

Faecal indicator bacteria at recreational bathing sites

This factsheet presents statistics on the suitability of recreational bathing sites for swimming, based on concentrations of faecal indicator bacteria, as recorded in Land, Air, Water Aotearoa's recreational bathing dataset. The Auckland region has been excluded from the analyses presented here, for reasons outlined in the 'Data for this indicator' section.

Key facts



During the 2018–19 bathing season, 75.0% of monitored river swimming sites, 40.6% of monitored beach sites and 24.1% of monitored lake sites were unsafe to swim at on at least one occasion owing to high concentrations of faecal indicator bacteria (FIB).



In the 2018–19 bathing season, 27.5% of monitored river swimming sites, 14.0% of monitored lake sites and 7.8% of monitored beach sites were frequently unsuitable for swimming, with 20% or more of the recorded FIB samples showing they were unsafe to swim.



Based on measurements taken between 2016–19, 51.2% of monitored freshwater bathing sites (rivers and lakes) and 6.8% of bathing sites at beaches are unsuitable for swimming at any time, with an overall high risk of bacterial infection.



The Manawatū-Whanganui region had the highest proportion of unsafe freshwater swimming sites – 90% of all monitored sites in the region were unsuitable for swimming between 2016–2019. The Hawke's Bay region had the highest proportions of unsafe beaches, with 14% of all monitored beaches being unsuitable to swim.



Between 2016–19, both freshwater and marine swimming sites in urban areas were least likely to be safe to swim.

Faecal indicator bacteria and health

Faecal indicator bacteria (FIB) occur in the gut of warm-blooded animals – including humans. They may be introduced to the environment through animal or bird excrement, stock effluent, wastewater discharge, and run-off from contaminated soil. The presence of FIB in recreational water may impact human health by causing gastrointestinal illnesses, as well as infections of ears, eyes, nasal cavity, skin, and the upper respiratory tract.

Testing for the presence of FIB as a measure of suitability for recreation is a common practice internationally, as it is difficult to test for the full range of pathogens that may be present in water. Bacteria like *E. coli* (at freshwater sites) and Enterococci (at marine sites) are used as indicators as their presence implies that other microorganisms such as *Campylobacter*, *Cryptosporidium*, or *Giardia* may also be present (McBride & Soller, 2017).

While the presence of a small amount of FIB (typically measured in terms of the number of bacteria per 100ml of water) may pose little to no danger to swimmers, higher concentrations may pose risk to children, the elderly or people with compromised immune systems. Concentrations of FIB may, and often do, rise to levels where swimming is not recommended for anybody.

Many bathing sites were occasionally unsafe to swim at

In the 2018–19 bathing season, 119 beaches (40.6% of those surveyed that year) were unsafe to swim at on at least one occasion during the season, as were 72 (75.0%) rivers and 13 (24.1%) lakes (Figure 1).

Figure 1: Percentage of sites that tested unsafe for swimming on at least one occasion, 2018/19

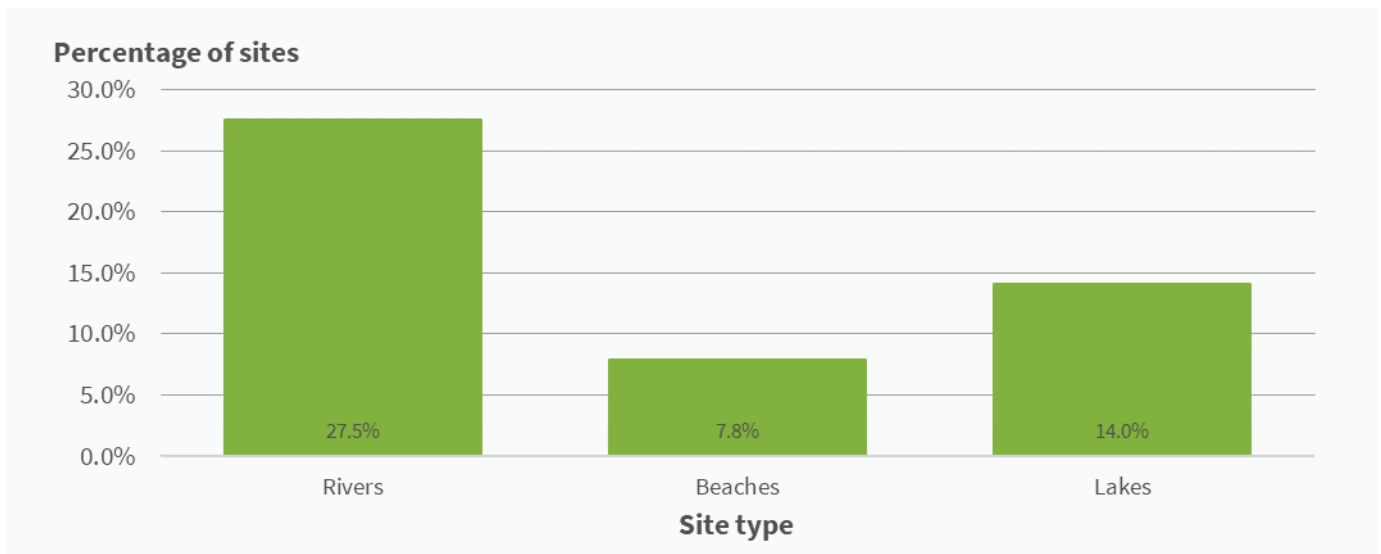


Source: Land, Air, Water Aotearoa, 2019.

