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<tr>
<th>Revision Nº</th>
<th>Prepared By</th>
<th>Description</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Logan Thomson</td>
<td>Draft for client review</td>
<td>01/06/2021</td>
</tr>
<tr>
<td>2</td>
<td>Ben Severinsen</td>
<td>Formatting &amp; Content</td>
<td>03/06/2021</td>
</tr>
<tr>
<td>3</td>
<td>Logan Thomson</td>
<td>Final for Council approval</td>
<td>30/07/2021</td>
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Appendix A: Wastewater Network Plans

Appendix B: Wastewater Bylaw Practice Note WW01
1 Introduction

1.1 Background

Central Hawke’s Bay District Council (CHBDC) are currently in the process of upgrading and reconsenting their Wastewater Treatment Plant (WWTP) discharges for the communities of Waipukurau, Waipawa, Otane, Takapau, Porangahau and Te Paerahi as part of ‘The Big Wastewater Story.’

Wastewater networks in these towns experience high levels of inflow and infiltration (I&I) from rainwater and groundwater entering the sewer network. This poses a risk to the current wastewater upgrade project in terms of potential for higher capital costs (than necessary) and inefficient operation. Given the scale of investment anticipated it is important the design of the scheme is optimised. This includes optimising the network flows through managing I&I in order to efficiently size the wastewater treatment facilities and to minimise potential for uncontrolled discharges to the receiving environment.

In addition, the district is projected to experience large population growth, particularly in Waipukurau and Otane. Population growth in these towns will be largely driven by new subdivisions built to council infrastructure standards. These subdivisions should be subject to minimal I&I.

Conditions of CHBDC’s current resource consents to discharge wastewater from these plants includes to implement and periodically update I&I Management Plans. This report outlines the background and strategy for investigation and management of I&I. Management plans have previously been produced for the networks in 2007 and 2010. These are concurrently being updated to be submitted to the Hawkes Bay Regional Council.

A Request for Tender (RFT) is currently on the Government Electronic Tender Service (GETS) to procure a contractor to undertake physical investigations, repair of defects and replacement of defective infrastructure. This strategy and the management plans will help inform which parts of the networks to investigate first identify the “low hanging fruit”. Once defects are identified and prioritised, the contractor will undertake repairs and replacement of infrastructure.

1.2 Funding

Funding for I&I management is derived from two sources and is summarised in Table 1-1. $300,000 has been granted by the Department of Internal Affairs (DIA) as part of Tranche 1 funding for the New Zealand water industry reforms. The condition of this funding is to have the works completed in the 2021/22 Financial Year. $100,000 of the DIA Tranche 1 Water Reform funding is currently being used to repair and replace manholes in Otane.

The remaining funding comes from CHBDC’s Long Term Plan (LTP) budgets and is budgeted at $300,000 per year for the next ten years.

Table 1-1: Summary of funding sources for the Inflow and Infiltration Management project.

<table>
<thead>
<tr>
<th>Source</th>
<th>Financial Year Ending</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department of Internal Affairs (DIA)</td>
<td>2022</td>
<td>$300,000</td>
</tr>
<tr>
<td>Tranche 1 Water Reforms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long Term Plan (LTP) budget</td>
<td>2021-2031 ($300,000 per year)</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>$3,300,000</td>
</tr>
</tbody>
</table>

Inflow and Infiltration Management Strategy | 3255239-1931296235-4644 | 30/07/2021 | 1
1.3 Project Drivers – The Big Wastewater Story

The Big Wastewater Story is CHBDC’s programme of works to upgrade the WWTPs and wastewater networks, achieving better outcomes for the environment, regulatory compliance and ultimately the community. The Big Wastewater Story consists of five projects:

- Replacement of Otane, Waipawa and Waipukurau WWTPs with new single plant at Waipawa (“WOW”)
- Upgraded Takapau WWTP
- Replacement of Te Paerahi and Porangahau WWTPs with new or upgraded WWTP at Porangahau
- Residual Management (i.e. sludge, screenings and grit)
- Loadings and Flow Management (management of I&I and trade waste)

Resource consents for several of CHBDC’s WWTPs have expired, and designs are in progress for the new and upgraded WWTPs. Discharge consents for each of CHBDC’s WWTPs are summarised in Table 1-2.

Table 1-2: Summary of existing CHBDC consents to discharge treated effluent

<table>
<thead>
<tr>
<th>WWTP</th>
<th>Consent Number</th>
<th>Expires</th>
<th>Discharge Into</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te-Paerahi</td>
<td>DP030324La</td>
<td>31st May 2021</td>
<td>Dunes via soakage</td>
</tr>
<tr>
<td>Porangahau</td>
<td>DP030233W</td>
<td>31st May 2021</td>
<td>Porangahau River</td>
</tr>
<tr>
<td>Takapau</td>
<td>DP180115W, DP180124A</td>
<td>31st October 2021</td>
<td>Makaretu River</td>
</tr>
<tr>
<td>Waipukurau</td>
<td>AUTH-113118-04 (W), AUTH-113834-04 (A)</td>
<td>30th Sept 2030</td>
<td>Tukituki River</td>
</tr>
<tr>
<td>Waipawa</td>
<td>AUTH-121814-02 (W), AUTH-113839-03 (A)</td>
<td>30th Sept 2030</td>
<td>Waipawa River</td>
</tr>
<tr>
<td>Otane</td>
<td>AUTH-121814 (W), AUTH-121816-02 (W), AUTH-121818-02 (W)</td>
<td>31st May 2042</td>
<td>Te Aute Drain then Papanui Stream</td>
</tr>
</tbody>
</table>

The following consent conditions are of note:

- The Otane discharge consent has a condition requiring a treatment plant upgrade by the 31st of March 2021
- The Waipukurau and Waipawa discharge consents require a Stormwater Infiltration (I&I) Management Plan to be submitted, and updated each year, to demonstrate CHBDC’s work undertaken and strategy going forward to reduce I&I into the wastewater networks.

