Greater Wellington Water

Asset Management Plan

November 2004

Greater Wellington Publication Number GW/SA-T-04/56

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1.0 Summary

Overview

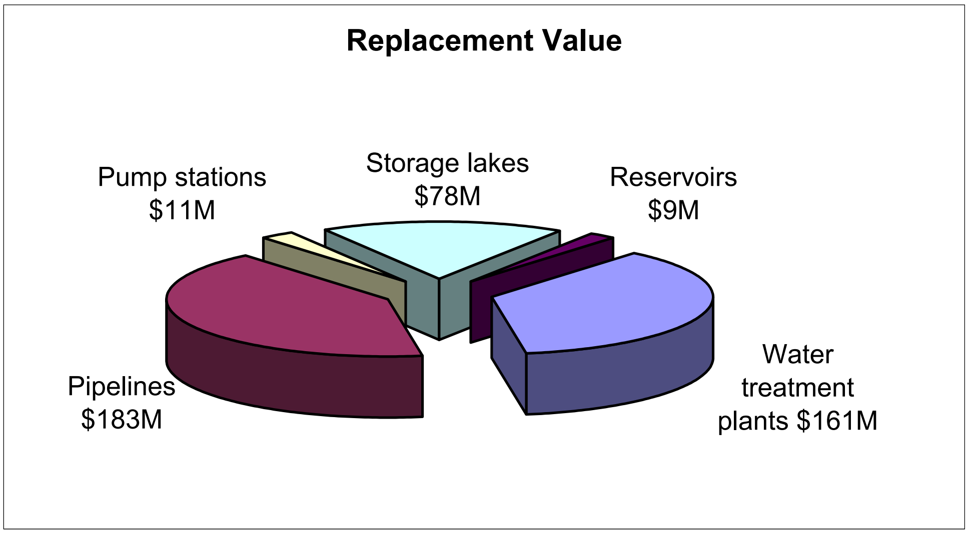
The stated purpose of Greater Wellington Water (GWW) is to;

Provide enough high quality water each day to meet the reasonable needs of the people of greater Wellington, in a cost effective and environmentally responsible way.

High quality refers to both water quality and water quantity. The targeted supply is one which:
- is sufficient to meet any drought condition except one that is equalled or exceeded once every 50 years, and
- meets all aspects of the Drinking Water Standards of NZ, including aesthetic requirements.

The purpose of this Asset Management Plan is to ensure that the necessary assets are in place and maintained to provide to customers the promised levels of service over the long term, at reasonable cost and in a sustainable and environmentally responsible way.

GWW owns and manages the assets summarised in the Figure below to deliver bulk water supply services.



- **Water intakes 6**
- **Wells 11**
- **Treatment plants 4**
- **Storage lakes 2**
- **Tunnels (10) 9.3 km**
- **Pipelines 182 km**
- **Pumping stations 15**
- **Reservoirs 3**

Total Replacement Value $442,000,000
Current Book Value $285,000,000 (Depreciated replacement cost)

Level of Service

Greater Wellington Water consistently achieves the target service levels. The service levels, which are the subject of consultation, and are published in the Annual Plan and (draft) customer service agreement, are:

Standard	Target
Quantity of Supply	
Sufficient water will be available on a daily basis to meet the 1 in 50 year return period drought situation.	100%
Meet the following criteria for each customer service reservoir supplied directly by GWW Maintain at least 60% full Maintain at least 50% full	 >90% of the time >98% of the time
Compliance with resource consents issued for water abstraction. Compliance monitored and demonstrated annually to an auditable standard.	100% 100%
Water conservation education programme implemented.	100%
Water supply infrastructure maintained & upgraded in accordance with GWW AM plan.	100%
Suitable emergency response plans in place	100%
Quality of Supply	
Compliance with NZ Drinking Water Standards 2000	100%
Achieve Ministry of Health Grading for water treatment: Wainuiomata plant Te Marua Waterloo Gear Island	A1-100% A-100% B-100% B-100%
Water testing will be carried out by IANZ registered laboratory to the programme defined by the Quality Assurance section of GWW.	100%
ISO 9001 accreditation compliance for wholesale water operations.	Full compliance
Public Health Risk Management Plans will be produced by 30 June 2004 (subject to legislation)	5 (by 06/04)
Vegetation management measures undertaken in accordance with GWW Forestry Management Plan.	100%
Implement and maintain an Environmental Management System accredited to ISO 14001.	100%

Demand growth

Greater Wellington Water utilises sophisticated models to analyse growth in demand and the impact on the ability of the water supply system to continue to meet service levels. The models indicate that a 1 in 50 year drought can be met for a Wellington population of approximately 377,000. Based on Statistics New Zealand projections, 377,000 could occur as early as 2007 for the high growth scenario. It should be noted that the medium growth projection is very low, and indicates that a population of 377,000 will not be reached until 2020. Population trends will therefore be regularly monitored.

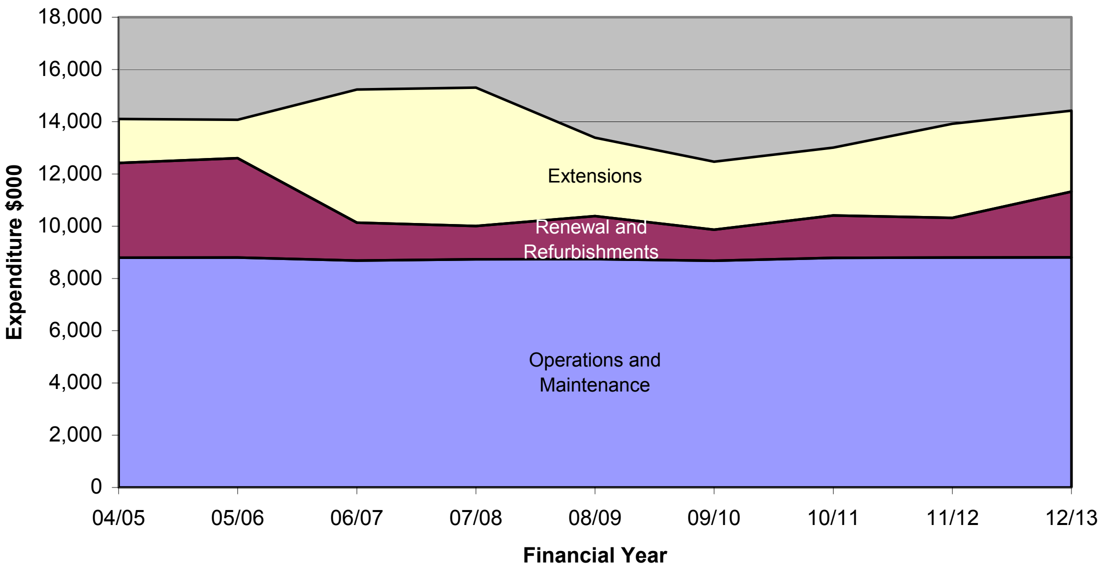
Risk Management

GWW has maintained a focus on risk management with a number of initiatives designed to improve the reliability of service quality and quantity for current and future customers:

- The preparation of Public Health Risk Management Plans (PHRMPS)
- A Comprehensive Safety Evaluation of Existing Dams (SEED review)
- Study of Seismic Risk hazards to the wholesale water supply and an extensive programme of works to mitigate the impacts of those risks.

Financial Forecast

Total budgeted expenditure for 2004/05 is $8.8M for operations and maintenance (excluding depreciation and corporate overheads) plus $3.6M for capital renewal and refurbishment works and $1.7M for capital extensions. The long-term expenditure projections are shown in the Figure below.



The significant trends in the forecast are;

- Operations and maintenance expenditure remains fairly constant at $8.8M per year.
- Renewal and refurbishment expenditure totals $18.6M over the nine year planning period, varying between a maximum of $3.8M in 2004/05 and $1.2M in 2009/10.
- Capital expenditure on extensions total $28.5M over the 9 year planning period, peaking at $5.3M in 2007/08.

Management Quality

The quality of asset management practices implemented by Greater Wellington Water has consistently improved over the past 5 years and is currently assessed as comparable to industry ‘best practice’ in New Zealand, with particular strengths in network modelling, implementation of asset management systems and GIS, risk management and data collection.

The priority improvement tasks to be undertaken over the next 3 years are focused on:

- Agreeing levels of service and supply arrangements with the customer councils in the form of a Water Supply Agreement.
- Analysing maintenance, condition, performance and cost data to allow better identification and prioritisation of capital renewal and development projects, optimisation of maintenance programmes and risk management.
- Further developing risk management and economic decision-making strategies.
- Further develop and enhance system modeling software.
- Capture spacial data associated with network assets in GIS system.
- Identify preferred next source for development.
- Identify transmission system shortcomings.

2.0 Business Overview

2.1 Role of Greater Wellington Water

Greater Wellington Water (GWW), the name given to the water supply function within the Utility Services Division is the wholesale water supplier to the four metropolitan city customers, Porirua, Hutt City, Upper Hutt City and Wellington. The stated purpose of GWW is to:

Provide enough high quality water each day to meet the reasonable needs of the people of greater Wellington, in a cost effective and environmentally responsible way.

High quality refers to both water quality and water quantity. The targeted supply is one which:

- is sufficient to meet any drought condition except one that is equalled or exceeded once every 50 years, and
- meets all aspects of the Drinking Water Standards of NZ, including aesthetic requirements.

GWW is the owner and manager of the bulk water system under the Wellington Regional Water Board Act 1972. This Act, which is now administered by the Greater Wellington Regional Council (GWRC), brought together the wholesale water treatment and distribution functions of the cities within the metropolitan Wellington area. It recognised that the critical wholesale water sources for the area are located within the boundaries of the cities of Hutt and Upper Hutt and allowed the available surface water catchments and aquifers to be utilised in the best way for the common good of all four cities.

The Act precludes any of the cities undertaking a wholesale water function without the approval of the GWRC. Generally the Act empowers the GWRC to provide for the provision of wholesale water for the community to meet the community's public health needs.

2.2 Scope of Assets

GWW owns and manages the asset summarised below to deliver bulk water supply services.

- **Water intakes 6**
- **Wells 11**
- **Treatment plants 4 (3 active, 1 standby)**
- **Storage lakes 2**
- **Tunnels (10) 9.3 km**
- **Pipelines 182 km**
- **Pumping stations 15**
- **Reservoirs 3**

Total Replacement Value $442,745,000
Current Written Down Value $285,334,000

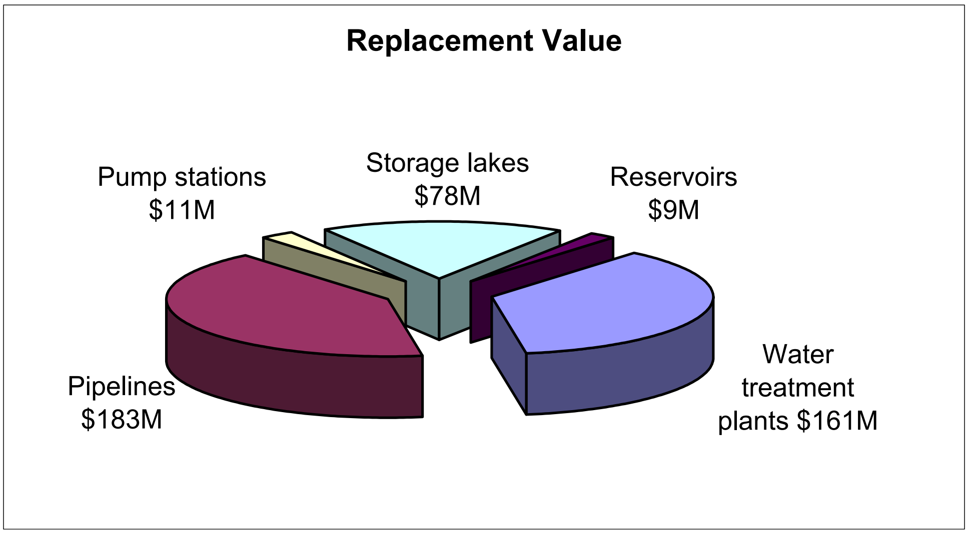
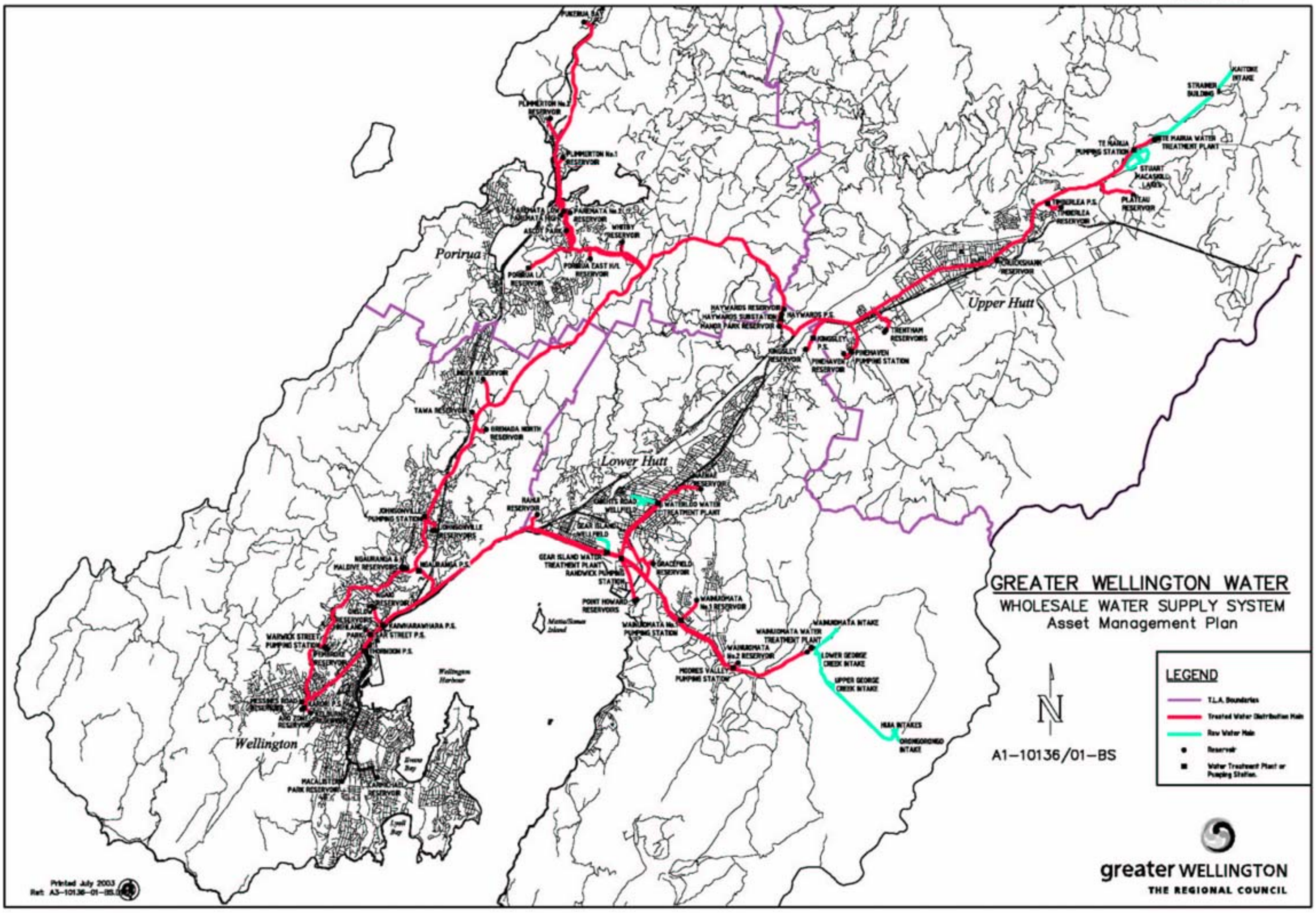


Figure 1: Replacement Value by Asset Type

FIGURE 2.


GREATER WELLINGTON WATER
WHOLESALE WATER SUPPLY SYSTEM
Asset Management Plan
LEGEND
T.L.A. Boundaries
Treated Water Distribution Main
Raw Water Main
Reservoir
Water Treatment Plant or Pumping Station.
A1-10136/01-BS
N
Porirua
Lower Hutt
Upper Hutt
Wellington
Printed July 2003
greater WELLINGTON
THE REGIONAL COUNCIL

A schematic plan of the bulk water supply layout is shown in Figure 2. The purpose and a brief description of the main system components is as follows.

a) Water sources: Greater Wellington Water takes water from both surface water and groundwater sources.

- **Surface water sources-** There are three river intake abstraction points for supply to the Te Marua and Wainuiomata Water Treatment Plants. The flow from the intakes to the treatment plants is not pumped. The three sources are:
  - The Hutt River at Kaitoke
  - The Wainuiomata River and its tributary George Creek
  - The Orongorongo River and its tributary Big Huia Creek.

  All land upstream of the abstraction points is owned and managed by the Greater Wellington Regional Council. These forested catchment lands have been under the control of the GWRC or its predecessor authorities for many years, with only strictly controlled public access and active control of animals. As a result, the quality of the water coming from these catchments is very high and the contamination risks are low. The asset management objectives and practices employed in the water supply catchments are described in the separate companion document "Greater Wellington Water Asset Management Plan – Water Collection Areas – Hutt, Wainuiomata/Orongorongo".
- **Groundwater sources-** The Waiwhetu aquifer, which lies beneath the lower reaches of the Hutt Valley, is an extremely productive and very safe aquifer, which has been used for water supply for many years. Water is abstracted from it at two locations, Waterloo and Gear Island. Wells at these locations contain a submersible pump, screened casing, delivery pipework and valves. The Waiwhetu aquifer is actively managed by the Environment Division of the GWRC.

b) Lakes: Surplus water from the Hutt River at Kaitoke is stored in the Stuart Macaskill Lakes at Te Marua. When water cannot be abstracted at the Hutt River, or there is insufficient water to meet demand, water is taken from the Stuart Macaskill Lakes and pumped to the Te Marua Water Treatment Plant.

c) Treatment Plants: Sophisticated treatment plants at Wainuiomata and Te Marua treat river-sourced water. The treatment plants at Waterloo and Gear Island receive artesian aquifer water and rely on the secure groundwater to provide a supply free of microbiological contamination.

d) Pipelines: Pipeline assets serve two functions, these being to deliver:

- Untreated water from the intakes and wellfields to the treatment plants.
- Treated water from the treatment plants to the supply points.

Pipeline assets include isolation valves, air valves, scour valves and bypass valves. Chamber structures of varying sizes house these valves. Branch pipelines of smaller diameter than the main trunk pipelines are used to deliver water from the trunk mains to supply points that are in most cases at the inlet of customers' reservoirs.

e) Tunnels: Topographical constraints and the need to avoid negative pressure in the pipelines has required pipelines to be installed in tunnels at several locations, e.g., through the Wainuiomata Hill. There are two tunnels (at Kaitoke) that transport water directly without the use of pipelines.

f) Pumping stations: Pumping stations serve several purposes:

- Deliver treated water from the treatment plants through trunk mains to reservoirs
- Boost flows or pressures on trunk mains
- Lift water from trunk mains to service reservoirs that are higher than the trunk line pressure
- Deliver raw water from the SM Lakes to TM plant
- Transfer water from one part of the distribution system to another (e.g. Ngauranga).

g) **Reservoirs:** Treated water is usually delivered to service reservoirs that are owned by the city council customers. The reservoirs that are owned by the Wellington Regional Council have been constructed at treatment plants for process reasons, or connected to trunk mains as emergency storage or for balancing water demand. Treatment plant reservoirs at Te Marua, Wainuiomata, Gear Island and Waterloo are included with treatment plant assets.

h) **Control systems:** Treatment plants, pumping stations, intakes and wellfields all contain instrumentation and control equipment. These assets are included on the asset lists associated with the particular facilities. In addition, there is instrumentation for flow and level measurement and electrical control equipment at numerous locations on the distribution system. Usually the equipment will be associated with individual supply points and will be required to control the flow rate into, or level of customers' service reservoirs. Flow meters at supply points are used to measure water quantities delivered for calculation of the water levy to be charged to each city. Communication between supply points, treatment plants and pumping stations is achieved using telemetry (radio) equipment.

i) **Roads and tracks:** The principal roads that are owned by Greater Wellington Regional Council have been constructed and maintained to allow access to treatment plants and into the catchment areas beyond the treatment plants. Access roads to treatment plants are sealed, while roading into the catchment areas are generally unsealed. Good drainage is recognised as important to protect these roading assets. The treatment plants incorporate carparking facilities and truck manoeuvring areas for chemical delivery trucks.