Rivers are more likely to be unsafe to swim on multiple occasions

At the national level, 66 river sites (27.5% of all those monitored) were found to be unsuitable for swimming on 20% or more of the occasions they were surveyed in the 2018–19 bathing season, along with 23 beach sites (7.8%) and eight freshwater lakes (14.0%) (Figure 2). In total, 51.2% of all freshwater bathing sites were unsuitable for swimming at any time.

Figure 2: Percentage of bathing sites that tested unsafe for swimming more than 20% of the time, 2018/19

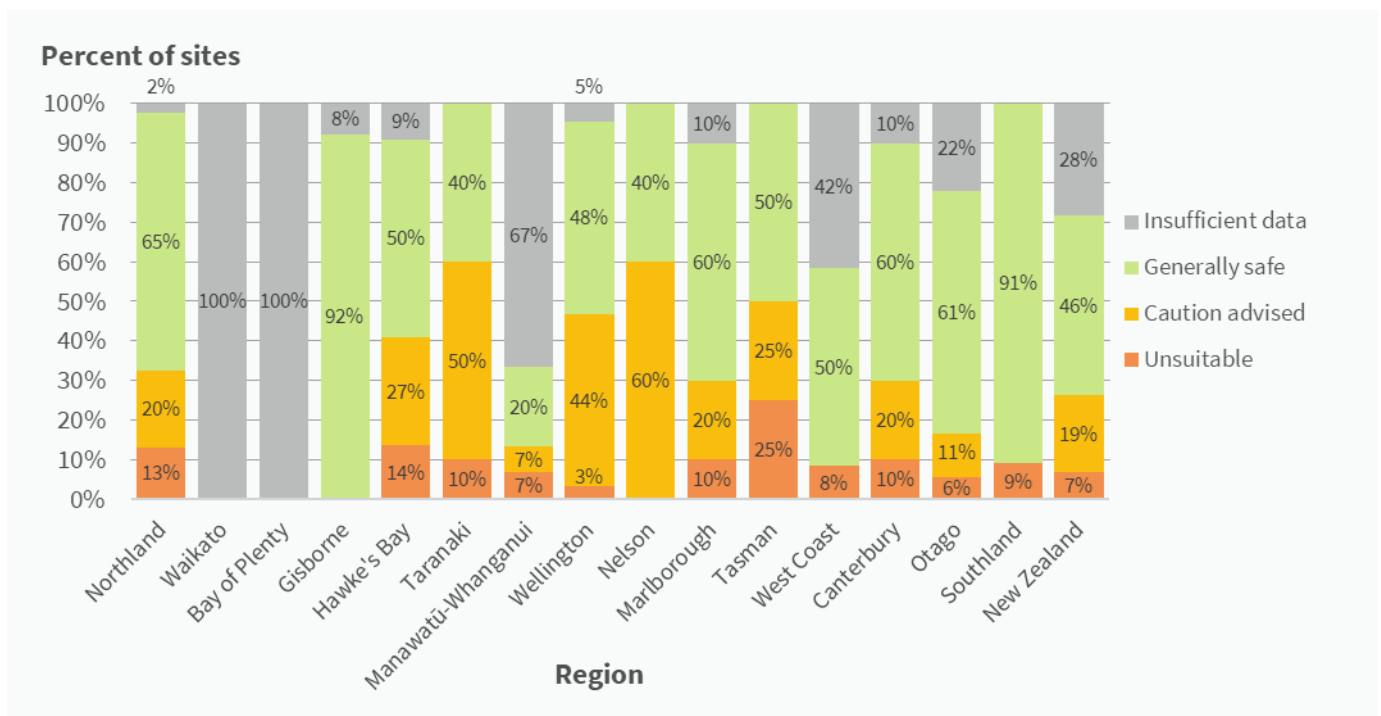


Source: Land, Air, Water Aotearoa, 2019.

Bacterial risk at beaches was generally lower at coastal beaches

Between 2016–19, the overall bacterial risk at marine bathing sites was generally lower in contrast to freshwater sites across all regions, though fewer than half (161 out of the 352 unique sites monitored between 2016–19) were able to be confirmed as ‘generally safe to swim’. Beaches tend to have lower concentrations of FIB as contaminants are more rapidly diluted by currents and the larger volume of water. The Hawke’s Bay region had the highest proportion of unsuitable beach sites (3 out of 22 monitored sites) while the Gisborne region had the lowest (zero out of 13) (Figure 3).