The consents for Te Paerahi and Porangahau have expired, and new consents are to be submitted at the end of July 2021. A new consent for Takapau was submitted on the 30th June 2021.

The benefits of reducing I&I in the district will be:

- Reduce capital costs for the new WWTPs, including conveyance, main hydraulic elements and storage
- Reduce operating costs from pumping and treating excessive wastewater volumes due to I&I
- Meet current resource consent conditions to discharge treated wastewater effluent, which stipulate a mean discharge limit and upper limit by which flow can only be exceeded 10% of the time.
- Assist in meeting new resource consent conditions, which are likely to require a higher standard of treatment
- Free up capacity in the networks to support population growth
- Better environmental outcomes due to reduction in uncontrolled overflows and flooding at manholes or on properties, exfiltration and reduction in hydraulic load at WWTPs.
1.4 Programme Drivers

Programme drivers for this project are:

- Undertake I&I reduction works and quantify new flow basis of design for WWTP upgrades. The WOW WWTP preliminary design is scheduled to commence in 2022.
- Meet the funding criteria for the various sources of funding.

1.5 Purpose

The purpose of this report is to propose a strategy to determine and prioritise investigations, renewals, upgrades, and new assets required to reduce I&I across the district.

1.6 Previous I&I Investigations

An I&I reduction programme was previously undertaken in the district in 2009. Records indicate works were undertaken across all towns. These consisted of:

- Private property inspections of low gully traps and directly connected downpipes
- Smoke testing
- CCTV filming
- Manhole inspections

The findings of the private property inspections are summarised in Table 1-3.

<table>
<thead>
<tr>
<th>Network</th>
<th>Properties Inspected</th>
<th>Properties with Faults</th>
<th>Gully Trap Faults</th>
<th>Other Faults</th>
<th>Smoke Faults</th>
<th>Total Faults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otane</td>
<td>206</td>
<td>30</td>
<td>31</td>
<td>4</td>
<td>4</td>
<td>39</td>
</tr>
<tr>
<td>Porangahau &amp; Te Paerahi</td>
<td>171</td>
<td>25</td>
<td>22</td>
<td>2</td>
<td>4</td>
<td>28</td>
</tr>
<tr>
<td>Takapau</td>
<td>190</td>
<td>28</td>
<td>29</td>
<td>0</td>
<td>8</td>
<td>37</td>
</tr>
<tr>
<td>Waipawa</td>
<td>861</td>
<td>122</td>
<td>111</td>
<td>2</td>
<td>48</td>
<td>161</td>
</tr>
<tr>
<td>Waipukurau</td>
<td>1,994</td>
<td>394</td>
<td>397</td>
<td>10</td>
<td>109</td>
<td>516</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>781</strong></td>
</tr>
</tbody>
</table>

Repairs on the private side (i.e. laterals serving individual properties and located on private land) included diverting downpipes away from the wastewater, raising low gully traps and repairing or replacing broken lateral pipes. The study identified 781 faults on the private side. Only 12 outstanding faults remained at the end of the study period\(^1\), for a 98% success rate of private side defects remedies. The I&I reduction measures were successful at the time. Figure 1-1 shows the percentage of days in the previous year in which the resource consent limit of 225m\(^3\)/day is exceeded. The consent allows the limit to be exceeded for 10% of time over the previous year. The chart shows that the I&I reduction works undertaken in Otane in 2009 and 2010 were successful in reducing high flows and helping CHBDC comply with the resource consent. From the chart it appears additional works were undertaken in 2011. Records of these works could not be obtained.

\(^1\) Infiltration Update Report to Council 29\(^{th}\) October 2009
This success rate of private defects repairs should be contrasted with more recent investigation work undertaken in Otane by Veolia in 2019 and 2020. The 2009 work found 30 faults on private property in Otane. All of these faults were reported as having been repaired. Property inspections in 2019 and 2020 found 62 defects on the private side of the network. Seven of these were properties that also had defects repaired in 2009.

Repairs on the public side included diverting incorrectly connected stormwater catchpits to the stormwater network, manhole repairs and sewer repair, replacement and relining.

1.7 Concurrent Work

1.7.1 I&I Physical Works Contractor

A Tender is currently on the Government Electronic Tender Service to procure a physical works contractor to undertake investigations in the wastewater network to identify defects causing I&I. Once the defects are identified the contractor will commence a programme of repairs.

1.7.2 Wastewater Treatment Plant Upgrades

The wastewater treatment plants (WWTPs) in the district are to be upgraded to remove surface water discharges and improve environmental and community outcomes. The proposed upgrades are:

- Waipukurau and Otane WWTPs to be decommissioned and wastewater pumped to an upgraded WWTP at Waipawa. Disposal via Rapid Infiltration Basins (RIBs) and, ultimately, irrigation to farmland.
- Decommissioning of Te Paerahi WWTP and upgrade or decommissioning of Porangahau WWTP and replacement with a new treatment plant. Treated wastewater will be discharged to land or river via enhanced overland flow path.

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Figure 1-1: Percentage of days in which resource consent flow limit exceed in previous year. Consent allows for flow limit to be exceeded 10% of the time.

Otane Wastewater Network Repair/Rehabilitation Plan, Veolia, 27th May 2020
• Takapau to have upgraded WWTP and disposal or dispersal to land.

The proposed new plant at Waipawa will require significant capital investment and ongoing operating costs. Capital cost estimates for the new plant are $51M, with a Net Present Value (NPV) of $96M$^3$. Therefore, meaningful reductions in I&I could result in significant capital and operating cost savings. Preliminary and detailed design of the proposed plant at Waipawa is scheduled to start in 2022. It is important that I&I reduction measures are implemented and adequately measured prior to commencing design so that design flows can be reconfirmed, and the overall scheme optimised.

