicators |
| PWC | Pressure Sewer Collection Unit |
| OD | Outside Diameter |
| SMH | Sewer Access Chamber |
| ET | Equivalent Tenement |
| CAD | Computer Aided Design |
| m/h | Metres head |
| TDH | Total Dynamic Head |
| RL | Reduced Level |

**BROADWATER PRESSURE SEWERAGE SYSTEM HYDRAULIC MODEL**

**462 L/ET/Day @ 10% Probability, k=0.15**

**EONE EXTREME PUMP (ISSUE D) 27/01/1012**

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| 1 | | 9 | 8 | 9 | 8 | 200 | 2 | 2.5 | 2 | 0.6 | 0.7 | 0.8 | 0.9 | 50 | | 29.4 | 18.5 | 3.8 | 6.9 |
| 2 | | 1 | 1 | 1 | 1 | 15 | 2.4 | 2.5 | 2.3 | 0.6 | 0.7 | 0.4 | 0.5 | 50 | | 27.5 | 16.2 | 3.4 | 6.3 |
| 3 | | 0 | 0 | 10 | 9 | 15 | 2.5 | 2.8 | 2.5 | 0.6 | 0.7 | 0.8 | 0.9 | 50 | | 27.1 | 15.8 | 2.4 | 5.3 |
| 4 | Stoponver Caravan Park = 1ET, Service Station = 1ET | 6 | 6 | 6 | 6 | 160 | 2.5 | 2.8 | 2.5 | 0.6 | 0.7 | 0.4 | 0.5 | 50 | | 28.4 | 17.4 | 4.0 | 6.9 |
| 5 | | 0 | 0 | 16 | 15 | 15 | 2.8 | 2.7 | 2.8 | 0.6 | 0.7 | 0.5 | 0.6 | 63 | | 26.7 | 15.3 | 2.3 | 5.2 |
| F1 | Future Land Releases (Residential) = 46ET | 46 | 0 | 46 | 0 | 620 | 2.5 | 2.5 | 2.5 | 1.1 | 0.0 | 0.7 | 0.0 | 75 | | 30.6 | 0.0 | 4.7 | 0.0 |
| F2 | Future Land Releases (Residential) = 47ET | 47 | 0 | 47 | 0 | 710 | 2.5 | 2.5 | 2.5 | 1.1 | 0.0 | 0.7 | 0.0 | 75 | | 31.0 | 0.0 | 5.0 | 0.0 |
| F3 | | 0 | 0 | 93 | 0 | 300 | 2.5 | 2.5 | 2.5 | 2.3 | 0.0 | 0.7 | 0.0 | 90 | | 28.3 | 0.0 | 2.7 | 0.0 |
| 7 | | 0 | 0 | 16 | 15 | 30 | 2.7 | 2.5 | 2.7 | 0.6 | 0.7 | 0.5 | 0.6 | 63 | | 26.6 | 15.3 | 2.2 | 5.1 |
| 8 | | 9 | 8 | 9 | 8 | 195 | 2.5 | 3 | 2.5 | 0.5 | 0.6 | 0.7 | 0.8 | 50 | | 34.9 | 25.3 | 6.0 | 9.4 |
| 9 | | 9 | 8 | 18 | 16 | 205 | 3 | 3 | 3 | 0.6 | 0.6 | 0.5 | 0.5 | 63 | | 32.8 | 22.9 | 4.6 | 7.8 |
| 10 | | 14 | 10 | 32 | 26 | 260 | 3 | 3 | 2.5 | 1.1 | 1.2 | 0.7 | 0.8 | 63 | | 32.8 | 22.8 | 3.3 | 6.5 |
| 11 | | 10 | 9 | 42 | 35 | 105 | 3 | 3 | 2.5 | 1.1 | 1.2 | 0.9 | 0.8 | 63 | | 30.5 | 20.0 | 2.5 | 5.4 |

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| 11.1 | Stopover Tourist Park = 17ET | 23 | 22 | 65 | 57 | 120 | 3 | 2.5 | 2.5 | 1.7 | 1.9 | 1.2 | 1.1 | 63 | | 29.6 | 18.8 | 2.2 | 5.1 |
| 12 | | 8 | 7 | 8 | 7 | 140 | 2.5 | 2.5 | 2 | 0.6 | 0.7 | 0.8 | 0.5 | 50 | | 28.5 | 17.4 | 3.2 | 6.2 |
| 13 | | 0 | 0 | 73 | 64 | 15 | 2.5 | 2.5 | 2.5 | 1.7 | 1.9 | 0.9 | 1.0 | 75 | | 26.7 | 15.3 | 2.0 | 4.9 |
| 14 | Future Land Releases (Residential) = 6ET | 7 | 1 | 189 | 80 | 145 | 2.5 | 2 | 2 | 3.4 | 1.9 | 1.1 | 0.7 | 90 | | 27.1 | 15.7 | 2.0 | 4.8 |
| 15 | | 1 | 1 | 190 | 81 | 35 | 2 | 2.2 | 2 | 4.0 | 1.9 | 1.1 | 0.7 | 90 | | 24.8 | 14.6 | 1.8 | 4.5 |
| 15.1 | Creek Crossing | 0 | 0 | 190 | 81 | 25 | 2.2 | 2.2 | 2.2 | 4.0 | 1.9 | 1.1 | 0.7 | 90 | | 24.0 | 14.3 | 1.8 | 4.4 |
| 16 | | 0 | 0 | 190 | 81 | 90 | 2.2 | 1.9 | 2.2 | 4.0 | 1.9 | 1.1 | 0.7 | 90 | | 23.6 | 14.1 | 1.8 | 4.3 |
| 17 | | 0 | 0 | 190 | 81 | 60 | 1.9 | 2.1 | 1.9 | 4.0 | 1.9 | 1.1 | 0.7 | 90 | | 22.1 | 13.8 | 1.7 | 4.1 |
| 18 | Future Land Releases (Residential) = 34ET | 36 | 2 | 226 | 83 | 190 | 2.1 | 4.2 | 1.5 | 4.7 | 1.9 | 0.8 | 0.5 | 110 | | 21.5 | 13.9 | 1.6 | 3.9 |
| 19 | | 1 | 1 | 227 | 84 | 40 | 4.2 | 3.2 | 3 | 4.7 | 1.9 | 0.8 | 0.5 | 110 | | 18.5 | 12.1 | 1.3 | 3.1 |
| 20 | | 0 | 0 | 227 | 84 | 30 | 3.2 | 3.5 | 3.2 | 4.7 | 1.9 | 0.8 | 0.5 | 110 | | 16.9 | 10.9 | 1.3 | 3.0 |
| 21 | | 2 | 2 | 229 | 86 | 95 | 3.5 | 2.95 | 2 | 4.7 | 2.6 | 0.8 | 0.5 | 110 | | 17.9 | 12.0 | 1.2 | 2.9 |
| 22 | Sunrise Caravan Park = 8ET | 9 | 9 | 243 | 98 | 75 | 2.95 | 2.5 | 2 | 4.7 | 2.6 | 0.9 | 0.6 | 110 | | 16.6 | 11.2 | 1.1 | 2.5 |
| 23 | | 2 | 2 | 9 | 7 | 65 | 2.2 | 2.7 | 2.5 | 0.7 | 0.7 | 1.0 | 0.5 | 50 | | 17.3 | 12.5 | 1.9 | 3.4 |
| 23.1 | | 5 | 4 | 14 | 11 | 80 | 2.7 | 2.2 | 2.5 | 0.7 | 0.7 | 1.0 | 1.0 | 50 | | 16.5 | 11.7 | 1.4 | 2.8 |
| 24 | | 0 | 0 | 14 | 11 | 10 | 2.2 | 2.5 | 2.2 | 0.7 | 0.7 | 1.0 | 1.0 | 50 | | 15.4 | 10.5 | 1.0 | 2.3 |
| 26 | | 0 | 0 | 257 | 109 | 10 | 2.5 | 2.6 | 2.5 | 4.7 | 2.6 | 0.9 | 0.6 | 110 | | 15.0 | 10.1 | 1.0 | 2.3 |
| 27 | Sunrise Caravan Park = 15ET | 15 | 15 | 15 | 15 | 70 | 1.9 | 2.6 | 2 | 0.7 | 0.7 | 0.6 | 0.7 | 63 | | 15.7 | 10.8 | 1.5 | 2.7 |
| 28 | | 0 | 0 | 272 | 124 | 150 | 2.6 | 2.2 | 2.6 | 5.4 | 3.3 | 1.0 | 0.7 | 110 | | 14.8 | 10.0 | 1.0 | 2.2 |

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| F4 | Future Land Releases (Residential) = 35ET | 35 | 0 | 35 | 0 | 180 | 10 | 3 | 3 | 1.1 | 0.0 | 0.8 | 0.0 | 63 | | 31.5 | 0.0 | 3.1 | 0.0 |
| F5 | | 0 | 0 | 35 | 0 | 80 | 3 | 8 | 3 | 1.1 | 0.0 | 0.8 | 0.0 | 63 | | 22.8 | 0.0 | 2.6 | 0.0 |
| F6 | Future Land Releases (Residential) =18ET | 18 | 0 | 53 | 0 | 185 | 8 | 20 | 8 | 1.2 | 0.0 | 0.8 | 0.0 | 75 | | 17.1 | 0.0 | 2.3 | 0.0 |
| F7 | | 0 | 0 | 53 | 0 | 130 | 20 | 9.4 | 20 | 1.2 | 0.0 | 0.8 | 0.0 | 75 | AV | 4.3 | 0.0 | 1.8 | 0.0 |
| F8 | | 4 | 0 | 57 | 0 | 95 | 9.4 | 22.9 | 10 | 1.8 | 0.0 | 0.8 | 0.0 | 75 | | 13.8 | 0.0 | 1.4 | 0.0 |
| F9 | | 5 | 0 | 62 | 0 | 165 | 22.9 | 2.2 | 2.5 | 1.8 | 0.0 | 0.8 | 0.0 | 75 | AV | 20.4 | 0.0 | 1.2 | 0.0 |
| 29 | | 12.3 | 3 | 12 | 3 | 65 | 6.5 | 3.6 | 3 | 0.6 | 0.6 | 0.8 | 0.5 | 50 | | 31.8 | 30.5 | 3.1 | 8.8 |
| 30 | | 13.1 | 3 | 25 | 6 | 250 | 3.6 | 20 | 3 | 0.6 | 0.6 | 1.2 | 0.5 | 50 | | 28.3 | 27.0 | 2.7 | 7.4 |
| 31 | | 1 | 1 | 26 | 7 | 15 | 20 | 19.5 | 22 | 1.2 | 0.6 | 1.2 | 0.5 | 50 | | 7.1 | 5.8 | 2.1 | 4.7 |
| 32 | | 5.1 | 4 | 5 | 4 | 130 | 7.5 | 19.5 | 7.5 | 0.6 | 0.6 | 0.5 | 0.5 | 50 | | 22.0 | 21.0 | 3.7 | 6.7 |
| 33 | | 3 | 2 | 35 | 13 | 85 | 19.5 | 24.7 | 20 | 1.2 | 0.6 | 0.8 | 0.6 | 63 | | 8.1 | 7.1 | 2.0 | 4.6 |
| 34 | | 0 | 0 | 35 | 13 | 15 | 24.7 | 24.5 | 24.7 | 1.2 | 0.6 | 0.8 | 0.6 | 63 | | 2.5 | 2.2 | 1.8 | 3.9 |
| 35 | | 2 | 2 | 37 | 15 | 30 | 24.5 | 26.5 | 25 | 1.2 | 0.6 | 0.8 | 0.6 | 63 | | 1.9 | 1.6 | 1.7 | 3.7 |
| 36 | | 3 | 3 | 40 | 18 | 10 | 26.5 | 26.5 | 20 | 1.2 | 0.7 | 0.6 | 0.5 | 75 | | 6.6 | 6.5 | 1.6 | 3.5 |
| 37 | | 7 | 6 | 47 | 24 | 90 | 26.5 | 11.2 | 9 | 1.2 | 0.7 | 0.8 | 0.7 | 75 | AV | 17.5 | 17.5 | 1.6 | 3.4 |
| 38 | | 1 | 1 | 1 | 1 | 10 | 17.3 | 17.8 | 17 | 0.7 | 0.7 | 0.6 | 0.6 | 50 | | 7.5 | 7.5 | 4.1 | 7.8 |
| 38.1 | | 1 | 0 | 2 | 1 | 65 | 17.8 | 11.2 | 14 | 0.7 | 0.7 | 0.6 | 0.6 | 50 | | 10.4 | 10.4 | 3.4 | 7.1 |
| 41 | | 2 | 1 | 51 | 26 | 140 | 11.2 | 2.7 | 4 | 1.3 | 1.3 | 0.8 | 0.7 | 75 | | 12.3 | 8.4 | 1.3 | 2.9 |
| 41.1 | | 1 | 1 | 1 | 1 | 20 | 2.5 | 2.7 | 2.5 | 0.7 | 0.7 | 0.5 | 0.6 | 50 | | 13.4 | 9.5 | 2.2 | 3.4 |
| 41.2 | | 0 | 0 | 52 | 27 | 35 | 2.7 | 2.2 | 2.7 | 1.3 | 1.3 | 0.8 | 0.7 | 75 | | 12.9 | 9.0 | 0.9 | 2.1 |
| 42 | | 0 | 0 | 386 | 151 | 125 | 2.2 | 2.5 | 2.2 | 7.2 | 3.3 | 0.8 | 0.5 | 140 | | 13.3 | 9.3 | 0.8 | 1.9 |
| 43 | | 11 | 1 | 11 | 1 | 195 | 8 | 2.5 | 2.5 | 0.6 | 0.7 | 1.0 | 0.5 | 50 | | 19.9 | 16.6 | 1.8 | 14.1 |

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| 44 | | 0 | 0 | 397 | 152 | 160 | 2.5 | 2.5 | 2.5 | 7.2 | 3.3 | 0.8 | 0.5 | 140 | | 12.3 | 8.9 | 0.6 | 1.4 |
| 45 | | 2 | 1 | 2 | 1 | 50 | 2.89 | 1.15 | 2 | 0.5 | 0.6 | 0.4 | 0.4 | 50 | | 34.4 | 27.6 | 10.3 | 16.2 |
| 46 | | 1 | 1 | 3 | 2 | 35 | 1.15 | 2.33 | 2.5 | 0.6 | 0.6 | 0.4 | 0.4 | 50 | | 31.8 | 24.9 | 8.6 | 12.9 |
| 47 | School = 3.6ET(Existing), 5.5ET(50 Year) | 6.5 | 3.6 | 10 | 6 | 105 | 2.33 | 2.98 | 2.5 | 0.6 | 0.6 | 0.7 | 0.4 | 50 | | 31.5 | 24.6 | 7.9 | 11.8 |
| 48 | | 1 | 0 | 11 | 6 | 30 | 2.98 | 2.5 | 2.5 | 0.6 | 0.6 | 0.8 | 0.4 | 50 | | 30.6 | 23.6 | 7.1 | 10.6 |
| 49 | | 8 | 8 | 19 | 14 | 405 | 2.5 | -1.5 | 2 | 0.6 | 0.6 | 0.5 | 0.5 | 63 | | 30.4 | 23.3 | 7.0 | 10.2 |
| 50 | | 0 | 0 | 19 | 14 | 230 | -1.5 | 1.8 | -1.5 | 0.6 | 0.6 | 0.5 | 0.5 | 63 | | 28.8 | 21.6 | 4.6 | 7.1 |
| 51 | | 2 | 2 | 2 | 2 | 120 | 1.65 | 1.6 | 1.6 | 0.6 | 0.6 | 0.4 | 0.5 | 50 | | 26.5 | 19.4 | 7.4 | 9.4 |
| 52 | Bowling Club = 3ET | 3 | 3 | 3 | 3 | 20 | 2 | 2.24 | 2 | 0.6 | 0.6 | 0.4 | 0.5 | 50 | | 26.9 | 19.8 | 5.5 | 7.5 |
| 52.1 | | 2 | 2 | 5 | 5 | 120 | 2.24 | 1.6 | 2 | 0.6 | 0.6 | 0.4 | 0.5 | 50 | | 26.7 | 19.6 | 5.1 | 7.0 |
| 53 | | 0 | 0 | 7 | 7 | 20 | 1.6 | 1.8 | 1.6 | 0.6 | 0.6 | 0.4 | 0.5 | 50 | | 25.3 | 18.0 | 3.5 | 5.5 |
| 54 | Sugar Mill Northern Amenities = 1ET | 8 | 8 | 8 | 8 | 220 | 2.5 | 2.9 | 2.5 | 0.6 | 0.7 | 0.8 | 0.9 | 50 | | 23.7 | 18.5 | 4.6 | 6.0 |
| 55 | Motel = 5ET, Hotel/Pub = 5ET, Service Station = 1ET | 14 | 13 | 14 | 13 | 65 | 2.3 | 2.9 | 2.3 | 0.6 | 0.7 | 0.9 | 1.0 | 50 | | 22.3 | 17.0 | 3.1 | 4.5 |
| 56 | | 3 | 3 | 25 | 24 | 85 | 2.9 | 2.8 | 2.5 | 0.6 | 0.7 | 0.8 | 0.9 | 63 | | 21.5 | 16.0 | 2.8 | 4.2 |
| 57 | | 1 | 1 | 26 | 25 | 30 | 2.8 | 2.65 | 2.8 | 1.2 | 0.7 | 0.8 | 0.9 | 63 | | 20.8 | 15.3 | 2.4 | 3.8 |
| 58 | | 0 | 0 | 26 | 25 | 20 | 2.65 | 2.6 | 2.65 | 1.2 | 0.7 | 0.8 | 0.9 | 63 | | 20.5 | 15.2 | 2.3 | 3.7 |
| 59 | | 0 | 0 | 26 | 25 | 20 | 2.6 | 2.5 | 2.6 | 1.2 | 0.7 | 0.8 | 0.9 | 63 | | 20.2 | 15.2 | 2.2 | 3.6 |
| 60.1 | Old Church (Future) = 2ET, Vacant Block | 7 | 1 | 33 | 22 | 150 | 1.8 | 2.6 | 1.7 | 1.2 | 0.6 | 0.7 | 0.5 | 63 | | 25.0 | 17.7 | 3.3 | 5.3 |

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| | (Future) = 5ET | | | | | | | | | | | | | | | | | | |
| 60.2 | | 0 | 0 | 33 | 22 | 30 | 2.6 | 2 | 2.6 | 1.2 | 0.6 | 0.7 | 0.5 | 63 | | 22.7 | 16.4 | 2.8 | 4.5 |
| 60 | | 4 | 4 | 37 | 26 | 175 | 2 | 2.5 | 2 | 1.2 | 0.6 | 0.8 | 0.8 | 63 | | 22.4 | 16.3 | 2.7 | 4.4 |
| 63 | | 9 | 8 | 9 | 8 | 120 | 2 | 2.5 | 2 | 0.6 | 0.7 | 0.9 | 1.0 | 50 | | 21.9 | 17.1 | 3.1 | 4.6 |
| 64 | | 0 | 0 | 46 | 34 | 30 | 2.5 | 2.5 | 2.5 | 1.2 | 1.3 | 0.7 | 0.6 | 75 | | 20.1 | 15.2 | 2.2 | 3.7 |
| 65 | Sugar Mill Central Amenities = 5ET, Future Industrial = 12ET | 19 | 6 | 91 | 65 | 140 | 2.5 | 3 | 2.5 | 2.5 | 1.9 | 0.8 | 0.7 | 90 | | 20.0 | 15.1 | 2.1 | 3.5 |
| 66 | Future Industrial = 22ET | 27 | 4 | 118 | 69 | 250 | 3 | 2.8 | 2.8 | 2.5 | 2.0 | 0.9 | 0.7 | 90 | | 18.8 | 14.2 | 1.8 | 3.1 |
| 67 | Sugar Mill Southern Amenities = 5ET, Toilet = 1ET | 7 | 7 | 7 | 7 | 70 | 3 | 2.8 | 3 | 0.7 | 0.7 | 0.3 | 0.3 | 63 | | 17.2 | 13.2 | 2.4 | 3.3 |
| 68 | | 0 | 0 | 125 | 76 | 30 | 2.8 | 2.7 | 2.8 | 3.1 | 2.0 | 0.9 | 0.7 | 90 | | 16.9 | 12.9 | 1.3 | 2.3 |
| 68.1 | | 6 | 6 | 6 | 6 | 65 | 2.5 | 2.7 | 2.5 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 17.6 | 13.8 | 2.0 | 2.9 |
| 68.2 | Community Centre = 1ET | 13 | 10 | 144 | 92 | 160 | 2.7 | 2.8 | 2.5 | 3.1 | 2.6 | 1.1 | 0.9 | 90 | | 16.8 | 13.0 | 1.3 | 2.2 |
| 69 | | 2 | 1 | 5 | 3 | 130 | 3.1 | 2.95 | 2 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 18.2 | 13.0 | 2.8 | 5.4 |
| 70 | | 3 | 2 | 3 | 2 | 25 | 3 | 3.1 | 2 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 18.5 | 13.3 | 3.3 | 6.2 |
| 72 | | 3 | 2 | 3 | 2 | 30 | 2.6 | 2.2 | 2 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 18.5 | 13.8 | 2.5 | 4.4 |
| 72.1 | | 4 | 3 | 4 | 3 | 70 | 2 | 2.2 | 2 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 18.5 | 13.8 | 3.0 | 4.9 |
| 75 | | 8 | 8 | 152 | 100 | 130 | 2.8 | 2.3 | 2 | 3.2 | 2.6 | 0.7 | 0.6 | 110 | | 15.7 | 12.3 | 1.0 | 1.8 |
| 76 | | 5 | 5 | 5 | 5 | 111 | 1.8 | 2.3 | 1.8 | 0.7 | 0.7 | 0.5 | 0.5 | 50 | | 16.2 | 13.0 | 2.2 | 2.8 |
| 77 | | 1 | 1 | 158 | 106 | 90 | 2.3 | 0.5 | 2 | 3.8 | 2.7 | 0.7 | 0.6 | 110 | | 14.7 | 11.5 | 0.7 | 1.4 |

| Zone Number | Zone Notes | Number of PSU's Connected This Zone | | Total Connected ET's Through This Zone | | Length m | Upstream RL of main m | Downstream RL of main m | Minimum Height of Pump m | 10% Probability Peak Instantaneous Flow L/s | | 1% Probability Maximum Velocity m/s | | Pipe Size mm | Air Valve | 10% Probability Total Dynamic Head Pump m | | Accumulated Retention Time hrs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots | | | 50 Year Lots | Existing Lots | 50 Year Lots | Existing Lots |
| 78 | | 0 | 0 | 158 | 106 | 80 | 0.5 | 2.5 | 0.5 | 3.8 | 2.7 | 0.7 | 0.6 | 110 | | 13.9 | 10.9 | 0.6 | 1.1 |
| 79 | | 0 | 0 | 554 | 258 | 10 | 2.5 | 2 | 2.5 | 9.8 | 5.3 | 1.1 | 0.7 | 140 | | 11.4 | 8.7 | 0.4 | 0.9 |
| 80 | SPS Site | 3 | 2 | 557 | 260 | 410 | 2 | 9.46 | 2 | 9.8 | 5.3 | 1.1 | 0.7 | 140 | | 11.4 | 8.7 | 0.4 | 0.8 |

# Appendix B – Drawing Schedules

**Sewer Rising Main Solutions Pty Ltd**
Unit 1/47-51 Lorraine Street
Peakhurst NSW 2210
AUSTRALIA

Tel: (02) 9584 1177
Fax: (02) 9584 1477

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**Project** : Broadwater Sewerage Scheme

