The state of our environment

Annual summary 2009/10

Quality for Life

greater WELLINGTON REGIONAL COUNCIL | Environment

The report cards in this folder summarise the state of the region's environmental resources during 2009/10. The cards cover:

The cards cover:

- Air quality
- Groundwater
- Harbours, estuaries and coast
- Rainfall and river flows
- River and stream health
- Recreational water quality
- Soil health and contaminated land

There is also an extra card summarising a targeted water quality investigation of the Mangatarere Stream catchment in Carterton.

Air quality 2009/10

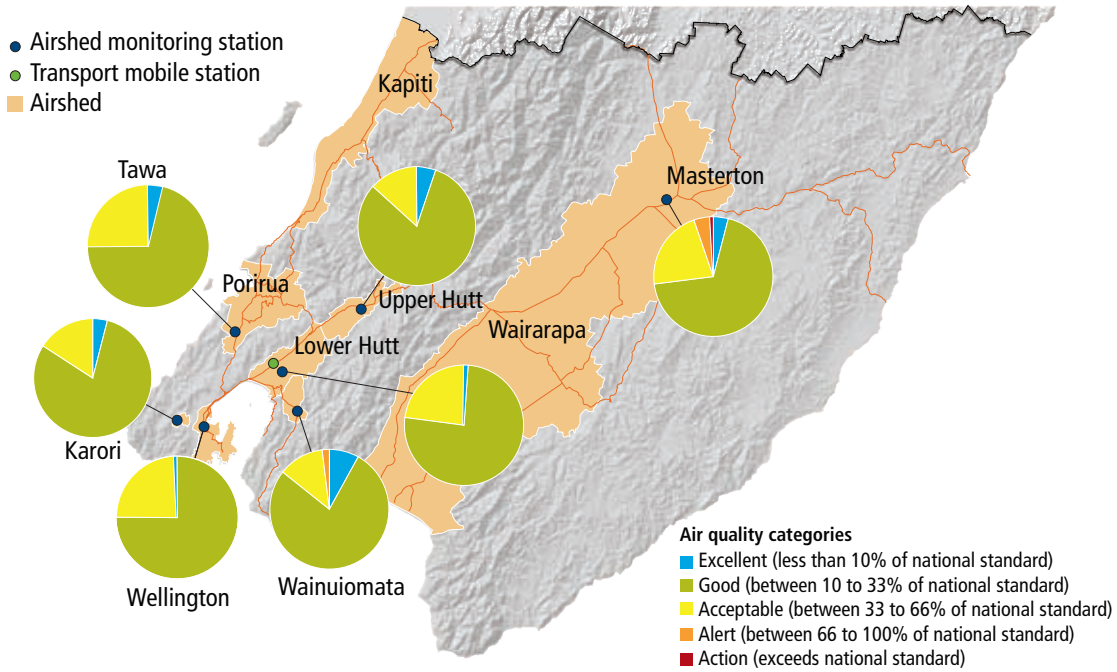
Key points:

- Air pollution levels are typically low in the region with only occasional episodes of poor air quality in some valley areas during winter.
- Particulate matter (PM_{10}) is the only pollutant measured that failed to meet the national environmental standard for air quality.
- During winter 2010, high pollution levels were recorded on four nights in Masterton, one night in Carterton and on one night in Wainuiomata. In winter 2009, there was only one high pollution night, recorded in Masterton.
- Air pollution levels measured beside busy roadsides in central Wellington and Lower Hutt meet national environmental standards and guidelines.

What happened in 2009/10?

Regional air quality

Greater Wellington monitored air quality at selected sites in the region. Three key pollutants were measured – particulate matter (PM_{10}), carbon monoxide and nitrogen dioxide – and the results compared against the national environmental standards and guidelines set to protect public health.



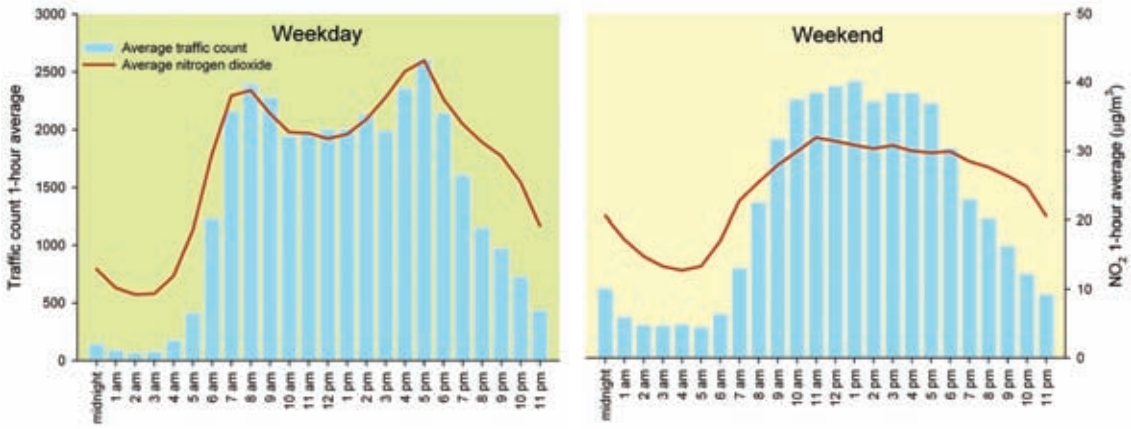
The pie graphs show the percentage of time during 2009 that PM_{10} levels fell into the five different air quality categories. The "excellent" category has the lowest level of risk to human health and the "action" category the highest risk. An "action" result also means that the upper limit for PM_{10} in air set by the national environmental standard has been exceeded. The national standard for PM_{10} is breached when there are two or more exceedences within an airshed in a year.

Levels of PM_{10} in air throughout the year are mostly "good". Masterton and Wainuiomata are susceptible to pollution from domestic fires. On still, cold and clear nights, smoke containing particulate matter (PM_{10}) accumulates and is not dispersed until the following morning when the ground heats up and the air starts to circulate. In 2009 air quality reached the "alert" level on 15 days in Masterton and four days in Wainuiomata. The national environmental standard was exceeded only on one day and this occurred in Masterton.

Carbon monoxide concentrations were mostly "excellent" and reflect the national trend for lower emissions from petrol vehicles due to improvements in vehicle technology. Nitrogen dioxide levels were generally "excellent", except for the central Wellington site where levels were mostly "good".

Roadside air quality

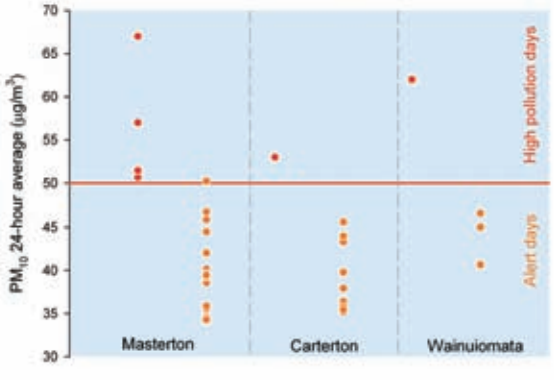
Air quality measured at our central Wellington monitoring station showed that levels of PM_{10}, nitrogen dioxide and carbon monoxide in 2009 were all well within the limits set by the national environmental standards. Traffic count data supplied by Wellington City Council were matched to average hourly concentrations of nitrogen dioxide. During week days the level of nitrogen dioxide (NO_2) reflects the morning and evening rush hour as vehicles travel southeast along Vivian Street and southwest along Victoria Street. During the weekend levels of nitrogen dioxide show a flatter, more sustained peak as traffic volumes are spread over most of the day.



The graphs show the average hourly traffic volumes during one week in August 2009 passing the central Wellington air quality station on the corner of Victoria and Vivian streets. Average concentrations of nitrogen dioxide (NO_2) are also shown.

Winter air quality in 2010

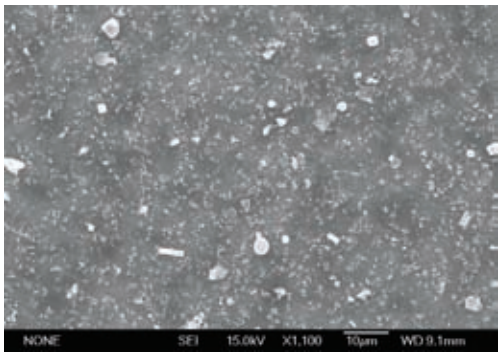
In winter 2010 we expanded our Wairarapa PM_{10} monitoring programme to include Carterton. Air quality reached the "alert" level on 19 days in Masterton, nine days in Carterton and three days in Wainuiomata. The national environmental standard was exceeded on four days in Masterton, and on one day in both Carterton and Wainuiomata.



