
SUPERVISION AND SURVEILLANCE REPORT

SHELLHARBOUR NORTH BEACH

**Supervision and Surveillance Report:
Shellharbour North Beach**

December 2023

This report was produced as part of *Coastal insights: safer coasts for the future*, a project proudly funded by the NSW Government and delivered by Surf Life Saving New South Wales to help reduce the risk of drowning and injury on the coastline.

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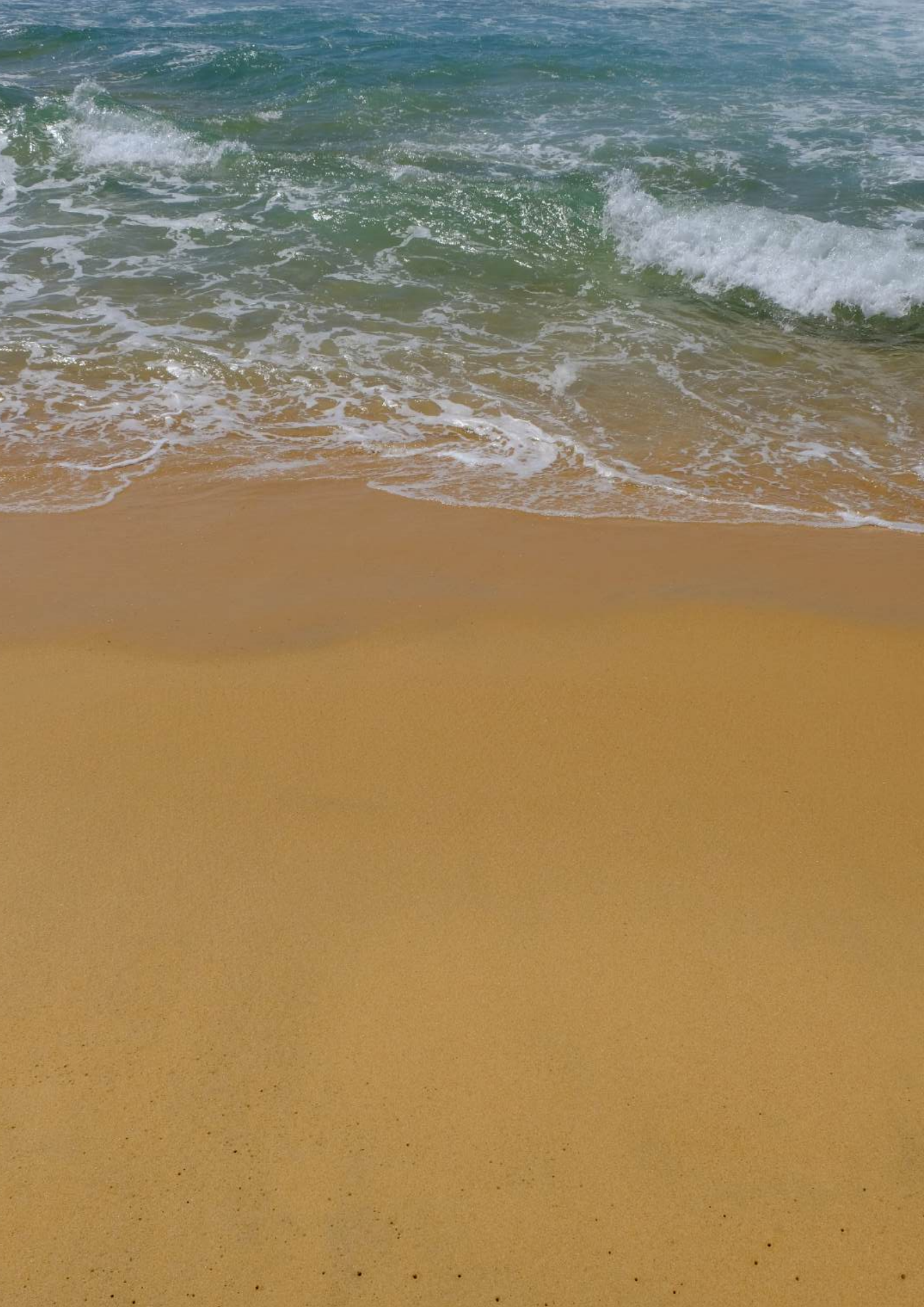


**SURF LIFE SAVING
NEW SOUTH WALES**



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Introduction

This report outlines the methods, results, and recommendations of a site-specific supervision and surveillance assessment undertaken at Shellharbour North Beach. The assessment was undertaken as part of *Coastal insights: safer coasts for the future*, a project proudly funded by the NSW Government to help reduce the risk of drowning and injury on the New South Wales coastline.

