DUNEDIN RURAL NETWORKS –WASTEWATER AND WATER MODELLING

L Sinclair:
Dunedin City Council

ABSTRACT

This paper discusses the contributing factors which led to the development of hydraulic models for small rural communities and the benefits that council believes these models will bring.

Three rural wastewater treatment plants are nearing resource consent renewal and a strategy to improve current discharge arrangements was required. Modelling these areas was the first stage in this strategy. In tandem a treated water model was developed to replicate the network servicing these rural communities. Network planning to ensure economic renewal of these assets is the desired outcome. An additional water model was built for another rural community where sustainable accommodation of growth was the main driver.

Building these models in-house has virtually removed consultant fees. The council's hands-on approach has highlighted data inadequacies and their consequence, including information availability, accuracy and integration across applications that may otherwise not have been discovered.

When model builds are undertaken internally, staff acceptance is generally quicker due to direct involvement and a sense of ownership of the entire journey. Like any project, communication is key and early definition of data requirements and model outcomes keeps all staff expectations consistent through the model build, calibration and end use.

KEYWORDS

Hydraulic modelling; Rural networks; Wastewater; Water; Development;

1 INTRODUCTION

Dunedin City Council (DCC) is working to improve its understanding of current levels of service provided in non-metropolitan areas of the city. The 3 Waters Strategy Project was fundamental to the development of a long term plan for the management and delivery of Dunedin's metropolitan water, stormwater and wastewater (3 Waters) systems. The total cost of the Project was approximately $5m over 3 years and the development of decision support tools, particularly hydraulic network models was a key output of the Project. The DCC has established hydraulic modelling capabilities in-house to make best use of these tools and now continues to develop these tools and models to encompass the non-metropolitan areas of the City.

The hydraulic models developed during the 3 Waters Strategy Project are used in-house daily by the Hydraulic Modeller and a number of other staff. Outputs of the hydraulic models are used across the business by Asset Planning, Water Production, Wastewater Treatment, Network Operations and Network Management. Hydraulic modelling work is also carried out in association with City Planning and the local fire service. The benefits of having hydraulic models of the main city are widely accepted and subsequently there is a growing interest to expand the coverage. It is anticipated that all of Dunedin's three waters networks will be hydraulically modelled in the near future.

To align with the work previously completed during the 3 Waters Strategy Project, expansion to rural schemes aims to continue the integrated asset management approach to determining the capital and operational needs required to sustain or modify current levels of service. The key objectives of the work are therefore:

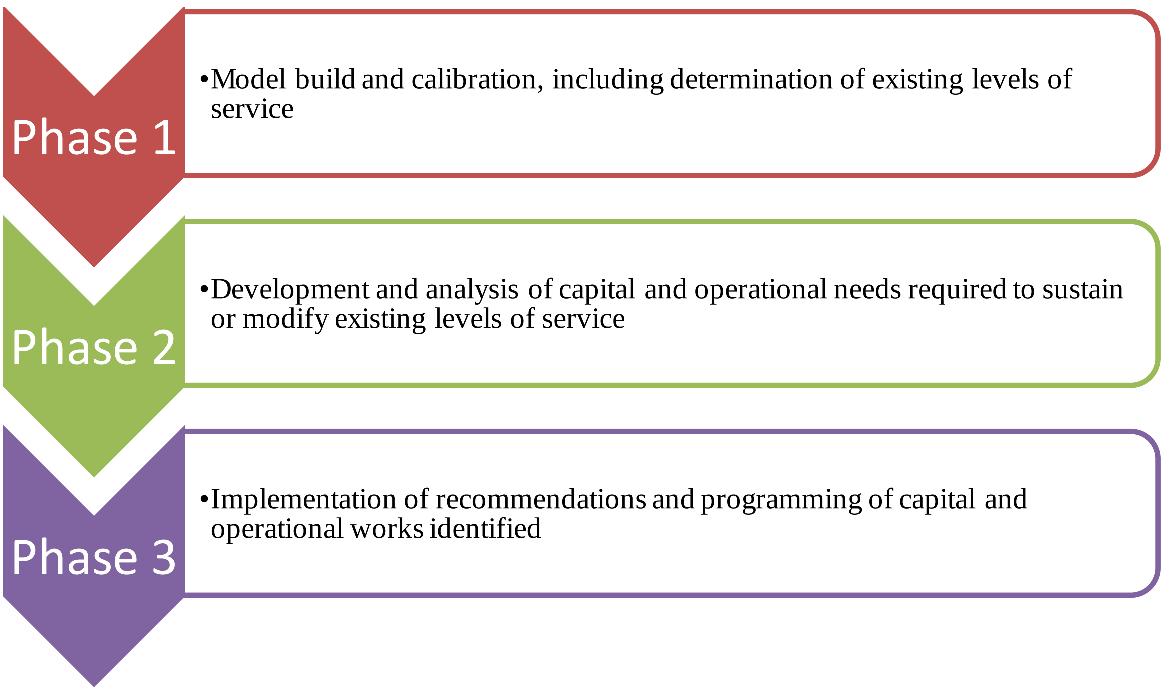
- Develop a greater understanding of the three waters network operations through targeted asset, flow and pressure data collection and the development of hydraulic models. This includes identification of any data integrity issues and the determination of the existing levels of service for each area.

- Examine consistency of existing levels of service across the city and determine the required future levels of service for each area, considering predicted growth, development and changing service needs.

- Use calibrated hydraulic models to determine the required capital and operational needs (and costs) of meeting these levels of service.

The work is already at a relatively micro-scale, with each service area modelled discretely. Subsequently, delivery is in the three phases highlighted in Figure 1.