**Project No** : 111007 Broadwater SRM **Page** : 1 **of** 1

**DRAWINGS/DOCUMENTS**

| Doc/Dwg | Document/Drawing Title | Issue Date Day | Month | Year |
|---|---|---|---|---|
| | | 7 | 3 | 12 |
| | Sewer Rising Main | 16 | 3 | 12 |
| RM000 | - Cover Sheet, Locality Plan & Drawing List | 26 | 3 | 12 |
| | | Issue | | |
| | | | | |
| | | A | B | |
| RM001 | - Layout Plan & Longitudinal Section Sheet 1 of 13 | A | B | |
| RM002 | - Layout Plan & Longitudinal Section Sheet 2 of 13 | A | B | |
| RM003 | - Layout Plan & Longitudinal Section Sheet 3 of 13 | A | B | |
| RM004 | - Layout Plan & Longitudinal Section Sheet 4 of 13 | A | B | |
| RM005 | - Layout Plan & Longitudinal Section Sheet 5 of 13 | A | B | |
| RM006 | - Layout Plan & Longitudinal Section Sheet 6 of 13 | A | B | |
| RM007 | - Layout Plan & Longitudinal Section Sheet 7 of 13 | A | B | |
| RM008 | - Layout Plan & Longitudinal Section Sheet 8 of 13 | A | B | |
| RM009 | - Layout Plan & Longitudinal Section Sheet 9 of 13 | A | B | |
| RM010 | - Layout Plan & Longitudinal Section Sheet 10 of 13 | A | B | |
| RM011 | - Layout Plan & Longitudinal Section Sheet 11 of 13 | A | B | |
| RM012 | - Layout Plan & Longitudinal Section Sheet 12 of 13 | A | B | |
| RM013 | - Layout Plan & Longitudinal Section Sheet 13 of 13 | A | B | |
| | Standard Detail Plans | | | |
| RM014 | - Sewer Rising Main General Notes, Typical Sections and Details | A | B | |
| RM015 | - Sewer Rising Main Pinch Valve Detail | | | A |
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**DRAWINGS/DOCUMENTS**

| Doc/Dwg | Document/Drawing Title | Issue | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sewage Pumping Station | | | | | | | | | | | | | |
| SPS000 | - Cover Sheet, Locality Plan & Drawing List | | B | | | | | | | | | | | |
| SPS001 | - Site Plan | | B | | | | | | | | | | | |
| SPS002 | - General Arrangement Sheet 1 of 2 | | B | | | | | | | | | | | |
| SPS003 | - General Arrangement Sheet 2 of 2 | | B | | | | | | | | | | | |
| SPS004 | - General Arrangement Vertical Section | | B | | | | | | | | | | | |
| SPS005 | - Wet Well and Chamber Reinforcement Detail | | B | | | | | | | | | | | |
| SPS006 | - Pit Details | | B | | | | | | | | | | | |
| SPS007 | - Not Used | | | | | | | | | | | | | |
| SPS008 | - Not Used | | | | | | | | | | | | | |
| SPS009 | - Not Used | | | | | | | | | | | | | |
| SPS010 | - Miscellaneous Details Sheet 1 of 3 | | B | | | | | | | | | | | |
| SPS011 | - Miscellaneous Details Sheet 2 of 3 | | B | | | | | | | | | | | |
| SPS012 | - Miscellaneous Details Sheet 3 of 3 | | B | | | | | | | | | | | |
| SPS013 | - Notes Sheet 1 of 2 | | B | | | | | | | | | | | |
| SPS014 | - Notes Sheet 2 of 2 | | B | | | | | | | | | | | |
| SPS015 | - Standard Thrust Block Details Sheet 1 of 2 | | B | | | | | | | | | | | |
| SPS016 | - Standard Thrust Block Details Sheet 2 of 2 | | B | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| SK04 | - Bulk Excavation / Groundworks | A | | | | | | | | | | | | |
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**Pressure Sewer Solutions Pty Ltd**
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Peakhurst NSW 2210
AUSTRALIA

Tel: (02) 9584 1177
Fax: (02) 9584 1477

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**Project** : Broadwater Pressure Sewer Scheme

**Project No** : 111007 Broadwater **Page** : 1 **of** 2

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**DRAWINGS/DOCUMENTS**

| Doc/Dwg | Document/Drawing Title | Issue | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Street Main Plans | | | | | | | | | | | | | | |
| S000 | - Pressure Sewer Cover Sheet, Legend, Notes & Key Plan | A | D | | | | | | | | | | | | |
| S001 | - Pressure Sewer Layout Plan Sheet 1 of 14 | C | F | | | | | | | | | | | | |
| S002 | - Pressure Sewer Layout Plan Sheet 2 of 14 | C | F | | | | | | | | | | | | |
| S003 | - Pressure Sewer Layout Plan Sheet 3 of 14 | D | G | | | | | | | | | | | | |
| S004 | - Pressure Sewer Layout Plan Sheet 4 of 14 | D | G | | | | | | | | | | | | |
| S005 | - Pressure Sewer Layout Plan Sheet 5 of 14 | C | F | | | | | | | | | | | | |
| S006 | - Pressure Sewer Layout Plan Sheet 6 of 14 | D | G | | | | | | | | | | | | |
| S007 | - Pressure Sewer Layout Plan Sheet 7 of 14 | C | F | | | | | | | | | | | | |
| S008 | - Pressure Sewer Layout Plan Sheet 8 of 14 | C | F | | | | | | | | | | | | |
| S009 | - Pressure Sewer Layout Plan Sheet 9 of 14 | C | F | | | | | | | | | | | | |
| S010 | - Pressure Sewer Layout Plan Sheet 10 of 14 | D | G | | | | | | | | | | | | |
| S011 | - Pressure Sewer Layout Plan Sheet 11of 14 | D | G | | | | | | | | | | | | |
| S012 | - Pressure Sewer Layout Plan Sheet 12 of 14 | D | G | | | | | | | | | | | | |
| S013 | - Pressure Sewer Layout Plan Sheet 13 of 14 | D | G | | | | | | | | | | | | |
| S014 | - Pressure Sewer Layout Plan Sheet 14 of 14 | C | F | | | | | | | | | | | | |
| | Standard Detail Plans | | | | | | | | | | | | | | |
| S201 | - Pressure Sewer Property Detail Sheet 1 | A | C | | | | | | | | | | | | |
| S202 | - Pressure Sewer Property Detail Sheet 2 | A | C | | | | | | | | | | | | |
| S203 | - Pressure Sewer Street Main Details | A | C | | | | | | | | | | | | |
| S204 | - Pressure Sewer Air Valve Details | A | C | | | | | | | | | | | | |
| | Set Out Plans | | | | | | | | | | | | | | |
| S301 | - Pressure Sewer Main Set out Details Sheet1 of 2 | C | E | | | | | | | | | | | | |
| S302 | - Pressure Sewer Main Set out Details Sheet2 of 2 | C | E | | | | | | | | | | | | |
| | Master Plans | | | | | | | | | | | | | | |
| S401 | - Pressure Sewer Master Plan Sheet1 of4 | D | F | | | | | | | | | | | | |
| S402 | - Pressure Sewer Master Plan Sheet2 of4 | C | E | | | | | | | | | | | | |
| S403 | - Pressure Sewer Master Plan Sheet3 of4 | C | E | | | | | | | | | | | | |
| S404 | - Pressure Sewer Master Plan Sheet4 of4 | C | E | | | | | | | | | | | | |
| | Loading Plans | | | | | | | | | | | | | | |
| S501 | - Pressure Sewerage Scheme Ultimate Lots Sewage Loading Sheet1 of4 | C | D | | | | | | | | | | | | |
| S502 | - Pressure Sewerage Scheme Ultimate Lots Sewage Loading Sheet2 of4 | C | D | | | | | | | | | | | | |
| S503 | - Pressure Sewerage Scheme Ultimate Lots Sewage | C | D | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Loading Sheet3 of4 | | | | | | | | | | | | | |
| S504 | - Pressure Sewerage Scheme Ultimate Lots Sewage Loading Sheet4 of4 | B | C | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Property Works | | | | | | | | | | | | | |
| | Property Plans (Refer to Property Audit Register Issue A) | | | | | | | | | | | | | |
| | Plumbing Reports (Refer to Property Connections Schedule Issue A) | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | Reports | | | | | | | | | | | | | |
| | Broadwater Pressure Sewerage System Design Report | B | | | | | | | | | | | | |
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# Appendix C – Rules Document

# Pressure Sewer Solutions

ABN 57 097 164 899

Unit 1 / 47-51, Lorraine Street
**PEAKHURST NSW 2226**

Ph: (61 2) 9584 1177
Fax:(61 2) 9584 1477
Email : admin@pssolutions.net.au


| | | |
|---|---|---|
| | **BROADWATER SEWERAGE SCHEME** | |
| | Client: Ledonne Constructions | **Contract:** 0602785-1 |
| | Location: BROADWATER NSW | **Document:** DOC 300.42 Issue J |

BROADWATER SEWERAGE SCHEME CONNECTION RULES

| | |
|---|---|
| 1. | Source:<br>1. RVC Pressure Sewer Policy 3.20.3 18/08/09<br>2. Home Owner manual<br>3. *RVC, Ledonne Constructions and Pressure Sewer Solutions P/L meeting held on site 11/10/11*<br>4. 1 in 100 Flood Level for Broadwater is 4.6M AHD. |
| 2. | Property Equipment Ownership and Easements<br>Ownership for the following items shall reside in RVC.<br>• Pressure Sewer Unit<br>• Boundary kit and Property discharge line (from pump unit to boundary kit)<br>• Control panel and cable<br>Property owners are not required or permitted to interfere with the operation of property equipment. Operation and Maintenance will be undertaken by Council. Council has authority to entre properties via Local Govt Act 1993 (Section 191A).<br>Easements are not generally required on private properties unless the collection main or property discharge main is required to pass through a neighbouring property.<br>The property owner will be responsible for maintenance of the electrical circuit between the control panel and property switchboard.<br>A positive covenant reinforcing Councils rights of access may be required as condition of consent for new sub-divisions serviced by a pressure sewerage system.<br>Property owners will be provided a home owner manual which outlines the service standards, what to do if alarm sounds, power failure occurs and swimming pool discharge etc. |
| 3. | Required Connections<br>It is desireable that all properties within Broadwater sewerage scheme will be connected upon sewerage being available. The majority of premises will be connected under the contract even if plumbing upgrades are required as identified in the audits. Property owners may choose to use Ledonnes to carry out these upgrades or a licenced plumber. However, Council will issue orders (in accordance with the LG Act) for those property owners that choose to use a private plumber for any plumbing upgrade works. |
| 4. | Single Dwelling Residential Properties<br>The Broadwater sewerage scheme will cover the cost for residential properties for the following:<br>The design, supply and installation of the street main network, the property discharge line, the boundary valves, a SINGLE pressure sewer unit with stub riser (property connection point), control panel and associated equipment.<br>RVC will also connect up to 5 meters of the sewer drainage to the PVC stub-pipe in accordance with Councils plumbing standards (AS 3500). For some properties where the pump unit cannot be located within 5m of the septic/house due to physical constraints (not at the request of the property owner), Council will pay for the extra plumbing work to make this connection.<br><br>Some properties have been amalgamated for rating purposes. For 2011/12, each lot that is capable of connection to water or sewer will now be subject to the sewer charge of $800, whether occupied or vacant. Property owners may claim an exemption from the charges such as when the building opportunity may not be readily achievable or the owner has no itention of developing the separate lot. |

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| | Sewer availability charge $800 (2011/12). |
| 5. | Vacant Lots<br>Vacant lots paying a sewerage vacant charge will be entitled to a connection to the sewerage scheme. Once development of the property commences the property owner needs to contact council to arrange the works and payment of the Property Levy (as identified in Council's fees and charges). This entitles the property owner to a pressure sewer unit and associated equipment (as per RVC Pressure Sewer Policy) with the installation costs to be met by the property owner.<br>A Boundary Kit is to be provided at each vacant lot (that is deemed to be sewerable with a building opportunity) 1m x 1m from the side and front boundary. The BK location is to be negotiated and agreed by the property owner. If the property owner is not available the BK is to be located on the low side of the lot. |
| 6. | Commercial and Multiple Dwelling Residential Properties<br>The Broadwater sewerage scheme will cover the cost for Commercial (including non-single dwelling residential lots) properties for the following:<br>The design, supply and installation of the street main network, the property discharge line, the boundary kit, pressure sewer unit with stub riser (property connection point), control panel and associated equipment.<br>Where more than one dwelling exists on a single property a larger single pump unit (with 2, 3 or 4 pumps) may be used. |
| 6A | Flats with Separate Owners with or without Strata Title or Body Corporate<br><br>Connection Requirements for Double or Multi Unit Developments - Strata title lots with 1 or 2 dwellings will get a PU for each dwelling.<br><br>If a *single property has more than 2 dwellings owned by separate people with common strata title areas and existing sewer drainage system drains to multiple septic tanks. The RVC policy states that a single larger PSU shall be installed i.e. allow a 2 or 4 pump PSU (based upon sewage loading) for the site in a position where the drainage can be modified to connect and allow the strata body to connect the sewer drainage.*<br>Where the above is not practical Pressure Sewer Solutions P/L will design the property works to install multiple PU's if in the opinion of the auditor it's the most practical solution. The property designer must document the reasons for the multiple PU's which will be desk top reviewed by RVC. The reasons may include the following.<br>A single PU may require:-<br>1. As single PU may not provide enough depth to obtain house sewer fall from all the dwellings.<br>2. Private house sewer to be installed under an existing structures, zone of influence or concrete slab.<br>3. Extensive decorative concrete cutting to install PU or house sewer.<br>4. 3 or 4 single PU will be lower capital cost than 1 large multi pump PU.<br>5. Electrical connection upgrade works for a common electrical supply to the PU may be extensive and expensive.<br>6. Restoration may be extensive e.g. structural surface finishes.<br>7. The house sewer drainage may need to pass through a property next door to connect to a single PU and the next door owner does not allow access for construction.<br><br>Ledonne to arrange to have RVC review on a case by case basis – a conditional signoff on the basis of |

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| | unconfirmed information for that case is not desirable<br><br>*Clearly where 1 PU is used it is preferable to connect the PU to a common property electrical circuit.*<br><br>*In the above situation where the lot is not a strata and each unit is separatly owned, a separate PSU shall be installed for EACH dwelling.*<br><br>Electrical Connection<br>For a strata or body corporate the electrical connection is required to extend off the "house" or "common" supply. If a common or house electrical supply does NOT exist details of the property are to be taken and reviewed with RVC prior to determining the connection location. |
| 8. | Caravan Parks<br>A PSU will be provided for each existing amenities building and each permanently occupied residential dwellings septic tank. The pump unit selection is based upon existing property design loadings. |
| 9. | Development Sites and Sub-Division<br>If approved by Council and in accordance with RVC Pressure Sewer Policy:-<br>Developer to meet all associated costs<br>Developer to design and install all collection network and property works<br>Developer to pay sewerage developer contribution<br>Provide instrument on the lot of each title – Property has a pressure sewer system and home owner manual requirements.<br>Pump units to be compatible with RVC units for Broadwater. |
| 10. | Connection Timeframe<br>It is desireable that all properties within Broadwater sewerage scheme will be connected upon sewerage being available. The majority of premises will be connected under the contract even if plumbing upgrades are required as identified in the audits. Property owners may choose to use Ledonnes to carry out these upgrades or a licenced plumber. However, Council will issue orders (in accordance with the LG Act) for those property owners that choose to use a private plumber for any plumbing upgrade works. |
| 11. | Existing Sewer Drainage and Electrical Audits<br>A plumbing and electrical audit shall be undertaken on each property by PS Solutions and Ledonne Constructions.<br>Property owners will be advised and be responsible for the cost of upgrade works to their existing sewer drains and electrical switchboard should it be determined by the property audit. Property owners will be provided a price for Ledonne's to do the upgrades based on tendered rates or get their own licenced plumbers/electricians to do the works. It is desireable that property owners ensure that any upgrade work is completed prior to the pump unit being installed if they choose to use their own plumber/electrician. |
| 12. | Separate Black and Grey Water<br>Properties having split system (separate black and grey water) must be combined and connected to sewer (including caravan parks). |
| 13. | Existing Sewer Drainage<br>All property owner's will be responsible for any plumbing upgrade works that are idetntified in the audits. The property owner may choose to use Ledonnes to carry out this work or they may choose to use a licenced plumber. If the home owner requests the pump unit to be located in a different location than that recommended by PSS Solutions (to be approved by Council first), then the cost of the additional plumbing/electrical works will be the responsibility of the property owner.<br>Property owners are also responsible for the decommissioning of their existing on-site systems. Refer to |

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| | Department of Health Guidelines and requirements of RVC Environmental Health section (EDS). |
| 14. | Council Fees<br>Sewer availability charge is $800 pa (2011) for both vacant and developed lots.<br><br>Some properties have been amalgamated for rating purposes. For 2011/12, each lot that is capable of connection to water or sewer will now be subject to the sewer charge of $800, whether occupied or vacant. Property owners may claim an exemption from the charges such as when the building opportunity may not be readily achievable or the owner has no itention of developing the separate lot.<br><br>Section 64 charge for 2011/12 is $26,000.<br><br>Property Levy is:<br>See attached email. |
| 15. | Existing on-site tanks cannot be reused for stormwater storage as required by RVC Environmental Health section. |

Note:

Audits start date 14th November 2011
Community Open Day 14/11/2011

Other Things to Know Prior to Start on Site

- Properties outside the scheme boundary can they connect? Yes/No at what cost? Scheme boundaries have been defined. Future developments outside the scheme boundaries will be assessed at that time.
- Councils construction program – Completion by February 2013.
- Any confidential issues - No
- Trade waste policies – RVC trade waste officer has visited all the Broadwater commercial properties. Refer to RVC Trade Waste Policy.
- Sewer Rates payment history, e.g. Are there any properties that shouldn't be connecting because they haven't made payment – to be advised. Some properties have not been charged sewer rates and Council has written to these property owners. Rates department need to advise if any problems exist.
- PS Solutions to enquire with each property owner if their property holds rain / storm water or floods and document the flooding extent on the property plan and check list.
- Mortar jointed VCP sewer drainage is deemed by RVC to be a non-conforming material therefore the system requires upgrade. Mortar joints will not be acceptable. All VC pipe to be replaced.

General PSU Equipment Location Rules

1. Pressure Sewer Solutions will provide an A4 size property outline plans which will incorporate the following information:-
    a) Property boundaries
    b) Location of the connecting street pressure sewer main.
    c) Property address
    d) Street name
    e) Property DP numbers and property identification.
    f) Standard clause for property owner's signature. The clause defining the property owner's consent of the various on lot pressure sewer equipment location and setout, also the owners consent for the construction works of the pressure sewer system.
2. Pressure Sewer Solutions will also provide a pressure sewer unit audit check list covering issues that need to be addressed on each property and with property owners. Each property will involve individual and unique issues that will require detailed attention or issue of notifications to the homeowner to upgrade the sewer drainage system to Australian Standards.
3. An appointment will be arranged with each property owner on each property to review and document on the above check lists and property outline plans resolutions regarding issues including but not limited to the following:-
    a) How the pressure sewer system will work at the Village and the benefits to the property owners and occupiers.
    b) Costs to the property owners (refer this to Council please).
    c) Pressure Sewer Solutions in association with the property owner will define the locations of equipment on site. Items of pressure sewer system equipment on individual properties e.g. the pressure sewer unit, alarm panel, Boundary kit and access box, electrical connections and existing septic tank etc.
    d) The location of the above equipment shall be coordinated by Pressure Sewer Solutions with the objective of integration into a complete and operating pressure sewer system. E.G. the location of the pressure sewer unit must be capable of collecting black and grey water from the existing dwelling.
    e) Pressure Sewer Solutions will also review with the property owner any plans they may have for future on property developments which may interfere with the pressure sewer equipment selected locations and or sewage discharging fixtures which may require connection to the tank at a later stage. These issues will be incorporated into the property audit plans.
    f) In extreme last resort circumstances only will the PSU be permitted to be installed in the existing septic tank.
    g) Audit check list to nominate any long electrical cables.
    h) Generator point will be provided on commercial properties.
4. The PSU agreed location is to nominated on the property by a spray painted PINK dot. This is to done ONLY with the consent of the property owner.
5. Note that all information that will be discussed and provided to the property owner and/or resident shall be provided to Pressure Sewer Solutions prior to accessing the site. Speculation and issues subject to opinion will not be discussed with any property owners or residence and only approved information is to be provided to property owners. This is to insure the consistency of information being provided to the community which is critical in the implementation of the system.

6. The house lot plan will also nominate relevant surface hard and soft finishes such as landscaping, driveways and pathways etc.
7. Photos of the front of the property, equipment and piping locations will be taken and tabulated.
8. Pressure sewer unit locations will also give consideration the adjacent buildings structural issues such as footings zone of influence.
9. The drawings will also nominate the construction methodology for the all items of pressure sewer equipment on site e.g. installation of the pressure main to be open cut trenched by a ditch witch or require trenchless technology for the pressure main installation due to extensive property disruption. In this instance quantity of required boring will be clearly shown on the drawing and the reason for it.
10. Once property audits have been documented and signed off by the property owners they will be scanned and copied onto CD ROM, for filing.
11. Each of the property plans will then be documented in CAD, reprinted and the original property owner signed off plan, photos and other documentation will be attached and reissued ready for construction.
12. Working hours will be to suit the individual property owner's appointments therefore this scope of works will require some out of normal hours work.

Property Audit Issues from the Project Specification

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| 1. | Review the audit check list on site with each property owner. |
| 2. | Determine location of pressure sewer equipment in accordance with the following list and in consultation with the property owner. |
| 3. | 16.2.1.2 Hydraulic Audit<br>The Contractor shall confirm the location and arrangement of the existing sanitary drainage and on-site disposal system (e.g. septic tank and absorption trench) to ensure the adequacy of these, that no stormwater is gaining access to the system and if there are separate greywater and blackwater lines and what will be required to get these into the new collection/pump unit. |
| 4. | 16.4.4 LOCATION OF COLLECTION / PUMP UNITS<br>Where possible, the collection/pump unit shall be installed in accordance with the following criteria:<br>· within 12 metres of the control / alarm panel due to pump standard control cable lengths (15m). Longer length control cables can be used where confirmed with supplier;<br>· For non-standard collection/pump unit installations, separation from buildings and other structures will be required to clear the "45 degree zone of influence" on the foundation;<br>· 2 metres from building walls or other structures (including retaining walls) to clear the "45 degree zone of influence" on the foundation (for a 2000 mm pressure sewer collection tank depth);<br>· 3 metres from opening window; and<br>· 1.5 metres from the side boundary of the property.<br>Where possible gully traps shall be at a level slightly lower than the collection tank lid to provide a dedicated point of relief.<br><br>Where there is insufficient space to install a collection/pump unit on the property or the property is based on hard rock, a collection/pump unit may be installed inside an existing septic tank (if one exists on the property) providing that the tank is structurally adequate and it has been cleaned to council's satisfaction before the installation is made. This option is a last resort.<br><br>Where possible, the pumping unit cover shall have a minimum 1 metre clearance all around the outer |

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| | circumference of the collection tank for at least 270 degrees on plan, with 2.5 metres clearance above. For pumping units installed above grade, such as under decking or a pole foundation, a winching point shall be provided above the cover with a 100 kg load capacity for grinder pump removal. Any such installations will be subject to the Principal's approval.<br><br>The pumping unit shall not be located within buildings or other enclosed areas.<br><br>Existing property sanitary lines and property grey water lines shall be exposed prior to installing the pressure sewer collection tank. Levels of these existing lines shall be confirmed to ensure that all sanitary and grey water lines can be drained to the collection tank. The pressure sewer collection tank shall be located at a level that permits sufficient slope on the new property sanitary lines as required by prevailing codes and standards. Where installations occur in flood areas the breather ports shall be sealed and venting provided above 1:100 Flood Level. |
| 5. | 16.6.2 PROPERTY DISCHARGE LINE<br>The property discharge line shall be constructed either by open trench excavation or by trenchless technology.<br>The property discharge line for a given property shall not cross onto any adjacent private property (unless an easement is provided), or collect the discharge from any other property. Any easements shall be in favour of the benefited property, and any legal or compensation costs for the creation of easements shall be the responsibility of the property owner. All easement conditions shall be met and approved by the Principal. Exceptions that may require easements include special properties where the access drive for a given property serves as access to additional properties as well. The property discharge line shall be offset from buildings at the required distance to clear the 45degree zone of influence on the foundation. |
| 6. | 16.7 PROPERTY BOUNDARY KIT<br>The property boundary kit is an EOne kit supplied by the Principal as part of the EOne pressure sewer unit.<br>The property boundary kit is to be located 1.0 metre inside the property line that parallels the pressure sewer network, and 1.0 metre inside the nearest side property line, unless obstructions or other site conditions dictate another location. |
| 7. | 16.8.1 CONTROL/ALARM PANEL<br>Installation works shall be completed as per the following conditions;<br>(a) The control/alarm panel shall be mounted on the building being serviced by the pressure sewer system, wherever possible. Where the pressure sewer pumping unit installation is required to be located more than 10 metres from the building being serviced, and there are no other suitable structures upon which to attach the panel, the panel must be mounted on a structurally sound frame.<br>(b) The control/alarm panel shall be located in a location that can be safely accessed by maintenance personnel without obstructing access to any features of the property by the owner. The control/alarm panel shall be located within line of site of the Pressure Sewer Pumping Unit, and shall be positioned in a location such that visible and audible alarms should be noticed during an alarm condition.<br>(c)<br>(d) Where possible, the control/alarm panel shall be mounted at a height of between 1200 and 1500 mm above ground level and a minimum of 400mm above the 1:100 year Flood Level if possible. The panel should be accessible and on a double storey house located on the upper verandah.<br>(e) Cable connection to the panel shall be through the bottom and shall have a compression gland supplied with the unit and installed inside to ensure it is waterproof. The cable shall terminate in the panel, while the conduit shall not extend into the panel. No holes shall be drilled through the panel. |

Pressure Sewer Code of Australia (Extracts)

WSA 07 – 2007

6.2 CLEARANCES

Minimum horizontal clearance between buried water services and any pressure sewer system components shall be 300 mm. Where the crossing of a buried water service is required, the property discharge line shall be located below the water service with a minimum vertical clearance of 100 mm.