1.7.3 Otane Remedial Works

Physical works for I&I management on public side infrastructure in Otane are already underway through a programme of manhole repairs. Work in Otane has not yet focused on the private side.

1.7.4 Wastewater and Stormwater Models

WSP are engaged to build a wastewater model of Waipukurau. Models for Waipukurau and Waipawa were previously built by Aurecon in 2009 and 2010 respectively. Flow monitoring for Waipukurau was undertaken by Field Services for a two-week period in 2019, and again for a three and a half month period from July to October 2020 to support the model build exercise. Flow monitoring provides high quality data to help understand the nature of the I&I (GWDII vs. RDII) and prioritise which catchments to investigate and repair first. This data has been made available to Beca and will be used to analyse flows in Waipukurau.

Stantec are engaged to build stormwater and wastewater models of Waipawa and Otane. It is understood the intention is to combine the stormwater and wastewater models into a single integrated model. As Otane has no reticulated stormwater system, the results of this model will be useful in determining options for private stormwater drainage in Otane - i.e. whether roadside drainage will be sufficient or whether reticulation is required.

1.7.5 Pipe Renewals

Along with the programme of I&I reduction, CHBDC have budgeted $1.2-1.5m for the first 4 years of the LTP along with approximately $600k per year for years 5-10 of the 2021 LTP for wastewater renewals. This equates to a total of $9.7m for the 10 years between 2021-2031 of the LTP. Wastewater renewals are to be considered when investigating and proposing I&I reduction works. WSP have identified a draft programme of renewals, based on pipe age and material. The renewals programme is to be validated against recommendations of the I&I Management Plans and the network modelling results.

1.7.6 Stormwater Maintenance and Upgrades

A programme of works has commenced to review compliance with CHBDC’s stormwater consent conditions, and to identify maintenance and upgrade projects. Maintenance of swales and culverts in Otane is proposed for the first physical works project under this programme.

---

$^3$ Central Hawkes Bay District Council Waipawa and Waipukurau WWTP Upgrade Scheme Concept Design, Beca, August 2020
2 Inflow and Infiltration Overview

2.1 Inflow and Infiltration Background

Inflow and Infiltration (I&I) is the sum of Rainwater Derived Inflow and Infiltration (RDII) and Groundwater Derived Inflow and Infiltration (GWDII). RDII is typically derived from the following sources:

- Roof downpipes discharging into gully traps or directly to wastewater lateral pipes
- Low or faulty gully traps
- Stormwater sumps connected to the wastewater network
- Vented manhole lids in the overland flow path
- Leaky manhole lids

GWDII results in a continuous baseflow for an extended period of time (subject to seasonal groundwater fluctuations), and is generally due to:

- Cracked, broken or leaky mains, lateral pipes and manholes below the groundwater level
- Incorrectly installed pipe joints, lateral connections and manhole connections below the groundwater level
- Pipe joints that have deteriorated and failed with the passage of time such as lime mortar joints in earthenware sewers, spigot-socket joints with tree root intrusion
- Disused private drainage connected to the wastewater network (i.e. septic tanks)

Figure 2-1 shows typical sources of inflow and infiltration to the sewer network.

![Typical sources of inflow and infiltration to the sewer network](image-url)
RDII is characterised by fast and slow increases in flow in the network observed by elevated flows following a rainstorm. GWDII contributes a consistent low baseflow. Figure 2-2 shows a hydrograph demonstrating the different flow characteristics due to RDII and GWDII in a sewer network.

![Hydrograph of different elements of I&I response following a rainfall event.](image-source: www.innovyze.com)

From Figure 2-2 it can be observed that RDII results in fast, "peaky" increases in flow, while GWDII contributes a constant baseflow, as observed by the following areas in the plot:

- **Fixed or Wallingford**: Fast, direct response due to hardstand areas directly connected to the sewer network (i.e. roofs via downpipes to laterals, low gully traps in hardstand areas, stormwater sumps disconnected)
- **New Percentage Runoff (PR) Equation**: Medium speed, direct response due to runoff from permeable areas such as lawns and grass verges. Enters the network through the same vectors as fast response runoff.
- **Soil Store**: Slow indirect response through rainfall percolating through soil and entering cracked pipes
- **Groundwater store**: Very slow, indirect response due to the groundwater table rise following a rainfall event
- **Baseflow**: Groundwater entering the sewer network through cracked manholes and pipes, defective joints and root intrusion where the network is below the groundwater table,

Factors that influence the amount of I&I received in a network are:

- **Extent of stormwater network and overland flow paths** (particularly in relation to private gully traps and leaky manhole covers)
- **Age and condition of network**
- **Pipe and lateral material**
- **Age of houses and standard of drainage works on private properties**
- **Dishonesty around the discharge location of downpipes**

---

1. Image source: www.innovyze.com
- Frequency and extent of drainage contractor errors in regard to making connections into existing networks
- Groundwater levels and soil type

A corollary of leaky networks is that when groundwater levels drop below the pipe network, raw wastewater may seep out of the pipes and into the groundwater table via exfiltration from the pipe network. This creates potential environmental hazards and a risk to public health, particularly if drinking water supplies are drawn from the same water table.
3 Existing Wastewater Networks

3.1 Overview

3.1.1 Network Description

The wastewater networks for Otane, Porangahau, Takapau and Te Paerahi were mostly constructed between 1979 and 1990 and are almost all plastic pipes. It is understood these networks replaced septic tanks, which were bypassed when the networks were constructed but remain in the ground (although it is reported that a significant source of I&I in the Porangahau network is from these septic tanks still being connected to the reticulation). The networks for Waipawa and Waipukurau are older, with sections first constructed in 1909 and 1922 respectively. As such these networks contain a mixture of earthenware, asbestos cement (AC), concrete and plastic pipes, with some older pipes in Waipawa having already been rehabilitated with Cure in Place Pipe (CIPP) liners. Plans of each network showing pipe material are shown in Appendix A.