2.3 Organisational Structure

The management structure for Greater Wellington Water is shown in Figure 3.

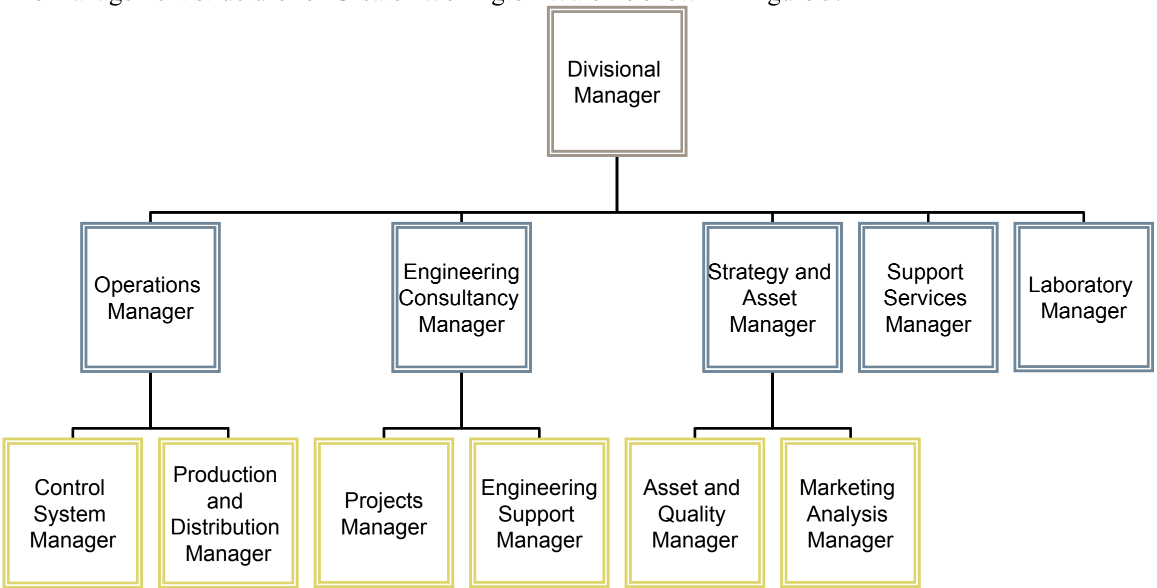


Figure 3: GWW Organisational Structure

A brief explanation of responsibilities of the groups associated with wholesale water supply is as follows.

- **Operations Group:** The Operations Group is responsible for the collection, treatment and distribution of water to the customer cities. Production staff operate and maintain water treatment plants, while maintenance and refurbishment work is generally carried out by Trade Services Contractors. Distribution staff manage and maintain the distribution network, including the SCADA (System Control and Data Acquisition) system, and operate the pumping stations. Pipeline maintenance is generally carried out by GWW staff, often assisted by private contractors.
- **Strategy and Asset Group:** Strategy and Assets staff are responsible for strategic planning, Asset Management, Quality Management, Environmental Management Compliance Management, and administering the Capital Works Programme. A Marketing Manager in the group co-ordinates and prepares Quarterly and Annual Business reports, and develops education and water conservation programmes.
- **Engineering Consultancy Group:** This Group provides design and project management services for GWW and a small number of other clients, and operates as a separate business unit. It also manages the plan records system and responds to customer enquiries and requests for information about the water supply system. Design and project management services associated with operational or capital expenditure are provided after briefing and engagement by Operations or Strategy and Asset staff.
- **Laboratory Services:** The Laboratory is a separate business unit and provides contracted services to the other Sections on request and to a number of other clients including the Environment Division of the Wellington Regional Council. While the Laboratory is housed in Waterloo Operations Centre its assets and operations do not fall within the scope of this Asset Management Plan.
- **Support Services:** This department provides managerial, financial, secretarial and administrative assistance to the departments of the Utility Services Division.

2.4 Stakeholders

- **Territorial Authorities**: GWW is required by the WRWB Act to supply water to the constituent authorities as defined in the Act. Currently these constituent authorities are the cities of Porirua, Hutt, Upper Hutt and Wellington. These four cities share the cost of Greater Wellington Water's operations in proportion to the amount of water they use, so they have a significant and vested interest in Greater Wellington Water activities. To date, the conditions under which water is supplied to these cities have been those broadly described in the WRWB Act. A detailed, formal supply contract is currently being negotiated and is expected to be agreed by the end of 2004. Regular consultation and liaison is undertaken with the constituent authorities, and a good working relationship exists.

- **Public Health Authorities:** The Regional Public Health section of the Hutt Valley District Health Board (HVDHB) carries out public health monitoring in the region under contract to the Government, and on behalf of other district health boards within the region. Part of their responsibility is to monitor public water supplies. This involves assessing annual compliance (with the Drinking Water Standards), Grading Assessments and involvement in any incidents of public health significance that might arise. A good working relationship is maintained with HVDHB staff, and information is supplied to them promptly and in a form that makes the discharge of their responsibilities as easy as possible.
- **Greater Wellington Environment Division:** One of the primary roles of GWRC is as the environmental administrator and regulator. As part of this role GWRC monitors the environment, researches natural resources and issues resource consents for the use of these resources, and for discharges into the environment. The primary issue dealt with by Environment Division staff is the granting of resource consents to GWW to take water from the various sources, and the monitoring of the conditions imposed in granting those consents. They also issue discharge consents for the various minor discharges from the treatment plants and distribution network. GWW staff work closely with Resource Investigation staff, particularly on issues like establishing safe, sustainable management practices for the Waiwhetu aquifer.

  GWW takes its environmental responsibilities very seriously, and works at maintaining a good working relationship with Environment Division staff by meeting all conditions imposed by consents, and reporting promptly, fully and honestly.
- **Ratepayers/Water Consumers:** The GWRC is elected by the ratepayers of the whole region, and to this extent they can be considered stakeholders. Citizens of the four customer councils who receive water from the public water supply are the end consumers of water supplied by Greater Wellington Water. However these people are considered by Greater Wellington Water and by the constituent authorities to be the customers of the city councils who operate the local reticulation networks. GWW does not have a direct relationship with these consumers.

2.5 Purpose of the Asset Management Plan

The purpose of this Asset Management (AM) Plan is to ensure that the necessary assets are in place to provide to Greater Wellington Water customers the promised levels of service over the long term, at reasonable cost and in an environmentally responsible way.

The plan sets out expectations for future growth, analyses legal and regulatory requirements, describes the environmental context, and examines the aspirations of the customer authorities. Current assets are described, their maintenance needs explained, and how they will provide the promised levels of service now and in the future set out. The plan has a time horizon of twenty years, but with a closer focus on the first ten years.

The plan outlines proposed future capital works, and the reasons these works are considered necessary. These reasons include growth, potential failure to meet agreed levels of service, obsolescence, environmental considerations, security of supply or risk reduction.

The AM Plan provides input into the Long Term Council Community Plan (LTCCP) which, following consultation with the community, forms the basis of all GWRC activity.

2.6 Relationship with the Long Term Council Community Plan

With the passing of the Local Government Act 2002, the LTCCP becomes the primary document by which councils signal their proposed activities to the community. The plan is not finalised until submissions from the community and other stakeholders have been received and considered.

LTCCPs have a 10 year span with expenditure over the first three years being considered a forecast, and the years beyond a projection with less certainty about the numbers. The projections and even the forecasts will change as more detailed information comes to hand, economic evaluations are carried out, and priorities are reassessed.

The AM Plan provides source information for the LTCCP, primarily in the area of proposed capital works, although it will also provide information about proposed maintenance activity and cost. Figure 4 shows the links between the AM Plan and the LTCCP. This AM plan is structured to mirror the AM planning process depicted in Figure 4, which includes the relevant Section references.

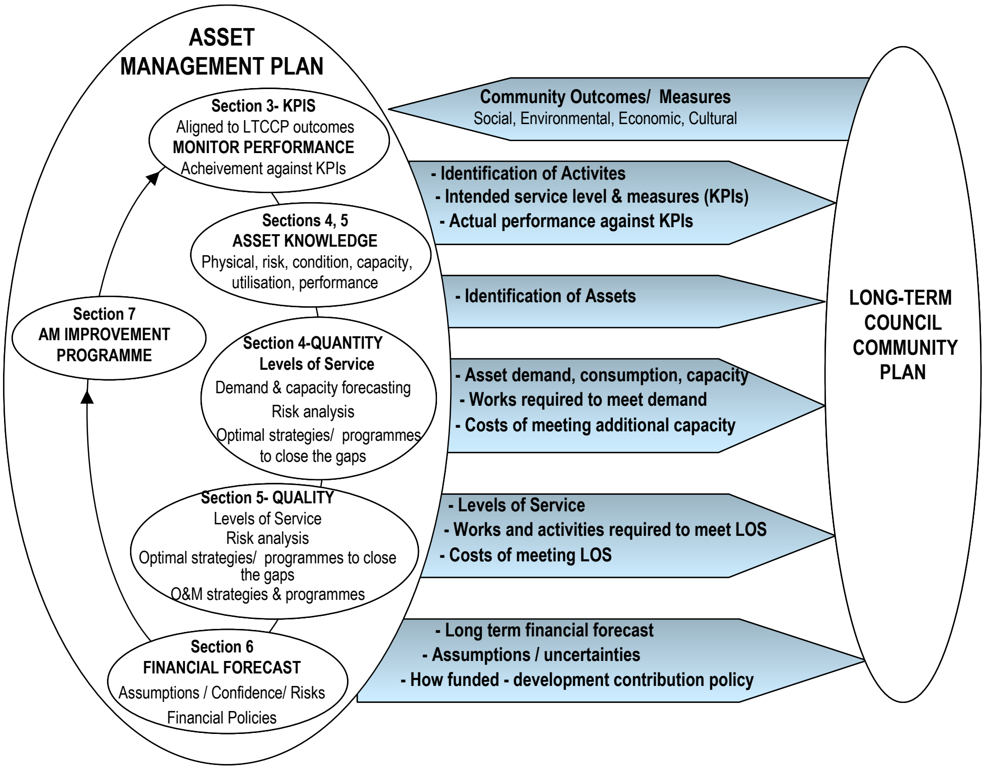


Figure 4: Links Between AM Plan and LTCCP

The regional bulk water supply network, including storage lakes, treatment plants, pipelines and reservoirs are considered by GWW to be strategic assets as defined in the Local Government Act 2002. All Council decisions relating to the transfer of ownership, control, construction, replacement or abandonment of strategic assets must be first included in the LTCCP for public consultation.

2.7 Legal Framework

The following legislation imposes specific compliance requirements on GWRC Wholesale Water Supply:

- Wellington Regional Water Board Act 1972
- Health and Safety in Employment Act 1992
- Health Act 1956 (and Water Supply Protection Regulations)
- Local Government Act 1974, LG Act 2002
- Council Bylaws (Hutt City, Porirua City, Upper Hutt City, Wellington City and Wellington Regional Water Board)
- Toxic Substances Regulations.

There will also be compliance with all other relevant legislation, and standards such as the Drinking Water Standard for NZ:2000. The development of the Health (Water Supply) Amendment bill is expected to impact on GWW activities and its development is being closely monitored by staff.

2.8 Sustainable Development

An adequate safe water supply is fundamental to a sustainable community.

Management of water sources by the GWRC Environment Division is focused on avoiding contamination of the surface water catchments and the protection of the Hutt aquifer, both of which are potentially vulnerable.

3.0 Objectives and Quality Policy

3.1 Community Outcomes

GWRC has adopted 10 ten 'quality for life' elements to describe how its work programmes contribute to the social, economic, cultural and environmental well being of the region. The bulk water supply contributes to three quality for life elements:

Water	• Operating a cost effective and environmentally friendly bulk water supply system for the metropolitan area • Encouraging people to use water wisely
Energy	• Committing to energy reduction programmes
Safety and Hazards	• Ensuring an adequate water supply in emergencies (joint responsibility with the territorial authorities)

The stated long term (by 2013) Community Outcome for operation of the bulk water supply system, is:

> *A wholesale water supply system that produces high quality water, fully complies with resource consent conditions and the Resource Management Act; and meets essential needs in droughts and natural disasters.*

To achieve this long-term target GWW has developed a Quality Policy and adopted key performance indicators to correctly focus the management of bulk water supply activities and monitor outcomes.

"High quality" equates with meeting all aspects of the Drinking Water Standards for NZ, including aesthetic requirements. Only in the most extreme of droughts will there be restriction on the amount of water available. However, a major natural disaster such as movement of the Wellington fault will seriously disrupt the wholesale supply network and require the use of stored water or other local or external sources until repairs can be completed, which may take several months.

3.2 Quality Policy

GWW's Quality Policy is a statement of its commitment to meeting customer requirements with respect to the supply of water, providing a framework for the setting of objectives relating to the achievement of policy aims and for the continual improvement of our staff, infrastructure and systems. All staff members have received a copy of the policy and it is a responsibility of managers and supervisors to ensure all staff understand and maintain the policy. The Quality Policy is:

> *Greater Wellington Water is committed to providing an adequate supply of high quality water to the customer territorial authorities at a cost comparable to that of other similar suppliers. All water will be fluoridated unless a territorial authority specifically requests otherwise and the supply of unfluoridated water is practicable. Water treatment plants will achieve a grading of at least 'A' and distribution zones at least 'a', unless customer preferences preclude this. Environmental impacts will be kept to the minimum practicable level.*

3.3 Key Performance Indicators (KPIs)

The KPIs adopted in the 2003/ 04 Annual plan represent a mix of legal and regulatory requirements and Council service expectations and embody the Council's judgement on what level of service is realistically achievable over the short to medium term. These KPIs have been the subject of preliminary negotiations with the four customers cities and will be modified to reflect the wholesale Water Supply Agreement when it is finalised.

	Standard	Target	Achieved 2003	Comment
	Quantity of Supply			
KPI 1	Sufficient water will be available on a daily basis to meet the 1 in 50 year return period drought situation.	100%	100%	Assumes routine hosing restrictions applied by customers.
KPI 2	Meet the following criteria for each customer service reservoir supplied directly by GWW Maintain at least 60% full Maintain at least 50% full	>90% of the time >98% of the time	Achieved for 99% of reservoir months	Criteria have subsequently been changed to At least 70% full >90% of time At least 60% full >98% of time
KPI 3	Compliance with resource consents issued for water abstraction. Compliance monitored and demonstrated annually to an auditable standard.	100% 100% Cost < $65,000	100% 100% $49,000	No significant breaches. $7,000 credit received because of previous overcharge
KPI 4	Water conservation education programme implemented.	100% Cost < $70,000	100%	See below
KPI 5	Water supply infrastructure maintained & upgraded in accordance with GWW AM plan.	100%	100%	Programmes implemented. No deferred maintenance identified.
KPI 6	Suitable emergency response plans in place	100%	100%	
	Quality of Supply			
KPI 7	Compliance with NZ Drinking Water Standards 2000	100%	100%	No significant breaches occurred.
KPI 8	Achieve the following Ministry of Health Grading for water treatment: Te Marua plant Waterloo Gear Island	A1-100% A-100% B-100% A-100%	100% 100% 100% B	Chlorination required to meet 'A' at Waterloo (not done at Hutt CC request). Gear Island does chlorinate but does not comply with all aspects of the chlorine rule in DWSNZ:2000.
KPI 9	Water testing will be carried out by IANZ registered laboratory to the programme defined by the Quality Assurance section of the Water Group.	100% Cost < $503,000	100% $502,500	
KPI 10	ISO 9001 accreditation compliance for wholesale water operations.	Full compliance	Achieved	
KPI 11	Public Health Risk Management Plans will be produced by 30 June 2004	5 done (by June 04)	100%	Work on hold pending legislation
KPI 12	Vegetation management measures undertaken in accordance with GWW Forestry Management Plan.	100% Cost < $170,000	100% $148,000	

KPI 13	Implement and maintain an Environmental Management System accredited under ISO 14001	100%	100%	
KPI 14	In 2003/04 approximately $70,000 from US went into the "Be the Difference' campaign run corporately, which included water conservation.			

Table 1: Key Performance Indicators

The strategies, work programmes and financial forecasts adopted to achieve these KPIs are detailed in Section 4 – Water Quantity and Section 5- Water Quality.

Currently there are no gaps between the target KPIs and the actual level of service being provided by GWW, except for the Gear Island treatment plant, where turbidity introduced as impurities in the lime added at waterloo prevents compliance with the Free Available Chlorine (FAC) rule. An FAC residual is required in order to achieve an A grading.

4.0 Quantity of Supply

The KPIs related to the quantity of supply are achieved by:

- Understanding and managing water demand, and upgrading of assets to provide for growth in demand – refer **Section 4.1.**
- The operation, maintenance and renewal of collection and distribution assets to deliver water reliably – refer **Section 4.2.**

These assets include:
- Delivery pipelines and tunnels
- Pumping stations
- Reservoirs
- Control systems

4.1 Water Demand

4.1.1 Forecast Demand

Historical Trends

The historical daily and annual water consumption statistics in Figure 5 and Figure 6 respectively show a similar trend of a consistent increase in demand over the past 10 years. Annual demand has increased at about 1% a year in recent years.

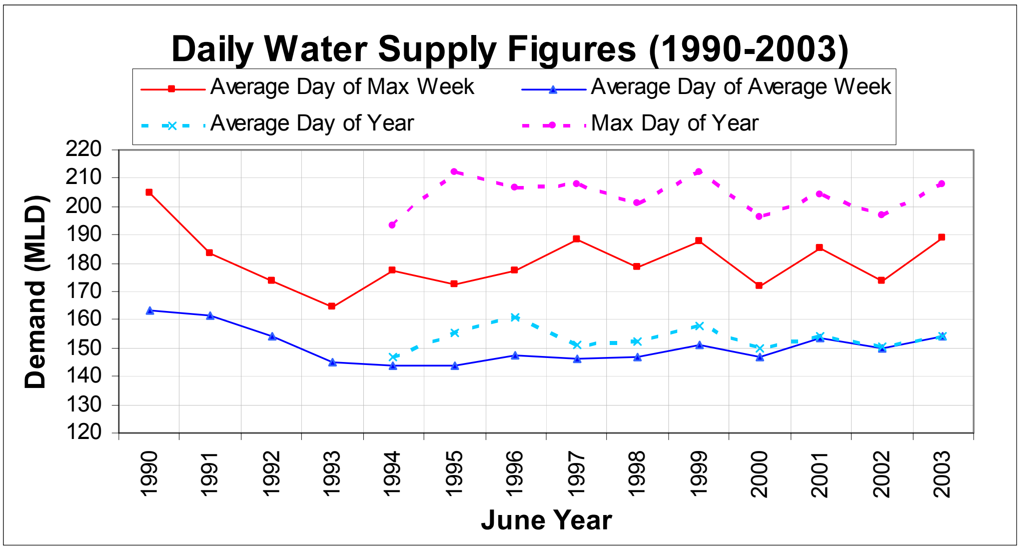


Figure 5: Daily Water Demand Trends

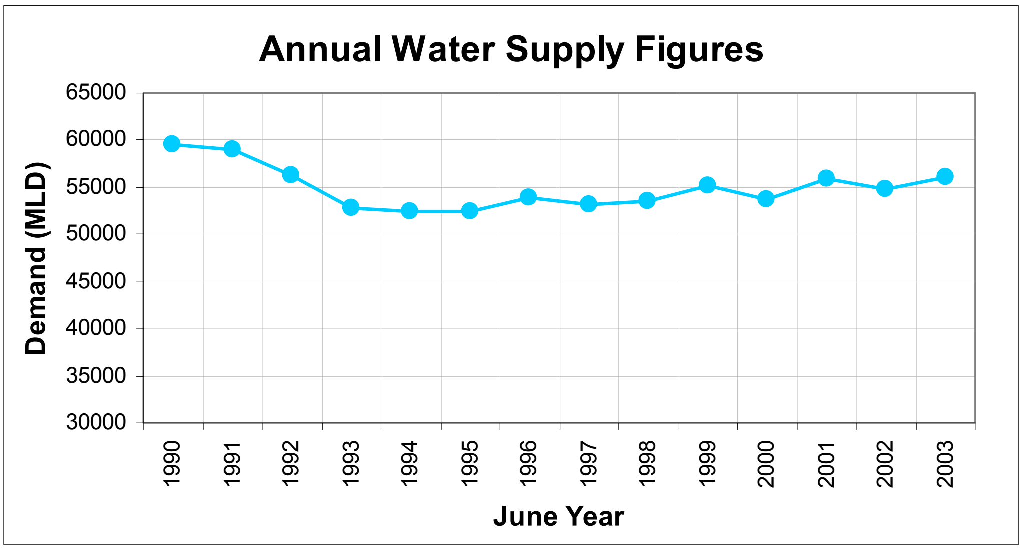


Figure 6: Annual Water Supply Trends

Population Growth

Population growth projections are a key input into the demand analysis models used by GWW. The population supplied as at June 2004 was 367,600. At 30 June each year, Statistics New Zealand produce an estimated resident population of people who usually live in the urban areas of Upper Hutt, Lower Hutt, Porirua and Wellington cities. These areas closely approximate the area supplied with water by GWW. The estimate is based on census counts subsequently updated for births, deaths and net migration.

