State of the beaches
2016–2017
Hunter region
Contents

Hunter region summary 2016–2017 1
  Beach monitoring in NSW 1
  Rainfall impacts 1

Port Stephens Council 5
  Overall results 5
  Management 7
  Zenith Beach 9
  Box Beach 10
  Fingal Beach 11
  One Mile Beach 12
  Birubi Beach 13
  Little Beach 14
  Dutchmans Beach 15
  Bagnalls Beach 16
  Lemon Tree Passage Tidal Pool 17
  Karuah Tidal Pool 18
  Georges Reserve 19

Newcastle City Council 20
  Overall results 20
  Management 21
  South Stockton Beach 23
  Nobbys Beach 24
  Newcastle Beach 25
  Bar Beach 26
  Merewether Beach 27
  Burwood North Beach 28
  Burwood South Beach 29

Lake Macquarie City Council 30
  Overall results 30
  Management 32
  Glenrock Lagoon Beach 34
  Dudley Beach 35
  Redhead Beach 36
  Blacksmiths Beach 37
  Swansea Heads Little Beach 38
  Caves Beach 39
  Catherine Hill Bay 40
<table>
<thead>
<tr>
<th>Location</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eleebana (Lions Park)</td>
<td>41</td>
</tr>
<tr>
<td>Croudace Bay</td>
<td>42</td>
</tr>
<tr>
<td>Arcadia Vale</td>
<td>43</td>
</tr>
<tr>
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<td>44</td>
</tr>
<tr>
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</tr>
<tr>
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<td>46</td>
</tr>
<tr>
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<td>47</td>
</tr>
<tr>
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<td>48</td>
</tr>
<tr>
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<td>49</td>
</tr>
<tr>
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<td>50</td>
</tr>
<tr>
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<td>51</td>
</tr>
<tr>
<td>Balcolyn</td>
<td>52</td>
</tr>
<tr>
<td>Sunshine</td>
<td>53</td>
</tr>
</tbody>
</table>

**How to read this report**

- Beach Suitability Grades    54
- Explanation of tables       54
- Explanation of graphs, charts, and information bars on beach pages 59

**References** 63
Recreational water quality has been monitored in the Hunter region since 1996 by Hunter Water Corporation as a requirement of Environment Protection Licences, and by Port Stephens Council and Lake Macquarie City Council under the Office of Environment and Heritage’s Beachwatch Partnership Programs. This report summarises the performance of 38 swimming sites in the Hunter region of New South Wales, providing a long-term assessment of how suitable a site is for swimming. Monitored sites include ocean beaches, estuarine areas in Port Stephens and designated swimming sites in Lake Macquarie.

In 2016–2017, 79% of swimming sites in the Hunter region were graded as Good or Very Good. These sites were suitable for swimming for most or almost all of the time. This is a good result, similar in performance to the previous year even with prolonged wet weather periods and significant storm events. The Hunter region has a large proportion of lake/lagoon and estuarine swimming locations in its program, which have been most susceptible to impacts from wet weather conditions.
Hunter region summary
2016–2017

Beach monitoring in NSW

The water quality of beaches and other swimming locations is monitored under the NSW Government’s Beachwatch programs 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 needed.

Swimming sites in New South Wales are graded as Very Good, Good, Fair, Poor or Very Poor in accordance with the National Health and Medical Research Council’s 2008 Guidelines for Managing Risks in Recreational Waters. These Beach Suitability Grades provide a long-term assessment of how suitable a beach is for swimming. The grades are determined from the most recent 100 water quality results (two to four years’ worth of data depending on the sampling frequency) and a risk assessment of potential pollution sources.

Recreational water quality has been monitored in the Hunter region by Hunter Water Corporation since 1996, Port Stephens Council since 2004 and Lake Macquarie City Council since 2010.

A quality assurance program ensures that the information collected and reported by Beachwatch and its partners is accurate and reliable.

Rainfall impacts

Rainfall is the major driver of pollution to recreational waters, generating stormwater runoff and triggering discharges from the wastewater treatment and transport systems. Changes in rainfall patterns are reflected in beach water quality over time due to variation in the frequency and extent of stormwater and wastewater inputs.

The Beach Suitability Grades for 2016–2017 are based on water quality data collected over the last two to four years. Rainfall over this period has been diverse, beginning with dry weather conditions, then a very wet year for the coast, and...
then variable rainfall with some heavy rain events, as well as extended dry periods:

- 2013–2014: driest summer in almost 30 years
- 2014–2015: above average rainfall, particularly on the coast
- 2015–2016: variable rainfall with significant wet weather events
- 2016–2017: variable rainfall with persistent dry periods and isolated wet months.

An east coast low event produced heavy rainfall along the Hunter coast from 4–6 June 2017, with 88mm recorded at Nobbys Beach (Newcastle) over the three days.

Extended dry weather conditions were experienced in late 2016 and early 2017, with below average rainfall at most coastal areas during these months.