This dot graph shows the number of high pollution days (red dots) and "alert" days (orange dots) recorded over May to August 2010 in Masterton, Carterton and Wainuiomata.

Air quality investigation in Carterton

In winter 2009 we collected samples of particulates in air over a two-week period for source 'finger-printing' by GNS Science. Most of the PM_{10} measured in air was made up of the smaller-sized particles measuring less than 2.5 microns ($PM_{2.5}$). These smaller particles present the greatest risk to health because they can penetrate deep into the lungs. The majority of the $PM_{2.5}$ was composed of organic compounds and black carbon (soot) typically associated with emissions from woodburners. Natural sources such as sea salt and soil made only a minor contribution to PM_{10} levels in air.



Scanning electron microscopy image of a filter used to collect particulate matter. The larger particles are sea salt. The extremely small particles (white specks) that can just be seen at this magnification are combustion particles that are 50 times smaller than the width of a human hair.

Source:
P Davy, PhD Thesis
(Greater Wellington)

What is Greater Wellington doing?

- Monitoring air quality at selected sites around the region, including Wellington, Lower Hutt, Upper Hutt, Wainuiomata, Karori, Tawa and Masterton.
- Carrying out a short-term study on winter air quality in Raumati South, Kapiti Coast.
- Offering financial assistance for home insulation and clean heating in connection with the EECA Energywise programme through the 'Warm Greater Wellington' targeted rate scheme (http://www.gw.govt.nz/warmer-gw).

What can you do?

- Insulate your house effectively and burn only dry untreated wood in your fireplace. After starting the fire, leave the air vent open for at least half an hour to create a hotter, cleaner burning fire.
- Don't burn rubbish or treated timber in your fireplace or outside. Send paper and plastic for recycling and compost green waste.
- Keep your vehicle tuned and serviced to reduce smoke and fumes.

More information

Some of the information on this card is a summary of the 2009 annual air quality monitoring report, which is available at **www.gw.govt.nz/envreports**

If you would like to know more about air quality, visit our website or contact us:

Phone: 04 384 5708 (Wellington office) or
06 378 2484 (Masterton office)

Email: environmentalscience@gw.govt.nz

Groundwater 2009/10

Key points:

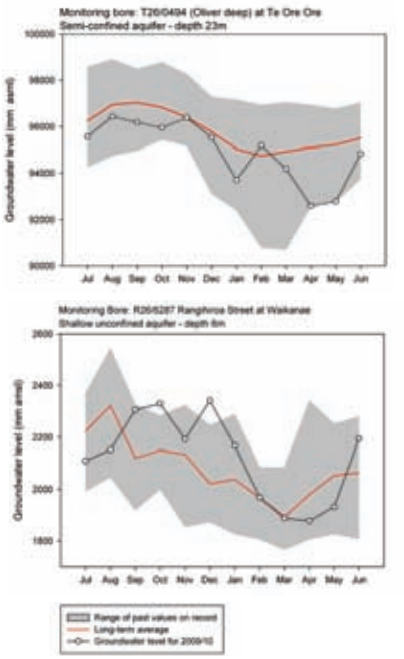
- A drier than average winter in 2009 resulted in average to below average groundwater levels in the region's aquifers. However, a wet January delayed the irrigation season in the Wairarapa until early autumn, allowing some recovery in groundwater levels during summer.
- Twenty nine of the 44 groundwater bores routinely monitored for *E. coli* bacteria and all but one of the 71 bores monitored for nitrate nitrogen during 2009/10 complied with national drinking water standards.
- Shallow groundwater in the Mangatarere catchment has elevated levels of nitrate as a result of pig and dairy farming activities.

What happened in 2009/10?

Groundwater levels

Groundwater levels during 2009/10 tended to follow historic trends and mirrored patterns in rainfall and river flows for the same period. Groundwater levels were generally higher during the months of June to late December, and lower from February onwards.

Groundwater levels were generally above average on the Kapiti Coast, average in the Hutt Valley and around average to below average in the Wairarapa. In the Wairarapa, January 2010 had exceptionally high rainfall and the groundwater levels during late January and early February were generally above average. The wet January meant that farmers were irrigating less, and so groundwater abstraction contributed to less seasonal decline in groundwater levels than normal. However, irrigation later in the season and lower rainfall in autumn saw groundwater levels drop slightly.



The drier than usual 2009 winter in the Wairarapa was reflected in below average groundwater levels seen in the Oliver Deep bore in Te Ore Ore, Masterton (left). Some recovery in groundwater level was seen in late January due to high rainfall and reduced irrigation. However, due to a dry autumn and increased irrigation, groundwater levels fell to historic minimums. Groundwater levels at Rangihiroa Street, Waikanae (right) were above average (and occasionally above historic maximums) during September to December. Groundwater levels declined during the months January to April due to low rainfall.

Wairarapa Valley groundwater investigation

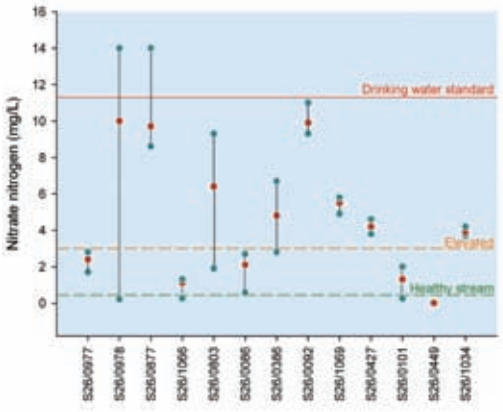
The 2009/10 year saw the completion of three computer models that simulate the groundwater and surface water environment in the lower, middle and upper parts of the Wairarapa Valley. The third and final phase of the groundwater investigation also began, which involves using the models to simulate groundwater levels and groundwater flow into streams under a range of climatic and water abstraction scenarios. The results of the groundwater investigation to date have highlighted the importance of taking into account linkages between groundwater and the surface water environment when reviewing the water allocation provisions in the Regional Freshwater Plan.

The Mangatarere Stream at Anderson's Line in late summer. The stream in this reach loses flow to groundwater during parts of the year and is often dry in summer. Downstream of this point the stream receives flow from groundwater, highlighting that streams and groundwater need to be managed together when assessing the effects of water takes.

Mangatarere catchment investigation

Between October 2008 and October 2009, 13 groundwater bores in the Mangatarere catchment, Carterton, were sampled on seven occasions as part of Greater Wellington's investigation into poor water quality in the catchment (see *Mangatarere Stream catchment water quality investigation* report card). Sampling groundwater was important because the flow of water between surface water and groundwater within the catchment is strongly interconnected.

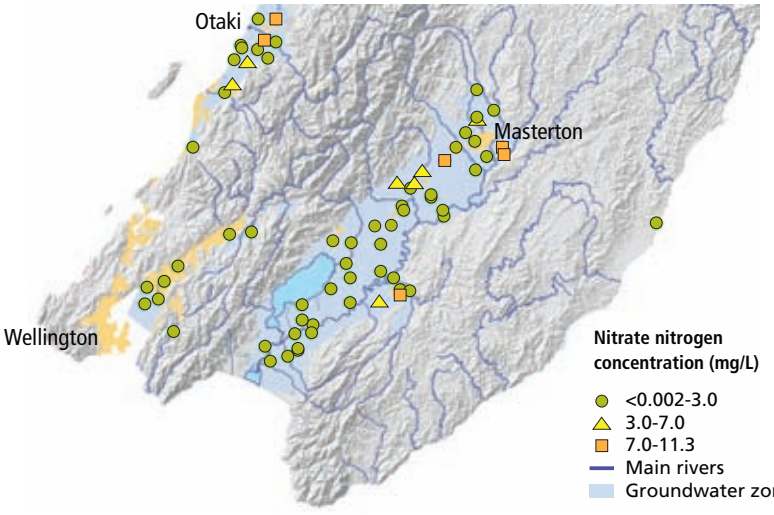
The groundwater monitoring results revealed elevated nitrate nitrogen levels (>3 mg/L) in many bores, particularly shallow bores located downgradient of intensive land uses that incorporate the application of piggery and dairy effluent discharges to land. The highest nitrate nitrogen levels were recorded in the winter months when groundwater levels were closer to ground level. This increases the likelihood of groundwater intercepting effluent that has been applied to land and leached through the soil. Nutrients are transported from the soil to the groundwater and subsequently to the rivers and streams.



