OPOTIKI DISTRICT COUNCIL FUNDED WORK ON PRIVATE LATERALS

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ABSTRACT

The Ōpōtiki District Council public sewer network is old (1950's), leaky, and subject to significant inflows of stormwater and infiltration (I&I) associated with storm events. Asset management decisions needed to be made which address the age and sometimes poor condition of the sewer network, and the contribution of I&I flows to the wastewater treatment plant from the public wastewater system and private laterals. Large I&I flows result in significantly increased volumes (> 10x ADWF) requiring wastewater treatment, and disposal.

Ōpōtiki town has a population of 3,879[1] (Statistics New Zealand, 2013), with 1,437[1] occupied dwellings. The median income for Ōpōtiki is $19,600pa[1] (Statistics New Zealand, 2013) (vs national median of $28,500[1] 2018 census data), and unemployment rate of 13%[1] (vs 7.1% nationally[1]).

Private laterals were found to be significant contributors to the overall I&I. A decision by a Council working group for Council to fully fund inspection and repair of all domestic private laterals was made. Latterly it was agreed that commercial laterals would be inspected and repaired as well. The inspection and repair has been carried out using a combination of open trench and trenchless technologies.

This paper describes the decision-making process, asset planning, and program of works undertaken by the Ōpōtiki District Council for the private and public wastewater network, and the treatment system.

KEYWORDS
Wastewater treatment, stormwater, trenchless technology, asset management planning, trade waste, gully traps, panel contract

PRESENTERS PROFILE

Sarah has been an employee of Opus and WSP for 11 years, working in the areas of municipal wastewater, onsite wastewater treatment, stormwater design and project management, and prior to that in Industrial Wastewater (5y) and Regulatory Roles (3y).

Janan has worked in design, contract management and project management of several three waters projects for over 15 years in New Zealand local councils.

1. INTRODUCTION

This paper reviews the asset management approach, council funding, and repair/rehabilitation technology approaches applied to private sewer laterals in the township of Opotiki.

The Ōpōtiki District Council had approved in the 2012-2022 Long Term Plan to investigate, renew and potentially extend the existing sewerage system in Opotiki. The impact of the project on a large section of the District's community, the potentially high estimated cost of the project, and the impact this would have on future generations made this a very significant project for the Ōpōtiki Council. Accordingly Council formed a Project Steering Committee, charged with overseeing the project to:

- Ensure prudent decision making as a step by step process to achieve the optimum outcome
- Manage two-way communication with the affected community
- Manage the broader risks posed by the project, both financially and in terms of any necessary trade-offs that might arise.

Deteriorated sewer assets, high groundwater levels, flat, low lying land and illegal stormwater connections were all contributing to high wet weather sewer flows (>10x ADWF) in Ōpōtiki, combined with an undersized stormwater system, resulted in poor levels of service in storm events.

In considering rehabilitation work, the Opotiki District Council was forced to consider the low rating base, with a median income of $20,700(district) (vs the national median of $28,500).

The Council made the decision to comprehensively address all the issues of deteriorating sewer mains & manholes, wastewater overflows, undersized stormwater systems and the inflow and infiltration (I&I) contribution from public sewer and private laterals.

2. BACKGROUND

Opotiki Township was reticulated in the 1950s. Five pumpstations deliver wastewater to the treatment system to the north of the town.

The township itself is relatively flat, and bounded to the north, east and west by the Otara and Waioeka rivers, both of which are tidal. Ground conditions are alluvial and estuarine flood plain, with interbedded silts, gravels and estuarine muds.

Parts of town are as little as 2m above sea level, with the highest being 5 - 6m above sea level. High groundwater is normal, particularly at the north end of

town, where groundwater level has been observed to fluctuate with the tide. Further, groundwater levels become elevated when river levels are high.

Stormwater is managed via a network of swale drains and piped reticulation, discharged via floodgated outlets. Stormwater is pumped when river levels are high.

3. WASTEWATER OVERFLOWS

Wastewater overflow has occurred in the past as a result of overloading of the wastewater system. The frequency of overflows had not been quantified prior to this project. Stormwater, during rainfall, direct inflow of illegal stormwater connections, low gully traps and infiltration from the deteriorating pipe network were suspected. Wastewater overflows sometimes occurred during dry weather, as a result of flat grades, dipped pipes, partial or full blockage of the pipe system, from pipe failure, tree roots, fat build up, or items such as sanitary wipes being flushed down toilets.