Territorial Authority population projections (2001 (base) – 2021) are provided by Statistics New Zealand, as shown in Figure 7. Low, medium and high projections are provided. These projections have been used to project resident populations.

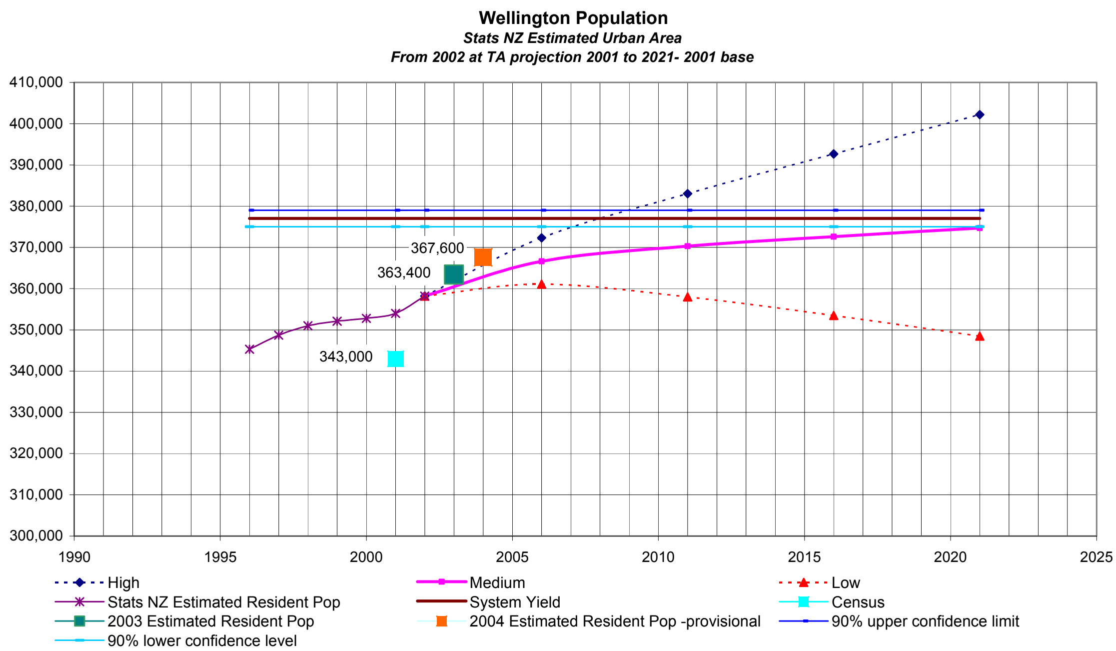


Figure 7: Population Projection

The low and high projections reflect more conservative and optimistic demographic scenarios respectively. Projections do not take into account non-demographic factors (e.g. war, catastrophes, major Government and business decisions) that may invalidate the projections. The June 2004 estimate suggests that the future population trend may be closer to the "high" projection.

There are no confidence intervals put on the population projections, and although the medium variant projections are considered the best at the time of their production, the low and high variant projections should also be considered equally valid. The assumptions adopted with these projections result in significant difference in the total population between the low and high variants over the next 20 years.

As the assumptions adopted with the medium variant population projections generally follow historical trends in fertility levels, mortality rates, and net migration levels of an area, the medium variant projections are considered the most appropriate for long-term demand modelling. However the recent lift in estimated population means that more note will be taken of the 'High' projection.

Demand Forecast

GWW utilises two models to analyse water demand and the capability of raw water sources and the water supply system to meet different demand scenarios (a full description of the models is included as Appendix B).

- The **Sustainable Yield Model (SYM)** is a daily supply model that takes into account climatic conditions, demand, population, river flows, aquifer storage, reservoir storage, and system constraints. The model can be used in a Monte Carlo simulation to generate 2000 two-year replicates to assess system reliability. A system annual probability of failure, daily demand shortfall, and shortfall quantity estimates can be derived for given population projections. Scenario modeling is used to assess the impacts of system constraint changes in relative rather than their absolute terms.
- The hydraulic model of the supply system is used to assess segment capacities, aiding decision-making on hydraulic aspects of the system.

When first developed in 1997, the SYM modelled the long-term average of the generated data as 500 L/capita/day with a correlation of 0.54 between daily values. The 2002 version of the model produced a mean of 450 L/capita/day, and an improved correlation of 0.73. The improved correlation was caused by reduced error in the demand data enabling better connections between demand and causative factors, such as temperature, to be identified.

For demand forecasting and hydraulic modelling and system capacity assessment a peak day of 650 L/hd/day has been adopted. The SYM indicates that a 1 in 50 year event (2% annual failure probability) can be met for a Wellington population of approximately 377,000 (refer Figure 6).

The SYM is estimated as having an absolute accuracy of ±10% for 95% of the simulated values it calculates. Comparing this value with the 10% error arising from the demand data suggests that the demand data is still the major source of model error.

4.1.2 Risk Assessment

GWW undertakes risk assessments to identify events that may impact on the achievement of the KPIs related to meeting water demand (refer Table 1), which are:

KPI 1	Sufficient water will be available on a daily basis to meet the 1 in 50 year return period drought situation (i.e. the estimated peak demand of 650 litres/head/day is met in these circumstances).
KPI 2	Customer service reservoirs are maintained at least 70% for greater than 90% of the time, and at least 60% full for greater than 98% of the time.
KPI 3	Compliance with resource consents issued for water abstraction.
KPI 4	Water conservation education programme implemented.
KPI 5	Water supply infrastructure upgraded (and maintained) to ensure water demand is met.

GWW use the SYM to assess risks associated with providing sufficient system capacity to meet forecast increases in demand, which impacts directly on the achievement of KPI 1, KPI 2 and KPI 3 and indirectly on the demand reduction targets for KPI 4.

The model can be used in a Monte Carlo simulation to generate 2000 two-year replicates to assess system reliability. A system annual probability of failure, daily demand shortfall, and shortfall quantity estimates can be derived for given population projections. Scenario modelling is used to assess the impacts of system constraint changes in relative rather than their absolute terms. A comparison of failure probability against the GWW 1 in 50 year standard for the system can be made.

The SYM indicates that a 1 in 50 year event (2% annual failure probability) can be met for a Wellington population of approximately 377,000. The annual failure probability for various populations is shown in Figure 8.

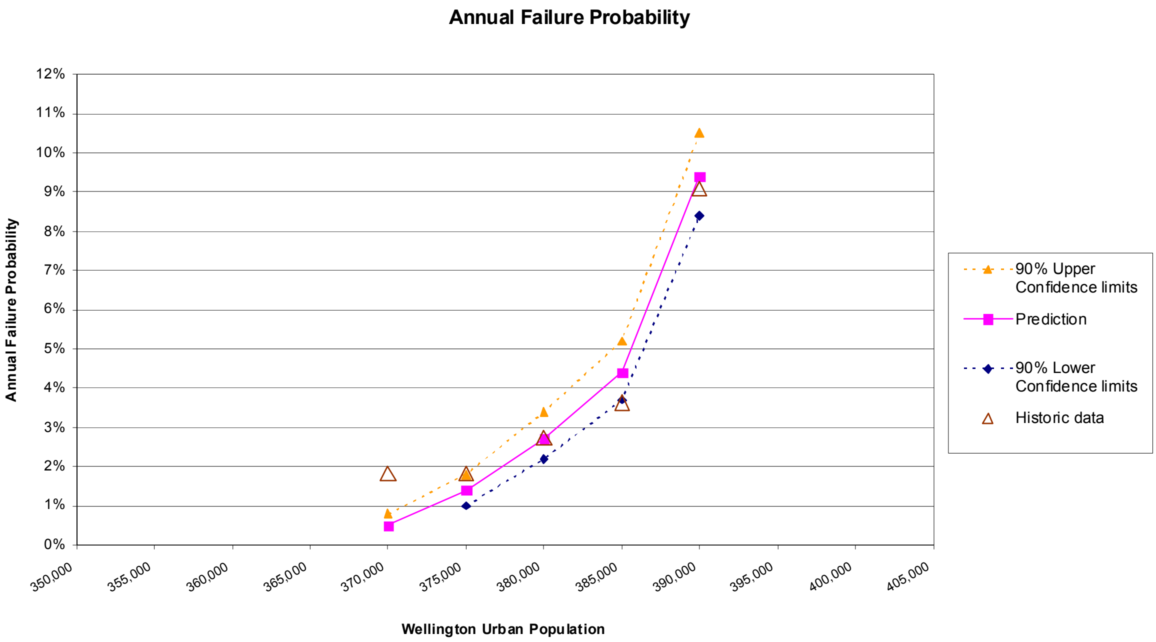


Figure 8: Annual Failure Probability

Based on Statistics New Zealand projections, 377,000 could occur as early as 2007 for the high growth scenario. A population increase of only 9,000 is required to reach the sustainable population of 377,000. Consequently annual population estimates and census results will be closely monitored in the future.

4.1.3 Demand Management Strategies

a) Demand Management

GWW utilises a number of demand management tools to delay the need to develop additional water sources or to fund increases in system capacity. However, as a wholesale supplier of treated water, the options available to GWW for introducing measures that require a specific response from consumers are limited, because there is no direct interface with the end users.

- **Water Conservation:** Water use in the Region's urban areas is relatively stable for approximately eight (winter) months of the year. The increase in water use – above base winter demand levels - during summer account for about 5 percent of the total demand per annum. However, daily demands can be as high as 150 percent of the average day. The primary cause of summer peaks is garden watering. Occasionally, very high daily peaks come close to the capacity of treatment and distribution assets. Consistently high demand over several weeks, particularly in late summer, may require the use of stored water, depleting reserves. GWW water conservation activity therefore targets demand peaks caused by garden watering.

Since 1997/98, GWW has run an annual campaign to raise awareness about the relationship between water supply and demand during summer and to promote a range of easy-to-use water conservation measures. This work has targeted both immediate behaviour change and the maintenance of more water-efficient gardening behaviour over time.

The actions promoted via the GWW campaigns have primarily addressed gardeners with professional, garden-friendly advice that aims to increase water us efficiency rather than asking gardeners to use less water, without regard for the health of their plants. The credibility of messages has been supported by endorsements from garden industry experts. Campaigns have been consistent in that approach since 1997, while adopting a variety of mass-communication tools to deliver the message.

Both qualitative and quantitative research has been undertaken at intervals since 1997 to gauge the impact and guide the development of conservation publicity. Results indicate useful progress in raising awareness of the issue of water conservation in relation to garden watering.

- **Education:** GW has for many years sought to raise the level of knowledge in the community about the value of water. This has been done by funding educational resources for schools, providing tours and presentations at our treatment facilities and producing general background information about the regional water supply system, which is made available in print form and via GW's web site. Providing learning opportunities for children is intended to promote 'water-wise' behaviours early in life and will hopefully result in these behaviours becoming the norm.

  GWW provided support for the development of GW's "Take Action for Water" environmental education programme, which provides hands-on learning for 8-12 year olds and is related directly to their neighbourhoods and experience.

- **Demand restrictions:** A stepped water restriction strategy[1] has been in place since October 1996. It lists trigger points for a range of actions, to be undertaken jointly by GWW and our customers if needed, to elicit greater effort to conserve water by the public. The action trigger points for restrictions are demand based without reference to availability of source water, and therefore must be carefully applied. When water availability has been taken into account, there has not been a situation requiring more restrictive watering regulation since the strategy was adopted. We are currently investigating a more appropriate set of demand restriction triggers that will include time of year and a modelled probability of exhausting raw water reserves as inputs.

- **Measurement for management:** Maximum utilisation of assets can be achieved if wastage and loss of water can be minimised. GWW upgraded to more accurate 'Magflow' meters for the recording of supply volumes in the late 1990s. Water take and treated volumes are monitored on a daily basis and supply volumes weekly, and these figures are used to track non-revenue water. Unaccounted-for water between treatment and supply has been less than 1 percent of the treated volume since June 2000. The potential for loss is greatest from the complex reticulation networks that are owned by the territorial customers. Accurate supply volume figures for our points of sale to the customers are a necessary starting point for the customer TAs programmes to identify and reduce losses within their systems.

- **Pricing:** GWW is of the view that a form of peak pricing could be adopted to signal the future impacts of peak demand, and further investigations of this demand management option will be undertaken.

b) Risk Management

A system redundancy policy of N-1 means there is one level of redundancy in a system, an N-2 policy means there are two levels of redundancy. The Council has adopted an N-1 policy for supply of water. One of the three main water treatment plants could be out of commission and sufficient water would still be available to meet the basic needs of the community under most circumstances.

The basic quantity of water required is approximately 130 ML a day. If this is the maximum quantity available, then conservation measures will be required to reduce demand to this level. For example, a complete ban on garden watering and a call for water to be conserved may be required. The Gear Island WTP, which is a standby plant, can be used to supplement supply if Waterloo or Wainuiomata is out of commission.

[1] WRC Bulk Water Department, Water Conservation Crisis Strategy, October 1996

c) System Monitoring and Operation

To improve the accuracy of demand forecasts GWW will periodically review and update all demand related data and enhance the sophistication and accuracy of the SYM Demand Model.

Telemetry and system control upgrades are continuously being implemented to improve the operation and reliability of the system. Increased sophistication provides opportunities to balance and smooth demand, to make optimum use of upstream facilities including the treatment plants and the limited water availability.

A sophisticated control system called the Derceto Optimiser manages pump and source selection in the Wainuiomata/Waterloo portion of the system. This system forecasts daily demand and schedules pumps and sources to minimise costs while keeping service reservoirs above their minimum level.

d) Water System Upgrading

GWW intends to develop new sources as required to ensure sufficient water is available to meet the unrestricted (other than by routine hosing restrictions) demand in all but a drought situation that has a severity equal to or greater than a 1 in 50 year drought.

GWW will also develop and extend the water supply infrastructure as required to ensure that sufficient water is available to meet demand in a 1 in 50 year drought.

Options to meet upgrading needs identified from system modelling are initially scoped, with a preliminary estimate of costs prepared (accuracy ±50 percent) and the item entered on to the 10 year programme. Once the item is committed to the 10 year programme, a brief is written by asset management staff to describe the outputs of the project. The briefs outline a requirement to assess all options available that will achieve the project objectives, and recommend the preferred alternative that will perform best over the lifetime of the new asset. Non-asset solutions and changes to maintenance and operation regimes are also evaluated. A triple bottom line evaluation is used

Alternatives are considered and recommendations for the preferred solution made. A preliminary design is completed and new cost estimates are prepared (likely accuracy ±15 percent). Internal or external consultants undertake the work.

Following acceptance of the preliminary design by Asset Management staff, the detailed design is commissioned. Detailed design is completed and a revised estimate completed (likely accuracy -10 percent +0 percent of final cost including a contingency sum). Detailed design includes drawings and specifications. Quality of documentation is reviewed by the Asset Management Section and relevant operational staff to ensure acceptable standards are specified.

4.2 Distribution Assets Management

4.2.1 Asset Information

a) Intakes

- **Asset Description:** Water is abstracted at river intakes for supply to the Te Marua and Wainuiomata Water Treatment Plants. The flow from the intakes to the treatment plants is not pumped.

Intake	Treatment Plant Supplied	Installation date	Construction	Capacity Limitation	Peak Consented Abstraction Rate (ML/d) (3)	Average Abstraction 03-04 (ML/d)
Kaitoke	Te Marua	1955	Reinforced concrete	140 MLD (nominal)	160 MLD	71.1
Orongorongo	Wainuiomata	1926	Reinforced concrete	60 MLD (Estimate)	40 MLD (2)	2.5
Big Huia	Wainuiomata	1926	Reinforced concrete	20 MLD (Estimate)	Included above	2.0
George Creek(1) (upper)	Wainuiomata	1945	Reinforced concrete	10 MLD (Estimate)	Included below	_ (1)
George Creek (lower)	Wainuiomata	1988	Reinforced concrete	15 MLD (Estimate)	Included below	3.1
Wainuiomata River	Wainuiomata	1988	Reinforced concrete	60 MLD (Estimate)	40 MLD (2)	15.6
Totals				305 ML/d	230 ML/d (2)	94.3

(1) Not generally used
(2) Combined abstraction from Wainui source and Orongorongo source must not exceed 60 ML/d. Effective consented maximum surface water take = 210 ML/d (Aquifer sourced water is additional to this quantity)
(3) Consents expire in 2036

Table 2: Schedule of Water Intake Assets

- **Asset condition/ Performance:** Kaitoke intake has suffered minor damage to the concrete toe and intake grill structure. Consultants have specified a repair methodology and the repairs will be completed in the next two years as a maintenance item. This work is expected to be ongoing.

  Wainuiomata and Lower George Creek intakes are modern structures and in good condition.

  The Orongorongo and Big Huia intakes are in good condition considering their age. Internal upgrading of the Orongorongo intake was carried out in 2004.

b) Lakes

- **Asset Description:** At times when water cannot be abstracted from the Hutt River because of high turbidity or colour, or when there is insufficient water to meet demand, water is taken from the Stuart Macaskill Lakes and pumped to the Te Marua Water Treatment Plant.

  In the past (prior to 1997) when water quantities were insufficient to meet Wellington City demand, treated water was taken from the Lower Karori Dam and gravitated into the supply after rechlorination. This dam was taken from service in 1997 and replaced by a much smaller 20 ML capacity covered reservoir at Ngauranga. The Karori Reservoir land has been vested in the Wellington City Council for development by the Karori Wildlife Sanctuary Trust.

Lake	Treatment Plant Supplied	Installation date	Construction	Capacity (ML)
Stuart Macaskill (north)	Te Marua	1985	Earth	1310 (1)
Stuart Macaskill (south)	Te Marua	1985	Earth	1680 (1)

(1) To soffit of lowest outlet

Table 3: Schedule of Storage Lakes Assets

- **Asset Condition/ Performance:** A 5 yearly comprehension Safely Review (refer Appendix G of New Zealand Dam Safely Guidelines November 2000) was carried out by MWH New Zealand Ltd in June

2003. This review found that *" In our opinion the dams and reservoir will continue to function in a safe manner, based on the evidence of past performance, the information reviewed, and our assessment of potential failure modes. This is subject to existing operational, maintenance, surveillance and inspection procedures being complied with."*

GMW is committed to operating the lakes in a safe manner and will continue to follow the guidelines set out in the New Zealand Dam Safety Guidelines unless or until they are superseded by dam legislation. Following the adoption of a new seismic loading code in 2004 the intake tower seismic strength will be reviewed. The programme of Capital Works contains $200,000 for strengthening these towers in 2005-2007, in the expectation that this work will be required.

c) Wells

- **Asset Description:** Hutt Valley artesian aquifer water is abstracted at two locations: Waterloo wellfield and Gear Island. Each well contains a submersible pump, screened casing and delivery pipework and valves.