*The preferred crossing angle is 90 degrees.*

6.3 VACANT LOTS -

A Boundary Kit is to be provided at each vacant lot 1m x 1m from the side and front boundary. The BK location is to be negotiated and agreed by the property owner. If the property owner is not available the BK is to be located on the low side of the lot.

6.4 EXISTING PROPERTY DATA COLLECTION (Extract from Pressure Sewer Code - WSA 07 2007)

The following data shall be collected in the field during the property inspection and documented on the Property Sewer Service Diagram:

(a) -
(b) -
(c) Property access issues such as fencing, gates, and animals.
(d) All Building outlines based on aerial photography or survey data.
(e) List of building plumbing facilities for all buildings.
(f) Any excessive discharge fixtures such as pools or spas.

> *Property owners need to be aware that all pool backwash / discharge water is to be directed to sewer. RVC require that residents regulates pool backwash volumes and rates so as not to exceed the capacity of the pressure sewer pumping unit and to avoid alarms being needlessly generated. The same provisions shall apply to draining swimming pools. The pump backwash / discharge rate must be less than 0.45L/sec. If this requirement cannot be met it will be necessary to provide additional storage (holding tank) with controlled discharge of less than 0.45L/sec.*

(g) Driveways, concrete footpaths, patios, decks, landscaping, fencing, and any other significant potential obstructions.
(h) Layout of all existing customer sanitary drains, including those which are not connected to an on-site effluent disposal system.
(i) Depth and material of each customer sanitary drain at building perimeter and at on-site effluent disposal system (if known).
(j) The location of all storm water drainage system components, including sub-surface drains, and the point(s) of discharge.
(k) -
(l) Electrical distribution box shown in its actual location.
(m) Any restoration considerations on the property as discussed.
(n) Underground services (if known).
(o) Geological formations, such as rock, at less than 1 m depth (if known).
(p) Steep, difficult grade or particularly rugged terrain.

## 6.5 DESIGN AND LAYOUT OF NEW ON-PROPERTY COMPONENTS

The following factors shall be considered prior to locating any on-property pressure sewer system components, listed in descending order of priority:

1 Avoid risk to structure foundations and other property assets. Locate the tank AWAY from any structure zone of influence.
2 Allow for access to and ongoing operation and maintenance of equipment being installed. Generally, access to the collection/pump unit by a 900 mm wide trolley, and walking access to all other on-property components.
3 Locate collection/pump unit away from natural drainage paths and depressions.
4 Minimise encroachment of equipment on property.
5 Locate equipment to minimise the extent, and associated cost, of new infrastructure.
6 Minimise the length of customer sanitary drain to be installed to minimise potential infiltration and to minimise the property owner's connection expense.
7 Any preferential locations requested by the property owner.
8 - Consideration from planned future extensions

Where possible and unless site conditions dictate a larger offset, property discharge lines shall be located within 1 m of a side boundary.
*The preferred property boundary assembly location is 1 m inside the property boundary crossed by the pressure sewer lateral and 1 m inside the nearest side property boundary, unless obstructions or other site conditions dictate otherwise.*

6.6 CONTROL AND ALARM PANELS

Shall be located in a weatherproof enclosure at least 1,200mm to 1,500mm above finished surface level in a clearly visible location in direct line-of-sight from the collection tank and as close as practicable to the tank.

In the case of flood-prone areas the weatherproof enclosure shall be located above the 1 in 100 year flood level, except where this would require ladders to access the panel. In any installations below the 1 in 100 year flood level, the enclosure shall be no lower than the existing property switchboard.
*It is preferable that the control and alarm panels are attached to the external wall of the building on the property being serviced. Where this is not practicable a panel on a post is acceptable.*
Locate the panel within 10 meters of the pressure sewer unit

7.3 LOCATION
*The collection/pump unit should be located on the property being serviced and clear of any built improvements so as to minimise the length of customer sanitary drain and power supply from the building switchboard within the limitations of the site and requirements of the property owner.*

7.6 COVERS AND FRAMES
The top of the tank shall be located at least 150 mm above the 1 in 100 year flood level.

Where permission has been given to locate the collection tank in areas subjected to flooding or ponding of water, the tank shall be provided with a watertight cover and a vent from the tank to a level above the roofline of the house in accordance with Clause 6.8.4 of AS/NZS 3500.2. Where the tank is located below the 1 in 100 year flood level, the watertight covers shall also be capable of being bolted-down.
The appropriate class of covers and frames for trafficable and non-trafficable areas shall be nominated on the Design Drawings i.e. Class B for non-trafficable and Class D for trafficable.
Where collection/pump units are to be located on public land, the covers shall be capable of being locked in place to prevent entry by non-authorised personnel (Refer to the Water Agency regarding supply of a standard master keyed lock).
Collection tank covers shall provide sufficient access opening for easy pump removal and routine maintenance of fixed items within the tank.

8.1 PROPERTY DISCHARGE LINE

8.2 LATERALS
Pressure sewer laterals shall connect the property boundary assembly of each property to the pressure reticulation sewer. Laterals shall connect the reticulation pressure sewer at right angles and, wherever practicable, cross roadways at right angles. Where a property boundary assembly is located more than 5 m inside the boundary crossed by the pressure sewer lateral, an isolation valve shall be installed on the pressure sewer lateral immediately adjacent to the pressure reticulation sewer.

8.3 DESIGN CRITERIA

Service connection design shall conform to the requirements of Clause 4.5 except that the minimum pipe size shall be DN 40. The service connections shall be also sized to cater for any known future development of the lot.

9.1 DIFFICULT GROUND CONDITIONS

9.1.1 Foundation design and ground water control

As necessary, the Design Drawings shall specify special precautions required to mitigate the effects of difficult geological and foundation conditions.

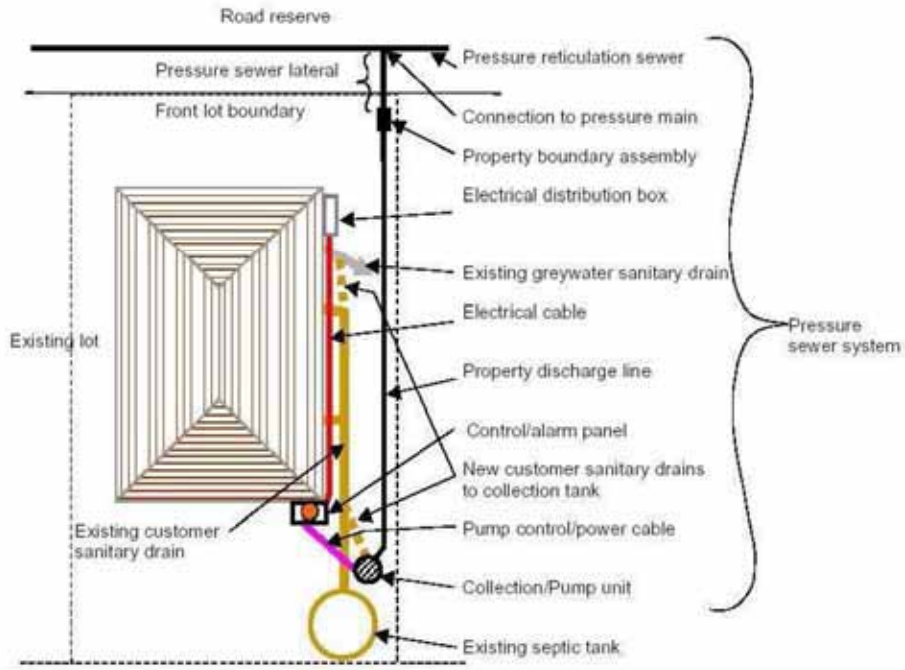
If the foundation conditions and/or the groundwater conditions (present or predicted to occur) call for special design details or construction practices, such requirements shall be specified in the Design Drawings. Where foundation treatments are necessary, and/or groundwater conditions affect either the design or construction of the sewer, then the Design Drawings shall specify:

(a) Details of any special foundations treatment required.
(b) Special methods necessary to control groundwater flow along the pipe embedment and/or trench fill e.g. by means of bulkheads.
(c) All sections of the sewer where the Constructor will need to pay particular attention to controlling groundwater prior to excavation to prevent heave of or loss of density in the trench floor material e.g. “boiling” sand.
(d) Areas subject to subsidence.
(e) Other geotechnical considerations e.g. zones of influence near structures.

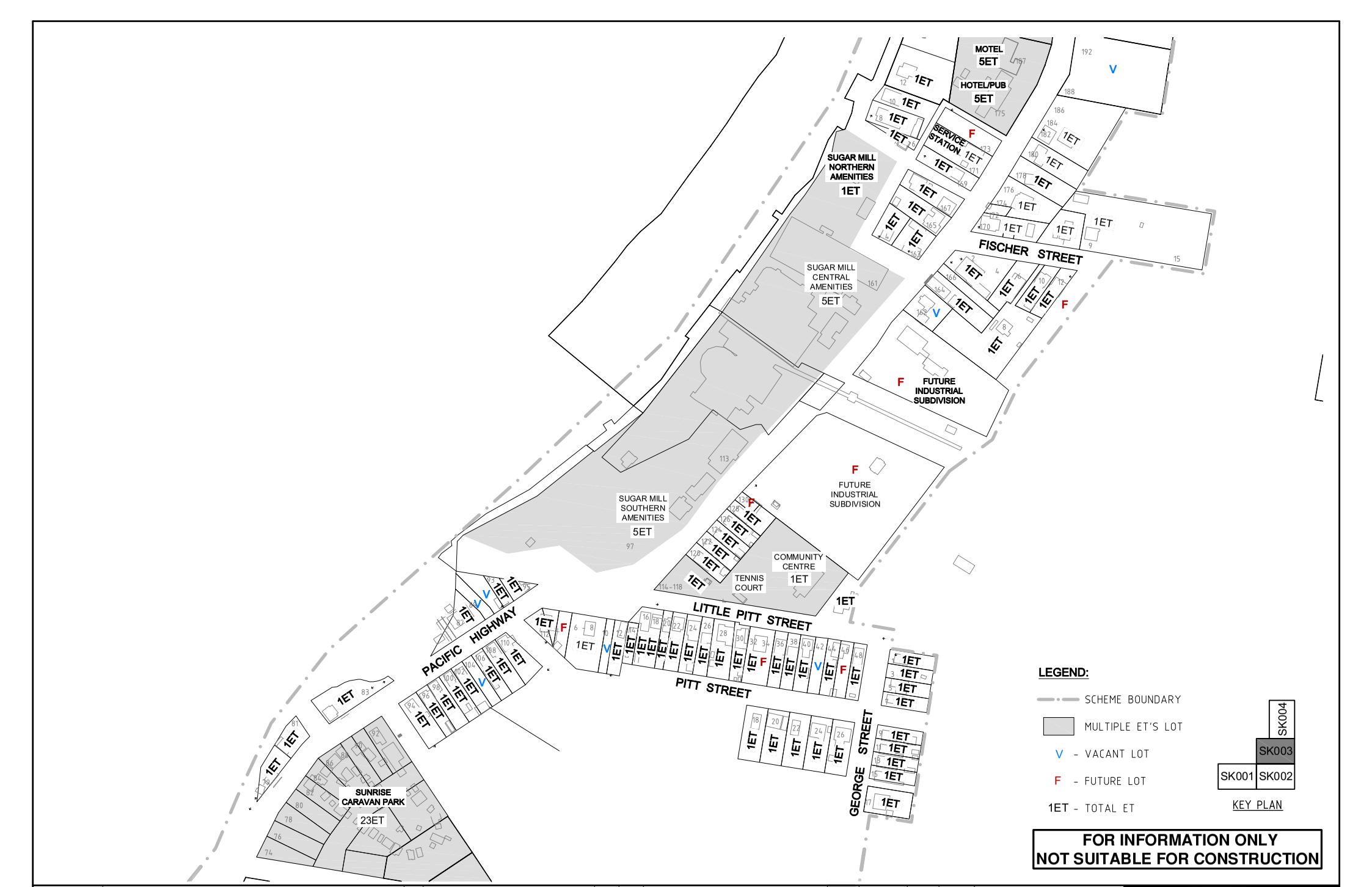
Where two or more dwellings are to be served by a single unit e.g. a strata title subdivision or where two families in the one building are to be served e.g. a dual-occupancy, the collection/pump unit should be located outside on common property clear of any built improvements to minimise the length of gravity sewers.

Collection/pump units located in geologically unstable (slip / talus) ground may require specialist geotechnical analysis and design and the Designer may need to consider the use of piered support. In rocky terrain the collection/pump units should be located on level compacted ground wherever practicable to assist in installation and maintenance of the unit

Figure 1 Schematic of Typical On-Property Components of Pressure Sewerage System



# Appendix D – Existing Loading Allocations






| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

DESIGN BY:

Pressure Sewer Solutions Pty Ltd
Unit 1/47-51 Lorraine Street
Peakhurst NSW 2210
Sydney Australia
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F: +61 2 9584 1477
E: admin@pssolutions.net.au
www.pssolutions.net.au

| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
EXISTING LOTS SEWAGE LOADING
SHEET 3 OF 4

DRG No. 111007-SK003

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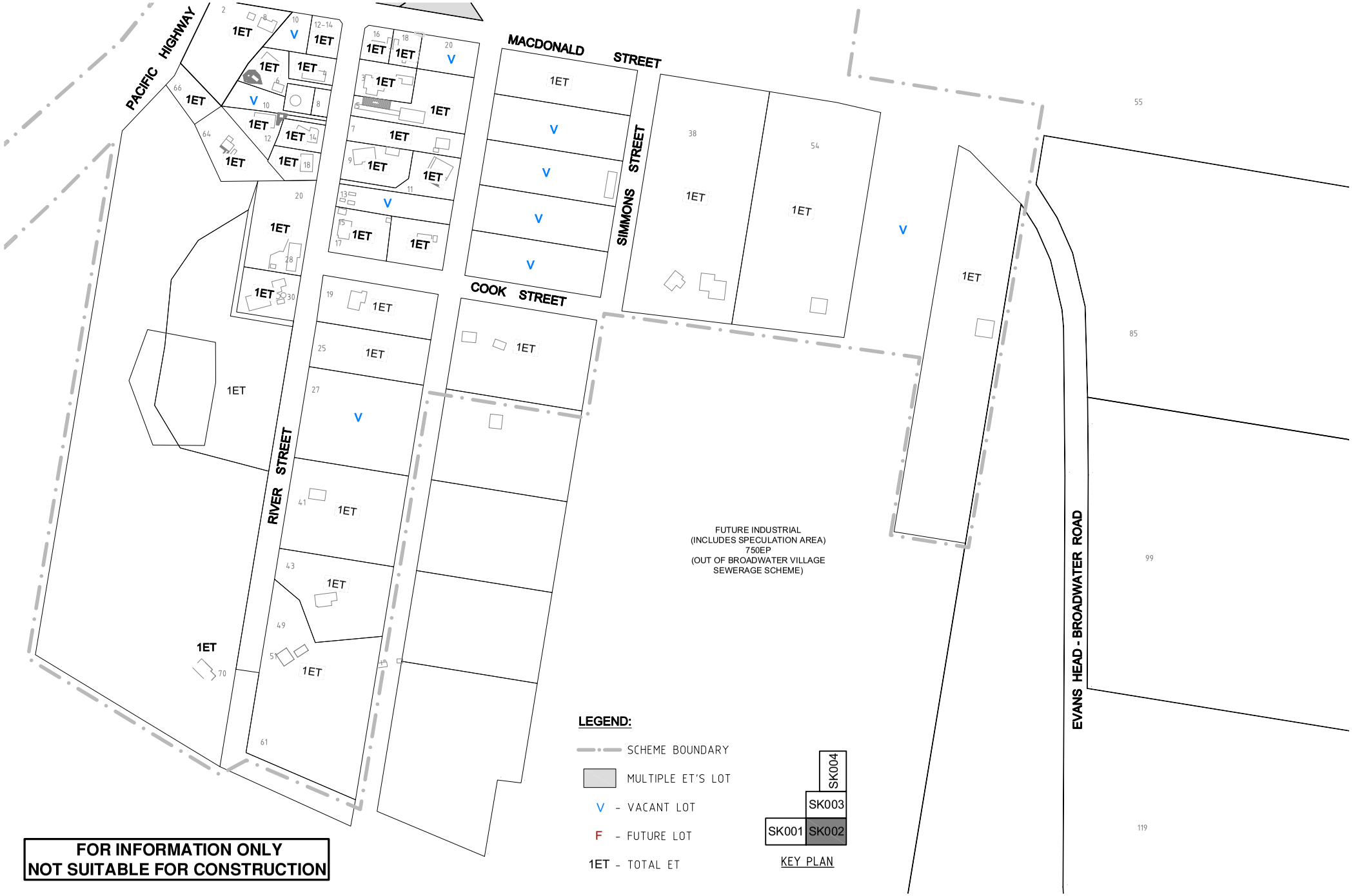
SIZE A1






| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

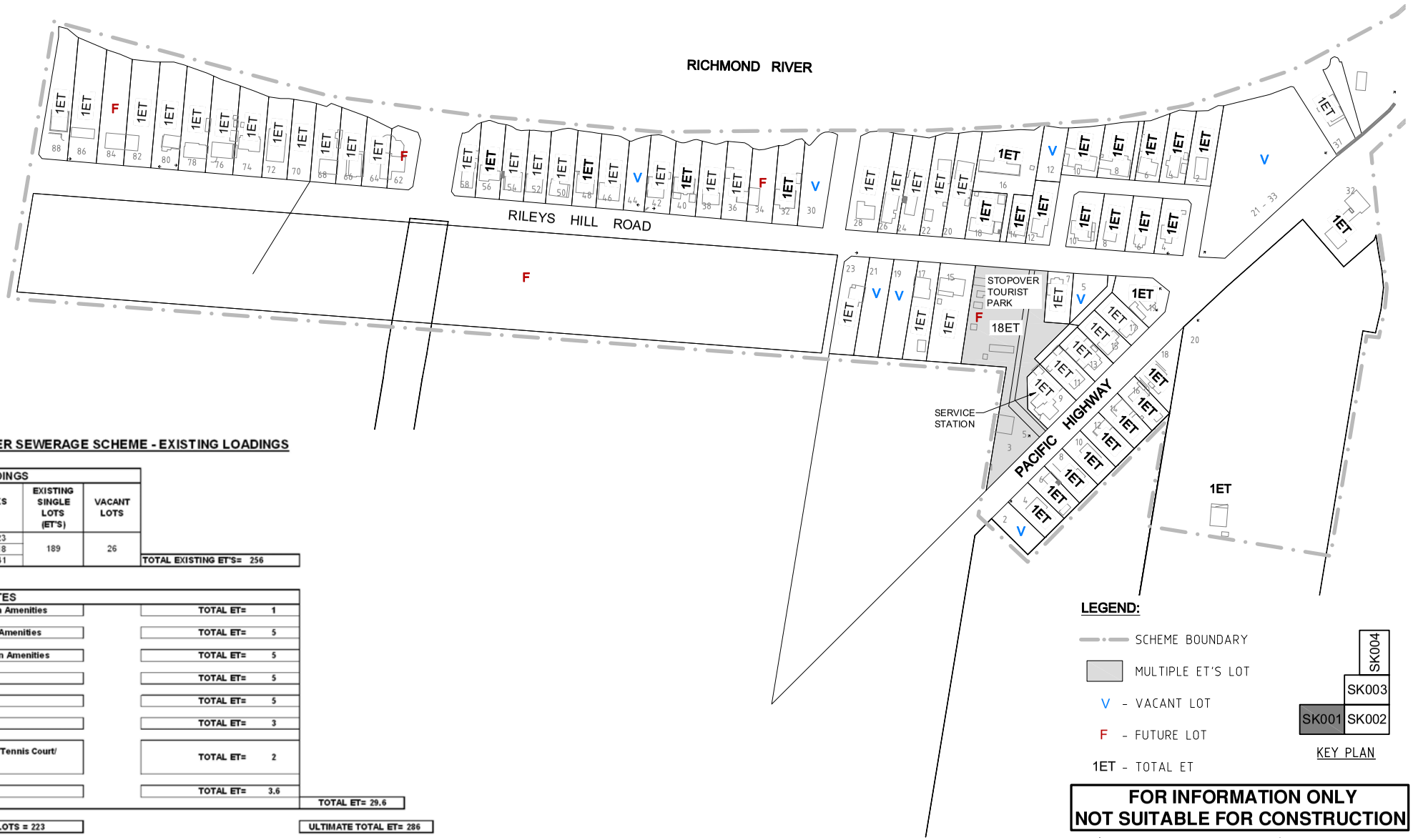
CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
EXISTING LOTS SEWAGE LOADING
SHEET 2 OF 4

DRG No. 111007-SK002

REV A




## BROADWATER SEWERAGE SCHEME - EXISTING LOADINGS

| EXISTING LOADINGS | | | | |
|---|---|---|---|---|
| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS | |
| Sunrise | 23 | 189 | 26 | |
| Stopover | 18 | | | |
| Total | 41 | | | TOTAL EXISTING ET'S= 256 |

| OTHER KEY SITES | | |
|---|---|---|
| Sugar Mill Northern Amenities | TOTAL ET= | 1 |
| Sugar Mill Central Amenities | TOTAL ET= | 5 |
| Sugar Mill Southern Amenities | TOTAL ET= | 5 |
| Hotel/Pub | TOTAL ET= | 5 |
| Motel | TOTAL ET= | 5 |
| Bowling Club | TOTAL ET= | 3 |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= | 2 |
| School | TOTAL ET= | 3.6 |
| | | TOTAL ET= 29.6 |

ULTIMATE TOTAL LOTS = 223

ULTIMATE TOTAL ET= 286

**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

Pressure Sewer Solutions Pty Ltd
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Sydney Australia
T: +61 2 9584 1177
F: +61 2 9584 1477
E: admin@pssolutions.net.au
www.pssolutions.net.au

| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

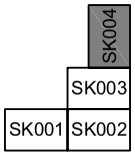
TITLE: PRESSURE SEWERAGE SCHEME
EXISTING LOTS SEWAGE LOADING
SHEET 1 OF 4

DRG No. 111007-SK001

REV A

**LEGEND:**

- SCHEME BOUNDARY
- MULTIPLE ET'S LOT
- V - VACANT LOT
- F - FUTURE LOT
- 1ET - TOTAL ET




KEY PLAN


**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

0 20 40 60 80 100m
SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:
CLIENT: RICHMOND VALLEY COUNCIL
PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
EXISTING LOTS SEWAGE LOADING
SHEET 4 OF 4

DRG No. 111007-SK004
REV A

# Appendix E – 50 Year Loading Allocations




| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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P.S. SOLUTIONS
ABN ST 007 164 899

| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1 (0, 20, 40, 60, 80, 100m)

HYDRAULIC OUTPUT:

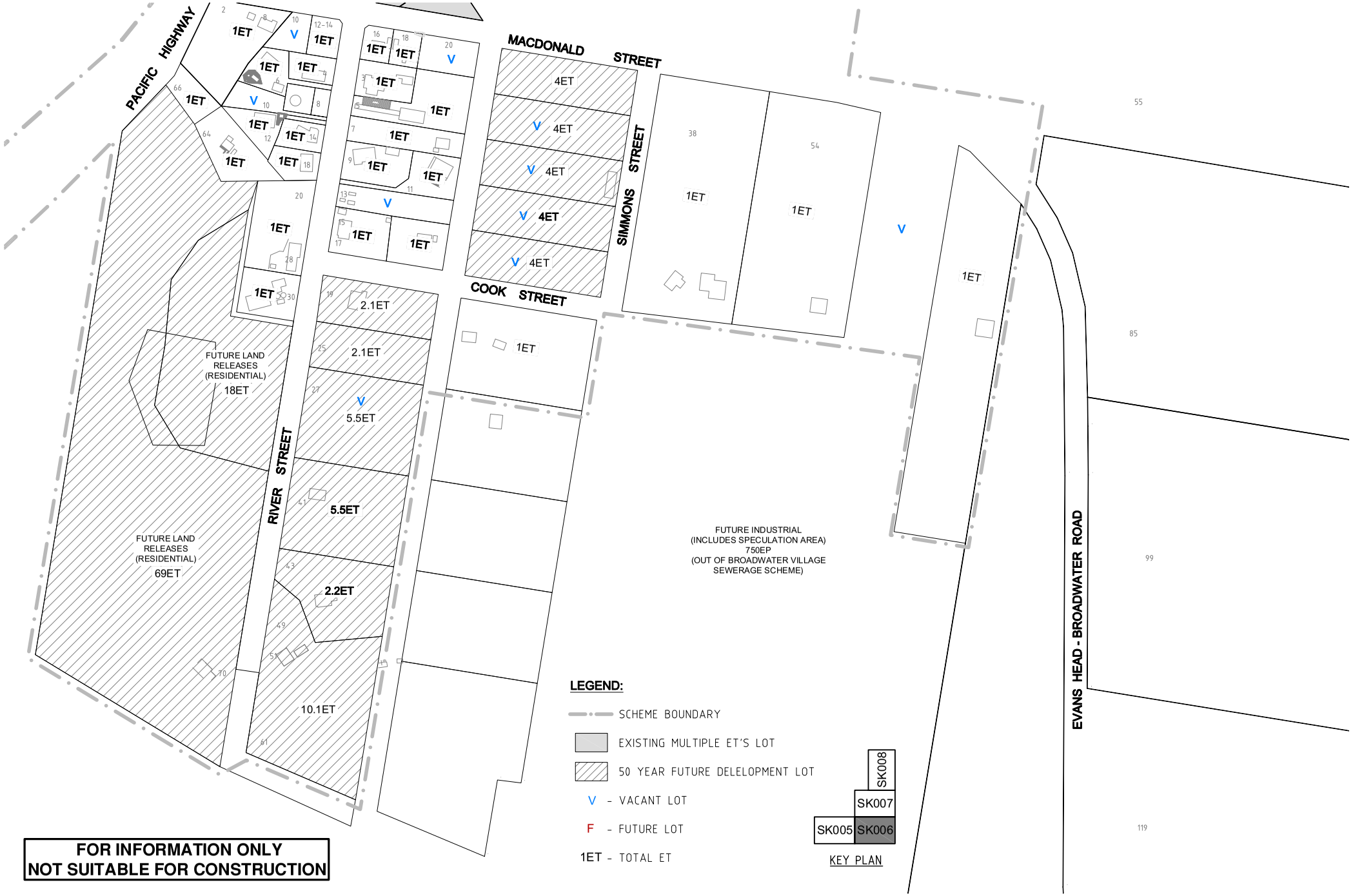
CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
50 YEARS LOTS SEWAGE LOADING
SHEET 3 OF 4