A *Supervision and Surveillance Model* was developed to quantify the risk of drowning and injury at sites throughout New South Wales. Site-specific information on beach morphology, wave height, the number of water users, and the types of water users at Shellharbour North Beach were input into the model to calculate the risk at different times of year and different times of day. These calculations were then contextualised using the *Supervision and Surveillance Framework* to recommend risk-appropriate and fit-for-purpose supervision and surveillance for Shellharbour North Beach.

The data used in the supervision and surveillance assessment was recorded on-site by surf lifesavers, captured and analysed by researchers, and collated from other sources. The site-specific *Supervision and Surveillance Report* will be followed by a multi-site *Supervision and Surveillance Report* for beaches, shore platforms, and coastal waterways in the City of Shellharbour.

This report has been produced to support Shellharbour City Council, Shellharbour City Council Lifeguard Service, Shellharbour Surf Life Saving Club, Surf Life Saving South Coast, and Surf Life Saving New South Wales to manage the risk of drowning and injury at Shellharbour North Beach.

Background

Since 1 July 2004, less than five fatal drowning incidents have been recorded at Shellharbour North Beach. However, over the period 1 July 2005 to 30 June 2022, surf lifesavers have recorded 3,106 preventative safety interventions, performed 536 rescues, and treated 1,521 people for injuries and/or medical incidents (Surf Life Saving Australia, 2023). Of note, lifeguards from Shellharbour City Council Lifeguard Service also prevented, responded to, and treated a considerable number of incidents at Shellharbour North Beach; however, these statistics are not included in this report. There likely were also other incidents that have not been formally recorded, for example, surfers who have rescued other water users.

The provision of lifeguard services and surf lifesaving services can be highly effective at managing the risk of drowning and injury. However, the provision of these services requires significant human and financial resources and should only be recommended where there is an identified need. This report provides recommendations on the times of year, times of day, and types of supervision and surveillance that are risk-appropriate and fit-for-purpose for Shellharbour North Beach.

Of note, lifeguard services and/or surf lifesaving services have typically been provided at Shellharbour North Beach from mid-September to late April. However, the data presented in this report is limited to the times when surf lifesaving services have been provided.

Aim

To support coastal safety stakeholders to manage the risk of drowning and injury with risk-appropriate and fit-for-purpose supervision and surveillance at Shellharbour North Beach.

Objectives

In order to achieve the aim, the following objectives must be met during the site-specific supervision and surveillance assessment:

- Classify the beach morphology and analyse the wave height, wave period, and wave direction at Shellharbour North Beach.
- Analyse the patterns of beach and water use at Shellharbour North Beach, as well as the prevalence of preventative safety interventions and incidents throughout the year and across the hours of the day.
- Analyse the different types of recreational activities at Shellharbour North Beach, including the temporal patterns and spatial distribution.
- Utilise the *Supervision and Surveillance Model* and *Supervision and Surveillance Framework* to calculate the probability of rescue and recommend supervision and surveillance that is risk-appropriate and fit-for-purpose for Shellharbour North Beach.
- Make the results and recommendations available to Shellharbour City Council, Shellharbour City Council Lifeguard Service, Shellharbour Surf Life Saving Club, Surf Life Saving South Coast, Surf Life Saving New South Wales, NSW Government, and other relevant coastal safety stakeholders.

Application and use of the report

The report should be used by coastal safety stakeholders to ensure risk-appropriate types of supervision and/or surveillance are provided at the identified times, thus managing the risk of drowning and injury as effectively as possible.

‘To support coastal safety stakeholders to manage the risk of drowning and injury with risk-appropriate and fit-for-purpose supervision and surveillance’



Coastal insights: safer coasts for the future

Coastal insights: safer coasts for the future utilises data-driven models and frameworks to assist coastal safety stakeholders to manage the risk of drowning and injury at beaches, shore platforms, and coastal waterways in New South Wales. The project is delivering results and recommendations to inform the provision of risk-appropriate and fit-for-purpose supervision and surveillance.