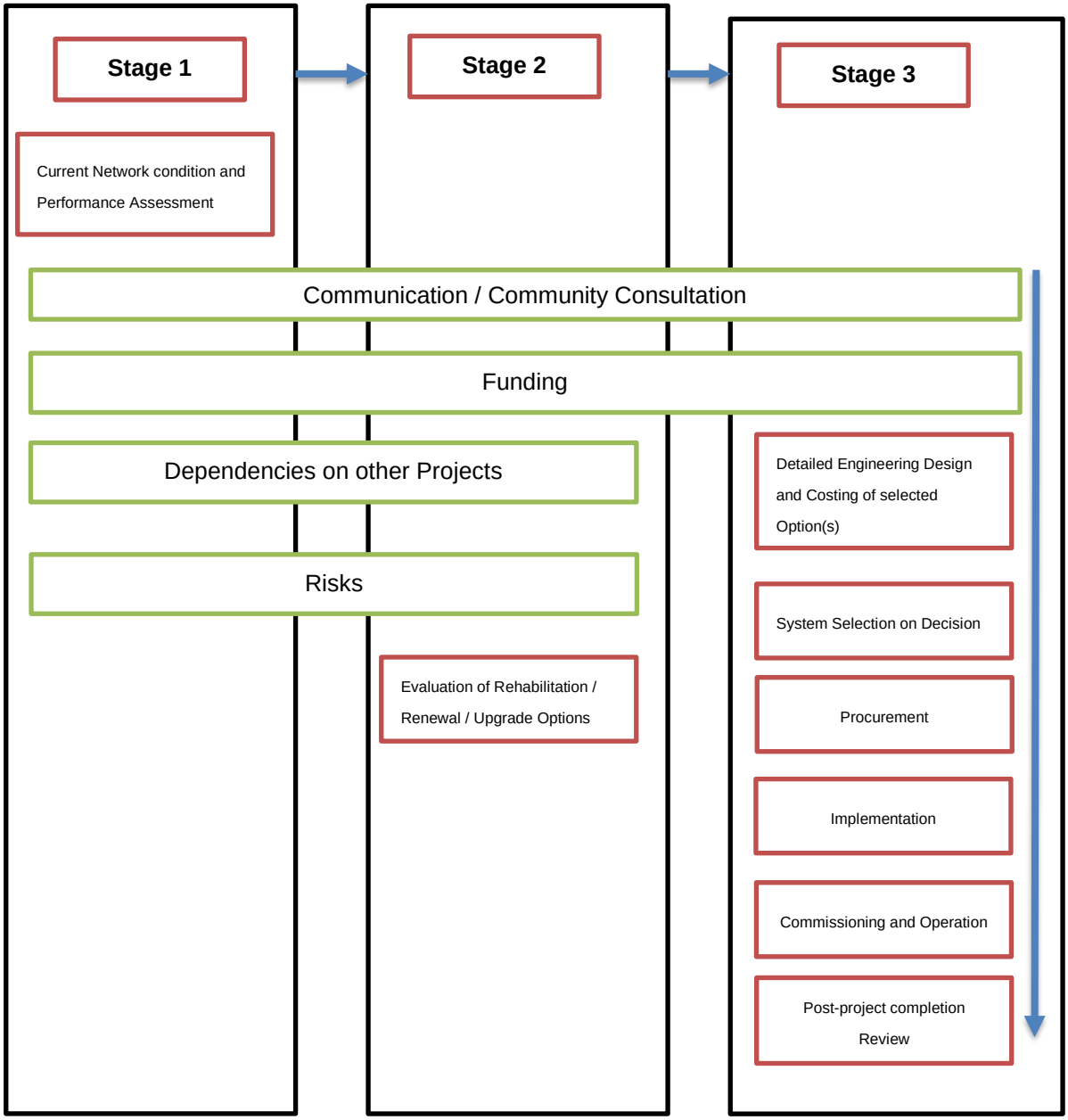
Wastewater overflows have many well-known adverse effects and pose risks to public health and the environment.

Presently Ōpōtiki District Council is working with Bay of Plenty Regional Council and along with seven other Territorial Local authorities in the Eastern Bay of Plenty Region to develop a guide "Regional Best Practice Guide for the Management of Wastewater Overflows" to manage the mitigation, response and reporting for wastewater overflows across the region by setting a minimum benchmark for evaluation of local Councils for when overflows occur.

4. PROJECT PROGRAMME

The Council agreed to take a thorough approach to assessing the current sewerage network condition and performance before adopting a particular upgrade or replacement solution. The below Project program shown in figure 1 depicts the proposed structure of the overall project:

Figure 1 Project Program



Opus Consultants (now WSP-Opus) were engaged to undertake investigations at stage one of the project. The brief was to assess the performance of the sewerage reticulation network within Ōpōtiki Township, identify the factors contributing to I&I and determine a preferred upgrade option for the sewer network.

