WHAT HAPPENED TO PROJECT CARE?

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ABSTRACT

Project CARE is a programme aimed at improving beach water quality by reducing wastewater overflows into streams and beaches in North Shore City. A $231 million (in 2002 dollars) improvement programme was approved in 2002 to achieve a target of 2 wet weather overflows per annum by 2021. This programme has enormous support from the council and the community. Another Project CARE commitment was to review the programme every six years to ensure the target will be met in 2021 at least cost.

The first six yearly review was recently completed. The programme is well underway and on target. The total costs for the programme have escalated mainly due to inflation and market forces, outside the control of council. To date $124 million dollars have been spent and another $303 million (in 2008 dollars) are required to complete the programme. Council has agreed to increase the budget to complete the programme in 2021, which shows its ongoing commitment to the community despite difficult financial times.

The paper will provided details around the actual and future system performance using hydraulic modeling, how the cost have changed and many observations and lessons learned that are worth sharing.

KEYWORDS

strategic planning; wastewater; wastewater overflows, wet weather overflows; beach water quality; hydraulic modeling; project CARE

1 INTRODUCTION

Project CARE is an ambitious programme to improve beach water quality in North Shore city by reducing the number of wet weather overflow events from well over 12 times per annum down to no more then two per annum. Council started the Wastewater Network Strategic Improvement Programme (WNSIP) estimated at $231 million in 2002. Council committed to a full review every six years to ensure that the improvement programme will be completed and the wet weather overflow target will be met by 2021 as agreed to with the community.

Figure 1-1: Beach water quality is important for the North Shore Community

The purpose of this paper is:

- To report on the outcome of the performance assessment; how does the actual performance compare to what was predicted at this stage of the process and what will the performance be of the programme if completed as originally scoped.
- To report on any changes to the scope of the remaining improvement programme
- Share some observations and lessons learned of the complex process
- To report on the outcomes of the programme review; what was completed, what is outstanding; what changes need to be made; how and why did the cost change.
- To share some experiences related to the political process in dealing with the outcomes of the review process

2 BACKGROUND TO PROJECT CARE

2.1 THE COMMUNITY DEMANDS

Figure 2-1: This is what the NSCC community values

Back in 1997/98 The North Shore City community became concerned about wastewater overflows resulting in the display of warning signs at popular East Coast Beaches. The wet weather overflows and the treatment plant outfall were perceived to be the major problem. It was found important that a full understanding of the problem was required to ensure a comprehensive improvement programme at least cost.

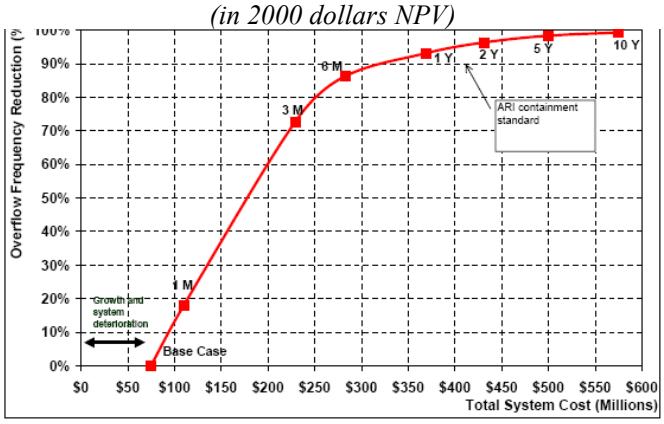
2.2 INVESTIGATIONS CARRIED OUT

The Project CARE strategic planning programme was carried out in four phases, starting in 1998 and completed in 2002:

- Phase 1 was the planning phase, when existing data were collected and reviewed in order to carry out the scoping of the project.
- Phase 2 involved the identification of all sources of bacterial pollution, quantifying them to establish a clear understanding of the performance of the wastewater and stormwater systems and the treatment plant outfall and their effect on beach water quality. Computer simulation tools were utilised to assist in the assessment.
- Phase 3 involved development and assessment of options to improve the wastewater system, divided into two functional phases:
    - 3a - Identification of the most cost effective solutions for system improvement by cost optimisation for a number of different levels of improvement.
    - 3b - Cost benefit analysis of options in order to agree on a level of improvement (using a containment standard as a design target) for 2050.

  The output of this phase was that a design standard of two wet weather overflows events per annum (annual average, based on computer modeling) was recommended and adopted (see section 2.3). A copy of the cost curve is shown in Figure 2-2.
- Phase 4 covered the development of a detailed programme of works called the Wastewater Network Strategic Improvement Plan (WNSIP) to meet the target.

Figure2-2: The cost benefit curve: Overflow Frequency Reduction versus Improvement Costs (in 2000 dollars NPV)



2.3 CONSULTATION OUTCOMES

Consultation was carried out based on the outcomes of phase 3 of the process. Many different consultation methods were used to ensure the community feedback was well captured. The outcome of the process was that a large majority of the community:

- accepted the recommended target of two wet weather overflow events per annum
- wanted the programme to be completed by 2021
- was prepared to pay for this.

2.4 NEED FOR FREQUENT REVIEWS

Given the many assumptions that were made and related uncertainties such as the level of growth, effectiveness of sewer rehabilitation, costs and climate change, a review process was deemed necessary to update the improvement programme on a frequent basis in order to ensure that the targets are met at least cost .

This review process is programmed to be carried out every 6 years, coinciding with council's LTCCP process. The review process will include gauging and recalibrating the wastewater networks and reviewing the remainder of the WNSIP to ensure the target is met.

2.5 INFORMATION AND RECOGNITION

Many technical documents have been produced as part of the Strategic Planning process. A summary report was produced in 2004.

Project CARE has been recognised nationally and internationally over the years and is still referred to as a leading edge, best practice strategic planning programme. Project CARE was presented in the annual conference of the International Water Association in 2001 and subsequently published, won an IPENZ award and was highly regarded in the 2008 IWA-WSAA international benchmarking project. Also a number of papers have been presented at WaterNZ conferences in the past.

3 THE PROJECT CARE REVIEW

3.1 SCOPE OF THE REVIEW

The Review was carried out along two streams, also shown in Figure 3-1.:

1) Programme Review Stream
2) Performance Review Stream

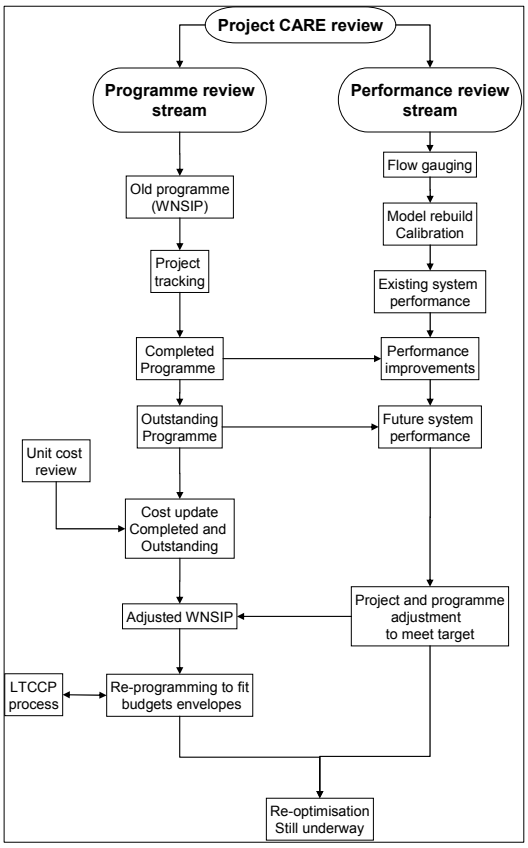
The programme review stream looks at what happened to the improvement programme, what is completed or underway and what is still outstanding. Another component of this stream was to have a look what happened to the costs of the projects and the programme as a whole.