The five specific objectives for *Coastal insights: safer coasts for the future* are as follows:

- 1 Quantify the influence of beach morphology and hydrodynamics, volume and frequency of water use, and social risk factors on the risk of drowning and injury.
- 2 Utilising the findings from the first objective, develop models and frameworks to guide evidence-based decision making by coastal safety stakeholders.
- 3 Provide the results and recommendations to coastal safety stakeholders.
- 4 Review the existing data collected by lifeguard services, surf lifesaving services, and support operations, and subsequently develop a 'data standard' for New South Wales.
- 5 Develop stronger relationships and collaboration with coastal safety stakeholders throughout New South Wales.

Coastal insights: safer coasts for the future is underpinned by scientific research principles to ensure that the risk of drowning and injury can be accurately and consistently assessed on the New South Wales coastline, and the recommendations are risk-appropriate and fit-for-purpose.

To achieve this, we gathered, cleaned, and analysed a significant volume of data on site information and safety interventions recorded by lifeguard services and surf lifesaving services. We aligned information on beach morphology and hydrodynamics with the relevant datasets.

Subsequently, we adopted the approach of Mulcahy (2014b) and analysed the influence of beach morphology and hydrodynamics on the risk of drowning and injury by investigating relationships between these factors and the occurrence of non-fatal incidents (Mulcahy, 2023a). We explored the patterns and distribution of beach and water users throughout the year and across the hours of the day. Additional data was captured through on-site observations, high-resolution aerial imagery, and coastal monitoring cameras. We also investigated the vulnerability of different groups through the analysis of non-fatal incidents.

The results of this research fed directly into the development of the *Supervision and Surveillance Model* (see page 8). This model enables us, for the first time, to objectively quantify and compare the risk of drowning and injury on the New South Wales coastline. Subsequently, the *Supervision and Surveillance Framework* (see page 25) conceptualises different types of supervision and surveillance that are risk-appropriate and fit-for-purpose for beaches, shore platforms, and coastal waterways. Site-specific calculations from the *Supervision and Surveillance Model* are ingested into the framework to guide evidence-based decision making; this report provides recommendations for Shellharbour North Beach.

Throughout *Coastal insights: safer coasts for the future*, we have worked to develop stronger relationships and collaborate with coastal safety stakeholders throughout New South Wales. We trust that the information provided in this report, as well as the additional outcomes of *Coastal insights: safer coasts for the future*, will be of significant value to coastal safety stakeholders as we collectively seek to reduce the risk of drowning and injury on the New South Wales coastline.

‘Coastal insights: safer coasts for the future utilises data-driven risk models and frameworks to assist coastal safety stakeholders to manage the risk of drowning and injury’



Enhancing evidence-based decision making

The provision of site-specific *Supervision and Surveillance Reports*, based on the data that is currently available, is a key deliverable of *Coastal insights: safer coasts for the future*. However, a number of other outcomes have been achieved as part of the project, which will significantly enhance data collection, analysis, and reporting to continually reduce the risk of drowning and injury on the New South Wales coastline.

A 'data standard' for lifeguard services, surf lifesaving services, and support operations

Lifeguard services, surf lifesaving services, and support operations collect data on site use, preventative safety interventions, and incidents. We utilise this data to determine the highest risk sites, times of year, and times of day, as well as identify those at the highest risk of drowning and injury. However, the quality of this analysis is contingent on the accuracy and consistency of the data. In New South Wales, there are currently 15 different ways data is collected and stored by coastal safety stakeholders. As a result, the data cannot easily be collated or systematically analysed to inform evidence-based decision making, from a site-specific to state-wide scale.

As part of *Coastal insights: safer coasts for the future*, we have developed a 'data standard' to facilitate accurate and consistent data collection. We analysed existing datasets, identified gaps, and undertook a survey of coastal safety stakeholders (n = 152) to identify 'use cases' and prioritise the data that should be collected (Mulcahy, 2023b). The 'data standard' was then developed in consultation with coastal safety stakeholders through a series of presentations, meetings, and workshops. We created a data model, defined terms and methodologies, outlined fields, categories, and reference information, determined the frequency and resolution of the data to be collected, and where possible, aligned with other relevant standards.