Analysing the groundwater dynamics in the Ōpōtiki Township and the intersection with the two river systems, tides and rainfall events was critical to understanding the I&I problem.

To understand the performance during the range of wet weather and ground water conditions, Opus worked with ODC staff to install flow devices at several locations shown in figure 2 to electronically monitor groundwater throughout the township. The findings were based on about seven months of collected data through winter and some large rain events.

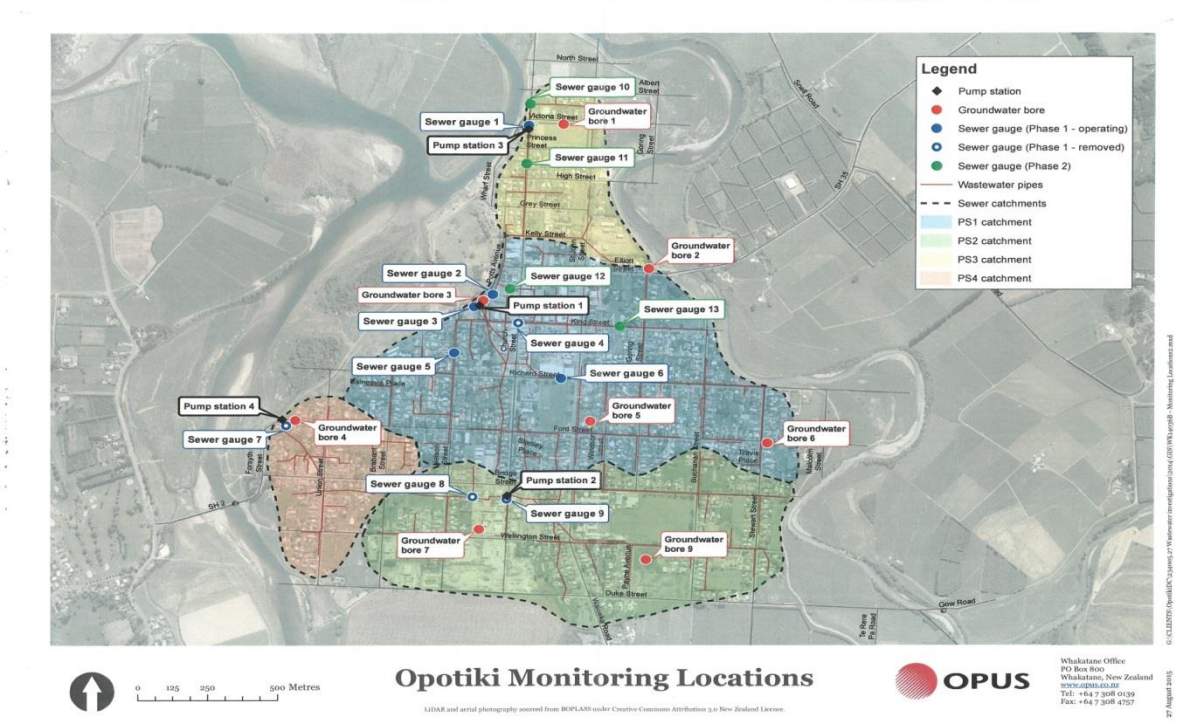


Figure 2 Opotiki Township Gauge and Catchment locations

The results indicated significant impacts from both direct inflow and infiltration with inflow producing fast response excess flows in the sewer pipes and infiltration also producing extreme flow during extended periods when the ground water rises appreciably. The investigation separated the town into four "catchment" areas which each drain to the main sewer pump stations.

5. DECISION MAKING

The existing wastewater system being costing top operate and providing a poor level of service to the ratepayers, led to pressure to investigate solutions. This came to a head with a period of frequent and severe storms from 2004 to 2012.

Council engineering staff put considerable effort into looking at alternative sewer reticulations including vacuum sewer. However, there was concern at the cost estimates, and the potential for Council to embark upon a path that would commit the community to a very large and uncertain capital expenditure.

Accordingly, Council resolved to take a step back and invest in a staged approach to problem definition to ensure that decisions on replacement or renovation were made on a sound basis. To ensure a coordinated approach to the towns sewage issues, ODC set up a project governance group. The sewerage upgrade steering subcommittee was formed to consider matters relating to the sewer upgrades outside of council meetings and make decisions to be ratified by council.

Opus Consultants were engaged to manage and coordinate a variety of investigations including council sewer loss of service, stormwater sizing issues and private contributions to the sewer.

Sewer options were considered in parallel, including new gravity sewer, new pressure sewer, and rehabilitation of the existing sewer.

NPV analysis showed that sewer rehabilitation – with a 50 – 80 year design life was the most cost effective solution, with a similar product life to new sewer, but at substantially reduced cost.

