NSW GOVERNMENT
Environment, Climate Change & Water

State of the Beaches 2009–2010

Beachwatch, Harbourwatch and Partnership Programs

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Summary

Beach monitoring in NSW

The water quality of beaches and other swimming locations is monitored to provide the community with accurate information on the cleanliness of the water and to enable individuals to make informed decisions about where and when to swim. Routine assessment also measures the impact of pollution sources, enables the effectiveness of stormwater and wastewater management practices to be assessed, and highlights areas where further work is required.

A total of 265 swimming locations along the New South Wales coast were monitored during 2009–2010 under three programs: Beachwatch, Harbourwatch and the Beachwatch Partnership Program (Figure S1).

Beachwatch

The Beachwatch program was established in 1989 to monitor Sydney's ocean beaches and was expanded to ocean beaches in the Hunter and Illawarra regions in 1996.

Harbourwatch

The Harbourwatch program was established in 1994 to monitor swimming locations in Sydney's estuarine waterways, including Pittwater, Sydney Harbour, lower Georges River, Botany Bay and Port Hacking.

Beachwatch Partnership Program

The Beachwatch Partnership Program was established as a pilot in 2002 and currently includes 14 local councils along the NSW coast:

- Byron Shire Council
- Ballina Shire Council
- Richmond Valley Council
- Clarence Valley Council
- Coffs Harbour City Council
- Kempsey Shire Council
- Port Macquarie–Hastings Council
- Port Stephens Council
- Newcastle Council
- Wyong Council
- Gosford Council
- Shoalhaven City Council
- Eurobodalla Shire Council
- Bega Valley Council.

The water quality sampling and laboratory analysis activities are fully funded by each local council. DECCW provides quality assurance support and assistance with community reporting.

Health risks

Contamination of recreational waters with faecal material from animal and human sources can pose significant health problems to beach users owing to the presence of pathogens (disease-causing micro-organisms) in the faecal material. The most common groups of pathogens found in recreational waters are bacteria, protozoans and viruses.

Exposure to contaminated water can cause gastroenteritis, with symptoms including vomiting, diarrhoea, stomach-ache, nausea, headache and fever. Eye, ear, skin and upper respiratory tract infections can also be contracted when pathogens come into contact with small breaks and tears in the skin or ruptures of the delicate membranes in the ear or nose.

Certain groups of users may be more exposed to the threat of microbial infection than others. Children, the elderly, people with compromised immune systems, tourists, and people from culturally and linguistically diverse backgrounds are generally most at risk.

Recreational water quality guidelines

In May 2009, new guidelines for monitoring and reporting recreational water quality were adopted for use in New South Wales: the National Health and Medical Research Council's Guidelines for Managing Risks in Recreational Water (NHMRC 2008).

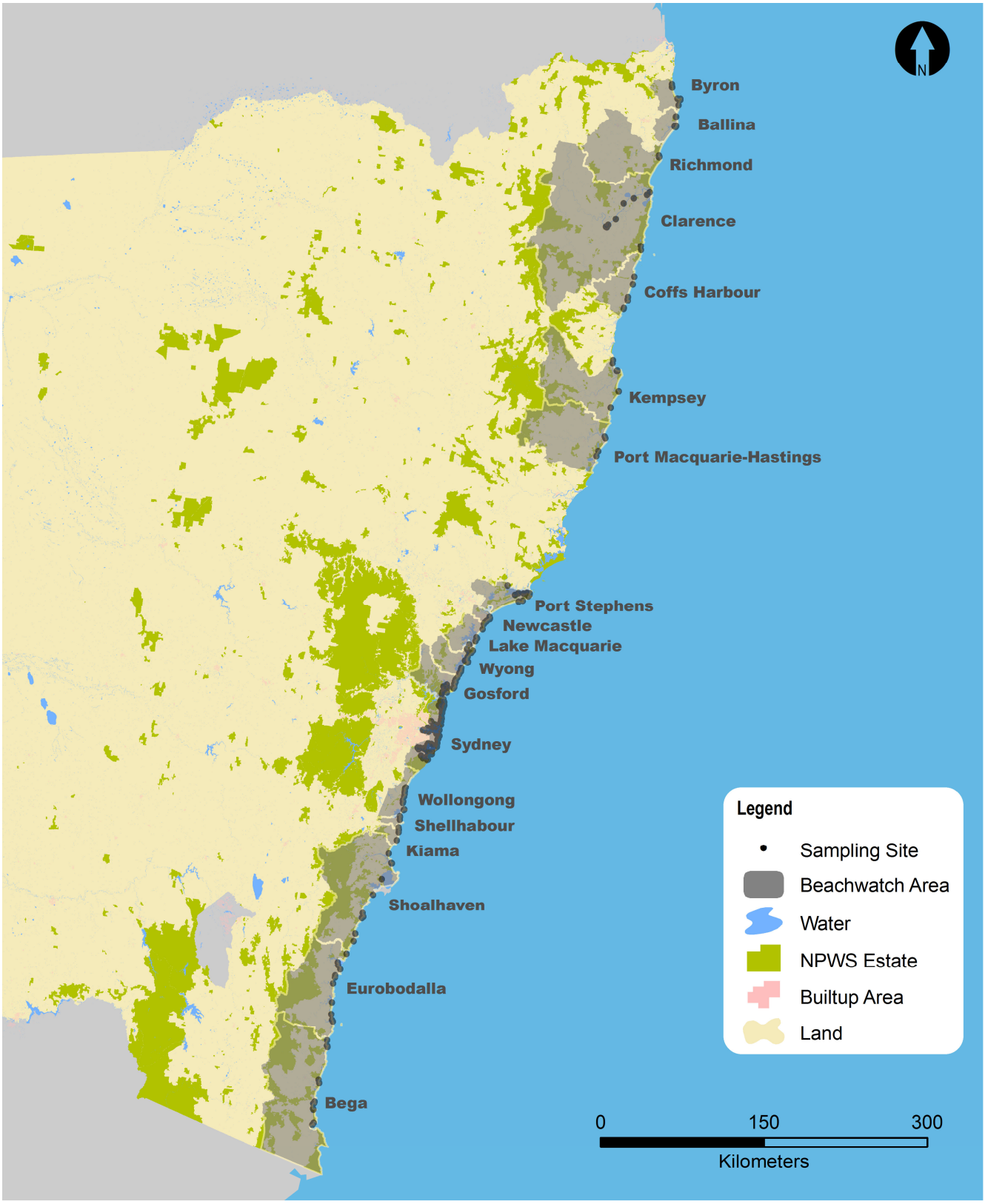


Figure S1: Sampling sites and areas monitored under the Beachwatch Programs

The NHMRC 2008 guidelines have been adopted in all Australian States that currently routinely monitor recreational water quality (Victoria, South Australia, Tasmania and Western Australia) and are supported by Guidance Notes developed by the Department of Health Western Australia following a national workshop held in Perth in 2007 (Department of Health, Western Australia 2007).

The new guidelines focus on the assessment and management of hazards to minimise health risks. Under the new guidelines, recreational water quality at swimming sites is no longer reported as percentage compliance based on microbial data, but as Beach Suitability Grades.

Beach Suitability Grades

Beach Suitability Grades provide an assessment of the suitability of a swimming location for recreation over time. There are five grades:

Very Good – Location has generally excellent microbial water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming for almost all of the time.

Good – Location has generally good microbial water quality and water is considered suitable for swimming for most of the time. Swimming should be avoided during and for up to one day following heavy rain at ocean beaches and for up to three days at estuarine sites.

Fair – Microbial water quality is generally suitable for swimming, but because of the presence of significant sources of faecal contamination, extra care should be taken to avoid swimming during and for up to three days following rainfall or if there are signs of pollution such as discoloured water, odour, or debris in the water.

Poor – Location is susceptible to faecal pollution and microbial water quality is not always suitable for swimming. During dry weather conditions, ensure that the swimming location is free of signs of pollution, such as discoloured water, odour or debris in the water, and avoid swimming at all times during and for up to three days following rainfall.

Very Poor – Location is very susceptible to faecal pollution and microbial water quality may often be unsuitable for swimming. It is generally recommended to avoid swimming at these sites.

The Beach Suitability Grades are determined from a combination of microbial assessment (water quality measurements gathered over previous years) and sanitary inspection (identification and rating of potential pollution sources at a beach) using the matrix in Table S1.

Microbial Assessment Category

NHMRC (2008) advocates the use of enterococci as the single preferred faecal indicator in marine waters. These bacteria are excreted in faeces and are rarely present in unpolluted waters.

The Microbial Assessment Category is determined from the 95th percentile of a dataset of at least 100 enterococci data points. The 95th percentiles in this report were calculated using a Microsoft® Excel tool developed by Dr Richard Lugg (Department of Health, Western Australia). This tool is also used by other State Governments (Department of Health, Western Australia 2007). There are four Microbial Assessment Categories (A to D) (Table S1).

Sanitary Inspection Category

The aim of a sanitary inspection is to identify all potential sources of faecal contamination at a swimming site and assess the risk to public health posed by these sources. It is a qualitative assessment, and should, to some degree, correlate with the microbial water quality data.

Table S1: Beach classification matrix

		Microbial Assessment Category (MAC)			
		A (≤ 40 cfu/100mL)	B (41–200 cfu/100mL)	C (201–500 cfu/100mL)	D (> 500 cfu/100mL)
Sanitary Inspection Category	Very Low	Very Good	Very Good	Follow Up	Follow Up
	Low	Very Good	Good	Follow Up	Follow Up
	Moderate	Good	Good	Poor	Poor
	High	Good	Fair	Poor	Very Poor
	Very High	Follow Up	Fair	Poor	Very Poor

Source: NHMRC (2008)

Sources considered in the Sanitary Inspection include: bather shedding, toilet facilities, stormwater discharges, sewage treatment plant discharges, sewage overflows, sewage chokes, on-site wastewater systems, wastewater re-use, river discharges, lagoon/lake discharges, boats and animals.

Through the sanitary inspection process, beaches are categorised to reflect the likelihood of faecal contamination. There are five categories, ranging from Very Low to Very High (Table S1).

Results for 2009–2010

Of the 265 swimming locations monitored during 2009–2010, 228 (86 per cent) were graded as Very Good or Good. While this is an outstanding result, there were differences in performance between ocean beaches, ocean baths, coastal lakes/lagoons, estuarine beaches and freshwater swimming sites.

Detailed results for geographical regions in NSW are presented in Tables S2 to S10 of this Summary.

Ocean beaches

Of the 156 ocean beaches monitored during 2009–2010, all but two were graded as Very Good or Good. These results indicate that the ocean beaches monitored in NSW generally have very good microbial water quality which is suitable for swimming for most, or almost all, of the time.