Persistent rain fell throughout March 2017, making it the wettest March on record in many coastal areas. Nobbys Beach recorded more than double the monthly average with 238mm of rain falling during March over 20 days.

**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 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.
### Beach Suitability Grades for Hunter region

<table>
<thead>
<tr>
<th>Swimming site</th>
<th>Site type</th>
<th>Beach Suitability Grade</th>
<th>Change</th>
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<tbody>
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<td>G</td>
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<td>VG</td>
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<td>Birubi Beach</td>
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<td>Karuah Tidal Pool</td>
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<td>Georges Reserve</td>
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<td>Lake/Lagoon</td>
<td>G</td>
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<td>Lake/Lagoon</td>
<td>P</td>
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<td>P</td>
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<td>Lake/Lagoon</td>
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<td>Balcolyn</td>
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<tr>
<td>Sunshine</td>
<td>Lake/Lagoon</td>
<td>G</td>
<td>▼</td>
</tr>
</tbody>
</table>

VG = Very good  G = Good  F = Fair  P = Poor  VP = Very poor
▲ = Improved  ▼ = Stable  ▼ = Declined
Port Stephens Council

Overall results

Nine of the 11 swimming sites were graded as Very Good or Good in 2016–2017. This is a similar performance to the previous year.

Percentage of sites graded as Very Good or Good:
- 2016–2017: 82%
- 2015–2016: 82%
- 2014–2015: 100%
- 2013–2014: 100%.

See the section on How to read this report on page 54 for an explanation of the graphs, tables and Beach Suitability Grades.

Best beaches

Zenith Beach, Box Beach, One Mile Beach and Birubi Beach.

These sites had excellent water quality and were suitable for swimming almost all of the time.

Swimming sites monitored in the Port Stephens region include ocean beaches and estuarine areas in Port Stephens, with each site type having a different response to rainfall-related impacts.

In general, estuarine swimming sites did not perform as well as ocean beaches, due to lower levels of flushing to disperse and dilute pollution inputs, taking longer to recover from stormwater events.

As a general precaution swimming should be avoided during and at least one day after heavy rain at ocean beaches, and up to three days in estuarine areas, or if there are signs of stormwater pollution such as discoloured water or floating debris.
Ocean beaches

Four of the five ocean beaches were graded Very Good: Zenith Beach, Box Beach, One Mile Beach and Birubi Beach. Water quality at these sites was suitable for swimming almost all of the time.

Fingal Beach was graded as Good in 2016–2017, downgraded from Very Good in the previous year. The water quality at this site was suitable for swimming most of the time, with elevated enterococci levels occasionally recorded during and one day after rainfall.

Swimming should be avoided for 24 hours after rainfall at ocean beaches, or if signs of pollution are present such as discoloured water or flowing stormwater drains.

Estuarine beaches

Four of the estuarine beaches in Port Stephens were graded as Good: Dutchmans Beach, Karuah Tidal Pool, Lemon Tree Passage Tidal Pool and Little Beach. Water quality at these sites is mostly suitable for swimming in dry weather conditions, but may be susceptible to pollution for up to three days after rainfall.

Bagnalls Beach and Georges Reserve were graded as Poor in 2016–2017, similar to the previous year. While microbial water quality at these sites has improved slightly, enterococci levels exceeded the safe swimming limit in low levels of rainfall. Elevated enterococci results were also occasionally recorded during dry weather. Swimming should be avoided at these sites during and for at least three days following rainfall.
Management

Port Stephens Council responds to reports of suspected algal contamination, stormwater and sewage pollution by managing swimming areas to minimise the risk to the swimmers. Council utilises various methods to communicate information to the public including council’s website and social media. If sewage or stormwater contamination is suspected, the swimming area may be closed and further water quality testing is undertaken until samples indicate that water quality is suitable for swimming.

There are more than 4800 on-site sewage management systems in the Port Stephens Council area, many of which are located in semi-rural villages and rural areas. Potential environmental and health impacts are managed by the council through routine inspections, application assessment and management, and an ‘approval to operate’ database.

Port Stephens Council is currently undertaking additional water sampling to investigate potential sources of faecal contamination impacting Bagnalls Beach and Georges Reserve.
Sampling sites and Beach Suitability Grades in Port Stephens Council
Zenith Beach

Zenith Beach is 400 metres long and is within Tomaree National Park. The beach is not patrolled by lifeguards.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with very few potential sources of faecal contamination.

Enterococci levels had little response to rainfall and remained below the safe swimming limit across most rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>100%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Box Beach

Box Beach is 350 metres long and within Tomaree National Park. The beach is not patrolled by lifeguards.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with only one potential source of faecal contamination.