6. INVESTIGATION OF CONTRIBUTING CONDITIONS

Groundwater levels, river levels, and rainfall were all investigated to determine interrelationships with sewage volumes. Loggers were installed in September 2014, and continue to be monitored.

The monitoring of groundwater clearly demonstrated the strong linkage between rainfall, river level (including tidal river level) and groundwater level. The response of groundwater to rainfall was very fast with rises of over 1 m in a few hours.

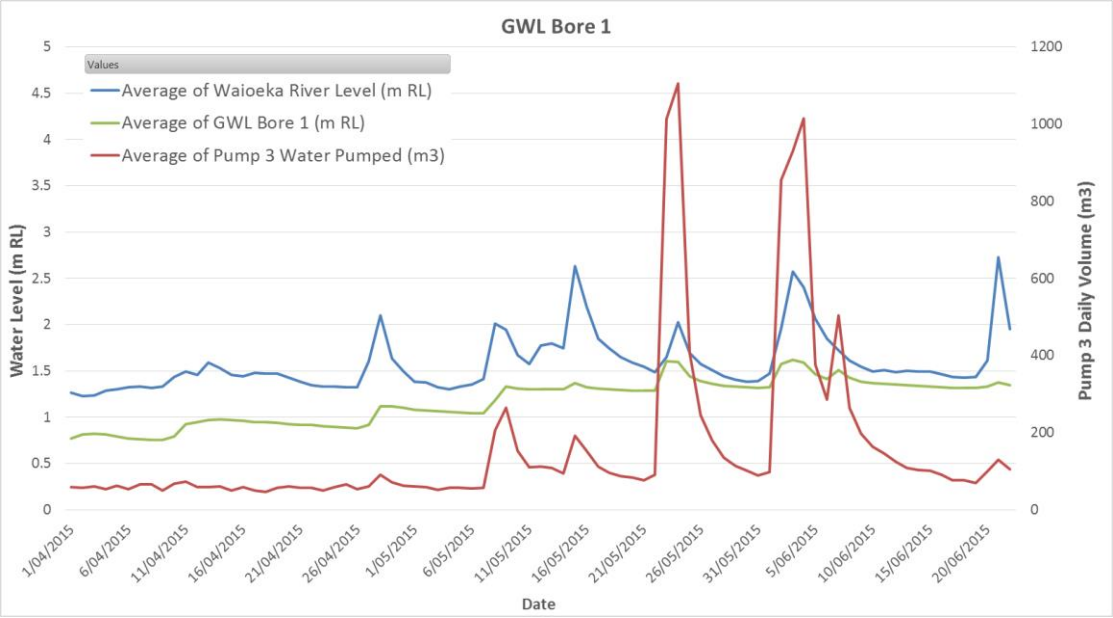


Figure 3 Groundwater, River level and pump station response

A two-pronged analysis of sewer flows was undertaken. Analysis of several storm events broke down the relative contributions of direct inflow, rain dependent infiltration and the longer duration base infiltration. As expected the direct inflow from rain was a large component of the flow.

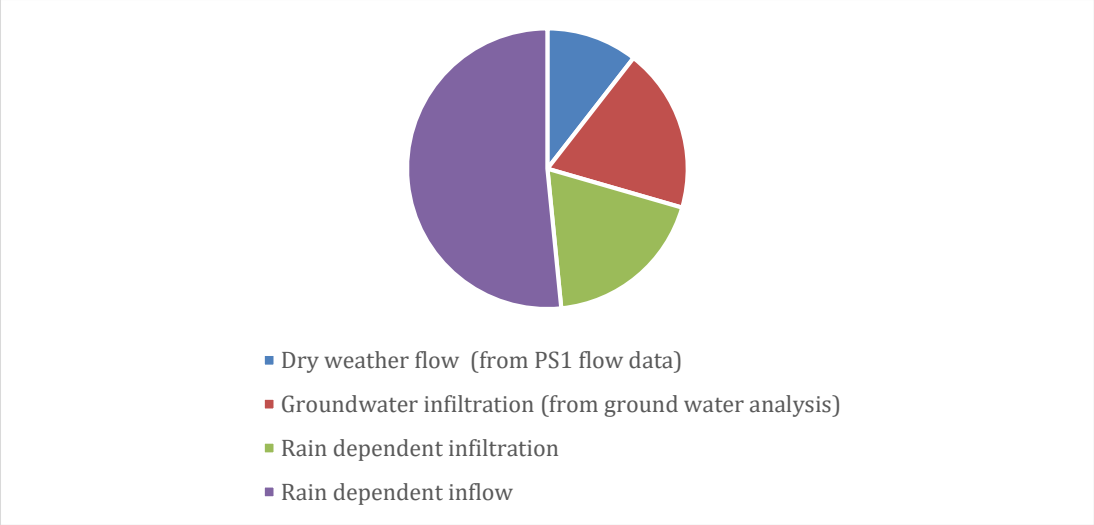


Figure 4 Daily Flow volume analysis (23 May 2015 event)