Figure 3: Bacterial risk for marine bathing sites, by region, 2016/17–2018/19



Note: Readers should use caution when drawing comparisons between regions displayed on this graph, owing to variable sample sizes in different regions. For more information, see the ‘FIB monitoring rates’ section below.

Source: Land, Air, Water Aotearoa, 2019.

Bacterial risk at beaches was generally lower at coastal beaches

On average, the Tasman region's marine sites had higher 95th percentile concentrations of Enterococci (Table 1).

Table 1: Average of all 95th percentile Enterococci concentrations at marine bathing sites, by region, 2016/17–2018/19

	Northland	Waikato	Bay of Plenty	Gisborne	Hawke's Bay	Taranaki	Manawatū-Whanganui	Wellington	Nelson	Marlborough	Tasman	West Coast	Canterbury	Otago	Southland
Enterococci/100ml:	294	N/A	N/A	56	258	280	208	235	218	314	329	188	275	172	123
Rank (lowest-highest):	11	N/A	N/A	1	8	10	5	7	6	12	13	4	9	3	2

Note: Only sites with sufficient data to determine an overall risk grade are included in the average.

Source: Land, Air, Water Aotearoa, 2019.

Figure 4: Bacterial risk for marine bathing sites, by region, 2016/17–2018/19

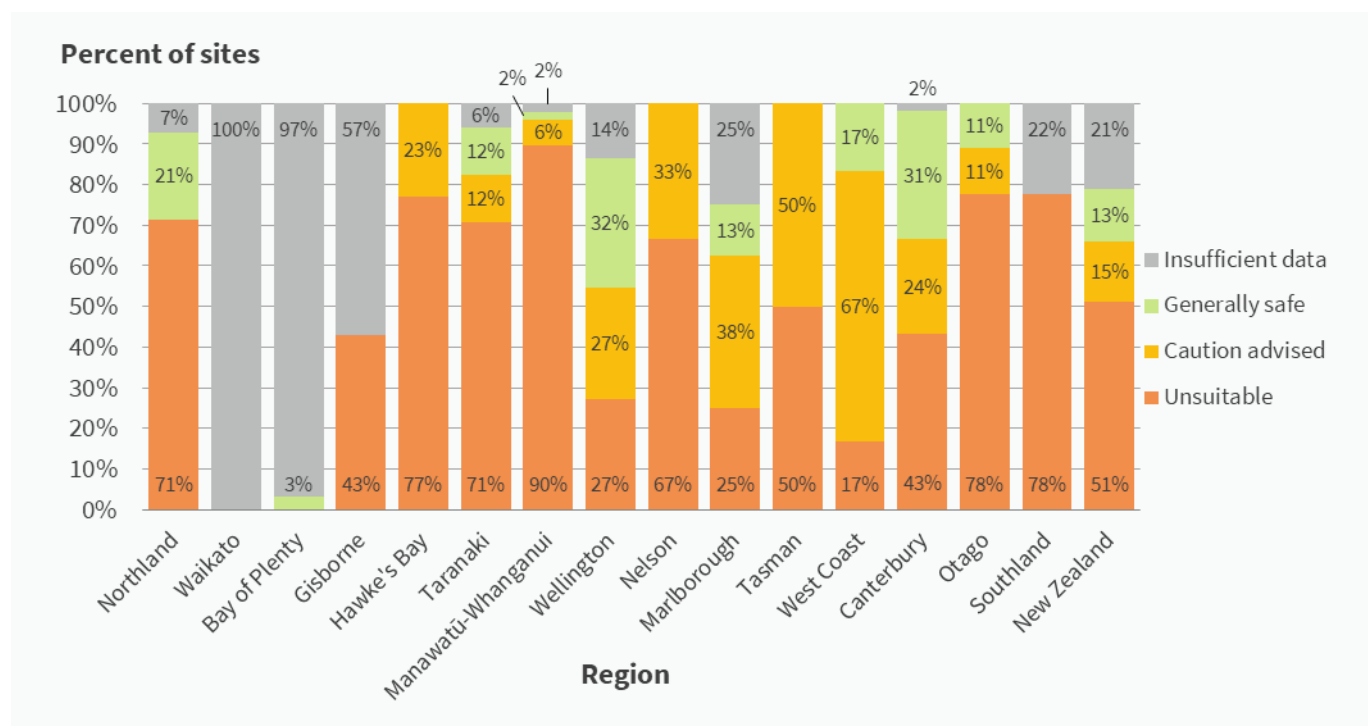


Source: Land, Air, Water Aotearoa, 2019.

Bacterial risk at beaches was generally high at freshwater bathing sites

In contrast to marine bathing sites, most freshwater bathing sites were not suitable for swimming, with only around one in seven sites nationwide (33 out of the 252 unique sites monitored between 2016–19) having FIB concentrations low enough to be considered ‘safe’. The Manawatū-Whanganui region had the greatest proportion of unsafe sites (44 out of 49 sites). Furthermore, the Gisborne, Hawke’s Bay, Nelson, Tasman and Southland regions did not have a single freshwater bathing site that was generally safe to swim at. (Figure 5).