Figure 1: Strategy Phases

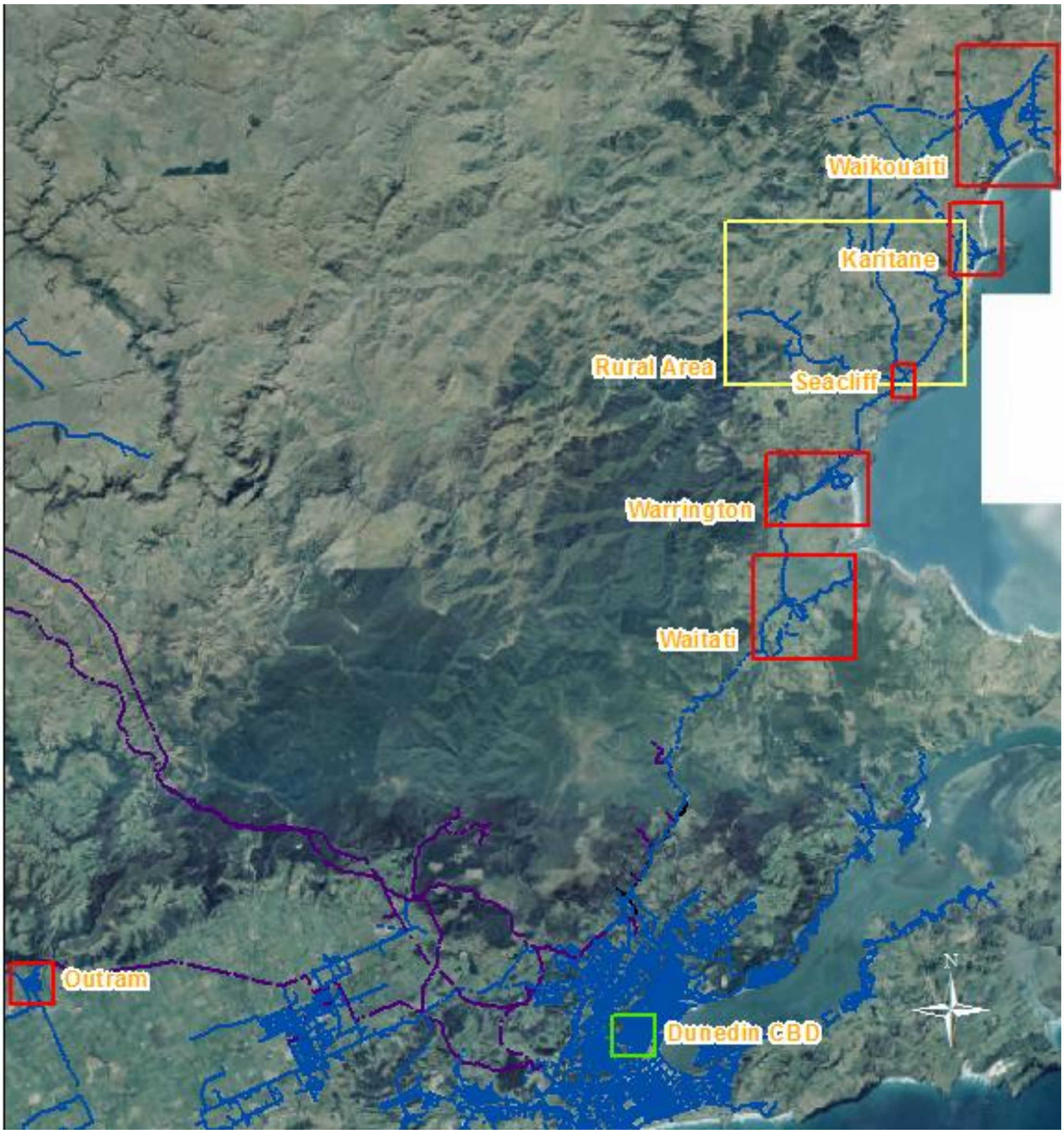


This paper discusses the strategy process outlined above for the following rural communities and services. These locations are indicated geographically in Figure 2.

- Outram water reticulation
- Waitati water reticulation
- Warrington water and wastewater reticulation
- Seacliff water and wastewater reticulation
- Karitane water and wastewater reticulation
- Waikouaiti water and wastewater reticulation
- Rural water reticulation

With the exception of Outram, these areas are collectively known as the 'Northern Schemes'.

Figure 2: Rural communities' locations in relation to Dunedin CBD



2 OUTRAM TREATED WATER MODEL

2.1 OVERVIEW

Outram is located 30km west of Dunedin city center on the Taieri Plains. The scheme supplies approximately 680 people in the Outram Township. Outram is built on a flood plain with fluvial soils that generally drain freely. Large lot size and a dry climate means that summer water usage is higher than other Dunedin areas.

Photograph 1 displays the main township and the Taieri River in the background.

Photograph 1: Outram

Strategy Phase 1:

The Outram water reticulation network has not historically been modelled. The requirement for a hydraulic model was driven by the need to understand, both the raw and treated water network in Outram and develop 'whole of life' asset management plans. The model was built, based on GIS and Hansen data, with additional information taken from paper reticulation plans, as-built plans, SCADA and operator knowledge. In March 2013 field equipment was installed in the Outram water network and data collected for three weeks. This actual data along with historic SCADA and metered customer data was used to calibrate the Outram water model.

Strategy Phase 2:

The calibrated Outram water model provided the basis to analyse a number of scenarios. These included present and future predicted demand scenarios during average and peak demand periods, fire-flow analysis, water age, modelling of proposed developments and population increase to 2033.

A series of options were then modelled to address any inconsistencies in levels of service and rough-order costing was developed for each of these options.

Strategy Phase 3:

Recommendations from the model build and options analysed were prioritised and subsequent renewals and upgrades will be programmed for capital expenditure.

2.2 OUTRAM WATER SUPPLY AND DRIVERS

2.2.1 RAW WATER

The raw water supply for the Outram Township comes from a single bore located in the Taieri borefield. The 1998 bore pump generally performs well. Water is pumped from here along the Outram raw water pipeline. This pipeline is approximately 600m of 100mm diameter steel. The 1973 pipeline generally performs well and is in relatively good condition.