Enterococci levels had very little response to rainfall and remained well below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

<table>
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<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
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<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>99%</td>
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Sanitary inspection: Very low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
### Fingal Beach

Fingal Beach is approximately 2.7 kilometres long and within Fingal Bay. The beach is patrolled from September to April.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rainfall, with several potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit across most rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
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<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>96%</td>
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### Sanitary inspection: Low

- Bathers
- Toilet Facilities
- Sewage Overflows
- Stormwater

### Microbial Assessment Category: B

![Graph showing Enterococci levels](image)

### Dry and wet weather water quality

![Graph showing Enterococci levels](image)

### Water quality in response to rainfall

![Graph showing Enterococci levels](image)
One Mile Beach

This 1.3 kilometre stretch of beach is at the southern end of Anna Bay and is patrolled from September to April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels had little response to rainfall and remained below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
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<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>99%</td>
<td>100</td>
<td>Stable</td>
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</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Birubi Beach lies among rocky outcrops at the northern end of Stockton Bight and is patrolled from September to April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered suitable for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 2004.

<table>
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<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
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<td>Ocean beach</td>
<td>Mar 2013 to Apr 2017</td>
<td>100%</td>
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<td>Stable</td>
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</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Little Beach

Little Beach is a netted swimming enclosure located on the southern shore of Port Stephens.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including river discharge.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to little or no rain.

The site has been monitored since 2004.

<table>
<thead>
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<th>Site type</th>
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<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
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</thead>
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<tr>
<td>Estuarine</td>
<td>Mar 2013 to Apr 2017</td>
<td>96%</td>
<td>100</td>
<td>Stable</td>
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</table>

Sanitary inspection: Low

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Dutchmans Beach (also known as Dutchies Beach) is on the southern shore of Port Stephens.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including river discharge.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit after 5mm or more of rainfall, and regularly after 20mm or more.

The site has been monitored since 2006.

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Sanitary inspection: Moderate

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Bagnalls Beach

Bagnalls Beach is located on the southern shore of Port Stephens.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination from river discharge and stormwater.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to little or no rainfall.

The site has been monitored since 2004.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
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<td>58%</td>
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Sanitary inspection: Moderate

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Lemon Tree Passage Tidal Pool is a netted swimming enclosure located in a shallow arm of Port Stephens.

The Beach Suitability Grade of Good indicates microbial water quality is generally safe for swimming but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including river discharge.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to little rainfall.

The site has been monitored since 2004.

<table>
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<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
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<td>Estuarine</td>
<td>Mar 2013 to Apr 2017</td>
<td>94%</td>
<td>100</td>
<td>Stable</td>
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Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Karuah Tidal Pool

Karuah Tidal Pool is a netted swimming enclosure located in the lower reaches of the Karuah River leading to Port Stephens.

The Beach Suitability Grade of Good indicates microbial water quality is generally suitable for swimming but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including river discharge.

Enterococci levels increased slightly with increasing rainfall, often exceeding the safe swimming limit in response to 20mm or more of rainfall.

The site has been monitored since 2004.

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<td>96%</td>
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**Sanitary inspection: Moderate**

**Microbial Assessment Category: B**

**Dry and wet weather water quality**

**Water quality in response to rainfall**
Georges Reserve

Georges Reserve is a narrow sandy beach located on the southern shore of Port Stephens.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with potential faecal contamination from river discharge and stormwater.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to little or no rain, and regularly after 10mm or more of rainfall.

The site has been monitored since 2005.

<table>
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<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Newcastle City Council

Overall results

All seven swimming sites were graded as Very Good or Good in 2016–2017. Excellent results were also recorded in previous years.

Percentage of sites graded as Very Good or Good:
- 2016–2017: 100%
- 2015–2016: 100%
- 2014–2015: 100%
- 2013–2014: 100%.

See the section on How to read this report on page 54 for an explanation of the graphs, tables and Beach Suitability Grades.

Best beaches

South Stockton Beach, Nobbys Beach, Newcastle Beach and Bar Beach.
These sites had excellent water quality and were suitable for swimming almost all of the time.

Ocean beaches were the only site type monitored in the Newcastle region.

As a general precaution swimming should be avoided during and at least one day after heavy rain at ocean beaches, or if there are signs of stormwater pollution such as discoloured water or floating debris.
Ocean beaches

Four of the seven ocean beaches were graded as Very Good: South Stockton Beach, Nobbys Beach, Newcastle Beach and Bar Beach. Water quality at these sites has been consistently excellent for many years, and is suitable for swimming almost all of the time.

Merewether Beach, Burwood North Beach and Burwood South Beach were graded as Good. Water quality at these sites was suitable for swimming for most of the time, however there are several potential sources of faecal contamination.

Management

Stormwater pollution warning signs have been permanently installed at swimming areas susceptible to stormwater pollution.

Hunter Water completed a $13 million upgrade to its wastewater system in Adamstown in 2012. The new pumping station and 4.5km of piping operates in periods of heavy rain to remove wastewater faster and greatly reduce the potential for overflows in the area.

Hunter Water has an ongoing program of testing for illegal stormwater connections to ensure excess water does not enter the wastewater system in wet weather.