Figure 5: Bacterial risk for freshwater bathing sites, by region, 2016/17–2018/19



Note: Readers should use caution when drawing comparisons between regions displayed on this graph, owing to variable sample sizes in different regions. For more information, see the ‘FIB monitoring rates’ section below.

Source: Land, Air, Water Aotearoa, 2019.

On average, Gisborne’s freshwater sites had vastly higher 95th percentile concentrations of *E. coli* than those in any other region (Table 2).

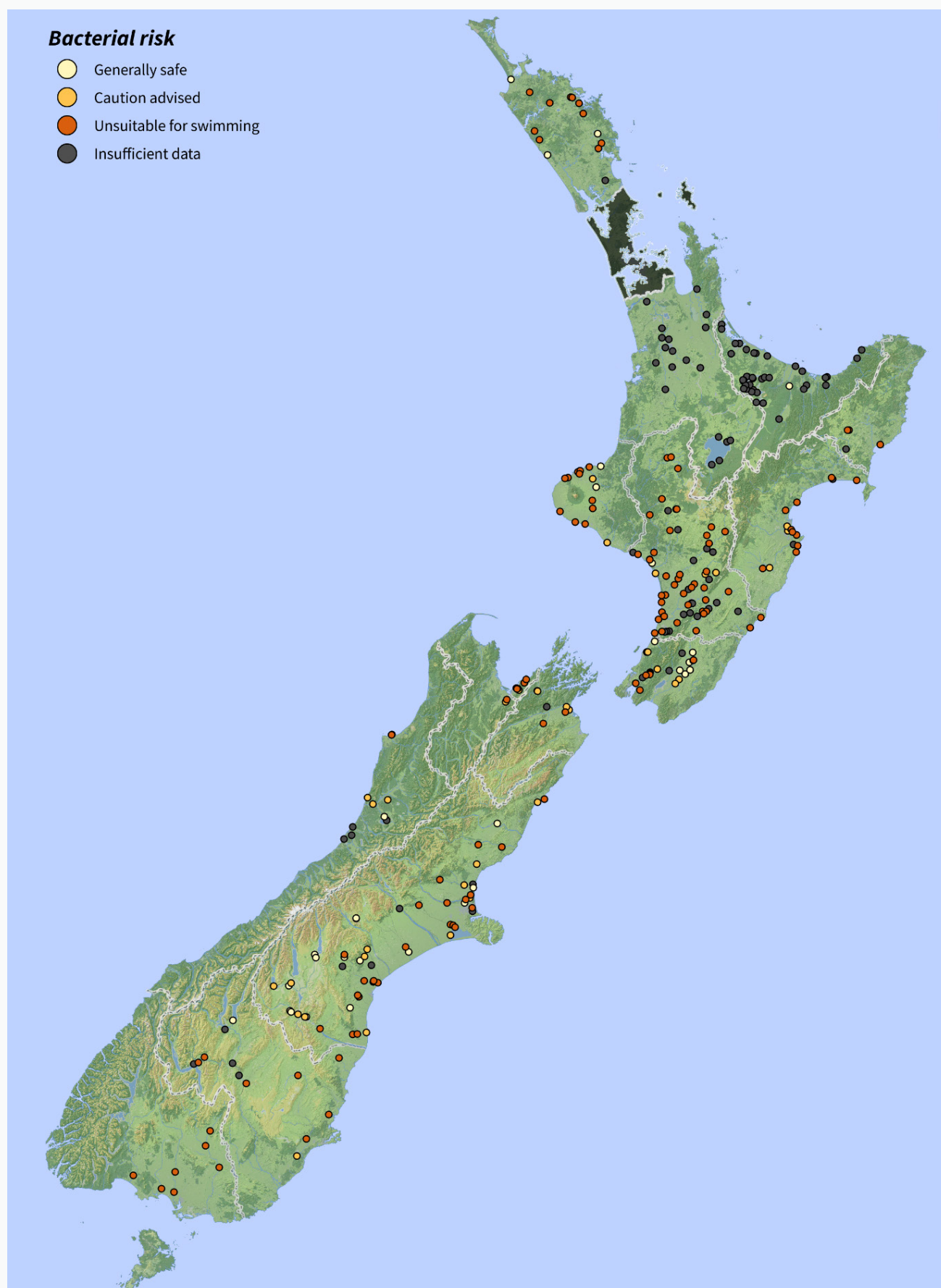
Table 2: Average of all 95th percentile *E. coli* concentrations at freshwater bathing sites, by region, 2016/17–2018/19

	Northland	Waikato	Bay of Plenty	Gisborne	Hawke's Bay	Taranaki	Manawatū-Whanganui	Wellington	Nelson	Marlborough	Tasman	West Coast	Canterbury	Otago	Southland
<i>E.Coli</i> /100ml:	1842	N/A	N/A	5725	1361	1281	2934	454	1079	707	510	399	832	865	1456
Rank (lowest-highest):	11	N/A	N/A	13	9	8	12	2	7	4	3	1	5	6	10

Note: Only sites with sufficient data to determine an overall risk grade are included in the average. The figures for Bay of Plenty are not included as only a single site had a valid overall risk grade.