The Outram Water Treatment Plant (WTP) receives a peak daily flow of approximately 688m^3/day if the bore pump runs continuously. Treated water demand, can exceed raw water flow rate at times during summer. The treated water reservoir is kept at 85-90% full to provide mitigation for this, but there is a limited buffer for 'downtime' of the plant during peak periods. With a water treatment plant capable of treating a greater volume than the raw water supply, and water use exceeding treatment volume at times, it was determined necessary to examine the source of raw water supply restriction.

2.2.2 WATER TREATMENT

The Outram WTP currently consists of limestone filtration to correct the pH level and chlorination.

A number of changes to Drinking Water Standards New Zealand (DWSNZ) come into effect from 1st July 2014. Subsequently, in May 2012 DCC Water and Waste Services put a report to the DCC Executive Management Team (EMT) detailing 3 broad options that were considered for the Outram Water Scheme to ensure compliance with these changes. These were:

A. Do nothing; continue to supply water to the scheme at current quality and accept that a permanent boil water notice will be required from 1 July 2014 due to legislative change.

B. Upgrade the Outram WTP utilising one or more of the upgrade options with costs that varied from $480k to $1.1m. Each option carries unique residual risks of non-compliance and subsequent temporary boil water notices.

C. Construct a pipeline from Taieri Industrial Estate to supply Outram with treated water from Mount Grand WTP in Dunedin central. This option carries negligible risk of non-compliance, however this option has the largest net present value and up front capital cost at $2.8m; and may not have been deliverable by 1 July 2014.

Option B was recommended and accepted by EMT which consisted of a $577k upgrade of the Outram WTP, considered a 'basic' upgrade option, utilising UV on a duty/standby arrangement.

It was recognized that the 'basic' upgrade of the Outram WTP could result in periodic non-compliance with DWSNZ during poor raw water quality events (caused by dissolved matter in the raw water). Water produced during these periods of non-compliance will be of equal or greater quality than that currently supplied with the existing plant and therefore presents no increased health risk, rather a non-compliance with the amended drinking water standards.

2.2.3 RETICULATION

Following treatment, water is stored in a distribution reservoir at the WTP site. The treated water storage reservoir provides 2,273m^3 of storage. This reservoir should be able to provide approximately eight days of storage based on average consumption of 200L/capita per day plus 1,080m^3 of firefighting storage. However, given the high water use in Outram the reservoir provides only five days storage during average demand and as little as two days storage during peak demand (plus firefighting storage). A water meter is present at the WTP and records the water usage demand.

From the treated water reservoir the water is distributed to the township by gravity via a single 150mm diameter watermain. The network consists of approximately 35km of watermain predominantly of 100mm diameter pipelines in a grid format. There are four small diameter pipelines predominantly to metered customers ranging from 25 to 50mm diameter.

2.2.4 DRIVERS

In 2012 the need for a hydraulic model was identified as the Outram network had not historically been modelled. The model would enable a better understanding of both the raw and treated water network in Outram, a review of the current network capabilities and aid in the review of proposed developments in Outram.

The modelling of Outram would also provide an understanding of winter and summer consumption patterns and enable the analysis of available fire flows and corresponding pressure reductions. The model outputs would also inform a 'whole of life' asset management plan for Outram, enabling the efficient balancing of renewals based on age and condition with infrastructure required for proposed growth.

Reviewing historical customer complaints with operations staff indicated no issues in the network with the exception of isolated low pressure complaints.

2.3 MODEL BUILD AND CALIBRATION

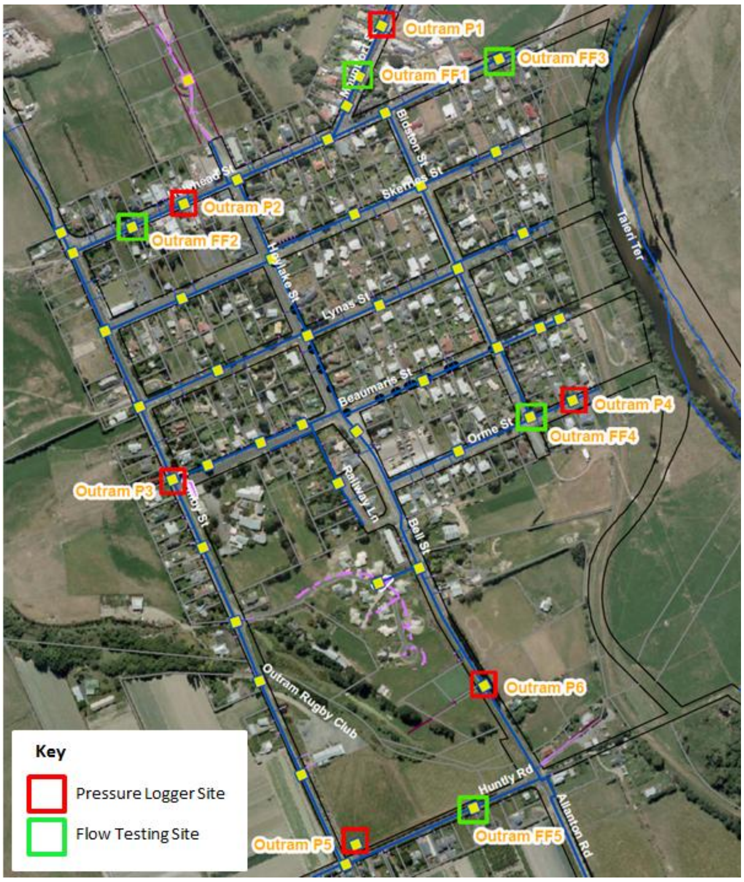
The Outram water model was built in-house using InfoWork WS. The model is fairly simple consisting of both raw water and treated water networks based on council asset data and operational knowledge.