Total pipe lengths for each of the CHBDC wastewater networks are summarised in Figure 3-1:

![Figure 3-1: Total length of pipelines by pipe material for each network](image)

The material used typically reflects the construction date, with earthenware pipe installed from 1910 until the 1970’s, and asbestos cement (AC) installed between 1960 to 1987. Plastic pipes have been installed from the 1970’s onwards. Figure 3-2 shows the lengths of pipe across the district by age and material.

---

1 Porangahau Stormwater Infiltration Management Plan, CHBDC, February 2010

2 DRAFT Community Infrastructure Strategy – 2021 – 2051, CHBDC, October 2020
Figure 3-2: Wastewater pipes by age and material in CHBDC networks.

3.1.2 Groundwater

Groundwater across the region is typically high. Groundwater levels are summarised in Table 3-1. Levels have been taken from the previous year’s data (April 2020 to March 2021) available from the nearest monitoring bore on the Hawkes Bay Regional Council website for Otane, Waipawa, Waipukurau and Takapau, and from a bore log drilled in 2003 for Porangahau.
Table 3-1: Indicative groundwater levels in study area.

The levels in Table 3-1 show that groundwater tables are generally shallow although can fluctuate by several meters. Therefore, lower lying parts of the networks in each of the towns are likely to be below the groundwater table for at least part of the year. Note that the monitoring bores are near but not in the towns, meaning there will be some variation in actual depth to groundwater in the towns.

3.1.3 Population Growth

The district is projected to experience significant population growth over the next 30 years. Population growth estimates are summarised in Table 3-2.

Table 3-2: Projected population growth estimates

The figures presented in Table 3-2 show that Otane and Porangahau/Te Paerahi are expected to more than double, Takapau and Waipukurau will almost double, while Waipawa has relatively low projected growth.

The projected population growth will put greater pressure on the wastewater network. However, new properties are unlikely to contribute significantly to I&I as new drainage will be required to meet modern infrastructure standards and will utilise modern materials less likely to leak. Overall, reducing current I&I over time will free up capacity in the network to help support growth, with such growth posing low risk of I&I for any planned capital works upgrades.

---

7 Catchment Risk Assessment, Porangahau, Tonkin and Taylor, March 2021
8 Population Growth Impact Assessments letter, Beca, 30th October 2020
9 Growth Impact Assessments – Small WWTPs, Beca, 7th December 2020
3.1.4 Current Flows

Flow meter data has been analysed to quantify the magnitude of the I&I problem across the district. Where available, flows have been taken from the inflow meters to the WWTPs. Where not available, flows have been taken from the discharge meters from the WWTPs. Inflow meters are preferable for this analysis, for two reasons:

- All of the WWTPs have ponds. Ponds will provide some buffering of peak flows due to dynamic storage above the normal operating level.
- Direct rainfall on the pond surface will be adding additional volume measured through the outflow meter.

The inflow meters typically have a smaller data series to analyse than the outflow meters, as these have not been in place as long. Meter type and extent of data series are summarised in Table 3-3.

Table 3-3. Meter location and extent of data series for each WWTP in CHBDC district.

<table>
<thead>
<tr>
<th>Plant</th>
<th>Meter Location</th>
<th>Data Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te-Paerahi</td>
<td>Outflow</td>
<td>Jan 2017 - Present</td>
</tr>
<tr>
<td>Porangahau</td>
<td>Outflow</td>
<td>Jan 2017 - Present</td>
</tr>
<tr>
<td>Takapau</td>
<td>Outflow*</td>
<td>Jan 2017 - Present</td>
</tr>
<tr>
<td>Waipukurau</td>
<td>Inflow</td>
<td>Jan 2017 - Present</td>
</tr>
<tr>
<td>Waipawa</td>
<td>Inflow</td>
<td>Sept 2020 - Present</td>
</tr>
<tr>
<td>Otane</td>
<td>Inflow</td>
<td>Oct 2018 - Present</td>
</tr>
</tbody>
</table>

* Inflow meter exists but data series was incomplete, therefore outflow data has been used.

Daily flows from the SCADA data available have been analysed to understand the nature of the I&I and the magnitude of the problem. HBRC groundwater levels from nearby groundwater monitoring bores were analysed to identify periods of high and low groundwater. Daily flows during the high and low groundwater periods have been analysed to determine the extent of groundwater infiltration (or exfiltration).

Peak wet weather flows (PWWF) have been analysed and peaking factors determined based on the ratio of PWWF to the median average dry weather flow (ADWF). Total depth of rainfall and equivalent Average Recurrence Interval has been provided for the rainfall storm causing the PWWF, to provide context to the peaking factors. The equivalent ARI is based on comparing the historical storm to a storm of equivalent depth and duration from the HIRDS V4 tool. Note that the calculation of ARI becomes inaccurate below 1 in 1.58 ARI. Therefore, smaller storms are simply reported as being less than 1 in 1.58 ARI. It should also be noted that beyond an approximately 1 in 2-year ARI, incrementally larger storms are unlikely to have additional effect on flows observed at the WWTP. This is due to increased overflows in the network.

Note the recurrence interval of the rainstorm and rainfall depth do not directly correlate with wastewater flows received at the WWTPs, as antecedent conditions, ground saturation, groundwater levels, storm duration and nested or back to back storms all also contribute to peak flow events.