DRG No. 111007-SK007

REV A




**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

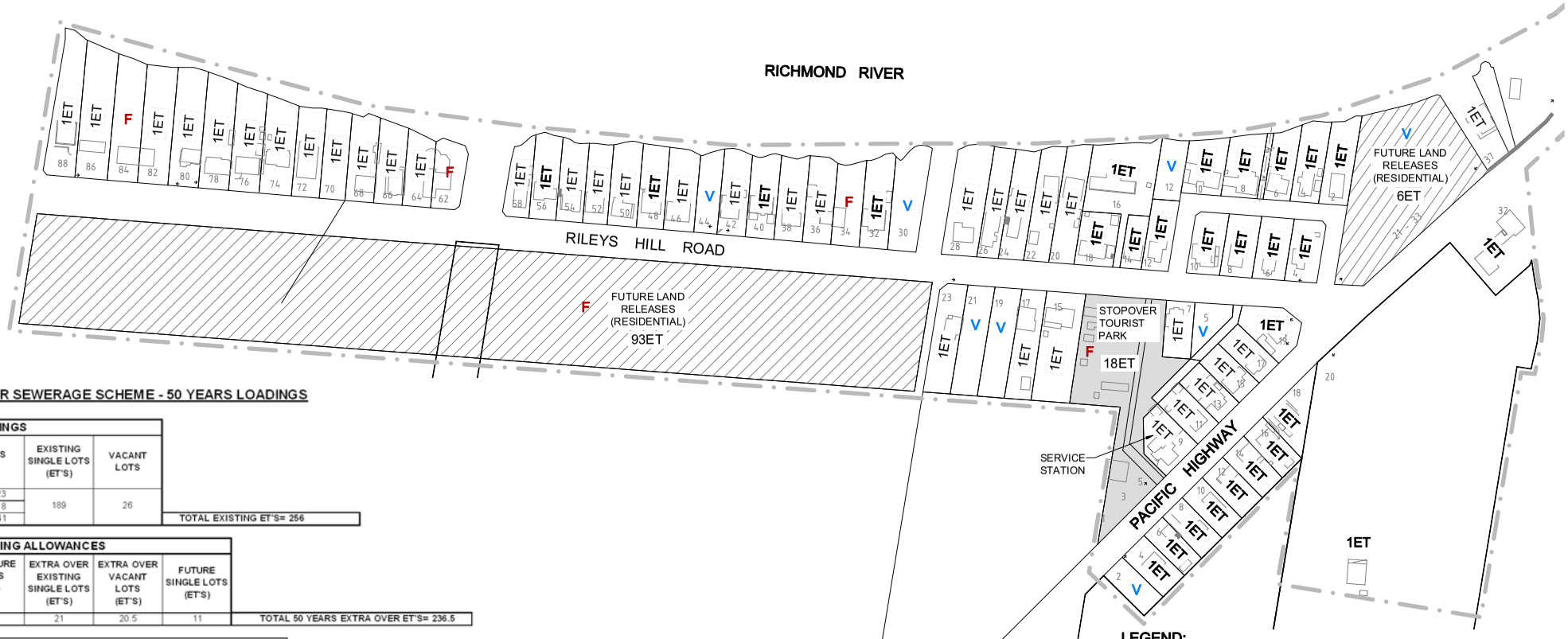
CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
50 YEARS LOTS SEWAGE LOADING
SHEET 2 OF 4

DRG No. 111007-SK006

REV A




## BROADWATER SEWERAGE SCHEME - 50 YEARS LOADINGS

**EXISTING LOADINGS**

| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS |
|---|---|---|---|
| Sunrise | 23 | 189 | 26 |
| Stopover | 18 | | |
| Total | 41 | | |

TOTAL EXISTING ET'S= 256

**50 YEARS LOADING ALLOWANCES**

| EXTRA OVER FUTURE LAND RELEASES (RESIDENTIAL) (ET'S) | EXTRA OVER EXISTING SINGLE LOTS (ET'S) | EXTRA OVER VACANT LOTS (ET'S) | FUTURE SINGLE LOTS (ET'S) |
|---|---|---|---|
| 184 | 21 | 20.5 | 11 |

TOTAL 50 YEARS EXTRA OVER ET'S= 236.5

**OTHER KEY SITES**

| | | |
|---|---|---|
| Sugar Mill Northern Amenities | TOTAL ET= | 1 |
| Sugar Mill Central Amenities | TOTAL ET= | 5 |
| Sugar Mill Southern Amenities | TOTAL ET= | 5 |
| Hotel/Pub | TOTAL ET= | 5 |
| Motel | TOTAL ET= | 5 |
| Bowling Club | TOTAL ET= | 3 |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= | 2 |
| School | TOTAL ET= | 5.5 |
| Village Industrial (Sugar Mill) | TOTAL ET= | 34 |

TOTAL ET= 65.5

ULTIMATE TOTAL LOTS = 237

ULTIMATE TOTAL ET= 558

**LEGEND:**

- SCHEME BOUNDARY
- EXISTING MULTIPLE ET'S LOT
- 50 YEAR FUTURE DELELOPMENT LOT
- V - VACANT LOT
- F - FUTURE LOT
- 1ET - TOTAL ET

KEY PLAN: SK008, SK007, SK005, SK006

**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY: P.S. SOLUTIONS

Pressure Sewer Solutions Pty Ltd
Unit 1/47-51 Lorraine Street
Peakhurst NSW 2210
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| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

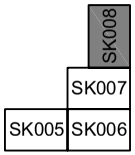
TITLE: PRESSURE SEWERAGE SCHEME
50 YEARS LOTS SEWAGE LOADING
SHEET 1 OF 4

DRG No. 111007-SK005

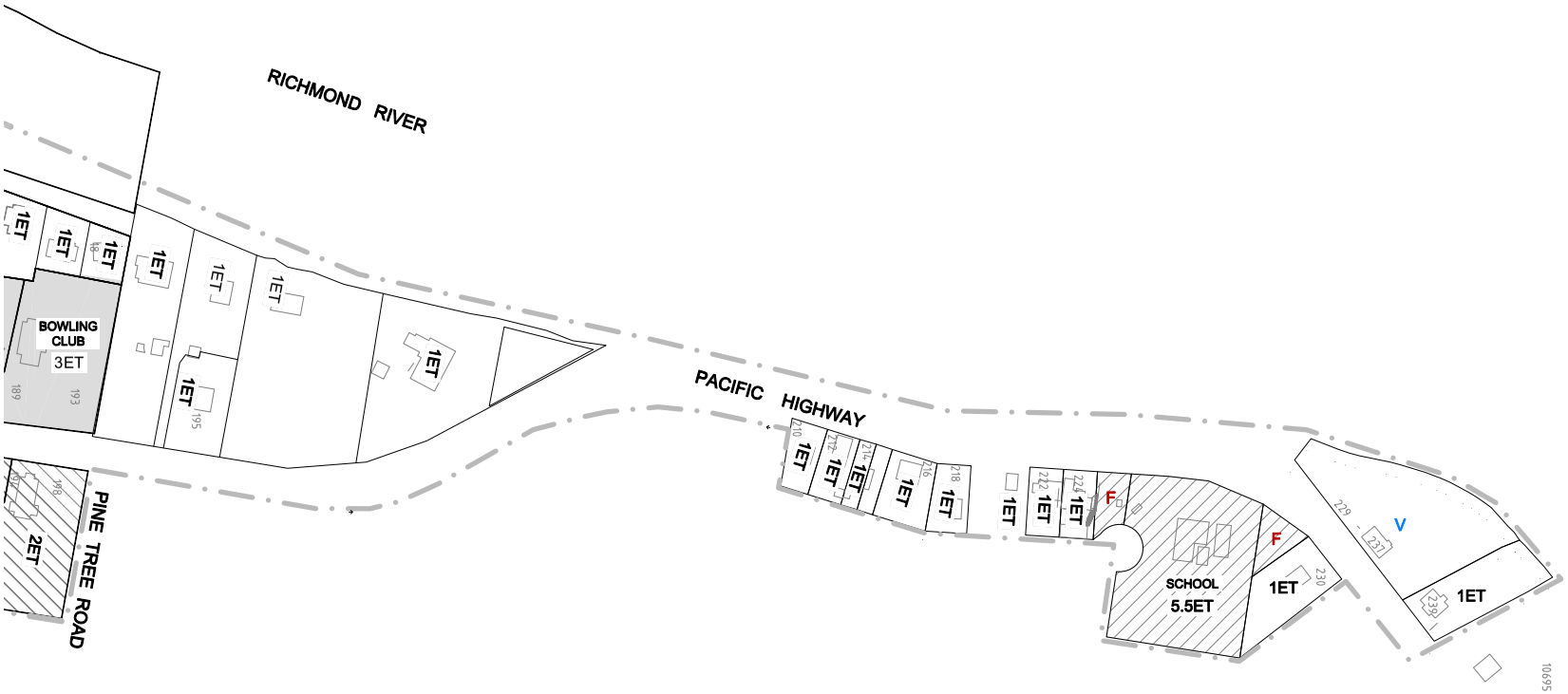
REV A

**LEGEND:**

- SCHEME BOUNDARY
- EXISTING MULTIPLE ET'S LOT
- 50 YEAR FUTURE DELELOPMENT LOT
- V - VACANT LOT
- F - FUTURE LOT
- 1ET - TOTAL ET




KEY PLAN




**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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www.pssolutions.net.au

| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

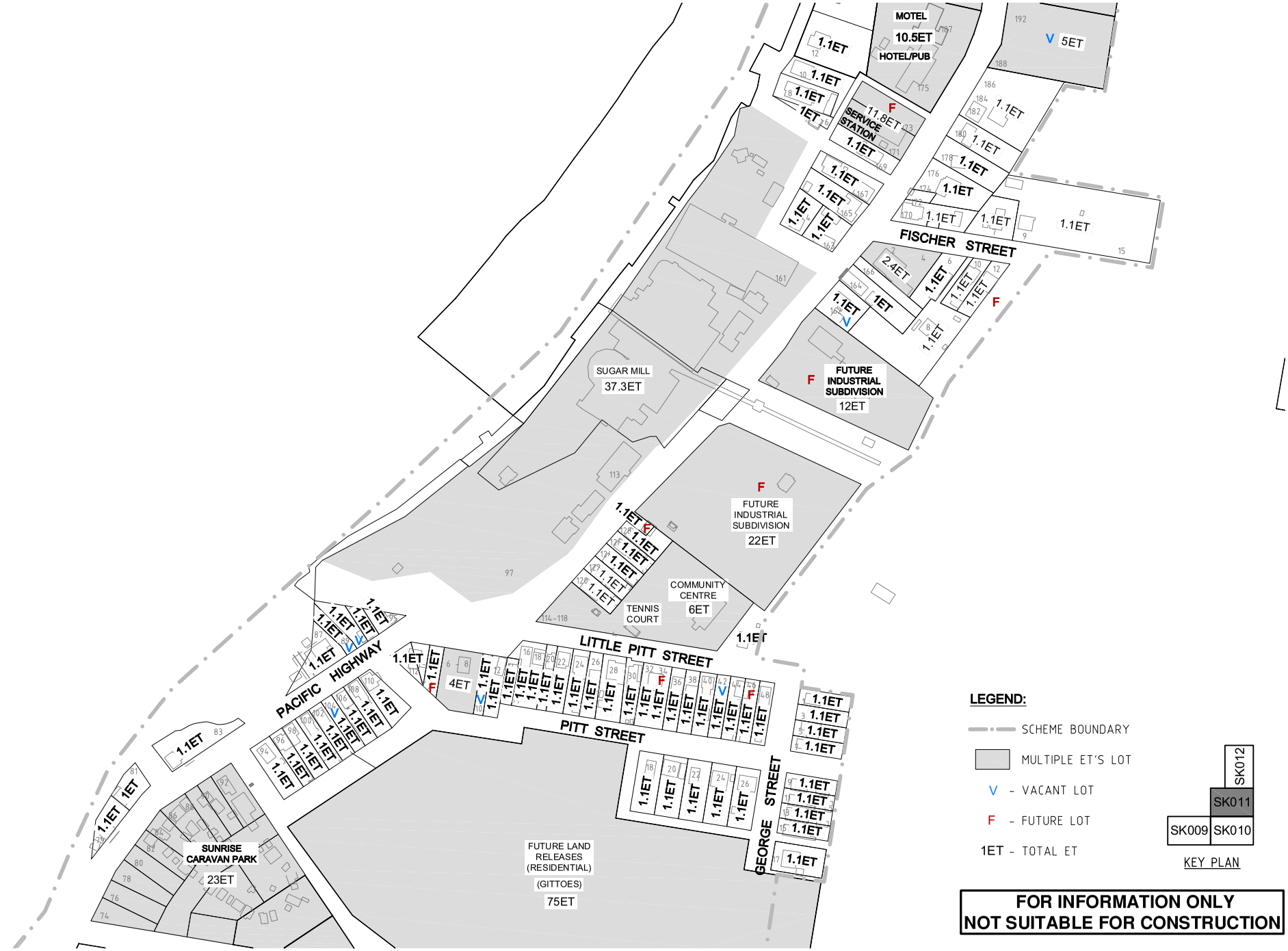
SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:
CLIENT: RICHMOND VALLEY COUNCIL
PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
50 YEARS LOTS SEWAGE LOADING
SHEET 4 OF 4

DRG No. 111007-SK008
REV A

# Appendix F – Ultimate Loading Allocations






| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| B | GITTOES FUTURE SITE ADDED | SW | 12/01/12 |
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

Pressure Sewer Solutions Pty Ltd
Unit 1/47-51 Lorraine Street
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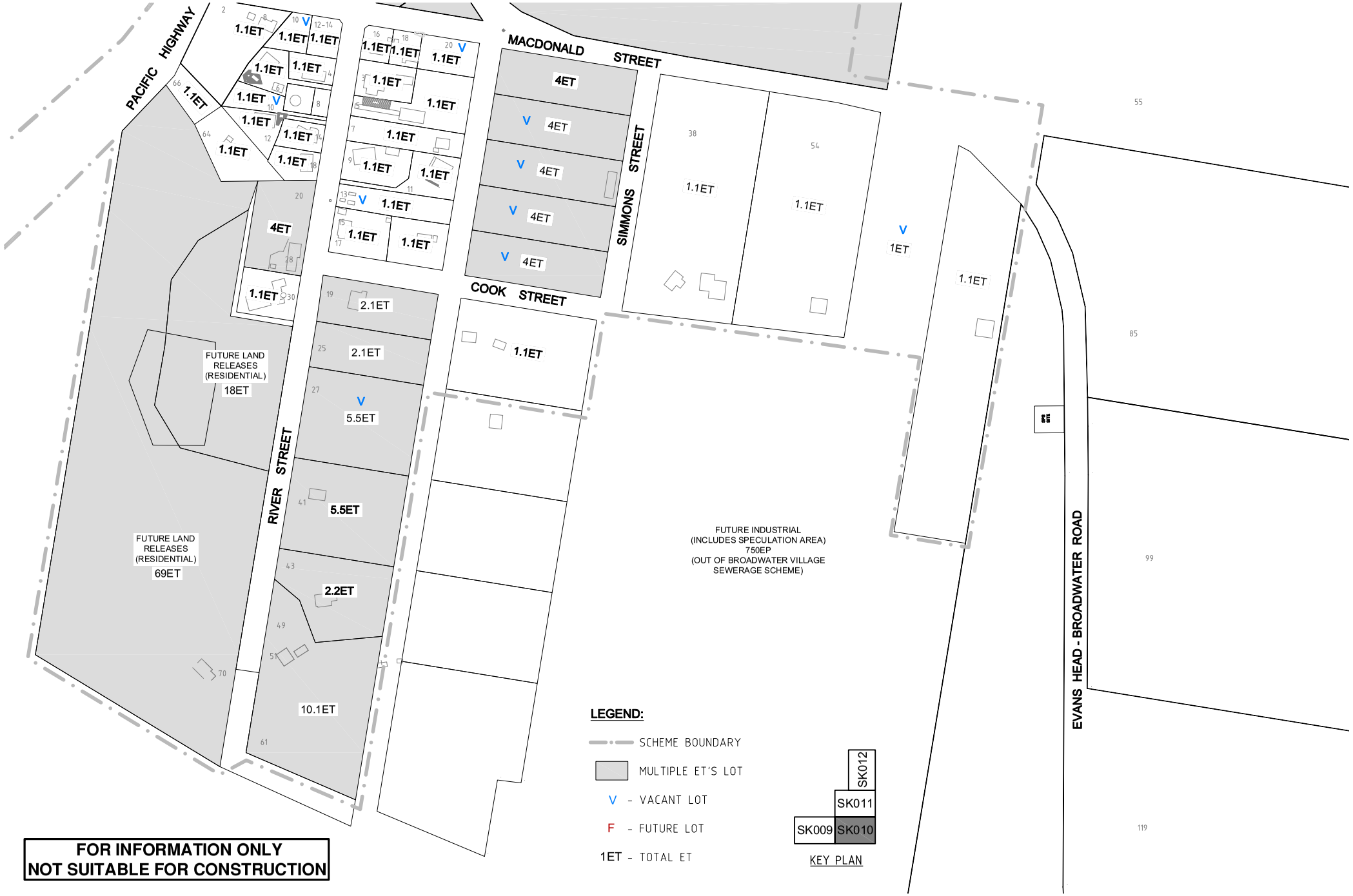
| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:
CLIENT: RICHMOND VALLEY COUNCIL
PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
ULTIMATE LOTS SEWAGE LOADING
SHEET 3 OF 4

DRG No. 111007-SK011
REV B




**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| B | GITTOES FUTURE SITE ADDED | SW | 12/01/12 |
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

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| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

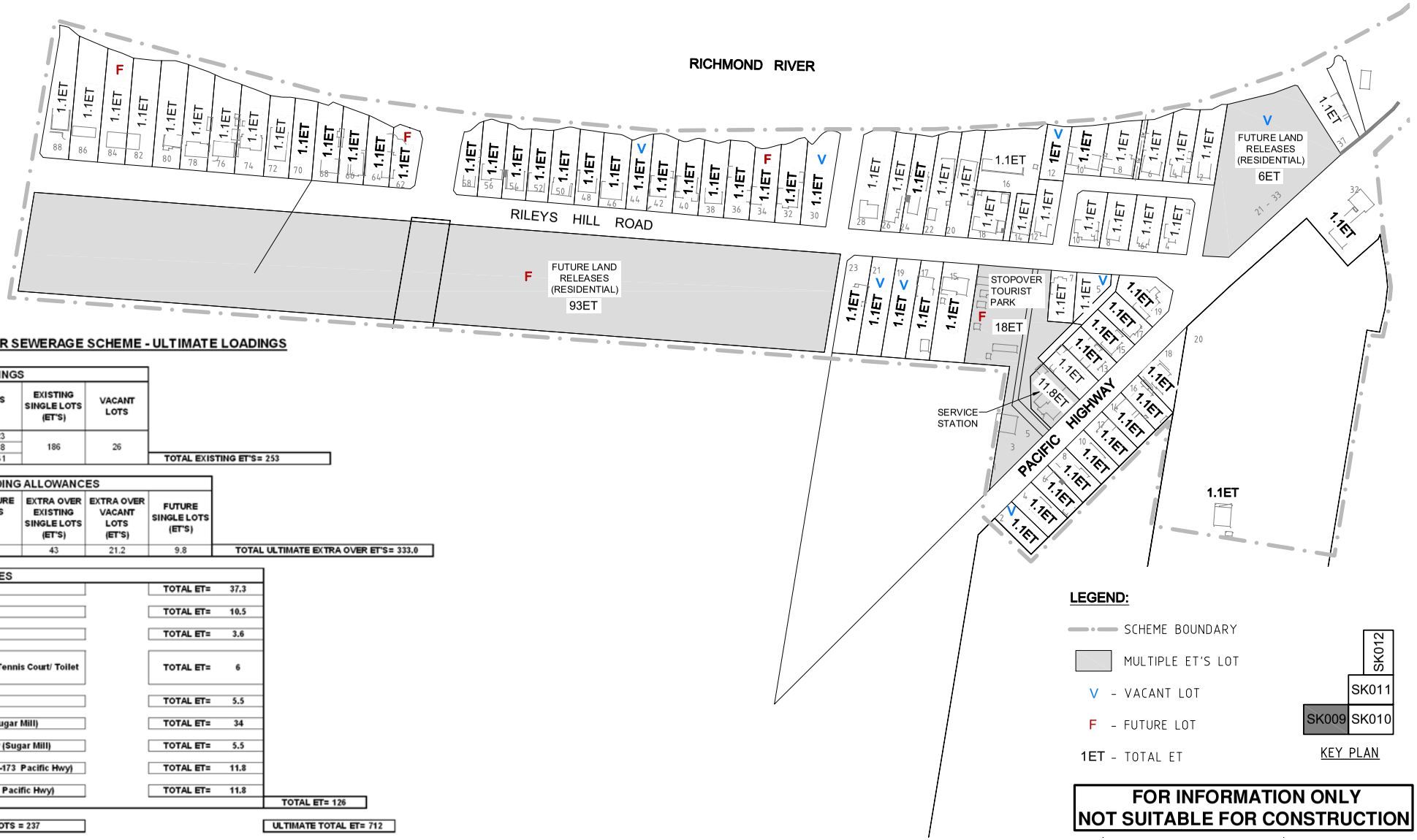
CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
ULTIMATE LOTS SEWAGE LOADING
SHEET 2 OF 4

DRG No. 111007-SK010

REV B




## BROADWATER SEWERAGE SCHEME - ULTIMATE LOADINGS

### EXISTING LOADINGS

| CARAVAN PARKS (ET'S) | | EXISTING SINGLE LOTS (ET'S) | VACANT LOTS | |
|---|---|---|---|---|
| Sunrise | 23 | 186 | 26 | |
| Stopover | 18 | | | |
| Total | 41 | | | TOTAL EXISTING ET'S= 253 |

### ULTIMATE LOADING ALLOWANCES

| EXTRA OVER FUTURE LAND RELEASES (RESIDENTIAL) (ET'S) | EXTRA OVER EXISTING SINGLE LOTS (ET'S) | EXTRA OVER VACANT LOTS (ET'S) | FUTURE SINGLE LOTS (ET'S) | |
|---|---|---|---|---|
| 259 | 43 | 21.2 | 9.8 | TOTAL ULTIMATE EXTRA OVER ET'S= 333.0 |

### OTHER KEY SITES

| | | |
|---|---|---|
| Sugar Mill | TOTAL ET= | 37.3 |
| Hotel/Pub & Motel | TOTAL ET= | 10.5 |
| Bowling Club | TOTAL ET= | 3.6 |
| Community Centre/Tennis Court/ Toilet | TOTAL ET= | 6 |
| School | TOTAL ET= | 5.5 |
| Village Industrial (Sugar Mill) | TOTAL ET= | 34 |
| 195 Pacific Highway (Sugar Mill) | TOTAL ET= | 5.5 |
| Service Station (171-173 Pacific Hwy) | TOTAL ET= | 11.8 |
| Service Station (7-9 Pacific Hwy) | TOTAL ET= | 11.8 |
| | | TOTAL ET= 126 |