The 'data standard' consists of two main components: site information and safety interventions. Site information is collected at regular intervals and includes the number of beach and water users, weather, and surf conditions. Information on safety interventions is collected when lifeguards and/or surf lifesavers intervene to prevent and/or respond to an incident. This includes the geographic location, time, and factors that contributed to the incident, as well as the recreational activity, demographics of those assisted, weather, tide, and surf conditions (where relevant).

Coastal safety stakeholders will be encouraged and supported to adopt the 'data standard', and existing datasets are being aligned to the standard, where possible.

Coastal Management Reporting System

We have developed the *Coastal Management Reporting System* to enable lifeguard services, surf lifesaving services, and support operations to record data on site information and safety interventions in line with the 'data standard'.

The *Coastal Management Reporting System* enables data to be collected accurately, consistently, and efficiently in a centralised system. Operational dashboards display information on site information and safety interventions recorded daily, over the previous four weeks, and the year to date (1 July to 30 June).

A number of other data sources will be progressively integrated into the *Coastal Management Reporting System*, including information on the weather, tide, and surf conditions. Data from coastal monitoring cameras, installed at sites along the New South Wales coastline (and using artificial intelligence to count the number of beach and water users), will also be displayed.

Data Analytics Hub

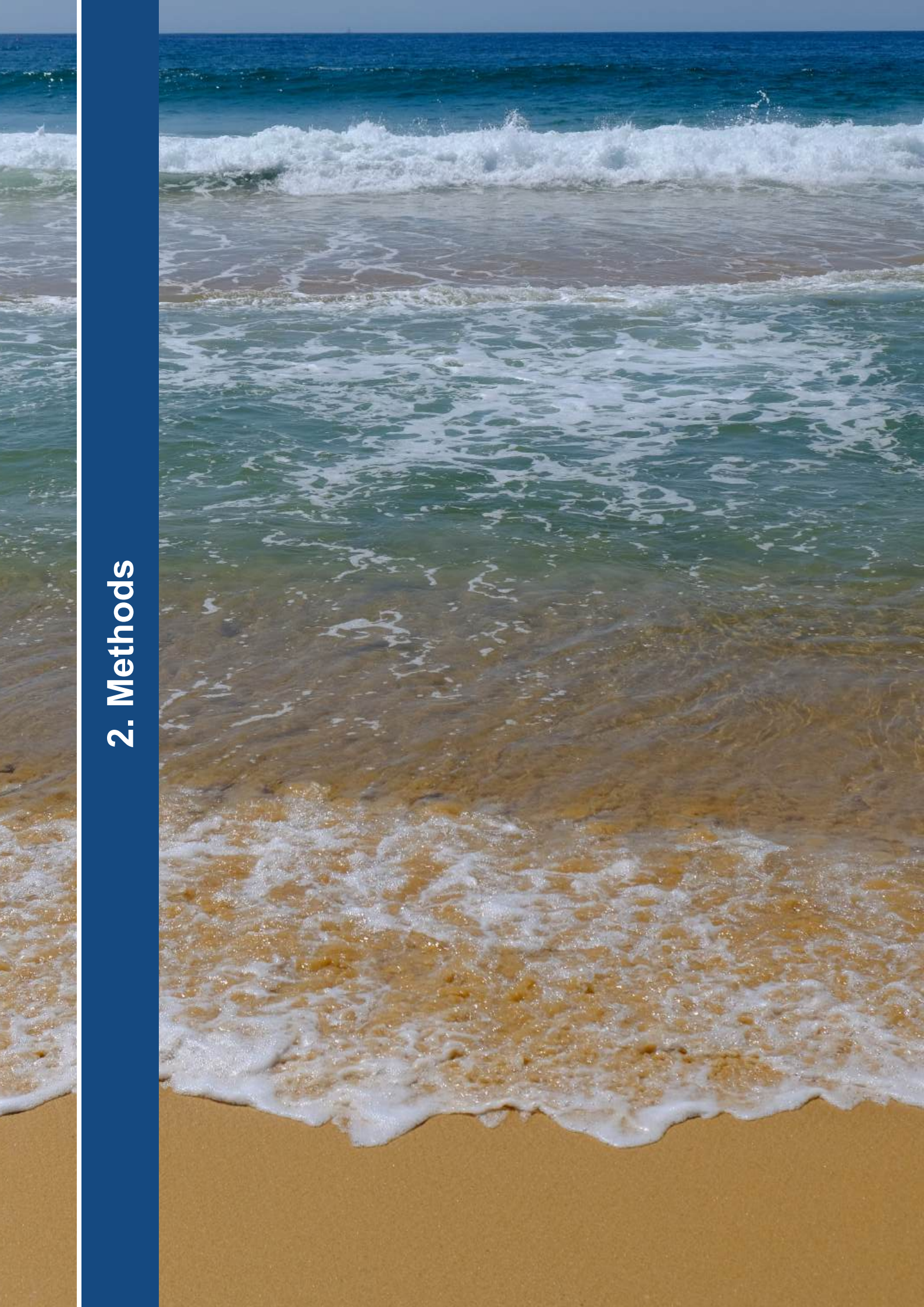
Finally, we have developed a *Data Analytics Hub* in Power BI to generate insights and modelled recommendations, with R Studio and Esri ArcGIS Pro integrations. Data on site use, preventative safety interventions, and incidents are analysed and displayed, with visualisations tailored from a site-specific scale (i.e., Surf Life Saving Clubs), to multi-site scale (i.e., Local Government Areas), to a state-wide scale.