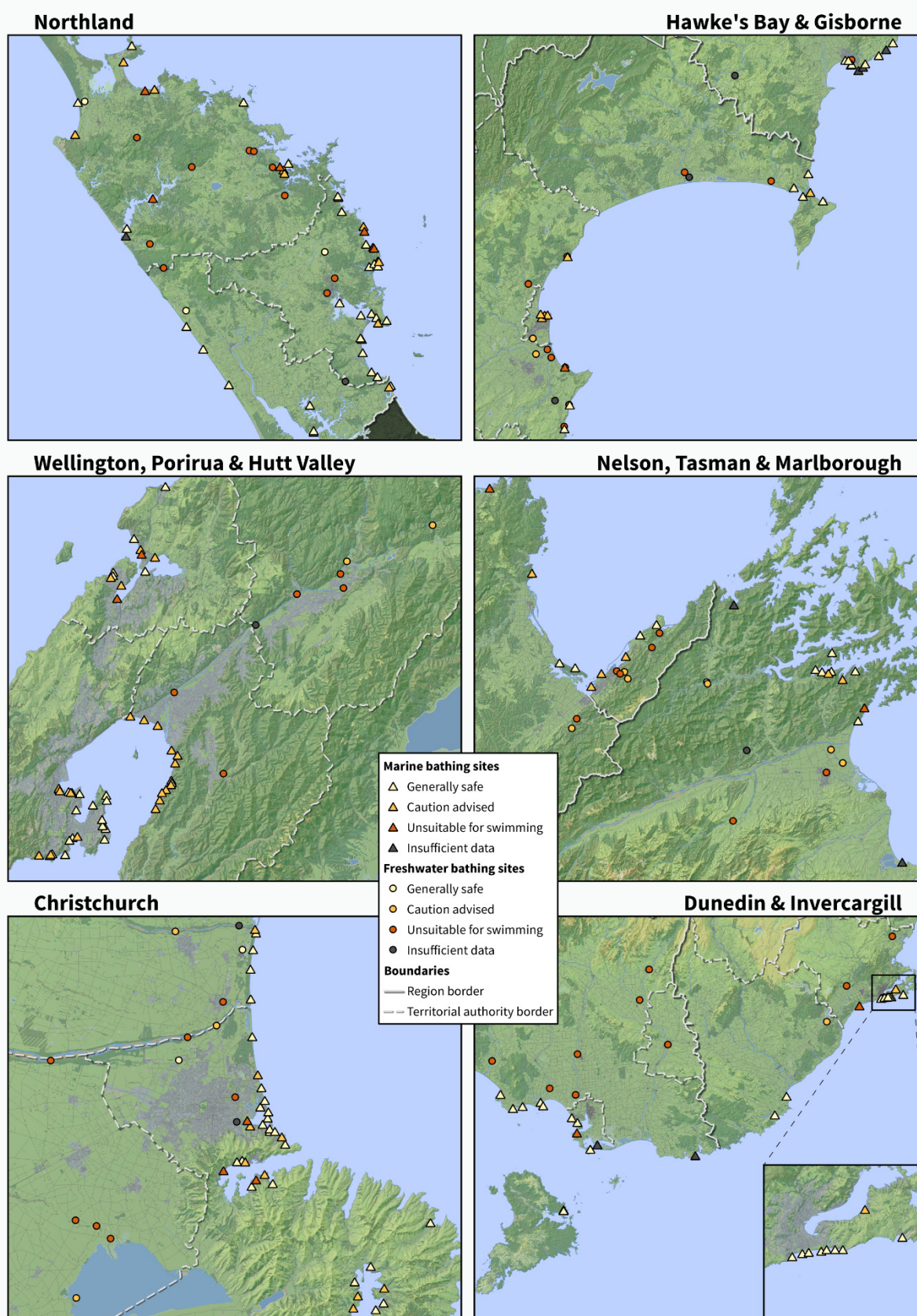
Source: Land, Air, Water Aotearoa, 2019.