To better understand the relationship of infiltration to groundwater level an analysis was carried out to correlate pump station flows with groundwater level in dry conditions, i.e. excluding any record within 24 hours of rain. It had been postulated that the sewer pipes, many of which are permanently submerged, have a large number of defects and so infiltration would be a function of the head of water on the pipe. However, the analysis showed quite a different response curve. Essentially pump station flow was relatively constant in a defined band until groundwater reached to within 1.0-1.3m of the ground surface, at which point there was a step change in flow (Figure 5). This response was clear in the Pump station 3 catchment, but also showed up in the other catchments as well. This indicated an increase in "leakiness" of the system at shallow depth. The likely explanation for this was the response of the private infrastructure, which is generally above water table except after heavy rain or in winter.

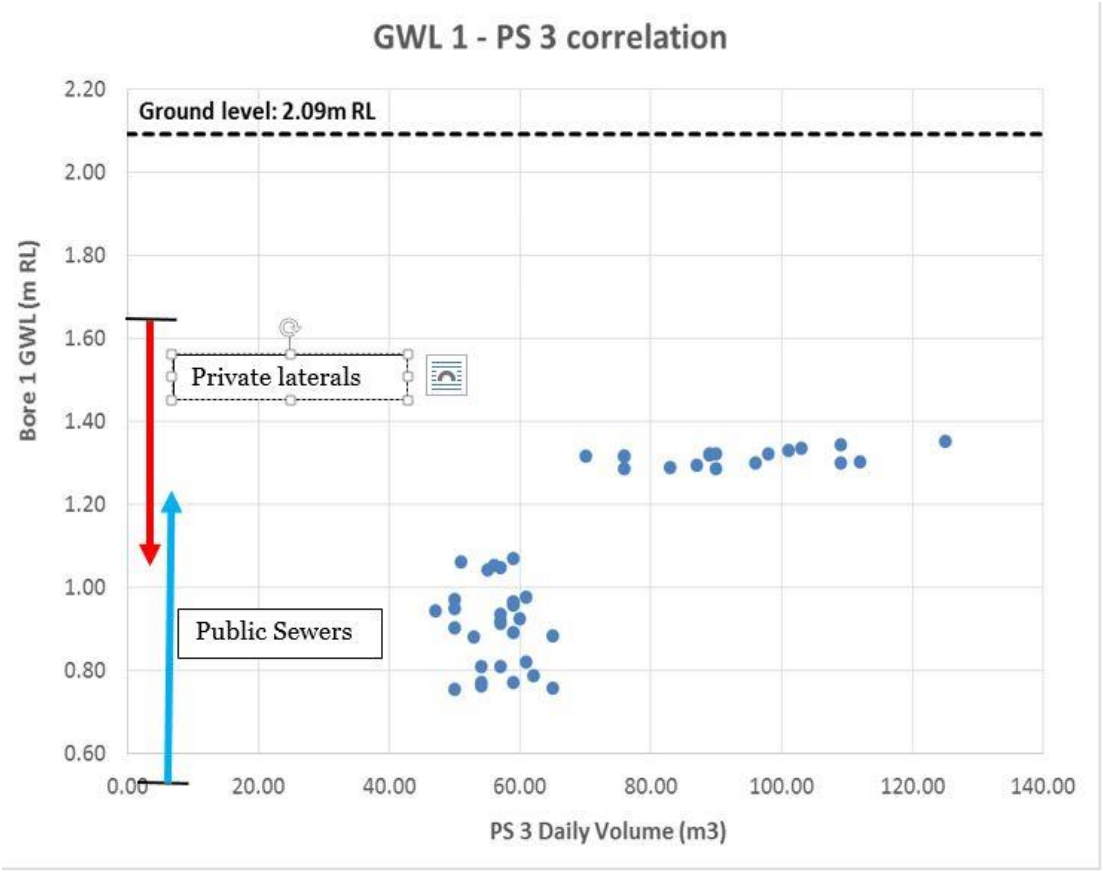


Figure 5 Correlation of groundwater level with PS 3 daily volume

7. PRIVATE PROPERTY WORKS, BUSINESS CASE, COUNCIL FUNDING

From the groundwater vs inflow investigation indicating 'leakiness at shallow depth' it was clear that direct inflow and infiltration at high groundwater depth were having a significant impact on wastewater volumes, and that private infrastructure was likely a major contributor to I&I.