Initially the raw water system was modelled in order to determine the location of the raw water restriction. A close match was achieved to the conditions seen on SCADA; where during peak summer periods demand temporarily outstrips raw water supply resulting in a relatively modest lowering of the treated water reservoir level. The reservoir level recovers overnight but this highlights that during peak demand periods 'headroom' may be reduced to as little as one to two days of treated water supply (plus firefighting capacity)..

In this context it is worth noting that water use in Outram is exceptional. Average daily demand is estimated at approximately 820l/connection/day compared to 540l/connection/day in the metropolitan area. Average day peak week demand in Outram is estimated to be as high as 1800l/connection/day.

Field logging for the reticulation was completed over a dry three week period in March which following several months of sustained dry weather. It was decided that the field testing should be carried out by an external contractor and Jeff Booth Consulting Ltd were awarded the tender. In total the Outram field testing consisted of six pressure loggers deployed for a period of three weeks and flow-testing of five fire hydrants to measure the network under stress. Figure 3 highlights the fire hydrant locations used for both pressure logging (red) and fire flow testing (green). The SCADA meter data from the WTP was also captured using the same polling time step. This actual data along with historic SCADA and metered customer data was used to calibrate the Outram water model.

Figure 3: Outram field testing March 2013 sites



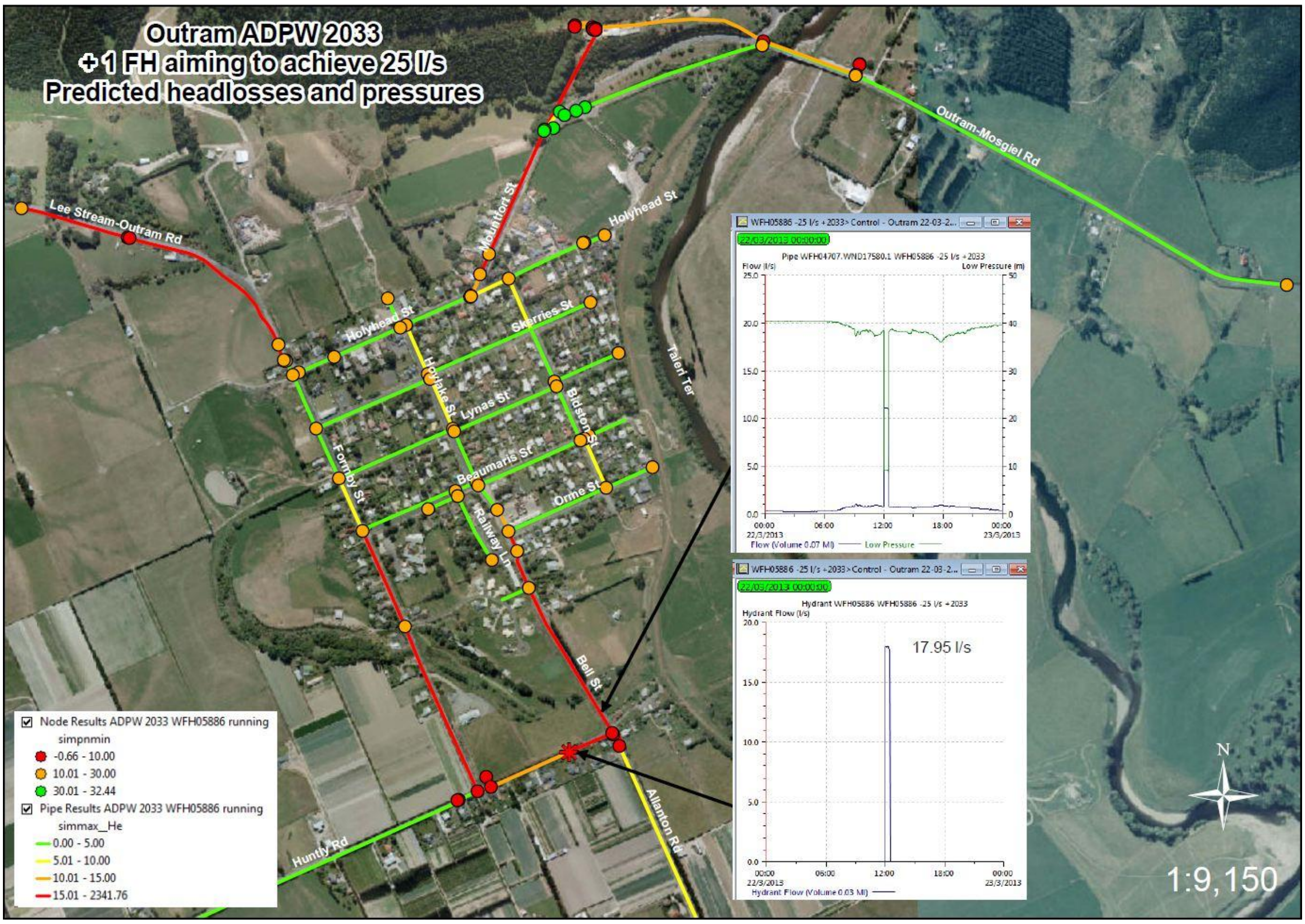
Of the 406 customer points represented in the model, 63 are metered. Some of these metered customers are businesses whilst some are residential properties used for water usage data collection. This Phase highlighted that the four small diameter mains extending to rural areas could benefit from meters to confirm water usage in these locations.

The hydraulic model was calibrated against the field test pressure and flow data. Assessing the current level of service through pipe headlosses and low pressures during an average day in a peak summer week, concluded Phase 1 of the Outram Strategy.

2.4 MODEL OUTPUT AND OUTRAM STRATEGY

Phase 2 of the Outram Strategy used the calibrated model to assess future growth scenarios (2033) to determine pipe headloss and pressure. Water age and network fire flows were also reviewed. This analysis was then extended to investigate the effect of a single fire hydrant open at a strategic point in the network. Figure 4 provides an example of this analysis.