Median (red circles) and range of nitrate nitrogen levels in groundwater samples collected from 13 bores in the Mangatarere catchment between October 2008 and October 2009. The median values for eight bores were above the 'elevated' threshold for groundwater and two bores recorded maximum values above the Ministry of Health drinking water standard. Almost all bores sampled recorded median nitrate levels above what is typically acceptable for healthy streams – a concern given groundwater feeds stream flow in the lower catchment.

Groundwater quality

Three-monthy testing of groundwater quality across the region during 2009/10 showed that *E. coli* bacteria counts met the Ministry of Health drinking water standard (<1 cfu/100 mL) in two thirds of the bores monitored. However, samples from 15 bores located in Kapiti and the Wairarapa Valley exceeded the standard on at least one sampling occasion. The highest *E. coli* count recorded was 800 cfu/100mL in a non-potable bore at Te Horo Beach. Median nitrate nitrogen concentrations were high (greater than 7 mg/L) in six bores and one individual sample result for a bore in the upper Wairarapa Valley exceeded the drinking water standard.



Median nitrate nitrogen concentrations recorded in groundwater monitoring bores sampled quarterly over 2009/10. No median values exceeded the Ministry of Health drinking water standard of 11.3 mg/L, although six bores recorded median concentrations of nitrate nitrogen in the highly elevated range (7–11.3 mg/L).

Collecting a water sample from one of the waterways entering Lake Wairarapa. This is one of 15 waterways and four groundwater bores that we sampled in December 2009 to get an idea of the water quality of streams, drains and shallow groundwater entering Lake Wairarapa. The results indicated that elevated levels of nutrients are entering the lake from drainage and stream networks located on its northern and eastern margins where intensive farming occurs.

What is Greater Wellington doing?

- Monitoring groundwater levels at 140 sites across the region.
- Monitoring groundwater quality at 71 sites across the region to check long-term changes in water quality.
- Investigating hydrological influences on ten significant wetlands in the Wellington region considered to be vulnerable to stress from groundwater abstraction.
- Reviewing existing groundwater allocation in the Wairarapa Valley, taking into account the interactions between surface water and groundwater.

What can you do?

- Apply for a resource consent before drilling a bore. You will need an additional consent if you plan to take more than 20,000 litres of water per day from your bore.
- If you have a consented groundwater take, read your meter regularly – this will aid any future consent renewal and assist with modelling and management of the groundwater resource.
- If you have your own bore for a domestic water supply, it's essential to have good well head protection, and to get the water tested regularly – we suggest annually. Greater Wellington staff can advise you on how to get the water tested.
- Manage animal effluent disposal systems and fertiliser use to ensure that application rates are appropriate for the soil type and soil moisture conditions.

More information

The information on this card is a summary of the 2009/10 annual groundwater monitoring report, which is available at

www.gw.govt.nz/envreports

If you would like to know more about groundwater, visit our website or contact us:

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Email: environmentalscience@gw.govt.nz

Harbours, estuaries and coast 2009/10

Key points:

- The ecological health of Porirua Harbour is gradually deteriorating, primarily due to sediment and nutrient inputs.
- Sedimentation is the main risk for Waikanae, Hutt and Whareama estuaries – the Whareama Estuary has very muddy and poorly oxygenated sediments that are not ideal for plants and animals.
- Initial monitoring suggests the ecological health of Lake Onoke is "moderate", despite elevated levels of phosphorus in the lakebed's sediments.
- Stormwater runoff from catchments where coal tar was used in road sealing may be the main source of harmful polycyclic aromatic hydrocarbons found at elevated levels in Wellington Harbour sediments.

What happened in 2009/10?

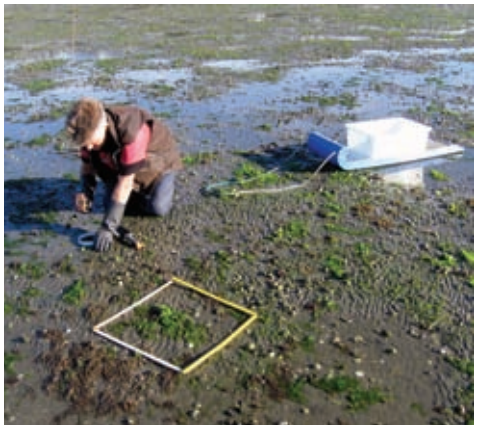
Estuary monitoring

Ecological monitoring was undertaken at one or more intertidal locations in Porirua Harbour and the Waikanae, Hutt and Whareama estuaries during January 2010. The monitoring targets key issues that threaten estuarine health such as sedimentation, eutrophication (excessive nutrient enrichment) and toxicity from heavy metals and other contaminants.

The monitoring included an assessment of sediment grain size and chemistry, mapping of intertidal algal cover, and identification of the types and numbers of sediment-dwelling fauna. In addition, sedimentation plates were buried in the estuaries. The depth of each sediment plate is measured each year, allowing us to determine the rate of sedimentation.

Prolific growths of macroalgae – mainly sea lettuce (*Ulva*) and *Enteromorpha* – at the southern end of the Onepoto Arm of Porirua Harbour in January 2010. Thick growths like this reduce oxygen reaching the underlying sediment and the rotting leaves can produce large quantities of hydrogen sulphide, a foul-smelling and noxious gas.

Four intertidal sites were sampled in Porirua Harbour: two in the Onepoto Arm and two in the Pauatahanui Arm. The results of some indicators differ between sites, with sedimentation rates and nuisance algal cover highest in the upper reaches of both arms. Overall, the dominant intertidal habitat in Porirua Harbour is considered to be in a "moderate condition". However, after three years of annual monitoring the sites show signs – such as increasing mud content and declining oxygen levels in the sediment – that suggest the harbour may be on the border-line of a shift towards excessive muddiness and nutrient enrichment. Ongoing management and monitoring of sediment and nutrients entering the harbour from residential and roading development, urban stormwater and agricultural runoff is required.



Photos courtesy of Wriggle Coastal Management

Collecting a sediment core from one of the monitoring sites in Porirua Harbour. At each site, sediment samples are collected for laboratory testing and the algae and animals living in and on the sediment are identified and counted.

The 2009/10 sampling in the Waikanae, Hutt and Whareama estuaries found low levels of nutrients and contaminants in the intertidal sediments. However, sedimentation appears to be an issue in all three estuaries. In the Whareama Estuary, based on two years of measurements, the average sedimentation rate is 6–7 mm/year. The estuary's sediments also have a high mud content, which translates to a poorly oxygenated habitat suited to few invertebrate species.

Lake Onoke monitoring

In August 2009 Greater Wellington started monitoring water quality in Lake Onoke on the South Wairarapa coast. An initial assessment in September 2007 found the lake was in a relatively poor condition and at risk from further degradation from a range of factors, including high inputs of nutrients, sediment and pathogens from land use intensification. With the Ruamahanga River discharging into the lake at its northeastern end, Lake Onoke is the receiving coastal water body for all nutrients, sediments and contaminants discharged to water in the Wairarapa Valley.

As well as the collection of monthly water samples, in January 2010 we collected samples of sediment and of animals living in and on the lake bottom from two locations. One sampling site was intertidal (exposed at low tide) and near the centre of the lake. The sediments at this site were predominantly sandy and looked to be well oxygenated – favourable conditions for most bottom-dwelling animals. In all, eight different species were found, with the crustacean *Paracorophium excavatum* the most abundant.

The second sampling site was subtidal and near the western margin of the lake. The sediments at this site were extremely muddy and anoxic (low oxygen), resulting in fewer species of bottom-dwelling animals being present at this site than at the intertidal site.

Chemical analyses revealed low levels of organic carbon and metals in the sediments at the intertidal site, but nitrogen and phosphorus levels were slightly and moderately elevated respectively, and DDT was detected at low levels in two samples. Slightly higher levels of nutrients and some metals were found in sediments at the subtidal site as compared with the intertidal site, but still well below national sediment quality guidelines.

Collecting sediment samples from the intertidal sampling site (left) and one of the sediment cores collected from a subtidal location in Lake Onoke (right). The sediments were black near the surface, indicating oxygen levels are low. Low oxygen conditions are not ideal for most sediment dwelling animals.

Staff using an echosounder (sonar) during a bathymetric survey in Lake Wairarapa in February. Lake Onoke was also surveyed. A bathymetric survey enables us to measure and map the amount of sediment that has built up over time on the lake bed.