Although water quality is of a high standard at Merewether, Bar, Burwood North and Burwood South beaches, a health risk assessment completed by Hunter Water in 2010 indicated that there was a small risk that the effluent plume from Burwood Beach Wastewater Treatment Plant (WWTP) could be driven back to the coast under certain combinations of wind and current. This risk was considered as part of the sanitary inspections for these beaches. The WWTP has recently been upgraded in March 2017 to disinfect the effluent, at a cost of $13 million, to address the small health risk identified in the study.
Sampling sites and Beach Suitability Grades in Newcastle City Council
South Stockton Beach

South Stockton Beach is at the southern end of a 32 kilometre stretch of beach and is patrolled from September to April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit after 10mm of rainfall.

The site has been monitored since 1996.

**Site type** | **Monitoring period** | **Dry weather samples suitable for swimming** | **Water samples** | **Beach grade**
--- | --- | --- | --- | ---
Ocean beach | Sep 2015 to Apr 2017 | 97% | 100 | Stable

**Sanitary inspection:** Low

**Microbial Assessment Category:** A

**Dry and wet weather water quality**

**Water quality in response to rainfall**
Nobbys Beach

Nobbys Beach is one kilometre long and is patrolled year round.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall but generally remained below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>97%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Newcastle Beach

Newcastle Beach is approximately 650 metres long and is patrolled from September to April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, but generally remained below the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>95%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Bar Beach

Bar Beach is approximately 500 metres long and is patrolled all year round.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 1996.

See ‘How to read this report’ for key to map

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Apr 2016 to Apr 2017</td>
<td>98%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 1996.
Merewether Beach

Merewether Beach is at the southern end of a 900 metre stretch of beach and is patrolled year round.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain from a number of potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, often exceeding the safe swimming limit after 20mm of rainfall or more.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Apr 2016 to Apr 2017</td>
<td>99%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Burwood North Beach

Burwood North Beach is at the northern end of an 800 metre stretch of beach and is not patrolled by lifeguards.

The Beach Suitability Grade of Good indicates microbial water quality is safe for swimming most of the time but may be susceptible to pollution after rain, with a number of potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20mm of rainfall or more.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Apr 2016 to Apr 2017</td>
<td>99%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Burwood South Beach

Burwood South Beach is located at the southern end of an 800 metre stretch of beach and is not patrolled by lifeguards.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with a number of potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20mm of rainfall or more.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean Beach</td>
<td>Apr 2016 to Apr 2017</td>
<td>100%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Overall results

Fourteen of the 20 swimming sites were graded as Very Good or Good in 2016–2017. This result is consistent with the previous year.

Percentage of sites graded as Very Good or Good:
- 2016–2017: 70%
- 2015–2016: 70%
- 2014–2015: 65%
- 2013–2014: 75%.

See the section on How to read this report on page 54 for an explanation of the graphs, tables and Beach Suitability Grades.

Best beaches

Dudley Beach, Blacksmiths Beach and Caves Beach. These sites had excellent water quality and were suitable for swimming almost all of the time.

Swimming sites monitored in the Lake Macquarie region include ocean beaches and lake/lagoon designated swimming areas in Lake Macquarie, with each site type having a different response to rainfall-related impacts.

In general, lake/lagoon swimming sites did not perform as well as ocean beaches, due to lower levels of flushing to disperse and dilute pollution inputs, taking longer to recover from stormwater events.

As a general precaution swimming should be avoided during and at least one day after heavy rain at ocean beaches, and up to three days in estuarine areas, or if there are signs of stormwater pollution such as discoloured water or floating debris.
Ocean beaches

Three of the seven ocean beaches were graded as Very Good: Dudley Beach, Blacksmiths Beach and Caves Beach. The water quality at these beaches is suitable for swimming almost all of the time.

Glenrock Lagoon Beach, Redhead Beach, Swansea Heads Little Beach and Catherine Hill Bay were graded as Good. Water quality at these sites was suitable for swimming for most of the time. Elevated enterococci levels were recorded occasionally after heavy rainfall.

Redhead Beach was downgraded to Good in 2016–2017, from Very Good in the previous year. Most elevated enterococci samples collected in 2016–2017 were associated with rainfall.

Lake/lagoon swimming sites

Seven of the 13 lake/lagoon swimming sites located in Lake Macquarie were graded as Good: Croudace Bay, Arcadia Vale, Belmont, Toronto, Kilaben Bay, Balcolyn and Sunshine. While water quality at these sites was suitable for swimming most of the time, elevated enterococci levels were recorded following rainfall. Kilaben Bay improved to Good, from a Poor grade in the previous year. During 2016–2017 enterococci levels were much improved with no samples exceeding the 200cfu/100ml, and only four samples slightly above the safe swimming limit of 40cfu/100ml.