Figure 4: Outram Average Day Peak Week (ADPW) Demand for future growth scenario (2033) model predictions with fire hydrant active



One of the main drivers for the calibration of the Outram water model was to analyse the effect of proposed residential developments. During Phases 1 and 2, two proposed developments were pending a hearing decision regarding private plan changes. In order to make a fair assessment, each development was added separately to the model to provide an understanding of their individual impact on the network.

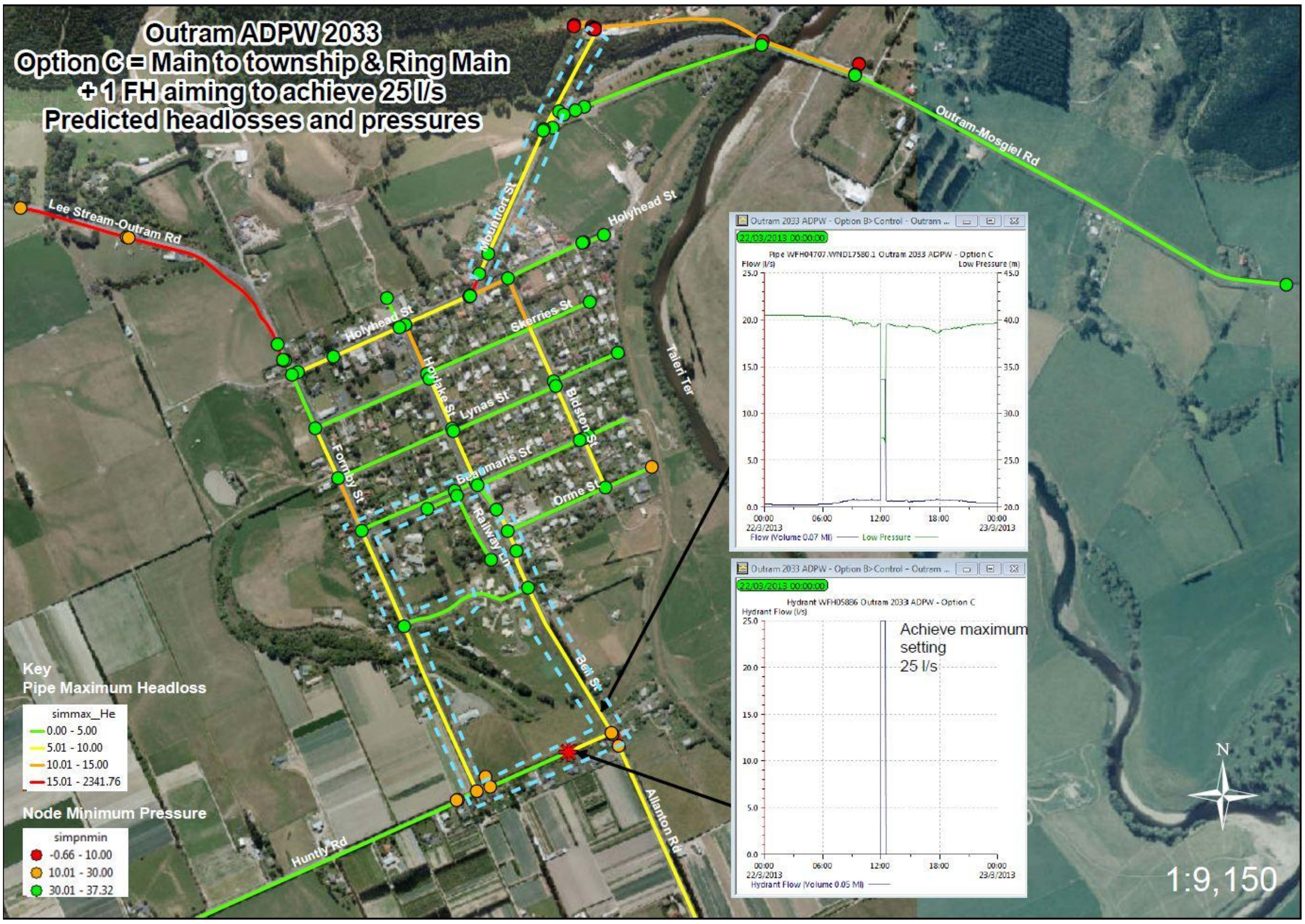
Once an understanding had been gained of the effect of each development and the impact of its location and number of connections on the network, the most satisfying element of modelling, 'optioneering' was explored.

It was obvious from Phase 1 that the Outram water network had a number of age-related deficiencies. New developments that require network upgrades can be funded through development contribution. A calibrated hydraulic model is the perfect tool to establish the staged network upgrade requirements and costs associated with achieving appropriate levels of service. The optioneering process focused on older watermains that in most cases were undersized when compared to current standards, specifically 100mm diameter asbestos cement pipes recorded as being installed in the 1950s.

The optioneering outputs for the 2033 Outram model will in reality be staged as renewal funds are available and as developments in Outram progress. It was decided that three options achieved the best outputs. The first stage will be the upsizing of the watermain from the WTP to the township, to 200mm diameter. When the development to the west of Outram is included it was found that a new 220m connection allowed an additional flow path. The longer-term renewals plan is to increase the ring main in the south west of the catchment from 100mm to 150mm diameter. Figure 5 indicates the model outputs with these options in place. Comparing this to Figure 4 shows a marked increase in the fire flow achieved and also the pressure level is kept above 30m and the headloss in the pipes is decreased.

These model outputs feed into the Outram Strategy as a renewals programme and Phase 3 of the strategy is the implementation of these recommendations.

Figure 5: Outram ADPW 2033 model predictions with network upgrades and fire hydrant active



The model outputs were documented and a complete model build and calibration report was kept as a 'current state' reference document. The model outputs were discussed across the 3 Waters Team. The outputs were also presented to City Planning staff and the consultants representing the developers. This wrap up was an important part of the strategy as many people had been involved through the model development.