Wellington Harbour – organic contaminants

In early 2009/10 we received the results of further laboratory testing of sediment samples collected from Wellington Harbour in late 2006. These tests sought to help identify the potential source(s) of polycyclic aromatic hydrocarbons (PAHs) – contaminants derived from the combustion of organic matter – found at elevated levels in the sediments of Lambton Basin and Evans Bay. The results, while not conclusive, suggest that the principal source may be stormwater runoff from catchments where coal tar was used in the past as a binder for sealing roads. Further testing is required to confirm this and may be considered in 2011 when a second round of sediment contaminant and ecological monitoring is undertaken in Wellington Harbour.

What is Greater Wellington doing?

- Regularly monitoring microbiological water quality at 74 coastal sites (see the *Recreational water quality* report card) and nutrient levels in Lake Onoke.
- Monitoring sediment quality and ecological health in sensitive estuarine and harbour environments.
- Working with Porirua City Council, Wellington City Council and a range of other organisations and community groups to develop an action plan by June 2011 to address various environmental issues in Porirua Harbour and its catchment.

What can you do?

- **Save the drain for rain:** Only water should go down stormwater drains because they lead directly to streams and coastal waters. Clean paint brushes in the laundry sink, wash your car in a car wash or use the lawn if you can, and take household chemicals and waste oil to collection points at the landfill.
- **Join a coastal care group and get planting** – see **www.gw.govt.nz/takecare**. Coastal plantings can help protect the shoreline from erosion and filter out sediment.

More information

The information on this card is a summary of the 2009/10 annual coastal monitoring report, which is available at
www.gw.govt.nz/envreports

If you would like to know more about the health of our coastal environments, visit our website or contact us:

Phone: 04 384 5708 (Wellington office) or
06 378 2484 (Masterton office)
E-mail: environmentalscience@gw.govt.nz

Rainfall and river flows 2009/10

Key points:

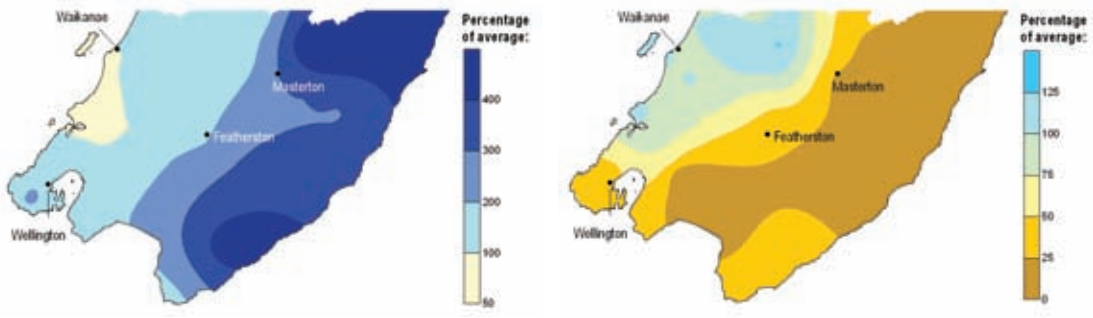
- Despite alternating periods of very wet and very dry weather, there were no significant floods or droughts in 2009/10.
- The Hutt and Wainuiomata valleys, south coast around Wellington City and eastern Wairarapa experienced the most extreme contrasts in rainfall. The eastern Wairarapa was particularly affected with record high mid-summer rainfall and record low rainfall in autumn.
- In 2009/10, the Tauherenikau and Otaki rivers were the focus of Greater Wellington's continued investigations into minimum flow requirements for sustaining river values.

What happened in 2009/10?

A year of contrasting wet and dry spells

Much like the previous year, 2009/10 was notable for alternating periods of very high and very low rainfall but an absence of significant floods or droughts. For example, parts of eastern Wairarapa received more than four times their average January rainfall but less than half their average for February and only one quarter their average for April. Over the whole year, rainfall was about average in the Wairarapa and a little lower than average in central and western areas including Wellington City, the Hutt Valley and the Kapiti Coast.

While the winter in 2009/10 was unusually dry, a wetter than average spring and summer in most places meant that base river flows were sustained and fewer summer restrictions on water takes were required compared with previous years. The unseasonably wet January in the Wairarapa kept soil moisture high for much longer into the summer than usual and led to an unusually 'green' landscape for the time of year. However, following the wet January, there were three consecutive months of lower than average rainfall across the region. The eastern Wairarapa was particularly dry and a medium-level drought was declared by the Minister of Agriculture in May. Shortly afterwards – much like the year before – the rains returned, eliminating the soil moisture deficit that had persisted through most of autumn.



Rainfall as a percentage of the long-term average for January (left) and April 2010 (right). Summer and autumn 2009/10 were seasons of extremes for the eastern Wairarapa, with record high rainfall in January and record low rainfall in April.

Minimum flows review

Greater Wellington uses minimum flow thresholds for rivers and streams to restrict consented water takes during dry spells to protect ecological, cultural and recreational values. To ensure minimum flows are set appropriately in the Regional Freshwater Plan we have been studying rivers throughout the region. During the year, we investigated the impact of changes in water level on fish habitat in the Tauherenikau and Otaki rivers. The results are still being assessed but indicate that the minimum flow for the Otaki River needs to be increased.

The Tauherenikau River; deep and swift at the Greater Wellington monitoring site in the Tararua Range foothills (top) and shallow and more placid near the river mouth (bottom). Like many other rivers in the Wairarapa and on the Kapiti Coast, the Tauherenikau River naturally loses flow through the river bed to groundwater once it emerges from the ranges and crosses the alluvial gravel plain. This loss can exacerbate low flows in the summer and must be accounted for when setting appropriate minimum flows.

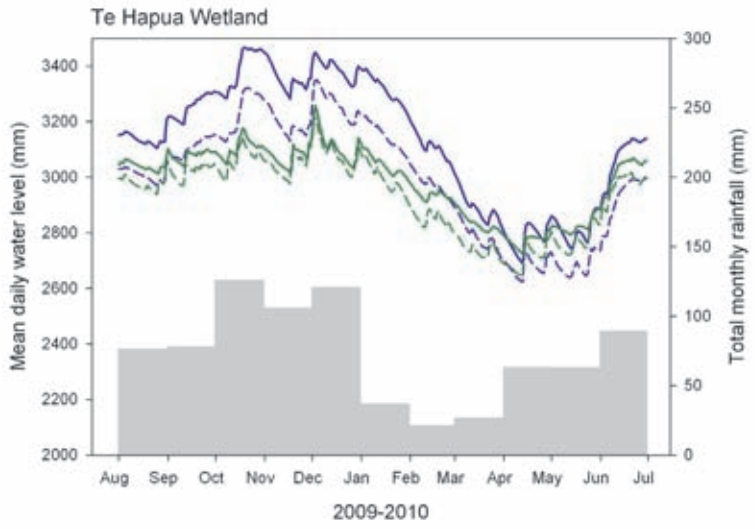
Learning about Lake Wairarapa's hydrology

Lake Wairarapa, part of the largest wetland complex in the southern North Island, covers an area of 80 square kilometres. The lake is shallow (only 2.5 metres at its deepest point) and is within a largely agricultural catchment, making it vulnerable to the impacts of intensive land use, including abstraction. To improve our understanding of the lake hydrology, we undertook a one-day survey of the inflows from tributary rivers and streams of the lake during a dry spell in April 2010. Sixteen significant tributaries were identified and these had a total combined flow of two cubic metres per second. Follow-up work to better quantify lake inflows and outflows under a range of conditions is planned.

A Greater Wellington staff member measuring the flow in one of the tributary streams on the northern shore of Lake Wairarapa in April 2010. Understanding the cumulative input of flow from tributaries during summer dry spells will help inform lake management policies, especially the setting of sustainable abstraction limits.

Te Hapua wetland – the first year of monitoring

The Te Hapua wetland, near Te Horo, is an important remnant of "the Great Swamp" that spanned over 2,000 hectares of the Kapiti Coast from Paekakariki to Foxton. In autumn 2009, Greater Wellington installed water level and rainfall monitoring equipment at four sites in the wetland. The aim is to help improve our understanding of natural variability in water levels as well as how activities on the land nearby may affect the wetlands.