The performance review had to answer two important questions:

a) How has the performance changed and how does this compare to the planned performance improvements?

b) Will the target be achieved when the remainder of the WNSIP will be implemented and if not, what changes should be made to ensure the target will be met?

Figure3-1 The project CARE review process



4 PERFORMANCE REVIEW STREAM

4.1 THE MODELLING PROCESS – REBUILD AND RECALIBRATION OF THE TRUNK SEWER MODEL

While the original Project CARE model was best practice when it was created, current best practice for modelling is significantly different to what it was in 2000. Computing abilities have moved on since 2000 helping to drive changes in the size and complexity of models.

4.1.1 2006 PROJECT CARE MODEL UPDATE AND RECALIBRATION OVERVIEW

This section summarizes the Project CARE 2006 model update. For each key model update phase, the following details are discussed:

- Activities undertaken during the Project CARE review modelling
- What worked
- Challenges and lessons learnt

4.1.2 2006 PROJECT CARE REVIEW STUDY OBJECTIVE AND SCOPE

The objective of the 2006 Project CARE review was to confirm or redefine the works required for the trunk wastewater system to achieve a system performance of 2 wet weather overflows per annum from the wastewater network.

Due to limitations with the original Project CARE model and significant upgrade works completed to the NSCC trunk sewer network, the 2006 Project CARE Review rebuilt the original Project CARE model to represent the current (2006) network state and extended the model to include critical trunk and local sewer assets. Additional model features include storage tanks, constructed overflows, siphons, increased network coverage, manhole ground levels and critical pump stations. The below Table 4-1, compares key model features between the 2000 and 2006 Project CARE models.

Item	2000 Project CARE Model	2006 Project CARE Model
Length of Modelled Sewer (km)	62	112
No. of Modelled Pump Stations	16	18
No. of Modelled Constructed Overflows	15	38

Table 4-1: Model Feature Comparison

No. of Modelled Uncontrolled Overflows	0	256
No. of Modelled Gauges	34	77 (47 Long Term Gauges + 12 Short Term Gauges +18 Pump Station Magflow and Wetwell Gauges)
No. of Rain Gauges	8	14
No. of Modelled Catchments	68	304
Population Projection	300,000	360,000

4.1.3 GAUGING PROGRAM

Gauging Program Overview

The 2000 Project CARE study installed 34 flow gauges, with the bulk of the gauges in operation for 1 year. The 2006 Project CARE study installed 47 long term flow gauges (in operation for 1 year), 34 of these gauges were installed at the same location as the previous 2000 gauges, the additional 12 gauges were included as a result of either system network alterations or to provide further resolution in key catchments.

The model was calibrated against the 47 long term flow gauges, 12 short term gauges and 18 pump station Magflow gauges. The 12 short term gauges (3 months of gauge data) were installed outside the original gauging period as part of detailed catchment studies. The 2006 model was calibrated against these gauges to improve resolution of particular network issues.

8 Rain Gauges were used in the 2000 modelling, the 2006 modelling used these same sites and an additional 6 sites around the city.

Project CARE 2006 Gauging Program – What worked

The following is a list of what worked well in regard to the Project CARE gauging program:

- Contractual obligation to achieve wet weather flow calibrations
- Strong penalties for gauge down time in wet weather
- Reporting for each gauge on confidence in the accuracy of the flow data across the full range of depths
- Installation of 2006 gauges in same location as the original gauging study, enabling a like with like comparison of flows and catchments
- Project plan was to finalise gauge data prior to model calibration starting
- Having a dedicated gauge auditor from the start of the contract dealing with correct installation of equipment and calibration and data editing to meeting contract requirements.
- Ensuring gauging program coincided with a Census year

Project CARE 2006 Gauging Program – Challenges and lessons learnt

The following is a list of what didn't work so well and lessons learnt in regard to the Project CARE gauging program:

- Final gauge data supplied 1 year late, both the gauge contractor and NSCC learnt what was realistic to achieve for future contracts.
- Additional gauge data required for areas not anticipated at the start of the programme. The unknown should have been planed for at the start of a job, there will always be areas where additional data is required which requires additional time in the programme.

4.1.4 MODEL BUILD AND NETWORK UPDATE

Model Build and Update Overview

The 2000 Project CARE model extents included sewers with diameters equal to or greater than 300mm. The 2006 updated model greatly expanded upon the 2000 model extents from 62kms of modeled pipe in 2001 to 112kms in 2006. The 2006 model extents were largely based upon key system release points (Constructed Overflows) and specific features such as inverted siphons and offline storage tanks. Much of the 2006 model build involved merging of relevant sections of various existing detailed models with the trunk sewer network. The 2006 model build also included assets which were previously simplified out of the original Project CARE model (excluded to minimize simulation run times). Model update of Asset IDs and ground levels were also included in the 2006 model.

Model Build and Update – What worked

The following is a list of what worked well in regard to the Project CARE model build:

- Close involvement of NSCC Operations during definition of model extents to ensure inclusion of relevant spill locations and known areas of hydraulic constraints
- Confirming which critical information from which data source
- Confirming pump station sizes and capacities
- Confirming known issues
- Matching the model to the same coordinate base as the corporate GIS system

Model Build and Update – Challenges and Lessons Learnt

The following is a list of what didn't work so well and lessons learnt in regard to the model build:

- Pulling together disparate data sources of asset data and resolving conflicting data
- To reduce the effort involved in model build and update of the strategic model every 6 years (as part of the CARE review planning schedule) the CARE model network should be updated at a more frequent interval as

network upgrades occur. Keeping the model live in this manner will also allow operational needs to be served outside of a review cycle.

4.1.5 MODEL CALIBRATION

Model Calibration Overview

The 2000 Project CARE model was calibrated against 34 flows and in general the 2001 Project CARE model is considered adequately representative of the 2000 trunk sewer system behavior for purposes of strategic planning.

The 2006 Project CARE model was calibrated against 47 long term gauges, 12 short term gauges and 18 magflows and in general the 2006 Project CARE model is considered adequately representative of the 2006 trunk sewer and relevant local sewer system behavior for purposes of strategic planning.