ULTIMATE TOTAL LOTS = 237

ULTIMATE TOTAL ET= 712

**LEGEND:**

- SCHEME BOUNDARY
- MULTIPLE ET'S LOT
- V - VACANT LOT
- F - FUTURE LOT
- 1ET - TOTAL ET

KEY PLAN

SK012 / SK011 / SK009 / SK010

**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| B | GITTOES FUTURE SITE ADDED | SW | 12/01/12 |
| A | CONCEPT APPROVAL | SW | 16/11/11 |

SIZE A1

DESIGN BY:

Pressure Sewer Solutions Pty Ltd
Unit 1/47-51 Lorraine Street
Peakhurst NSW 2210
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E: admin@pssolutions.net.au
www.pssolutions.net.au

| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:500 AT A1

HYDRAULIC OUTPUT:

CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

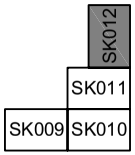
TITLE: PRESSURE SEWERAGE SCHEME
ULTIMATE LOTS SEWAGE LOADING
SHEET 1 OF 4

DRG No. 111007-SK009

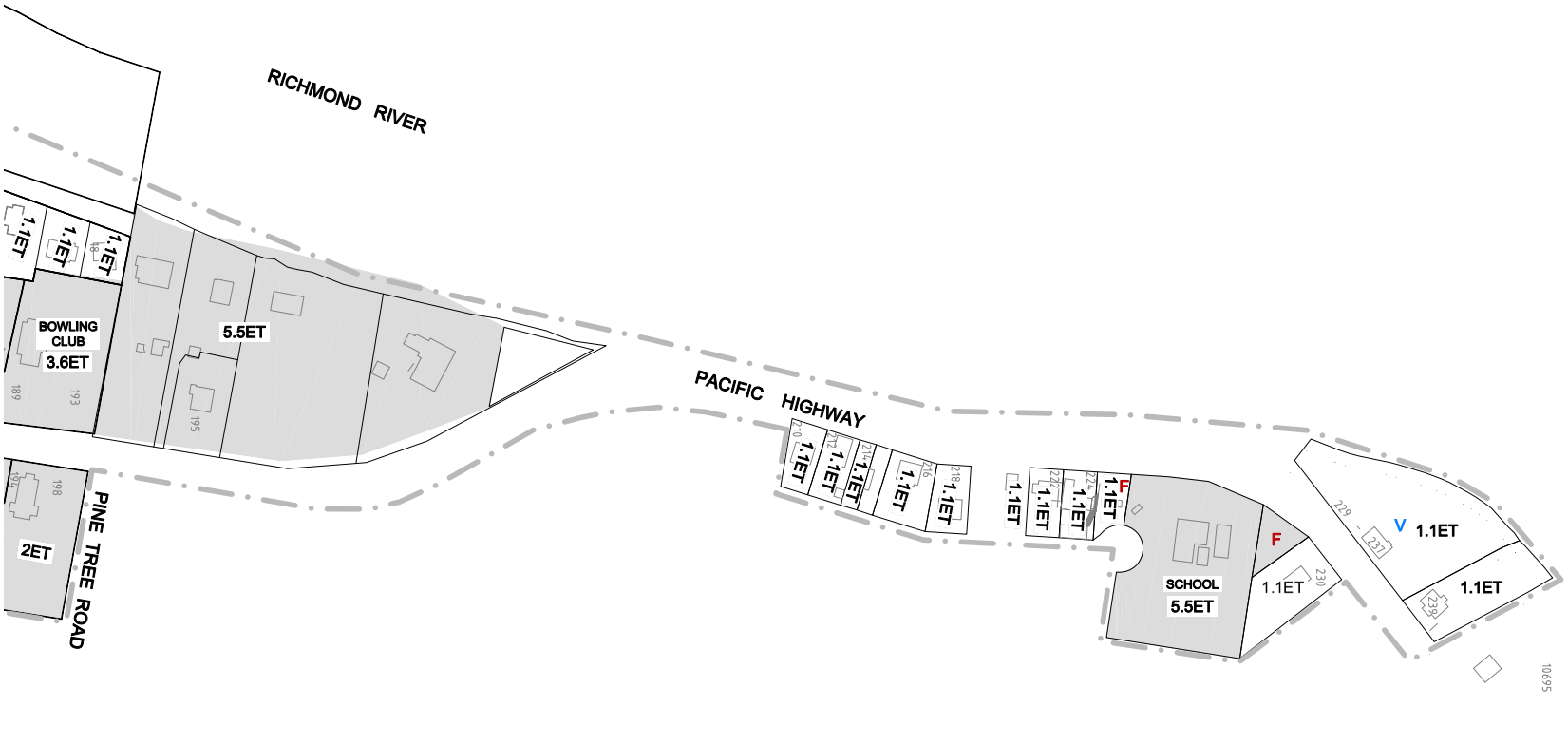
REV B

**LEGEND:**

- SCHEME BOUNDARY
- MULTIPLE ET'S LOT
- V - VACANT LOT
- F - FUTURE LOT
- 1ET - TOTAL ET




KEY PLAN




**FOR INFORMATION ONLY**
**NOT SUITABLE FOR CONSTRUCTION**



| REV | DESCRIPTION | BY | DATE |
|---|---|---|---|
| A | CONCEPT APPROVAL | SW | 10/11/11 |

SIZE A1

DESIGN BY:

Pressure Sewer Solutions Pty Ltd
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| | | | |
|---|---|---|---|
| DRAWN | SR | DATE | 03/06/11 |
| CHECKED | RRS | DATE | 03/06/11 |
| APPROVED | SW | DATE | 03/06/11 |

SCALE 1:1500 AT A1

HYDRAULIC OUTPUT:

CLIENT: RICHMOND VALLEY COUNCIL

PROJECT: BROADWATER SEWERAGE SCHEME

TITLE: PRESSURE SEWERAGE SCHEME
ULTIMATE LOTS SEWAGE LOADING
SHEET 4 OF 4

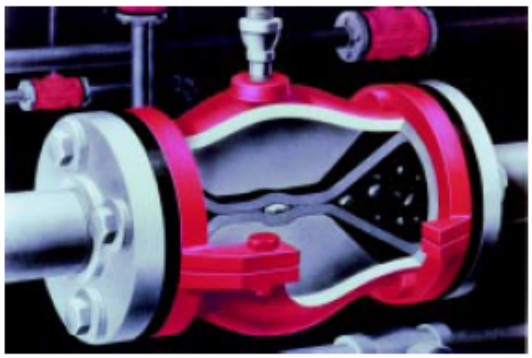
DRG No. 111007-SK012

REV A

# Appendix G – Pinch Valve Details

# Type A Pinch Valve

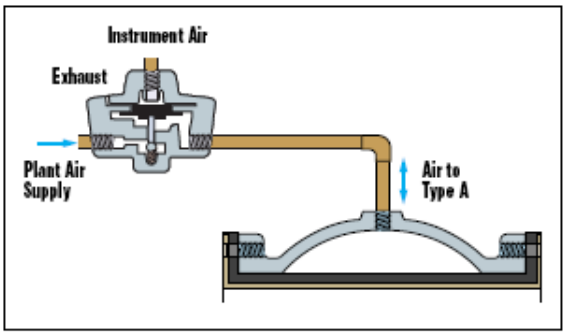
- Closes drop-tight on entrapped solids
- Body functions as built-in actuator
- No cavities or dead spots to bind valve operation
- Full-port, double-wall or cone sleeve trim
- Simple design not affected by harsh external environments
- No packing to replace or maintain, ever
- Cost effective, maintenance free



## Materials of Construction

- Cast iron or aluminum body
- Sleeves available in Pure Gum Rubber, Neoprene, Hypalon®, Chlorobutyl, Buna-N, EPDM and Viton®
- ANSI Class 125/150, 250/300

### Controlling a Type A with a Proportional Relay




Red Valve recommends an adjustable relay (as opposed to a fixed, proportional relay).

Introduced and patented by Red Valve, the air-actuated Type A Pinch Valve offers a unique, cost-effective solution to flow control problems. More Red Valve Type A Valves are in use than any other pinch valve throughout the world. The secret is in the rubber sleeve – the valve's only wetted part.

Actuation of the valve, the pinching action, is accomplished by air or hydraulic pressure placed on the sleeve. The valve body acts as a **built-in actuator**, eliminating costly pneumatic, hydraulic or electric actuators. Modulating the air pressure within the annular space between the body and the sleeve can open, throttle or close the valve. Approximately 35 psi over line pressure is required for closure.

The sleeve's flexibility allows the valve to close drop-tight around entrapped solids, eliminating hang-ups that could damage the valve. The sealing area is equal to 95 percent of the valve's length. There are no seats or packing to replace and no cavities or dead spots to collect debris and bind valve operation. The Type A Valve's abrasion resistance is unmatched. When the valve is open, it operates like a straight piece of pipe in the line. Type A Valves are used on remote locations or harsh environments since there are no external links, levers, pistons or rotating parts to cause downtime.

### Control

Throttling control is accomplished by using a booster or proportional relay to modulate air pressure to the Type A Valve. A changing air signal through the proportional relay will modulate the Type A Valve.

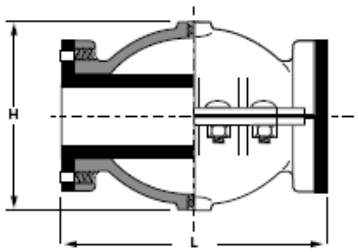
### Type A Double Wall

Designed for highly abrasive applications, the Type A Double-Wall Sleeve Valve outlasts even stellited V-Ball valves and metal-seated valves on abrasive slurries. To compensate for the extra sleeve thickness, the valve body is increased to the next size.

### Type A Cone

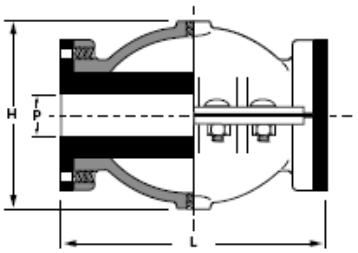
Type A Cone Sleeve Valves are designed specifically for throttling control applications. The $C_V$ of the valve can be matched to any requirement by reducing the port at the center of the sleeve. The port reduction is maintained through the downstream half of the sleeve for increased wear resistance, and, since pressure recovery occurs downstream of the valve, cavitation is minimized.

# Type A – Full Port



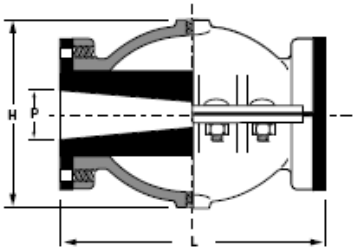

| VALVE SIZE | LENGTH L | HEIGHT H | WORKING PRESSURE psi | WEIGHT CAST IRON lbs | AIR VOLUME ft³ | AIR INLET NPT |
|---|---|---|---|---|---|---|
| 1/2" | 3" | 3-1/2" | 150 | 5 | .002 | 1/4" |
| 3/4" | 4" | 3-3/4" | 150 | 7 | .002 | 1/4" |
| 1" | 5" | 4-1/4" | 150 | 9 | .002 | 1/4" |
| 1-1/2" | 7" | 5" | 150 | 17 | .007 | 1/4" |
| 2" | 9" | 6-1/2" | 150 | 32 | .016 | 1/4" |
| 2-1/2" | 10" | 7" | 150 | 40 | .028 | 1/4" |
| 3" | 12" | 8" | 150 | 55 | .049 | 1/4" |
| 4" | 12-1/2" | 10-5/8" | 150 | 85 | .091 | 1/4" |
| 5" | 16-1/2" | 11-1/2" | 150 | 119 | .187 | 1/4" |
| 6" | 20" | 13" | 150 | 166 | .327 | 1/4" |
| 8" | 22" | 16-1/4" | 125 | 235 | .640 | 1/4" |
| 10" | 24" | 21" | 100 | 425 | 1.09 | 1/4" |
| 12" | 26" | 24" | 100 | 640 | 1.70 | 1/4" |
| 14" | 30" | 22" | 75 | 780 | 2.39 | 1/4" |
| 16" | 34" | 29-1/2" | 75 | 910 | 3.59 | 1/4" |
| 18" | 39" | 30-1/2" | 50 | 1,275 | 5.27 | 3/4" |
| *20" x 24" | 43" | 31" | 50 | 1,704 | 7.25 | 1" |
| *24" x 28" | 51" | 38-1/2" | 50 | 2,100 | 12.5 | 1" |

# Type A – Double Wall




| VALVE SIZE | PORT SIZE P | LENGTH L | HEIGHT H | WORKING PRESSURE psi | WEIGHT CAST IRON lbs | AIR INLET NPT |
|---|---|---|---|---|---|---|
| 1" | 1/2" | 5" | 4-1/4" | 150 | 11 | 1/4" |
| 2" | 1" | 9" | 6-1/2" | 150 | 33 | 1/4" |
| 2-1/2" | 1-1/2" | 10" | 7" | 150 | 42 | 1/4" |
| 3" | 2" | 12" | 8" | 150 | 57 | 1/4" |
| 4" | 2-1/2" | 12-1/2" | 10-5/8" | 150 | 88 | 1/4" |
| 4" | 3" | 12-1/2" | 10-5/8" | 150 | 88 | 1/4" |
| 5" | 4" | 16-1/2" | 11-1/2" | 150 | 123 | 1/4" |
| 6" | 5" | 20" | 13" | 150 | 171 | 1/4" |
| 8" | 6" | 22" | 16-1/4" | 125 | 239 | 1/4" |
| 10" | 8" | 24" | 21" | 100 | 432 | 1/4" |
| 12" | 10" | 26" | 24" | 100 | 648 | 1/4" |
| 14" | 12" | 30" | 22" | 75 | 826 | 1/4" |
| 16" | 14" | 34" | 29-1/2" | 75 | 970 | 1/4" |
| 18" | 16" | 39" | 30-1/2" | 50 | 1,343 | 3/4" |
| *20" x 24" | 18" | 43" | 31" | 50 | 1,800 | 1" |
| *24" x 28" | 20" | 51" | 38-1/2" | 50 | 2,365 | 1" |

# Type A – Cone




| VALVE SIZE | AVAILABLE PORT SIZES P** | LENGTH L | HEIGHT H | WORKING PRESSURE psi | WEIGHT CAST IRON lbs | AIR INLET NPT |
|---|---|---|---|---|---|---|
| 1" | 1/4", 1/2", 3/4" | 5" | 4-1/4" | 150 | 9 | 1/4" |
| 1-1/2" | 3/4", 1", 1-1/4" | 7" | 5" | 150 | 17 | 1/4" |
| 2" | 3/4", 1", 1-1/2" | 9" | 6-1/2" | 150 | 32 | 1/4" |
| 2-1/2" | 1", 1-1/2", 2" | 10" | 7" | 150 | 40 | 1/4" |
| 3" | 1-1/2", 2", 2-1/2" | 12" | 8" | 150 | 55 | 1/4" |
| 4" | 2", 2-1/2", 3" | 12-1/2" | 10-5/8" | 150 | 85 | 1/4" |
| 5" | 2-1/2", 3", 4" | 16-1/2" | 11-1/2" | 150 | 119 | 1/4" |
| 6" | 3", 4", 5" | 20" | 13" | 150 | 166 | 1/4" |
| 8" | 4", 5", 6" | 22" | 16-1/4" | 125 | 235 | 1/4" |
| 10" | 5", 6", 8" | 24" | 21" | 100 | 425 | 1/4" |
| 12" | 6", 8", 10" | 26" | 24" | 100 | 640 | 1/4" |
| 14" | 8", 10", 12" | 30" | 22" | 75 | 810 | 1/4" |
| 16" | 10", 12", 14" | 34" | 29 1/2" | 75 | 940 | 1/4" |
| 18" | 12", 14", 16" | 39" | 30 1/2" | 50 | 1,321 | 3/4" |
| *20" x 24" | 14", 16", 18" | 43" | 31" | 50 | 1,770 | 1" |
| *24" x 28" | 16", 18", 20" | 51" | 38 1/2" | 50 | 2,277 | 1" |

*Valve uses extended flange.
** Other port sizes available – consult factory.

# Appendix H – SRM Water Hammer Analysis Report

# Review of Design

# And

# Waterhammer Analysis

# Broadwater Sewage Pumping Station & Rising Main

# to

# Evans Head STP

Commissioned by Pressure Sewer Systems Pty Ltd
Issue Rev B revised pump size and pipeline material
Prepared by Geoffrey D Stone F I Mech E C. Eng; F I E Aust C.P. Eng
DATE 9TH FEBRUARY 2011

## *Table of Contents*

## TABLE OF FIGURES

## 1 Brief:

Pressure Sewer Systems Pty Ltd provided the GHD report of a new pump station and rising main connecting Broadwater SPS to Evans Head STP. A waterhammer analysis was required to verify the selection of pumps and pipeline material to meet Council's requirements. In addition a review of the design criteria was requested in order that Council can provide guidance to Tenderers to achieve conformity of offers.

A hydraulic analysis was undertaken on the following scenarios:

1. Steady state analysis to confirm pump selection
2. Pump trip due to loss of power
3. Analysis of pipeline with DN150 PN16 SDR 37 PVC-O

A review was undertaken to provide:-

1. Recommend surface roughness (K) and SRM velocity
2. De rating assessment of the SRM material
3. SRM drain down options

Refer to revision A of this report for details of the study into different materials, pump options and the DN100 pipeline.

## 2 Summary

The following points summarize the findings of this analysis:-

1. AS4441 PVC-O SDR37 PN16 is the material selected for this project. The derated design pressure for this material based on 10million cycles is 800kPag.
2. A surface roughness of 0.01mm minimum and 0.3mm maximum is recommended to be specified for the range of hydraulic conditions.
3. De-rating of the pipeline material depends upon the estimated pressure cycles (fatigue) and temperature..
4. SRM drain down operations is consistent with current design practices.
5. A flanged nozzle at section valves is recommended for pigging/swabbing operations.
6. The flow rate and pipe diameter provides the necessary scouring velocity
7. Upon pump stop section Ch1869 to Ch2300m will drain down. Upon start up this odourous air will need to be evacuated or it may cause hydraulic blockages as it travels down the pipeline.

# 3 The Report

## *3.1 Hydraulic Analysis*

### 3.1.1 Hydraulic Analysis Software

The models were created and analysed using AFT's Impulse version 4.0 dated 12/01/2012. Centrifugal pump selection was made using ITT Flygt's Flyps 3.1 dated March 2010.

Further data can be found at www.aft.com & www.flygt.com.au

For the steady and unsteady state AFT uses the Darcy Wiesbach friction factor. This has the added accuracy of taking into account the variation of Reynolds number in determining head loss due to friction. This method is preferred in the WSA 04 Sewage Pumping Stations Code.

Data from AS 2280-2004 & Tyco Water was used for DICL at the pumping station. This was based on Class 35.

Data from AS 4441 & Iplex Pipelines PVC-O handbook was used for the PVC-O.

### 3.1.2 Data

The pipeline profile was provided on drawings 22-13370-W001 to 013 rev 3. Pumping station details are from NU Pumps PPS 2250/06 although it is understood that this is a typical pump station only.

Data from the Flyps program such as head vs. flow and moment of inertia was directly input into the AFT Impulse model for transients involving loss of power.

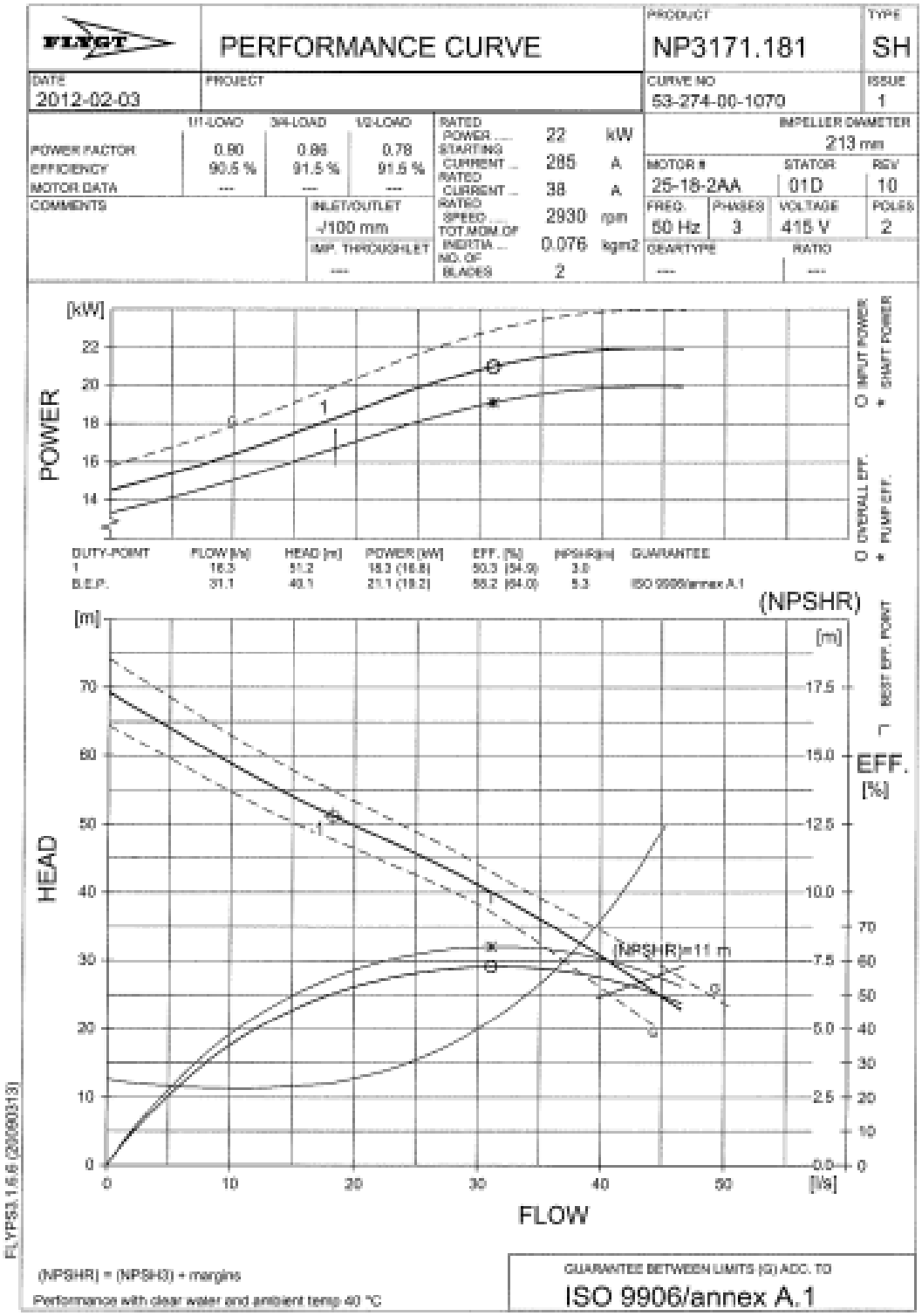



**Figure 1 Flygt Pump Curve NP3171.181SH**

Water was assumed to be at 25ºC for the analysis.

Air release valves were shown on the pipeline as type 1 & 2. However DN50 Ventomat type RGx valves were used in the analysis for type 1. Type 2 are manual valves and are only used for line fill and scour.

## *3.2 Steady State Analysis*

### 3.2.1 System Schematic

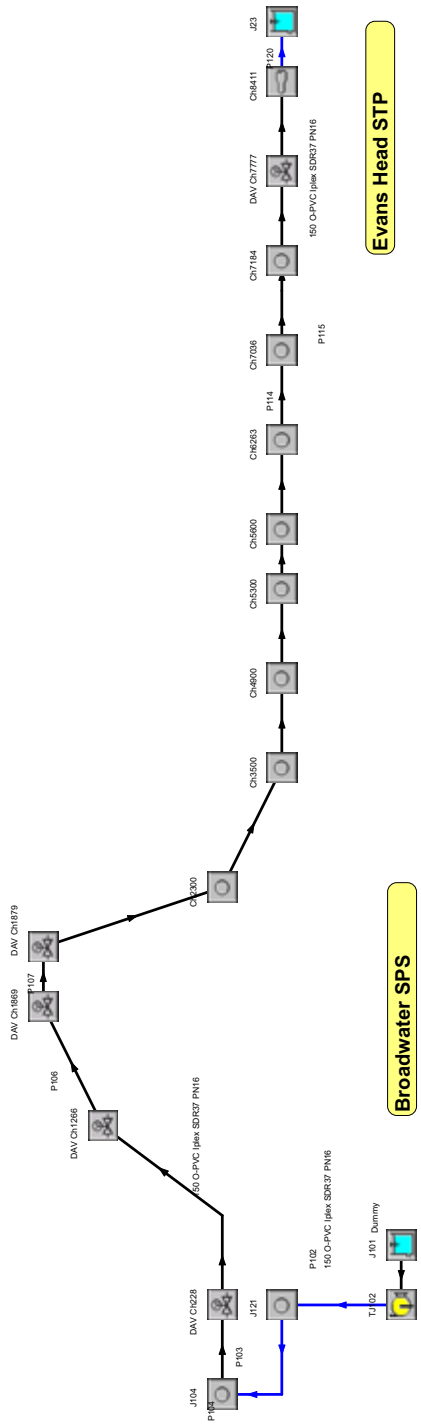



**Figure 2 System Schematic**

### 3.2.2 Normal Operation Pump

The system is based upon DN150 SDR37 PN16 PVC-O. From the graphs below the HGL is above the pipeline elevation.