This graph shows results from the first year of monitoring at two sites – approximately 800 metres apart – in the Te Hapua wetland complex. Solid lines show wetland water levels, dashed lines show shallow groundwater levels and the vertical grey bars show total monthly rainfall. There is a clear correlation between wetland and groundwater levels and a strong seasonal pattern in both that is driven by rainfall highs and lows during the year. Overall, initial results indicate that western parts of the wetland complex (such as the sites shown above), which are recharged mainly by rainfall, are likely to be less vulnerable to activities such as groundwater abstraction and land drainage than eastern parts of the complex where groundwater input is more important.

What is Greater Wellington doing?

- Monitoring rainfall, river flows and lake levels at more than 90 automatic recording stations across the region.
- Operating a flood warning system that involves monitoring river levels, forecasting flood peaks, and issuing warnings to people who may be affected.
- Assessing compliance with resource consents to take water from rivers and streams, and issuing water take restrictions during times of low flows.
- Continuing to investigate minimum flow requirements needed to sustain river values, and using this information to contribute to the current review of our Regional Freshwater Plan.

What can you do?

Conserve water by watering your garden deeply once or twice a week during dry spells, rather than watering lightly every day. This encourages deeper-growing roots, making the plants more resistant to drought. Other tips on saving water in your garden can be found on our website.

More information

Some of the information in this card is a summary of the 2009/10 annual hydrology monitoring report, which is available at **www.gw.govt.nz/envreports**

River flow, lake level, soil moisture, and rainfall data, along with other environmental monitoring data, can be viewed on our website: **www.gw.govt.nz/monitoring** The information is updated frequently throughout the day.

If you would like to know more about rainfall or river flows, visit our website or contact us:

Phone: 04 384 5708 (Wellington office) or 06 378 2484 (Masterton office)

Email: environmentalscience@gw.govt.nz

River and stream health 2009/10

Key points:

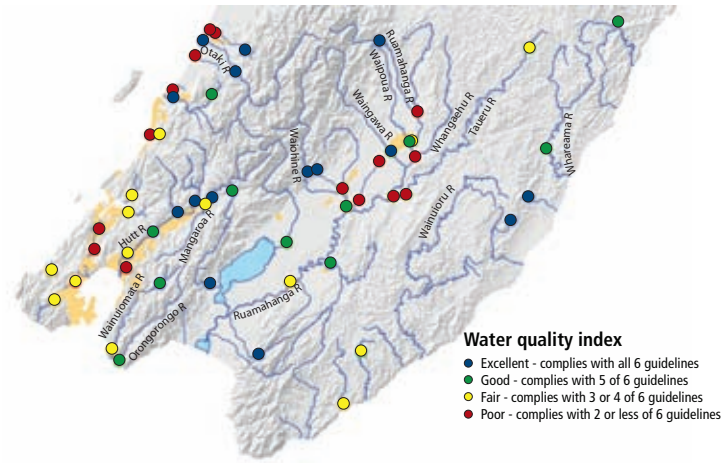
- The best water quality was found in rivers and streams in the Aorangi, Tararua and Rimutaka ranges where catchments still retain a large amount of indigenous forest.
- The poorest water quality was recorded in urban streams and in the lower reaches of small rivers and streams draining intensive agricultural catchments.
- Intermittently flowing small streams can have invertebrate communities that are distinct from permanently flowing streams and so add to the overall aquatic biodiversity of the Wellington region.
- Flood protection activities such as channel realignment have had a localised impact on aquatic habitat diversity in a reach of the Waingawa River near Masterton.

What happened in 2009/10?

Water quality monitoring

As with previous years, monthly monitoring during 2009/10 showed that the best water quality is found in rivers and streams located in catchment areas where the land cover is predominantly indigenous forest and human influences are minimal. Of the 55 river and stream sites monitored, 15 had excellent water quality and complied with all six guidelines we use to measure overall stream health. A further 11 sites failed just one guideline and were classed as having good water quality. Sites with excellent or good water quality are typically on rivers and streams flowing out of the Aorangi, Tararua and Rimutaka ranges.

Over half of the river and stream sites monitored exceeded two or more guidelines and were classed as having fair or poor water quality. The most common guideline to be exceeded was water clarity (32 sites), followed by *E. coli* bacteria (27 sites), dissolved reactive phosphorus (26 sites) and nitrite-nitrate nitrogen (15 sites). Ammoniacal nitrogen and dissolved oxygen guidelines were exceeded far less often. River and stream sites with poor water quality grades in 2009/10 were generally located in lower catchment reaches that are heavily influenced by sediment, faecal bacteria and nutrient inputs associated with either intensive agriculture or discharges from urban areas (e.g. stormwater). A few sites may also be impacted by sewage inputs. Approximately two thirds of the region's rivers and streams are in catchments with significant proportions of agricultural or urban land use and are likely to be degraded to some degree.



The level of compliance with guidelines for six key water quality variables (water clarity, dissolved oxygen, dissolved reactive phosphorus, nitrite-nitrate nitrogen, ammoniacal nitrogen and *E. coli*) gives us an overall picture of water quality in the region's rivers and streams. The water quality index ratings shown here are based on a comparison of median values from monthly data collected between July 2009 and June 2010 against national guideline values.

What lives in streams that can run dry?

Small headwater streams that dry up during the summer months (known as intermittently flowing streams) are commonly overlooked and undervalued when it comes to stream biodiversity. As such, they are often at risk from being filled in and piped during land development and in rural areas can be degraded by stock access. Sampling of some intermittently flowing streams during 2009/10 revealed that they had aquatic invertebrate communities distinct from those in permanently flowing streams and were home to several species unlikely to occur in other types of habitat. Several insects of conservation interest were also recorded, confirming that small intermittently flowing streams add to the overall aquatic biodiversity of the region and need greater protection.

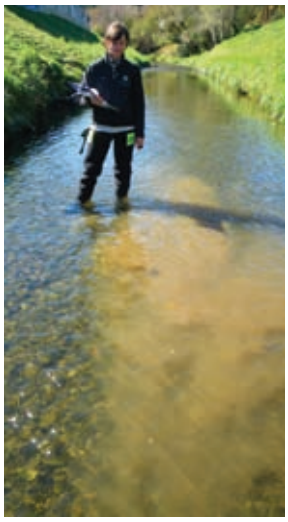
Periphyton (algae) monitoring

As well as monitoring water quality at 55 river and stream sites, Greater Wellington assesses aspects of ecosystem health at these sites, including periphyton growth. Periphyton is the brown or green slimy mats and filaments that coat rocks in rivers and streams. Excessive periphyton growth looks unsightly, can reduce the quality of habitat of fish and other aquatic life and is a nuisance to people swimming and fishing. Some species are even known to produce toxins (see *Recreational water quality card*). Of the 46 river and stream sites monitored in 2009/10, 26 exceeded at least one of the guidelines used to assess periphyton.

Sites that exceed periphyton guidelines, such as the Kopuaranga River near Masterton pictured here, typically have elevated levels of dissolved nutrients which fuel periphyton growth. Other factors such as limited shading and long periods of stable stream flow can also promote periphyton growth.

Sedimentation measurement trials

Excessive sediment is known to have many impacts on aquatic ecosystems, including smothering the fauna and flora and degrading the overall stream habitat. Many of the region's waterways receive heavy sediment loads from stormwater discharges, large scale earthworks and/or intensive agriculture. Sediment that ends up in rivers and streams ultimately makes its way downstream into sensitive water bodies such as estuaries and harbours where it can accumulate and have further impacts. No standardised monitoring techniques are available for assessing sediment in streams, so in 2010 Greater Wellington, along with regional councils and other research organisations, participated in a trial of several assessment methods. Results from the trial will be used to develop a standardised protocol for monitoring instream sedimentation effects.



Measuring sedimentation in the Porirua Stream by disturbing the streambed and assessing the resulting change in water clarity.

Flood protection river works investigation

Greater Wellington is required to manage the region's rivers and streams to protect adjacent land and infrastructure from erosion and flood damage. Realignment of river channels is one practice that is commonly used to protect river banks and adjacent land from erosion. However, the effects of channel realignment on aquatic ecosystems are largely unknown.

A bulldozer realigning a section of the Waingawa River channel to reduce erosion that is occurring along the left bank.

During 2009, we investigated the effects of extensive channel realignment on the aquatic ecosystem in a reach of the Waingawa River near Masterton. Channel realignment was shown to immediately reduce the number and quality of deep water habitats (e.g. pools) within this river reach. Re-establishment of pools did begin to occur but took several months. Some aquatic fauna, such as large longfin eels, prefer to live in deep pools and may have suffered from the loss of these types of habitats. Further work is required to see how the localised loss of habitat may impact on the wider river ecosystem and to investigate ways to lessen the potential impact from flood protection activities.