Project CARE 2006 Model calibration – What worked

The following is a list of what worked well in regard to the Project CARE model calibration:

- Inclusion of the Real Time Control (RTC) code in the model to show the model was calibrated and to assess the performance of the current operational RTC controls and their effect on overflow frequency
- International peer review ensured appropriate level of detail and concentration on the important areas of the model.
- Gauges calibrated and calibration validated proving the quality of the gauge data, the model, and the density of the rain gauge network.
- Tracking changes made to the system by operations staff during the gauging period. Changes that are made by operations can have a significant effect on the performance of the network and hence on the calibration and reliability of the model
- Tracking what projects were being constructed during the gauging period

Model Calibration – Challenges and Lessons Learnt

The following is a list of what didn't work so well and lessons learnt in regard to the model calibration:

- Despite clear instructions to operational staff about not manually operating the system some gates and pump stations were operated manually during the gauging period making calibration more difficult. Minimising operational changes (e.g. set points and manual intervention) during gauging periods and recording any change / interventions when they do occur is very important to ensure good calibration.
- Simulation of NSCC's Real Time Control strategy in the modelling software was a significant challenge and required some user written code to be developed.

4.1.6 SYSTEM PERFORMANCE ASSESSMENT

System Performance Overview

The scope of system performance phase of the 2006 Project CARE review was to quantify the performance of the existing and estimated future wastewater system loads in terms of its:

- Loading
- Capacity
- Overflow characteristics
- Surcharge occurrence
- Catchment 'leakiness' and
- Siltation potential.

In order to compare system performance between the 2000 and 2006 Project CARE models the 2000 wet weather performance assessment methodology was applied to the 2006 model. This involved use of the same 17yr rainfall time series, to estimate overflow spill statistics (occurrence probability, peak discharge, volume & duration) and to indicate catchment Inflow and Infiltration rates.

Project CARE 2006 System Performance – What worked

The following is a list of what worked well in regard to the Project CARE system performance:

- Using same 17 year long term time series as in the 2000 study
- Geospatial thematic mapping of the system performance to evaluate spill locations as the number of modeled overflow locations increased by 20 fold (from 15 to 294).

System Performance – Challenges and Lessons Learnt

The following is a list of what didn't work so well and lessons learnt in regard to the model system performance assessment phase.

- The adopted 17 year rainfall time series (as maintained from the original 2000 CARE study) is a single rainfall time series recorded at one location and therefore does not simulate spatial rainfall variation.
- The predicted performance of the system would be different if the 17 year long term rainfall record was spatially distributed
- Original 2000 CARE study catchment I/I rates were increased for deterioration of pipes in the catchment for the future development scenario, no provision was made for infill development increasing catchment density I/I (increase in private connections).
- The Project CARE 2006 study adopted the 2000 I/I deterioration rate but also an estimate was developed for increase in the number of private wastewater laterals (catchment density) for future development scenarios. To assess future development leakage the calibrated leakage parameters were adjusted to account for the assumed increase in I/I due to the increase in pipe length (private connections) as the catchment infills.

4.2 MODEL SYSTEM PERFORMANCE RESULTS

4.2.1 SYSTEM PERFORMANCE – PREDICTED SYSTEM PERFORMANCE

The image below shows the predicted 2021 System performance. Each overflow has three bars showing the performance each for a separate future scenario.

- The left bar is the predicted overflow frequency if no further changes are made to the wastewater network between now and 2021 (existing network including changes made between 2000 & 2006 and including committed works to 2010).
- The middle bar is the predicted overflow frequency if the 2002 WNSIP programme is implemented as was planned by 2021.
- The right bar is the predicted overflow frequency if the 2008 revised WNSIP programme is implemented as planned by 2021.

The differences in scope and costs between the WNSIP options are given in the table below and explained in section 5.

Table 4-2 scope and costs and 2021 overflow frequencies of modeled programme scenario's

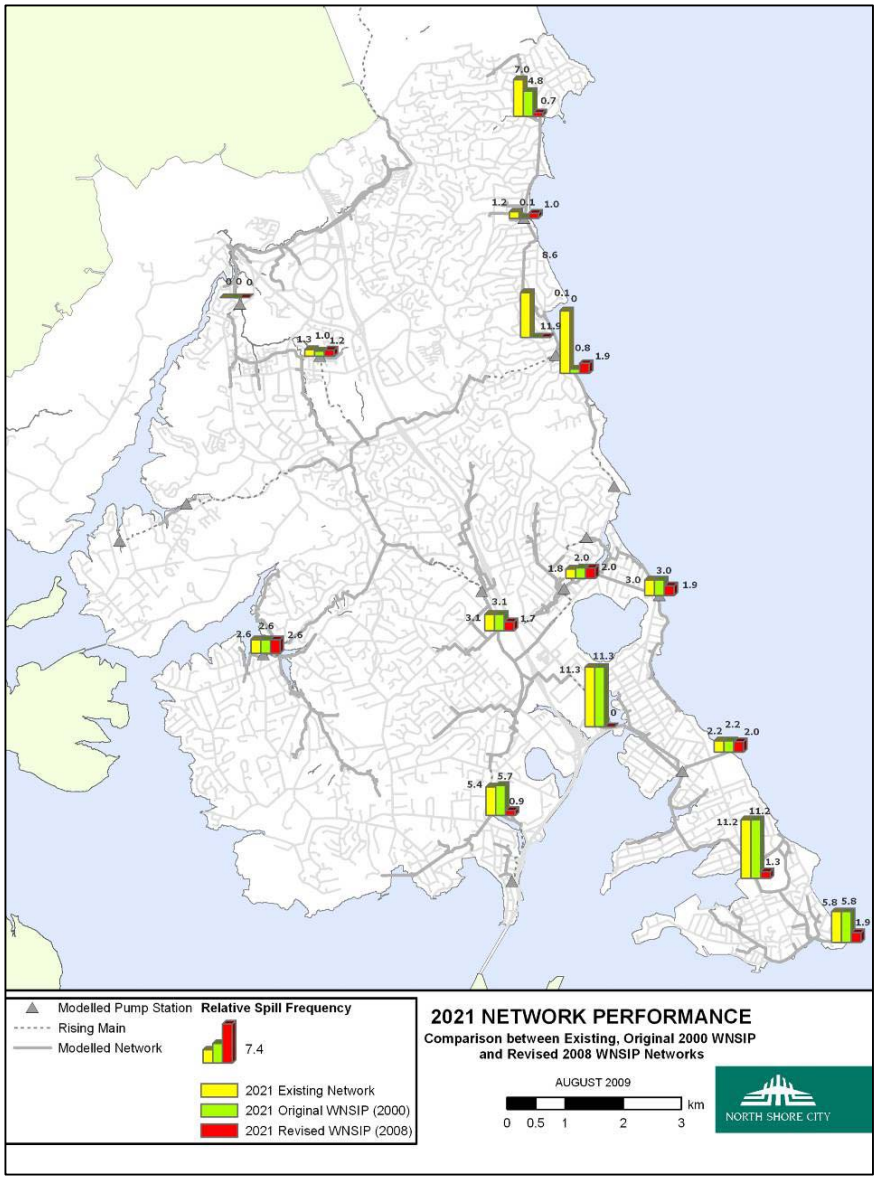
Network	Assessment Year	No of Locations Failing LOS of 2 Spills per Year	Capital Expenditure (2008 $M)
Existing Network	2021	11	$145
Original WNSIP (2002) Implemented	2021	9	$414
Revised WNSIP (2008) Implemented	2021	1	$448

Figure 4-1 shows where the outstanding 2002 WNSIP needed to be adjusted to meet the system performance target by 2021.

For clarity the image shows only the major constructed overflows in the network, many other system release points are included in the model and require improvement works to meet the target containment standard. As mentioned in section 4.12 the number of overflow locations represented in the 2006 model has increased 20 fold giving many more overflow release points to be resolved by the WNSIP.