The council subcommittee considered a number of options for funding private property work, including owner funding, council rates funding and council debt funding.

Ōpōtiki has low median incomes, low levels of home ownership, and high numbers of absentee landlords mean that trying to get work done on private laterals by the owners is time consuming, and expensive – council employees spent considerable hours getting owner/occupier approval to carry out council funded work.

Because of difficulties in getting low income home owners and absentee landlords to pay for work, which in some cases may have no discernible benefit for the occupant [i.e. occupant not experiencing any drainage difficulties], the decision was made for Council to fully fund the private property work as part of the overall scheme.

The sewerage steering committee opted to rates/debt fund the private property work because the repair or renewal work in the property gully traps, laterals and public laterals would reduce the inflow and infiltration into the ODC sewer network which in turn reduces "whole of life" costs and extend the useful life of the existing reticulation and pump stations. Without tackling the private infrastructure, the benefits of improvement to the public sewers would not be realised.

The reduction of I&I will also reduce the likelihood of sewerage overflows and loss of service which present a risk to public health and the environment.

8. PHASE 1 – PILOT INVESTIGATIONS

The area of reticulation serviced by PS3 was chosen for the pilot investigations. The PS3 catchment contains 120 properties. PS3 was chosen over other areas of town because of it's low lying nature, and because the sewer catchment and reticulation were relatively simple, with PS3 serving only the north end of town, and with pump operation not affected by activity in other parts of the reticulation network.

Approval was sought from every property owner in the catchment prior to works proceeding via bulk mailout. It was necessary to go house to house, and to search the ratings database, and NZ white pages, to capture all of the properties, and gain owner approval. Many home owners or tenants were found to have thrown away approval letter information, or not to have read the information provided, in some cases because it came on Council letterhead.

The contract for the works was let to two independent contractors, Opotiki Drainlayers and Waiotahi Contractors with approximately 60 properties each. Claims were paid on the basis of scheduled items including for the location of the lateral and inspection port, camera inspection, and faults repaired as described below. In some cases longer sections of pipe were replaced as required. Engineer's approval was required for anything more extensive than spot dig and repair.

Initial investigative work involved video inspection of private sewer laterals, and repair of faults contributing clean water to the sewer. Typical faults included cracked pipes, faulty joints, root intrusions (associated with either cracks or faulty joins), illegal stormwater connections, broken gully traps, old ineffective gully traps and gully traps which were too low. Low gully traps were a major contributor to inflow, due to low lying land and ponded storm water.

Faults were repaired at the time of inspection, unless they were extensive and requiring replacement of large sections of lateral line. Illegal stormwater connections are disconnected from the sewer, and routed away, with a notification letter delivered by the contractor. An additional inspection was conducted by council staff 6 months after the work, to ensure that the illegal connection

remained disconnected. Gully traps were repaired, and /or raised, based on known flood levels in the area.

As builts were a required part of the work, and in general, on-property work was not approved without the provision of as-built drawings for every house. As built information was required to include gully locations, inspection port (IP) locations and depths, line locations and depths, and location and depth of the sewer connection point.

A surveyor captured gully trap heights at a later date, to verify that the gully heights are above the known surface flooding level in the area.

In general, the work was completely in a timely manner to a good standard. After phase one of on-property works, the cost of repairs across the PS3 catchment was an average of $1,780/lot, including the initial inspection and CCTV, validating the initial funding assumption by the steering committee that by the time a drainlaying crew was mobilised to a property to do an inspection, it would be more cost effective to carry on and fix defects. The cost to have chased up property owners, re-establish the drainlaying crew etc if the repairs had not been done by Council would have been much more than $1,800.

Table 1 Pump Station Three Catchment Repairs

Type of repair	Number in PS3	Total Cost
Replace gully trap	24	$9,360
Repair gully trap	9	$1,755
Raise level of gully trap	110	$20,920
Repair/replace single crack in private lateral	23	$10,410
Replace lateral (grass reinstatement)	15	$870
Replace lateral (reinstatement under concrete or seal)	15.7	$2151
Clear root intrusion (single location)	46	$15,810
Excavate beyond gully to enable camera access	105	$31,410
Camera inspection of lateral	120	$41,580
Install inspection port at boundary	4	$1,980
Excavate junction at upper end of ramped riser	2	$1020
Seal manhole lid to riser	1	$295
Re-route of illegal storm water connection	16	Included in Dayworks rates
Whole lateral replacements and other dayworks		$30,247

Monitoring of wastewater flows indicated significant reductions in I&I even at this early stage.