The quality of the insights and modelled recommendations generated through the *Data Analytics Hub* will progressively improve once the 'data standard' is implemented, data is collected consistently and accurately, and is supplemented by data from other sources (such as high-resolution aerial imagery and coastal monitoring cameras).

'As part of Coastal insights: safer coasts for the future, we have developed a 'data standard' to facilitate accurate and consistent data collection'



2. Methods



Methods

Conceptually, there are three key factors that influence the risk of drowning and injury: the hazardousness of the site, the volume and frequency of site use (exposure), and the vulnerability of those using the site (Mulcahy, 2014a; Mulcahy and Lowe, 2019a; Figure 2-1). Information on these factors was gathered as part of the supervision and surveillance assessment, and then input into the *Supervision and Surveillance Model* to quantify the risk of drowning and injury at Shellharbour North Beach at different times of year and different times of day.

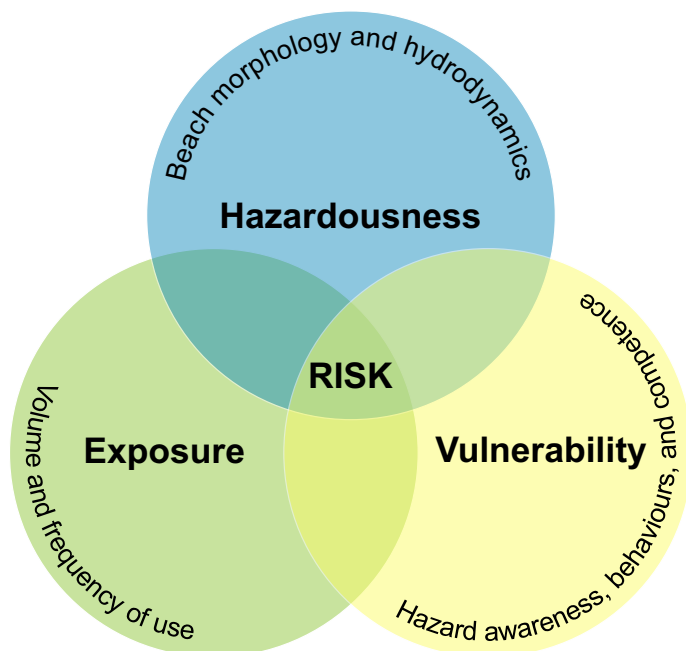


Figure 2-1: Conceptual framework showing the factors that contribute to the risk of drowning and injury.

Beach morphology and hydrodynamics

The morphology of Shellharbour North Beach was classified according to the beach types of Wright and Short (1984), following a review of Short (2007) and in-depth analysis of high-resolution aerial imagery captured by Nearmap from January 2010 to December 2022. Information on the hourly significant wave height, peak wave period, and peak wave direction was extracted from the most representative node at 10 m water depth in the NSW Department of Planning and Environment's 'State Wide Nearshore Wave Transformation Tool' (NSW Department of Planning and Environment, 2023).