The ocean beaches graded as Very Good were:

- The Strand, Belongil Beach, Wategos Beach, Tallow Beach (Byron Bay), Tallow Beach (Suffolk Park), Seven Mile Beach, Lighthouse Beach, Airforce Beach, Main Beach and Shark Bay on the Far North Coast
- Sawtell Beach, Grassy Head, Trial Bay and Flynns Beach on the North Coast
- Zenith Beach, Box Beach, Fingal Beach, One Mile Beach, Birubi Beach, South Stockton Beach, Nobbys Beach, Newcastle Beach, Dudley Beach, Redhead Beach, Blacksmiths Beach and Caves Beach in the Hunter Region
- Frazer Beach, Birdie Beach, Budgewoi Beach, Lakes Beach, Hargraves Beach, Jenny Dixon Beach, Cabbage Tree Bay, Lighthouse Beach, Gravelly Beach, Soldiers Beach, North Entrance Beach, Blue Bay, Toowoon Bay, Shelly Beach, Blue Lagoon, Bateau Bay Beach and Forresters Beach, North Avoca Beach, Copacabana Beach, MacMasters Beach and Killcare Beach on the Central Coast
- Whale Beach, Avalon Beach, Bilgola Beach, Bungan Beach, Mona Vale Beach, Greenhills Beach, Elouera Beach and Shelly Beach (Sutherland) in the Sydney Region
- Austinmer Beach, Woonona Beach, Wollongong City Beach, Fishermans Beach, Warilla Beach, Shellharbour Beach, Boyds Jones Beach and Werri Beach in the Illawarra Region
- Shoalhaven Heads Beach, Tilbury Cove, Warrain Beach, Collingwood Beach, Cudmirrah Beach, Mollymook Beach, Rennies Beach, Bawley Point Beach, Merry Beach, Cookies Beach, Caseys Beach, Malua Bay Beach, Bengello Beach, Brou Beach, Narooma Main Beach, Camel Rock Beach, Beares Beach, Tathra Beach, Short Point Beach, Main Beach (Merimbula), Pambula Beach, Aslings Beach and Cocora Beach on the South Coast.

The ocean beaches graded as Good were:

- South Beach (Brunswick Heads), Main Beach (Byron Bay), Clarkes Beach and Shelly Beach on the Far North Coast
- Woolgoolga Main Beach, Emerald Beach, Diggers Beach, Park Beach, Jetty Beach, Horseshoe Bay, Hat Head Beach, Killick Beach, Town Beach and Rainbow Beach on the North Coast
- Bar Beach, Merewether Beach, Burwood North Beach, Burwood South Beach, Glenrock Lagoon Beach and Swansea Heads Little Beach in the Hunter Region
- The Entrance Beach, Wamberal Beach, Terrigal Beach, Avoca Beach, Pearl Beach and Umina Beach on the Central Coast
- Palm Beach, Newport Beach, Warriewood Beach, Turimetta Beach, North Narrabeen Beach, Collaroy Beach, Long Reef Beach, Dee Why Beach, North Curl Curl Beach, South Curl Curl Beach, Freshwater Beach, Queenscliff Beach, North Steyne Beach, South Steyne Beach, Shelly Beach (Manly), Bondi Beach, Tamarama Beach, Bronte Beach, Clovelly Beach, Coogee Beach, Maroubra Beach, Little Bay Beach, Boat Harbour Beach, Wanda Beach, North

Cronulla Beach, South Cronulla Beach and Oak Park in the Sydney Region

- Thirroul Beach, Bulli Beach, Bellambi Beach, Corrimal Beach, North Wollongong Beach, Coniston Beach, Port Kembla Beach, Bombo Beach and Surf Beach (Kiama) in the Illawarra Region

- Racecourse Beach, Broulee Beach, Shelley Beach, Tuross Main Beach, Horseshoe Bay and Bar Beach on the South Coast.

No ocean beaches were graded as Fair.

Surf Beach in the Eurobodalla Shire was graded as Poor. While the beach had generally good microbial water quality during dry weather conditions, elevated levels of enterococci were often measured following light rainfall. The site is susceptible to faecal contamination from a number of potential sources, including stormwater runoff and discharges from the Batemans Bay Sewage Treatment Plant (STP). Upgrade works at Batemans Bay STP commenced in 2010 and are anticipated to result in improvements in microbial water quality at the site.

Malabar Beach in Sydney was graded as Very Poor. While water quality was often suitable for swimming during dry weather conditions, the site is very susceptible to faecal contamination from the stormwater drain on the northern side of the beach. The drain flows following light rainfall, and while bacterial levels in the discharge are typical of urban runoff (not sewage), they are sufficiently elevated to raise levels in the bay to values unsuitable for swimming for around 50 per cent of the time. Relocation of the stormwater drain has been proposed as an option to achieve long-term improvements in water quality at the beach. While swimming should generally be avoided at this site, the risk of illness can be reduced by carefully following the pollution advisories on the Beachwatch Bulletin, not swimming during and for at least one day following rainfall, and not swimming if there are signs of stormwater pollution, such as discoloured water or odour or floating debris.

Ocean baths

A total of six ocean baths were monitored during 2009–2010 and all were graded as Good or Very Good, indicating that these locations have very good microbial water quality that is suitable for swimming for most or almost all of the time.

The ocean baths graded as Very Good were:

- Newcastle Baths, Canoe Pool, Merewether Learners Pool and Merewether Main Pool in the Hunter Region

- Pearl Beach Rockpool on the Central Coast.

Sawtell Rock Pool on the North Coast was graded as Good.

Coastal lagoons/lakes

A total of 15 swimming sites in lakes/lagoons were monitored during 2009–2010 and nine (60 per cent) of these locations were graded as Good:

- Lake Ainsworth West on the Far North Coast

- Gwandalan, Chain Valley Bay, Elizabeth Bay, Wamberal Lagoon, Avoca Lagoon, Bulbararing, and Cockrone Lagoon on the Central Coast

- Mogareeka Inlet on the South Coast.

Entrance Lagoon Beach in Lake Illawarra was graded as Fair. Microbial water quality at this site was generally suitable for swimming during dry weather conditions, but there were several potential sources of faecal contamination, including outflow from Lake Illawarra, stormwater and birds. Modifications to improve tidal flushing at the swimming location are planned and are likely to improve water quality.

The five remaining lake/lagoon swimming locations were graded as Poor:

- Kolora Lake on the Far North Coast

- Lake Cathie on the North Coast

- Canton Beach (Tuggerah Lake) and Terrigal Paddleboats (Terrigal Lagoon) on the Central Coast

- Narrabeen Lagoon in the Sydney region.

While the water quality at the above five locations was generally suitable for swimming during dry weather conditions, all were very susceptible to faecal contamination following rainfall. Care should be taken to avoid swimming during and for three days following rainfall at these sites. Swimming should also be avoided if there are any signs of stormwater pollution, such as discoloured water or odour or floating debris.

The water quality in coastal lagoons/lakes is often dependent on whether the entrance to the water body is open or closed to the ocean. When the entrance is open and the lake/lagoon is well-flushed by clean ocean water, the water quality may be of a high standard. When the entrance is closed, the lake/lagoon can become a collection point for stormwater runoff and, as a precaution, swimming should be avoided at all times during these periods.

Estuarine beaches

A total of 82 estuarine swimming locations were monitored during 2009–2010 and 56 (68 per cent) were graded as Very Good or Good.

Six estuarine swimming sites were graded as Very Good:

- Barrenjoey Beach, The Basin, Great Mackerel Beach, Nielsen Park, Manly Cove and Jibbon Beach in the Sydney region.

Fifty estuarine swimming sites were graded as Good:

- Shaws Bay East, Evans River, Illuka Bay, Wooli Estuary North and Wooli Estuary South on the Far North Coast
- Stuarts Point on the North Coast
- Little Beach, Dutchmans Beach, Bagnalls Beach, Georges Reserve, Lemon Tree Passage Tidal Pool and Karuah Tidal Pool in the Hunter region
- The Entrance Channel, Ettalong Channel, Pretty Beach Baths, Davistown Baths, Woy Woy Baths and Yattalunga Baths on the Central Coast
- Paradise Beach Baths, Clareville Beach, Bayview Baths, Elvina Bay, North Scotland Island, South Scotland Island, Watsons Bay, Parsley Bay, Redleaf Pool, Dawn Fraser Pool, Chiswick Baths, Greenwich Baths, Hayes St Beach, Clifton Gardens, Balmoral Baths, Edwards Beach, Chinamans Beach, Clontarf Pool, Forty Baskets Pool, Fairlight Beach, Little Manly Cove, Silver Beach, Sandringham Baths, Dolls Point Baths, Ramsgate Baths, Monterey Baths, Congwong Bay, Horderns Beach and Lilli Pilli Baths in the Sydney region
- Wagonga Inlet, Bruce Steer Pool and Pambula River Mouth on the South Coast.

A further 13 sites were graded as Fair, indicating that microbial water quality was generally good, but there were significant sources of faecal contamination in the vicinity of the swimming sites:

- Torakina Beach and The Serpentine on the Far North Coast
- Rose Bay Beach, Cabarita Beach, Woolwich Baths, Woodford Bay, Northbridge Baths, Gurney Crescent Baths, Jew Fish Bay Baths, Carss Point Baths, Brighton-le-Sands Baths, Yarra Bay and Gunamatta Bay Baths in the Sydney region.

Ten estuarine swimming locations were graded as Poor:

- Back Creek, Korogoro Creek and Killick Creek on the North Coast
- Tambourine Bay, Davidson Reserve, Como Baths, Oatley Bay Baths, Kyeemagh Baths, Frenchmans Bay and Gymea Bay Baths in the Sydney Region.

Back Creek, Korogoro Creek and Killick Creek are located in the Kempsey Shire Council area. Elevated bacterial levels are often recorded in Back Creek during dry weather conditions, and because of the unpredictable nature of the contamination swimming at this site should be avoided at all times. Korogoro Creek and Killick Creek generally have good water quality during dry weather conditions but are very susceptible to faecal contamination following rainfall. Care should be taken to avoid swimming in Korogoro Creek and Killick Creek during and for up to three days following rainfall, or if there are any signs of stormwater pollution, such as discoloured water or odour or floating debris.

At the seven Sydney estuarine swimming locations graded as Poor, microbial water quality was generally suitable for swimming during dry weather conditions. However, these sites were very susceptible to faecal contamination during and following rainfall due to significant sources of contamination and/or relatively low levels of tidal flushing. Swimming at these locations should be avoided during and for up to three days following rainfall or if there are signs of stormwater pollution, such as discoloured water or odour of floating debris. Lane Cove Council has currently closed Tambourine Bay Baths and the long-term future of the site is yet to be determined.

Three estuarine swimming locations were graded as Very Poor:

- Simpsons Creek on the Far North Coast
- Saltwater Creek on the North Coast
- Foreshores Beach in the Sydney Region.

Simpsons Creek is located in the Byron Shire Council area. Elevated enterococci levels were often recorded in the creek during dry weather conditions and because of the unpredictable nature of the contamination, swimming should be avoided at all times. Potential pollution sources in Simpsons Creek include discharge from the Brunswick Heads Sewage Treatment Plant (STP), discharge from the Brunswick River, stormwater runoff and possible boat discharges. The Brunswick Heads STP is due to be decommissioned in November 2010, and it is expected that this will result in improvements in water quality in Simpsons Creek.

Saltwater Creek is located in Kempsey Shire Council and is only intermittently open to the ocean. Water quality in the creek can be unsuitable for swimming during dry and wet weather conditions, and swimming should be avoided at this location at all times when the entrance is closed. When the entrance is open, swimming should be avoided during and for at least three days following rainfall or if there are signs of stormwater pollution, such as discoloured water or odour or floating debris.

Foreshores Beach is located in Botany Bay. Microbial water quality is generally suitable for swimming during dry weather conditions, but the location is very susceptible to faecal contamination from the sewage overflows that discharge into Mill Pond Creek. While swimming should generally be avoided at this site, the risk of illness can be reduced by carefully following the daily pollution advisories on the Beachwatch website and checking Sydney Water's website for recent sewage overflows.

Freshwater rivers

All six freshwater river swimming sites monitored during 2009–2010 were located on the Clarence River on the Far North Coast of NSW.

Three swimming locations were graded as Good: Maclean Jetty, Ulmarra Jetty and Lawrence Jetty. Microbial water quality was generally suitable for swimming at these locations, but they were susceptible to faecal contamination following rainfall.