3 NORTHERN SCHEMES

3.1 OVERVIEW

There are a number of rural communities to the North of Dunedin's city centre that are provided with water and wastewater services. Figure 2 in Section 1 highlighted their location in relation to Dunedin CBD.

Strategy Phase 1:

The Northern Schemes water reticulation network and the three wastewater catchments have not historically been modelled. The models were built based on GIS and Hansen data with additional information taken from paper reticulation plans, as-built plans, SCADA and operator knowledge.

In March 2013 pressure loggers were installed in the Northern Schemes water network and data collected for three weeks. This actual data along with historic SCADA and metered customer data is being used to calibrate the water model at the time of writing. In July 2013 rain gauges, flow and conductivity monitors were installed in the three wastewater catchments and data is currently being collected. This field data along with historic Wastewater Treatment Plant (WwTP) flow data and outputs from the calibrated water model will be used to calibrate these wastewater models.

Strategy Phase 2:

Once calibrated the Northern Schemes water and wastewater models will provided the basis to analyse a number of scenarios. For water supply these include future predicted demand scenarios during average and peak demand periods, fire-flow analysis and modelling of various options for watermain renewals. In relation to wastewater these include future predicted flows, surcharge, flooding and constructed overflow analysis and modelling of various options for network and WwTP renewals.

A series of options for each of water and wastewater can then be modelled to address any inconsistencies in levels of service and rough-order costing can be developed for each of these options.

Strategy Phase 3:

The recommendations from Phase 2 will be prioritised with subsequent renewals and upgrades can be programmed for capital expenditure.

3.2 NORTHERN SCHEMES WATER SUPPLY AND WASTEWATER

The rural communities of Waitati, Warrington and Seacliff receive water from Dunedin's Mount Grand WTP via the 'Northern Pipeline' commissioned in 2010. The Waitati zone has two metered connections from the Northern Pipeline. The Warrington and Seacliff zones both have single individual connections although only Warrington is metered. A number of customers are metered and all other connections are charged a standard fixed charge water rate. These properties are classed as rural connections and under the water supply bylaw require 1m^3 of onsite storage. Fire hydrants are included in the system although the New Zealand Fire Service Code of Practice requirement of 25 l/s from two hydrants is not practical in some areas due to the rural nature of the schemes.

Karitane and Waikouaiti are supplied from the Waikouaiti WTP via the Waikouaiti River. Currently the high level and low level zones of Waikouaiti are separately metered. However the zone interaction point and the Karitane zone are not metered. The largest water user in Waikouaiti is a poultry farm.

Prior to the commissioning of the Northern Pipeline, the Waikouaiti WTP fed both Waikouaiti and Karitane and also supplied the Seacliff Reservoir which in turn fed Seacliff and Warrington. If required, the Waikouaiti WTP can still feed these rural communities.

The Warrington, Seacliff, Waikouaiti and Karitane rural communities have wastewater services consisting of mainly 150mm diameter gravity sewers and three WwTPs. The WwTPs consist of oxidation ponds and land application systems.

Table 1 summarises the Northern schemes' areas and networks.

Table 1: Northern Schemes' Network Summaries

Location	Services	Population	Water Network Summary	Wastewater Network Summary
Waitati	Water	500	7.9km <100mm 4.3km 100mm 2 meters, 1 PRV	N/A
Warrington	Water & Wastewater	430	4.6km <50mm 5.3km 50 to 100mm 1 meter, 1 PRV	1.8km 100mm 3km 150mm 1.8km 200mm 11m 300mm Oxidation Pond, land disposal
Seacliff	Water & Wastewater	80	450m <60mm 1 PRV	10km 150mm Sand bed & trickle irrigation
Karitane	Water & Wastewater	350	4.1km <50mm 3km 50 to 100mm	2.1km 100mm 6km 150mm 2.8km 200mm 3 pumping stations Karitane & Waikouaiti Oxidation Ponds, land disposal
Waikouaiti	Water & Wastewater	1,100	7.3km <50mm 14km 50 to 100mm 12.5km 150mm 5.5km 200mm 1 pump station, 1 reservoir, 2 meters	953m 100m 13.7km 150mm 1.4km 200mm 1.7km 225mm 627m 300mm 15m 900mm 4 pumping stations Karitane & Waikouaiti Oxidation Ponds, land disposal
Merton Rural Area	Water	75 Customer Points	21.8km <100mm 1.8km 100 to 150mm 4.4km 150mm 2 pump stations, 2 reservoirs	N/A

3.3 WASTEWATER

3.3.1 DRIVERS

The resource consent for Waikouaiti WwTP has recently been renewed with a short term 15 year consent which expires in 2027. The resource consents for Seacliff and Warrington WwTPs are due to expire in 2018 and 2024 respectively. The Northern Wastewater Strategy seeks to establish the most cost effective long-term options for dealing with wastewater from these communities. The calibrated hydraulic models are the first phase in the strategy, beginning with an assessment of the network levels of service with regards to surcharging, flooding and pump station emergency overflows.

3.3.2 MODEL BUILD AND CALIBRATION

The three wastewater models have been built in-house using InfoWorks CS. Hansen and GIS data was used as the base data and as-built plans used to model the pump stations correctly. SCADA data for the pump stations within the catchments have been used to confirm historic high and low flows and general usage patterns.

The wastewater field work was all carried out by DCC Network Maintenance staff. Twenty percent of manholes were surveyed to provide missing data and check accuracy of the data already held. The opportunity was also taken for the Appraisal Engineer and Hydraulic Modeller to visit all the pumping stations and carry out a condition assessment survey which fed into the renewals plan. In addition to condition information, the existence and location of emergency overflow, wet well sizes and pump on and off levels were confirmed. Furthermore, discussions were had with pump station operators to ensure the model correctly represents what is actually happening on site during rainfall events.