Flows are presented in Table 3-4.
<table>
<thead>
<tr>
<th>Plant</th>
<th>ADWF (m³/day)</th>
<th>Population</th>
<th>ADWF Per Capita (l/person/day)</th>
<th>PWWF (m³/day)</th>
<th>Peak Factor</th>
<th>PWWF Rainfall Event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Low GW</td>
<td>High GW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Te-Paerahi</td>
<td>67</td>
<td>N/A*</td>
<td></td>
<td>312</td>
<td>215</td>
<td>6.1</td>
</tr>
<tr>
<td>Porangahau</td>
<td>134</td>
<td>N/A*</td>
<td></td>
<td>255</td>
<td>525</td>
<td>12.8</td>
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<td>Takapau</td>
<td>93.5</td>
<td>45</td>
<td>255</td>
<td>620</td>
<td>151</td>
<td>9.3</td>
</tr>
<tr>
<td>Waipukurau</td>
<td>1,800</td>
<td>1,571</td>
<td>1,886</td>
<td>4,580</td>
<td>393</td>
<td>3.0</td>
</tr>
<tr>
<td>Waipawa</td>
<td>379</td>
<td>376</td>
<td>767</td>
<td>2,180</td>
<td>174</td>
<td>7.9</td>
</tr>
<tr>
<td>Otane</td>
<td>91</td>
<td>87</td>
<td>177</td>
<td>710</td>
<td>128</td>
<td>6.0</td>
</tr>
</tbody>
</table>

*Groundwater monitoring data unavailable for Te-Paerahi and Porangahau therefore only the median is reported
**No rainfall was recorded at the nearest rain gauge to Waipawa during the peak flow event

Table 3-4: Ratio of average dry weather wastewater flows to peak wet weather flows
The figures presented in Table 3-4 show that:

- All networks have high peaking factors, except for Waipukurau
- Waipukurau has a lower peaking factor, however there is also a shorter period of SCADA data from which to analyse flows
- Takapau, Waipawa and Otane all have significant variation in ADWF between high and low groundwater periods, indicating significant infiltration
- Takapau has very low ADWF during low groundwater periods, indicating exfiltration.
- Porongahau and Waipukurau have high per capita consumption. Part of Waipukurau’s high per capita consumption may be explained by trade waste and industrial users, which contribute approximately 15% of the town’s flows.\(^{10}\)

Per capita flows of less than 170l/p/d are indicative of exfiltration, while flows of greater than 270l/p/d are indicative of significant groundwater infiltration.\(^{11}\) This suggests that despite the approximately 15% of flow from industrial users, Waipukurau still has a groundwater infiltration problem. Porangahau has a significant groundwater infiltration problem. Porangahau’s infiltration problem may be exacerbated or caused by the direct connection of septic tanks to the sewer system when the system was installed in 1988.\(^{12}\)

The per capita flows during low groundwater periods also indicate both Takapau and Otane experience exfiltration. The fluctuation in dry weather flows between high and low groundwater periods indicate these two towns have particularly leaky networks.

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\(^{10}\) The Big Wastewater Story – District Wastewater Treatment and Discharge Management Strategy, CHBDC, September 2020

\(^{11}\) Infiltration & Inflow Control Manual Volume 1, Water New Zealand, March 2015

\(^{12}\) Porangahau Stormwater Infiltration Management Plan, CHBDC, February 2010
4 Management Strategy

4.1 Overall Approach

The management strategy presents a methodology for prioritising investigations; identifying defects causing I&I; developing a programme of field investigations; repairing defects, implementing asset renewals or capacity upgrades (to be determined by the hydraulic modelling), and quantifying the effectiveness of reduction measures.

The management strategy has been separated into different strategies for private and public side infrastructure. Repairs to the public side are simpler for the Council to implement as they own and have greater access to the asset. Repairs to the private side are more difficult as, although Council bylaws allow the Council to enforce repairs and recover costs if necessary, repairs are dependent on public compliance.

The steps in the strategy are described in the sections below and presented as a flow chart in Figure 4-1.
Figure 4-1: Proposed management strategy flow chart
Typically, approximately half of removable I&I enters the wastewater network through private laterals\textsuperscript{13}. However, this factor is network specific. For the I&I reduction programme to be successful works are required on both the private side and public side of the network.

Factors to be considered when prioritising investigations, repairs and renewals are:

- Extent of stormwater system
- Catchment peaking factors
- Baseflow from GWDII
- Plans for downstream upgrades – i.e. new WWTPs
- Growth projections
- Historical evidence of causes of problem (i.e. septic tanks in Porangahau)

A leaky network prone to I&I may have high levels of exfiltration when seasonal groundwater levels are low. This poses a potential health risk if water supplies are drawn from the same groundwater table, particularly private bores where no reticulation exists. The lack of adequate stormwater infrastructure will make I&I reduction more difficult, and most of the towns have little to no stormwater infrastructure. This is discussed further in Section 4.2.4.

Table 4.1: Summary of extent of stormwater reticulation for CHBDC towns considered for I&I management strategy

<table>
<thead>
<tr>
<th>Town</th>
<th>Stormwater Reticulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porangahau</td>
<td>Limited</td>
</tr>
<tr>
<td>Te Paerahi</td>
<td>Approx. half of town</td>
</tr>
<tr>
<td>Takapau</td>
<td>✓</td>
</tr>
<tr>
<td>Otane</td>
<td>Limited</td>
</tr>
<tr>
<td>Waipukurau</td>
<td>✓</td>
</tr>
<tr>
<td>Waipawa</td>
<td>✓</td>
</tr>
</tbody>
</table>

Wet weather peaking factors as per \*Groundwater monitoring data unavailable for Te-Paerahi and Porangahau therefore only the median is reported

\**No rainfall was recorded at the nearest rain gauge to Waipawa during the peak flow event

Table 3.4.4 show which towns have the biggest I&I problems. Removing the worst of the I&I first will be more cost-effective, as further reductions will become progressively harder to identify and repair.

Understanding the baseflow from groundwater infiltration will allow further prioritisation of catchments beyond only considering peak factors.

Implementing repairs to Waipukurau, Waipawa and Otane first may allow review of the flow basis of design for the new Waipawa WWTP, reducing capital costs.

Growth projections will influence where I&I management should be focused, as reducing I&I frees up capacity in the network and treatment facilities. This provides capacity to support further growth and potentially delay upgrades.