Prince Street at Grafton was graded as Poor, whereas Corcoran Park at Grafton and Grafton Sailing Club were graded as Very Poor. Elevated enterococci levels were occasionally measured during dry weather conditions at all three locations, and were often measured following low levels of rainfall. The poor water quality at these sites has been investigated by DECCW and the council, with inspection and testing of the sewerage system and faecal sterol analysis of the river water to identify the source of contamination (the results were inconclusive). The recent upgrade of North Grafton and Clarenza STPs and the decommissioning of the South Grafton STP will reduce the pollutant load to the river and may result in an improvement in water quality. Further investigations into the unknown source of contamination at Grafton Sailing Club are planned.

Quality assurance

To ensure that data collected under the Beachwatch Programs is accurate and reliable, quality assurance of field sampling, laboratory analysis, data management and community reporting is undertaken.

Field sampling

Auditing of field sampling in the Sydney, Hunter, Illawarra and Beachwatch Partnership regions showed an excellent level of compliance with established Beachwatch sampling protocols. All sampling officers demonstrated a good understanding of aseptic sampling and storage techniques and a sound local knowledge of potential beach pollution sources and water quality issues.

Laboratory analysis

The results from laboratories used in the three Beachwatch Programs were found not to be significantly different from those of other NATA accredited laboratories in their estimation of enterococci densities. This indicates that the results reported are in the acceptable range, and confidence can be placed in the accuracy of water quality results reported under Beachwatch Programs. Although one laboratory used in the Partnership Program reported three results outside the acceptable range, testing of additional samples were found to be within the acceptable range.

Data management

Water quality data are electronically forwarded to Beachwatch Programs from the contracted laboratory, Hunter Water, Sydney Water and partnership councils. The water quality data are uploaded to the Beachwatch water quality database (BACTO) for storage and data evaluation. All data are cross checked and anomalous results identified.

Community reporting

Beachwatch Programs provides beach water quality information through Sydney daily bulletins, weekly star ratings, monthly reports and regional council reporting.

The Sydney daily bulletins were produced to a high standard with an average of 98 per cent accuracy and timeliness, with only minor formatting errors detected. Weekly star ratings and monthly reports were created by using computer-generated calculations and were approved by a number of individuals and/or agencies to ensure the accuracy of information reported before distribution.

Community reporting in regional areas by partnership councils was assessed by Beachwatch staff during field visits. Most regional councils provide information on their websites, and regularly forward results to Beachwatch Programs for weekly star rating reporting on the DECCW website.

A number of joint media releases were issued by DECCW and councils throughout the summer season to promote councils' monitoring and reporting activities and to advise on recreational water quality.

Table S2: Beach Suitability Grades in the Far North Coast Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Byron Shire Council	The Strand	Ocean beach	Low	Category A	Very Good
	Torakina Beach	Estuarine	High	Category B	Fair
	Simpsons Creek	Estuarine	High	Category D	Very Poor
	South Beach (Brunswick Heads)	Ocean beach	Moderate	Category A	Good
	Belongil Beach	Ocean beach	Low	Category A	Very Good
	Main Beach (Byron Bay)	Ocean beach	Low	Category B	Good
	Clarkes Beach	Ocean beach	Moderate	Category A	Good
	Wategos Beach	Ocean beach	Low	Category A	Very Good
	Tallow Beach (Byron Bay)	Ocean beach	Low	Category A	Very Good
	Tallow Beach (Suffolk Park)	Ocean beach	Low	Category A	Very Good
Ballina Shire Council	Seven Mile Beach	Ocean beach	Low	Category A	Very Good
	Lake Ainsworth West	Lagoon/lake	Moderate	Category B	Good
	Shelly Beach	Ocean beach	Moderate	Category B	Good
	Shaws Bay East	Estuarine	Moderate	Category B	Good
	The Serpentine	Estuarine	High	Category B	Fair
	Lighthouse Beach	Ocean beach	Low	Category A	Very Good
Richmond Valley Council	Airforce Beach	Ocean beach	Low	Category A	Very Good
	Main Beach	Ocean beach	Low	Category A	Very Good
	Shark Bay	Ocean beach	Low	Category A	Very Good
	Evans River	Estuarine	Moderate	Category B	Good
Clarence Valley Council	Illuka Bay	Estuarine	Moderate	Category B	Good
	Kolora Lake	Lagoon/lake	Moderate	Category C	Poor
	Maclean Jetty	Freshwater river	Moderate	Category B	Good
	Lawrence Jetty	Freshwater river	Moderate	Category B	Good
	Ulmarra Jetty	Freshwater river	Moderate	Category B	Good
	Corcoran Park	Freshwater river	High	Category D	Very Poor
	Prince Street	Freshwater river	Moderate	Category C	Poor
	Grafton Sailing Club	Freshwater river	High	Category D	Very Poor
	Wooli Estuary North	Estuarine	Moderate	Category A	Good
	Wooli Estuary South	Estuarine	Moderate	Category B	Good

Table S3: Beach Suitability Grades in the North Coast Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Coffs Harbour City Council	Woolgoolga Main Beach	Ocean beach	Moderate	Category B	Good
	Emerald Beach	Ocean beach	Low	Category B	Good
	Diggers Beach	Ocean beach	Moderate	Category A	Good
	Park Beach	Ocean beach	Moderate	Category A	Good
	Jetty Beach	Ocean beach	Moderate	Category A	Good
	Sawtell Beach	Ocean beach	Low	Category A	Very Good
	Sawtell Rock Pool	Ocean baths	Moderate	Category B	Good
Kempsey Shire Council	Grassy Head	Ocean beach	Low	Category A	Very Good
	Stuarts Point	Estuarine	Moderate	Category B	Good
	Back Creek	Estuarine	Moderate	Category D	Poor
	Horseshoe Bay	Ocean beach	Low	Category B	Good
	Trial Bay	Ocean beach	Low	Category A	Very Good
	Saltwater Creek	Estuarine	High	Category D	Very Poor
	Hat Head Beach	Ocean beach	Low	Category B	Good
	Korogoro Creek	Estuarine	Moderate	Category C	Poor
	Killick Beach	Ocean beach	Moderate	Category B	Good
	Killick Creek	Estuarine	Moderate	Category C	Poor
Port Macquarie-Hastings Council	Town Beach	Ocean beach	Moderate	Category B	Good
	Flynns Beach	Ocean beach	Low	Category A	Very Good
	Lake Cathie	Lagoon/lake	Moderate	Category C	Poor
	Rainbow Beach	Ocean beach	Moderate	Category B	Good

Table S4: Beach Suitability Grades in the Hunter Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Port Stephens Council	Zenith Beach	Ocean beach	Low	Category A	Very Good
	Box Beach	Ocean beach	Very Low	Category A	Very Good
	Fingal Beach	Ocean beach	Low	Category A	Very Good
	One Mile Beach	Ocean beach	Low	Category A	Very Good
	Birubi Beach	Ocean beach	Low	Category A	Very Good
	Little Beach	Estuarine	Low	Category B	Good
	Dutchmans Beach	Estuarine	Moderate	Category A	Good
	Bagnalls Beach	Estuarine	Moderate	Category B	Good
	Georges Reserve	Estuarine	Moderate	Category B	Good
	Lemon Tree Passage Tidal Pool	Estuarine	Moderate	Category B	Good
	Karuah Tidal Pool	Estuarine	Moderate	Category B	Good
City of Newcastle Council	South Stockton Beach	Ocean beach	Low	Category A	Very Good
	Nobbys Beach	Ocean beach	Low	Category A	Very Good
	Newcastle Baths	Ocean baths	Low	Category A	Very Good
	Canoe Pool	Ocean baths	Low	Category A	Very Good
	Newcastle Beach	Ocean beach	Low	Category A	Very Good
	Bar Beach	Ocean beach	Moderate	Category A	Good
	Merewether Beach	Ocean beach	Moderate	Category A	Good
	Merewether Learners Pool	Ocean baths	Low	Category A	Very Good
	Merewether Main Pool	Ocean baths	Low	Category A	Very Good
	Burwood North Beach	Ocean beach	Moderate	Category A	Good
	Burwood South Beach	Ocean beach	Moderate	Category A	Good
Lake Macquarie Council	Glenrock Lagoon Beach	Ocean beach	Moderate	Category A	Good
	Dudley Beach	Ocean beach	Low	Category A	Very Good
	Redhead Beach	Ocean beach	Low	Category A	Very Good
	Blacksmiths Beach	Ocean beach	Low	Category A	Very Good
	Swansea Heads Little Beach	Ocean beach	Moderate	Category B	Good
	Caves Beach	Ocean beach	Low	Category A	Very Good

Table S5: Beach Suitability Grades in the Central Coast Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Wyong Shire Council	Frazer Beach	Ocean beach	Low	Category A	Very Good
	Birdie Beach	Ocean beach	Low	Category A	Very Good
	Budgewoi Beach	Ocean beach	Low	Category A	Very Good
	Lakes Beach	Ocean beach	Low	Category A	Very Good
	Hargraves Beach	Ocean beach	Low	Category A	Very Good
	Jenny Dixon Beach	Ocean beach	Low	Category A	Very Good
	Cabbage Tree Bay	Ocean beach	Low	Category A	Very Good
	Lighthouse Beach	Ocean beach	Low	Category A	Very Good
	Gravelly Beach	Ocean beach	Low	Category A	Very Good
	Soldiers Beach	Ocean beach	Low	Category A	Very Good
	North Entrance Beach	Ocean beach	Low	Category A	Very Good
	The Entrance Beach	Ocean beach	Moderate	Category A	Good
	Blue Bay	Ocean beach	Low	Category A	Very Good
	Toowoon Bay	Ocean beach	Low	Category A	Very Good
	Shelly Beach	Ocean beach	Low	Category A	Very Good
	Blue Lagoon	Ocean beach	Low	Category A	Very Good
	Bateau Bay Beach	Ocean beach	Low	Category A	Very Good
	Gwandalan	Lagoon/lake	Moderate	Category B	Good
	Chain Valley Bay	Lagoon/lake	Moderate	Category B	Good
	Elizabeth Bay	Lagoon/lake	Moderate	Category B	Good
	Canton Beach	Lagoon/lake	Moderate	Category C	Poor
	The Entrance Channel	Estuarine	Moderate	Category B	Good
Gosford City Council	Forresters Beach	Ocean beach	Low	Category A	Very Good
	Wamberal Beach	Ocean beach	Moderate	Category A	Good
	Wamberal Lagoon	Lagoon/lake	Moderate	Category B	Good
	Terrigal Beach	Ocean beach	Moderate	Category A	Good
	Terrigal Paddleboats	Lagoon/lake	High	Category C	Poor
	North Avoca Beach	Ocean beach	Low	Category A	Very Good
	Avoca Beach	Ocean beach	Moderate	Category A	Good
	Avoca Lagoon	Lagoon/lake	Moderate	Category B	Good
	Bulbararing	Lagoon/lake	Moderate	Category B	Good
	Copacabana Beach	Ocean beach	Low	Category A	Very Good
	Cockrone Lagoon	Lagoon/lake	Moderate	Category B	Good
	MacMasters Beach	Ocean beach	Low	Category A	Very Good
	Killcare Beach	Ocean beach	Low	Category A	Very Good
	Pearl Beach	Ocean beach	Moderate	Category A	Good
	Pearl Beach Rockpool	Ocean baths	Low	Category A	Very Good
	Umina Beach	Ocean beach	Moderate	Category A	Good
	Ettalong Channel	Estuarine	Moderate	Category B	Good
	Pretty Beach Baths	Estuarine	Moderate	Category B	Good
	Davistown Baths	Estuarine	Moderate	Category B	Good
	Woy Woy Baths	Estuarine	Moderate	Category B	Good
	Yattalunga Baths	Estuarine	Moderate	Category B	Good