Six swimming sites in Lake Macquarie were graded Poor: Eleebana (Lions Park), Swansea, Cams Wharf, Speers Point Park, Bolton Point and Wangi Point (Van Park). Although water quality is regularly within safe swimming limits during dry weather, elevated enterococci levels are often recorded following low levels of rainfall, and on some occasions in dry weather. Although Wangi Point (Van Park) was downgraded to Poor, from a Good grade, only two samples collected in 2016–2017 were slightly above the safe swimming limit, and were associated with rainfall.

These sites have several significant potential sources of faecal contamination, and retain pollution inputs, taking longer to recover from faecal contamination. It is recommended that swimming at these sites is avoided during and for up to three days following rainfall, or if there are signs of stormwater pollution such as discoloured water, flowing stormwater drains or floating debris.
Management

Over the last 10 years, Hunter Water has invested more than $50 million in wastewater system upgrades around Lake Macquarie to cater for population growth and reduce wet weather overflows. The upgrade of regional wastewater pump station infrastructure in Belmont by 2016, at a cost of more than $9 million, further reduces wet weather overflows in the north-east of Lake Macquarie.

Wastewater system upgrades in Glenrock State Conservation Reserve were completed in 2010 and 2016 by Hunter Water to reduce wastewater overflows to the environment. The cost of the works was in excess of $5 million. Recent analysis of the current system performance indicates a reduction in the frequency and volume of wet weather overflows since the upgrades were implemented.

Although water quality was of a high standard at Glenrock Lagoon Beach, a health risk assessment completed by Hunter Water in 2010 indicated there was a small risk that the effluent plume from Burwood Beach Wastewater Treatment Plant (WWTP) could be driven back to the coast under certain combinations of wind and current. This risk was considered as part of the sanitary inspections for this beach. The WWTP has recently been upgraded to disinfect the effluent, at a cost of $13 million, to address the small health risk identified in the study.

Lake Macquarie City Council continues to invest significant resources to improve water quality, especially within the Lake Macquarie estuary. Council currently manages and maintains over 250 stormwater quality improvement devices (including gross pollutant traps, constructed wetlands and bioretention basins). Council also requires that all new development complies with strict criteria for water quality discharges to the estuary, coast and other receiving waters.

The Lake Macquarie Coastal Zone Management Plan (CZMP) was certified by the NSW Government in August 2016, under the provisions of the *NSW Coastal Protection Act 1979*. This plan covers Lake Macquarie’s coastline, the estuary, as well as Swansea Channel. It contains actions to manage coastal hazards, improve the health of the coastal zone, and to improve community access to coastal areas.

Council has commenced a number of priority actions identified in the CZMP, including the removal of weeds from coastal dunes (especially bitou bush), reshaping of dunes, re-establishment of native vegetation, the installation of stormwater treatment devices in priority locations (recent installations include Redhead, Caves Beach and Balmoral), as well as completing works to stabilise eroding stream-banks and foreshore areas.
Sampling sites and Beach Suitability Grades in Lake Macquarie City Council
Glenrock Lagoon Beach

Glenrock Lagoon Beach is 300 metres long and is located at the southern end of Burwood Beach. The beach is not patrolled by lifeguards.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution from a few potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>97%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Dudley Beach

Dudley Beach is one kilometre long and is not patrolled by lifeguards.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 5mm or more of rainfall.

The site has been monitored since 1996.

See ‘How to read this report’ for key to map

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>100%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Redhead Beach

Redhead Beach is located at the northern end of a 10 kilometre stretch of beach and is patrolled between September and April.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain from several potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to little rainfall.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>98%</td>
<td>100</td>
<td>Declined</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall

See ‘How to read this report’ for key to map
Blacksmiths Beach

Blacksmiths Beach is at the southern end of a 10 kilometre stretch of beach and is patrolled between September and April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few significant sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20mm or more of rainfall.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>100%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall
Swansea Heads Little Beach

Swansea Heads Little Beach is 60 metres long and located on the southern side of the entrance to Lake Macquarie. The beach is patrolled from September to April.

The Beach Suitability Grade of Good indicates microbial water quality is suitable for swimming most of the time but can be susceptible to pollution after rain, with a few potential sources of faecal contamination including outflow from Lake Macquarie.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit across all rainfall categories.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>86%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Caves Beach

Caves Beach is located at the southern end of a 1.8 kilometre beach and is patrolled between September and April.

The Beach Suitability Grade of Very Good indicates microbial water quality is considered safe for swimming almost all of the time, with few potential sources of faecal contamination.

Enterococci levels increased slightly with increasing rainfall, occasionally exceeding the safe swimming limit in response to 20mm or more rainfall.

The site has been monitored since 1996.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean beach</td>
<td>Sep 2015 to Apr 2017</td>
<td>100%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Low

Microbial Assessment Category: A

Dry and wet weather water quality

Water quality in response to rainfall

See ‘How to read this report’ for key to map
Catherine Hill Bay

Catherine Hill Bay is at the southern end of a two kilometre stretch of ocean beach and is patrolled from September to April.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with a few potential sources of faecal contamination, including creek discharge.