Volume and frequency of use

Data on the number of beach and water users recorded by surf lifesavers at different times of the year and different times of the day was collated and analysed. To standardise the data and reduce the influence of weather-induced variability on the patterns for any particular year, data collected from 1 July 2005 to 30 June 2022 was adjusted to align weekdays and weekends (rather than the calendar date); the first Monday in January was used as the reference point. This method was adapted from Mulcahy (2014b). The data was then analysed in Power BI, with visualisations produced in R Studio, to calculate and display the typical water use (62.5th percentile) and the range of water use that should be considered in decision making (50th to 75th percentile).

Vulnerability of site users

Surf lifesavers separately record the number of swimmers and surf craft users at Shellharbour North Beach. Surf craft users are typically more competent in the surf and have a form of flotation, and as such they are at lower risk of drowning. The proportion of swimmers compared to surf craft users at different times of the year and different times of the day was analysed.

Due to limitations with the data, relationships between demographics (i.e., gender, age, cultural and/or ethnic group(s)) and vulnerability were unable to be analysed. This will be addressed when data is collected in line with the 'data standard' for lifeguard services, surf lifesaving services, and support operations in New South Wales.

High-resolution aerial imagery

In addition, as part of *Coastal insights: safer coasts for the future*, we have developed an innovative method to analyse exposure and vulnerability using high-resolution aerial imagery captured by Nearmap. The georeferenced on-nadir (vertical) aerial imagery has a Ground Sampling Distance of 5.6 cm, sufficient to detect individual site users, and a Root Mean Square Error of 19.8 cm. Each site user was digitised as a point feature in Esri ArcGIS Pro, and categorised by zone (beach, shore platform, or water) and recreational activity.

We analysed 7 aerial images of Shellharbour North Beach. The spatial distribution of beach and water users, classified by recreational activity, is displayed on page 16.



Supervision and Surveillance Model

The *Supervision and Surveillance Model* quantifies the influence of hazardousness, exposure, and vulnerability on the risk of drowning and injury. This is the first time these factors have been quantified and integrated in a risk model, in this case for the purpose of informing the provision of supervision and surveillance on New South Wales coastline.

To date, hazard and risk models utilised within the water safety sector have typically been conceptual, or have not quantified the influence of the three factors on the probability of incidence. Mulcahy (2014b) modelled the influence of hazardousness and exposure on the probability of rescue on the New Zealand coastline.

The *Supervision and Surveillance Model* represents a significant advancement, and enables the calculation and comparison of the risk of drowning and injury at sites on the New South Wales coastline.

Development of the Supervision and Surveillance Model

The probability of rescue was used as the proxy for risk, and was calculated for different scenarios by dividing the number of rescues by the number of water users (Mulcahy, 2023a). This first required a considerable amount of data to be gathered, sorted, and aligned in preparation for analysis.

The *Supervision and Surveillance Model* utilises data on rescues and water use recorded by lifeguards from the Australian Lifeguard Service and surf lifesavers from Surf Life Saving Clubs at 181 sites along the New South Wales coastline, from 1 July 2005 to 30 June 2022. This amounted to 365,382 patrol instances, including 3,400,098 counts of the number of beach users, swimmers, or surf craft users. 95,023 rescues were recorded over these patrol instances, with additional information on the recreational activity of those rescued by lifeguards and/or surf lifesavers available for 9,784 of the incidents.

Information on beach morphology and hydrodynamics was then aligned to each count of site use (beach users, swimmers, and/or surf craft users) and each rescue recorded by lifeguards and/or surf lifesavers. The morphology of each site was determined following a review of Short (2007) and in-depth analysis of high-resolution aerial imagery (captured by Nearmap from January 2010 to December 2022), using the classifications of Wright and Short (1984). The significant wave height, peak wave period, and peak wave direction at the time of each count and rescue were extracted from the most representative node at 10 m water depth in the NSW Department of Planning and Environment's 'State Wide Nearshore Wave Transformation Tool' (NSW Department of Planning and Environment, 2023).

Hazardousness

Correlations between beach morphology and hydrodynamics and the probability of rescue were explored, and a number of significant relationships were found (Mulcahy, 2023a).

There were statistically significant differences in the probability of rescue at sites that were characterised by different prevailing beach morphologies, while controlling for wave height and the number of water users. 'Transverse bar and rip', is the most common beach morphology among patrolled beaches on the New South Wales coastline (45.3%). An adjustment factor was

calculated for each beach morphology, relative to transverse bar and rip (which was assigned an adjustment factor of one). The adjustment factors are shown in Table 2-1.