Table S6: Beach Suitability Grades in the Sydney Ocean Beaches Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Northern Sydney	Palm Beach	Ocean beach	Low	Category B	Good
	Whale Beach	Ocean beach	Low	Category A	Very Good
	Avalon Beach	Ocean beach	Low	Category A	Very Good
	Bilgola Beach	Ocean beach	Low	Category A	Very Good
	Newport Beach	Ocean beach	Low	Category B	Good
	Bungan Beach	Ocean beach	Low	Category A	Very Good
	Mona Vale Beach	Ocean beach	Low	Category A	Very Good
	Warriewood Beach	Ocean beach	Moderate	Category B	Good
	Turimetta Beach	Ocean beach	Moderate	Category A	Good
	North Narrabeen Beach	Ocean beach	Moderate	Category B	Good
	Narrabeen Lagoon	Lagoon/lake	High	Category C	Poor
	Collaroy Beach	Ocean beach	Moderate	Category B	Good
	Long Reef Beach	Ocean beach	Moderate	Category A	Good
	Dee Why Beach	Ocean beach	Moderate	Category B	Good
	North Curl Curl Beach	Ocean beach	Moderate	Category B	Good
	South Curl Curl Beach	Ocean beach	Low	Category B	Good
	Freshwater Beach	Ocean beach	Moderate	Category B	Good
	Queenscliff Beach	Ocean beach	Moderate	Category B	Good
	North Steyne Beach	Ocean beach	Moderate	Category B	Good
	South Steyne Beach	Ocean beach	Moderate	Category B	Good
	Shelly Beach	Ocean beach	Moderate	Category B	Good
Central Sydney	Bondi Beach	Ocean beach	Moderate	Category B	Good
	Tamarama Beach	Ocean beach	Moderate	Category B	Good
	Bronte Beach	Ocean beach	Moderate	Category B	Good
	Clovelly Beach	Ocean beach	Moderate	Category B	Good
	Coogee Beach	Ocean beach	Moderate	Category B	Good
	Maroubra Beach	Ocean beach	Moderate	Category B	Good
	Malabar Beach	Ocean beach	High	Category D	Very Poor
	Little Bay Beach	Ocean beach	Low	Category B	Good
Southern Sydney	Boat Harbour	Ocean beach	Moderate	Category B	Good
	Greenhills Beach	Ocean beach	Low	Category A	Very Good
	Wanda Beach	Ocean beach	Low	Category B	Good
	Elouera Beach	Ocean beach	Low	Category A	Very Good
	North Cronulla Beach	Ocean beach	Low	Category B	Good
	South Cronulla Beach	Ocean beach	Low	Category B	Good
	Shelly Beach	Ocean beach	Low	Category A	Very Good
	Oak Park	Ocean beach	Low	Category B	Good

Table S7: Beach Suitability Grades in Pittwater and Sydney Harbour – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Pittwater	Barrenjoey Beach	Estuarine	Low	Category A	Very Good
	Paradise Beach Baths	Estuarine	Moderate	Category A	Good
	Clareville Beach	Estuarine	Moderate	Category B	Good
	Bayview Baths	Estuarine	Moderate	Category B	Good
	Elvina Bay	Estuarine	Moderate	Category A	Good
	North Scotland Island	Estuarine	Moderate	Category A	Good
	South Scotland Island	Estuarine	Moderate	Category A	Good
	The Basin	Estuarine	Low	Category A	Very Good
	Great Mackerel Beach	Estuarine	Low	Category A	Very Good
Sydney Harbour	Watsons Bay	Estuarine	Moderate	Category A	Good
	Parsley Bay	Estuarine	Moderate	Category B	Good
	Nielsen Park	Estuarine	Low	Category A	Very Good
	Rose Bay Beach	Estuarine	High	Category B	Fair
	Redleaf Pool	Estuarine	Moderate	Category B	Good
	Dawn Fraser Pool	Estuarine	Moderate	Category B	Good
	Chiswick Baths	Estuarine	Moderate	Category B	Good
	Cabarita Beach	Estuarine	High	Category B	Fair
	Woolwich Baths	Estuarine	High	Category B	Fair
	Tambourine Bay	Estuarine	High	Category C	Poor
	Woodford Bay	Estuarine	High	Category B	Fair
	Greenwich Baths	Estuarine	Moderate	Category B	Good
	Hayes St Beach	Estuarine	Moderate	Category B	Good
	Clifton Gardens	Estuarine	Moderate	Category B	Good
	Balmoral Baths	Estuarine	Moderate	Category B	Good
	Edwards Beach	Estuarine	Moderate	Category A	Good
	Chinamans Beach	Estuarine	Moderate	Category B	Good
	Northbridge Baths	Estuarine	High	Category B	Fair
	Davidson Reserve	Estuarine	High	Category C	Poor
	Gurney Crescent Baths	Estuarine	High	Category B	Fair
	Clontarf Pool	Estuarine	Moderate	Category B	Good
	Forty Baskets Pool	Estuarine	Moderate	Category A	Good
	Fairlight Beach	Estuarine	Moderate	Category A	Good
	Manly Cove	Estuarine	Low	Category A	Very Good
	Little Manly Cove	Estuarine	Moderate	Category B	Good

Table S8: Beach Suitability Grades in Botany Bay, lower Georges River and Port Hacking – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Botany and lower Georges River	Silver Beach	Estuarine	Moderate	Category B	Good
	Como Baths	Estuarine	High	Category C	Poor
	Jewfish Bay Baths	Estuarine	High	Category B	Fair
	Oatley Bay Baths	Estuarine	Moderate	Category C	Poor
	Carss Point Baths	Estuarine	High	Category B	Fair
	Sandringham Baths	Estuarine	Moderate	Category B	Good
	Dolls Point Baths	Estuarine	Moderate	Category B	Good
	Ramsgate Baths	Estuarine	Moderate	Category B	Good
	Monterey Baths	Estuarine	Moderate	Category B	Good
	Brighton-le-Sands Baths	Estuarine	High	Category B	Fair
	Kyeemagh Baths	Estuarine	High	Category C	Poor
	Foreshores Beach	Estuarine	High	Category D	Very Poor
	Yarra Bay	Estuarine	High	Category B	Fair
	Frenchmans Bay	Estuarine	Moderate	Category C	Poor
	Congwong Bay	Estuarine	Low	Category B	Good
Port Hacking	Jibbon Beach	Estuarine	Low	Category A	Very Good
	Horderns Beach	Estuarine	Moderate	Category B	Good
	Gymea Bay Baths	Estuarine	High	Category C	Poor
	Lilli Pilli Baths	Estuarine	Low	Category B	Good
	Gunamatta Bay Baths	Estuarine	High	Category B	Fair

Table S9: Beach Suitability Grades in the Illawarra Region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Wollongong City Council	Austinmer Beach	Ocean beach	Low	Category A	Very Good
	Thirroul Beach	Ocean beach	Moderate	Category B	Good
	Bulli Beach	Ocean beach	Moderate	Category B	Good
	Woonona Beach	Ocean beach	Low	Category A	Very Good
	Bellambi Beach	Ocean beach	Moderate	Category B	Good
	Corrimal Beach	Ocean beach	Moderate	Category A	Good
	North Wollongong Beach	Ocean beach	Moderate	Category A	Good
	Wollongong City Beach	Ocean beach	Low	Category A	Very Good
	Coniston Beach	Ocean beach	Moderate	Category A	Good
	Fishermans Beach	Ocean beach	Low	Category A	Very Good
	Port Kembla Beach	Ocean beach	Moderate	Category B	Good
Shellharbour Council	Entrance Lagoon Beach	Lagoon/lake	High	Category B	Fair
	Warilla Beach	Ocean beach	Low	Category A	Very Good
	Shellharbour Beach	Ocean beach	Low	Category A	Very Good
Kiama Municipal Council	Boyds Jones Beach	Ocean beach	Low	Category A	Very Good
	Bombo Beach	Ocean beach	Moderate	Category A	Good
	Surf Beach	Ocean beach	Moderate	Category A	Good
	Werri Beach	Ocean beach	Low	Category A	Very Good

Table S10: Beach Suitability Grades for the South Coast region – 2009–2010

	Site	Site type	Sanitary Inspection Category	Microbial Assessment Category	Beach Suitability Grade
Shoalhaven City Council	Shoalhaven Heads Beach	Ocean beach	Low	Category A	Very Good
	Tilbury Cove	Ocean beach	Low	Category A	Very Good
	Warrain Beach	Ocean beach	Low	Category A	Very Good
	Collingwood Beach	Ocean beach	Low	Category A	Very Good
	Cudmirrah Beach	Ocean beach	Low	Category A	Very Good
	Mollymook Beach	Ocean beach	Low	Category A	Very Good
	Rennies Beach	Ocean beach	Low	Category A	Very Good
	Racecourse Beach	Ocean beach	Moderate	Category A	Good
	Bawley Point Beach	Ocean beach	Low	Category A	Very Good
	Merry Beach	Ocean beach	Low	Category A	Very Good
Eurobodalla Shire Council	Cookies Beach	Ocean beach	Low	Category A	Very Good
	Caseys Beach	Ocean beach	Low	Category A	Very Good
	Surf Beach	Ocean beach	Moderate	Category C	Poor
	Malua Bay Beach	Ocean beach	Low	Category A	Very Good
	Broulee Beach	Ocean beach	Moderate	Category A	Good
	Bengello Beach	Ocean beach	Low	Category A	Very Good
	Shelley Beach	Ocean beach	Moderate	Category B	Good
	Tuross Main Beach	Ocean beach	Low	Category B	Good
	Brou Beach	Ocean beach	Low	Category A	Very Good
	Wagonga Inlet	Estuarine	Moderate	Category A	Good
	Narooma Main Beach	Ocean beach	Low	Category A	Very Good
Bega Valley Shire Council	Camel Rock Beach	Ocean beach	Low	Category A	Very Good
	Bruce Steer Pool	Estuarine	Moderate	Category A	Good
	Horseshoe Bay	Ocean beach	Moderate	Category A	Good
	Beares Beach	Ocean beach	Low	Category A	Very Good
	Mogareeka Inlet	Lagoon/lake	Moderate	Category A	Good
	Tathra Beach	Ocean beach	Low	Category A	Very Good
	Short Point Beach	Ocean beach	Low	Category A	Very Good
	Bar Beach	Ocean beach	Moderate	Category A	Good
	Main Beach (Merimbula)	Ocean beach	Low	Category A	Very Good
	Pambula Beach	Ocean beach	Low	Category A	Very Good
	Pambula River Mouth	Estuarine	Moderate	Category A	Good
	Aslings Beach	Ocean beach	Low	Category A	Very Good
	Cocora Beach	Ocean beach	Low	Category A	Very Good

Chapter 1
Beach Monitoring in New South Wales

The water quality of beaches and other swimming locations is monitored to provide the community with accurate information on the cleanliness of the water and to enable individuals to make informed decisions about where and when to swim. Routine assessment also measures the impact of pollution sources, enables the effectiveness of stormwater and wastewater management practices to be assessed, and highlights areas where further work is required.

The Programs

There are three main beach monitoring programs in New South Wales: Beachwatch, Harbourwatch and the monitoring undertaken by local councils as part of the Beachwatch Partnership Program.

A total of 265 swimming locations along the New South Wales coast were monitored under these programs during the 2009-2010 swimming season.

The Beachwatch Program

Beachwatch was established in 1989 in response to public concern over the level of sewage pollution at Sydney's ocean beaches. At that time, more than 1 billion litres of effluent was discharged to Sydney's coastal waters each day. Beachwatch was given responsibility to monitor and report on beach pollution levels. Over the last 20 years the program has tracked significant improvements in water quality: Sydney's beaches are now up to 98 per cent cleaner than they were two decades ago.