Enterococci levels increased slightly with increasing rainfall, regularly exceeding the safe swimming limit in response to 20mm or more of rainfall.

The site has been monitored since 2010.
Eleebana (Lions Park)

Eleebana is located at the northern end of Lake Macquarie in Warners Bay.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions. There are several potential sources of faecal contamination, including stormwater and Lake Macquarie.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to little or no rain.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>75%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: High

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Croudace Bay

Croudace Bay is a netted swimming area near Sheppard Creek on the eastern side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including discharge from Sheppard Creek and Lake Macquarie.

Enterococci levels increased with increasing rainfall, regularly exceeding the safe swimming limit in response to 10mm of rainfall or more.

The site has been monitored since 2010.

---

**Sanitary inspection:** Moderate

**Microbial Assessment Category:** B

**Dry and wet weather water quality**

**Water quality in response to rainfall**
Arcadia Vale is situated on the western side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain from a few potential sources of faecal contamination.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit after 5mm of rainfall or more.

The site has been monitored since 2010.

---

**Sanitary inspection: Moderate**

**Microbial Assessment Category: B**

**Dry and wet weather water quality**

**Water quality in response to rainfall**
Belmont

Belmont swimming area is located on the eastern side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination, including stormwater.

Enterococci levels increased with increasing rainfall, regularly exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>99%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Swansea

Swansea is on the eastern edge of Lake Macquarie near Swansea Channel and Lakes Entrance.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with several potential sources of faecal contamination, including a population of black swans in the vicinity of the site.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit in response to little or no rain.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>67%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Cams Wharf is a netted swimming area on the eastern side of Lake Macquarie.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall and occasionally during dry weather conditions, with several potential sources of faecal contamination, including stormwater discharge from a nearby creek.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to little rainfall, and regularly after 20mm or more of rainfall.

The site has been monitored since 2010.
Speers Point Park

Speers Point is in Cockle Bay at the northern end of Lake Macquarie.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall, and occasionally during dry weather conditions, with potential faecal contamination from sewage overflows, discharge from Cockle Creek, and Lake Macquarie.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to 5mm or more of rainfall.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>85%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Bolton Point

Bolton Point is a designated swimming area on the north-western side of Lake Macquarie.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall, and occasionally during dry weather conditions, with several potential sources of faecal contamination including stormwater and Lake Macquarie.

Enterococci levels increased with increasing rainfall, regularly exceeding the safe swimming limit in response to 10mm or more of rainfall.

The site has been monitored since 2010.

### Site type
Lake/Lagoon

### Monitoring period
Dec 2012 to Mar 2017

### Dry weather samples suitable for swimming
88%

### Water samples
100

### Beach grade
Stable

#### Sanitary inspection: High

#### Microbial Assessment Category: C

#### Dry and wet weather water quality

#### Water quality in response to rainfall
Toronto is a designated swimming area on the western side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain from a few potential sources of faecal contamination, including stormwater.

Enterococci levels increased with increasing rainfall, regularly exceeding the safe swimming limit after 10mm or more of rainfall.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>87%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Kilaben Bay

Kilaben Bay is a designated swimming area located on the western side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with a few potential sources of faecal contamination including stormwater.

Enterococci levels increased with increasing rainfall, occasionally exceeding the safe swimming limit during little or no rain, and regularly after 5mm or more of rain.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>92%</td>
<td>100</td>
<td>Improved</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: B

Dry and wet weather water quality

Water quality in response to rainfall
Wangi Point (Van Park) Beach grade

Wangi Point is on the western side of Lake Macquarie and located near the van park.

The Beach Suitability Grade of Poor indicates microbial water quality is susceptible to faecal pollution, particularly after rainfall, and occasionally during dry weather conditions, with several potential sources of faecal contamination including stormwater and a large population of pelicans in the vicinity of the site.

Enterococci levels increased with increasing rainfall, often exceeding the safe swimming limit in response to little rainfall, and frequently after 20mm or more of rainfall.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>86%</td>
<td>100</td>
<td>Declined</td>
</tr>
</tbody>
</table>

Sanitary inspection: Moderate

Microbial Assessment Category: C

Dry and wet weather water quality

Water quality in response to rainfall
Balcolyn is a swimming area on the western side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit with no rain, and often after 5mm or more of rainfall.

The site has been monitored since 2010.

<table>
<thead>
<tr>
<th>Site type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>85%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

**Sanitary inspection:** Low

**Microbial Assessment Category:** B

**Dry and wet weather water quality**

**Water quality in response to rainfall**
Sunshine is a netted swimming area on the western side of Lake Macquarie.

The Beach Suitability Grade of Good indicates microbial water quality is considered safe for swimming most of the time but may be susceptible to pollution after rain, with several potential sources of faecal contamination.

Enterococci levels generally increased with increasing rainfall, occasionally exceeding the safe swimming limit after little or no rain and regularly after 20mm or more of rainfall.