The critical overflows with the highest overflow frequency and volumes are represented in both the 2000 model and the 2006 model – these are the overflows shown in the 2021 Network Performance image.

Figure 4-1: 2021 Predicted Network Performance



4.2.2 SYSTEM PERFORMANCE – IMPLEMENTED WNSIP ASSESSMENT

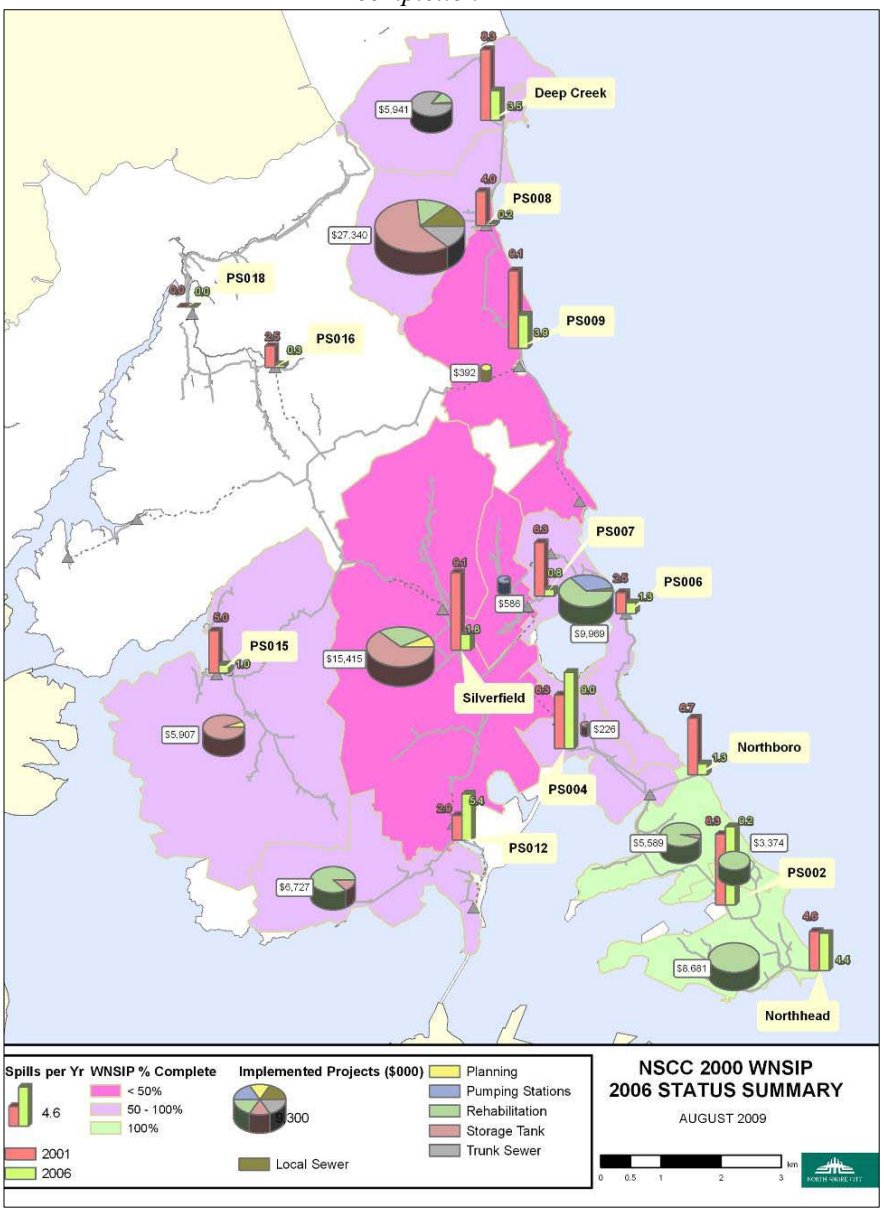
The overflow locations from the 2000 model were compared against the overflows in the 2006 model which represent the same system release points. This comparison is necessary to determine if implementation of the 2002 WNSIP which was designed to fix known problems is in fact having the desired impact on the wastewater network and the frequency of overflows to the environment.

Figure 4-2 illustrates;

- the change in overflow frequency between 2000 and 2006,
- the amount of money spent to date in each area and what the money was spent on
- the proportion of the 2002 WNSIP budget spent by area (completion)

Generally, where significant amounts of money have been spent, an improvement to overflow frequency has been achieved.

Figure 4-2: 2006 performance against predicted performance and level of completion



5 PROGRAMME REVIEW

5.1 STARTING WITH THE OUTCOME: WE NEED ANOTHER $303 MILLION TO COMPLETE THE PROGRAMME

The WNSIP has been updated to ensure the target can be met in 2021 and to include any changes in scope and costs as a result of improvements during planning work undertaken to date.

In the context of this review, projects in the outstanding programme have been adjusted to include:

- Refinements in the outstanding works programme to date
- Updates on costs expressed in 2008 dollars using new unit rates
- Some adjustments in the timing of the projects for practical or budget reasons
- Adjustments made to the programme as a result of the performance assessment

The outcomes of the review are shown in figure 5-1 and table 5-1. These also show the sections in which further information on most of the components or steps is provided..