Monitoring of Sydney's ocean beaches is conducted by Department of Environment, Climate Change and Water (DECCW) staff and Sutherland Council lifeguards. Beaches are sampled every six days throughout the year and tested for the bacterial indicator enterococci. Samples are collected from between the flags (or the most commonly used area if the beach is not patrolled). A total of 36 ocean beaches and one lagoon site are monitored in the Sydney region.

Beachwatch was expanded to the Hunter and Illawarra regions in 1996. Monitoring in these areas is conducted by Hunter Water Corporation and Sydney Water Corporation as a requirement of their Environment Protection Licences to discharge sewage effluent. Seventeen ocean beaches are monitored in the Hunter region, and 17 ocean beaches and one lagoon site are monitored in the Illawarra region.

The Harbourwatch Program

Harbourwatch commenced in November 1994. The program complements the Beachwatch Program by monitoring and reporting on the water quality at estuarine beaches and swimming baths in Sydney Harbour, Botany Bay, Georges River, Port Hacking and Pittwater.

Water samples are collected by DECCW staff every sixth day during the swimming season (October to April) and monthly for the remainder of the year. The program includes 27 sites in Sydney Harbour, nine sites in Pittwater, 15 sites in the lower Georges River and Botany Bay and five sites in Port Hacking.

The Beachwatch Partnership Program

This program provides local councils undertaking recreational water quality monitoring and reporting programs with technical advice, quality assurance and assistance with community reporting. All regional coastal councils in New South Wales are invited to take part in the program before the start of the swimming season each year.

During summer 2009–2010, 14 coastal councils in regional NSW participated in the program:

- Byron Shire Council
- Ballina Shire Council
- Richmond Valley Council
- Clarence Valley Council
- Coffs Harbour City Council
- Kempsey Shire Council
- Port Macquarie–Hastings Council
- Port Stephens Council
- Newcastle Council

- Wyong Council
- Gosford Council
- Shoalhaven City Council
- Eurobodalla Shire Council
- Bega Valley Council.

All monitoring and reporting activities are fully funded by each local council. A total of 137 sites were monitored during the 2009–2010 swimming season, including ocean and estuarine beaches and swimming locations in freshwater lakes, tidal pools, bays, rivers, lagoons and harbours.

Health risks

Contamination of recreational waters with faecal material from animal and human sources can pose significant health problems to beach users owing to the presence of pathogens (disease-causing micro-organisms) in the faecal material. The most common groups of pathogens found in recreational waters are bacteria, protozoans and viruses.

Bacteria

There are many thousands of species of these simple single-celled organisms. The vast majority of bacteria are harmless and perform a variety of essential roles, including the breakdown of organic material, fermentation and nitrogen fixing. Enteric bacteria live in the intestinal tracts of warm-blooded animals and help with digestion. Several groups of bacteria are pathogenic, including *Salmonella* and *Vibrio*.

Protozoans

Protozoans are single-celled organisms that live as parasites in humans and animals. In the environment, they exist as dormant cysts, enabling them to survive harsh conditions such as high temperatures and salinity. When swallowed by a host, the protozoans multiply and are spread through excretion of faeces. At the height of an infection, there may be between two and ten million cysts in every gram of faeces excreted. Approximately 30 per cent of the 35,000 known species of protozoans are pathogenic. *Giardia lamblia* and *Cryptosporidium parvum* are two of the best known pathogenic protozoans.

Viruses

These consist of nucleic acid (RNA or DNA) surrounded by a protein shell. Viruses are not able to take in food, get rid of waste or reproduce by themselves. Viral infection does not always lead to disease. In some cases the host will have no symptoms; in others the host will become very ill. Person-to-person contact is the most common transmission route. Viruses found in water include hepatitis A and E, norovirus, coxsackie, rotavirus and adenovirus.

Exposure

Exposure to water-borne human pathogens when at the beach can occur through direct contact with polluted water while swimming, by accidental ingestion of contaminated water or by inhalation of small water droplets in the air.

Primary contact with contaminated water can cause a variety of diseases of the gastrointestinal tract, collectively known as gastroenteritis. Symptoms of gastroenteritis include vomiting, diarrhoea, stomach-ache, nausea, headache and fever.

Diseases and conditions that affect the eyes, ears, skin and upper respiratory tract can also be contracted when pathogens come into contact with small breaks and tears in the skin or ruptures of the delicate membranes in the ear or nose.

Epidemiological studies

People who contract diseases as a result of swimming in contaminated water do not always associate their illness symptoms with this contact. As a result, disease outbreaks are often inconsistently reported. As the incidence of disease among swimmers is difficult to determine, numerous studies have been conducted in an attempt to establish a link between illness and the level of faecal contamination. A review of these studies by Pruss (1998) drew two conclusions:

- The relative risk of swimming in contaminated water ranged from one to three times above the risk associated with swimming in uncontaminated water.
- Symptom rates were higher in individuals with compromised immune systems.

Certain groups of users may be more vulnerable to the threat of microbial infection than others. Children, the elderly, people with compromised immune systems, tourists, and people from culturally and linguistically diverse backgrounds are generally most at risk.

Recreational water quality guidelines

In May 2009, new guidelines for monitoring and reporting recreational water quality were adopted for use in New South Wales: the National Health and Medical Research Council's Guidelines for Managing

Risks in Recreational Water (NHMRC 2008). These guidelines supersede the Australian Guidelines for Use of Recreational Water (NHMRC 1990) and the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC 1992), on which the previous Beachwatch guidelines were based.

The NHMRC 2008 guidelines have been adopted in all Australian States that currently routinely monitor recreational water quality (Victoria, South Australia, Tasmania and Western Australia) and are supported by Guidance Notes developed by the Department of Health Western Australia following a national workshop held in Perth in 2007 (Department of Health, Western Australia 2007).

The new guidelines represent a major revision of the previous guidelines by focusing on the assessment and management of hazards to minimise health risks. Under the new guidelines, recreational water quality at swimming sites is no longer reported as percentage compliance based on microbial data, but as Beach Suitability Grades.

Beach Suitability Grades

Beach Suitability Grades provide an assessment of the suitability of a swimming location for recreation over time and are based on a combination of sanitary inspection (identification and rating of potential pollution sources at a beach) and microbial assessment (water quality measurements gathered over previous years). There are five grades, ranging from Very Good to Very Poor (Table 1).

Provisional Beach Suitability Grades

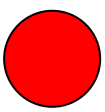
The NHMRC (2008) guidelines recognise that there will be occasions when there is a need to issue advice on the classification of a recreational water environment, even though the information required is incomplete because of limited bacterial data or limited information on potential pollution sources in a beach catchment.

As this is the first year of monitoring and reporting under the NHMRC 2008 Guidelines, many of the Beach Suitability Grades in this report are provisional, and this is noted in the council summary sections of the report, where applicable. The information gaps for most sites are minor, and Beachwatch has confidence in the grades presented in this report.

Determining Beach Suitability Grades

Beach Suitability Grades are determined by using the matrix in Table 2. Microbial assessment categories and sanitary inspection categories are described in the following sections.

Table 1: Beach Suitability Grade Definitions

	**Very Good** – Location has generally excellent microbial water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming for almost all of the time.
	Good – Location has generally good microbial water quality and water is considered suitable for swimming most of the time. Swimming should be avoided during and for up to one day following heavy rain at ocean beaches and up to three days at estuarine sites.
	**Fair** – Microbial water quality is generally suitable for swimming, but because of the presence of significant sources of faecal contamination extra care should be taken to avoid swimming during and for up to three days following rainfall or if there are signs of pollution such as discoloured water or odour or debris in the water.
	**Poor** – Location is susceptible to faecal pollution and microbial water quality is not always suitable for swimming. During dry weather conditions, ensure that the swimming location is free of signs of pollution, such as discoloured water, odour or debris in the water, and avoid swimming at all times during and for up to three days following rainfall.
	Very Poor – Location is very susceptible to faecal pollution and microbial water quality may often be unsuitable for swimming. It is recommended to avoid swimming at this site.

Source: Adapted from NHMRC (2008)

Table 2: Beach classification matrix

		Microbial Assessment Category (MAC)			
		A (≤ 40 cfu/100mL*)	B (41–200 cfu/100mL*)	C (201–500 cfu/100mL*)	D (> 500 cfu/100mL*)
Sanitary Inspection Category	Very Low	Very Good	Very Good	Follow Up	Follow Up
	Low	Very Good	Good	Follow Up	Follow Up
	Moderate	Good	Good	Poor	Poor
	High	Good	Fair	Poor	Very Poor
	Very High	Follow Up	Fair	Poor	Very Poor

Source: NHMRC (2008). * See Table 3 for Microbial Assessment Category details

Microbial water quality assessment

Faecal indicator bacteria

Direct detection of pathogens in recreational waters is generally not undertaken owing to the difficulty of the analysis. Where reliable laboratory methods exist they generally require the collection of large volumes of water; analysis is costly, and it can take a week or more to obtain a result. In addition, decisions about how many and which specific pathogens to test for need to be made.

NHMRC (2008) advocates the use of enterococci as the single preferred faecal indicator in marine waters. These bacteria are excreted in faeces and are rarely present in unpolluted waters. Enterococci have shown a clear dose–response relationship to disease outcomes in marine waters in the northern hemisphere. In accordance with the NHMRC 2008 guidelines, Beachwatch tests for enterococci only, with faecal coliform analysis discontinued on 30 April 2009.

Sampling programs

The new swimming guidelines state that sampling should cover the range of conditions that occur while the swimming location is in use (NHMRC 2008). For most beaches along the New South Wales coast, the highest use occurs during the swimming season (October to April). For beaches on the North Coast use can extend throughout the year, whereas at beaches on the South Coast use is usually restricted to summer months.

Harbour swimming sites in Sydney tend to operate only during the swimming season, with many pools closed and shark nets removed during the winter.

Under the new guidelines, Sydney's ocean beaches continue to be sampled every six days throughout the year. Estuarine sites in the Harbourwatch Program continue to be sampled every six days during the swimming season (October to May) with monthly surveillance sampling undertaken between May and September when the swimming sites are generally not in use.

Monitoring under the Beachwatch Partnership Program varies among councils. Owing to the resource-intensive nature of recreational water quality monitoring, most councils restrict monitoring to the swimming season and some councils focus their resources on sample collection only during those summer months when use is highest.

Samples are collected using aseptic sampling technique, placed on ice and transferred to the laboratory for analysis. Sampling undertaken as part of the Beachwatch, Harbourwatch and Beachwatch Partnership programs is checked under the quality assurance program and the results of this are presented in the Quality Assurance section of this report.

Microbial Assessment Category calculation

There are four Microbial Assessment Categories (A to D), and each is associated with risks of illness determined from key epidemiological studies (Table 3).

The Microbial Assessment Category is determined from the 95th percentile of an enterococci dataset of at least 100 data points. The 95th percentile is a useful statistic for summarising the distribution of enterococci data at a site, because it embodies elements of the location of the distribution (how high/low the enterococci counts are) and the scale of the distribution (how variable the enterococci counts are).

Table 3: Microbial Assessment Categories

Category	95%ile of enterococci (cfu/100 mL)	Basis of derivation	Associated overall illness rates
A	≤40	No illness seen in most epidemiological studies	GI* illness risk: <1% AFRI** risk: <0.3%
B	40–200	Upper threshold is above the threshold of illness transmission reported in most studies	GI illness risk: 1%–5% AFRI risk: 0.3%–1.9%
C	201–500	Represents a substantial elevation in the probability of adverse health outcomes	GI illness risk: 5%–10% AFRI risk: 1.9%–3.9%
D	>500	Above this level there may be significant risk of high levels of illness transmission	GI illness risk: >10% AFRI risk: >3.9%

Source: NHMRC (2008). * GI = gastrointestinal Illness ** AFRI = acute febrile respiratory illness

The risks of illness in Table 3 are not those associated with the 95th percentile enterococci level, but are the overall risk of illness associated with an enterococci dataset with that 95th percentile (see Wyer *et al*. 1999 for further information).