Wellfield	Treatment Plant	Number of wells	Installation date	Capacity ML/d	Total installed kW	Average daily abstraction 03/04
Waterloo	Waterloo	6 fixed speed 2 variable speed	1981 1988	6 x 14 ML/d 2x 23 ML/d Effective wellfield capacity 115 ML/d	6 x 57 KW 2 x 76 kW	64.2
Gear Island	Gear Island	3 fixed speed	1975	3 x 11 ML/d	3x 24.5 kw	0.6 ML/d

Note (1): Consented maximum total abstraction from Hutt aquifer = 115 ML/d except that the 365 rolling day average must not exceed 83 ML/d. Consents expire in 2033.
Note (2): Gear Island is effectively a standby plant and is only used in unusual or emergency situations.

Table 4: Schedule of Wells

- **Asset Condition/ Performance:** Well head security is important for quality compliance and is regularly checked. The integrity of the well casing screen can only be assessed using a special camera and when the pump is not in position. Whenever pumps are removed for maintenance or inspection, the casing and screen will be inspected.

d) Pipelines

- **Asset Description:** Pipeline assets serve two functions, these being to deliver;
  - untreated water from the intakes and wellfields to the treatment plants, and
  - treated water from the treatment plants to the supply points.

The pipelines are usually buried but because of topographical constraints may be above ground, to span waterways or when installed in tunnels. There are two tunnels (at Kaitoke) which transport water directly without the use of pipelines. Pipeline assets include numerous components: e.g., line valves, air valves, scour valves and bypass valves. Chamber structures of varying sizes house these valves.

Branch pipelines of smaller diameter than the main trunk pipelines are used to deliver water from the trunk mains to supply points that are usually at the inlet of customers' reservoirs.

The full description of the pipelines is held in the Hansen Asset Information System. However, they have been summarised in the Figures below.

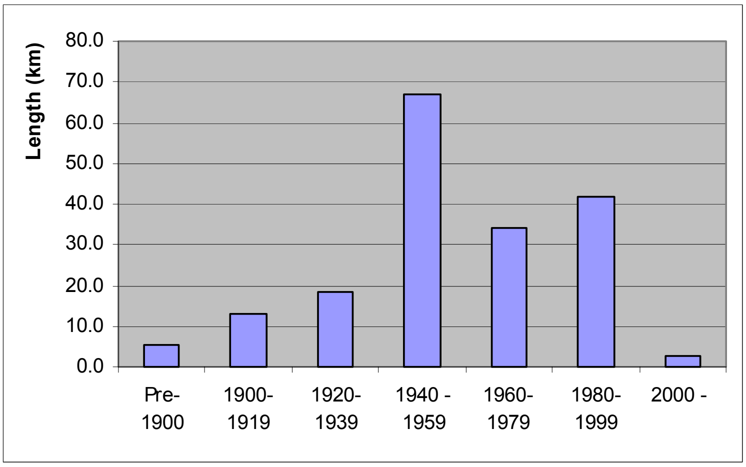


Figure 9: Pipe Length by Year of Construction

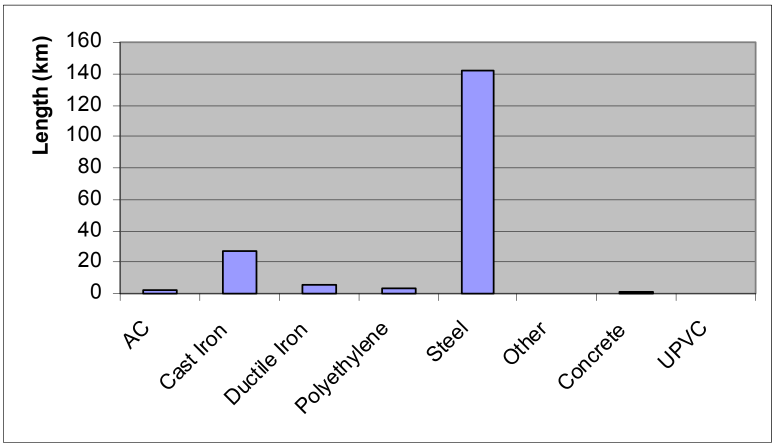


Figure 10: Pipe Length by Material Type

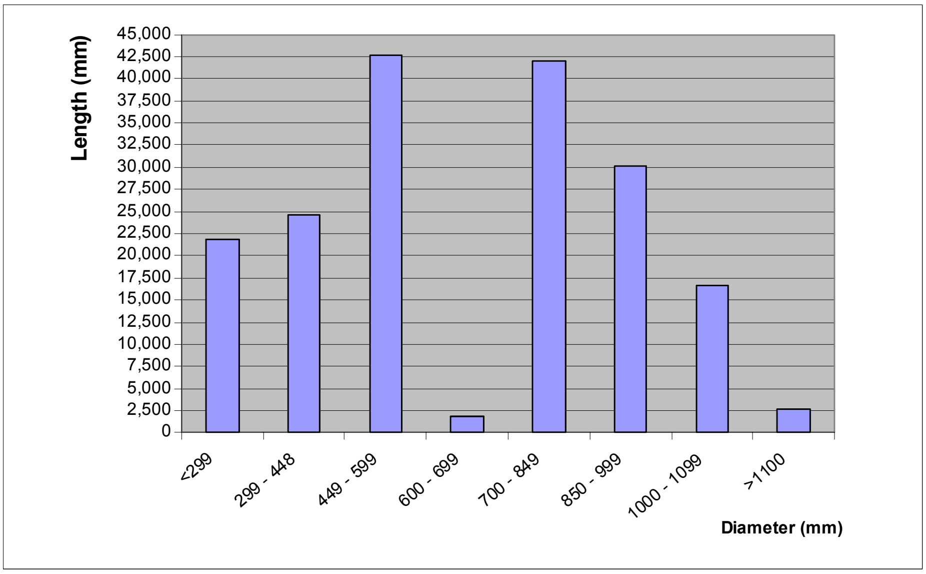


Figure 11: Pipe Length by Diameter

- **Asset Condition/ Performance:** All major trunk mains and the majority of branch mains have been either laid or cement mortar lined since 1950. That is, the majority at the pipeline assets have a remaining file of 30 to 50 years at least. Detailed condition assets work is focussed on assets nearing the end of their useful lives. For example, studies in 2002 led to the replacement of the last section of the 1925 Orongorongo- Karori pipeline in 2003/04. Studies in the near future will be focused at the 750 mm diameter cast iron main through Wainuiomata, which was laid in 1884 and cement lined in 1989, and continues to provide reliable service. However significant breakages are expected in a major earthquake. Its replacement is tentatively programmed for 2012/14.

Asbestos cement pipes have also been the subject of detailed condition assessment in recent years, as AC is recognised in the industry as having a relatively short life. However GWW AC pipes were shown to be performing well and were not in need of replacement.

Losses from the wholesale water mains are currently less that 1%, that is within meter error. Leaks and breaks rarely occur. When they do, the details are recorded and taken account of in detailed condition assessment studies.

Major investment has occurred since the early 1970s in pipeline replacement. The oldest pipes where 100 percent utilisation is required are associated with the Kaitoke to Wellington Supply Scheme. These pipes still have over half of their predicted life remaining.

e) Tunnels

- **Asset Description:** Pipelines have been installed in tunnels at some locations to carry both treated water and raw water. In addition, there are two tunnels at Kaitoke that act as conduits, conveying raw water without pipes.

Tunnel	Length (m)
Raw Water Tunnels	
Kaitoke No. 1	680
Kaitoke No. 2	2,750
Raw Water Pipeline Tunnels	
Orongorongo No. 1	103
Orongorongo No. 2	3,250
Treated Water Pipeline Tunnels	
Takapu Road Tunnel No. 3	483
Takapu Road Tunnel No. 4	244
Khandallah Tunnel No. 5	352
Karori - Raroa Road	382
Wainuiomata/Hutt Valley 1,100 mm steel pipeline tunnel	880
Rocky Point	220
Total	**9,344**

Table 5: Schedule of Tunnels

- **Asset Condition/ Performance:** All tunnels have been recently assessed and found to be in good condition, except for a small leak in the Kaitoke No. 2 tunnel. Access provisions were improved and pipe restraints added to Takapu Road tunnels 3 and 4 and the Rocky Point Tunnel in 2002/03. Investigations are in hand into leakage in the Kaitoke No.2 tunnel when the water level is unusually high. Repairs are expected to be completed early in 2005.

f) Pumping Stations

- **Asset Description:** Pumping stations serve three purposes:
  - Deliver treated water from the treatment plants through the trunk mains to principal reservoirs and gravity fed service reservoirs.
  - Boost flows or pressures in trunk mains.
  - Lift water from trunk mains to service reservoirs which are higher than the trunk line pressure.

Pumps, motors and control equipment are in permanent structures. Standby capacity is installed in all cases.

Pumping Station	Age of Building	Age of Equipment	Installed kW	No. Pumps
Treatment				
Te Marua	1984	1984	2,600	10
Waterloo WTP				
Diesel standbys	1981	1981	298kw each	2
Electric	1981	1981	225kw each	5
Electric	1981	1998	630 kw each (3,611 kw total)	3
Gear Island	1976	1976	700	2
	1976	1988	315	2
Karori	1957	1957, 1962	760	4
Line Boost				
Haywards	1971	1971	1,299	3
Ngauranga	1993	1993	1,434	4
Service Reservoirs				
Point Howard	1982	1982	150	2
Timberlea	1989	1989	37	1
Pinehaven	1974	2004	34	2
Kingsley	1976	1976	116	3
Johnsonville	1957	1973	420	3
Kelburn/Messines	1962	1957, 1964	460	2
Wainuiomata 1	1961	1992	300	2
Wainuiomata 2	1992	1993	330	2
Kaiwharawhara	1932	1997	560	4
Sar Street	1986	1985	15	1
Thorndon	1936	1982	264	2
Warwick Street	WCC	1965, 2004	93	2

Table 6: Schedule of Pump Stations

Note: well pumps not included.

- **Asset Condition/Performance**

Haywards pumping station is operated during high demand periods only, and currently very rarely. Although the pumps were installed in 1971, a major refit of controls and motors was completed in 1989. The pumps are Direct Current with variable speed.

Ngauranga pumping station enables transfer of water from the Wainui/Waterloo system to the Kaitoke system. This is only done in unusual circumstances, as additional cost is involved. It is currently manually controlled.

Karori pumping station is located very close to the Wellington fault and directly below the lower Karori dam, which although no longer used for water supply is still full. Any movement of the Wellington vault would cause serious damage to the pump station. The station is the only source of water to the large suburb of Karori and therefore a critical asset. Relocation of the pump station to a more secure location close to the Northland tunnel is currently being planned. The Capital Works Programme contains $1.712M for this work in 2004/06, but the forecast expenditure has increased to $2.2M.

A new pumping station at **Seaview** will replace the Pt Howard Pumps at Randwick during 2004. The new pump station will be less susceptible to damage from flooding or earthquake. The Capital Work Programme contains $367,000 for this work in 2004/05.

Timberlea pumping station was constructed to ensure a water supply to the Cruickshank reservoir is available when boost pumps at Te Marua are unavailable. This situation has never occurred and the pumps have never operated.

- **Pinehaven** pumps are submersible pumps, located in an underground pit. New pumps are being installed in 2004 and the underground chamber up graded. These pumps only operate during periods of high demand.

  The installation date of the **Kingsley** pumps is listed as 1976. The controls were replaced in 1997 and one motor has been replaced. A review of the operation of this pump station has been conducted, but upgrading is not justified.

  Johnsonville pumps are continuously used. Two of the pumps and the controls were replaced in 2003.

  Equipment at **Wainuiomata 1, Wainuiomata 2 and Kaiwharawhara** Pump Stations is new and operating satisfactorily.

  Pump-sets at **Thorndon** were installed for emergency purposes but have not been used for many years. Recently the existing, disused pipeline between Thorndon and Karori was upgraded to facilitate transfer of water in either direction during an emergency. It is intended to re-commission the Thorndon pumps so they can be used if necessary.

g) Reservoirs

- **Asset Description:** Generally treated water is delivered to service reservoirs that are owned by the city council customers. The reservoirs, that are owned by the Wellington Regional Council are constructed at treatment plants for process reasons, or connected to trunk mains to provide diurnal[2] storage or for system control. Treatment plant reservoirs at Te Marua and Wainuiomata are included with treatment plant assets. Other reservoirs are listed below:

Location	Constructed	Construction	Volume
Ngauranga	1997	Precast, post tensioned concrete	20 ML
Haywards	1970	Post tensioned concrete	18 ML
Haywards (No. 1)	1955	Externally post tensioned reinforced concrete (out of service)	4.5 ML
Karori Contact Tank	1960	Reinforced concrete (Service reservoir for Wellington City Aro zone)	2.2 ML

Table 7: Schedule of Reservoirs

- **Asset Condition/ Performance:** Haywards No. 1 Reservoir is not used and is empty. Excessive leakage around the base was observed when it did contain water and its structural integrity is suspect. Repair costs would be very high. Repair is considered uneconomic.

  Modifications of the valving and pipe work at the No. 2 Hayward's reservoir in 2002 have enabled control of inlet and outlet flows with consequent more effective use of the reservoir for diurnal storage. The site of the reservoir is however likely to be damaged in a large earthquake, with a resultant loss of emergency storage. Discussions are being held with the customer TA's regarding the possibility of constructing a new more secure reservoir on a site at the head of Takapu valley. The Capital Works Programme contains a tentative allocation of $10.0M in 2004/08 for this work.

  Negotiations are also in train for a possible reservoir to be sited at near the CBD in Wellington City and jointly owned and used by Wellington City, Wellington Hospital and GWW. If this were to proceed it would replace the Wainuiomata Terminal reservoir currently programmed in 2010/13.

h) Control System/Telemetry/Meters

- **Asset Description:** Treatment plants, pumping stations, intakes and well-fields all contain instrumentation and control equipment. These assets are included on the asset lists associated with the particular facilities. In addition, there is instrumentation for flow and level measurement and electrical control equipment at numerous locations in the distribution system. Usually the equipment is associated with individual supply points and is required to control the flow rate into, or the level of

[2] Diurnal storage provides for demand peaks during the day, with the objective of smoothing demand over a 24 hour period.

water in the customers' service reservoirs (Ref section 6.1.1). Flow meters at supply points are used to measure water quantities for revenue collection. Communication between supply points, treatment plants and pumping stations is achieved using telemetry equipment. The equipment is housed in below ground chambers or small above-ground structures.

- **Asset Condition/ Performance:** Replacement of all revenue flow meters with electronic "magflow" meters has been completed, as proposed in a report titled *Wholesale Water Supply Flow Meters - Volumes 1 and 2* dated December 1997. Since completion of this work a very good balance between supply and delivery volumes has been achieved.

  The inflow of water into customers' reservoirs is controlled remotely via the telemetry system. Should communications be lost, local controls take over automatically and keep the reservoirs full. For historic reasons, the telemetry systems operated by Wellington City Council and GWW are closely linked. Wellington City Council wish to enhance the functionality of their system, and this may necessitate GWW setting up separate independent links and translators. The Capital Works Programme contains $260,000 for this work in 2004/05. However discussions being held between GWW, HCC and WCC regarding the integration of telemetry and control system in order to achieve economics.

  Remote reading of revenue meters was installed in 2004 and the results are currently being evaluated. Ultimately this will reduce visits to read meters from weekly to once every six or twelve months.

i) Roads and Tracks

- **Asset Description:** The principal roads that are owned by GWW have been constructed and maintained to allow access to treatment plants and into the catchment areas beyond the treatment plants. The more important roads are sealed while remote access tracks remain unsealed, but are constructed with good roadside drainage and traversing culverts to protect them from water damage. In addition, some other installations e.g., treatment plants, incorporate car or truck parking facilities.
- **Asset Condition/ Performance:** The cost of road and bridge maintenance at Kaitoke is shared 50/50 with the Regional Parks Department. Most access bridges have been recently upgraded and all are in good condition.

  External consultants inspected all bridges within the Wainuiomata and Orongorongo areas in 1994.

  A resealing programme of all sealed access roads and the SM lakes ring roads was completed in 2002/04.

  During a storm in February 2004 damage occurred to the main access bridge to the Wainuiomata treatment plant. The central pier was undermined and displaced. A temporary 'bailey' bridge was erected within a few days and repairs have been completed by GWW's insurers.

4.2.2 Risk Assessment

a) Risk assessment activities

GWW undertakes risk assessments to identify events that may impact on the achievement of the KPIs related to water distribution (refer Table 1), which are:

KPI 5	Water supply infrastructure maintained (and upgraded) to ensure water demand is met.
KPI 6	Suitable emergency response plans are in place to effect a prompt restoration of service in the event of a service failure.

GWW have undertaken several formal risk assessments relating to the achievement of these KPIs.

- **Seismic Risk:** Seismic hazards to the wholesale water supply include movement of the Wellington Fault, movement of the West Wairarapa Fault, movement of other faults in the Region producing strong ground shaking, and earthquakes at more remote locations. The Lifelines Group adopted the Wellington Fault event as the most severe seismic scenario to be used in the consideration of seismic impact on lifelines such as the wholesale water supply.

The Wellington Fault is a major feature of the region. It can be traced in the Wellington area from Cook Strait along the western margin of the Hutt Valley to the Tararua Ranges. Typically a Wellington Fault event would have a Richter magnitude of 7.5 and cause approximately 5 metre horizontal and 1 metre vertical fault movement. The event has an average recurrence interval of 600 years, and the elapsed time since the last rupture is approximately 340 to 490 years. The probability of a Wellington Fault event occurring in the next 50 years is approximately 10%.

Earthquake generated hazards include: fault displacement, ground shaking, ground liquefaction, landslides, uplift/subsidence, tsunami or seiches and ground settlement. A report "Lifelines in Earthquake – Wellington Case Study" was completed by the Centre for Advanced Engineering, University of Canterbury in 1991. As a result of this, in 1993, Kingston Morrison (now Sinclair Knight Merz,) consulting engineers, carried out a seismic assessment of most of the Wholesale Water Supply facilities. The assessment excluded more modern structures known to have been designed to comply with current earthquake loadings. Assets assessed included tunnels, buried pipelines, bridges and stream crossings and the fixing of plant and equipment.

Kingston Morrison made a number of recommendations for investigation or mitigation work assigning a priority based on the importance of that element to operation of the wholesale water supply system and vulnerability to earthquake generated hazards. Over the past 10 years, progress has been made working through projects identified by Kingston Morrison.

The mitigation standards for some projects are not necessarily to the Wellington Fault event standard, due to practical considerations. Some structures for example, have only moderate seismic resistance and possibly will be replaced during the next 20 years. At that time, replacement structures would be designed to the latest seismic design code. In the meantime, only relatively minor upgrading is being undertaken. With some projects, the main reason has been to replace life expired assets. In doing so, the design has been to the latest seismic codes that allow improved seismic performance for the replaced asset.

The total cost of seismic mitigation projects completed to date is approximately $1.3M. Appendix C includes schedules of completed seismic strengthening projects and seismic risks under evaluation or recently upgraded. Several major projects to reduce exposure to seismic hazard are planned and are described in Appendix C.

- **Identification of Critical Assets:** The assessment of asset criticality has not been completed on a formal basis. Plant and pipeline supervisors are aware of the implications of failure of individual assets, and have developed maintenance programmes in recognition of perceived criticality. Criticality has been assessed at the design stage of most facilities to decide whether a standby plant is warranted. However, operational needs change with time. A formal process of assessing criticality regularly is being developed as a basis for planning future maintenance and refurbishment/replacement programmes. This assessment process is called Reliability Centred Maintenance and it will assess the criticality of assets and the likely failure modes. From this will flow maintenance and operational strategies that will achieve a high level of reliability.