Figure 5-1: Changes in the WNSIP costs

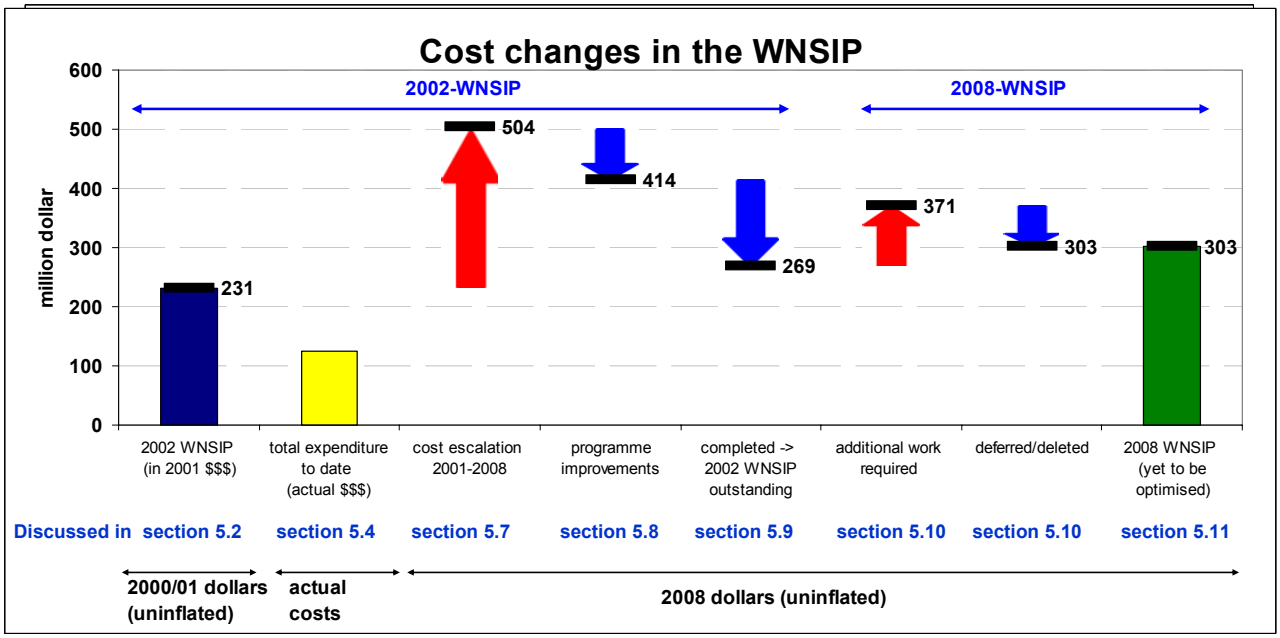


Table 5-1: Key outcomes of the cost review

Milestone	Description	Further detail in	Costs
2002	**Adopted WNSIP by council in 2002.** The costs were based on 2000/2001 unit rates; At the time there was no requirement to add inflation. Projects carried out before 2002 were not included.	Section 5.2	$231 (2001 dollars)
2001-2008	**Total actual expenditure to date.** Also including project expenditure before 2002 and projects underway	Section 5.4	$124 (actual)
2001-2008	**Total expenditure to date.** As above but expressed in 2008 dollars	Section 5.9	$145 (2008 dollars)
2008	Initial **2002-WNSIP escalated to 2008 dollars** using the new unit rates and including projects before 2002.	Section 5.7	$504 (2008 dollars)
2008	As previous and including **savings** as a result of refinement	Section 5.8	$414

Milestone	Description	Further detail in	Costs
	undertaken to date.		(2008 dollars)
2008	Total costs of **2002-WNSIP outstanding** work	Section 5.9	$269 (2008 dollars)
2008	Total **costs of changes** to the 2002 WNSIP outstanding programme as result of performance review	Section 5.10	$34 (2008 dollars)
2008	**2008-WNSIP costs**: Total outstanding budget required to meet the target in 2021.	Section 5.11	$303 (2008 dollars)

5.2 THE 2002 WNSIP

The Wastewater Network Improvement Programme was adopted by council in November 2002 and was used as input into the 04/14 City Plan process. Table 5-2 shows a costs breakdown of the WNSIP.

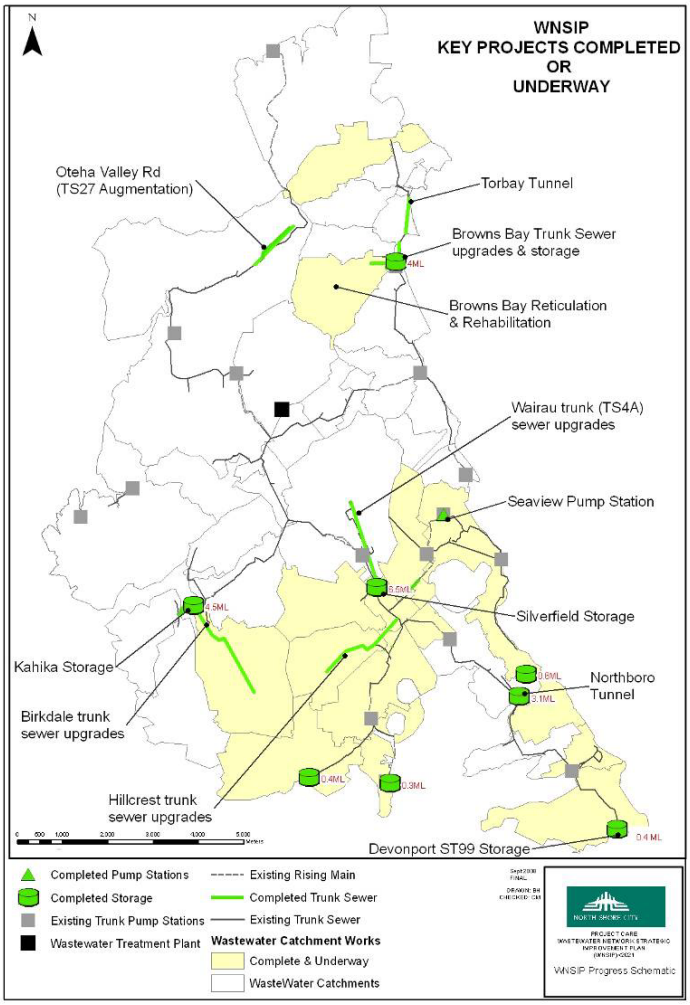
Table 5: breakdown of the 2002-WNSIP

	Costs
New Capital	$156m
Rehabilitation	$75m
Total	$231m

Notes:

- The WNSIP was based on cost data that originated from around the year 2000. At the time these costs weren't escalated to 2002 dollars, because it was felt that any changes were within the margin of error of the estimates.
- These costs only include works between 2001 and 2021 when the target is planned to be met. It did not include improvement costs for works carried out before 2001 and works required to keep up with growth and system deterioration between 2021 and 2050.
- For the purpose of the 04/14 and 06/16 LTCCP's most of the project costs were updated, but only using the Consumer Price Index (CPI) as a general inflation indicator.

Figure 5-2: completed key projects



5.3 PROJECT TRACKING

During the refining and design process and as a result of the catchment planning process projects have been changed, bundled and un-bundled. To ensure a like-with-like comparison care was taken that no projects were left out and that there were no overlaps. Project tracking has been problematic and complex because project rationalisation is often carried out on a group of projects, so that a project by project comparison is not always possible.

Another problem was how to translate a catchment upgrade with an allocated budget in the 2002-WNSIP to a number of specific projects within that catchment, when many catchment planning projects are not completed. In many cases engineering judgment was used to resolve this.

5.4 COMPLETED PROJECTS

The implementation of projects to reduce the frequency of wet weather overflows started around 1997/1998. To date, the total amount of money spent is $124 million (actual costs). This includes costs of projects currently being prepared or under construction. Expressed in 2008 dollars the $124 actual costs translate in $145 million.

Figure 5-2 shows the location of the key projects that have been completed. Section 4 discussed the performance improvements achieved by these projects. Key projects completed include the Browns Bay Storage Tunnel, The Silverfield and Kahika Storage tanks, the Oteha Valley and Wairau trunk sewer upgrades, the Northboro storage tunnel and the Seaview pumping station in Milford.

Figure 5-3: trenchless technologies are often used

5.5 CATCHMENT PLANNING

5.5.1 TARGETTING CATCHMENTS

The Project CARE strategic planning process was based on a trunk sewer model and the performance of catchments as measured at the bottom of these catchments. During the cost optimisation some of the catchments were targeted for sewer rehabilitation (reducing stormwater ingress) and/or better conveyance. Design targets were set related to the amount of Inflow and Infiltration (I/I) reduction and/or capacity upgrades within the catchment. Further catchment planning is required as part of the implementation process to identify the actual physical works that are required to meet these targets.