The 95th percentile values for each of the four Microbial Assessment Categories were determined by the World Health Organization using enterococci data collected from swimming locations across Europe, and so these values will represent different probabilities of illness if the distribution of enterococci data from swimming locations in NSW differs from the European distribution. In recognition of this issue, Dr Richard Lugg (Department of Health, Western Australia) has developed a Microsoft® Excel tool for calculating a modified 95th percentile that takes into account the distribution of data. This tool has been used to calculate the 95th percentile values presented in this report and has been adopted for use by other State Governments (Department of Health Western Australia, 2007).

Sanitary Inspection

The aim of a sanitary inspection is to identify all sources of faecal contamination that could affect a swimming location and assess the risk to public health posed by these sources. It is a qualitative assessment of bacterial water quality at the site and should, to some degree, correlate with the bacterial water quality results obtained from sampling. Sanitary inspections are discussed in detail in the following section.

Through the sanitary inspection process, beaches are categorised to reflect the likelihood of faecal contamination. There are five categories, ranging from Very Low to Very High.

The knowledge of the catchment, pollution sources and receiving water processes gained from the sanitary inspection provides beach managers with a good foundation for investigating pollution incidents, prioritising and implementing pollution abatement measures, and providing sound advice to the community on where and when to swim.

Reporting beach water quality information

Water quality data and results

All data collected as part of the Beachwatch, Harbourwatch and Beachwatch Partnership programs can be downloaded from the Beachwatch website (www.environment.nsw.gov.au/beach).

Daily bulletins

The Beachwatch and Harbourwatch Daily Bulletins provide the community with advice on the likelihood of pollution at Sydney ocean and estuarine beaches. The bulletins are released at 7:30 am every day during the swimming season (October to April). Outside this period, the bulletin is released at 9:30 am on weekdays, with a weekend forecast is issued at 5:00 pm on Friday afternoons.

The likelihood of pollution is determined from rainfall in the previous 24 to 72 hours and uses the relationship between enterococci levels and rainfall at each beach. When the rainfall exceeds the pre-

determined rainfall threshold for the beach or waterway, the bulletin indicates that pollution is 'LIKELY'.

The Daily Bulletins are updated during the day as beach and weather conditions change and in response to incident reports from council lifeguards or Sydney Water. The bulletin is also updated to include information on beach closures.

The Daily Bulletins are available online (www.environment.nsw.gov.au/beach), via a recorded telephone information line (1800 036 677), and by email.

Weekly reports – star ratings

Weekly star ratings were introduced in 1996 as a community information service for beach users in the Illawarra and Hunter regions. Star ratings are currently available for most sites in the Beachwatch, Harbourwatch and Beachwatch Partnership programs on the Beachwatch website.

Beaches are allocated one to four stars, based on the Microbial Assessment Categories in the NHMRC 2008 Guidelines (Table 4)

Star ratings are based on the latest enterococci result for a beach. They provide a snapshot of water quality at the site; the result will depend on rainfall prior to sampling or any pollution incidents. The star rating for a particular day may not be indicative of long-term water quality.

Table 4: Microbial Assessment Categories

Star rating	Enterococci result	Description
★★★★	<41 cfu/100 mL*	Good
★★★	41–200 cfu/100 mL*	Fair
★★	201–500 cfu/100 mL*	Poor
★	>500 cfu/100 mL*	Bad

* Based on Microbial Assessment Category ranges in Table 3.

Monthly reports

The monthly reports summarise the results of water quality analyses, compare these with rainfall, and may also include reported visual pollution or information from telemetered sewage overflows. They are provided for swimming sites in the Beachwatch and Harbourwatch programs and are available on the Beachwatch website.

Media releases

Media releases are issued by many local councils participating in the Beachwatch Partnership Program, usually at the start of the swimming season, at the peak Christmas holiday period and at the end of the swimming season. The media releases advise on the scope of the councils program and provide a summary of results.

Annual State of the Beaches report

The State of the Beaches report is issued around the start of the swimming season each year, usually in October or November. The report provides a comprehensive summary of activities and results of water quality monitoring for the previous year.

In previous years, two State of the Beaches reports have been released, one for the Beachwatch and Harbourwatch programs, covering the Sydney, Hunter and Illawarra regions, and one for the Beachwatch Partnership Program, covering swimming locations monitored by local councils. This report combines both of these reports.

State of the Beaches reports from 1999–2000 onwards are available on the Beachwatch website (www.environment.nsw.gov.au/beach).

Chapter 2
Sanitary Inspections

The sanitary inspection provides an 'assessment of the area's susceptibility of influence from human faecal contamination' (WHO 1999). It is a qualitative assessment of bacterial water quality at the site, and should, to some degree, correlate with the bacterial water quality results obtained through sampling.

The sanitary inspection process

There are three key steps:

1. identify all pollution sources that might affect a swimming location
2. determine the likelihood of each source affecting the site
3. determine the overall likelihood, or Sanitary Inspection Category, for the site.

The results of the Sanitary Inspection for each site are presented on the beach pages in Chapter 4 of this report.

Step 1: Identify pollution sources at a site

While a sanitary inspection investigates all sources of faecal pollution affecting a swimming site, a lower weighting is given to animal sources. This is because many of the pathogens in animal faeces do not affect human health owing to the 'species barrier' (NHMRC 2008, WSAA 2003). Animal sources are not excluded completely because there are some human pathogens found in animal faeces, such as *Cryptosporidium parvum* and *E. coli* (WHO 2003).

The main sources of faecal pollution affecting recreational waters are:

- bather shedding
- toilet facilities
- stormwater discharges
- sewage/wastewater treatment plant discharges and bypasses
- sewage overflows
- sewage chokes and leaks
- on-site sewage/wastewater treatment systems (such as septic tanks)
- wastewater re-use
- river discharges
- lagoon (or coastal lake) discharges
- boats
- animals.

While this list is extensive, where other sources are present at a swimming site they are also included in the sanitary inspection. The pollution sources are described later in this section.

Information on pollution sources is gathered from desktop study, field inspections, and interviews with sewerage authorities, local council officers, lifeguards and other stakeholders.

Step 2: Determine the likelihood for each pollution source

For each identified pollution source, the likelihood of a public health event occurring must be determined. A public health event can be conservatively defined as an occasion when a pollution source could cause enterococci levels in excess of the illness threshold of 40 cfu/100 mL at a swimming site. The likelihood categories are defined in Table 5.

Table 5: Microbial Assessment Categories

Category	Definition
Very Low	Event occurs only in exceptional circumstances: about once every ten bathing seasons
Low	Event occurs infrequently: once every five bathing seasons
Moderate	Event occurs occasionally: once or twice each bathing season
High	Event occurs with some regularity: three or four times each bathing season
Very High	Event occurs frequently: several times each month

Step 3: Determine the Sanitary Inspection Category for the site

The Sanitary Inspection Category is the overall likelihood posed by all identified sources of faecal contamination at a site and is categorized as Very Low, Low, Moderate, High or Very High.

While it is not possible to sum qualitative values such as the likelihood categories (Very Low, Low etc.), the categories are derived from event frequencies that are quantitative (Table 6).

Table 6: Likelihood categories, values and category ranges

Likelihood	Event frequency	Value	Category range
Very Low	1 in 10 bathing seasons	0.1	<0.2
Low	1 in 5 bathing seasons	0.2	0.2 to <1
Moderate	1 per bathing season	1	1 to <3
High	3 per bathing season	3	3 to <12
Very High	12 per bathing season	12	12 or greater

To determine the overall likelihood, or Sanitary Inspection Category, the likelihood values for all pollution sources at a site are summed to give a total value. This total value is then compared with the category range to determine the overall likelihood, or Sanitary Inspection Category.

For example: Site A has four identified sources of pollution with associated likelihoods of Very Low, Moderate, Moderate and High. The overall likelihood would be 0.1 + 1 + 1 + 3 = 5.1 = High (range of 3 to <12). The Sanitary Inspection Category for the site is therefore High.

The pollution sources

Bather shedding

A number of studies have found that bathers themselves can be a source of faecal contamination in recreational waters (NHMRC 2008). The effect is greatest at sites where:

- dilution and tidal flushing are low, for example in shallow coastal lakes
- bather density is very high
- small children swim, wade or play at the site
- there are no toilet facilities.

Toilet facilities

Leaks from toilet facilities are most likely to be a source of microbial contamination when they are:

- located in very close proximity to the swimming area (<50 metres)
- not connected to the sewer, but rely on on-site treatment
- very old and require upgrading
- present in high numbers (high flow)
- located at a very popular beach (high use).

A history of discharges, leaks or odours may also indicate that toilet facilities are more likely to be a source of contamination.

Stormwater

Rainwater is removed from urban environments via the stormwater system. The runoff can carry a range of natural and artificial compounds found in, or derived from, the catchment, including:

- silt and organic or inorganic suspended particles
- sewage from overflows and leakages in the sewerage system
- animal faecal waste (for example, dog droppings)
- oils, greases and surfactants from roadways and industrial and domestic sites
- plant fertilisers, pesticides and chemicals from building sites and gardens
- litter (including rubbish and leaf litter, grass clippings and twigs).

The amount of runoff is determined by factors such as the volume and intensity of rainfall, the geology and topography, the proportion of impervious surfaces in a catchment, and the soil saturation.

Stormwater drains will have the greatest impact on recreational waters when the:

- discharge volume is large because the catchment is large and/or the area receives high rainfall
- catchment is densely populated
- catchment's sewerage system is old and/or poorly maintained
- drain discharges close to the swimming area.

Urban runoff is typified by large volumes of fast-flowing turbid water entering drains within minutes of a rain event and eventually draining into the local creeks, rivers and harbours and onto beaches.

Very high levels of bacteria have been measured in stormwater drains at Sydney's beaches. It is recommended that all contact with stormwater be avoided, including stormwater pooled on the beach. Swimming in the vicinity of stormwater drains should also be avoided.

Sewage treatment plant discharges

Sewage treatment plants (also know as wastewater treatment works) are located near most urban centres and remove pollutants from sewage before discharging it to the environment. Discharges from sewage/wastewater treatment plants will have the greatest impact when the:

- discharge point is located close to the swimming area
- level of dilution and dispersion available in the receiving water is low
- level of treatment at the plant is low
- volume of effluent discharged is high.

Sewage treatment levels are defined in Table 7.

Bypasses from sewage/wastewater treatment plants

On occasion, sewage entering a sewage/wastewater treatment plant may not receive full treatment before discharge to the environment. This can occur because of human error, mechanical malfunction or electrical malfunction. During wet weather it can also occur when the capacity of the plant is exceeded due to large volumes of rainwater in the sewer system. Sewage treatment bypasses will have the greatest impact on recreational waters where the treatment plant:

- bypasses frequently because it is operating close to operational capacity, has no storage capacity and/or is subject to large peaks in flow during wet-weather
- uses older technology without backup or warning systems
- is unable to disinfect bypassed effluent.

The level of dilution in receiving waters is particularly important when assessing potential impact. The volume of effluent discharged and the tidal movement, currents and depth of the receiving water are all considered.