Figure 6: Bacterial risk for freshwater bathing sites, by region, 2016/17–2018/19



Source: Land, Air, Water Aotearoa, 2019

Figure 7: Bacterial risk for freshwater & marine bathing sites, selected regions with higher densities of bathing sites, 2016/17–2018/19

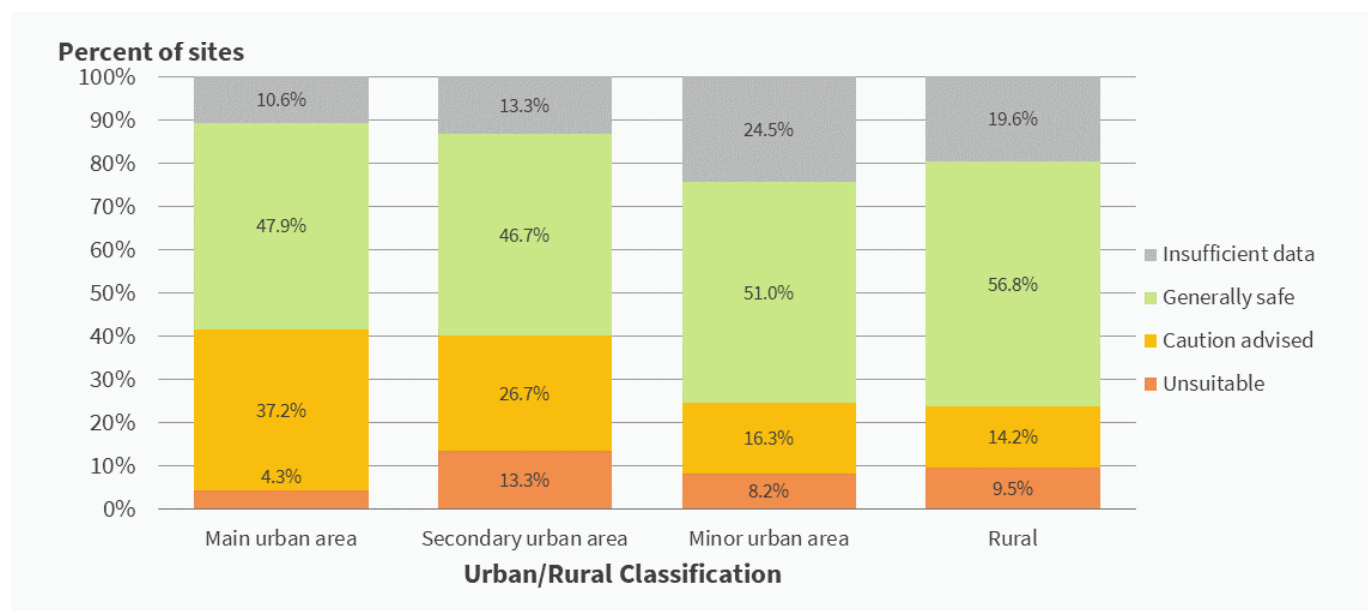


Source: Land, Air, Water Aotearoa, 2019.

Bathing sites in urban areas are less likely to be suitable for swimming

Monitored marine swimming sites in main and secondary urban areas had the lowest proportions of ‘generally safe’ marine swimming sites (Figure 8). However, main urban areas had the lowest proportion of ‘unsuitable’ sites, while also having the highest share of ‘caution advised’ sites.

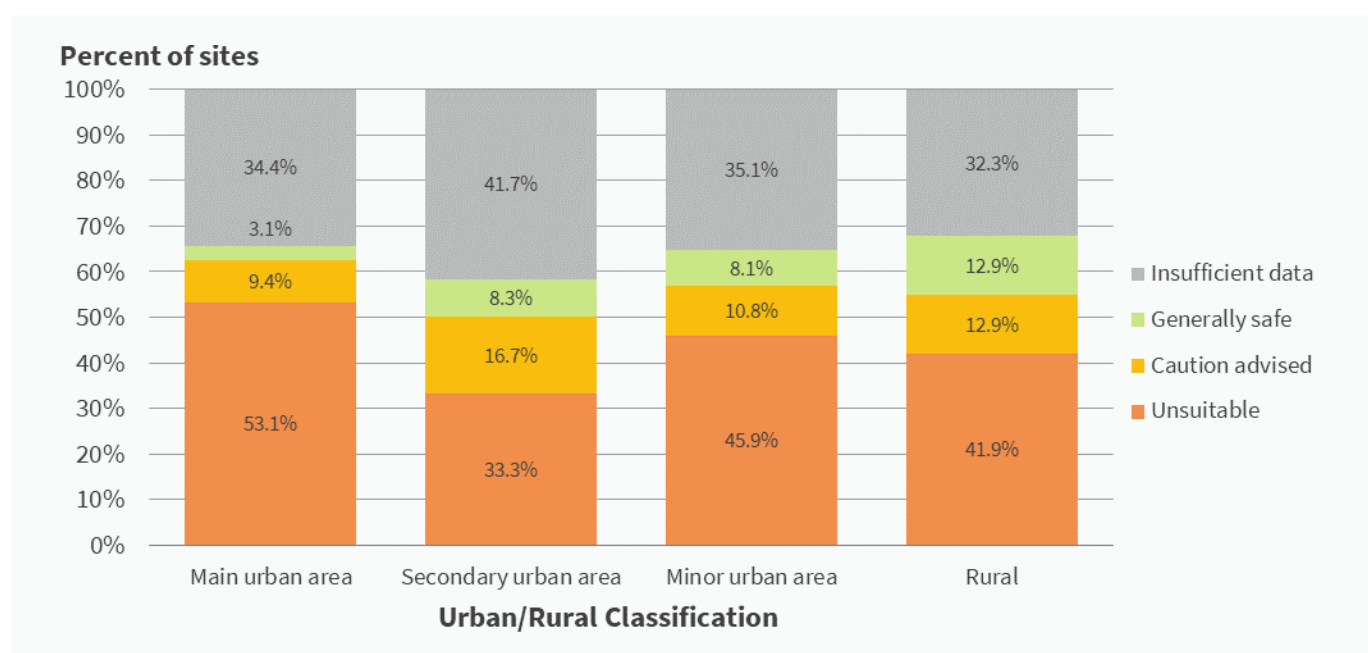
Figure 8: Bacterial risk at marine bathing sites, by urban/rural category, 2016/17–2018/19