The main objectives during catchment planning are:

- Meeting the performance target of not more than 2 wet weather overflows per annum, possibly better.
- Meeting reduction and capacity requirements specific for that catchment as set in the Project CARE programme, to avoid unplanned effects on the downstream trunk system
- Ensuring all wastewater is conveyed to the designated overflow locations in the trunk sewer system. This means that these local wastewater systems have to be designed to a higher standard than the trunk.
- Looking for integration opportunities (e.g. interfacing with stormwater planning) and community outcomes (eg minimising disruption, choice of location, etc)

A typical catchment planning programme includes:

- A detailed flow gauging survey within the catchment and additional surveys of missing asset data.
- Detailed model build, calibration and verification to create a model representing the current system.
- Using the model to assess the catchment performance for leakiness, capacity in wet and dry weather for current and future demand (growth) and wet weather overflow performance and the locations where these overflows occur.
- Developing options for improvement to meet the design targets
- Running improvement options through the model and assessing whether the containment standard and other design targets can be met.
- Preparing a works programme for the entire catchment including cost estimates.
- Replacing the ‘generic catchment upgrade project-budget’ in WNSIP and the City Plan programme with the actual recommended physical works within a Project CARE catchment.

5.5.2 DIFFICULTIES

The Catchment Planning process has proven to be more problematic then initially anticipated for a number of reasons, including:

- Inconsistencies, inaccuracies in gauging and modeling that resulted in unreliable outputs. This has been addressed by introducing better specifications and resulted in longer periods of gauging and improvements in model build and calibration.
- The lack of reliable asset data. In many cases further data capture needs to be undertaken to enable catchment planning. We now complete a survey for each catchment to collect any outstanding asset data and connectivity issues at the start of the process.
- A number of proposals for physical works were rejected during the implementation process because of practical feasibility and/or consenting issues. Catchment planning now includes feasibility studies and planning assessments to ensure that recommended improvement works can actually be implemented.

As a result a typical catchment planning process now takes up to 3-4 years to complete.

It is important that the improvements described above are implemented to ensure that the most cost effective solutions are identified and to ensure that recommended projects are reliable and can be implemented without unnecessary delay and will deliver on the outcomes sought.

The result of the above is that some projects that are obvious / no-risk have been identified and in some cases are underway (such as the Birkdale sewer upgrade) but that many catchment plans that were programmed to be completed have not been finalised to date.

5.6 OUTSTANDING PROJECTS

The outstanding 2002 WNSIP was identified to:

- enable those projects which are planned but not built to be entered in the 2021 hydraulic model, so the 2021 performance could be calculated
- enable a cost comparison between the 2002-WNSIP and the 2008-WNSIP

5.7 COST ESCALATION

During the Strategic Planning work, the costs for most of the improvement works were based on unit rates. During implementation project costs often turned out to be higher then compared to what was assumed in the WNSIP. A thorough analysis was undertaken to understand the reasons behind these differences.

5.7.1 CHANGE IN UNIT COSTS

The unit costs per asset category were reviewed and it was found that the unit costs have increased about 2 to 4 times faster than the CPI inflation allowance that was used in previous City Plan processes.

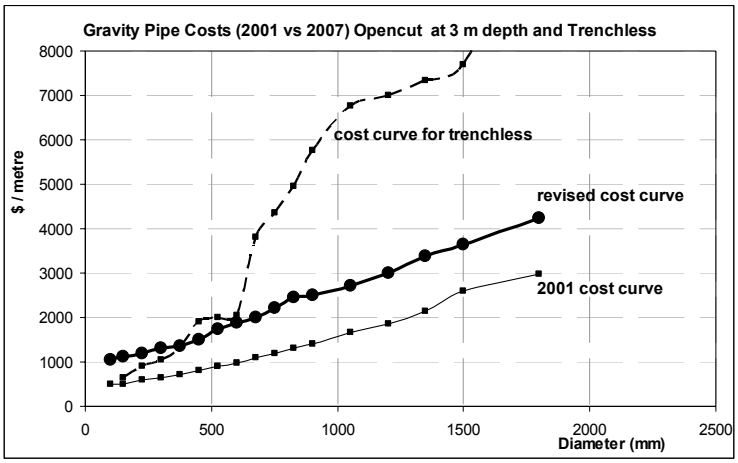
Unit costs have changed for a number of reasons as listed below

- Increase in construction labour and material costs. This item represents the major reason for the changes, estimated at more then 90% of the total unit rate increase)
- Other changes account for the remaining 10%, such as:
    - An increase in costs for obtaining consents, consultation and increased levels of construction supervision to address NSCC's increased requirements to meet Health, Safety and Environmental Controls, traffic control, quality assurance, and environmental monitoring. Overall, the engineering and project management costs have increased from 4.5%-8% of construction cost, as assumed in 2001, to 12%.
    - Costs for condition surveys and monitoring, and land owner compensation which were previously not included.

- Due to difficulty in obtaining land owner agreement and consents, pipe line corridors and sites for structures have at times been relocated to more difficult areas than expected in 2002. In these cases this has increased construction costs
- Most trenchless technologies are relatively cost-competitive with open-trenching, with the exception of micro-tunnelling which is a relatively high cost technology and sometimes chosen, which was not foreseen in 2002.
- There has been a general increase in specification to ensure better quality, including choice of contractors
- Options are selected on best value using a life cycle cost approach, which in some cases favors high capital low operation and maintenance solutions

As an example sewer line unit rates increased by 130% relative to the 2000/01 unit rates, compared with30% cumulative increase in CPI over the same period.. Figure 5-4 shows the graphical representation of the analyses showing the difference in the unit rate for gravity pipes at 3 m depth between 2001 and 2007. It shows that costs doubles for lines with diameters up to 600mm. It also shows the cost implications for lines with a diameter larger then 600 mm when opting for trenchless rather then open cut. More then 90% of the projects were implemented using trenchless technologies for a variety of reasons, including minimising disruption.

Figure 5-4: Example of change in unit rates



Other observations were:

- Unit costs for pumping stations and rising mains increased by 73%
- Unit cost for sewer rehabilitation per linear meter increased by 132%
- Storage tanks increased by 35%
- The operational component in a whole life cost assessment has increased in pumping stations from 30% to 50%.

5.7.2 HIGHER LEVEL OF COMPLEXITY THAN ENVISAGED IN CATCHMENT UPGRADES

Assumptions in the Project CARE Strategic Planning phase related to catchment upgrades were largely based on Sydney experience. Catchment planning carried out to date has shown that upgrading these catchments is more complex then expected, sometimes resulting in higher costs. This observation was also made in Sydney about 4 years ago.

5.7.3 HIGHER COSTS IN SEWER REHABILITATION OFFSET BY REDUCTION IN SCOPE

The costs for sewer rehabilitation have shown to be more expensive then assumed. One of the reasons is that the method of rehabilitation was assumed to be 80% grouting and 20% lining. Grouting is no longer used (unreliable), which has resulted in a more expensive programme. Another reason is that the costs for source detection and private property inspections are higher then originally assumed. This increase has been offset in the revised WNSIP as the scope of the work has reduced: a few catchments have been removed from the works programme because detailed analyses showed a better performance compared to CARE expectations.