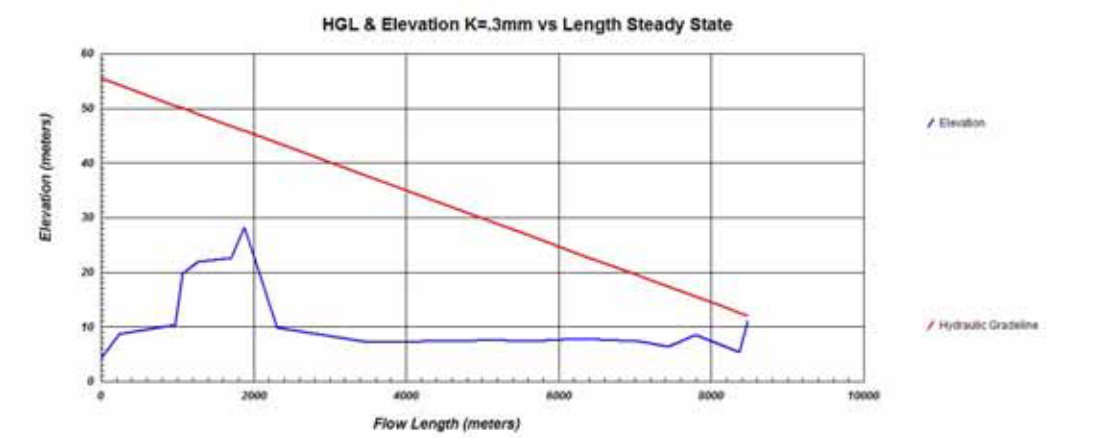



**Figure 3 HGL & Elevation K=.3mm versus Length Steady State**

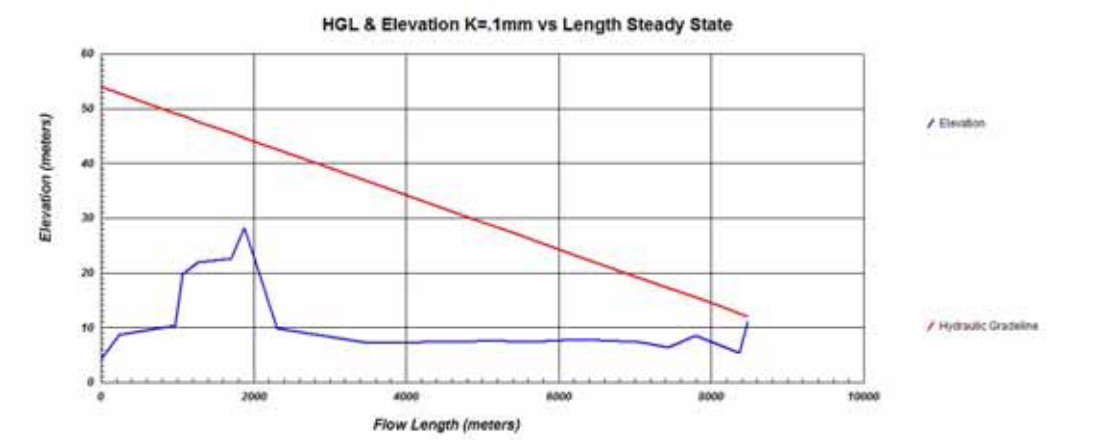



**Figure 4 HGL & Elevation K=.1mm vs Length Steady State**

The steady state summary below shows there is very little difference between the estimated pipe roughness values of K=0.1 and K-0.3.

**Table 1 Steady State Summary**

| K mm | Q L/s | ΔH m | Efficiency % | Power kW | Velocity m/s |
|---|---|---|---|---|---|
| .01 | 21.7 | 48.34 | 53.54 | 19.15 | 0.98 |
| 0.1 | 20.21 | 49.75 | 52.05 | 18.86 | 0.91 |
| 0.3 | 18.6 | 51.26 | 50.25 | 18.54 | 0.84 |
| 0.6 | 17.43 | 52.36 | 48.71 | 18.31 | 0.79 |

Velocity in the pipeline is 0.84 -0.91m/s. This is greater than the minimum scour velocity of 0.6m/s. WSA03 3.2.5.4 nominates a range of 0.8 to 1.4m/s for economic velocities in a rising main. WSA 02 4.5.7.1 nominates a velocity of 0.7m/s for cleansing of grit and debris. Thus the pipe diameter and flow rate are consistent with this design philosophy.

### 3.2.3 Unsteady State

The system modelling is reported with a surface roughness of 0.3mm. Other values of K were modelled but he results were not very different and thus are not reported.

The maximum pressure shown in the DN150 SDR37 PN16 PVC-O system is the steady state pressure of ~500kPag. This is less than the de-rated pressure class of PN16 for the design life, temperature and anticipated number of pressure cycles. This varies from 800 to 880kPag depending upon the number of cycles (10 million to 5 million). There is little difference between the graphs for K = 0.1 mm & 0.3 mm.

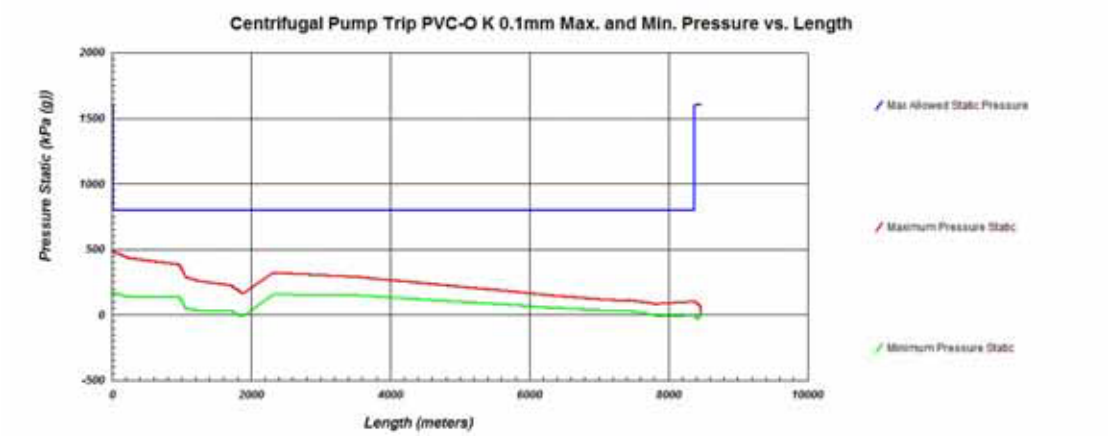



**Figure 5 Centrifugal Pump Trip PVC-O K 0.1mm Maximum and Minimum Pressure vs. Length**

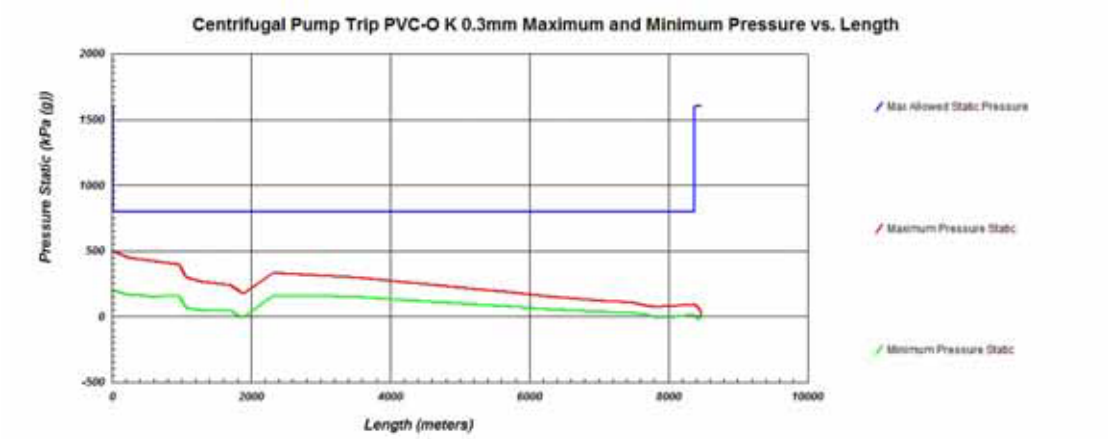



**Figure 6 Centrifugal Pump Trip PVC-O K 0.3mm Maximum and Minimum Pressure vs. Length**

### *3.3 SRM Pump Stop Effect on Pipeline*

Due to the topography when the pump stops the section of SRM from the high point Ch1869 to ~2230m will drain. Air will be drawn into the SRM through the automatic air valve at Ch1869m. Upon pump start up this section of 360m of line will contain 8,000L of air. To evacuate this air through and air release valve would take ~7.5minutes at 18L/s. The number of pump starts is given as 5 to 6 starts per hour.

### *3.4 Selection of Pipe Material*

***3.5*** PVC-O SDR37 PN16 DN150 has been nominated as the preferred material. This material has an inside diameter = 167.9mm with a wall thickness of 4.9mm. The

modulus of the material used in the analysis = 4200MPa. This was advised by Iplex by email.

### *Variable Frequency Drives*

VFD drives have been adopted for this project. This could be for protection of the electrical supply. The benefit is that the starting of the pumps can be configured so that there are no pressure transients on normally starting and stopping of pumps. Thus the number of pressure cycles can be reduced.

### *3.6 SRM Surface Roughness*

Thermoplastic materials are quoted to have a wide variation of surface roughness dimensions. For new pipe the manufacturers state a K dimension of 0.01mm. For aged pipe WSA standards vary somewhat. WSA 02 for sewer gravity mains uses a factor of 1.5mm. WSA02 refers to WSA 03 for rising mains. WSA03 3.2.5.3 suggests that K =0.25-0.3mm should apply.

Experience has shown with thermoplastic pipes that surface roughness of 0.3mm is conservative for pumped systems where the average velocity is > 1.0m/s. This results in a conservative selection of motor power.

The steady state section of this report indicates that there is little hydraulic variation between a K=0.1mm and K=0.3mm. Variation in diameter has a greater impact than surface roughness.

There is a need to be diligent in monitoring the dimensions of thermoplastic pipe materials. The cost of resin and energy encourages manufacturers to produce with the thinnest wall possible of thermoplastic pipes. This is feasible for long extrusion runs and modern manufacturing and measuring equipment. When thicker wall pipes are substituted because of stock levels or manufacturing strategies this can dramatically affect the hydraulic design. This is unlikely in this project because the length of runs is considerable and the pipe material recommended is a preferred size and class.

### *3.7 Pipeline De-rating*

WSA04 defers to WSA 03 for the design of a rising main in respect of material de-rating. WSA03 Table 3.2 provides fatigue de-rating factors. The design de-rating factors below is based upon the pump starting and stopping 6 times an hour. With a design life of 100years this results in 10million cycles. For a 50 year design life the number of cycles is 5million.

For the centrifugal pump solution the number of pressure cycles defined by WSA04 based on a minimal sized pump station would be 4,380.000. This equates to 10 starts per hour.

WSA03 Table 3.3 provides data for the de-rating due to temperature considerations. For a temperature of 25° for the PVC-O the de-rating factor is 0.55 & O.5 for 5 & 10 million cycles respectively. This equates to design ratings of Iplex PN16 PVC-O of 880 & 800kPag respectively.

### *3.8 SRM Drainage Options*

Scour points are located at low points on the SRM. Additional scour points are not recommended. What may be advantageous is the provision of points at the section valves of a flange to enable the insertion of a sponge ball or spherical pig. This could

be used to scour or de-slime the pipeline if required over the longer term. This provision should be in conformity to Council's normal mode of operation.

### *3.9 Air Valves*

Air valves have been located in places that are considered traditional for an SRM. Manual valves have been adopted at points for the fill and scour of the pipeline and are nominated as Type 2. Automatic air valves, nominated as Type 1, have been located at Ch 228, 1266, 1266, 1869, 1879 & 7777m.

Modelling with the air valve at Ch1879m indicates that this is not required for surge mitigation purposes.

Upon pump stop section Ch1869 to Ch2300m will drain down. Upon start up this odourous air will need to be evacuated or it may cause hydraulic blockages as it travels down the pipeline. It is recommended that an automatic air valve is added at this point to avoid a considerable amount of air progressing down the pipeline. Such air may cause hydraulic blockages.

DN50 Ventomat RGx type air valves are recommended. During the surge analysis it was apparent that the air valves did not operate under pump trip conditions. Thus they are only required for pump start, fill and drainage of the SRM. Sizing and location of air valves is outside the scope of this review.

## 4 Conclusions

The following conclusions are drawn from this review:-

1 AS4441 PVC-O SDR37 PN16 is the material selected for this project. The derated design pressure for this material based on 10million cycles is 800kPag
2 A surface roughness of 0.01mm minimum and 0.3mm maximum is recommended to be specified for the range of hydraulic conditions.
3 De-rating of the pipeline material depends upon the estimated pressure cycles (fatigue) and temperature. The fatigue is related to the type of pump operation.
4 SRM drain down operations is consistent with current design practices.
5 A flanged nozzle at section valves is recommended for pigging/swabbing operations.
6 The flow rate and pipe diameter provides the necessary scouring velocity
7 Upon pump stop section Ch1869 to Ch2300m will drain down. Upon start up this odourous air will need to be evacuated or it may cause hydraulic blockages as it travels down the pipeline.

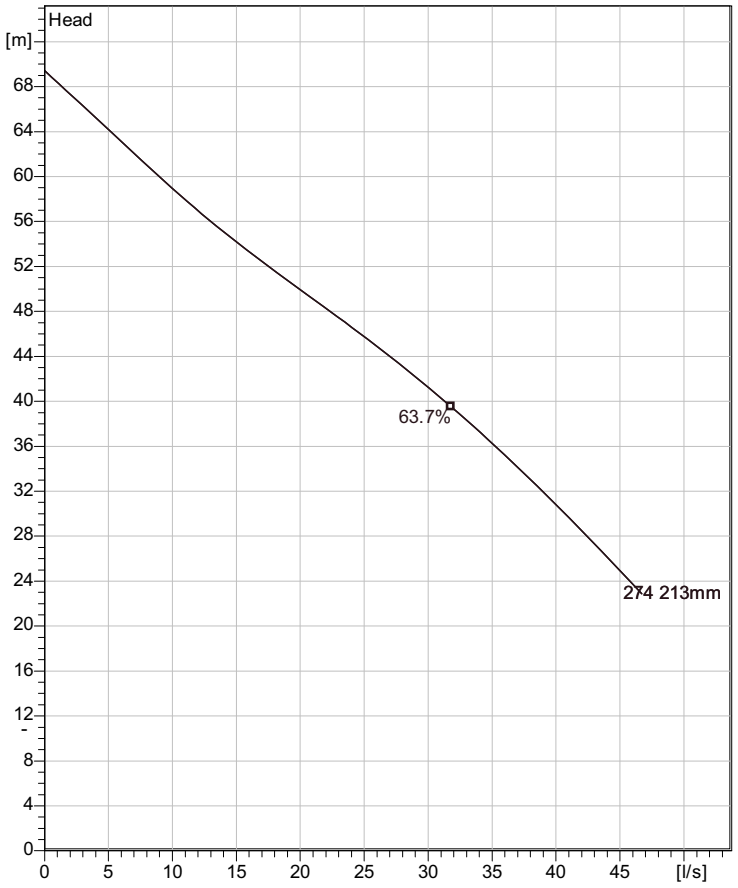
## 5 Recommendations for Mitigation Devices

Add DN50 Ventomat air valve at Ch2300m

# Appendix I – SPS Selected Pumps

# NP 3171 SH 3~ 274

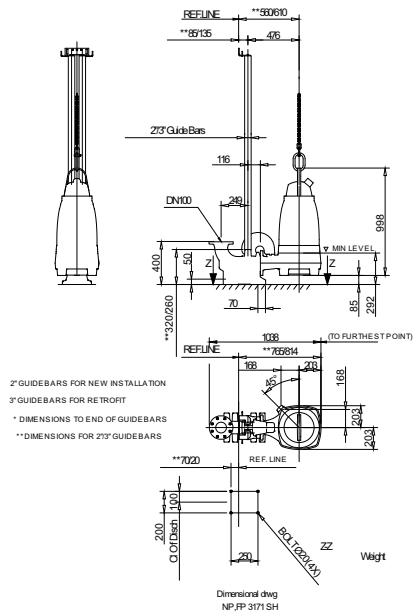
## Technical specification




*Curve according to: ISO 9906*

*Note: Picture might not correspond to the current configuration.*

**Installation: P - Semi permanent, Wet**




### General

Patented self cleaning semi-open channel impeller, ideal for pumping in most waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

### Impeller

| | |
|---|---|
| Impeller material | Grey cast iron |
| Outlet width | 100 mm |
| Inlet diameter | 150 mm |
| Impeller diameter | 213 mm |
| Number of blades | 2 |
| Throughlet diameter | |

### Motor

| | |
|---|---|
| Motor # | N3171.181 25-18-2AA-W 22KW |
| Stator variant | |
| Frequency | 50 Hz |
| Rated voltage | 415 V |
| Number of poles | 2 |
| Phases | 3~ |
| Rated power | 22 kW |
| Rated current | 38 A |
| Starting current | 285 A |
| Rated speed | 2930 1/min |
| Power factor | |
| 1/1 Load | 0.90 |
| 3/4 Load | 0.86 |
| 1/2 Load | 0.78 |
| Efficiency | |
| 1/1 Load | 90.5 % |
| 3/4 Load | 91.5 % |
| 1/2 Load | 91.5 % |

### Configuration

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| **Ledonne Constructions** | **Broadwater SPS** | | **2011-11-29** | **2011-11-30** |

# NP 3171 SH 3~ 274

## Performance curve

### Pump

| | |
|---|---|
| Outlet width | 100 mm |
| Inlet diameter | 150 mm |
| Impeller diameter | 213 mm |
| Number of blades | 2 |
| Throughlet diameter | |

### Motor

| | |
|---|---|
| Motor # | N3171.181 25-18-2AA-W 22KW |
| Stator variant | |
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| Power factor | |
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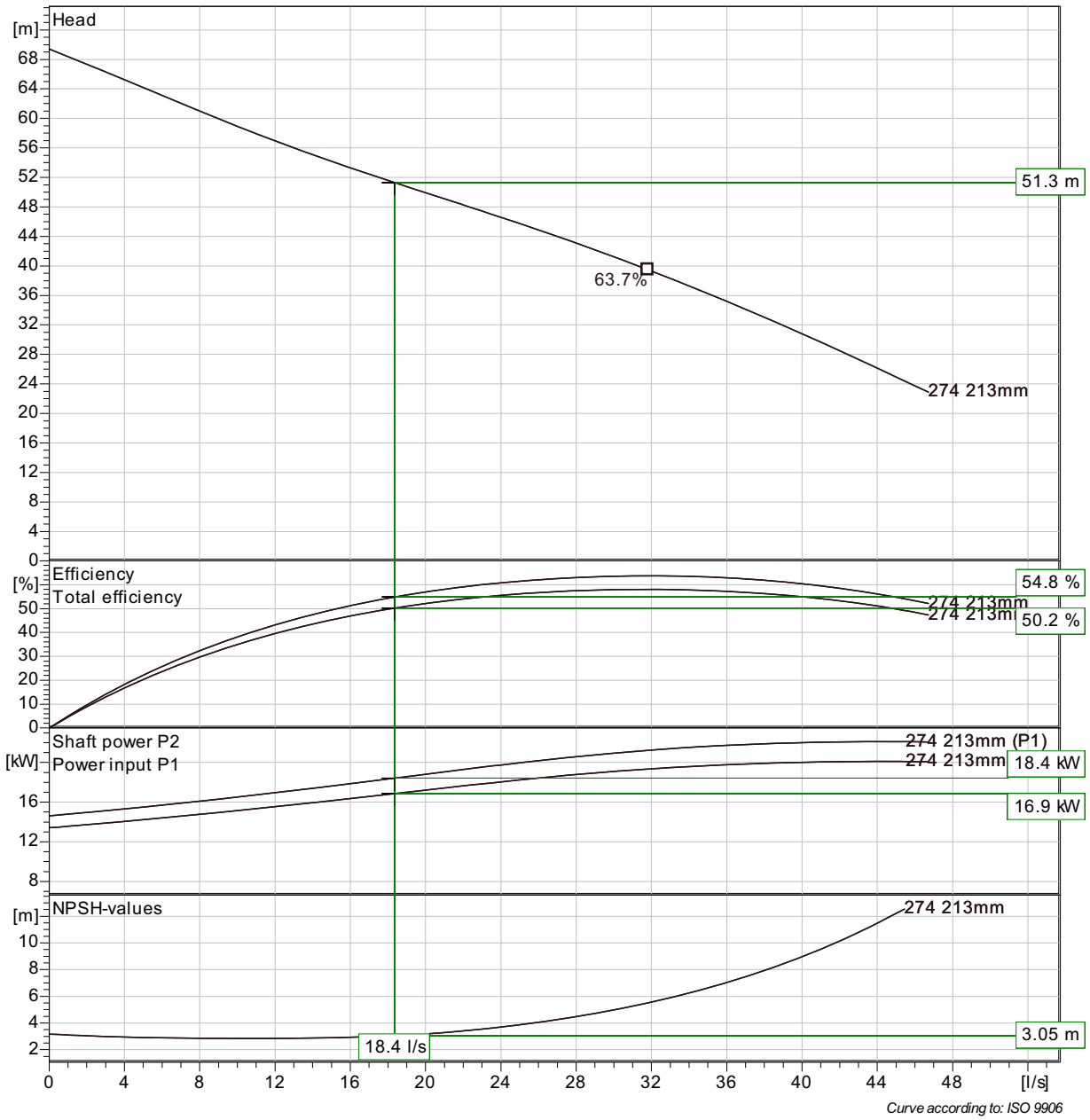
| 1/1 Load | 0.90 |
| 3/4 Load | 0.86 |
| 1/2 Load | 0.78 |
| **Efficiency** | |
| 1/1 Load | 90.5 % |
| 3/4 Load | 91.5 % |
| 1/2 Load | 91.5 % |




*Curve according to: ISO 9906*

**Duty point**

| Flow | Head | Shaft power | NPSHre | Hyd eff. |
|---|---|---|---|---|
| 19 l/s | 55 m | | | % |

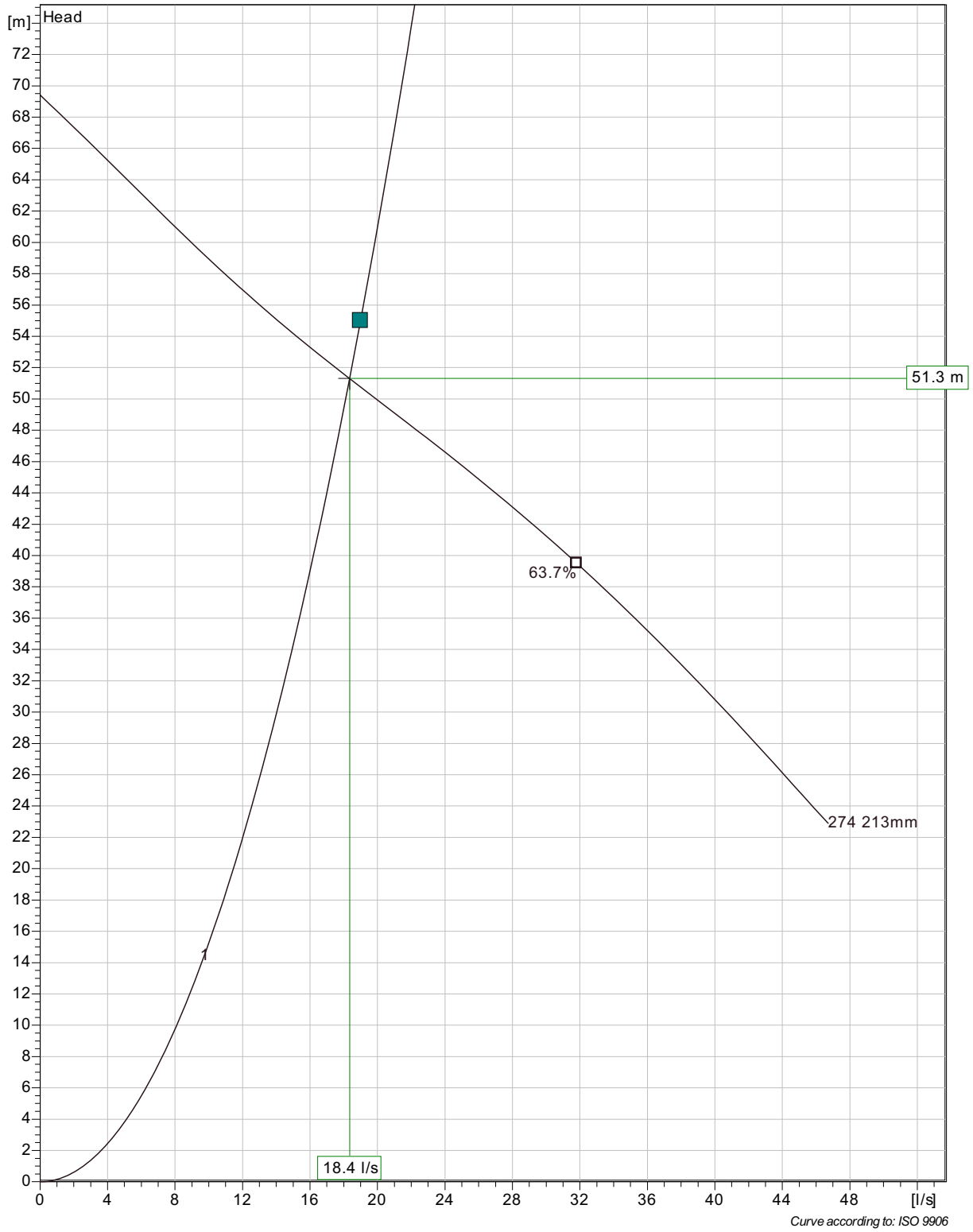
**Guarantee**

| ISO_9906_Grade_2 |
|---|
| No |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| **Ledonne Constructions** | **Broadwater SPS** | | **2011-11-29** | **2011-11-30** |