Source: Land, Air, Water Aotearoa, 2019.

Main urban areas had both the smallest proportion of ‘generally safe’ freshwater swimming sites and the largest proportion of ‘unsuitable’ sites (Figure 9), though by a comparatively small margin in contrast to marine bathing sites (Figure 8 above). Conversely, rural areas had the highest proportion of ‘safe’ sites and the lowest proportion of ‘unsuitable’ ones.

Figure 9: Bacterial risk at freshwater bathing sites, by urban/rural category, 2016/17–2018/19



Source: Land, Air, Water Aotearoa, 2019.

Table 3 presents the average 95th percentile values at marine and freshwater bathing sites in the different categories.

Table 3: Average of all 95th percentile FIB concentrations by urban/rural category 2016/17–2018/19

FIB Type	Main urban area	Secondary urban area	Minor urban area	Rural
Enterococci/100ml	262.5	321.2	212.1	225.8
<i>E. coli</i> /100ml	1731.2	1247.9	1568.8	1495.4

Source: Land, Air, Water Aotearoa, 2019

Insight into suitability for swimming varies considerably by region

The proportion of sites with insufficient data to calculate overall bacterial risk varied between regions to a large degree, with the Bay of Plenty and Waikato regions having almost no sites with enough data to calculate overall risk (Table 4).

Table 4: Percentage of monitored sites with insufficient data to calculate overall bacterial risk, by region, 2016/17–2018/19

Region	Site type	% of sites lacking data	Comments
Northland	Marine	7%	
	Freshwater	2%	
Waikato	Marine	100%	All marine sites lacked data in both 2017/18 (only 5 measures per site) and 2018/19, (no data at all). Freshwater sites either had no data for 2016/17 or 2017/18, or both.
	Freshwater	100%	
Bay of Plenty	Marine	97%	Almost all sites had no recorded data for 2016/17.
	Freshwater	100%	
Gisborne	Marine	57%	The high proportion of disqualified marine sites is due to too few measurements being taken in 2018/19.
	Freshwater	8%	
Hawke's Bay	Marine	0%	
	Freshwater	9%	
Taranaki	Marine	6%	
	Freshwater	0%	
Manawatū-Whanganui	Marine	2%	Most disqualified freshwater sites were not monitored in 2016/17.
	Freshwater	67%	
Wellington	Marine	14%	
	Freshwater	5%	
Nelson	No sites with insufficient data		
Marlborough	Marine	25%	One marine site (out of 11) had no data for the 2016/17 season, another lacked data for 2017/18 and 2018/19
	Freshwater	10%	
Tasman	No sites with insufficient data		
West Coast	Marine	0%	The proportion of disqualified freshwater sites is due to too few measurements being taken in 2016/17.
	Freshwater	42%	
Canterbury	Marine	2%	
	Freshwater	10%	
Otago	Marine	0%	Four sites had no data in 2016/17, and three of these four also had no data in 2017/18
	Freshwater	22%	
Southland	Marine	22%	Two sites fell short of the necessary number of measures (only 9 per year, with 10 being the minimum)
	Freshwater	0%	

Source: Land, Air, Water Aotearoa, 2019.

The number of sites in each region (irrespective of the quantity of recorded data at each) is also highly variable (Table 5). The Wellington region reported data on the most individual marine bathing sites, while the Canterbury region reported the most freshwater sites - and also the most sites overall. The Canterbury region's number of monitored sites is out of proportion to the other regions of the South Island, which generally reported on fewer sites than those in the North Island.

The Tasman region recorded the fewest bathing sites, even in contrast to the generally lower numbers in the South Island. The scarcity of reported sites here may be an issue of concern as the region is popular with holidaymakers, and the participation rates in water-based recreational activities, especially ocean swimming, should be accordingly higher than average there.