\textsuperscript{13} Infiltration & Inflow Control Manual, Water New Zealand, March 2015
4.2 Private Side Works

4.2.1 Illegal Stormwater Connection Bylaw

Council’s bylaws may be used to enforce residents to repair defects on private property. The proposed CHBDC wastewater bylaw 2021\(^{14}\) requires that the customer must take reasonable steps to ensure that:

- There is no direct connection of any stormwater pipe or drain to the wastewater system
- Gully trap surrounds are sealed and set above stormwater ponding or overland flow path levels
- Inspection covers are in place and are sealed
- Private drains are kept and maintained in a state free from cracks and other defects

In the event that defects are identified, the Council may serve a defects notice advising of the defect and steps to be taken to remedy the defect, with the onus on the customer to remedy the defect. If the customer does not repair the defect, the bylaw allows the Council to repair the defect and to recover the cost. The process of inspections and issuing of defects notices is outline in Appendix B.

4.2.2 Private Side Defects Repairs

While the responsibility to remedy defects on the private side lies with the landowner, the Council will need to undertake on-property inspections to identify defects.

Following inspections, the Council will issue defects notices to landowners. A round of follow up inspections will be required to determine whether defects have been repaired. If defects are not repaired the Council will need to make a political decision over whether to enforce the repairs under the bylaw and recover costs.

If the Council wish to achieve quick improvements in I&I from the private property side, they may need to consider partially or fully funding repairs. Otherwise repairs will take longer and are likely to have an overall lower successful completion rate. It should be noted that the most successful private lateral rehabilitation programmes have involved agency funding (i.e. council funding)\(^{15}\).

If paying for these repairs, the Council would need to consider potential political implications, such as certain residents appearing to get a “freebie” off the Council or setting a precedent for repairing private defects. This may be perceived as inequitable to any landowners who have recently financed their own repairs.

Other schemes which may improve participation rates are where the Council engages a contractor to undertake repairs and recovers the cost from the resident. This could be through a rates levy, loan scheme or similar to spread the cost to the resident. Other benefits of the Council engaging the contractor are:

- Same contractor is undertaking each item of works, resulting in economies of scale and better familiarity with work and specifications
- Less effort required on behalf of the resident, therefore more likely to take up the offer

For context, a programme of I&I reduction works by the former North Shore City Council achieved 75% rehabilitation of private laterals with the financial responsibility on the property owner\(^{13}\).

A paper is being prepared for presentation to the Council on the 12th of August presenting options for funding of private side repairs. Following the meeting the Council will decide on the approach for private side repairs.

4.2.3 Communications Plan

Achieving meaningful reductions in I&I on the private side of the boundary will depend on high levels of public engagement. A strong communications plan is critical in achieving this. Educating residents on the

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\(^{14}\) Part 22: Draft Wastewater Bylaw, February 2021

\(^{15}\) Infiltration & Inflow Control Manual, Water New Zealand, March 2015
causes and effects of I&I, and the consequent environmental and public health benefits and savings to ratepayers from reduced capital and operating expenditure will help motivate some residents to implement works. Communications with the public typically take the form of:

- Dedicated website or web page on Council’s website
- Public Meetings
- Brochures (dropped in mailboxes or handed out at public meetings)
- Dedicated email or webpage enquiry form

In the public communications plan it will be critical to outline who is responsible for payment for repairs on the private side of the property.

Marketing and branding of the I&I management programme may assist with public engagement. Gisborne District Council’s (GDC) Drainwise project is an example of marketing the project to increase public engagement. The communications plan included making YouTube videos to explain the drainage network, inflow and infiltration, and why reducing overflows is important. The website also provides up to date details of the project, with a page for residents to submit flooding issues, while the GDC Facebook page provides high visibility of the project. GDC had a presence at community events to promote the initiative, such as the A&P show.

4.2.4 Stormwater Reticulation

Reducing I&I from defects in the private side is complicated by the lack of reticulated stormwater networks in many of the towns. The absence of a stormwater system has been shown to significantly contribute to I&I due to the inability of stormwater to drain away and due to illegal direct connections made to the wastewater system in the absence of an alternative\(^\text{16}\). It may be difficult to enforce disconnection of downpipes connected to the wastewater system without an adequate stormwater system. If downpipes are disconnected, the Council may find landowners simply divert them back into gully traps to prevent surface flooding on property. Anecdotally this has occurred in the past.

Investigation into the requirement for and feasibility of a more comprehensive stormwater system in the towns with no stormwater infrastructure is recommended. Budget for this could be sourced from the I&I management programme, as improved stormwater drainage will assist I&I reduction. The results of the stormwater model for Otane being constructed by Stantec will help quantify the extent of the problem and identify solutions.

4.3 Field Investigations

4.3.1 Public Side Field Investigations

Typical field investigations on the public side of the network consist of:

- Visual inspection of manholes
- CCTV filming of pipes and laterals
- Smoke testing
- Distributed Temperature Sensing (DTS)
- Dye testing

Visual inspections of manholes and CCTV filming of pipes are considered the highest priority field investigations as they are relatively low cost, can be provided by a number of service providers, and will be required to provide condition assessments to inform the renewals programme. As well as providing a condition assessment of the manholes, visual assessment of the depth and clarity of flow through the

\(^\text{16}\) Infiltration & Inflow Control Manual, Water New Zealand, March 2015
manhole channels is a good indication of GWDII when inspections are undertaken during dry weather. A similar assessment of characteristics such as clarity and flow rate in wet weather can help quantify RDII.

Smoke testing is relatively low cost and is good at identifying miss-connected stormwater sumps, house downpipes or other cross connections. The effectiveness is reduced in areas with high groundwater, surcharged pipes or deep pipes. Given potential high groundwater levels, smoke testing may be less effective in lower areas of Otane, Waipukurau and Waipawa.