  In general all GWW asset installations are critical. While loss of a pump will quickly call a standby pump, loss of a pumping station or a major water main will mean that the community supplied by those facilities will be without water as soon as local storage runs outs. GWW therefore pays great attention to reliability through high standards for materials and workmanship. GWW is working closely with the customer TA's to put in place emergency storage and public education programmes to minimise the impact of a major emergency.

4.2.3 Distribution System Management Strategies

a) Quality assurance

GWW implement quality processes for all key business activities in accordance with its accredited ISO 9001 Quality Management System.

b) Planned Inspections

GWW will implement a risk-based programme of inspections to monitor asset condition and performance to manage risk. A comprehensive record of all leaks and asset failures is maintained which includes details of location, date, failure mode, times and costs for repair.

Intakes	Structural assessments are undertaken by engineering consultants, with special attention to weir crests and aprons which are liable to damage. Regular inspections by staff to confirm that all valves, stop logs, gates and penstocks can be operated to perform their nominated function.
Lakes	Regular monitoring of the Te Marua Lakes is undertaken according to the surveillance manual. GWW staff members carry out weekly, monthly, quarterly and annual evaluations, inspections and reports. Consultants prepare annual reports about lake performance and condition, and 5 yearly Comprehensive Safety Evaluations are undertaken in accordance with the November 2000 New Zealand Dam Safety Guideline).
Wells	Regular visual inspections of well heads are carried out. Closed circuit television inspections to assess well casing and pipework integrity are undertaken as opportunities arise.
Pipelines	Pipeline condition assessments are programmed when pipes reach 90% of their anticipated useful life. Apart from pipeline fixtures (valves, chambers' crossings), the integrity of a pipeline depends on the integrity of the exterior coating, the internal linings and the joints. Pipeline condition assessment will involve taking a number of representative samples and subjecting these to detailed evaluation to determine (primarily) internal and external pitting depths. Extreme value analysis will then be used to estimate when pitting may lead to unacceptable leakage rates. Opportunistic condition inspections are undertaken in association with repairs and other work that involves excavation. An asset condition assessment record will document soil types, bedding material, groundwater presence and a description of the condition of the pipe joint or barrel that is exposed. Regular inspections of pipeline fixtures (valves, chambers' crossings) are undertaken. In 2004 a detailed schedule of all above ground pipes was compiled and a programme of maintenance work developed.
Tunnels	A 5 yearly interior inspection of each tunnel to check drainage, water ingress through tunnel walls, rock falls and lining integrity is carried out.
Pump stations	Routine visual inspections of external components, especially bearing and seals are carried out. Vibration monitoring will be carried out as necessary to assist in diagnosing any problems.
Reservoirs	Exterior Inspection Programme: The exterior of reservoirs (walls, roof, and, where possible, underdrains) will be inspected five yearly. Items to identify and record are cracks, seepage, rust marks, joint deterioration, soundness of ladders, access lids and vents, and any graffiti. Interior Inspection Programme: The inside of reservoirs should also be inspected at five yearly intervals. Items to be identified and recorded are build-up of silt on the floor, sealant loss or degradation, possible slime accumulation on walls and corrosion of ladders and safety equipment.
Roads and Bridges	Visual inspections of roads and bridges will be completed at 5-10 year intervals (depending on age). Structural assessments of bridges will be undertaken as judged necessary.
Control systems	Monitoring of instrumentation, automatic controls and telemetry equipment are operational is carried out on an ongoing basis. In addition to reliability, accuracy is required. Regular calibration is carried out and calibration history and calibration records retained in the Hansen Asset Information System.

c) Performance monitoring

GWW undertakes the following monitoring activities to manage risk and measure business performance against KPIs.

Resource consents	Appropriate monitoring and reporting against conditions of resource consents (particularly for abstraction, overflows and discharges and maintenance) is undertaken to ensure compliance with consents and with IS0 14001 requirements.
Health & Safety	Safety procedures comply with legislation and regulatory requirements and are kept up to date.
Efficiency	Regular recording of pump performance data e.g., flow versus head and energy consumption will enable early detection of deteriorating performance and assist with the monitoring of pump efficiency and indicate priorities for replacement or refurbishment. This work will be addressed in an energy savings plan.
Leakage	Losses between abstraction and production and between production and supply will be monitored and reported. These are currently very low.
Seismic Assessment	An assessment of seismic vulnerability has been completed. The capital works programme provides for mitigation works according to priorities identified in the assessment.

d) Risk management

Risk exposure will be managed by implementing risk mitigation measures to maintain risk exposure at a level compatible with the GWW risk policy. Risk mitigation measures will include maintaining appropriate insurance cover, self insurance reserves, emergency response planning, condition monitoring of critical assets, preventative maintenance, operations manuals, review of standards and physical works programmes and maintaining IS0 9001 and IS0 14001 accreditation.

Reliability Centred Maintenance (RCM): A recent development in the maintenance area is consideration of the use of RCM. A specialist consultant has provided initial training and facilitated a three-day workshop aimed at identifying critical assets and assigning some measure of relative criticality. This work will be used to assign priorities to further the development of RCM.

Insurance: Insurance against possible loss or damage is a standard method of managing risks. Organisational risk may be in many forms and the consequences of damage to water supply assets may be life threatening. The costs and benefits of insuring these assets have been assessed. Currently the water supply is covered under a risk management package of insurance policies. This provides cover for Material (Property) Damage, Business Interruption, Public Liability, Professional Indemnity and Motor Vehicles. Three components of the infrastructure have been excluded from our cover. These are the Te Marua Lakes, the pipeline network, and tunnels, which are self-insured. The decision to self-insure the assets was based on financial risk assessment advice and a detailed damage assessment. A cash reserves is being accumulated for self-insurance. It currently (June 2004) stands at $6.8M with a target value of $20M. A bank credit line is held to cover the balance.

Spares: To date, the assessment by plant supervisors of asset criticality has had a bearing on the extent of spare parts that are retained in stock. Treatment plants retain spares when it is known that they are unavailable in New Zealand and would take considerable time to source from overseas. Pipeline spares have been retained with particular emphasis on the ability to restore supply after a major earthquake. Water main sizes are unusual for New Zealand systems and the distribution network in Wellington is vulnerable to disruption after a major earthquake. Considerable work has been undertaken by the Wellington Lifelines Group which includes representatives from Wellington Regional Council's Wholesale Water Supply. Extensive stocks of pipe are held to enable repairs following earthquake damage. They are strategically located and buried to avoid UV damage to the coating. These stocks will be reviewed as more detailed information on possible damage come to light.

e) Environment Management

GWW has implemented and maintains an Environmental Management System which has ISO 14001 accreditation. This system instils discipline around these activities and sets environment policies, standards and targets to minimise the risk of any environmental impacts and improve resource use efficiency.

f) Asset Management Tools

GWW will optimise the application of the Hansen AM system, GIS, sustainable yield model and hydraulic model over the short to medium term and develop their functionality in line with business needs and growth.

g) System failures

GWW will effectively respond to and manage incidents to ensure system availability and service continuity, and mitigate adverse effects. Spares are retained in key locations to be available after a seismic event.

h) Asset renewals

Cyclic renewal needs are identified by analysing;
- risk assessments,
- condition reports,
- maintenance records (asset failure and expenditure history),
- water quality tests,
- water leakage studies,
- observations of Water Services staff and contractors.

Renewal forecasts are based on an assessment of remaining asset lives (integrated with the valuation process). For pipe assets standard effective lives have been developed using available condition data for asset groups with similar deterioration drivers (e.g. pipe material).

As the need to replace particular items arises, the needs are assessed in detail and financial provision is made for refurbishment or replacement.

Decisions on renewal works consider the short and long-term effects on the operating and structural integrity of the system. Renewal works are designed and undertaken in accordance with industry standards (or known future standards) and system design loadings.

i) Asset development

Potential development projects are identified by monitoring asset performance;
- pressure and flow testing,
- customer service requests,
- flow monitoring and network modeling,
- risk assessment, and
- demand forecasts (see Section 3).

A register of potential development projects is maintained. All feasible options, including non-asset demand management options generally are considered in the economic assessment.

4.2.4 Works Programme

a) Asset Operation and Maintenance Plan

O&M activities

- All programmed maintenance is based on recommended industry standards that are progressively modified from experience based on observed failure rates and plant performance.
- All programmed maintenance is initiated by work order and recorded on the computerised asset maintenance system (Hansen).
- Asset refurbishment programmes are based on an assessment of operational needs and maintenance history.
- All critical items of mechanical and electrical plant have standby backup in case of failure.
- Flow meters, level and pressure sensors and on-line water quality analytical equipment will be calibrated regularly. Calibration frequency and history will be recorded in Hansen.
- Automatic call out of maintenance or operational personnel will be generated on failure of critical equipment that affects reservoir levels or treatment plant outlet quality or flow.

- The cost of maintenance will be separated from operational costs and reported against budget. Note that, to date, operational and maintenance costs have not been separated.

When preparing the long-term financial strategy an estimate of the required maintenance expenditure is made. Maintenance is defined as *all actions necessary for retaining an asset as near as practicable to its original service condition*.

All maintenance expenditure is funded from wholesale water revenue.

To date the budget for maintenance has been based on previous years' expenditure. Some adjustments to budgetary provision for specific areas are made if specific needs are identified when setting the budgets.

Historically, operational costs and maintenance costs have not been recorded separately, nor estimated as separate budget items. This has occurred because operations and maintenance work has been completed by the same people, often concurrently. Future budgets and cost history information will differentiate between planned maintenance, unplanned maintenance and operational activities. Operational and maintenance budgets will be separated from 2005-2006.

Maintenance Trends and Costs (Planned and Unplanned)

All maintenance and minor capital improvement works at the treatment plants and other Production assets have been recorded in the Hansen AMS since 2002. Details of the work and costs are entered against the appropriate asset. The costs of Capital Projects are very carefully reconciled with the FIS, and refurbishment costs are incorporated into the asset valuation record.

- Pumping Stations (Production and Distribution Sections): The use of the Hansen system for pumping station maintenance has been restricted to recording planned maintenance work. During 2004 the system was expanded to include all pump station maintenance.
- Pipelines and Tunnels: All assets have been entered into Hansen and maintenance history is being recorded on the system.

  Until 1992 the implementation of planned pipeline maintenance was ad hoc. Since 1992 there has been a methodical programme of inspection, maintenance and component replacement on all pipelines, which is now completed. A small funding allocation is included each year in the Capital Works Programme to fund valve replacement on an as required basis. A programme of valve exercising helps identify valves that may need replacement. A recently completed project is to catalogue and inspect all the above ground pipelines. Casual observation has indicated that the maintenance requirements for these are significant and have not been adequately attended to in recent years. This report will result in a detailed maintenance programme (i.e. painting) for these pipes.

  A comprehensive history of water main leaks back to 1977 is stored in Hansen and records are updated. However leaks and bursts are rare and the data is of limited use at present.
- Roads: During the period 2001-2004 all road surfaces were inspected and prioritised for resealing. The resealing programme has been completed. Road seal has been recorded as a separate asset with an appropriate life.
- Structures: Major maintenance is carried out on an as required basis. A painting contract was let in 2001 to paint all facilities. All buildings were painted in the period 2001-2003. An on going relationship has been established with this contractor and further re-painting will be undertaken as required.

Standards and Specifications

Plant and equipment maintenance requirements are based on the recommendations outlined in manuals or (in their absence) manufacturer's information. This literature is retained by the plant supervisors. Often experience gained from working with the equipment over many years, indicates that different (in some cases lesser) maintenance requirements are appropriate.

Treatment plants are staffed during normal working hours, and pumping stations are visited and checked regularly. Because water supply is a 24hour/day 365 days of the year business, staff are trained to understand that high standards are necessary in all aspects of the operation. Maintenance needs are noted by operation staff and passed to plant Supervisors and the Production Manager for actioning. Items which involve capital additions or refurbishment are passed to the Asset and Quality Manager for approval and allocation of funds.

Maintenance Forecasts

The 10 year (2004-2013) forecast for operating expenditure is summarised in section 6 (Table 10).

The only identified instance of deferred maintenance involved stream crossings on the Tunnel to Wainui WTP water main which were noted as being in a dangerous condition and in need of immediate replacement in 2002. The pipeline has now been replaced.

b) Renewal programme

A programme of refurbishment and replacement of facilities and plant items is developed each year as part of the Capital Works Programme (see Table 9). Generally the replacement or refurbishment will reinstate the previous level of service, but sometimes, especially in the case of electronic equipment, an upgrade if incorporated.

The replacement or refurbishment of assets is initially planned according to a Schedule of Useful Lives (see Table 8). Following initial identification a detailed condition assessment will be undertaken to confirm that replacement is necessary.

Most asset types are included in this schedule. There are some specific asset types excluded - generally where they are uncommon. In these cases an assessment of useful life has been included on the detailed Asset list.

Description	Life Span
Buildings – concrete	80
Buildings - timber	50
Dams	100
Storage lakes	150
Pumping and treatment equipment	25
Pipelines - steel, concrete lined	90
Pipelines - bitumen lined	75
Pipelines - unlined cast iron	100
Pipelines - cast iron, concrete lined	130
Pipelines - asbestos cement	50
Pipelines - ductile iron, concrete lined	130
Pipelines - concrete	60
Tunnels	150
Structures - reinforced concrete	100
Reservoirs- concrete	80
Bridges - timber	50
Bridges - steel	80
Bridges - concrete	100
Roads - seal	10-15
Electrical control equipment, computers	5-10
Valves (sluice)	50
Valves (other)	30
Flow meters, transmitters	20
Monitoring instruments	10

Table 8: Asset Useful Lives

However, refurbishment or replacement of assets may be advanced or delayed because of:

- Failure history
- Superseded technology or lack of compatibility with other similar assets
- Condition assessment predicts likely failure with unacceptable risk consequences
- Lack of service support/unavailability of spares.

Some assets have been identified as operational beyond their predicted life. The reasons for their extended life will be specific to their particular duty. When replacement is due their condition will be assessed as part of capital expenditure planning, with a view to keeping them operational as long as it is financially beneficial.

c) Capital development programme

The 10 year capital expenditure programme (2004 – 2013) has been summarised, and is included in section 6 (Table 10). Background and justification for the major projects is given in section 4.2.

Only nine years are shown as this programme is part of the 2003 – 2013 LTCCP, i.e. the first year of the update.

5.0 Quality of Supply

The KPIs (refer Table 1) related to the quality of supply are achieved by the operation, maintenance and renewal of production assets to reliably produce potable water. The KPIs cover:

- Compliance with NZ Drinking Water Standards 2000
- Achievement of Ministry of Health A Grading for water treatment (unless customer requirements dictate otherwise)
- Water quality testing programme
- Production of Public Health Risk Management Plans
- ISO 9001 accreditation and compliance.

Production assets are:
- Te Marua Treatment Plant
- Waterloo treatment plant
- Wainuiomata treatment plant
- Gear Island treatment plant

5.1 Production Assets Information

a) Te Marua Treatment Plant

This is a modern plant (1989), which incorporates coagulation, flocculation, clarification dual media filtration, pH adjustment, chlorination and fluoridation. Normally water direct from the Kaitoke intake or the Hutt River is treated, but during times of high colour or turbidity or when river flows are very low, stored water from the Stuart Macaskill lakes is treated. Trials in 2002 determined that river water, which is normally of a high standard, could be more efficiently treated by direct filtration methods, that is, the clarifiers are by-passed. In this mode the plant was ran at 135 ML/d during trials in April 2004. However, when treating lake water use of the clarifiers is necessary, and this down-rates the plant capacity to approximately 80 ML/d.

Investigations are currently under way to alter the plant configuration to enable different treatment processes to be employed simultaneously for lake and river water. This will enable blending of water when the river is low and demand is high. The capital work programme contains $300,000 for this work in 2004/2006. Te Marua WTP easily exceeds the requirements of the DWSNZ:2000, and is likely to meet more stringent rules to be introduced in 2005, provided account is taken by the new standard of the high quality of the raw water.

b) Wainuiomata Treatment Plant

The Wainuiomata WTP is a DAF (Dissolved Air Flotation) plant commissioned in 1993. In a DAF plant, air coming out of solution lifts the floc, which is floated off. After the floc is lifted the water passes through a conventional sand filter. The plant also corrects pH and adds chlorine and fluoride. The nominal plant capacity is 60 ML/d, but its effective maximum capacity is approximately 50 ML/d.

The plant easily meets the requirements of the DWS NZ:2000, and is likely to meet new lower turbidity standards expected to be introduced in 2005.

c) Waterloo Treatment Plant

Waterloo WTP meets the DWS NZ 2000 by virtue of the fact that the Waiwhetu aquifer has been shown to be secure under the criteria set out in the standard. Treatment is limited to the adjustment of pH by the addition of lime. A project to utilise aeration to reduce the amount of lime added is under study, and $150,000 is included in the Capital Works Programme (04-06) for this work.

d) Gear Island Treatment Plant

The Gear Island WTP fulfils two functions. It acts as a stand by plant when water is drawn from the wells, but also routinely chlorinates and fluoridates water from Waterloo being pumped to Wellington. In this latter role it effectively acts as an extension of the Waterloo Plant.

Gear Island WTP currently has a 'B' grading, ostensibly because the water is not chlorinated. In fact the water is chlorinated, but high turbidity, resulting primary from impurities in the lime added at Waterloo, means that the turbidity requirement of the FAC rule (that turbidity be < 0.5 NTU) cannot be achieved. GWW policy is for plants to be graded A. The turbidity requirements of the FAC rule are presently under review in the context of a review of the DWSNZ. If changes are not made to the turbidity aspect of the FAC rule, and aeration does not significantly reduce turbidity, significant changes may have to be made to the treatment process to achieve an A grading. The scope and nature of these possible changes is not known, and no allowance for them is included in the Capital Works Programme.

5.2 Risk Assessment

GWW is preparing Public Health Risk Management Plans (PHRMPS) to assess and mitigate risks associated with the achievement of water quality related KPIs.

The following main risk events that may impact adversely on the achievement of these KPIs have been identified as:

- Contamination of water sources
- Contamination of water due to asset failures – (e.g. pipe leaks and breaks, pump failure, well corrosion, control systems, treatment equipment)
- Contamination of water due to asset condition failures caused by natural hazards (e.g. flooding, earthquakes
- Design inadequacies
- Poor repair methods
- Inadequate security (unauthorised entry, sabotage)
- Operator error
- Power failure.

The plans identify preventive measures and corrective actions that are in place or will be put in place to eliminate or mitigate these risks.

5.3 Water Quality Management Strategies

5.3.1 Quality assurance

GWW implement quality processes for all key business activities in accordance with its accredited**.**
ISO 9001 Quality Management System.

5.3.2 Planned Inspections

GWW will implement a risk-based programme of inspections to monitor asset condition and performance to manage risk. A comprehensive record of all asset failures is maintained which includes details of location, date, failure mode, times and costs for repair.

Regular visual inspections of all components undertaken in conjunction with RCM evaluations confirm:

- Compliance with Codes and Legislation
- Hazards have been assessed and that all facilities are safe for staff, contractors and visitors
- Chemical storage facilities comply with dangerous goods and toxic substances regulations
- Building Act compliance is supported with "Warrants of Fitness".

5.3.3 Performance monitoring

GWW routinely monitors water quality at production facilities (and sample points in the distribution network) to confirm compliance with DWSNZ and measure business performance against KPIs. Results are reported to the Hutt Valley District Health Board.

5.3.4 Risk management

Risk exposure is managed by implementing risk mitigation measures to maintain risk exposure at a level compatible with the GWRC risk policy.

5.3.5 System failures

GWW effectively responds to and manages incidents to ensure system availability and service continuity, and mitigate adverse effects. Spares are retained in key locations to be available after a seismic event.

5.3.6 Asset renewals

Cyclic renewal needs are identified by analysing;
- risk assessments
- condition reports
- maintenance records (asset failure and expenditure history)
- water quality tests
- observations of Water Services staff and contractors.

Renewal forecasts are based on an assessment of remaining asset lives (integrated with the valuation process).