9. PHASE TWO

Phase two of the work was again let by competitive tender - this time at the request of both contractors - to a single contractor. Phase 2 of the work contained 350 properties. A slightly modified schedule was used, with the addition of items such as 'schedule work scope', included to acknowledge time spent explaining required changes, and discussions with the engineer, or engineers' assistant.
Areas known to be in an old waterway, and as such lower than the remainder of town were targeted to ensure 'bang for buck' hopefully eliminating as many low storm water gully traps as possible, earlier in the project.

Phase two as-builts were required to be completed on paper and directly to tablets provided by the ODC, with Opotiki aerial imagery, and geo-location, to be included in the councils infrastructure overlays.

Phase two of the project did not go as well as phase one, and the contractor was only able to complete 94 properties out of 350 properties. This was mainly due to the contractor encountering numerous issues including; loss of staff, delay due to weather conditions as well as large portion of highly deteriorated pipeline. Highly deteriorated pipeline will have resulted in sections of, or whole laterals having to be dug up and replaced. This is time consuming and costly.

The issues encountered account for the increased cost for this phase of work, of $2,000 - $2,200 per lot.

Table 2 Phase Two Repairs

Type of repair	Number	Total Cost
Replace gully trap	8	$2,784
Repair gully trap	9	$1,593
Raise level of gully trap	23	$5,313
Repair/replace single crack in private lateral	28	$13,440
Replace lateral (grass reinstatement) (m)	165	$28,124
Replace lateral (reinstatement under concrete or seal) (m)	15	$4,365
Clear root intrusion (single location)	24	$15,725
Excavate beyond gully to enable camera access	64	$25,200
Camera inspection of lateral	99	$37,450
Install inspection port at boundary	1	$435
Excavate junction at upper end of ramped riser	0	-
Seal manhole lid to riser	1	$600
Re-route of illegal storm water connection	6	$960

10. PHASE THREE

To avoid further delays to progress on private property lateral repairs, a business case was developed seeking approval to tender all the remaining on property repairs in 15 separable portions. Each separable portion contains approximately 80 properties. This approach was recommended to give Council the best possible opportunity to attract capable contractors.

As with the previous works, the contract works include CCTV inspection, assessment and repair or renewal of 1,200 private property laterals including gully traps and public laterals from the property boundary to the public sewer.

An open tender process was used with the "Price Quality Method". The price quality method was chosen as there are several elements of the work such as Methodology, Programme, Proposed Team, Resources, Relevant Experience and Track Record, which are crucial to the success of the project. It was important to ensure that the successful tenderer(s) scored adequately in these areas relative to price.

This weighting on the non-price attributes were considered highly relevant due to the importance for the Council to be aware of how the Contractor proposes to:

- Manage the construction risk and their strategies for the mitigation
- Limit the extent of any disturbance to the private properties
- Commit resources and achieve specified programme of works

The three companies tendered for all of the blocks, and used the same prices in every schedule.

At award, three companies, two out of town, and one local, were each allocated three separable portions.

Differences for this contract include that the contractors are expected to carry out the camera inspection, and get all proposed improvements approved by Council, prior to the work being carried out. The rationale for this is that all of the issues in any given block can be prioritised, and any 'nice to have improvements' – which may or may not make a significant difference to wastewater volume outcome - are not carried out in preference to improvements which will contribute an obvious improvement. For example, raising gully traps, removing illegal storm water connections, and repairing obvious leaks in laterals are given priority over repairing minor root intrusions. This has allowed the overall cost of the project to be well controlled.

The local contractor's methodology for large repair/replace sections is to dig and cut the displaced or damaged section of old concrete or earthenware pipe with PVC pipe. The other two contractors are utilising CIPP lining.

At the time of writing work is progressing well, with the expectation that inspection work on the initial blocks will soon be concluded, and rehabilitation and as-builts will be completed, before other blocks will be allocated. A difficulty is that as the season has been very dry, leaks are difficult to identify. The dry weather does mean that work has progressed well.

At the time of writing the average cost per lot for the phase three on-property contract is approximately $1,950 per lot, including establishment and other contractor costs. This price is thought to be due to a combination of factors, including the more competitive nature of the current contract, the very good weather conditions experienced to date, in combination with the areas allocated being new, with high proportions of PVC fittings and laterals.

Table 3 Phase Three Repairs to end May

Type of repair	Number	Total Cost
Replace gully trap	15	$4,605
Repair gully trap	25	$4,645
Raise level of gully trap	155	$44,190
Repair/replace single crack in private lateral	0	-
Replace lateral (grass reinstatement)	107	$15,453
Replace lateral (reinstatement under concrete or seal)	45	$8,213
Clear root intrusion (single location)	109	$27,355
Excavate beyond gully to enable camera access	606	$149,980
Camera inspection of lateral	539	$142,100
Install inspection port at boundary	10	$9,950
Excavate junction at upper end of ramped riser	0	-
Seal manhole lid to riser	0	-
Re-route of illegal storm water connection	29	$7,950
CIPP Relining (m)	639	$137,997
Replace Grate	69	$1,380

11. PUBLIC SEWER WORK

The Council accepted early on that just dealing with the private laterals was not enough on its own to solve the loss of service issues in the sewer, private houses and storm water. A three-pronged approach was required. Accordingly, in conjunction with the private lateral work, inspection and repair of the public sewer network, and improvements to the town storm water have been undertaken as well.