DTS consists of laying a fibre optic cable through the invert of the pipeline. Pulses of light are transmitted through the cable which can accurately measure differences in water temperature at specific points along the sewer. Therefore, DTS is good at locating point source inflows from groundwater or rainwater, which tend to be colder than population derived wastewater flows. DTS is relatively new technology and City Care are currently the only known service provider in New Zealand. Christchurch City Council have had reasonable success in using DTS to inform I&I reduction programmes.

Dye testing typically involves flushing non-toxic dyes down stormwater drains and observing the wastewater network for the dye. It is a low cost and low technology test for identifying cross connections, although is labour intensive and has variable results due to the necessity to observe the correct sewer at the correct time. It is likely to be more beneficial for identifying defects on the private side of the boundary, which requires access permission. In particular, dye testing may be useful at identifying septic tanks still connected to the network.

Following inspections and CCTV, it can be decided whether further investigations are required. Further investigations may be implemented following completion of works identified by CCTV and inspections if necessary, depending on follow up analysis to quantify the success of the I&I management works and remaining budgets.

4.3.2 Private Side Field Investigations

Private side field investigations will require property inspections to identify downpipes discharging to gully traps and low and cracked gully traps. Smoke testing and CCTV filming can be used to locate cracked laterals on the private side of the property. The network conditions will need assessed prior to undertaking smoke testing to determine whether it is an appropriate test.

A potentially large source of I&I from the private side is through disused septic tanks which may not have been disconnected correctly when the reticulations were installed. This is relevant to Otane, Takapau, Porangahau and Te Paerahi, which have relatively new reticulations (constructed in the 1980s). It has been noted previously that septic tanks in Porangahau were connected to the network at the time of construction. These could be identified through review of property files, CCTV of private laterals (although is slow and invasive due to need to film from gully trap), visual inspection and dye testing.

4.4 Priority Catchments

Priority catchments to inform the programme of investigation works are to be determined by:

- Assessing flows and peaking factors as per Table 3-4.
- Further assessment of flows from flow monitoring exercises in Waipukurau, Waipawa and Otane
- Pipe age and material
- Growth projections
- Preliminary visual observations
- Priority and scale of downstream upgrades (specifically WWTP upgrades)
- Compliance with resource consent limits for discharge

Pipe age and material has been provided by CHBDC in GIS layers. Along with peaking factors, age and material will be analysed as this will help identify pipes for renewals. Appendix A presents maps of each of
the wastewater networks, delineating pipes by material. By identifying the catchments with the worst I&I, we can focus investigations on areas most likely to have the “low hanging fruit”.

From the plan of Waipawa in Appendix A, a lot of the network in the lower lying areas has been rehabilitated by pipe re-lining. This was undertaken around 2009. Anecdotally, other territorial authorities have had sewer relining fail after 10 years. It is therefore proposed initial CCTV investigations review the relined sewers to assess the condition. As relining is a potential remediation, its previous success needs to be reviewed as part of this Strategy.

Consideration of growth projections may inform priority areas for investigations, as removing baseflow from areas with high predicted growth may allow deferring of capacity upgrades. It is assumed the scope of works for WSP and Stantec’s respective modelling exercises includes growth modelling and will identify mains requiring up sizing to support the growth. These recommendations are to be considered when undertaking repairs under the I&I Investigation and Repair contract as an upgrade may supersede the need to repair.

Reducing I&I potentially offers savings on proposed infrastructure projects downstream, therefore prioritisation of investigations and remedial works should be located where the largest capital works savings can be achieved. This is essentially Otane, Waipukurau and Waipawa due to the new WWTP proposed.

It is therefore proposed that the following areas are prioritised for investigation:

- Low lying areas in Waipawa, due to the extent of ADWF received during high groundwater periods and to assess effectiveness of previous relining projects, and the potential for large downstream savings in capital and operating costs
- Earthenware pipes in Waipukurau, due to relatively high per capita wastewater flows, extent of earthenware pipe in the network, and potential for large downstream savings in capital and operating costs
- Porangahau, due to the very high per capita wastewater flows and the potential for quick wins by removing disused septic tanks from being connected to the network.
- Takapau, due to the variation in ADWF between high groundwater and low groundwater periods, and the subsequent high levels of infiltration and exfiltration respectively.

The extent of investigations will need to be reviewed once the contract is awarded and contract rates established, to determine the investigations can fit within CHBDC’s budgets. Further prioritisation of investigations may be required to depending on the budgetary requirements.

Further prioritisation will also be required depending on each discharge’s compliance with resource consent limits for discharge volumes. These are detailed in the I&I Management Plans for each of the networks.

Although Otane has high levels of I&I, comprehensive investigations have already been undertaken, and a programme of works is underway to repair or replace manholes. From the investigation results, it is likely the largest gains will be made on the private side, following manhole repairs. The success of private side defects repairs are also likely to be dependent on the recommendations from Stantec’s stormwater modelling project.

4.5 Update Management Plans

Conditions of the resource consents to discharge treated effluent from the Waipawa and Waipukurau WWTPs require Infiltration and Inflow Management Plans to be submitted and updated annually, detailing:

- Work carried out to reduce I&I
- Strategy going forward to further reduce I&I
- Timeframes for works
• Details of actions undertaken in accordance with the I&I management plans

A district wide I&I Management Plan was prepared in February 2007. Specific management plans were prepared for Porangahau and Te Paerahi in February 2010 and for Waipawa and Waipukurau in November 2010. These plans have not been updated since originally published and are currently being updated for submission to HBRC prior to the 1st of August 2021. Plans are being updated for all of the networks.

4.6 Implement Strategy

4.6.1 Physical Works

A Tender is currently out to market to procure a contractor to undertake investigations and to undertake physical works to reduce I&I in all networks across the district. Once the Tenders are received and the contract awarded, the contract rates can be used to build up a quantum of works to fit within the project budget. This will determine the extent of investigations of the priority catchments and whether further prioritisation is required.