What is Greater Wellington doing?

- Monitoring stream and river health at 55 sites around the region and water quality in two lakes.
- Participating in national trials of new monitoring techniques assessing instream sedimentation and the use of biofilms (slime on rocks) as an indicator of ecological health.
- Carrying out surveillance monitoring at selected river sites for the presence of the invasive freshwater alga, didymo (*Didymosphenia geminata*).
- Providing advice to landowners about streamside management. In 12 high quality catchments we provide plants to landowners who have fenced off streams.
  Email riparian@gw.govt.nz or visit **www.gw.govt.nz/streams** to learn more.
- Supporting 36 care groups to improve streamside and wetland environments across the region.

What can you do?

- Keep stock, especially cattle and deer, out of rivers and streams, including small feeder streams and marshy areas in catchment headwaters.
- Restore riparian zones – the vegetative borders of rivers that help prevent bank erosion and improve aquatic habitat.
- Don't pour paint, chemicals or any other waste into stormwater drains.
- Join Greater Wellington's "Be the Difference" programme and learn some easy steps to help the environment for generations to come. Sign up on-line at **www.bethedifference.gw.govt.nz**

More information

Some of the information on this card is a summary of the 2009/10 annual freshwater quality monitoring report, which is available at **www.gw.govt.nz/envreports**

If you would like to know more about river or stream health, visit our website or contact us:

Phone: 04 384 5708 (Wellington office) or 06 378 2484 (Masterton office)

Email: environmentalscience@gw.govt.nz

Recreational water quality 2009/10

Key points:

- Coastal water quality was suitable for swimming on all sampling occasions at 36 of the 74 beach sites monitored weekly during the 2009/10 bathing season.
- River water quality was suitable for swimming on all sampling occasions at seven of the 21 swimming spots monitored weekly during the 2009/10 bathing season.
- Most of the occasions when water quality was unsuitable for swimming were during and shortly after rain.
- Extensive growth of toxic blue-green algae occurred in the Waipoua River over the summer.

What happened in 2009/10?

Coastal waters

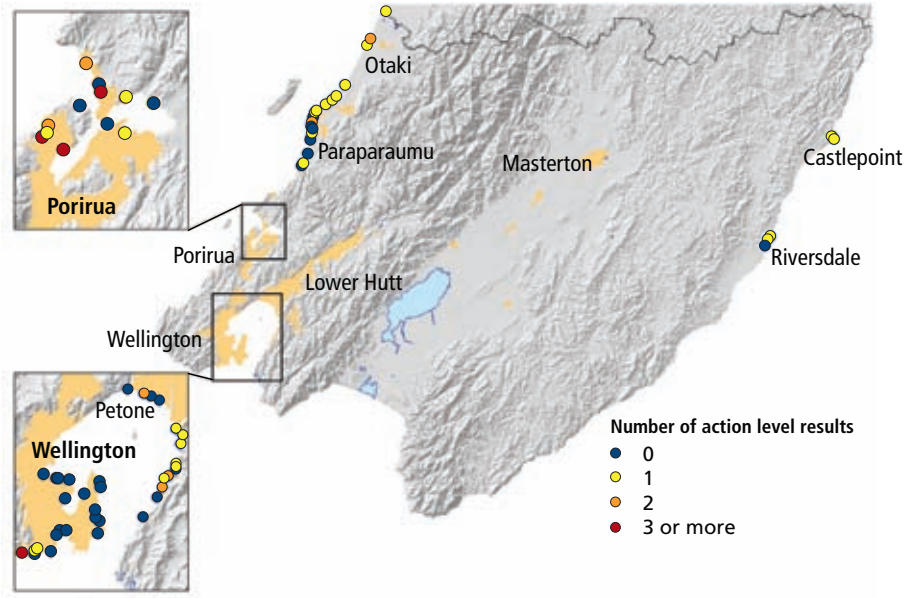
Recreational water quality was good at most beaches throughout the region over the summer. Although 38 of the 74 sites monitored weekly exceeded the "action" guideline of the national recreational water quality guidelines for indicator bacteria (280 enterococci/100 mL), many of these (27 sites) exceeded the guideline on only one sampling occasion.

Nearly 70% of the occasions when sites exceeded the "action" guideline coincided with at least 10 mm of rainfall in the three days before sampling. The correlation between rainfall and elevated bacteria counts in coastal waters relates to runoff from the land entering stormwater systems, rivers and streams discharging to the coast. Pollution in rivers and streams can also affect water quality at some beaches during dry weather, as can re-suspension of sediments due to wind and tidal action.

Photo: Juliet Milne

Scorching Bay (Wellington City) on Waitangi Day – this monitoring site was suitable for swimming on all sampling occasions last summer.

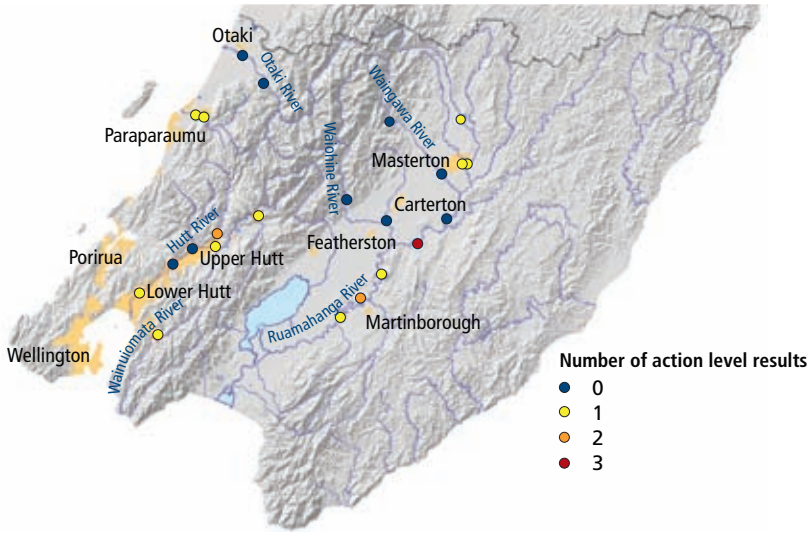
One sampling site – Owhiro Bay in Wellington City – exceeded the action guideline nine times during the bathing season. Health warning signs were put up around Owhiro Bay during late January, and a follow-up investigation resulted in repairs being carried out on sewer and stormwater systems around Brooklyn and Owhiro Bay. The warning signs were removed in April, when water sample results complied with the guidelines.



The number of times over the 2009/10 summer that beach bathing sites in the Wellington region exceeded the "action" level of the national microbiological water quality guidelines for coastal recreational areas. For up-to-date results about bathing water quality, check our website during summer.

Rivers

Fourteen of the 23 river sites monitored over the summer exceeded the "action" level of the national recreational water quality guidelines for indicator bacteria (550 *E. coli*/100 mL). Of these sites, most (11 sites) exceeded the guideline on only one sampling occasion. All of the "action" level results coincided with at least 10 mm of rainfall in the three days before sampling. Rainfall causes bacteria to be washed into rivers and streams via urban and agricultural runoff, and also stirs up bacteria attached to streambed sediment.



The number of times last summer that river bathing sites exceeded the "action" level of the national microbiological water quality guidelines for freshwater recreational areas. The Ruamahanga River at Kokotau was the only site to exceed the action level on three sampling occasions.

Swimmers in the Waikanae River, 7 February 2010. Our two monitoring sites on the Waikanae River were both suitable for swimming on 19 of 20 sampling occasions last summer.

Toxic algae

Although swimming spots in rivers were mostly safe from pathogens, the Waipoua River in Masterton was affected by widespread growth of toxic blue-green algae (cyanobacteria) from mid January onwards. Health warning signs were put up along the river, but unfortunately a dog died after coming into contact with the toxic algal mats. For more information on toxic blue-green algae go to **www.gw.govt.nz/toxic-algae**.

Photo courtesy of Dr Susie Wood

Blue-green algal mats on the bed of the Waipoua River at Paerau Road, 4 km northwest of Masterton. These types of mats can produce toxins that may harm people and animals, especially dogs.

How do you tell if it is safe to swim?

Greater Wellington uses the national microbiological water quality guidelines "traffic light" system on our website to let people know whether water is suitable for swimming, surfing and other recreational activities.

Green (surveillance) for go – sampling indicates a low health risk.