A selection of public sewer pipes were inspected using CCTV. The CCTV inspections of the first selection of pipes showed:

- Many sewers were heavily coated with fat
- Large quantities of sediment were present, consequently heavy cleaning was required.

Overall the condition of the pipes was moderate. The pipes chosen for the initial CCTV inspection were based on known service issues. This was reflected in the general condition of those pipes, with a disproportionate number with dips, and service conditions. Many of the lines inspected at this initial stage had to be cameraed after heaving cleaning, and some with the aid of a jetting unit. While some pipes were deteriorated to the point where relining or possibly even replacement was justified a sizeable proportion still had substantial service lives remaining.

Based on the results from the initial public sewer CCTV, indicating a requirement for complete replacement of up to 20% of lines, it was decided to survey the remaining sewer lines. The information gathered proved that the expected extent of relining and replacement of public sewer lines was less than indicated by the initial survey work, with at most 9% requiring immediate full reline or complete replacement to repair obvious faults including holes and bad pipe displacements. This was valuable data for the costing of upgrade options.

With the benefit of the comprehensive picture of the reticulation built up from the full CCTV survey, detailed estimates were made for the rehabilitation and replacement options for the full sewer network. These clearly showed a large cost advantage for rehabilitation at around 2/3 of the cost of replacement.

Rehabilitation maximises the use of the existing assets, is well suited to staging, is not disruptive and could be adjusted to match Council's other budget priorities. However, the downside is that the town is left with a large number of old assets, with less resilience to earthquake and surface flooding than a complete new system.

The options were carefully considered by the Steering Group and a decision was made to proceed with the Rehabilitation option.

Rehabilitation of 7,836 m of 150 and 225mm sewer pipe has been carried out by Interflow, using spiral wound inners. A further 875 m of relining is programmed in the coming year. This will mean approx. 40% of the sewers will have been treated, including all the high priority lines.

Ōpōtiki Council are then planning to prioritise deeper buried asbestos cement (AC) pipe, which scanning has shown is nearing the end of its life.

Manhole repairs have also been carried out. Manholes were inspected, and a range of interventions were applied depending upon the defects, again an 80:20 approach was undertaken with an emphasis on the major direct inflow

components. Where concrete work had deteriorated, spun Calcium Aluminate (CAS) coatings were budgeted to be applied, but weren't required. While full replacement of deeper manholes was budgeted in the project as a last resort, no replacements were found to be necessary.

12. STORMWATER

Concurrent with the sewer rehabilitation, ODC are upgrading storm water infrastructure. Projects include:

- New trunk mains
- Additional storage basins
- More pump capacity
- Stopbanking to divert rural water to the main Bay of Plenty Regional Council pump station at the south of the town

Reducing ponding is key to improving the level of service provided by the wastewater reticulation. It is also very important to improving the overall quality of life in the residential area. Unfortunately, the storm water works will not in themselves solve the overarching problem of the towns location on low land between two major rivers with climate change causing more intense storms and higher sea levels.

13. CONCLUSION

Council funding for the works on private property lateral repairs was approved in the 2018 – 2028 Long term plan. The total allocation for the private property repair works is $2,000,000 spread over 3 years. A total of 1,700 lots comprising of 1,550 residential and 150 commercial properties are programmed for the inspection and repair or renewal works.

The Ōpōtiki wastewater project is a credit to the Ōpōtiki Council. It demonstrates the value of being willing to invest upfront in the comprehensive investigations that are essential to fully understanding a problem. With the benefit of the resulting information fully informed decisions can be made. The consequences of options are better defined. The comprehensive information that was available to the project team, especially from the Council funded on property work and the full CCTV has allowed more robust estimating and minimised the potential for cost overruns.

Also of note, was that the Council accepted early on that addressing one aspect of the sewer / storm water capacity problem would not be enough to solve the wet weather sewer functionality issues, and were prepared to tackle all three aspects (private sewer/public sewer/storm water) concurrently.

The Council funding of on property repairs of all private infrastructure is a notable feature of the project and is a bold approach by Council. It is an approach that is working well for the Ōpōtiki Community. It would work well in other similar smaller communities.

ACKNOWLEDGEMENTS

Marty Schutz and Nicola Cossil