Table 5: Number of swimming sites by 'overall risk' grade, region and site type, 2016–19

	Northland	Waikato	Bay of Plenty	Gisborne	Hawke's Bay	Taranaki	Manawatū-Whanganui	Wellington	Nelson	Marlborough	Tasman	West Coast	Canterbury	Otago	Southland
Marine bathing sites															
'Generally safe'	30	0	0	12	11	4	6	31	2	6	2	6	30	11	10
'Caution advised'	9	0	0	0	6	5	2	28	3	2	1	0	10	2	0
'Unsuitable'	6	0	0	0	3	1	2	2	0	1	1	1	5	1	1
'Insufficient data'	1	19	38	1	2	0	20	3	0	1	0	5	5	4	0
Marine sites surveyed	46	19	38	13	22	10	30	64	5	10	4	12	50	18	11
Freshwater bathing sites															
'Generally safe'	3	0	1	0	0	2	1	7	0	1	0	1	16	1	0
'Caution advised'	0	0	0	0	3	2	3	6	2	3	1	4	12	1	0
'Unsuitable'	10	0	0	3	10	12	44	6	4	2	1	1	22	7	7
'Insufficient data'	1	9	29	4	0	1	1	3	0	2	0	0	1	2	2
Freshwater sites surveyed	14	9	30	7	13	17	49	22	6	8	2	6	51	11	9
Total sites surveyed	60	28	68	20	35	27	79	86	11	18	6	18	101	29	20

Source: Land, Air, Water Aotearoa, 2019.

Data for this indicator

Data availability

As the Auckland region does not supply the results of water quality sampling to LAWA, and instead only provides modelled data based on in-field measurements, the region has been excluded from both the recreational bathing data set, and so all analyses in this factsheet as field measurements and predicted data are not comparable.

Grading of sites

Two measurements of swim site quality are presented in this fact sheet, based on data contained in Land, Air, Water Aotearoa (LAWA)'s recreational bathing water quality raw dataset. Firstly, the regular monitoring results which are passed to LAWA by regional councils, based on regular field sampling at each site. A grade is assigned to every measurement based on the concentration of FIB at the time of measurement. Sampling is usually conducted at least once per week during the summer bathing season (the last week in October to the end of March). Grades are assigned as follows:

Grade	Criteria (<i>E.coli</i> –freshwater sites)	Criteria (Enterococci–marine sites)
Green	The site was safe to swim at the time of measurement.	
	Less than 260 <i>E. coli</i> per 100ml	Less than 140 Enterococci per 100ml
Amber	The site was generally safe at the time of measurement, but caution would be advised for children, the elderly, or those with compromised health	
	More than 260 <i>E. coli</i> per 100ml	More than 140 Enterococci per 100ml
Red	The site was not safe to swim at the time of measurement.	
	More than 550 <i>E. coli</i> per 100ml	More than 280 Enterococci per 100ml

Source: Land, Air, Water Aotearoa, 2019.

Secondly, ‘overall bacterial risk’, which is calculated based on the 95th percentile value of the recorded FIB concentrations at a given swim site over the past three monitoring seasons. Overall risk is assigned as follows:

Grade	Criteria (<i>E.coli</i> –freshwater sites)	Criteria (Enterococci–marine sites)
Generally suitable for swimming	<p>Contact with the water at this site poses a low risk of infection (less than 1%), if any at all.</p> <p>95th percentile value is ≤ 260 <i>E. coli</i> / 100ml.</p>	<p>95th percentile value is ≤ 200 Enterococci / 100ml.</p>
Caution advised	<p>Contact with the water at this site poses a moderate risk of infection. Swimming should be avoided after heavy rain, or if the water is discoloured. Caution is advised for children, the elderly, or those with compromised health.</p> <p>95th percentile value is between 261–550 <i>E. coli</i> / 100ml.</p>	<p>95th percentile value is between 201–500 Enterococci / 100ml.</p>
Unsuitable for swimming	<p>Contact with the water at this site poses a high risk of infection (greater than 5%). Swimming is not recommended unless recent weekly monitoring indicates safe levels of FIB and there has been no rain recently</p> <p>95th percentile value is > 550 <i>E. coli</i> / 100ml.</p>	<p>95th percentile value is > 500 Enterococci / 100ml.</p>

Source: Land, Air, Water Aotearoa, 2019.

To receive a valid ‘overall risk’ grading, sites must have at least 30 sample results across the 2016/17 – 2018/19 period, with at least 10 results in each year. If a site has less than 10 sample results in one year, then a minimum of seven samples in that year is required, with at least 35 samples over the three-year period.

For additional information, see the metadata link below.

References

Land, Air, Water Aotearoa. 2019. *Factsheet: Coastal and freshwater monitoring*. Retrieved from <https://www.lawa.org.nz/learn/factsheets/coastal-and-freshwater-recreation-monitoring/> on 20/10/2020

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McBride G, Soller J. 2017. *Technical Background for 2017 MfE 'Clean Water' Swimmability Proposals for Rivers*. NIWA.

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