Table 7: Levels of sewage treatment

Level	Treatment processes
None	No treatment – raw sewage discharged.
Preliminary	Screen filtration to remove large solid material.
Primary	Sewage is filtered through fine screens to remove material like paper, cotton tips and plastic. Heavier particles like sand sink to the bottom and are removed. The sewage then flows into the primary sedimentation tanks where human waste, called sludge, settles to the bottom and oils and grease float to the surface where they are collected.
Secondary	This step removes dissolved and suspended organic and inorganic solids. Bacteria are used to naturally break down the material, then particles settle to the bottom of the tank for collection.
Tertiary	This step further removes inorganic compounds, and substances such as the plant nutrients nitrogen and phosphorus.
Disinfection	Tthis step can be added to any treatment level to inactivate disease-causing micro-organisms such as bacteria, viruses and parasites.

Sewage overflows

During wet weather rainwater can enter the sewerage system through cracks in the pipes or illegal connections from the stormwater system. If the flow in the pipe increases to beyond the capacity of the sewer, the excess flow (a mix of stormwater and sewage) will discharge from designed overflow structures to prevent the sewer backing up and overflowing into houses.

Sewage overflows can also occur during dry weather when mechanical and electrical components of the sewer system, such as those at pumping stations, fail because of power outages or other failures.

Sewage overflow points are designed into the system in order to minimise discharges to habitation and the risk to human health. Sewage overflows generally either occur directly to receiving waters or enter the stormwater system and then flow to receiving waters.

Sewage overflows will have the greatest impact on recreational waters when the:

- overflow point is located close to the swimming location
- sewer system is old or poorly maintained, with cracks allowing rainwater to enter the pipes and increase flow beyond the design capacity
- sewer system is operating at close to capacity due to increases in serviced population
- sewer system serves a large population.

Sewer chokes and leaks

Sewage chokes occur when sewer pipes become blocked by tree roots, oil and grease or debris. Sewage builds up behind the blockage, leading to discharge from openings in the sewer, usually at inspection points or designed overflow structures. Sewers may also leak sewage through cracks in the pipes or areas where the pipe has been damaged.

Sewer chokes and leaks will have the greatest impact on recreational waters when:

- they are located close to the swimming location
- the sewer is operating at close to capacity owing to increases in serviced population
- large trees are planted in the vicinity of sewer pipes.

On-site sewage treatment systems

On-site systems, such as septic tanks, will have the greatest impact on recreational waters when they are:

- incorrectly designed or located,
- not maintained and/or there are reports of leaks or odours
- present in large numbers in the catchment
- located close to the swimming area, particularly if soils are sandy and porous.

Wastewater re-use

Wastewater re-use, such as irrigation of treated sewage effluent on grazing land or parks or outside use in residential areas where a dual reticulation system is provided, can be a source of faecal contamination in recreational waters, particularly when:

- wastewater is not treated to a high level before re-use
- the re-use area is located close to the swimming site and soils are porous or sandy
- a large volume of effluent is re-used.

River/creek discharges

Discharges from the rivers and creeks can be a significant source of faecal contamination to recreational waters, particularly when:

- the volume of river/creek discharge is high because the catchment is large and/or the region receives high rainfall
- there are many sources of faecal contamination in the catchment and the level of faecal contamination in the river/creek water is high
- the river discharges close to the swimming site.

It should be noted that, when rivers or creeks were identified as a pollution source, care was taken to ensure that sources of faecal contamination affecting the river/creek water quality were not double-counted as pollution sources also affecting the swimming site.

Where sewage/wastewater treatment plants discharge to a river, the impacts of these will be greatest when:

- the level of treatment at the sewage/wastewater treatment plant is low
- there is a large population in the catchment and a large volume of effluent is discharged from the plant
- the flow in the river is low, providing little dilution of discharged effluent.

Lagoons

Many coastal lagoons are open to the ocean only following large wet weather events. Water quality in these lagoons tends to be poor due to the low levels of tidal flushing from clean ocean waters. These lagoons rarely affect recreational waters during dry weather conditions, but they have significant impacts when the entrance is forced following heavy rainfall.

In some cases, the lagoon entrance (outlet) has been modified and the lagoon is open to the ocean for much of the time. Water quality in these lagoons tends to be of higher quality due to tidal flushing. However, discharges can affect recreational waters during dry weather conditions as well as during wet weather conditions.

Coastal lagoons/lakes will have the greatest impact on recreational waters when:

- discharge volumes from the lagoon are high due to large catchment area and/or the area receives high rainfall
- the outflow is located close to the swimming site
- the lagoon receives urban or agricultural runoff or discharges from the sewerage system, such as sewage overflows.

Boats

Disposal of human sewage from boats can contribute to faecal contamination in recreational waters.

Boats will have the greatest impact when there are:

- a large number of boats in the vicinity of the site
- no requirements for holding-tanks or effluent treatment before disposal
- no or insufficient pump-out facilities for boats
- no on-shore toilets.

Animals

Animal faeces can affect recreational waters, particularly when:

- large numbers of aquatic birds are present at the site
- large numbers of native animals are present at the site
- domestic animals have direct access to the water
- domestic animal exercise areas are not regularly cleaned of animal faeces.

Effect of rainfall

Rainfall has an important effect on flow rates in sewerage systems and stormwater drains. Each beach has a different response, depending on the catchment area, the extent and stage of development, and the condition of the sewerage system.

In general, faecal contamination increases with rainfall, but some beaches appear to reach a rainfall threshold above which faecal contamination rises rapidly (for example, North Curl Curl Beach in Sydney), whereas others exhibit an apparent log-linear response (for example, Tamarama Beach in Sydney). Others appear to be largely unaffected by rainfall (for example, Box Beach in Port Stephens Shire Council area).

Response to rainfall plots are provided for each swimming site on the beach pages in Chapter 4, with information on their interpretation provided at the beginning of Chapter 4.

Chapter 3
Managing Beach Pollution

Management of beach pollution is the joint responsibility of State and Local governments, with many non-government and community groups and individuals also making a significant contribution to pollution prevention. While many projects are outlined in detail in the council pages of this report, a broad overview of some of the key programs is provided below.

NSW Government

Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) provides the NSW environmental regulatory framework and includes a licensing requirement for certain activities.

Environment protection licences are used to control the localised, cumulative and acute impacts of pollution in NSW. The licences aim to protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development and to reduce risks to human health.

Discharges from sewage treatment plants in NSW are licensed under the POEO Act. These licences require progressive environmental improvements, including the reduction of pollution at source and the monitoring and reporting of environmental quality on a regular basis.

Discharges from the sewage transport systems (pipes and pumping stations) managed by Sydney Water Corporation and Hunter Water Corporation are also licensed. These licences contain performance targets and require that the frequency and volume of sewage overflows and sewage chokes be reduced.

Environmental Trust

Funding for sustainability projects is provided under the NSW Government's Environmental Trust $80 million Urban Sustainability Program. Grant funding is targeted at local councils working with the community and business to protect and improve the urban environment. Some funded projects have specifically addressed urban water management issues, including stormwater management, reducing urban runoff and improving water quality.

In 2008, $30 million in grant funding was made available through the Urban Sustainability Major Projects and Urban Waterways Initiative for up to three years. The priority catchment areas for the Urban Waterways funding stream are the Cooks River, Georges River, Hawkesbury Nepean River, Central Coast/Lower Hunter catchments and Sydney Harbour.

From 2006 to 2008 the Environmental Trust provided over $19.8 million for 26 projects to improve the condition of degraded urban waterways through rehabilitation and restoration activities. The projects implemented include initiatives such as stormwater reuse schemes, water-sensitive urban design, and activities to restore streams and creeks in various local government areas, improving local water quality and overall catchment health. These projects have also included the implementation of education and engagement programs around maintaining the health of urban catchments.

Further information on the Environmental Trust's grant programs is available on the DECCW website (www.environment.nsw.gov.au/grants/envtrust.htm).

Diffuse Source Water Pollution Strategy

The NSW Government has developed a state-wide Diffuse Source Water Pollution (DSWP) Strategy to reduce diffuse source pollution inputs into all NSW surface and ground waters. Diffuse source water pollution is the contamination of water bodies by pollutants (such as pathogens, chemicals and salinity) from urban and rural land-use activities in the catchment.

The DSWP Strategy will contribute towards the NSW water quality objectives and state-wide natural resource management targets listed in the State Plan. The DSWP Strategy will bring together Catchment Management Authorities (CMAs), relevant NSW government agencies and local councils to jointly manage and address these issues.

Water utilities

Sydney Water Corporation

Sydney Water Corporation is a statutory State-owned corporation responsible for providing water and sewerage services to the Sydney, Blue Mountains and Illawarra regions (an area of over 12,700 square kilometres). They are responsible for more than 23,500 kilometres of sewerage pipes and operate 11 coastal sewage treatment plants. Sydney Water Corporation undertakes a range of projects and programs to minimise impacts from the sewage treatment and transport systems; these are in the regional and relevant council summaries in this report.

Sydney Water Corporation also manages five per cent of Sydney's stormwater network, mainly in the lower reaches of catchments where the stormwater channels are large and cross a number of council boundaries. Approximately 65 stormwater quality improvement devices, such as litter booms, sediment traps, gross pollutant traps and a wetland have been installed and remove pollutants from nearly 46 per cent of the stomrwater runoff in Sydney Water's infrastructure.

Hunter Water Corporation

Hunter Water Corporation is a statutory State-owned corporation responsible for providing water and sewerage services to the Hunter Region (an area of over 5300 square kilometres). It is responsible for more than 4500 kilometres of sewerage pipes and operates five sewage treatment plants, which discharge to the ocean. Projects and programs to minimise impacts from the sewage treatment and transport systems are described in the regional and relevant council summaries in this report.

Hunter Water Corporation also manages sections of the stormwater network in the lower Hunter, consisting of just over 94 kilometres of channel.

Local councils

Urban Stormwater Program

Local councils have extensive responsibility for the stormwater system. In Sydney alone, they are collectively responsible for stormwater assets worth more than $1.5 billion.

Councils have made significant improvements in stormwater management over the last decade, with many programs funded under the NSW Government's Urban Stormwater Program, which ran from 1997 until 2006. This program provided $67 million in funding, with an additional $40 million provided by councils.

Projects included stormwater harvesting, wetland construction, installation of gross pollutant traps and community education. As of June 2009, an estimated 39,000 tonnes of pollution has been prevented from entering our waterways as a result of the program's activities.

Stormwater levy

The Local Government Amendment (Stormwater) Bill was passed in October 2005 to enable local councils to raise additional revenue for river health improvements, flood mitigation, stormwater harvesting and asset management.

Stormwater management plans

All councils in NSW have developed stormwater management plans, often in partnership with neighbouring councils and other stakeholders, such as the Roads and Traffic Authority and Sydney Water. These plans assist councils to manage stormwater pollution more effectively on a catchment-wide basis.

Development

Local councils regulate the siting and construction of buildings in their LGAs. Construction sites can be a significant source of stormwater pollution, and councils ensure that developments do not overload the stormwater system, causing flooding, and do not contribute sediment pollution.

On-site sewage treatment systems

Local councils are not only responsible for approving the installation of on-site sewage treatment systems and dealing with complaints about odours and discharges; they are also required to undertake systematic monitoring and reporting of system performance to manage risks to the environment and public health.

Lifeguard services

Local councils are responsible for all aspects of beach management, including access, waste management and beach safety. Most local councils provide lifeguard services at popular beaches, in addition to the volunteer Surf Life Saving Clubs. These services may operate year-round or only during the summer holiday period. Details of lifeguard services are provided in each council section.

Environment and community groups

A great range of commercial and non-profit groups are also doing their bit to tackle stormwater pollution. These include council and commercially funded environment centres, volunteer groups, and stormwater and wastewater associations.