Once investigations have been undertaken, repairs and renewals can be determined. Cost estimates will be prepared from the Contract rates and the Contractor (if repair method is not included in the rates) to determine that the quantum of work is within CHBDC’s budgets, and to further prioritise works within those budgets.

4.6.2 Update Design Basis for WWTPs

Once I&I reduction works have been implemented, flows to the WWTPs will be reviewed to assess the effectiveness of reduction measures and revise the design basis for the new WWTPs. Note that the detailed design is set to recommence in 2022, therefore there will not be a large data series. In addition, other factors including rainfall events and groundwater levels will need to be considered. Changes to the design basis will need to err on the conservative side, given the short data series on which to draw conclusions.

Te Paerahi and Porangahau do not have flow meters on the terminal pump stations. It is recommended that flow meters are installed on the pump station rising mains to measure inflow to the WWTPs.
5 Recommendations

It is recommended that the following catchments are prioritised for CCTV investigations once the I&I Investigation and Reduction physical works Contractor is appointed:

- Low lying areas in Waipawa, to determine the effectiveness of previous pipe relining, extent of groundwater infiltration and to capture any potential benefits to the design of the WOW project.
- Earthenware pipes in Waipukurau, to identify and repair defects to capture any potential benefits to the design of the WOW project.
- Porangahau, to determine the extent of disused septic tanks connected to the network, potentially enabling quick wins in reducing I&I in this catchment. This may allow reduced capital expenditure for the new or upgraded plant proposed in Porangahau.
- Takapau, due to the apparent amount of infiltration and exfiltration during high and low groundwater periods respectively. This is indicative of a particularly leaky network and removing these issues will result in improved environmental outcomes. Losing less wastewater to exfiltration will also allow for a more appropriate design basis for the new WWTP.

Prioritisation of investigations will also need to consider compliance with resource consent discharge limits, once all of the I&I Management Plans are complete.

Once the physical works contract is awarded, the extent of investigations will be valued to ensure it fits within the budget. Consideration will be required to implementing repairs in Waipawa and Waipukurau whilst leaving sufficient time to collect data to review the design basis for the WOW upgrade scheme.

It is also recommended that:

- CHBDC install flow meters on the terminal pump stations in Porangahau and Te Paerahi to allow measurement of inflows to the WWTP, and quantify reduction in I&I.
- Private side fault repair strategy in Otane is to consider the lack of stormwater network and the outcomes from Stantec’s stormwater modelling.

Manhole repairs in Otane being done by Downer are on hold until groundwater levels rise, allowing for re-assessment of priority manholes.
6  Next Steps

The next steps in the project are to:

- Update and submit I&I Management Plans to HBRC
- Evaluate Tenders and award Contract for physical works investigations and repairs
- Value investigation works against Contract rates and determine quantum of investigations
- Instruct Contractor to undertake investigations
- Review results of investigations, create schedule of repair works
- Review proposed repairs against outcomes of hydraulic modelling studies, to determine if pipes should be replaced rather than repaired.
- Review SCADA data to determine effectiveness of repairs and revise design basis for WOW scheme
- Prepare and submit paper to Council on options for funding private side defects
- Undertake programme of private side repairs, depending on outcome of Council decision
- Consider options for stormwater in Otane, following outcomes of Stantec modelling exercise
7 References

- DRAFT Community Infrastructure Strategy – 2021 – 2051, CHBDC, October 2020
- Infiltration Update Report to Council 29th October 2009
- Otane Wastewater Network Repair/Rehabilitation Plan, Veolia, 27th May 2020
- Central Hawkes Bay District Council Waipawa and Waipukurau WWTP Upgrade Scheme Concept Design, Beca, August 2020
- Water Network Modelling Standard, Watercare, December 2017
- Infiltration & Inflow Control Manual, Water New Zealand, March 2015
- CHBDC Draft Wastewater Bylaw, February 2021
- Catchment Risk Assessment, Porangahau, Tonkin and Taylor, March 2021
- Population Growth Impact Assessments letter, Beca, 30th October 2020
- Growth Impact Assessments – Small WWTPs, Beca, 7th December 2020
- Porangahau Stormwater Infiltration Management Plan, CHBDC, February 2010
- The Big Wastewater Story – District Wastewater Treatment and Discharge Management Strategy, CHBDC, September 2020
Appendix A – Pipe Network Plans
Defect Notice Process

Defect notices

Defect Notices are issued where the wastewater and/or stormwater installation on premises (including private property) does not meet the New Zealand Building Code, NZS4404:2010 Land development and subdivision infrastructure, or Council’s requirements under the Wastewater Bylaw 2021, or the Stormwater Bylaw 2021, or via any consents issued.

Non-compliant installations can result in stormwater getting into the wastewater system. This can cause overflows from the wastewater system – at people’s houses and into the environment. It can also mean toilets can’t be flushed and water can’t be used in the house in some situations, particularly in wet weather.

Defect Notice Process

The first Defect Notice issued will contain information regarding the defect Council has identified on the premises. It will give a due date for the defect to be remedied – normally 1-2 months. Resolving the defect is the Customer’s responsibility.

A re-inspection is to be undertaken after the deadline date given in the letter.

If the defect is not resolved, Notice 2 will be sent to the Customer, noting the fact that the defect was not resolved when the property was re-inspected (noting date of re-inspection). A new deadline date is to be given in the letter – again, normally 1-2 months.

A re-inspection is to be undertaken after the deadline date given in Notice 2.

If the defect is not resolved after the second re-inspection, a third notice is to be sent to the Customer, outlining the next steps.

Defect identified through inspection.

Notice 1 sent to customer with details of defect and date to be resolved by.

Re-inspection undertaken.

Defect not resolved

Notice 2 sent to customer noting re-inspection date, and new date of when to be resolved by.

Re-inspection undertaken.

Notice 3 sent to customer outlining next steps.

Defect resolved

Letter sent to customer confirming defect is resolved

Defect resolved

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