Minimal historic CCTV data was available for most of the rural areas however the entire Seacliff network was filmed in 2009. A review of this data showed a number of minor issues and some filming was repeated for comparison. In total 2.5kmof sewer (less than one percent) was filmed across the three catchments to assess the condition and aid modelling.

Since 2011 DCC has purchased a number of portable flow monitors to be used in various applications around the city. Initially it was debated whether flow monitoring equipment should be hired or purchased. The flow monitoring equipment is now considered a valuable tool. For the Northern Wastewater Strategy it was determined to install flow monitoring equipment at various points in the networks and gather data over the winter period of 2013.

In addition to the flow monitors, DCC-owned conductivity loggers were also installed at various locations. The conductivity loggers enable sea water intrusion to be identified. Typical sewage is estimated to have conductivity no greater than 3,000 µS/cm; so any readings over this concentration will be investigated further.

Photograph 2 and 3: Flow and conductivity monitor installations

In order to monitor rainfall in the three catchment areas it was decided that the two existing rain gauges would suffice; these were already installed and being used by water production and wastewater treatment. One rain gauge was relocated to provide more accurate readings and enable data to be collated on SCADA. A second rain gauge already on SCADA was adjusted to poll at the required frequency.

In order to plan the location of flow monitors and conductivity loggers a desk top analysis was carried out. Based on modelling requirements and likelihood of saline intrusion, eight flow monitors and eight conductivity logger installation sites were planned, but like all desk top exercises, on-site reality caused locations to be adjusted. As all equipment is owned by DCC and frequently used, installation was a smooth process and feedback from the staff installing the equipment on the expected results from selected locations came from firsthand knowledge of the system.

A workshop with staff was held to discuss the rural schemes, installation requirements, expected data issues and sharing operational knowledge. The workshop and subsequent correspondence ensured all parties had the same knowledge and understanding with regard to the aim of the strategy.

The flow monitoring period is due to end in October 2013 or once a significant rainfall is recorded. Initial downloads are as expected and model calibration will be undertaken following the conclusion of the flow monitoring. A review of predicted surcharging, flooding and overflows compared to historic complaint records and operational knowledge will help to confirm model calibration. This will enable the existing level of service to be determined and therefore complete Phase 1 of the strategy.

3.3.3 MODEL OUTPUTS

Once the existing level of service is established for each catchment, mitigation options will be modelled to remove confirmed areas of surcharge, flooding and emergency overflows for a 1 in 10 year rainfall event. These solutions can be costed and prioritised for capital expenditure.

3.4 WATER

3.4.1 DRIVERS

In part, timing drove Phase 1 of the Northern Schemes water model. In order to achieve a reasonable price for field testing such small networks it was decided that Outram and the Northern Schemes could be logged simultaneously. Furthermore whilst the Northern Wastewater models were being built to meet wastewater discharge consent timeframes, water supply assets in the area could be also be assessed to provide a complete Northern Schemes Strategy and 'whole of life' asset management plan.

An additional requirement was to establish a renewal programme for specific assets. An example of this is a long small diameter watermain over rural property supplying 15 customer, which has experienced a large number of bursts (shown as red stars in Figure 7). The cost of each individual repair was considered low, due to the small diameter, however this has continued over time, reaching a trigger point and it is now considered timely to plan a renewal. The model can aid in the sizing and appropriate alignment of the new main.

Figure 7: Rural Northern Schemes water reticulation and bursts (red stars)