These groups are working closely with local business, industry and government agencies on cooperative projects to improve stormwater quality and eliminate pollution, as well as developing 'leading edge' technology and approaches to stormwater management and pollution control. They also play an important role in community education on water pollution issues.

You, your friends and family

To help protect your local beach and waterway, there are plenty of community groups to join:

- Contact Streamwatch to find out if there is a group linked to your local school.
- Get involved in local activities sponsored by Clean-Up Australia and Keep Australia Beautiful.
- Call your local council to find out about Bushcare activities in your local area.
- Join a local conservation group, such as Dune Care, Landcare or Coastcare, or the Australian Trust for Conservation Volunteers.

Further information can be accessed from the Marine and Coastal Community Network (www.mccn.org.au). The Network promotes information-sharing among community groups, government agencies and industry.

For information on how to live more sustainably at home, work and play, visit the Our Environment It's a Living Thing (www.livingthing.net.au) and Water for Life (www.waterforlife.nsw.gov.au) websites.

You can also make a difference at the beach:

- Take litter and leftovers home with you.
- Park cars carefully, preferably on hard surfaces, to avoid damaging grass verges or coastal vegetation.
- Keep beach showers to a minimum.

The community can help prevent beach pollution in lots of ways. Table 8 lists the ways in which you can help to improve stormwater quality and Table 9 lists ways you can ease the load on the sewer system.

Table 8: Ways to improve stormwater quality

Actions to do more often	Actions to avoid
Pick up litter in the park or on the street.	Washing the car in the street.
Sweep the gutters and driveways regularly and place the sweepings on the garden or in the compost or green waste bin.	Hosing dirt off hardstand surfaces (roads, paths, driveways) into gutters.
Clean up pet droppings and dispose of them in the garden, rubbish bin or toilet.	Dropping packaging or cigarette butts on the ground.
Rake up leaves or lawn clippings and use them as mulch on the garden or place them in the compost.	Leaving rubbish where bins are already full.
Grass or replant areas of disturbed soil.	Piling sand and soil on areas where it can wash into the stormwater system.
Purchase water-efficient appliances	Hosing leaves and grass clippings into gutters.
Maintain the car, making sure there are no leaks and that the fuel is burnt 'cleanly' by keeping the vehicle tuned.	Washing cement mixes into the gutter.
Use the minimum amount of detergent for cleaning outside.	Overuse of chemicals (pesticides, herbicides) in the garden.
Wash paint-brushes and rollers over a sand filter on the lawn.	Using too much fertiliser (follow the instructions).
Take the car to a car wash where the water is treated and recycled.	Using pesticides and herbicides when rain is forecast the same day.
Make sure sewerage pipes are not connected illegally to stormwater.	Vehicle maintenance where oil and grease may wash into gutters.
Install a rainwater tank.	Pouring paint, solvent or cleaners in the gutter or where they may enter drains.
Direct roof runoff from downpipes to the garden (with council approval).	Disposing of oil or chemicals into gutters.
Replace impermeable surfaces (e.g. concrete) with permeable surfaces such as timber decks.	Covering large areas with impervious surfaces, e.g. concrete, bitumen.
Plant native gardens that require less water, fertiliser and pesticides.	
Have a composter or worm farm for garden and household organic waste.	

Table 9: Ways to ease the load on the sewer

Actions to do more often	Actions to avoid
Install dual flushing in the toilet.	Putting oil down the sink.
Get sewer pipes smoke-tested for false stormwater connections.	Planting trees near sewer lines, as tree roots are a major cause of pipe damage.
Use a sink strainer.	Stormwater entering outdoor sewer pits.
Use the dishwasher and washing machine only when there is a full load. This not only reduces the amount of detergents entering the sewer system, but also saves water and energy.	Putting vegetable scraps, tea leaves, coffee grounds or eggshells down the sink. These can be composted.
	Using the toilet as a garbage bin by flushing tampons, sanitary napkins, condoms, cotton buds and cigarette butts down the toilet. Place them in a bin instead.
	Washing hair down drains. This can be composted.

Chapter 4
Results for 2009-2010

Presentation of results

This report includes results from all swimming locations monitored in New South Wales under the Beachwatch, Harbourwatch and Beachwatch Partnership programs. Results are presented for eight regions:

- Far North Coast (Byron Bay, Ballina, Richmond Valley and Clarence Valley councils)
- North Coast (Coffs Harbour, Kempsey and Port Macquarie–Hastings councils)
- Hunter (Port Stephens, Newcastle and Lake Macquarie councils)
- Central Coast (Wyong and Gosford councils)
- Sydney Ocean Beaches (Pittwater, Warringah, Manly, Waverley, Randwick and Sutherland councils)
- Sydney Estuarine Beaches
- Illawarra (Wollongong, Shellharbour and Kiama councils)
- South Coast (Shoalhaven, Eurobodalla and Bega Valley councils).

Each region includes a general overview, an overview of the council or waterway and beach pages showing results for individual swimming locations.

Explanation of graphs and charts on beach pages

Firm conclusions about beach water quality cannot be made on the basis of a single bacterial result, owing to the inherent variability in bacterial data. However, trends in bacterial density can provide useful information.

Sanitary Inspection Category charts

The Sanitary Inspection process is described in Section 2 of this document. The results of the Sanitary Inspection for each swimming location are presented in a vertical bar chart, such as the one in Figure 1. The graph shows the likelihood that each identified pollution source will contribute to faecal contamination at a swimming site, as indicated by size and colour of the components of the bar, with the sum of these contributions being the overall likelihood, or Sanitary Inspection Category.

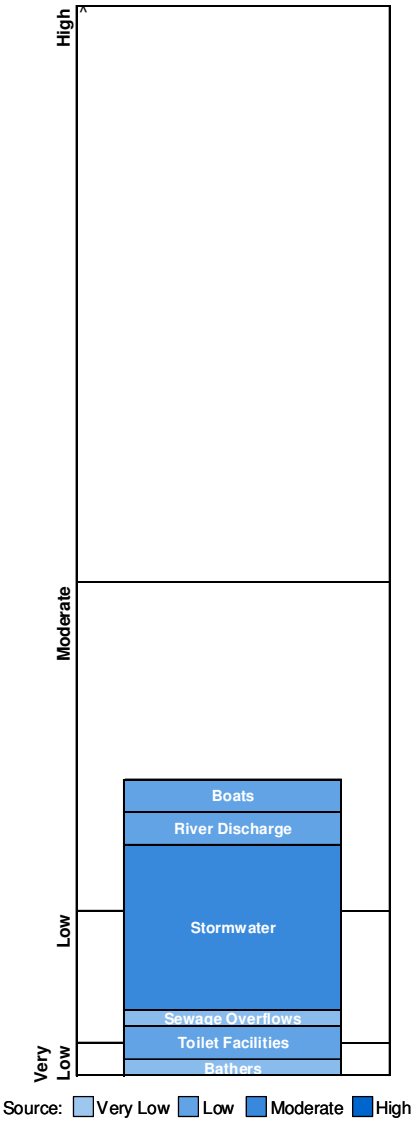


Figure 1: Example Sanitary Inspection chart

In Figure 1, the Sanitary Inspection identified six possible sources of microbial contamination at the site. Bathers and Sewage Overflows were assessed as having a Very Low likelihood of contamination; Toilet Facilities, River Discharge and Boats were assessed as having a Low likelihood of contamination; and Stormwater was assessed as

having a Moderate likelihood of contamination. The sum of these likelihoods (=the overall likelihood or Sanitary Inspection Category) was Moderate.

Where the bar extends up to a line, this is the start of the next Sanitary Inspection Category.

Microbial Assessment Category graphs

The Microbial Assessment Category graphs are simple bar graphs that show the 95th percentile values at a swimming location over the last five years (Figure 2). The 95th percentile value is labelled, and thresholds dividing the A, B, C and D categories are marked for reference (see Table 3).

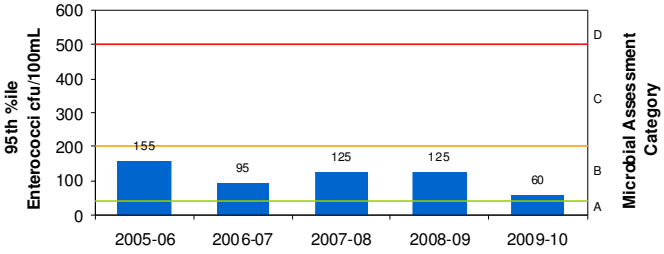


Figure 2: Example Microbial Assessment Category chart

Response to rainfall plots

Trends in enterococci levels in response to rainfall are shown using a box plot (Figure 3). This graph shows the spread, skew and distribution of the enterococci data in each of five rainfall categories.

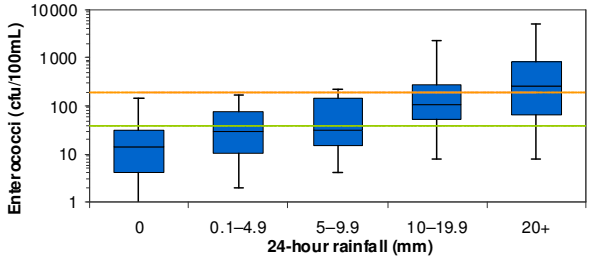


Figure 3: Example response to rainfall plot

Each part of the box plot represents a significant percentile value of the sample population (Figure 4):

- 5% of the samples lie below the bottom whisker.
- 25% of the samples lie below the bottom of the box
- half the samples are on each side of the middle line of the box (median)
- 75% of the samples lie below the top of the box
- 95% of the samples lie below the top whisker.

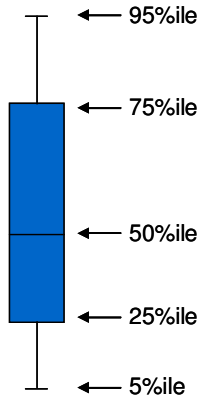


Figure 4: Box plot

The enterococci data in the response to rainfall graphs were obtained from the last five years of monitoring. Rainfall data were obtained from rain gauges situated close to the sample site. They are presented as a range and are for the 24 hours to 9:00 am on the day of sampling.

Box plots are not generated if there are fewer than five enterococci data points in a rainfall category and individual data points are presented. At sites where many results are below the detection limit (1 cfu/100 mL), only the upper portion of the box plots will be visible.

Epidemiological studies suggest that enterococci levels above 40 cfu/100 mL indicate an increased health risk to bathers and levels above 200 cfu/100 mL indicate a substantially increased health risk. These levels are marked on the graphs for comparison. The 40 cfu/100 mL level is referred to as the 'safe swimming limit'.

Historical enterococci data graphs

Trends in enterococci levels through time are presented for each swimming location as a bar graph (Figure 5). Each year's bar is colour coded to show the percentage of enterococci results less than 40 cfu/100 mL, between 41 and 200 cfu/100 mL, between 201 and 500 cfu/100 mL and greater than 500 cfu/100 mL. These categories reflect the Microbial Assessment Category thresholds.

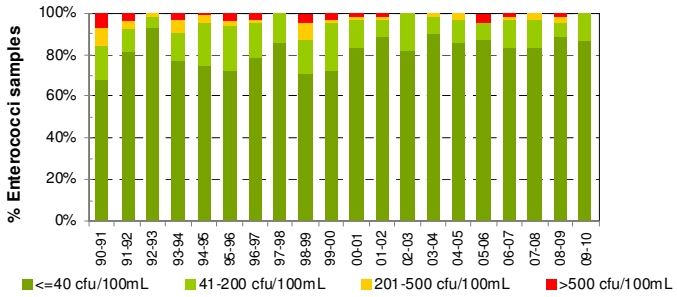


Figure 5: Example historical enterococci data graph