Amber (alert) for caution – sampling indicates the health risk has increased, but is still within an acceptable range.

Red (action) for stop – sampling indicates the water poses an unacceptable health risk.

What is Greater Wellington doing?

Together with the city and district councils and public health agencies, Greater Wellington monitors and reports on:

- The suitability of water quality for recreation at 23 freshwater sites and 74 coastal sites around the region. At most sites the water is sampled weekly during the "bathing season" (from 1 November to 31 March) and the results are assessed against the national recreational water quality guidelines so that we can advise people whether or not, from a public health perspective, the water is suitable for swimming and other forms of contact recreation.
- The suitability of water quality for shellfish gathering at nine coastal locations.
- The presence and potential risk to river users of toxic algal blooms.

What can you do?

- Avoid swimming during and shortly after rain and in rivers where toxic algal mats are present.
- Pick up litter you see on the beach or along riverbanks and ensure that you pick up your dog's droppings.
- Keep stock, especially cattle and deer, out of rivers and streams to prevent them fouling the water.

More information

The information on this card is a summary of the 2009/10 annual recreational water quality monitoring report, which is available at **www.gw.govt.nz/envreports**

If you would like to know more about recreational water quality, visit our website at **www.gw.govt.nz/on-the-beaches** or contact us:

Phone: 04 384 5708 (Wellington office) or 06 378 2484 (Masterton office)

Email: environmentalscience@gw.govt.nz

Soil health and contaminated land 2009/10

Key points:

- Over half of the market garden and cropping sites tested last year had at least two soil quality indicators outside the target range for their land use and soil type.
- Parts of the Mangatarere catchment have compacted soils, increasing the risk of overland runoff, which may be impacting on water quality in adjacent waterways.
- Over 21,900 poplars and willows were planted on 315 hectares of erosion-prone land, assisting with soil conservation in the region.
- The removal of contaminated sediment in the Waiwhetu Stream has been successfully completed. The stream is flowing naturally again and planting of native vegetation along the stream banks is underway.

What happened in 2009/10?

Soil quality monitoring

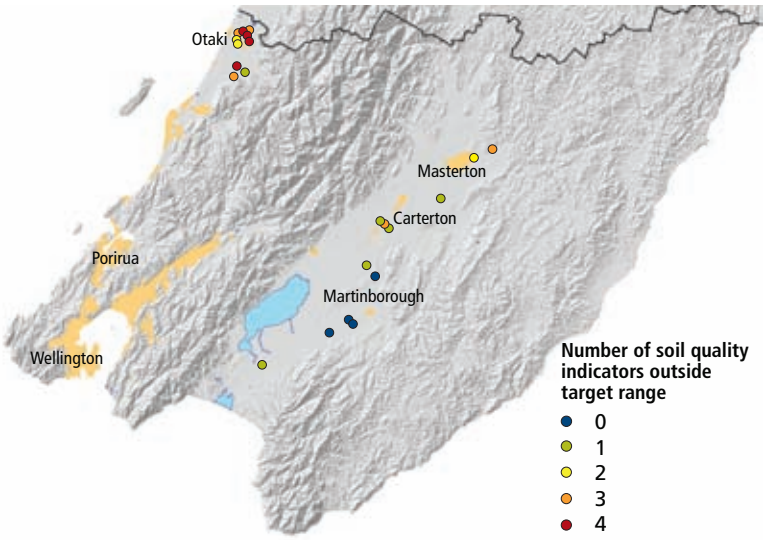
Greater Wellington's soil quality monitoring programme comprises 118 sites across the region covering a range of land uses with high quality soils. Soil health is assessed at these sites using a set of seven physical, chemical and biological indicators – including soil structure, nutrients, organic matter and trace elements.

In autumn 2010 we re-sampled soils from 22 market garden and cropping sites that had previously been sampled twice between 2001 and 2007. The main findings from the sampling were:

- Eighteen out of the 22 sites sampled had at least one indicator outside the target range for horticultural/cropping land use and their soil type, with nine sites outside the target range for three or more soil quality indicators.
- The market garden sites consistently contained low total carbon, high Olsen P and very low aggregate stability (an indication of poor soil structure), while the cropping sites often had low macroporosity (an indication of soil compaction).

This market garden in Otaki is one of our soil quality monitoring sites. The soil at this site (as with many of the market garden sites) had poor structure, low soil carbon, and a high level of plant available phosphorus.

Low total carbon and aggregate stability at market garden sites is common throughout New Zealand, and generally results from intensive cultivation. High Olsen P concentrations are commonly caused by applying large and often excessive quantities of phosphate fertilisers. Low soil carbon and poor soil structure decrease productivity and make soils susceptible to erosion, and if combined with high levels of phosphorus there is an increased risk of sediment and nutrient-rich runoff contaminating nearby streams. Land management practices such as returning crop residues, using minimum tillage, nutrient budgeting and minimising the use of machinery can all be used to restore soil carbon and maintain good soil structure, while ensuring nutrient levels are appropriate for the land use and soil type.



Summary of the results of soil quality sampling in autumn 2010. The sites sampled are colour-coded according to the number of soil quality indicators outside the target range for their market garden or cropping land use and soil type.

Mangatarere catchment investigation

In spring 2009, soils on 16 sites situated on various dairy and drystock farms in the Mangatarere catchment, Carterton, were sampled as part of Greater Wellington's investigation into poor water quality in the catchment (see *Mangatarere Stream catchment water quality investigation* report card). Including soil sampling in the investigation meant land use impacts on soil quality could be assessed as well as the migration of nutrients from the soil zone to groundwater aquifers and streams.

The soil quality sampling results showed that many sites with poorly-drained soils were often compacted, presenting an increased risk of overland flow to adjacent drains and streams. In addition, a few sites with well-drained soils contained elevated nutrients, resulting in an increased risk of nutrients – especially nitrogen – leaching into groundwater.

Waiwhetu Stream clean-up

The Waiwhetu Stream is flowing naturally again. Over a six-month period 56,000 tonnes of contaminated sediment (equating to 4,400 truckloads) was removed for disposal at Silverstream landfill. A further 32,000 tonnes of cleanfill was removed at the same time to widen and deepen the stream channel to reduce the risk of flooding.

The project used an innovative technique involving damming 200 metre sections of the stream with sheet-piling, dewatering the resulting "cell" and excavating the contaminated material. Upstream and downstream dams were required in the lower reaches where the stream is tidal.

Over the next five years extensive plantings of native species will be undertaken to enhance the ecological and visual qualities of the area. Stage 1 started in July 2010 with 20,000 eco-sourced native plants being planted on the stream banks.

Diggers removing contaminated sediment from a section of the Waiwhetu Stream upstream of the Hutt Park bridge (left) and the same section of stream flowing naturally again and ready to be planted with native vegetation (right).

Soil conservation

To help control soil erosion, particularly in the Wairarapa hill country, Greater Wellington works with landowners to prepare farm plans and implement soil conservation programmes. In 2009/10 we helped 144 landowners plant more than 21,900 poplars and willows on 315 hectares of erosion-prone pastoral land. In addition, 350 hectares of land was planted under the Government's Afforestation Grant Scheme. Two kilometres of shelterbelts were also established to decrease the effects of wind erosion on alluvial soils within the Wairarapa Valley.

Greater Wellington also assists landowners fence and plant streamsides to help improve water quality by decreasing stream bank erosion and increasing stream shading. During 2009/10 2.1 kilometres of new fencing and planting, and 2.2 kilometres of maintenance planting, were completed.

One of seven drystock sites in the Mangatarere catchment where soil samples were collected. Each site was surveyed first by excavating small soil cores with an auger to determine the soil type.

What is Greater Wellington doing?

- Sampling and testing soils under various land uses to monitor the quality of soils across the region.
- Undertaking a project ('S-Map') to update and improve existing maps of the high quality soils of the region.
- Implementing the Wellington Regional Erosion Control Initiative in five selected catchments to increase the protection of erosion-prone soils.
- Maintaining, on behalf of the city and district councils, the Selected Land Use Register, which contains a list of sites in the region that have (currently or historically) used, stored or disposed of hazardous substances (e.g. landfills, petrol stations, timber treatment sites).

What can you do?

- Use a nutrient budget to determine crop and plant requirements and ensure that animal effluent disposal systems and fertiliser application rates are appropriate for your soil type.
- Fence and retire steep and non-productive land, and plant trees to stabilise erosion-prone land, enhance biodiversity and provide shelter and shade for stock.
- Ensure hazardous waste – such as old paints and used oil – is taken to the hazardous waste collection facility at the landfill or to the household hazardous waste collection run by your city or district council.