# NP 3171 SH 3~ 274

## Duty Analysis



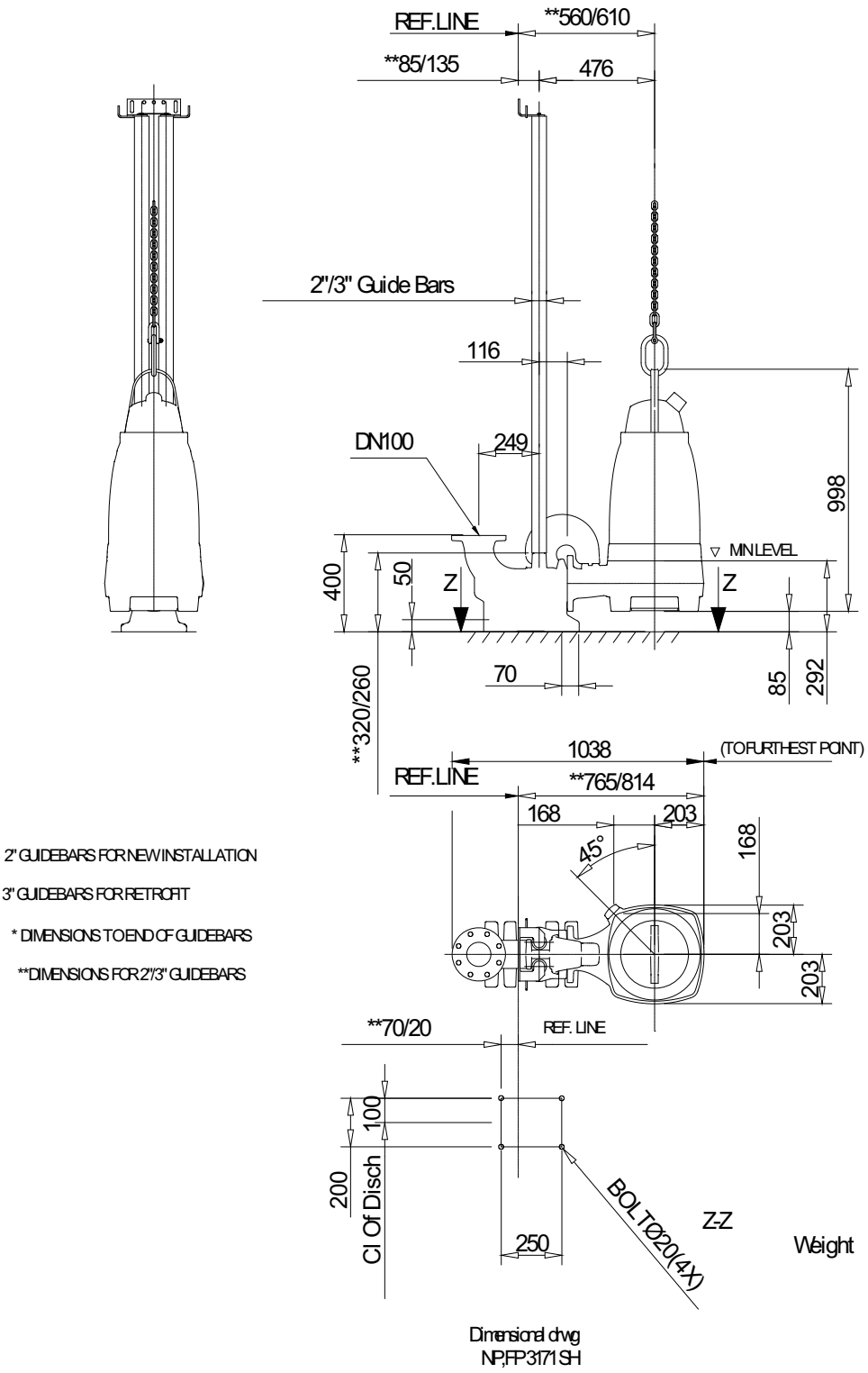

*Curve according to: ISO 9906*

| Pumps running /System | Individual pump | | | Total | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flow | Head | Shaft power | Flow | Head | Shaft power | Hyd eff. | Specific energy | NPSHre |
| 1 | 18.4 l/s | 51.3 m | 16.9 kW | 18.4 l/s | 51.3 m | 16.9 kW | 54.8 % | 0.279 kWh/m³ | 3.05 m |

| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| **Ledonne Constructions** | **Broadwater SPS** | | **2011-11-29** | **2011-11-30** |

# NP 3171 SH 3~ 274

**Dimensional drawing**




| Project | Project ID | Created by | Created on | Last update |
|---|---|---|---|---|
| **Ledonne Constructions** | **Broadwater SPS** | | **2011-11-29** | **2011-11-30** |

ITT

Water & Wastewater


# Enhanced Flygt N-technology

## Now customized for any application

*Engineered for life*

# The most advanced N-technology yet

**Enhanced Flygt N-technology now suits every wastewater pumping application. The flexible modular design, improved self-cleaning system and wider choice of materials make enhanced N-technology better than ever before.**

Leave it to the engineers at ITT Water & Wastewater to make Flygt's N-pumps even better.

Back in 1999, Flygt N-technology revolutionized submersible wastewater pumps with sustained pump efficiency, clog-free operation and lower total cost of ownership. Suddenly it was easy to maintain high hydraulic efficiency with a two-vane impeller, avoid efficiency loss due to partial blockages and adjust impeller clearance without disassembling the pump.

In a little over a decade, Flygt N-technology has gained a solid reputation for legendary quality and reliability. With the introduction of enhanced Flygt N-technology, the bar is raised even higher – making N-technology the optimal choice for the most challenging tasks in wastewater pumping.

## The self-cleaning concept

The semi-open impeller and the volute relief groove work together.

Stage 1: The N-impeller blades with backswept leading edges sweep solids from the center to the perimeter of the inlet.

Stage 2: The relief groove and guide pin in the volute push solids, such as rags, away from the impeller.

Stage 1

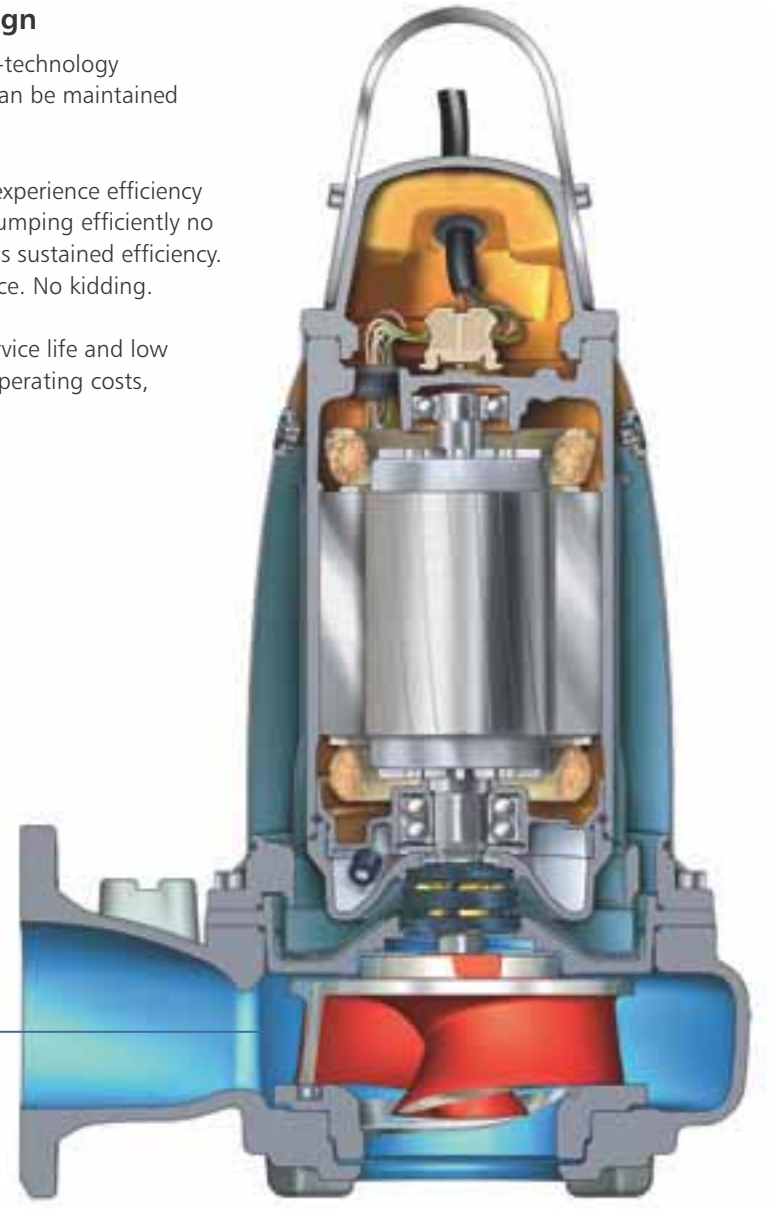
Stage 2

## Sustained efficiency, sustainable design

Thanks to its ingenious design, enhanced Flygt N-technology consistently provides a high efficiency level that can be maintained over long operating periods.

Unlike conventional solids-handling pumps that experience efficiency loss due to clogging, Flygt N-technology keeps pumping efficiently no matter what wastewater may contain. We call this sustained efficiency. Maximum hydraulic power, extreme clog resistance. No kidding.

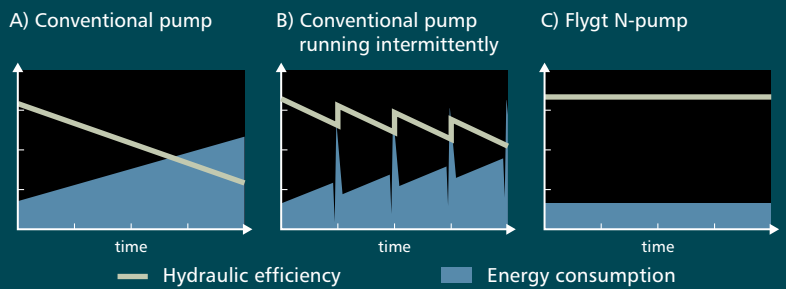
Energy-efficiency, trouble-free operation, long service life and low maintenance reduce your carbon footprint and operating costs, making your operations more sustainable, too.



### Enhanced N-technology advantages

- **+ Maximum uptime, extreme clog resistance**
- **+ Reduced energy costs, sustained high efficiency**
- **+ Hydraulic can be customized for any application**
- **+ Option for more durable material made of Hard-Iron™**
- **= Lower total cost of ownership**

### Sustained efficiency




A) Clogging of conventional pumps: Energy consumption increases as efficiency decreases.

B) Backflushing achieves temporary efficiency gains as well as spikes in energy consumption.

C) Virtually clog-free N-pump: Consistent efficiency and energy savings.

# What’s new and improved

**With enhanced Flygt N-technology, ITT Water & Wastewater now brings you more ways to customize your hydraulic pump to meet the requirements of virtually any application.**

## Customized modules: Standard, Hard-Iron™ or chopper

Choose the standard cast iron module for typical wastewater applications, the Hard-Iron™ module for extremely abrasive or corrosive applications, and the chopper module for cutting long fibers or solids in wastewater. Whatever you choose, you never sacrifice pump efficiency – and you can easily switch the module should operating conditions change.

## More robust hydraulic design

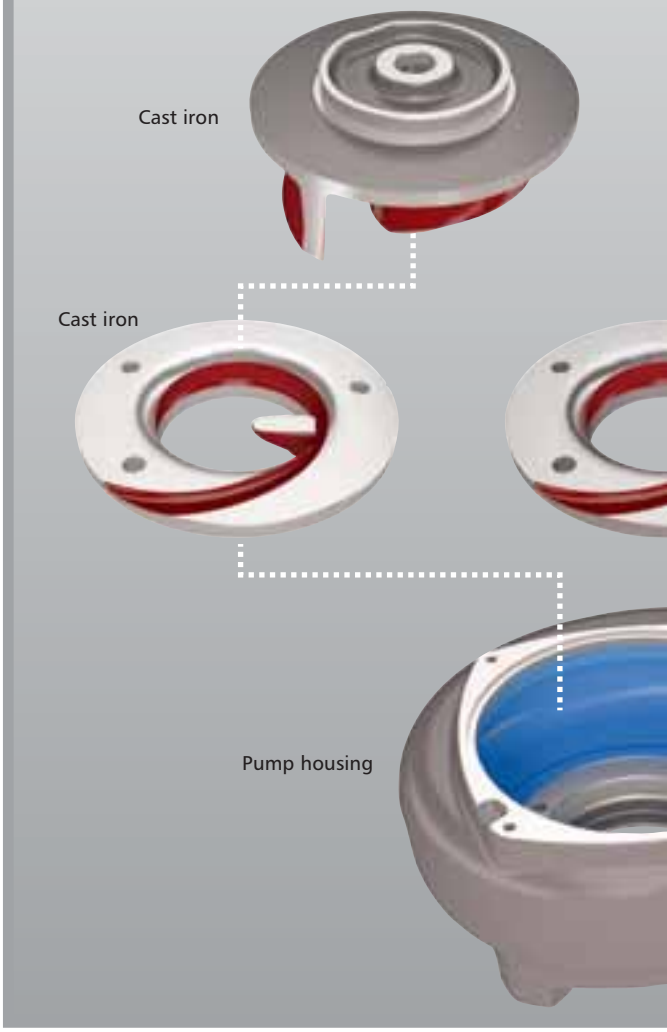
From the start, Flygt N-technology brought innovation to wastewater pumps. We introduced a patented combination of a semi-open two-vane impeller and volute relief groove to ensure clog-free operation. We’ve now made significant improvements to our trademark impeller.

**Redesigned impeller blades.** Blade geometry has been optimized and the leading edges are machined to ensure that nothing sticks to the impeller.

**Longer relief groove in the volute.** The signature Flygt N-technology relief groove has been reshaped and extended halfway around the diameter of the opening. This provides about 40% more surface area to capture and guide fibrous material to the impeller periphery for removal.

**Integrated guide pin.** A guide pin has been integrated into the insert ring. It clears the impeller core by pushing solids along the relief groove toward the periphery for removal.

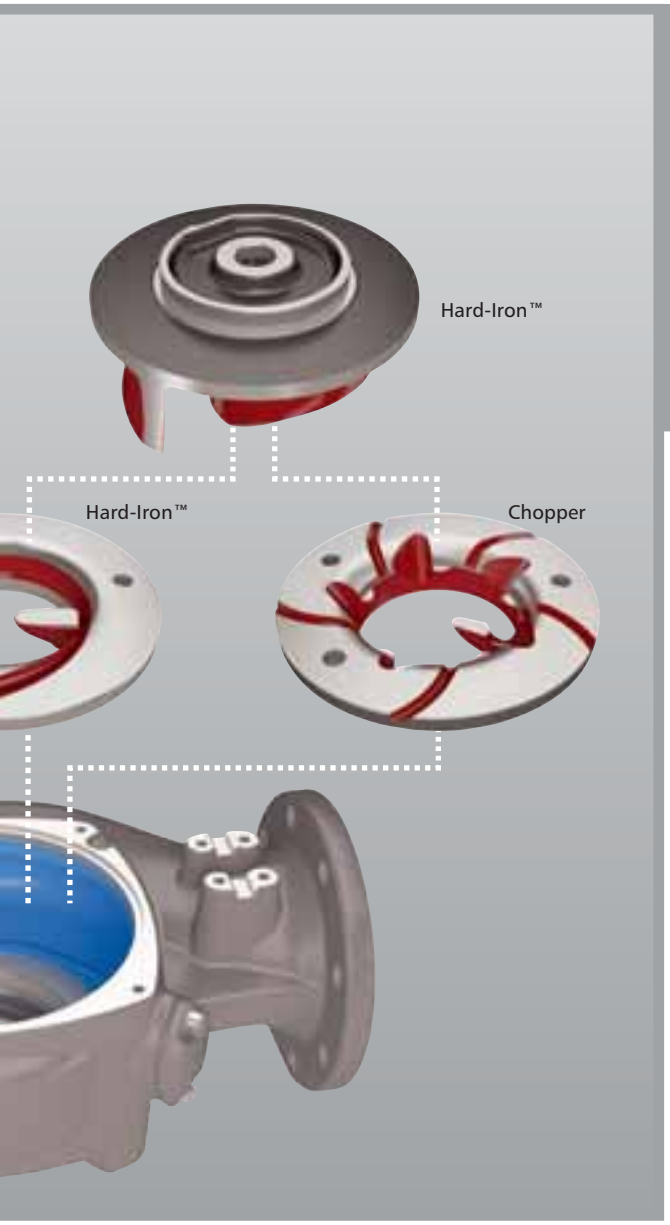
**Greater flexibility with modular design**
Customize your pump by choosing the capacity, head, insert ring, type of material and options that best suit your specific operating conditions.




## Hard-Iron™ for the toughest wastewater challenges


Accelerated wear tests prove that Hard-Iron™ hydraulic components keep on working efficiently with minimal wear even after 200 hours of pumping water with a very high concentration of coarse sand (2,400 tons).

Extensive field testing has shown that, despite salt, sand infiltration and grit removal duties, Flygt N-pumps with Hard-Iron™ components continue to deliver sustained efficiency without clogging or erosion corrosion.




**Improved self-cleaning system.** The patented self-cleaning N-hydraulic now features machined backswept leading edges, an extended relief groove and integrated guide pin to ensure high efficiency and clog-free operation for long periods.

**Choice of materials**. Choose conventional cast iron or Hard-Iron™ for all Flygt N-technology components. As its name implies, Hard-Iron™ provides exceptional wear resistance for highly abrasive and highly corrosive wastewater.

## Tougher with Hard-Iron™

Hard-Iron™ is extremely hard. It is at least four times more durable than conventional grey iron and twice as durable as duplex stainless steel. Hard-Iron™ is a high-strength alloy with a 25% chromium content. It is therefore suitable for wastewater with oxygen or chloride levels up to 500 ppm.

## Chopper module

Give your Flygt N-pump chopping functionality with the new chopper insert ring. Rugged, wear-resistant and self-cleaning, it cuts tough solids without clogging or sacrificing pump efficiency. Both the impeller and insert ring are made of Hard-Iron™. Typical applications include agriculture, aquaculture, food processing, pulp and paper, and wastewater facilities with chopping requirements. Optional cutting knife for food and fish processing wastewater and feeding screw for agricultural wastewater are available.

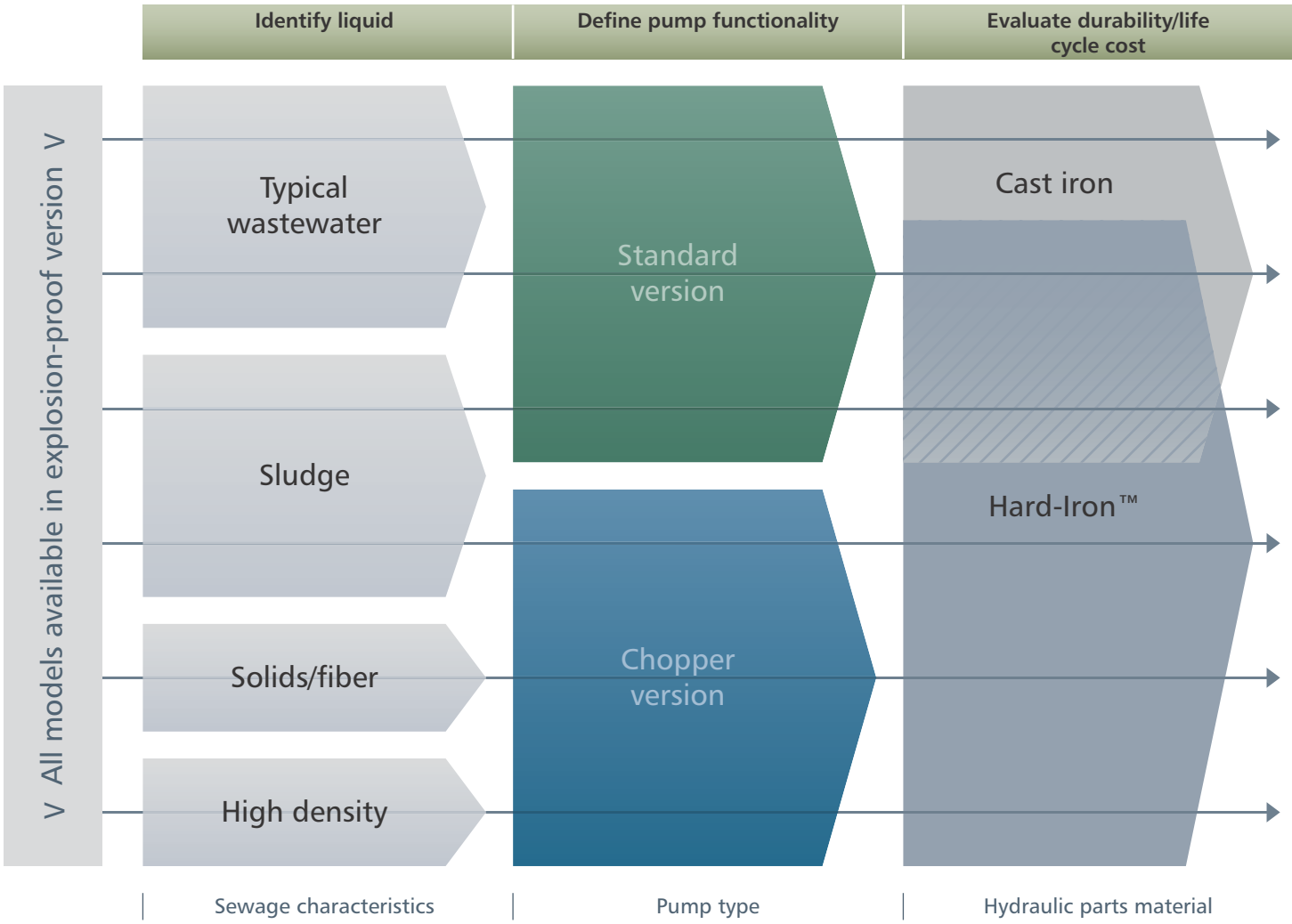
## Chop anything with the Flygt chopper pump

It's amazing what ends up in your wastewater. We've seen it all – from plastic bottles and wood to textiles and clothing, including jeans, sneakers and bedspreads, and even motor cables.

That's why the engineers at ITT Water & Wastewater put the Flygt chopper pump to the test. It is subjected to extreme conditions at our test lab to ensure continuous operation with sustained hydraulic efficiency.