5.7.4 CONSERVATIVE DESIGN

Every time a project enters into the design phase, the design parameters, as provided through the Project CARE programme, are being reviewed. One of the considerations is what the cost would be for getting it wrong and actual flows turn out to be higher than the Project CARE targets, which are set on the bases of assumed demand

and wet weather overflow performance. We have seen examples where we did not use a conservative design approach and a design was carried out according to population densities based on the then-current District Plan, but had to carry out expensive amplification works only 10 years later, because actual development densities turned out to be a lot higher. If we would have designed 'conservatively', by say using a safety factor on predicted design flows, then this amplification might have been avoided. However if we would over-design all projects in the programme, this would come at a large cost. As an example, if we would design for a 1 year ARI rather then a 6 Month ARI. this will result in a programme that is approximately $80 million (2001 dollars, NPV) more expensive. This is equivalent to approximately $150 million in 2008 dollars. Hence we need to be very careful to control how much additional margin we allow for uncertainty in future flows as the cost implications on the total programme can be significant.

5.8 PROGRAMME IMPROVEMENTS

Many projects have been refined as a result of planning or design work undertaken to date. Over the years some projects have been replaced by other projects, bundled or split while achieving similar design objectives. This is a normal business process looking at continuous improvement.

Over the last 8 years changes to the original 2002-WNSIP have been made for reasons explained below. As a result the total costs have come down by approximately $90 million.

Project rationalisation and detailed catchment investigations

Project rationalisation has lead to significant savings. This is because detailed investigations have identified less expensive solutions meeting the same performance objectives.

Also detailed gauging has resulted in the elimination of catchment work where the performance showed a better performance compared to the more coarse gauging carried out during the Project CARE investigations.

Specific changes in individual projects

In a number of completed projects the scope was changed relative to the original WNSIP recommendations for a range of reasons such as addressing local issues such as disruptions. An example is the Browns Bay Storage tunnel. The original proposal was to upgrade the Trunk Sewer as well as to build a large storage tank. This would have resulted in two separate projects and related disruption. These projects were combined into the Browns Bay Large Sewer along Beach Front Lane and Anzac Street. However the cost implications were about $3 million extra.

5.9 ESCALATED COSTS FOR THE COMPLETED AND OUTSTANDING 2002 PROGRAMME

The value of the completed programme in 2008 dollars is $145 million

The value of the outstanding 2002 WNSIP, using the above information is now estimated at a total of $269 million.

5.10 ADJUSTMENTS TO THE SCOPE OF THE 2002 PROGRAMME

As part of the performance assessment (more detail in section 4) hydraulic modeling was carried out to calculate the predicted wet weather overflow performance in 2021, based on the re-calibrated model and the improvement programme. The model outcomes showed that in some locations the system was over-performing and in other locations it was under-performing. In cases of over-performance, projects were removed, deferred or reduced in scope. In cases of under-performance, projects were added to the programme to meet the target in 2021. This has the following result:

The total value of projects removed, deferred or reduced on scope	$ 67 million
The total value of projects added	$ 101 million
Balance	$ 34 million

Overall this is considered a very good result. In 2000 assumptions were made related to the project CARE strategic planning programme. With this type of strategic planning project an error of 20% to 30% is considered

typical. The above change in total costs is less than 7%. The scope of the programme has changed by about 20%. This is significant and highlights the importance of the reviews.

The scope of the added projects has been done using engineering judgment while the performance improvement was assessed using the hydraulic model. It is likely that further refinements and optimisation will identify savings. The re-optimisation is addressed in section 7.

The scope of the projects is based on 2021 demand. The actual demand and the demand after 2021 is one of the biggest uncertainties and could potentially change the scope of future projects because although the need for the projects is identified by the 2021 model, the scope of a project is determined by ultimate (2050) demand.

5.11 THE REVIEWED PROGRAMME: THE 2008 WNSIP

The 2008 WNSIP is considered much more accurate and reliable then the 2002 WNSIP for the following reasons

- One-third of the upgrade programme is already complete
- Unit cost rates have been done much more accurately and are in part based on experiences to date
- The hydraulic model is more reliable (see section 4)
- Some projects have been further refined

The result is that the outstanding WNSIP has a value of $303 million. A breakdown is provided in table 5-3, showing the optimal mix of sewer rehabilitation, storage and capacity improvements.

Table 5-3 breakdown of the 2008-WNSIP

Project category	**2008 WNSIP Outstanding** 2008 dollars
Storage Tanks	$48 m
Trunk Sewer	$36 m
Pumping Stations and Rising Mains	$54 m
Local Sewers	$98 m
Rehabilitation	$64 m
Planning	$3 m
Total	$303 m

6 BUDGETS -> LTCCP

6.1 INFLATED OR UNINFLATED

The LGA-2002 requires councils to express their budgets and costs in inflated dollars. Before this requirement, NSCC displayed un-inflated costs in its LTCCP.

Although one can understand why this is now a requirement, this change has triggered significant discussions in North Shore at all levels:

Accuracy:

We have been pushed to provide costs for projects as accurately as possible. Future CPI is in comparison very uncertain. Mixing these two to come up with costs for future projects up to 10 to 20 years out

- makes our efforts to get the costs more accurate feel pointless
- makes the accuracy of what is presented in LTCCP a lot less reliable
- and as a consequence actual versus budget comparisons show large differences, food for blaming the council for not able to control the costs and getting it wrong again, while the real reason is more likely tha not changes in CPI, which we can not control.

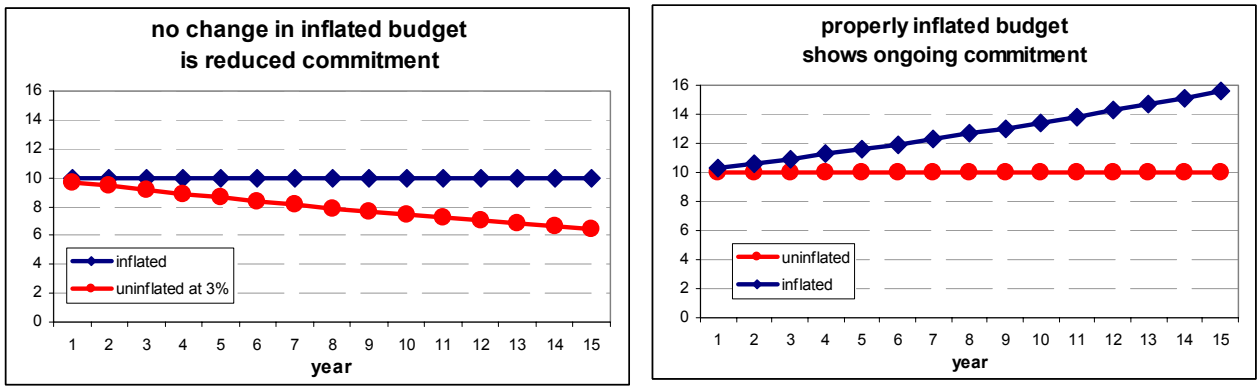
Market

Everyone knows that the market is not that predictable. Tender prices often come in anywhere between plus or minus 30 percent of the best engineers estimates.

Debating budgets

You expect budgets to be debated using what is actually presented in a LTCCP process, thus looking at inflated numbers. This process is illustrated by the blue line in the left hand graph of figure 6-1 below. It looks as if there is an ongoing continued commitment. If you however un-inflate these numbers at say 3% per annum, the red line represents the un-inflated budgets, showing a significant reduction in the actual annual commitment.