More information

Some of the soil quality information on this card is a summary of the 2009/10 annual soil quality monitoring report, which is available at **www.gw.govt.nz/envreports**

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Mangatarere Stream catchment water quality investigation

Key points:

- Water quality is excellent at the Mangatarere Gorge but declines downstream of this point. Aquatic invertebrate health also declines with distance down the Mangatarere Stream.
- There was a lack of flow in some stream reaches during summer 2009, contributing to warmer water temperatures and nuisance algal growth.
- Water quality and aquatic invertebrate health in the lower reaches of the Mangatarere Stream have deteriorated since 2003.
- The application of piggery and dairy effluent onto land contributes to elevated nitrogen concentrations in groundwater and the Mangatarere Stream.
- Phosphorus loads were highest in the lower reaches of the stream below the discharge from the Carterton wastewater treatment plant.
- When stream sampling coincided with rain events, diffuse sources, including runoff from pasture, contributed the majority of the nutrient loading.

Why did we investigate water quality in the Mangatarere catchment?

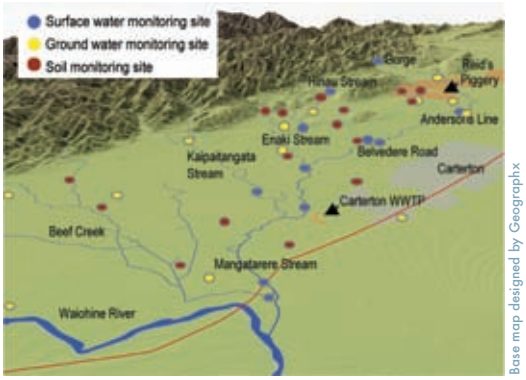
The Mangatarere is a large rural stream in Wairarapa with significant management issues. While the headwaters of the Mangatarere are pristine and have significant fish values and the river into which it discharges (the Waiohine) has very good water quality, the middle and lower reaches of the stream have poor water quality. This is because this part of the catchment experiences the cumulative effects of water abstraction, intensive farming, and the discharge of treated municipal wastewater from Carterton township.

The mid reaches of the Mangatarere Stream at Andersons Line

Routine monitoring by Greater Wellington has consistently shown that nutrient concentrations in the stream are high on both a regional and national scale. Understanding the problem and causes of this poor water quality is vital before we can take steps towards improving the health of the stream.

What did the investigation involve?

Greater Wellington spent 13 months on an intensive environmental monitoring programme and also reviewed long-term water quality data and resource consent data from within the Mangatarere catchment. The monitoring programme, carried out in 2008 and 2009, involved monthly water sampling at 11 stream sites and two-monthly sampling of 13 groundwater bores. The water samples were tested for a range of variables such as suspended sediment, nutrients, *E. coli* bacteria and metals. Algae and invertebrate (e.g. insects and snails) samples were also collected to provide an indicator of the stream's ecological health. In addition, soil samples were taken from 16 locations under different land uses and tested for organic material, nutrients, fertility and trace elements. The purpose of the soil and groundwater sampling was to help pinpoint contaminant sources.



Sampling sites. Stream flow was measured each time water samples were collected.

Measuring flow in the Kaipaitangata Stream, a tributary of the Mangatarere stream. Note the cattle beast in the background with access to the stream.

What did we find?

The state of water quality in the Mangatarere Stream

Water quality was excellent at the Mangatarere Gorge but gradually got worse below this point as the stream flows across the intensively farmed plains. The stream water had increasingly high concentrations of dissolved nutrients and *E. coli* bacteria and, at some sites, reduced water clarity, elevated water temperatures and nuisance algal growth. Aquatic invertebrate health also declined with distance down the Mangatarere Stream.

Site-specific impacts were identified, particularly in parts of the Enaki Stream and Beef Creek subcatchments. These included compacted soils – which can promote overland flow of effluent into streams and drains – and stock access to waterways, resulting in significant water quality impacts. There was also a lack of flow in some stream reaches during summer. While this can occur naturally, it is made worse by the taking of water from streams and shallow bores for irrigation.

The lower reaches of the Enaki Stream reduced to a few pools in February 2009

Dairy cows in the Enaki Stream

Has water quality been getting better or worse?

Long-term data shows that since 2003 water quality has changed. There has been an improvement in stream water temperature, *E. coli* counts, and in water clarity. However, this is countered by significant increases in the concentrations of phosphorus and ammoniacal nitrogen and a decline in stream invertebrate health. This tells us that, overall, water quality in the lower reaches of the Mangatarere Stream has declined since 2003.

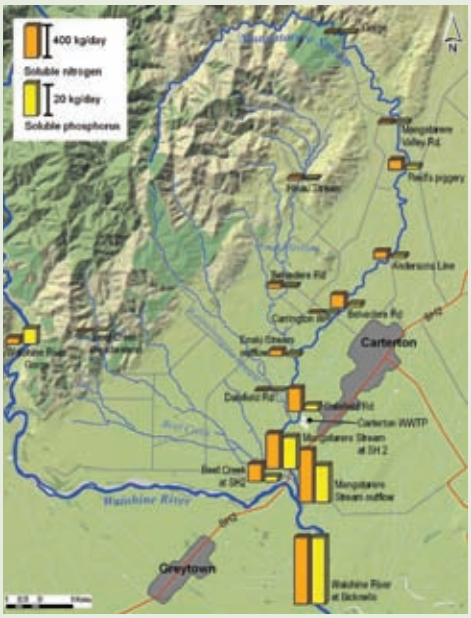
Nutrient sources

The total amount or 'load' of nutrients – in particular soluble (available) nitrogen and phosphorus – was found to increase in the Mangatarere Stream downstream from the gorge. While nitrogen loads increased steadily across the plains, phosphorus loads only increased significantly in the lower reaches of the stream below the discharge from the Carterton wastewater treatment plant. Monitoring by Carterton District Council confirms that the wastewater discharge has had a measureable impact on stream health.

Beef Creek was found to contribute relatively large loads of nitrogen and phosphorus to the lower reaches of the Mangatarere Stream. It is estimated that one-third of the nitrogen load in the Mangatarere Stream (as it enters the Waiohine River) comes from Beef Creek. The Beef Creek subcatchment comprises both dairying and drystock farming, highlighting the impact intensive agriculture can have on water quality. These impacts can occur through both surface runoff of dairyshed effluent and fertilisers, and effluent and fertilisers leaching through the soil to enter shallow groundwater systems that are connected to streams.

The application of piggery effluent onto land in the mid reaches of the Mangatarere catchment was found to be having a measureable impact on soil, groundwater and stream water quality. In particular, the activity has resulted in elevated nitrogen concentrations in groundwater. This groundwater then receives further nitrogen inputs from dairy farming in the mid catchment before joining the Mangatarere Stream downstream of Andersons Line. During rainfall events, other diffuse sources – including runoff from pasture – contributed the majority of the nutrient loading.

The results of the investigation clearly show that there is a need to manage both point and diffuse sources of nitrogen and phosphorus in the catchment.



Average loads of soluble (readily available) nitrogen and phosphorus at different locations in the Mangatarere catchment during the investigation period. Loads are calculated by multiplying the nutrient concentrations in the stream by stream flow. The height of each coloured bar is proportional to the nutrient load present.

What next?

Addressing the causes of water quality degradation highlighted by this investigation will require a cooperative effort. Greater Wellington would like to establish joint initiatives with iwi, landowners, industry groups and the wider community to address water quality issues. Options include riparian rehabilitation (already occurring and benefiting aquatic life in the lower Enaki Stream), bridged stock and vehicle stream crossings, stock exclusion from streams and deferred storage for dairyshed effluent.

More information

The information on this card is a summary of a comprehensive technical report, which is available at **www.gw.govt.nz/technical-reports**

If you would like to know more, visit our website or contact us: Phone: 04 384 5708 (Wellington office) or 06 378 2484 (Masterton office)

E-mail: environmentalscience@gw.govt.nz

Water, air, earth and energy – elements in Greater Wellington's logo combine to create and sustain life. Greater Wellington promotes **Quality for Life** by ensuring our environment is protected while meeting the economic, cultural and social needs of the community

For more information, contact Greater Wellington:

Wellington office
PO Box 11646
Manners Street
Wellington 6142
T 04 384 5708
F 04 385 6960

Masterton office
PO Box 41
Masterton 5840
T 06 378 2484
F 06 378 2146

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