As the need to replace particular items arises, the needs are assessed and financial provision is made in the Capital Works Programme or refurbishment or replacement.

Decisions on renewal works consider the short and long-term effects on the operating integrity of the treatment plants. Renewal works are designed and undertaken in accordance with industry standards (or known future standards) and system design loadings.

5.3.7 Asset development

Potential development projects are identified by monitoring asset performance:
- water quality testing,
- risk assessment, and
- demand forecasts (see Section 3).

A register of potential development projects is maintained.

All feasible options, including non-asset demand management options, are considered in the economic assessment.

5.4 Works Programme

a) Asset Operation and Maintenance Plan

O & M activities: O & M strategies and trends for production assets are the same as for distribution assets (refer Section 4.2.4).

Standards and Specifications: Plant and equipment maintenance requirements are based on the recommendations outlined in manuals or (in their absence) manufacturer's information. This literature is retained by the plant supervisors. Often experience gained from working with the equipment over successive years, will indicate that different (sometimes lesser) maintenance requirements are appropriate.

Treatment plants are staffed during normal working hours. Because water supply is a 24hour/day 365 days of the year business concerned with public health, staff trained to understand that high standards are necessary in all aspects of the operation. Maintenance needs are noted by operation staff and passed to plant Supervisors and the Production Manager for actioning. Items which involve capital additions or refurbishment are passed to the Asset and Quality Manager for approval and allocation of funds.

Maintenance Forecasts: The 10 year forecast for operating expenditure is summarised in Table 10 (Section 6).

b) Renewal programme

Renewal strategies are as described for distribution assets in Section 4.2.4.

The 10 year financial forecast (2004 – 2013) for asset renewals is detailed in Table 10. (Renewal items are designated R in column 4.)

c) Capital development programme

The 10 year capital expenditure programme (2004 – 2013) has been summarised, and is included in Table 9. Background and justification for the major projects associated with water quality is given in Section 4.2.4.

Only nine years are shown as this programme is part of the 2003 – 2013 LTCCP (i.e. the first year of the update).

6.0 Financial Summary

6.1 Background

6.1.1 Water Supply Levy

The Wellington Regional Water Board Act (WRWBA) provides for the recovery of all costs from the customer authorities and forms the basis for setting the annual revenue requirement of wholesale water.

Each city currently pays a percentage of the revenue that is the same as its percentage of the annual total water quantity delivered. Cities pay an amount (through equal monthly payments) based on the percentage consumption in the previous year. Then at the end of the year, there are debits and credits when the actual percentage is compared with the percentage from the previous year. Customers currently prefer this methodology though there is provision in the WRWBA for both fixed and variable charging or a combination method.

As part of the Annual Plan process, city customers are consulted about various aspects of the water supply business including the levy for the year ahead.

Over the last few years, the total wholesale water levy has either remained constant in nominal dollars or reduced. This is in spite of, in recent years, substantial increases in insurance premiums and recently introduced local authority rates on utility services. Over the last two years, these items have increased costs by $1.6M a year. In real dollar terms, the levy has substantially reduced over the last seven years.

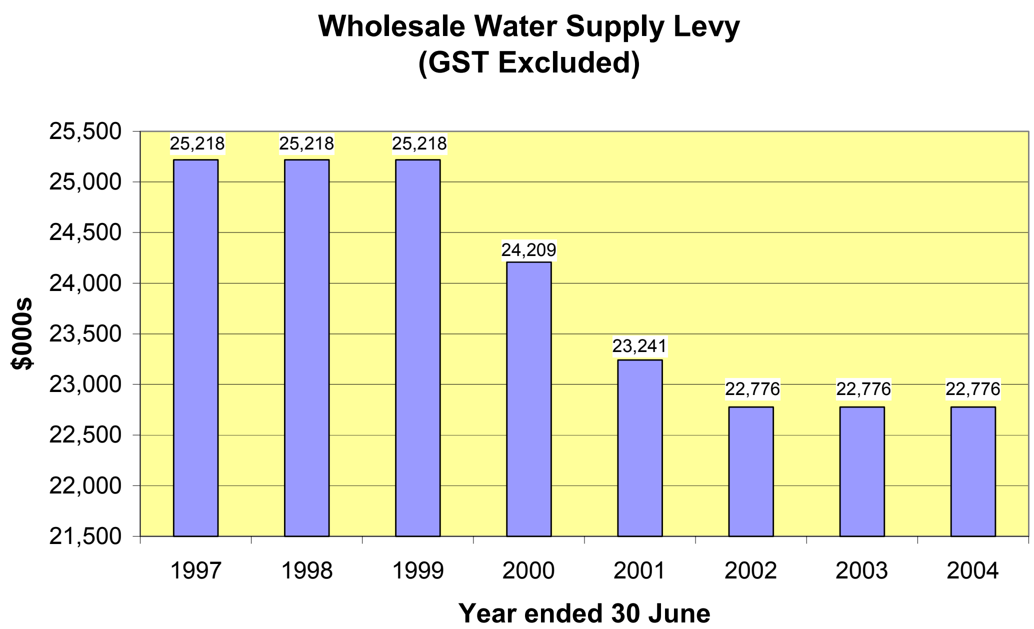


Figure 12: Wholesale Water Supply Levy

For the next few years, the levy is expected to stay constant in real dollars, but this depends on the amount of debt repaid each year. The long-term financial projection shown in Figure 13 shows that unless the levy is increased before 2010 borrowing levels will increase. This however depends on the actual borrowing undertaken to fund major projects.

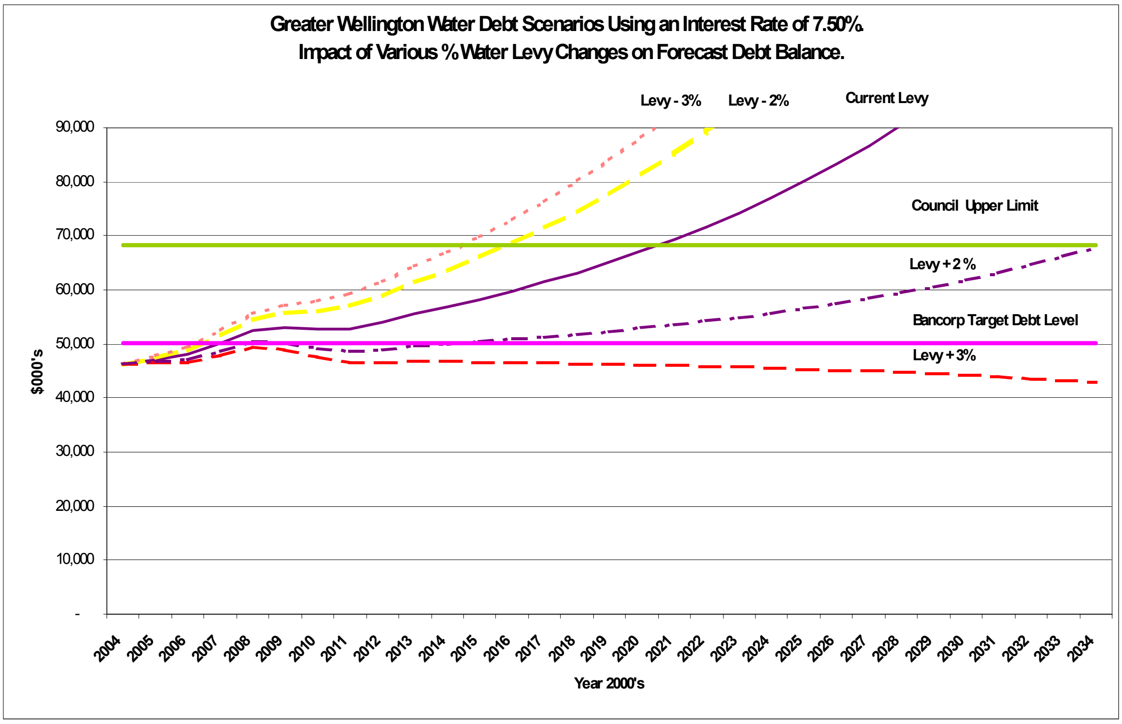


Figure 13: Projected Debt Levels

6.1.2 Expenditure Definitions

Maintenance expenditure	The expenditure required to preserve the level of service provided by an asset. Responsibility for maintenance expenditure lies with the Production and Distribution Managers.
Capital Expenditure - Renewals	The expenditure required to refurbish or replace an asset to restore or improve its level of service. Responsibility for renewal expenditure lies with the Asset and Quality Manager and it is funded from the Capital Works Programme.
Capital Expenditure Extensions	The expenditure required to create a new asset or to extend the level of service of the system. This expenditure may result from growth, changing customer needs, environmental protection, public health protection, occupational health and safety issues or security of supply, e.g., seismic, drought or flood protection. Responsibility for capital expenditure lies with the Asset and Quality Manager.

Note: all funding programmes are subject to consultation and approval by Council through the Annual Planning process. All funding programmes are reviewed each year.

6.2 Financial Management

6.2.1 Insurance Management

General Policy

Water supply assets will be revalued annually for insurance purposes. Maximum probable damage studies for all assets have recently been completed as part of a review of insurance policy, and in an attempt to reduce premiums. Maximum probable damage is likely to result from movement of the Wellington fault.

The geographic spread of the water supply assets means that other disasters such as a fire will be localised and although the damage could be extensive, it should not prevent other parts of the system from operating.

Insurance Policy and Self Insurance

Assets will be either insured external to the Council, or self-insured through the holding of a cash reserve and purchasing credit lines with banks to support the reserve.

In 1995, there was a substantial increase in insurance premiums but there was not a perceived increase in risk to the water supply assets. Accordingly, it was decided at the time to set up a self-insurance fund using the premium of $0.5M that would have been used to purchase insurance. This was to cover damage to the following assets:

- The Stuart Macaskill storage lakes at Te Marua
- Pipelines

When it was set up, it was thought that a fund of about $12M would have been adequate to cover the maximum expected losses. Subsequently, tunnels have also been included in the self-insurance. At 30 June 2004, the reserve fund was $6.8M. Assessments by Opus and SKM Consultants in 2002 concluded that the maximum damage estimate is now $29.9M for the self-insured assets.

A review of insurance premiums currently available show they are expensive as the insurance industry is at a premium peak, following recent international incidents. As a result of the increase in the maximum expected damage and premium cost if insurance was once again to be purchased, the Council adopted the following:

- Self-insured funding contribution should increase from $0.5M to $0.75M a year from 2003/4.
- The target value of the fund is $20M and this is expected to be reached in 2013 if assumptions on interest rates are met. Should the damage exceed $20M, then repairs would be funded through loans.
- The fund will be reviewed regularly and targets and projections adjusted inflation and changes in interest rates.
- Lines of credit will continue to be purchased to cover the shortfall in the reserve fund.

Assets, other than those included in the self-insurance fund, are insured. An assessment in 2002 of the maximum probable damage to the insured assets (again from a seismic event) is $43M.

Consideration was given to self-insuring these assets but it was concluded the potential financial exposure, together with the under funded self-insurance reserve was too high so insurance will continue. When the policies are renewed each year, the level of the deductible sums is reviewed.

Some of the local authorities in New Zealand insure through a collective arrangement, usually referred to as LAPP. An insurance proposal was received from this organisation but it was judged to be unsuitable for the level of damage that could be sustained in a major seismic event.

The mix of insured versus self-insurance assets will be reviewed from time to time. However it is not expected that the insurance policy will change or that any of the assets will become un-insured.

6.3 Financial Projection

6.3.1 Assumptions

There is a main overriding assumption that Greater Wellington Water will remain in its current structure. Several attempts to create a more efficient integrated regional water supply organisation have been made over the past few years but change has not yet been supported by GWW. The following general assumptions and explanations apply to the financial information provided:

- The information is made up of all activities funded by the wholesale water levy, as well as the asset acquisitions, asset disposals and capital projects undertaken by GWW for the benefit of the wholesale supply network. Specifically, this includes Operations Administration, Production and Distribution Sections of the Operations Group, and the Strategy and Asset Group.
- The information also includes wholesale water related activities but excludes activities undertaken by GWW's business units, Engineering Consultancy Services and Laboratory Services.

- The costs incurred by the contracting of services from these business units and the Support Services Department are incorporated in both the reported costs as internal consultant charges, and shown as part of the reported total internal revenue figure (approximately $2M per annum).
- The wholesale water charges are budgeted at the current level throughout the nine year period. Holding the levy at current levels is possible partly because of reducing financial cost.
- Significant savings have been achieved as a result of repaying the debt as quickly as possible with any available annual surpluses.

6.3.2 Capital Extensions and Renewals Expenditure

The forecast capital and renewals expenditure is shown in Table 9. Background to the various projects and an explanation of how they contribute to the achievement of KPIs is contained in sections 4 and 5.

Renewal and refurbishment expenditure totals $18.6M over the nine year planning period, varying between a maximum of $3.8M in 2005/06 and $1.2M in 2009/10.

Capital expenditure on extensions total $28.5M over the 9 year planning period, peaking at $5.3M in 2007/08.

Wholesale Water Operating Plan - Capex Projects 2004-2013

Category	Project	SAP	Cat	Total	04/05 $x000	05/06 $x000	06/07 $x000	07/08 $x000	08/09 $x000	09/10 $x000	10/11 $x000	11/12 $x000	12/13 $x000
Sources	Kaitoke Strainers Replace	(4)	R	150						50	100		
(Profit Centre 66820)	Strengthen SM Lakes Intake Towers	668/135/1	E	230	**30**	100	100						
	SM Lakes Aeration	668/136/1	E	100	**50**	50							
	Hutt River Intake	(4)	E	5000					500	2000	2000	500	
	Wainui/Orong Catchment Northern Bdy Fence	668/331/3	E	300	**100**	100	100						
	Secure Wainui Lower Dam	668/354/1	E	300	**300**								
	Spare Well Pump for Waterloo WF	668/237/1	E	60	**60**								
	Wainui Off River Storge	668/313/1	E	3100	**100**			100	2400	500			
	Refurbish Kaitoke Weir (Rebudget)	668/106/2	R	10	**10**								
	Te Marua Roading reseals	668/108/1	R	100							100		
Sources Total				**9350**	**650**	**250**	**200**	**100**	**2900**	**2550**	**2200**	**500**	**0**
Treatment Plants	TM WTP replace controls	668/113/2	R	150	**30**	20	30	20	30	20			
(Profit Centre 66830)	TM WTP replace equipment	668/129/2	R	3100	**100**	500	500	500			500	500	500
	TM WTP Modifications for twin streams	668/138/1	E	300	**200**	100							
	Waterloo WTP replace equipment	668/222/2	R	600	**100**	100	100				100	100	100
	Waterloo Aeration	668/238/1	E	150	**100**	50							
	Wainui WTP replace equipment	668/352/1	R	1750	**150**	100	100	100	500	500	100	100	100
	Wainui WTP, Road reseals	668/320/3	R	170	**70**							100	
	WTPs Unplanned Minor Replacement/Refurb.	668/900/2	R	2100	**300**	300	300	200	200	200	200	200	200
Water TPs Total				**8320**	**1050**	**1170**	**1030**	**820**	**730**	**720**	**900**	**1000**	**900**
Pipelines	Replacement Material for Silverstream Bridge	668/501/2	**E**	100	**100**								
(Profit Centre 66840)	Valve Replacement	668/503/3	R	480	**120**	120	120	20	20	20	20	20	20
	Cathodic protection - upgrade	668/537/1	R	250	**50**	100	100						
	Purchase Seismic Repair Pipe Stocks	668/558/1	E	200	**200**								
	Relocate Kaitoke Main on SS Bridge	668/501/3	R	460	**150**	310							
	Manor Park branch replace AC	668/515/1	R	10		10							
	Kaitoke Main - Relocate SH2 to Haywards	668/547/1	R	1800	**800**	1000							
	Kaitoke Main - Relocate Haywards to Brittens	(4)	R	730				30	700				
	Replace 750 CI main through Wainuiomata (2)	(4)	R	500									500
Pipelines Total				**4430**	**1420**	**1540**	**220**	**50**	**720**	**20**	**20**	**20**	**520**
Pump Stations	Karori Pump Station Relocate (1)	668/525/1	R	1712	**870**	842							
(Profit Centre 66850)	Thorndon PS replace equipment	(4)	R	200	**0**			200					
	TM PS Replace equipment	(4)	R	500	**0**								500
	Point Howard Pump Station (3)	668/542/1	R	367	**367**								
	Randwick PS Modifications	668/559/1	E	50	**50**								
	Te Marua PS Replace PLCs	668/560/1	R	145	**145**								
	Ascot Park Pump Station (new)	668/528/1	E	120	**0**	**120**							
Pump Stations Total				**3094**	**1432**	**962**	**0**	**200**	**0**	**0**	**0**	**0**	**500**
Reservoirs	Takapu Reservoir (Repl. for Haywards Reservoir	668/561/1	E	10050	**50**	600	4700	4700					
(Profit Centre 66860)	Terminal Reservoir for Wainui system	(4)	E	6500							500	3000	3000
Reservoirs Total				**16550**	**50**	**600**	**4700**	**4700**	**0**	**0**	**500**	**3000**	**3000**
Monitoring & Control	Meter Replacement/Additions	668/511	R	300		100				100			100
(Profit Centre 66870)	Telemetry System Renewal	668/554/2	R	260	**160**	100							
	Control System Upgrade	668/820/1	E	900	**100**	100	100	100	100	100	100	100	100
	System Optimiser Stg 2	668/805/2	E	500			100	400					
Monitoring and Control Total				**1960**	**260**	**300**	**200**	**500**	**100**	**200**	**100**	**100**	**200**
Miscellaneous	Minor Work	668/803	R	2800	**200**	200	200	200	200	300	500	500	500
(Profit Centre 66880)	Upgrade for Seismic protection	668/802	E	500	**250**	250							
Miscellaneous Total				**3300**	**450**	**450**	**200**	**200**	**200**	**300**	**500**	**500**	**500**
Totals				**47004**	**5312**	**5272**	**6550**	**6570**	**4650**	**3790**	**4220**	**5120**	**5620**
Funding Breakdown	Replacement and Refurbishment			18644	**3622**	3802	1450	1270	1650	1190	1620	1520	2520
	Extensions			28460	**1690**	1470	5100	5300	3000	2600	2600	3600	3100

Note (1): Funding to decommission existing PS to be 05-06 Opex.

Note (2): Project extends to 2015/2016

Note (3): $30,000 Contribution from HCC not included in budget.

Note (4) WSB Elements not yet allocated

Table 9: Capital and Renewals Expenditure Projection

6.3.3 Operations and Maintenance Expenditure

The forecast operations and maintenance expenditure (excluding depreciation and corporate overheads is shown in Table 10. Background to the various activities and an explanation of how they contribute to the achievement of KPIs is contained in Sections 4 and 5. Overall O&M expenditure for production, distribution and administration increases marginally from $8.796M to $8.805M over the 9 year planning period.

Projected expenditure is based largely on historical trends, which are shown in Figure 14 below.