Figure 6-1: illustration of working with inflated ad un-inflated budgets



Showing a continued – not increased – commitment is more looking like the red line in the right hand graph. The problem is that the blue, inflated line is what goes in the LTCCP, is being discussed in the council chambers and ends up in the media, making the council look like not able to control the cost.

On top of this, for the work related to Project CARE, the actual cost escalation is much higher than the CPI used in the LTCCP's over the same period.

6.2 POLITICAL COMMITMENT

So, we needed more budget to complete the programme, for reasons explained in the previous sections. The engagement of the North Shore City councilors on this matter was commendable, which is not surprising given the history of community involvement in project CARE.

A number of budget scenarios were developed. In summary the question was

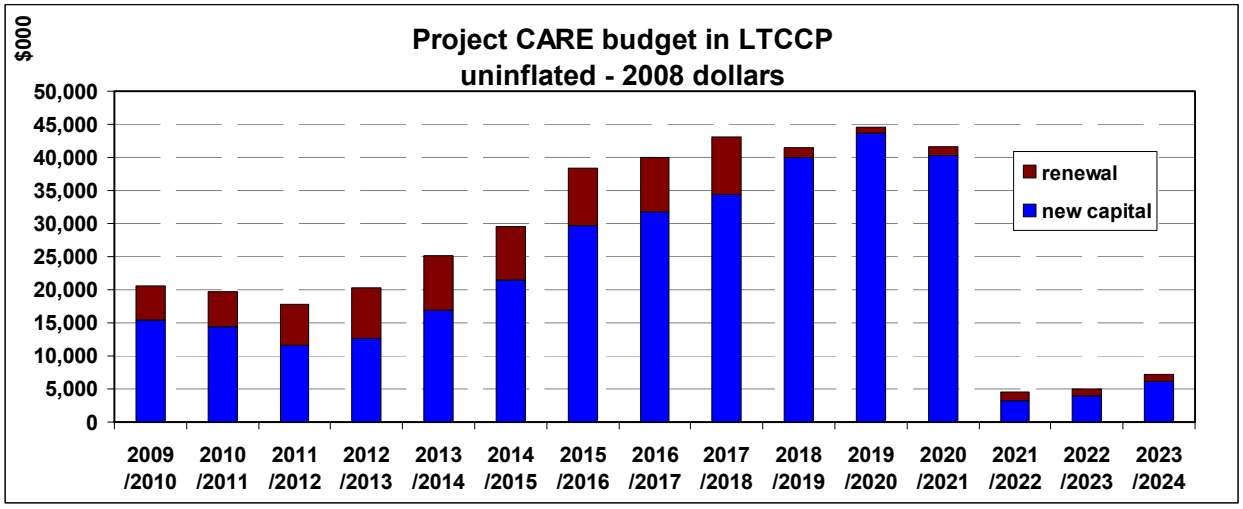
a) Do we continue our commitment at the same level and complete the programme later, or

b) Do we increase the budget and complete to programme in 2021 as per original target.

This debate was held in the middle of the discussion to further reduce the cost and rates compared to the previous LTCCP. One of the key considerations was that during the 2002 consultation the community expressed its lack of trust that council would later change its mind and not complete or defer the upgrade programme.

The outcome was that council showed its commitment to Project CARE and increased the budget to enable completion in 2021. The approved budget is shown in Figure 6-2.

Figure 6-2: Project CARE budget in approved LTCCP (2008 dollars, un-inflated)



7 NEXT STEP: OPTIMISATION

In project CARE, optimisation was used to identify the most cost optimal mix between different technologies to improve the performance of the network. These technologies are:

- Sewer rehabilitation aimed at reducing inflow and infiltration
- Increase the capacity of the
  - Trunk Sewer capacity (gravity system, pumping stations and rising mains)
  - Local Reticulation
  - Wastewater treatment plant
- Build network storage capacity
- Provide alternative routes to transfer flows

Council decided to re-optimise the system as a subsequent phase of the CARE review for the following reasons:

- Unit costs have gone up at different rates between the different technologies which can result in a different mix of technologies to achieve the target.
- The additional work identified in section 4.7 has been based on initial engineering assessments, mainly using storage. It is more likely than not that optimisation can identify further savings on the total programme.

- The computer model (SEWCOM) that was used at the time is not commercially available. Other, commercially available software has become available. We have used this software as a pilot in the Albany basin. A separate paper on this software will be presented during this conference..

The Optimisation phase is now well underway. Results are expected around the end of 2009.

8 EVALUATION:

8.1 WHERE DOES THE NETWORK CONSENT FIT IN?

Project CARE is a community outcomes triggered programme, not RMA driven. It started before council started its process to apply for a network consent for its wastewater and stormwater systems. From 2002 onwards, a network consent was applied for and provided, appealed to the Environment Court and almost resolved during mediation. Even though Project CARE was not driven by the consenting process it provides an ideal tool for planning and auditing of any consent condition once granted.

The question is whether or not the network consent process added any benefits to the outcomes in relation to the wastewater network and its effects on the environment. Probably because NSCC has shown leadership during the planning and decision phase and has processes in place to implement, monitor and report progress, the consent process has added very little if anything to what would have been done anyway.

One benefit is that the consent will make it harder to compromise the targets in the future.

Another question that needs to be asked is whether the implementation of RMA should be focused on those that are leading. Presumably the RMA was in place to improve environmental outcomes. In keeping with this intent of the RMA, the energy should be focused on those who haven't set a bar for themselves, where the base is very low and where performance is known to be a problem.

8.2 EFFORT / COST / BENEFIT: WORTH WHILE?

It has taken about 2 years and a considerable amount of resourcing to carry out the review and another year to carry out the re-optimisation.

The total estimated cost for the remainder of the project CARE improvement programme is estimated at $303 million. Even if the costs of the review were about $1 million, this would be 0.3% of the total cost. The cost for getting it wrong would be a lot higher. You can't build a storage tank for $1 million

The current review has been providing important information to ensure the programme is on track and the money will be spent wisely. Future reviews are planned to be carried out at 6-yearly intervals.

9 CONCLUSIONS

The project CARE review has been a very worthwhile exercise.

The programme is 1/3 underway in 1/3 of the programmed time. System improvements to date have been focused on big trunk sewer projects with immediate noticeable improvements, such as storage tanks in Browns Bay, Kahika and Wairau. The focus is now shifting to many relatively small improvement works in the catchments where overflow frequencies are still high.

The review process had been challenging but has resulted in a more reliable hydraulic model and improvements to the WNSIP to ensure the target will be met at least cost. Re-optimisation of the WNSIP programme is underway and scheduled for completion around the end of 2009.

The cost escalation has been very high, much higher then the CPI used in the LTCCP process, but mainly (more then 90%) caused by the market and outside control of council. The estimated value of the outstanding programme is $303 million. Council has increased the budgets in the LTCCP to maintain the target completion date of 2021, showing its genuine commitment to the community.

Project CARE, the Project CARE review and the continuing political commitment have shown that a non-regulatory approach can work very well.

GLOSSARY

ARC	Auckland Regional Council (the consent authority)
I/I	Inflow and Infiltration
LTCCP	Long Term Council and Community Plan (10-15 year strategic plan including budgets)
NSCC	North Shore City Council
WNSIP	Wastewater Network Strategic Improvement Programme
RMA	Resource Management Act
RTC	Real Time Control

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