# Finding the right pump

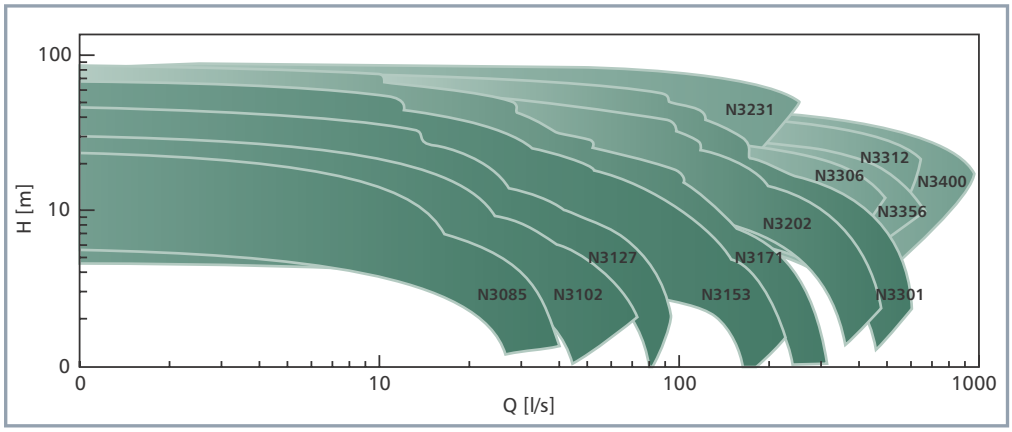
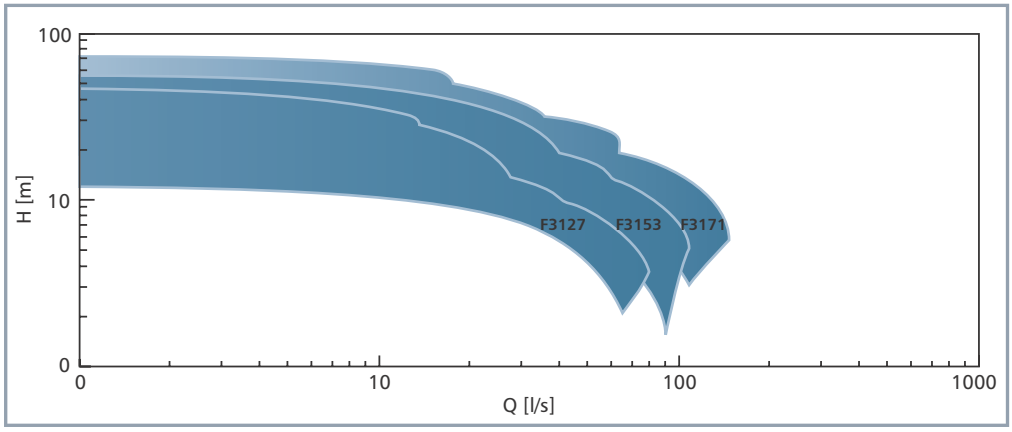
**Identify the pump that meets your needs based on your capacity requirements and applications. All Flygt N-pumps are designed for heavy-duty service in municipal wastewater plants – from pump stations to retention basins and sludge treatment.**




**N-pumps are energy efficient**

Northumbrian Water's Lustrum in UK decided to refurbish their pump station since blockages and the maintenance time and costs were becoming an issue. A huge benefit of the refurbishment was the installation of the Flygt N-pumps. There have been no blockages and it's bringing increased efficiency to the station.

The original pumps were delivering 0.43M³/kWh while the new N-pumps pump 0.9M³/kWh. In electrical terms alone this offers a potential saving of £22,000 per annum at current rates, plus the maintenance time and costs have dramatically reduced.

| Identify models that match your needs | Choose relevant capacity |
|---|---|
| N3085, N3102, N3127, N3153, N3171, N3202, N3301, N3231, N3306, N3312, N3356, N3400 |  |
| N3085, N3102, N3127, N3153, N3171, N3202, N3301 | |
| N3085, N3102, N3127, N3153, N3171, N3202, N3301 | |
| F3127, F3153, F3171 |  |
| F3127, F3153, F3171 | |
| F3153, with feeding screw | |
| Flygt pump models | Performance criteria |





## Flygt chopper pumps eliminate the blockage problems

The Chapelknowe Sewage Pumping Station had pump blockages three or four times per week, causing unacceptable costs.

David Thomson, Engineering & Maintenance Team Leader for Scottish Water, commented: "The Flygt Chopper Pump has solved a major issue at Chapelknowe where the number and scale of blockages were becoming highly problematical operationally and financially".

After six months installation Chapelknowe has not experienced a single blockage while service inspections showed no wear on the hydraulic parts, clearly demonstrating the durability of this product.

ITT

**What can ITT Water & Wastewater do for you?**

Integrated solutions for fluid handling are offered by ITT Water & Wastewater as a world leader in transport and treatment of wastewater. We provide a complete range of water, wastewater and drainage pumps, equipment for monitoring and control, units for primary and secondary biological treatment, products for filtration and disinfection, and related services. ITT Water & Wastewater, headquartered in Sweden, operates in some 140 countries across the world, with own plants in Europe, China and North and South America. The company is wholly owned by the ITT Corporation of White Plains, New York, supplier of advanced technology products and services.

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# Appendix J – Designers Safety Report

The intent of this designer's safety report is to consider and advise the project constructors and operators of safety related issues addressed during the Broadwater and North Woodburn pressure sewerage system design process. Many of the following construction, commissioning and operation safety issued require continuing ownership and attention to planning and monitoring procedures by each entity involved with the project. This review is based upon the "For Construction" design documents.

Generic issues not addressed include in this report include the following:-

Power tools, safety footwear, use of ladders, scaffolding, flammable gas cylinders (oxy acetylene) , crane use, safety rail during construction, welding, forklifts, use of solvents, elevated platforms, use of synthetic mineral fibre, trench shields, construction vehicles, minor cuts and abrasions.

| PRESSURE SEWER SYSTEM SITE SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Poor planning | Inefficient planning resulting in potential reduction in safe methodologies used for project delivery process | L | Concept and detail Design reviews by Contractor, project manager and RVC (end owner) identified issues that were resolved. | ✓ | ✓ | | |
| Flooding site | Site condition | L | Locate electrical equipment above flood level | | ✓ | | |
| Unstable ground - Landslip | Soft water charged ground can result in excavation wall collapse | H | • Design facilitates the use of directional drilling to reduce open excavation<br>• Shoring required | ✓ | | | |
| Hydrogen sulphide exposure in sewerage pit | H2S in pump units and at discharge points | H | • Discharge PS main directly into sewage pumping station<br>• Air valve above ground air release direct to atmosphere (not in pit) | | ✓ | | |
| Pipe suspension (working over and near water) | Pipe suspended on Monti Creek bridge crossing. Risk from fall, drowning and traffic | H | • Directional drill creek crossing option investigated and designed however RVC required the pipe to be direct fixed to bridge.<br>• Pipe supports located close to bridge top structure to avoid accessing creek for installation. | ✓ | | | |

| PRESSURE SEWER SYSTEM SITE SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Confined space workplace (under houses) | Property sewer connections under house | L | Alternative solution used where possible | ✓ | | | |
| RMS HDD Road crossing frac-out | Breakdown of road structure resulting in (slippery) boring fluid on the surface of the road. Clearly dangerous for moving traffic. | H | Designed to be smallest pipe practical to limit the bore hole size and therefore risk. Depth of bore increased to 1,200 cover. | ✓ | | | |
| Traffic issues associated with Pacific Hwy crossing | Road work area and crossings incorporates high volume of Vehicles ranging from B-Double trucks to motor cycles | H | • Minimise number of road crossings<br>• Use directional boring technology | ✓ | | | |
| Semi trailers in Wharf street | Truck movements (forward and reversing) around work area. | H | • Small main designed to facilitate directional drilling.<br>• Construction management safety plan required. | ✓ | | | |
| Service station fuel tanks. | Excavation machines damage fuel tanks or lines thereby exposing workers to risk. | H | Pipes designed to avoid know fuel tanks and lines at operating and non-operational fuel stations. | ✓ | | | |
| North Woodburn Bridge crossing | Traffic, Fall, lifting concrete services culvert covers, confined space with existing services | L | Detailed pipe setouts provides maximum separation from other services. | ✓ | | | |

Issues Common to Construction Sites

The following issues are generally associated with all construction sites and are therefore addressed by the installing contractors SWMS and not in this designers report.

*Power tools, safety footwear, use of ladders, scaffolding, flammable gas cylinders (oxy acetylene) , crane use, safety rail during construction, welding, forklifts, use of solvents, elevated platforms, use of synthetic mineral fibre, trench shields, construction vehicles, minor cuts and abrasions.*

| COMMON HA ARD NORMAL TO CONSTRUCTION SITE | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction Issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP | Critical Design Elements | Relevant Regs and Standards | Other |
| Property owner interface | Aggressive property owners | L | Multiple notification and interface points in process | ✓ | | | |
| pressure sewer unit installation methods | Private property construction equipment and excavation and electrical work. Risk to public and workers | H | Installation of equipment in accordance with manufactures installation instructions and detail construction management. | ✓ | | | |
| Unknown inground services | Inground services such as water, gas and power can be damaged if impacted resulting in uncontrolled release of dangerous elements in work area. | H | • Dial before you dig resources used<br>• Visual inspection<br>• Mains set-out documented | ✓ | | | |
| Contaminated ground conditions | Exposure to contaminants | L | Client advised none known in work area | | | | ✓ |
| Acid sulphate soils (ASS) | Exposure to acid sulphate | L | Client advised no ASS known in area | | | | ✓ |
| Inground asbestos | Exposure to Asbestos | L | Client advised none known in area. | ✓ | | | |

| COMMON HA ARD NORMAL TO CONSTRUCTION SITE | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction Issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP | Critical Design Elements | Relevant Regs and Standards | Other |
| services | | | | | | | |
| Excavation in zone of structural influence | Structure failure and collapse into trench. | H | Design pipe locations to avoid structural zone of influences | ✓ | | | |
| Damage to existing pressure services e.g. water mains | Pressure main impact failure is similar to small explosion | L | Existing services identifies | ✓ | | | |
| High pressure testing - Water | Pressure main test failure can be similar to small explosion | H | SWMS required | ✓ | | | |
| Pressure Testing - Air | Due to compressibility of air a major test failure will be similar to small explosion | H | Recommendation - Never test pressure main with air. | | | | ✓ |
| Exposure to sewage | Existing house sewer connections | L | SWMS required | ✓ | | | |
| Exposure to electricity | Control panel connection – Construction issue | L | SWMS required | ✓ | | | |
| Structurally failing Septic tanks (Fall in) | Excessive weight on ST cover may result in worker falling into septic tank - Construction issue | L | SWMS required | ✓ | | | |
| Open excavations | Fall issue | L | SWMS required | ✓ | | | |
| Pets e.g. dogs | Dog bite on private property or in street | L | SWMS required | ✓ | | | |

| COMMON HA ARD NORMAL TO CONSTRUCTION SITE | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction Issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP | Critical Design Elements | Relevant Regs and Standards | Other |
| Wildlife e.g. snakes | Snake bite on private property or in street | L | SWMS required | ✓ | | | |
| Pressure sewer unit products related issues e.g. confined space | pressure sewer unit issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions and safety directions. | ✓ | | | |
| Medical | Construction issue | L | SWMS required | ✓ | | | |
| Noise | Construction issue | L | SWMS required | ✓ | | | |
| Construction plant and equipment | Construction issue | L | SWMS required | ✓ | | | |
| Dust | Construction issue | L | SWMS required | ✓ | | | |
| Working in School grounds | Construction issue | L | SWMS required | ✓ | | | |
| Unknown Contaminated ground conditions | Construction issue | L | SWMS required | ✓ | | | |
| RMS road crossing HDD Fracout | Construction issue | L | SWMS required | ✓ | | | |
| Exposure to vehicles where mains located in verge eg | Exposure to traffic Construction issue | L | SWMS required | ✓ | | | |

| COMMON HA ARD NORMAL TO CONSTRUCTION SITE | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction Issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP | Critical Design Elements | Relevant Regs and Standards | Other |
| isolation valves, flushing points and air valves. | | | | | | | |
| Overhead power cables | Construction issue | L | SWMS required | ✓ | | | |
| Dirty roads | Construction issue | L | SWMS required | ✓ | | | |
| Health risk from chemicals or microbiology from excavated soils | Construction issue | L | SWMS required | ✓ | | | |
| Traffic control | Construction issue | L | SWMS required | ✓ | | | |
| Burn risk | Construction issue | L | SWMS required | ✓ | | | |
| Sun burn | Construction issue | L | SWMS required | ✓ | | | |
| Dehydration | Construction issue | L | SWMS required | ✓ | | | |
| Trip hazards | Construction issue | L | SWMS required | ✓ | | | |
| Power / light pole undermining | Construction issue | L | SWMS required | ✓ | | | |
| HDD machine set-up and operation on road verge | Construction issue | L | SWMS required | ✓ | | | |
| Environment – hot, cold, wet, dark, night | Construction issue | L | SWMS required | ✓ | | | |

| COMMON HA ARD NORMAL TO CONSTRUCTION SITE | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction Issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP | Critical Design Elements | Relevant Regs and Standards | Other |
| Overhead power | Construction issue | L | SWMS required | ✓ | | | |
| Manual handling hazards | Construction issue | L | SWMS required | ✓ | | | |
| Mosquito induced disease | Construction issue | L | SWMS required | ✓ | | | |

| PRESSURE SEWER UNIT SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>Construction issue<br>Product issue<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Pressure sewer unit installation methods | Private property construction equipment and excavation and electrical work. Risk to public and workers | H | Installation of equipment in accordance with manufactures installation instructions and detail construction management. | ✓ | | | |
| Confined space access | Product installation and operation issue | L | Not required for installation or operation | ✓ | | ✓ | |
| Electrical panel components | Product installation and operation issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions | ✓ | | ✓ | |
| Materials eg GRP | Product installation and operation issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions | ✓ | | | |
| Sewage exposure | Product installation and operation issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions | ✓ | | | |
| Lifting pump out of tank | Product installation and operation issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions | ✓ | | | |
| | | | | | | | |

| PRESSURE SEWERAGE SYSTEM OPERATIONAL SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Operational<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Confined space access to PSU | Operational | L | Refer to pressure sewer unit suppliers installation and operation safety instructions<br>Selected pressure sewer unit does not require entry by operator | ✓ | | ✓ | |
| Electric shock from panel components | Live components in panel and connection to pump inside tank | L | Refer to pressure sewer unit suppliers installation and operation safety instructions<br>Clear electrical separation plate inside panel.<br>Install and operate in accordance with local electrical authorities requirements<br>Only suitably qualified electricians to maintain electrical system<br>Tank cover and Panel to be permanently locked | ✓ | | ✓ | |
| Hazardous waste enters system e.g. paint, oil, petrol, chemicals | Operators exposure to hazardous waste | H | Refer to pressure sewer unit suppliers installation and operation safety instructions | ✓ | | | |
| Sewage exposure | Operators exposed to Raw sewage and associated infection and disease (hepatitis) | L | • Operators safe work procedures<br>• Refer to pressure sewer unit suppliers installation and operation safety instructions | ✓ | | | |
| Lifting pump out of tank | Product installation and operation issue | L | Design details in accordance with pressure sewer unit product manufactures installation instructions | ✓ | | | |
| Pipe burst | Exposure to raw sewage | L | • 160m safe working pressure pipe specified, max system pressure = 80m | ✓ | ✓ | | |

| PRESSURE SEWERAGE SYSTEM OPERATIONAL SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Operational<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| | | | • Flushing points designed to facilitate by-pass around pipe break.<br>• Isolation valves incorporated to isolate broken pipe sections. | | | | |
| Operation of Flushing Points | Exposure to raw sewage | L | • Flushing point valves to be lockable to prevent access to public<br>• FP connection pipe is specified as stainless steel for increased strength<br>• Do not fix sealed kamloc caps to top of FP<br>• Concrete encase FP pits | ✓ | ✓ | | |
| Traffic | Exposure to vehicles including B-Double trucks | H | No isolation valves, air valves or flushing points are located within carriage way | ✓ | ✓ | | |
| Vandalism of Exposed Pressure pipe | Pressure sewage release at North Woodburn bridge crossing | L | • Main located in concealed services culvert across bridge<br>• Protective shroud around pipe at exposed entry and exit point to bridge<br>• Pipe located inground where crossing under bridge | | ✓ | | |
| Snake bite | North Woodburn is known brown snake area | H | Operations protective clothing and safe work methods required | ✓ | | | |
| Uncovered tank | Fall and / or trip risk from leaving the tank uncovered. Possible fall into tank. | L | Refer to pressure sewer unit suppliers installation and operation safety instructions | ✓ | | | |
| I and I | Excessive stormwater / rainwater flows into pressure sewer unit resulting in sewage overflow | L | Pressure sewer unit incorporates excessive flow alarm indicating I&I issue at property<br>Flow meter located at inlet to sewage pumping station indicates excessive flows. When calibrated with rainfall event is indicative of I&I entering the system. | | ✓ | | |

| PRESSURE SEWERAGE SYSTEM OPERATIONAL SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Operational<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Discharge shut-off valve left closed with pump on | Build-up of pressure if pump operates with potential component burst. | H | • Pressure sewer unit components rated above max pump pressure trip-out.<br>• Refer to pressure sewer unit suppliers installation and operation safety instructions | ✓ | | | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Access (entry and exit) from / to adjacent road (100km/h) | Traffic accident between operators vehicle and private vehicle | H | • Pressure Sewer Solutions P/L recommendation to RVC to engage traffic engineer to review the entry and exits to the selected sewage pumping station site.<br>• Pressure Sewer Solutions P/L recommendation to RVC to reduce road speed from 100km/h to 50 km/h from Broadwater village to past sewage pumping station site entry and exit locations.<br>• Entry and exit turning radius onto road increased to be suitable for 8.5m service vehicle.<br>• No right turn from sewage pumping station site onto road due to close corner approx 100 metres to the left and a max posted vehicle speed of 100 km/h.<br>• Vehicle can also turn inside sewage pumping station site and exit from the Eastern driveway (farthest away from the blind corner). | ✓ | ✓ | ✓ | |
| Reduced Traffic sightlines due to vegetation growth | Traffic accident between operators vehicle and private vehicle | H | Refer to operators safety reviews | ✓ | ✓ | ✓ | |
| Site stormwater run on to adjacent road | Additional rainwater onto Broadwater – Evans Head Road may cause a vehicle to aquaplane and reduce driver control thereby increase risk of | H | • Sewage pumping station entry and exit driveway rainwater system (piped and surface flow) directed to the existing table drain.<br>• Existing table drain levels not changed<br>• No obstructions to existing table drain from proposed sewage pumping station. | ✓ | ✓ | | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| | vehicle accident. | | • Rainwater run-off from sewage pumping station site to be directed to existing table drain, NOT onto road | | | | |
| Confined space access | | | • Ladder and step irons provided into pits and wetwell<br>• Davit point designed adjacent to wetwell access cover for operator safety line. | ✓ | | | |
| Falls | Wetwell, pits | L | • Ladder and step irons provided into pits and wetwell<br>• Davit point designed adjacent to wetwell access cover<br>• Pit covers incorporate “void protection”<br>• Pits surrounds designed to be all the same level to avoid trip hazards. | ✓ | ✓ | | |
| Toxicity | H2S exposure | H | • Sewage pumping station Induct (low level) and educt vent (high level) vents designed.<br>• Chemical dosing facility provided (to future detail)<br>• Pinch valve on SRM to reduce odour discharges at STP. | ✓ | ✓ | | |
| Trips and slips | Falls and or trips | L | • Pits surrounds designed to be all the same level to avoid trip hazards.<br>• Driveway bund reduced to 100mm high and 600mm wide to reduce trip hazard. | | ✓ | | |
| Electrical panel components | Exposure to live electrical components | H | Refer to control panel designer’s safety report. | ✓ | ✓ | | |
| Chemical dosing and filling | To future detail.<br>Exposure to chemicals classified as a Hazard | L | • Odour chemical storage platform and surrounds designed to be all the same level as sewage pumping station to avoid trip hazards.<br>• Safety shower and eye wash water supply.<br>• Bunded area for filling truck<br>• Water point for washdown | ✓ | ✓ | | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Sewage exposure | Operator | H | • Controlled overflow point from wetwell located to the back of the site.<br>• Sewage pumping station by-pass designed to prevent overflow from wetwell.<br>• Actuator controlled sewage pumping station inlet valve will fail closed and wetwell by-passed. Sewage conveyed to STP with pressure sewer unit pump pressure.<br>• Wetwell sewage levels monitored via telemetry system to provide early notification of potential failure of sewage pumping station components.<br>• Safety shower point located | ✓ | ✓ | | |
| Lifting pumps out of wetwell | Operator | L | Davit point located for operator | ✓ | ✓ | | |
| High mains pressure potential | Component failure due to high pressure resulting in raw sewage exposure | L | • Pressure sewer unit pumps max pressure limited to 80 metres with system components safe working pressure of 160 meters. Equates to a 100% safety factor.<br>• Pump discharge check valve flow switches monitored.<br>• Discharge SRM pressure transducer alarm monitored for high pressure. | ✓ | ✓ | | |
| Sewage pumping station overflow | Exposure to raw sewage | H | • Duty / Stand-by pumps designed.<br>• Controlled overflow point from wetwell located to the back of the site.<br>• Sewage pumping station by-pass designed to prevent overflow from wetwell.<br>• Wetwell levels monitored via telemetry system to provide early notification of potential failure of sewage pumping station | ✓ | ✓ | | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| | | | components.<br>• Safety shower point located | | | | |
| Check valve stuck open | By-Pass failure | L | Monitor to alarm pump run and check valve flow switch operation | ✓ | ✓ | | |
| Controls system failure and fire | Sewage exposure | L | • Actuator controlled sewage pumping station inlet valve will fail closed and wetwell by-passed. Sewage conveyed to STP with pressure sewer unit pump pressure. System will re-set when flows return to normal levels.<br>• Refer to control panel designers safety report. | ✓ | ✓ | | |
| Pressure sewerage system after power outage high inflow | Inflow higher than sewage pumping station discharge design capability resulting in overflow | L | • Upon high sewage level in pumping station the actuator controlled inlet valve will closed and wetwell will be by-passed. Sewage conveyed to STP with pressure sewer unit pump pressure. System will re-set when flows return to normal levels. | ✓ | ✓ | | |
| I&I inflow to sewage pumping station | Inflow higher than sewage pumping station discharge design capability resulting in overflow | L | • Upon high sewage level in pumping station the actuator controlled inlet valve will closed and wetwell will be by-passed. Sewage conveyed to STP with pressure sewer unit pump pressure. System will re-set when flows return to normal levels. | ✓ | ✓ | | |
| Water hammer | VSD fails / pump trips / power failure | L | • Sewage pumping station pumps and rising main materials hydraulically modeled and specified to accommodate water hammer<br>• Thrust blocks specified at all rubber ring jointed fittings.<br>• Flanged fittings specified for pipe work adjacent to sewage pumping station. | ✓ | ✓ | ✓ | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| Vandalism | Exposure to hazards e.g. Sewage, trip, fall, toxic and electrical | L | All pit covers and control cabinets are lockable. | | ✓ | | |
| Differential settlement between structures | Structural failure | L | Ground loading capacity of 200 kPa to be tested and confirmed prior to construction and ground loading capacity augmented where required. | ✓ | ✓ | | |
| Electrical conduits not or poorly sealed | Sewage flow into control panel | L | • Refer to control panel design and designers safety report.<br>• As a back-up strategy the sewage pumping station wetwell incorporates overflows to prevent sewage level being high enough to enter control cabinet. | ✓ | ✓ | | |
| Explosive fuels dumped into system | Exposure to hazardous and / or explosive materials | L | Operations monitoring and procedures required | ✓ | ✓ | ✓ | |
| Materials and corrosion risk | Metals and concrete | L | • Sulphate resistant concrete specified<br>• Wetwell concrete surfaces specified to be epoxy lined for protection<br>• Valves to be FBE lined<br>• Wetwell incorporate induct and educt vents | ✓ | ✓ | | |
| Incoming electrical supply | Pole transformer electrical or structural failure | L | Refer to electrical suppliers safety report | ✓ | ✓ | | |
| Inground live electrical cables | Exposure to live electrical cables | L | • Refer to electrical suppliers safety report<br>• Documented on WAE drawings | ✓ | ✓ | | |
| Excavation subsidence | Wet well excavation in soft sandy soil and water | H | Wetwell diameter is 3.6 metres to provide specified capacity and reduce depth thereby exposure to water charged ground. | ✓ | ✓ | | |

| SEWAGE PUMPING STATION SPECIFIC HA ARD | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hazards | Hazard Details | Risk Level | Risk Reduction Measures | | | | |
| | e.g.<br>Design Issues<br>End Product<br>Onsite exposure | (H) High<br>(L) Low | Hazard mitigation or removed | SMP Required | Critical Design Elements | Relevant Regs and Standards | Other |
| | charged ground | | | | | | |
| Inground ferric chloride dosing lines | Exposure to dangerous goods line If broken. | L | • Chemical dosing line is located inside PVC conduit.<br>• Lines to be documented on WAE plans. | | ✓ | | |
| Road settlement due to insufficient fill compaction or erosion. | Slab on ground structure not fully supported and fails when loaded. | L | • Compaction specification documented.<br>• RVC specified level of RL7.5 results in additional fill with 1:4 batters.<br>• Grass to stabilise batter.<br>• Compaction test results required | ✓ | ✓ | ✓ | |
| Poisson effect | Pipe failure due to contraction when loaded | L | • Thrust resistance concrete anchors added | ✓ | ✓ | | |
| Traffic management on SRM | Main offset from edge of 100 km/h road | H | • Main located with maximum clearance where possible.<br>• Refer to constructors and operators safety reviews and management plans. | ✓ | ✓ | ✓ | ✓ |