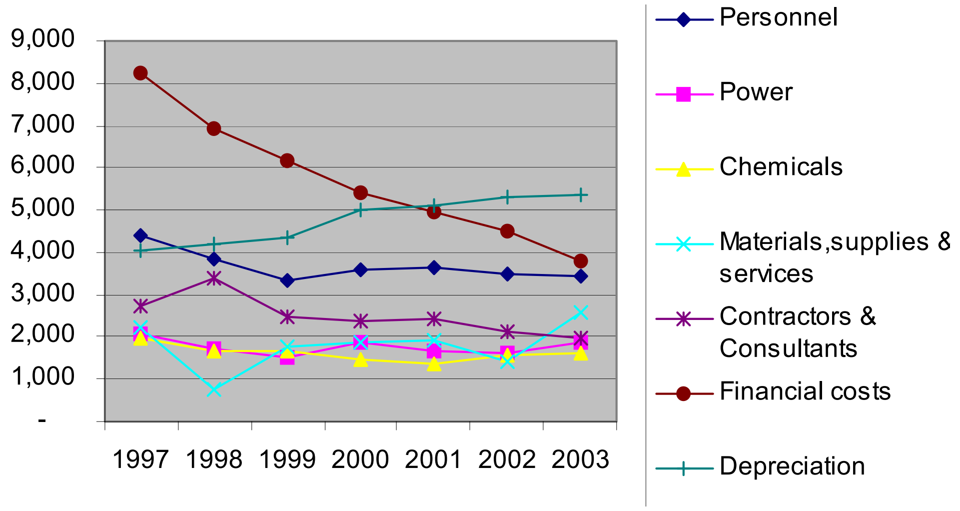


Figure 14: Operating Expense History – 1997- 2003

Table 10: Operations and Maintenance Expenditure Projection

Wholesale Water Operating Plan - OPEX Expenditure Budget 2004-2013

Category	Project	Total	04/05 $x000	05/06 $x000	06/07 $x000	07/08 $x000	08/09 $x000	09/10 $x000	10/11 $x000	11/12 $x000	12/13 $x000
Distribution	Personnel costs	4,446,342	**494,038**	**494,038**	**494,038**	**494,038**	**494,038**	**494,038**	**494,038**	**494,038**	**494,038**
	Materials and supplies	8,437,500	**937,500**	**937,500**	**937,500**	**937,500**	**937,500**	**937,500**	**937,500**	**937,500**	**937,500**
	Travel and Transport	433,350	**48,150**	**48,150**	**48,150**	**48,150**	**48,150**	**48,150**	**48,150**	**48,150**	**48,150**
	Contractors and consultants	2,260,800	**251,200**	**251,200**	**251,200**	**251,200**	**251,200**	**251,200**	**251,200**	**251,200**	**251,200**
	Internal contractors	3,861,693	**429,077**	**429,077**	**429,077**	**429,077**	**429,077**	**429,077**	**429,077**	**429,077**	**429,077**
	Loss (gain) on disposal	-186,400	**-9,000**	**-8,000**	**-124,000**		**-6,000**	**-14,000**	**-18,000**	**-7,400**	
Distribution Total		**19,253,285**	**2,150,965**	**2,151,965**	**2,035,965**	**2,159,965**	**2,153,965**	**2,145,965**	**2,141,965**	**2,152,565**	**2,159,965**
Production	Personnel costs	6,515,343	**723,927**	**723,927**	**723,927**	**723,927**	**723,927**	**723,927**	**723,927**	**723,927**	**723,927**
	Materials and supplies	34,780,950	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**	**3,864,550**
	Travel and Transport	402,165	**44,685**	**44,685**	**44,685**	**44,685**	**44,685**	**44,685**	**44,685**	**44,685**	**44,685**
	Contractors and consultants	4,622,777	**514,000**	**514,973**	**514,423**	**511,708**	**514,423**	**513,750**	**513,750**	**512,000**	**513,750**
	Internal contractors	8,149,924	**905,189**	**904,216**	**904,766**	**907,481**	**904,766**	**905,439**	**905,439**	**907,189**	**905,439**
	Loss (gain) on disposal	-289,200	**-10,400**	**-6,000**	**-9,000**	**-84,000**	**-75,000**	**-74,000**	**-6,000**	**-9,000**	**-15,800**
Production Total		**54,181,959**	**6,041,951**	**6,046,351**	**6,043,351**	**5,968,351**	**5,977,351**	**5,978,351**	**6,046,351**	**6,043,351**	**6,036,551**
Administration	Personnel costs	2,893,356	**321,484**	**321,484**	**321,484**	**321,484**	**321,484**	**321,484**	**321,484**	**321,484**	**321,484**
	Materials and supplies	459,000	**51,000**	**51,000**	**51,000**	**51,000**	**51,000**	**51,000**	**51,000**	**51,000**	**51,000**
	Travel and Transport	117,315	**13,035**	**13,035**	**13,035**	**13,035**	**13,035**	**13,035**	**13,035**	**13,035**	**13,035**
	Contractors and consultants	279,000	**31,000**	**31,000**	**31,000**	**31,000**	**31,000**	**31,000**	**31,000**	**31,000**	**31,000**
	Internal contractors	1,724,805	**191,645**	**191,645**	**191,645**	**191,645**	**191,645**	**191,645**	**191,645**	**191,645**	**191,645**
	Loss (gain) on disposal	-75,400	**-5,400**	**-5,000**	**-3,000**			**-54,000**	**-5,000**	**-3,000**	
Administation Total		**5,398,076**	**602,764**	**603,164**	**605,164**	**608,164**	**608,164**	**554,164**	**603,164**	**605,164**	**608,164**
Total Forecast Expenditure		**78,833,320**	**8,795,680**	**8,801,480**	**8,684,480**	**8,736,480**	**8,739,480**	**8,678,480**	**8,791,480**	**8,801,080**	**8,804,680**

6.4 Asset Valuation

6.4.1 Background

Assets are valued at the component level (approximately 5,000 components) and the information is held in the Valuation Module of the Hansen AMS. Assets were first valued at this detailed level in 1999, and have been re-valued as at 30 June 2004.

This valuation has been carried out by a Registered valuer in accordance with the requirements of the "New Zealand Infrastructure Asset Valuation and Depreciation Guidelines" and Financial Report Standard No. 3 "Accounting for Property, Plant and Equipment" (FRS-3).

The value of these infrastructure assets is contained in the FMS as a one-line entry. Depreciation is run in Hansen at the end of each month and reported to the Finance Division who incorporate it into the monthly accounts run in the FMS.

The value of assets is reported in the Statement of Financial Position (Balance Sheet) and is one measure of the worth of an organisation. The fundamental accounting principle is that the values reported in the financial statements of an organisation must give a true and fair view of the financial situation of an entity, both in terms of its performance and worth.

6.4.2 Asset Ownership Rationalisation

Some of the infrastructure used in the wholesale water supply system dates as far back as the 1880s and its use in some cases has changed over time. Accordingly, there are some assets that, with the change in use would be better owned by the customers. Likewise, there are a small number of customer owned assets that could be better managed as part of the wholesale water supply system. Assets currently identified include:

- The cast iron 525mm diameter pipeline between Thorndon and Ngauranga used by the Wellington City Council (WCC) but owned by GWW.
- The 2.17 ML reservoir at Karori that serves as a WCC service reservoir but previously served as a chlorination contact tank, and is owned by GWW.
- The pipeline from Thorndon to Macalister Park owned by the WCC is essentially a wholesale pipeline in size and function. GWW keeps spares for this size of pipe and has the expertise to carry out repair work.

Ownership of these assets may be changed should opportunities arise which would facilitate this. However in the short term the status quo is expected to remain.

6.4.3 Current Replacement Value

Table 11 lists the replacement value of Wholesale Water Infrastructure assets as at 30/6/2004 broken down by asset type and location.

6.4.4 Current Book Value

Table 12 is the book value of Wholesale Water Infrastructure assets as at 30/6/2004 broken down by asset type and location.

Wholesale Water Assets
Summary of Valuation
Replacement Values as at 30/6/2004

	Asset Type									
Location	**Equipment Assets**	**Fluid Storage Tanks**	**Miscellaneous Plant Assets**	**Wells**	**Water Mains**	**Miscellaneous Water Assets**	**Water Meters**	**Reservoirs**	**Valves**	**Total**
Treatment Plants										
Te Marua Water Treatment Plant	15,590,860	13,786,860	12,258,780		3,930,100	4,668,000		1,927,000		**52,161,600**
Wainuiomata Water Treatment Plant	6,560,230	7,937,000	9,491,700		7,725,280	31,145,000		1,080,000	260,130	**64,199,340**
Waterloo Water Treatment Plant	5,285,350	266,770	4,569,900	1,104,000	1,732,800			1,622,000	247,520	**14,828,340**
Gear Island Water Treatment Plant	12,000	114,920	1,214,500	396,000	485,400			1,345,800	12,000	**3,580,620**
Total Treatment Plants	**27,448,440**	**22,105,550**	**27,534,880**	**1,500,000**	**13,873,580**	**35,813,000**	**0**	**5,974,800**	**519,650**	**134,769,900**
Distribution Pipelines										
Kaitoke to Karori					13,725,500	82,979,740			1,151,500	**97,856,740**
Wainuiomata to Wellington					10,541,000	58,386,590			1,306,300	**70,233,890**
Waterloo Artesian System						13847600			631,990	**14,479,590**
Monitoring and Control Equipment	656,780									**656,780**
Total Distribution Pipelines	**656,780**	**0**	**0**	**0**	**24,266,500**	**155,213,930**	**0**	**0**	**3,089,790**	**183,227,000**
Pumping Stations										
Ngauranga Pumping Station	1,255,760		1,257,800							**2,513,560**
Haywards Pumping Station	963,480		1,150,800							**2,114,280**
Thorndon Pumping Station	531,070		335,800							**866,870**
Satellite Pumping Stations (11)	3,730,860		2,151,400							**5,882,260**
Total Pumping Stations	**6,481,170**	**0**	**4,895,800**	**0**	**0**	**0**	**0**	**0**	**0**	**11,376,970**
Reservoirs										
Stuart Macaskill Lakes	745,760		255,200		1,565,300	35,340,000		66,100,000		**104,006,260**
Ngauranga Reservoir	153,620							3,826,440		**3,980,060**
Haywards Reservoir	265,670		24,000					3,461,040		**3,750,710**
Karori Contact Tank	4,520							660,060		**664,580**
Assets in customer service reservoirs	944,700		25,000							**969,700**
Total Reservoirs	**2,114,270**	**0**	**304,200**	**0**	**1,565,300**	**35,340,000**	**0**	**74,047,540**	**0**	**113,371,310**
Totals	**36,700,660**	**22,105,550**	**32,734,880**	**1,500,000**	**39,705,380**	**226,366,930**	**0**	**80,022,340**	**3,609,440**	**442,745,180**

Source: Knight Frank Ltd valuation of 30 June 2004

Table 11: Replacement values

Wholesale Water Assets
Summary of Valuation
Book Values as at 30/6/2004

	Asset Type									
Location	**Equipment Assets**	**Fluid Storage Tanks**	**Miscellaneous Plant Assets**	**Wells**	**Water Mains**	**Miscellaneous Water Assets**	**Water Meters**	**Reservoirs**	**Valves**	**Total**
Treatment Plants										
Te Marua Water Treatment Plant	8,047,502	10,154,800	8,459,720		2,698,000	20,677,000		1,431,000		**51,468,022**
Wainuiomata Water Treatment Plant	3,996,810	6,461,860	6,659,490		6,684,680	15,206,500		939,000	175,840	**40,124,180**
Waterloo Water Treatment Plant	2,756,420	131,200	2,649,900	550,000	1,311,100			914,000	93,490	**8,406,110**
Gear Island Water Treatment Plant	1,137,320	94,620	801,500	33,000	354,300			821,800	1,740	**3,244,280**
Total Treatment Plants	**15,938,052**	**16,842,480**	**18,570,610**	**583,000**	**11,048,080**	**35,883,500**	**0**	**4,105,800**	**271,070**	**103,242,592**
Distribution Pipelines										
Kaitoke to Karori					8,222,500	45,337,710			605,520	**54,165,730**
Wainuiomata to Wellington					8,590,000	28,426,300			828,100	**37,844,400**
Waterloo Artesian System						9,713,170			443,680	**10,156,850**
Monitoring and Control Equipment	322,790									**322,790**
Total Distribution Pipelines	**322,790**	**0**	**0**	**0**	**16,812,500**	**83,477,180**	**0**	**0**	**1,877,300**	**102,489,770**
Pumping Stations										
Ngauranga Pumping Station	699,960		1,073,800							**1,773,760**
Haywards Pumping Station	$361,470		654,800							**1,016,270**
Thorndon Pumping Station	123,460		65,800							**189,260**
Satellite Pumping Stations (11)	1,600,620		1,313,400							**2,914,020**
Total Pumping Stations	**2,785,510**	**0**	**3,107,800**	**0**	**0**	**0**	**0**	**0**	**0**	**5,893,310**
Reservoirs										
Stuart Macaskill Lakes	405,260		165,000		1,265,300	7,028,000		58,134,000		**66,997,560**
Ngauranga Reservoir	101,190							3,224,000		**3,325,190**
Haywards Reservoir	226,650		22,000					2,137,000		**2,385,650**
Karori Contact Tank	2,890							333,000		**335,890**
Assets in customer service reservoirs	609,740		54,760							**664,500**
Total Reservoirs	**1,345,730**	**0**	**241,760**	**0**	**1,265,300**	**7,028,000**	**0**	**63,828,000**	**0**	**73,708,790**
Totals	**20,392,082**	**16,842,480**	**21,920,170**	**583,000**	**29,125,880**	**126,388,680**	**0**	**67,933,800**	**2,148,370**	**285,334,462**

Source: Knight Frank Ltd valuation of 30 June 2004

Table 12: Book values

6.5 Funding Strategy

Under the WRWB Act, GWW is allowed to recover all its costs for water treatment and distribution, including depreciation, debt servicing and capital repayments from the customer authorities. However, it is precluded from recovering a return on the assets employed. Any surplus funds are kept separate from general GWRC funds and can only be used for wholesale water supply purposes, such as debt repayment or capital works.

All expenditure incurred in carrying out the operations, maintenance, renewals and capital activities within The Water Group is funded from the wholesale water levy, transfers to and from reserve investments and new debt.

The type of expenditure dictates the method that will be used to fund it.

- All expenditure incurred to operate and maintain the wholesale supply network is funded from the wholesale water levy. These costs are a component of each customer Councils' water rates and charges.
- Capital expenditure incurred on new assets to enhance and improve the system is usually funded by new debt.

Any surplus of income over expenditure on operational activities at financial year end is transferred to debt repayment or reserves.

A transfer to the insurance reserve of $750,000, from which the cost of repairing any damage to self-insured assets is funded, is made each year.

The smoothing of variations in cash flows is assisted as a result of the above strategy. Capital expenditure is uneven because of the nature of the assets and the long life of many of them. Because of this, the actual new debt drawn will vary.

7.0 Improvement Plan

7.1 Improvement Planning

The key elements of lifecycle AM are:

- Business processes used in the implementation of AM activities, including strategic planning, data collection, and asset operations/maintenance and capital work practices.
- Information systems to support (and often replicate) AM processes and store/manipulate data.
- Asset data and knowledge, its appropriateness, reliability and accessibility.
- Implementation strategies including contractual, organisational, and people issues.

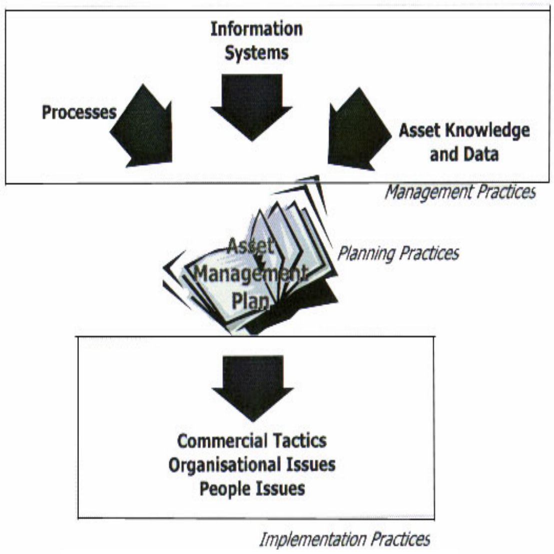


Figure 15: Inputs to AM Plan

7.2 Review of 1998 Improvement Plan

GWW undertook a comprehensive review of its asset management planning practices in 1998 and adopted a long-term plan of improvements to continually enhance the quality of planning and asset management.

All of the improvements identified in the 1998 plan are underway, completed, or identified as impractical. At present, the major outstanding item is the negotiation of a Wholesale Water Supply Agreement. However, a draft contract has been written and negotiations are ongoing. Details of the 1998 Improvement Plan and the exact status of each task are shown in Table 13.

Table 13: Asset Management Improvement Programme

Item	Item description	Dates	Current Status (December 2003).
Consultation with Customers	Negotiation of Wholesale Water Supply Agreements	By 30 June 2004	Negotiations on a supply contract have recommenced, based on a draft contract prepared by the customers
Environmental Management System	Council will develop an EMS	To be completed by 31 Dec 1999	EMS re-certified September 2003.
Demand Forecast	Refinements to the SYM including taking account of local effects are envisaged. TAs are to be asked to provide 5 year growth projections for individual supply points.	On going	Sub regional model not practical. Hydraulic model and SYM model complete.
Land Management	Compilation of a computerised database of land information. Assets on private land to be covered by easements.	October 1999	Fox PMS system in place and available to ECG staff.
Asset Management System	Implementation of a computer based asset management system.	Implemented by 30 September 1998	The Hansen database is installed and in use. All assets are now loaded. Additional data will be collected progressively.
Asset Information	See detail below	Completion by 30 June 2000	See detail below
Roads Bridges and Structures Information	Compile list of assets. Reconcile with fixed asset register. Prep maintenance programme.	Completion by 30 June 2000	Basic information about these assets has been captured. Reseals have been captured as a separate asset to facilitate programming future re-seals
Plant and Machinery Information	Review existing information	Completion by 30 June 2000	Production assets have now been loaded into HAMS. Additional data from W/O etc is being added progressively. New assets are being loaded progressively.
Pipeline Information	Existing data to be reviewed and entered into data base. Detail to be expanded.	Completion by 30 June 2000	Pipeline assets have been loaded and checked. Detail about new and refurbished assets being systematically added.
Linking Assets to drawing information	Appropriate, preferably as built record drawings to be listed against each asset.	Completion by 30 June 2000	Complete. GIS project underway.
Planned Maintenance Requirements	Preparation of detailed maintenance programmes	Completion by 30 June 2000	All maintenance schedules in Hansen. Reports on costs and completion being generated.
Pipeline Planned and Unplanned Maintenance History	Capture of existing maintenance information, leak history etc.		Historic leak info entered. Distribution staff trained in Hansen. Best use will only come with completion of GIS project.
Asset Condition	Develop asset condition assessment techniques and implement condition assessment	Completion by 30 June 2000. Actual	Detailed asset condition assessment of Pinehaven branch completed. Stokes Valley Branch and OK at Wainui CA completed. OK main to

Item	Item description	Dates	Current Status (December 2003).
	programme.	condition assessment on going.	be replaced and work has started on this. Stokes valley main OK.
Coordination of tasks	Reach agreement on methodology, resources and programme for the tasks listed under 8.7.	Completion by 31 August 1998	Close coordination has been achieved between S&A, Production and Distribution staff.
Asset Valuation	Comprehensive revaluation of all assets	After compilation of asset information	Component based valuation completed. Monthly component based depreciation being run in Hansen and reported to Finance as a one line report.
Changing Customer Needs	Improved customer liaison and development of formal processes to signal development needs are envisaged.	On going	A clause has been inserted into the Wholesale Water Supply Agreement with TAs requiring them to give notice of any proposed new connections. New connection installed at Plateau Rd.
Security of Supply	A coordinated risk analysis to evaluate total risk cost is envisaged.	On going	A wide range of seismic improvements have been investigated and some have been implemented. Work is on-going.
Efficiency of Delivery	Review of all components of the business is to be undertaken to improve efficiency. Economic analysis for each Capex project to establish operational savings greater than capital cost is promised.	On going	An optimising control system has been installed on the Wainui/Waterloo system. It forecast demand, schedules pumps to achieve the most economic outcome. Significant savings have been achieved.
Capital Expenditure Procedure Manual	Procedure manual to identify key stages and accountabilities for implementing capital works is to be prepared.	Completion by 1 December 1998	Comprehensive purchasing and project management procedures have been produced as part of the ISO9001 upgrade.
Capital Expenditure Programme	Extend to 20 yr. time frame.	Completion by 1 December 2000	Capital works programme is updated each year. However time frame is still ten years. Simple extrapolation is used to model long term financial outlook.
Asset Capacity and Performance	Review of the capacity and performance of each significant asset is envisaged.	On going	Network and SYM model provide tools to undertake detailed analysis of system capacity.
Identification of Critical Assets	This work relates to the identification of the need for and presence of appropriate standby capacity.	Treatment plant equipment and pump stations assessed by 31 December 1998	On-going process. Duplication of critical assets is being achieved. Most recent additions include PLCs and control computers. Spares for older electronic equipment are being sought and stored as they become hard to get.
Review of Pipeline Spares	A review based on previous seismic vulnerability reviews to determine quantities, cost and storage locations is envisaged.	Completion by 30 June 2000	Spare pipes and couplings were purchased in 1995. A review of the current seismic stock has been initiated. Further purchase is expected. WSMG Mutual Aid proposal has been received and will be considered.