The site has been monitored since 2010.

**Site**

<table>
<thead>
<tr>
<th>Type</th>
<th>Monitoring period</th>
<th>Dry weather samples suitable for swimming</th>
<th>Water samples</th>
<th>Beach grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake/Lagoon</td>
<td>Dec 2012 to Mar 2017</td>
<td>92%</td>
<td>100</td>
<td>Stable</td>
</tr>
</tbody>
</table>

**Sanitary inspection:** Low

**Microbial Assessment Category:** B

**Dry and wet weather water quality**

**Water quality in response to rainfall**
How to read this report

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:

**Very Good**

Location has generally excellent microbial water quality and very few potential sources of faecal pollution. Water is considered suitable for swimming 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 generally recommended to avoid swimming at these sites almost all of the time.

Some of the Beach Suitability Grades in this report are provisional, as the information required for the analysis is incomplete due to limited bacterial data or limited information on potential pollution sources in a beach catchment.
The guidelines

The National Health and Medical Research Council's *Guidelines for managing risks in recreational water* (2008) were adopted for use in New South Wales in May 2009. These guidelines have been adopted in all Australian states and territories and are supported by guidance notes developed by the Department of Health Western Australia (2007).

Enterococci

The national guidelines advocate 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 guidelines, Beachwatch tests for enterococci only. The enterococci density in water samples is analysed in the laboratory using method AS/NZS 4276.9:2007.


Enterococci are measured in colony forming units per 100mL of sample (cfu/100mL).
Beach Suitability Grades are determined by using the following matrix:

<table>
<thead>
<tr>
<th>Sanitary Inspection Category</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>Very Good</td>
<td>Very Good</td>
<td>Follow Up</td>
<td>Follow Up</td>
</tr>
<tr>
<td>Low</td>
<td>Very Good</td>
<td>Good</td>
<td>Follow Up</td>
<td>Follow Up</td>
</tr>
<tr>
<td>Moderate</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>High</td>
<td>Good</td>
<td>Fair</td>
<td>Poor</td>
<td>Very Poor</td>
</tr>
<tr>
<td>Very High</td>
<td>Follow Up</td>
<td>Fair</td>
<td>Poor</td>
<td>Very Poor</td>
</tr>
</tbody>
</table>

Using the Beach Suitability Grade classification matrix, sites assigned a moderate Sanitary Inspection Category can only be rated as Good or Poor with no option of Fair grades. This can create the impression of a large change in water quality when in fact there need only be a slight increase in bacterial counts to push it over the threshold, with no significant increase in the risk to public health.
Microbial Assessment Category (MAC)

There are four Microbial Assessment Categories (A to D) and these are determined from the 95th percentile of an enterococci dataset of at least 100 data points. Each MAC is associated with a risk of illness determined from epidemiological studies. The risks of illness shown below are not those associated with a single data point but are the overall risk of illness associated with an enterococci dataset with that 95th percentile (Wyer et al 1999).

Risk of illness associated with Microbial Assessment Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Enterococci (cfu/100ml)</th>
<th>Illness risk*</th>
</tr>
</thead>
</table>
| A        | ≤40                     | GI illness risk: <1%  
|          |                         | AFR illness risk: <0.3% |
| B        | 41–200                  | GI illness risk: 1–5%  
|          |                         | AFR illness risk: 0.3–1.9% |
| C        | 201–500                 | GI illness risk: >5–10%  
|          |                         | AFR illness risk: >1.9–3.9% |
| D        | >500                    | GI illness risk: >10%  
|          |                         | AFR illness risk: >3.9% |

* GI = gastrointestinal illness; AFR = acute fever and rash

Calculating the MAC

The 95th percentile is a useful statistic for summarising the distribution of enterococci data at a site. It embodies elements of both the location of the distribution (how high/low the enterococci counts are) and the scale of the distribution (how variable the enterococci counts are).

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. These values will represent different probabilities of illness if the distribution of enterococci data from swimming locations in New South Wales 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 in Australia.

The tool can be downloaded from: https://ww2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications under Forms and templates [accessed 19/06/17].
Sanitary Inspection Category (SIC)

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 an assessment of the likelihood of bacterial contamination from identified pollution sources and should, to some degree, correlate with the bacterial water quality results obtained from sampling.

The main sources of faecal contamination considered in the sanitary inspection are: bathers, toilet facilities, wastewater treatment plants (WWTP), sewage overflows, sewer chokes, onsite systems, wastewater reuse, stormwater, river discharge, lagoons, boats and animals.

Through the sanitary inspection process, beaches are categorised to reflect the overall likelihood of faecal contamination. There are five categories: Very Low, Low, Moderate, High and Very High.

Stormwater in urban areas often contains sewage from leakages, overflows or sewer chokes when the sewerage system fails.