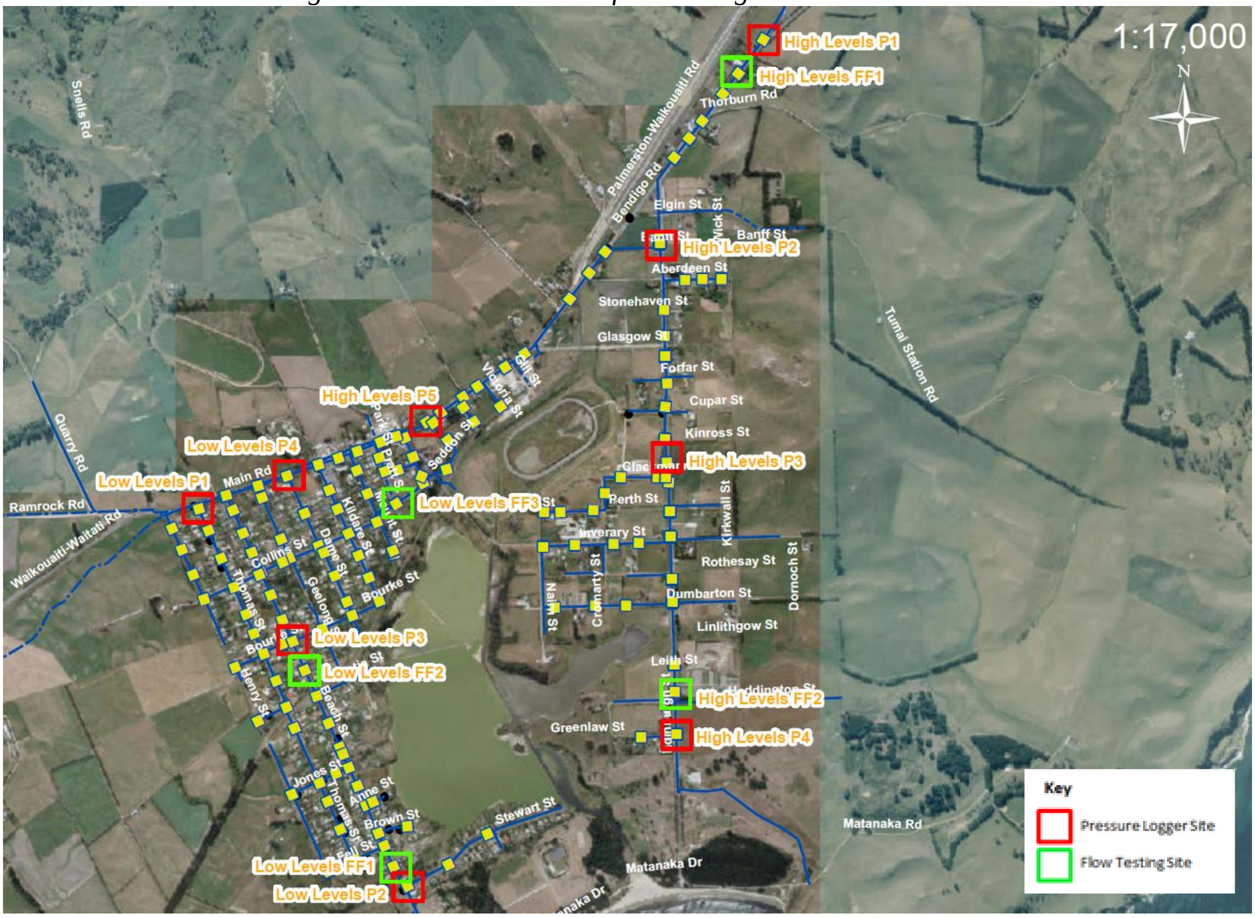
3.4.2 MODEL BUILD AND CALIBRATION

The Northern Schemes water model was built as a single system with two discrete water sources and various zones representing the rural communities. Fortunately a number of water zones are currently metered which allows for a much easier calibration.

The Northern Schemes field testing consisted of 22 pressure loggers deployed for a three week period and flow testing of 11 fire hydrants to measure the network under stress. The SCADA meter data (where available) was also captured using the same polling time step. Figure 8 indicates the pressure logger sites (green) and fire flow hydrants (red) for Waikouaiti high and low levels. Standard fixed charge water rate billing data in conjunction with water meter billing data was used to add assumed and known demand to the model.

The Northern Schemes model is currently being calibrated as a staged process as time allows. Each zone with a discrete meter is assessed for daily pressures and fire flow. The remaining zones will have assumed demands in the model until meter data is available.

Figure 8: Waikouaiti field testing March 2013 sites



3.4.3 MODEL OUTPUTS

Although Phase 1 calibration is not yet complete at time of writing, a number of elements have already been identified for Phase 2 of the strategy. One of the recommendations is the installation of zone meters at Seacliff and Karitane. In addition a meter between the high and low level in Waikouaiti would confirm the nature of their interaction.

An important anticipated output of the calibrated model is an understanding of the fire flow availability across the Northern Schemes. Currently these rural areas are associated with the 25l/s category however it is accepted that this target is overly optimistic for these zones.

Phase 2 of the strategy will provide renewal options for the aforementioned small diameter watermain with numerous breaks whilst addressing other level of service defects in the network.

4 CONCLUSION

Overall the modelling work and anticipated outputs of the Outram and Northern Schemes water and wastewater strategies are considered highly valuable. Although calibration will be ongoing in certain zones as additional data is collected, the outputs will be well-used across the business for a number of years to come. The development of these models has enabled DCC to review asset data in a new format and use various sources of data to check consistency. Taking asset data and visually looking at long sections has identified a number of historic mistakes. Using LiDAR data, a ground model has been generated for the city which has highlighted significant anomalies such that Seacliff ground and invert levels were all 100m too low.

The models are used as a tool to assess the current levels of service and the renewal/upgrade requirements for changes to levels of service, new developments and consent conditions. Being able to define the predicted effect on the network of various developments enables equitable development contributions to be established. The phased process of the strategy ensures level of service requirements and development contributions are separately identifiable. Level of service decisions based on various costed options enables informed decisions to be made. Developer contributions are clear-cut and transparent.

In the case of Outram it is anticipated that the model outputs will be used to educate the Outram community of their high water use during summer months. The capital upgrade to the WTP did not need to involve increasing the capacity, providing excessive water use can be managed.

The benefits of hydraulic modelling are now widely recognised within DCC and there is now an expectation that all water and wastewater networks are eventually modelled.

The decision to purchase flow monitoring equipment was a significant advantage to this project and provided the flexibility for installation, download and removal of flow monitoring when required. The financial savings realised by not using a specialist flow monitoring contractor are significant.

Informed decisions from these strategies will enable DCC to better plan for future renewals. In the case of the Northern Schemes WwTPs the answers are not yet apparent and the hydraulic modelling is just part of the strategy.

Projects like this bring teams together with a common end goal. Using mainly in-house resources achieves an ownership element to the strategy outputs. Documented outputs can be tailored; for instance a modelling guide was produced alongside the strategy document. A simplified version was provided to City Planning and developers. Informed discussions with the fire service can confirm the expected available fire flows in rural areas and any plans to improve levels of service.

DCC believes having in-house modelling capability is cost effective and brings many additional benefits. The most important benefit of in-house modelling capabilities is the ability to fully utilise the models and outputs readily. In addition to the Hydraulic Modeller, a number of other key staff use the water models to varying degrees. Updating the models as changes occur, enable the models to be considered a current tool.

In conclusion, modelling, whether carried out in-house or by a consultant is a valuable tool in asset management and renewals planning. The modelling work for Outram and the Northern Schemes has been an effective tool and a stepping stone in the process of the strategies for each of these rural communities. Overall the modelling work and subsequent output of the Outram and Northern Schemes Strategy is considered beneficial and will be used for a number of years to come.

ACKNOWLEDGEMENTS

Jeff Booth and Vicki Koopal - Jeff Booth Consulting

Jeff McLean – Opus

Tom Osborn – DCC, Water and Waste Services, Asset Strategy Team Leader

REFERENCES

MWH (2012) 'Outram Water Treatment Plant Treatment Options Assessment'