Item	Item description	Dates	Current Status (December 2003).
Deferred Maintenance	Some deferred maintenance is expected to be revealed by a comprehensive review of assets and their performance.	Completion 30 June 2000	Some deferred maintenance of above ground pipelines has been identified. This is currently being attended to.
Disposal Plan	Plan for the disposal of surplus assets	Completion by 30 June 2000	Surplus buildings at Kaitoke have been demolished. Other major surplus assets include the lower Wainui Dam and Haywards No.1 reservoir. A study of re-development of the Lower Wainui dam has commenced.

7.3 Future Asset Management Improvements

The following are areas in which GWW will focus its asset management efforts over the next five years.

- Finalise Whole Water Supply Agreement and Levels of Service
- Completion of Public Health Risk Management Plan (expected to be made mandatory by pending legislation)
- Complete capture of spacial information about distribution assets in the GWRC's GIS system
- Ensure that all GWW assets located on private property are fully protected by easements
- Establish the benefits of an Optimiser/Scheduler on the Kaitoke System and implement it if justified
- Complete condition assessment on all assets that have reached 90% of their useful life
- Further develop system models to facilitate various strategic studies
- Identify preferred location for next source
- Complete seismic mitigation projects
- Complete a detailed assessment of the transmission capability of the network and plan how any shortcomings may be overcome.
- Review of SYM model in 2006
- Improvements to Hydraulic Model, especially controls
- Development of a short-term predictive model to aid in the imposition of water use restrictions.

Appendix A – Asset Management Systems & Standards

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A.1 Accounting System

Wellington Regional Council uses a financial system called SAP. Within the system is a group of modules which record, report and process the financial transactions of all divisions within the Council. The SAP modules include:

- Debtors
- Creditors
- Job Costing
- Report writing
- Purchase Orders

A.2 Asset Management System

GWW employs the Hansen Asset Information System, an electronic computerised database that:

- Holds attribute details of all assets (approximately 10,000) down to sub-component level.
- Holds financial information for all assets at a component level (approximately 5,000).
- Generates work orders for planned works and inspections.
- Records maintenance costs and other details for completed works orders against the subject asset.
- Interfaces with the GIS system.

The Hansen AIS is the system of choice for local authorities as identified by the PAMS working group of INGENIUM in the mid 90s.

Each asset is uniquely numbered using an "intelligent" numbering system. That is, the number provides a coded reference to the location of the asset, the type of asset, the facility it is associated with and the plant schematic it is shown on.

A.3 Land Information

There are two types of land assets managed by the Council for Wholesale Water Supply:

- Land owned by the Council with certificates of title.
- Land owned by others but containing easements in favour of the Council.

Land assets are manually recorded. Copies of certificates of title are retained by the Council's land management consultants and all information is stored on the Fox LIS.

A recent detailed study has shown that there are 11 private properties on which water mains are located but not protected by easements.

Appendix B - Water Supply System Models

Appendix B – Water Supply System Models

a) Sustainable Yield Model

The Sustainable Yield Model (SYM) is a daily supply model that takes into account climatic conditions, demand, population, river flows, aquifer storage, reservoir storage, and system constraints. In 1997 NIWA completed the model that is based on WATHNET software and network linear programming. In 2001/02 the model was updated in the light of new data, structural changes to the network and revised environmental consent conditions. Approximately 40,000 days (1890 to 2001) of river flow and demand data, constructed from available hydrological and meteorological data, complement the model. Environmental constraints include complex surface water and aquifer abstraction rules, and minimum aquifer level rules to reduce the risk of aquifer saline intrusion. Penalties and artificial costs are used to determine priorities of supply. Included in the model is an aquifer sub-model that is used to mimic the response of the Hutt aquifer to pumping.

The model can be used in a Monte Carlo simulation to generate 2000 two-year replicates to assess system reliability. A system annual probability of failure, daily demand shortfall, and shortfall quantity estimates can be derived for given population projections. Scenario modelling is used to assess the impacts of system constraint changes in relative rather than their absolute terms. A comparison of failure probability against the GWW 1 in 50 year standard for the system can be made.

Demand Model Upgrade

A demand model has been developed and used to generate daily per capita demand from 1890 to 2001. Since completion of the original SYM work, significant improvements to the available demand data set have been made. The 1997 model was a function of household size, percentage of detached dwellings, daily rainfall, soil moisture storage and maximum daily temperature. For the 1997 model the long-term average of the generated data was 500 L/capita/day with a correlation of 0.54 between daily values.

More accurate daily demand data available from February 1997 was used to prepare a new 2002 demand model. The 2002 model produced a mean of 450 L/capita/day, and an improved correlation of 0.73. The improved correlation was caused by reduced error in the demand data enabling better connections between demand and causative factors, such as temperature, to be identified. The 2002 demand model uses maximum daily temperature, soil moisture storage, and sunshine hours classified as summer (November to March) and winter (April to October). A stochastic component was added to further improve the realism of the generated demand record. For hydraulic modelling of system capacity a peak day demand of 650 L/hd/day has been adopted.

While the model statistically accounts for demand variations over the modelled period, there can be significant variation on a day to day basis. The correlation of the timing of peak demand against low river flows becomes important when there is limited plant inlet storage available.

Apart from the Wainuiomata water treatment plant, all our plants effectively have storage available on the plant inlet side. Although demand is modelled on a regional basis as though there were a single demand centre, the SYM uses seven distributed demand zones. Population is used as the sole basis for assigning demand to each of the seven demand zones. Since the demand zones actually have different mixes of population and industry, disaggregation of the regional demand on a population basis is less than ideal and is seen as a limitation to further disaggregation of demand zones.

System Constraints

New surface water abstraction consents were put in place during 2001. Aquifer abstraction has also shifted from the Gear Island water treatment plant at the Petone foreshore to the Waterloo water treatment plant approximately 3km inland to reduce the risk of saline intrusion. Surface water abstraction requirements are complex with minimum, maximum and flow sharing conditions for six surface water intakes. There are also high turbidity cut-off thresholds for each of the catchments set by the practicality and cost of treating the water. For the Orongorongo and Wainuiomata catchments there are minimum and maximum combined catchment abstraction conditions to be modelled.

Accuracy

Model accuracy was assessed with a focus on the model's long-term performance. To focus on individual extreme days can be an unreliable guide to overall performance because of the ability of within day operational requirements to completely negate the value of a single day's result from the SYM. The SYM was estimated as having an absolute accuracy of ±10% for 95% of the simulated values it calculates. When this value is compared with the 10% error arising from the demand data it suggests that the demand data is still the major source of model error.

In the Figure on the next page the boxes labelled "D" represent the demand centres of Upper Hutt (62), Porirua and Johnsonville area (61), Lower Hutt (32), Upper (36) and Lower (48) Wellington, Petone (49), and Wainuiomata (40). Broken lines represent stream channels and flow through the Hutt aquifer, and link stream nodes that are confluences or locations where abstractions or discharges may occur. Lines represent pipelines and link nodes that may be pipe junctions, water treatment plants or pumping stations. Boxes labelled "R" represent actual storage at Stuart Macaskill Lakes (5) and Ngauranga (34), or conceptual storage in the aquifer (29, 7, 23, 24, 25, and 30).

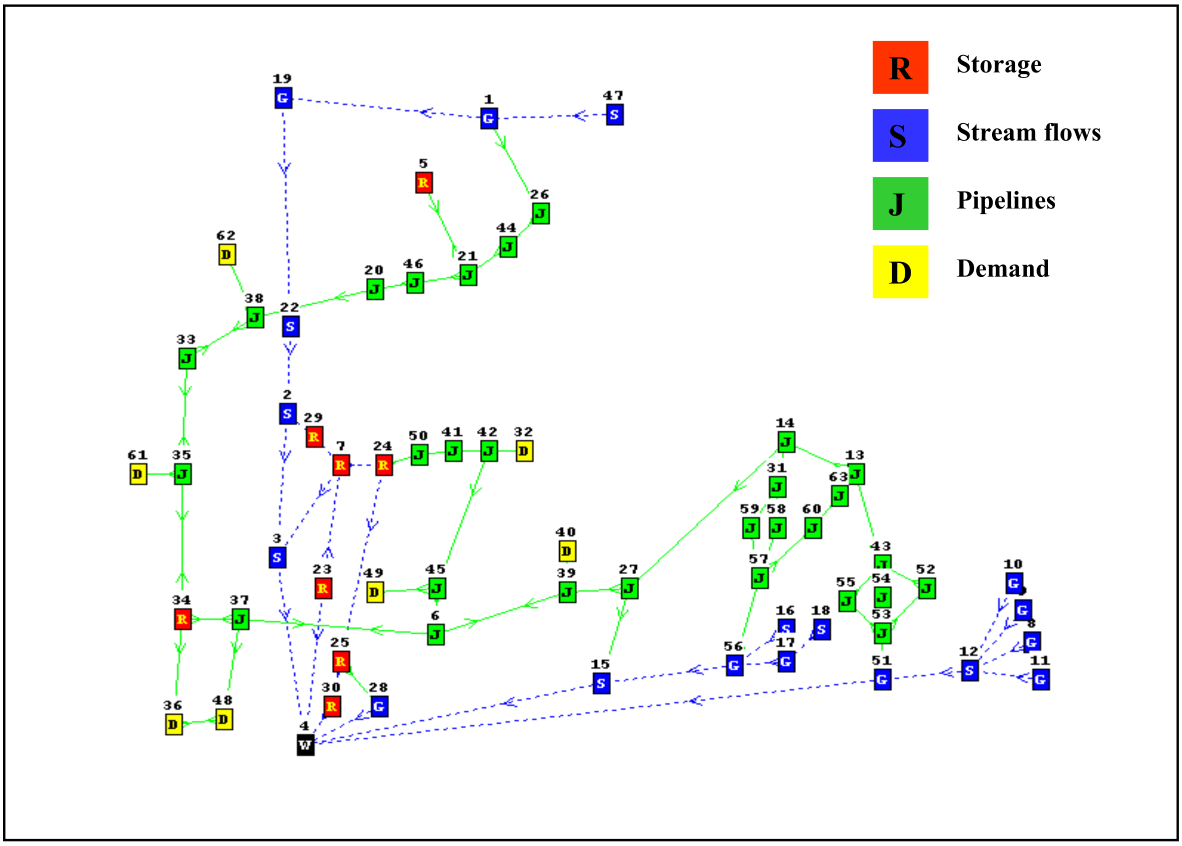

Figure 16: Sustainable Yield Model (SYM) Network

Future updates

In accordance with standard modelling protocol, the sustainable yield model should be subjected to periodic review, improvement, and calibration verification as new data and information becomes available.

Future update would include:

- 5 yearly demand and hydrological data update in July 2006,
- Review of stream flow data using more recent modeling techniques in July 2006,
- Verification of aquifer sub-model in July 2006, and
- Ongoing structural improvements to the network model.

b) Hydraulic Model

A hydraulic model of the supply system is used to aid decision making on hydraulic aspects of the system. This model was developed in 2000/01 and calibrated in 2001/02. Model development was undertaken in a staged manned including data gathering, development of a skeletal model, demand analysis, gross anomaly resolution and calibration. EPANET, developed by the US Environmental Protection Agency (USEPA), is the adopted software packaged for the model.

The model includes many rule based and simple controls for handling scheduling and control of reservoirs and pumping stations. As an approximation of reality the model includes a number of modelling techniques such as the use of pressure sustaining and flow control valves in place of variable speed controlled pumps. A review was made of how to model demand from over 50 reservoirs. Taking into account the buffering effect of storage between customer demand and the wholesale delivery systems, seven regional demand curves were adopted to allow for regional variations in demand.

While the skeletal layout of the wholesale water supply is relatively easy to hydraulically model, modelling of the system controls and diurnal system demand is more complex. The development and calibration of the hydraulic model has proven very useful and has been used extensively for modelling the system over extended periods (24 hours to 5 days) to assess segment capacities for the SYM model. Weaknesses of the existing model to be addressed in future include modelling diurnal variations on the Kaitoke main, inability to model Thorndon pressure control, very limited pump control features and limited scheduling ability.

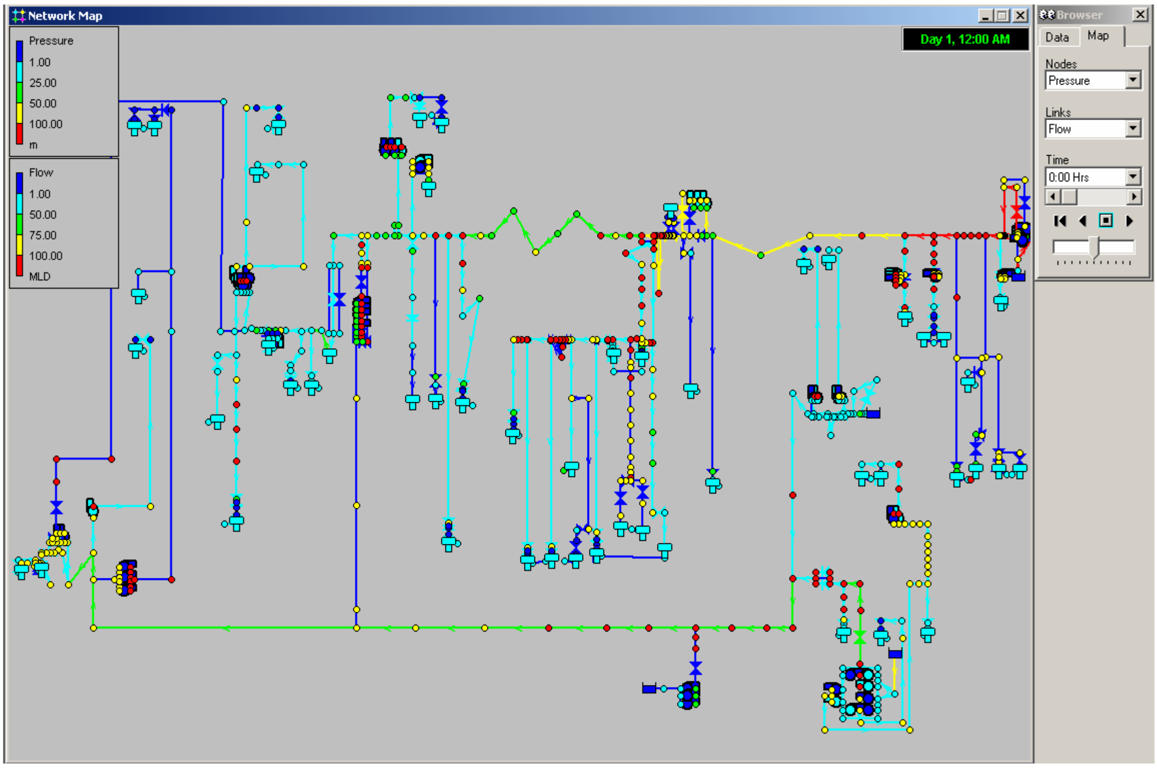

Figure 17: Pressure Network Map from Hydraulic Model

Future hydraulic model enhancements may include:

- improved pump control and scheduling features for assessment of system capacity and optimisation,
- energy analysis, and
- water quality analysis.

Appendix C - Seismic Projects

Appendix C - Seismic Projects

a) Seismic projects completed or projects with improved seismic performance:

- Purchase of spare pipes and fittings. To allow repairs to start immediately following an event requires spare materials (pipes, couplings and fittings) to be available. Materials valued at $430,000 are currently stored at various locations.
- Orongorongo Tunnels Nos. 1 and 2
  - Pipeline replaced and holding down straps fitted.
- Big Huia Pipeline
  - Additional seismic restraints
- Orongorongo Truss Bridge
  - Replaced
- Wainuiomata Water Treatment Plant Access Road Bridge
  - Waterway improved under the bridge and piers strengthened.
- Korokoro Stream crossing by OK main – the above ground crossing was replaced with a pipe below the streambed as part of the Petone foreshore refurbishment project.
- Wainuiomata Main
  - Rocky Point tunnel. Holding down straps fitted to the pipeline
- Gear Island Water Treatment Plant
  - Electrical control panel secured
  - New fixings between roof rafters and the walls
  - Control reservoir structural strengthening
- Hutt Estuary Road Bridge
  - Bridge strengthened by Hutt City Council. Movement joints fitted to pipeline
- Kaitoke Main
  - Flume bridge adjacent to Tunnel No. 1 strengthened
- Stuart Macaskill Lakes
  - Automatic activation of shut off valves.
- Haywards No. 2 Reservoir
  - Seismic shut off valves fitted
- Plimmerton/Pukerua Bay Branch Line
  - Emergency high flow cut-off valve installed.
- Kaitoke Main Tunnel Nos. 3, 4 and 5
  - Access to tunnels improved and holding down straps fitted to pipelines
  - Installation of flexible joints to facilitate differential movement between pipelines and structures.
  - Installation of a standby generator at the Te Marua pumping station - $750,000.
    Note: other standby generators or direct drive diesel equipment are available at Te Marua Water Treatment Plant (WTP), Wainuiomata WTP, Waterloo WTP, and Waterloo Wellfield

b) Seismic crossings under evaluation or recently upgraded

- Relocation of the Kaitoke main between SH2 and SH58. (Separate report to March 2003 Utility Services Committee meeting). $1.8M allocated in Capex programme for 2004/06.
- Hutt River crossing at Silverstream. Upper Hutt City Council have programmed bridge strengthening in 2004/06. $0.10M allocated in 2004/05 capital works programme for the stockpiling of spare materials. $0.46M allocated in capital works programme 04/06 for contribution to strengthening of the Silverstream Bridge and raising of the water main on the bridge (separate report to October 2002 Utility Services Committee meeting).
- Randwick pumping station and valve chamber. Point Howard reservoir pumps are to be relocated to a new above ground pumping station. Currently being designed.
- Crossings and pipelines in the Te Marua WTP area. Currently under investigation.
- Paremata Bridge
    - Pipeline has been shifted to the new road bridge recently being constructed to be commissioned May 2004.
- Mangaroa Stream crossing and Black Creek crossing. Currently under investigation.
- Johnsonville pumping station has been seismically strengthened.
- Karori Pumping station
    - Major refurbishment has been deferred. Instead the pumping station will be relocated to a more secure location and suitable sites are being evaluated. $1.712M included in the 2004/06 capital works programme, but the forecast expenditure has increased to $2.2M.
- A replacement for Haywards Reservoir
    - The reservoir is positioned on land that is likely to be unstable during a major seismic event. An alternative site is being considered.
- Alternative water source for the Te Marua water treatment plant (Hutt River Pumping Station)
    - Damage is expected to Tunnels 1 and 2 (both only partly lined) during a fault movement earthquake.
    - The Kaitoke intake structure could be buried.
    - Even though the flume bridge has been strengthened, a cascade of water from a dam burst caused by a slip in the catchment could destabilise the flume bridge
- Stuart Macaskill Lakes – intake towers
    - Concrete spalling at the base of the towers may be sufficient to allow the lakes to leak through the towers. Strengthening work is being investigated.
- Stream crossings between the Orongorongo No.2 tunnel and the Wainuiomata Water Treatment Plant
    - To be replaced when the pipeline is replaced in 2003/4.
- Big Huia Stream Pipeline Bridge
    - Currently being assessed.
- Hospital reservoir – new terminal reservoir (35ML) shared with WCC and Hospital for emergency storage is being considered.
- Stream and River Crossings
    - Several have been examined and some are vulnerable
    - Improvements expensive and may not significantly reduce risk
    - Best strategy is to store replacement pip nearby
    - Silverstream studied in detail but diversion uneconomic. Upper Hutt City Council plan to strengthen bridge in 04/06. Capital Works Programme contains $460,000 to contribute to this and to replace pipe.