Sewage overflows can occur in wet weather when the network has exceeded capacity due to rainwater entering the system. The mix of sewage and rainwater discharges from designated overflow points and drains to waterways, usually via the stormwater system. Overflows from the sewerage system can also occur in dry weather due to mechanical failure or power outage.

Sewer chokes occur due to blockages in the pipes usually due to tree roots, oil, grease or debris. This causes sewage to back up and escape via sewer inspection points, designed overflow structures or cracks in the pipes, then drain to waterways, usually via the stormwater system.

Where there is a known history or evidence of sewage overflows or sewer chokes in the catchment they are identified as sources of potential faecal contamination, particularly if they are located close to the swimming location. In these instances, the risk posed by stormwater is adjusted accordingly to ensure the overall risk to public health is not overestimated.
Explanation of tables

Each region contains tables listing all monitored swimming sites including site type, beach grade and change in grade from the previous year.

The following symbols are used to show the change in beach grade from the previous year:

- Stable
- Improved
- Declined

A provisional grade indicates the assessment is based on limited data collected during the assessment period and should not be compared to the beach grade from the previous year.

Explanation of graphs, charts, and information bars on beach pages

Microbial Assessment Category (MAC) chart

On each beach page, the MACs for the last five years are displayed on a simple bar chart. The bars are labelled with the 95th percentile value for each year and the thresholds dividing the A, B, C and D categories are marked in green, amber and red for reference.
Sanitary Inspection Category (SIC) chart

The results of the sanitary inspection for each swimming location are presented in a radar pie chart. The chart shows the likelihood that each identified pollution source will contribute to faecal contamination at a swimming site, as indicated by the size and colour of the segment, ranging from very low (lightest colour) to very high (darkest colour) as shown below. The sum of these contributions is the overall likelihood, or Sanitary Inspection Category.

Wet and dry weather water quality chart

Enterococci levels in wet and dry weather conditions are presented for each swimming location as a bar graph. Dry weather is defined as no rainfall recorded in the previous 24 hours. Each bar is colour coded to show the number of enterococci results up to 40cfu/100ml, between 41 and 200cfu/100ml, between 201 and 500cfu/100ml and greater than 500cfu/100ml. These categories reflect the Microbial Assessment Category thresholds and are coloured on the graph as dark green, light green, amber and red respectively.
It is expected that swimming sites with lower levels of flushing show some elevated bacterial results in dry weather samples (no rainfall in the previous 24 hours) due to the longer time needed to recover from a rainfall event. At some estuarine and lake/lagoon swimming locations the impacts of stormwater pollution on beach water quality may be detected up to three days after rainfall.

**Water quality in response to rainfall**

Trends in enterococci levels in response to rainfall are shown using a box plot. For reference, enterococci levels of 40cfu/100ml and 200cfu/100ml are indicated with a green and orange line, respectively. The 40cfu/100ml level is referred to as the ‘safe swimming limit’. The enterococci data were obtained from the last five years of monitoring. Rainfall data were obtained from rain gauges situated close to the sample site and are 24-hour totals to 9am on the day of sampling. If there are fewer than five enterococci data points in a rainfall category, individual data points are presented instead of a box plot. At sites where many results are below the detection limit (1cfu/100ml), only the upper portion of the box plots will be visible.

Each part of the box plot represents a significant percentile value of the sample population:

- 95% of the samples lie below the top whisker
- 75% of the samples lie below the top of the box
- half the samples are on each side of the middle line of the box (median or 50%ile)
- 25% of the samples lie below the bottom of the box
- 5% of the samples lie below the bottom whisker.
Information bars

Information bars on each beach page provide a summary of details about the swimming site.

The monitoring period shows the timeframe in which the water samples were collected. The NHMRC guidelines state beach grades should be determined from the most recent 100 water quality results collected within a five-year period. The monitoring period varies between sites depending on sampling frequency.

Dry weather samples suitable for swimming shows the percentage of water samples with enterococci levels below 40cfu/100ml. Dry weather is defined as no rainfall in the previous 24 hours. Swimming sites with lower levels of flushing often have a lower percentage of dry weather samples within the safe swimming limit due to the impacts of rainfall detected up to three days after the event.

Explanation of maps

A map of individual swimming locations is presented on each beach page. The scale of the maps is 1:15,000. Each map shows the location of the sampling site, land use and features such as surf lifesaving clubs. Potential pollution sources such as stormwater drains, sewage pumping stations, wastewater treatment plants, lagoons, rivers and creeks, are shown where accurate data is held.
References

NHMRC 2008, Guidelines for managing risks in recreational water, National Health and Medical Research Council, Australian Government Publishing Service, Canberra, ACT.

Department of Health, Western Australia 2007, Microbial quality of recreational water guidance notes in support of chapter 5 of the National Health and Medical Research Council guidelines for managing risks in recreational water, 2006, Department of Health, Western Australia and The University of Western Australia, October 2007. Available at www2.health.wa.gov.au/Articles/A_E/Environmental-waters-publications. Accessed on 19/06/17.