Of note, a modification to the adjustment factor for a site may be necessary where there are other influencing factors that increase the risk of drowning and injury, i.e., if the beach is situated at the mouth of an estuary, and exposed to strong currents with ebb and flood tides.

Table 2-1: Adjustment factors for beach morphologies on the New South Wales coastline.

Beach morphology	Factor
Reflective	0.39
Low tide terrace / Reflective	0.57
Low tide terrace	0.73
Transverse bar and rip / Low tide terrace	0.87
Transverse bar and rip	1.00
Rhythmic bar and beach / Transverse bar and rip	1.11
Rhythmic bar and beach	1.22
Longshore bar and trough / Rhythmic bar and beach	1.31
Longshore bar and trough	1.40
Dissipative / Longshore bar and trough	1.48
Dissipative	1.55

Wave height was also found to have a significant influence on the probability of rescue at patrolled beaches in New South Wales (Mulcahy, 2023a). The probability of rescue per water user increases with increasing wave height, and a strong linear relationship was found (Figure 2-2).

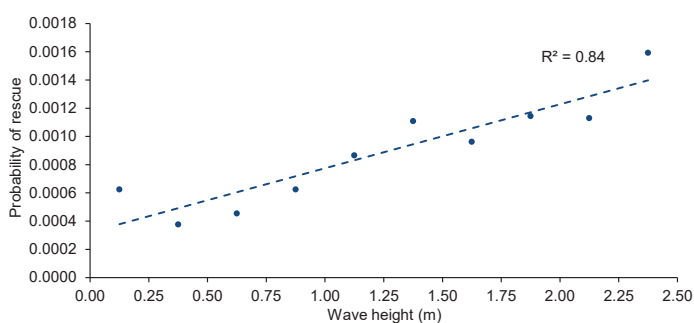


Figure 2-2: Relationship between wave height and the probability of rescue per water user.

Exposure

As the number of water users increases so too does the probability of rescue. However, the probability of rescue per water user was found to decrease as the number of water users increases. The decreasing rate (of increase) may be due to other water users assisting members of the public in difficulty before lifeguards and/or surf lifesavers are required to intervene.



A logarithmic relationship was found to be the most appropriate fit to the data (Figure 2-3); however, there was insufficient data to have confidence in any relationship beyond 500 water users (which accounted for only 0.65% of the counts). As such, where water use is greater than 500, the per person probability of rescue at 500 water users is applied.

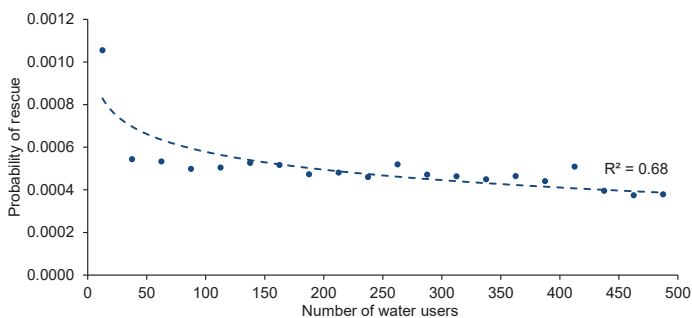


Figure 2-3: Logarithmic relationship showing the decreasing per person probability of rescue as water use increases.

Vulnerability

The vulnerability of swimmers and surf craft users was also investigated. When controlling for the number of people engaged in the respective recreational activities, swimmers were found to be 2.88 times more likely to be rescued compared to surf craft users.

On average, water use is comprised of 67.1% swimmers and 32.9% surf craft users. As such, where the proportion of swimmers exceeds 67.1%, the calculated probability of rescue increases; where the proportion of surf craft users exceeds 32.9% the calculated probability of rescue decreases.

Probability of rescue

These statistical relationships were combined into a formula to calculate the probability of rescue, given site-specific data on the beach morphology, wave height, number of water users, and the proportion of swimmers to surf craft users. The calculated probability of rescue is then used as a proxy for the risk of drowning and injury. These factors are shown in the simplified equation below (Figure 2-4).

Validation of the Supervision and Surveillance Model

To validate the *Supervision and Surveillance Model*, the probability of rescue was calculated at all sites patrolled by the Australian Lifeguard Service and/or Surf Life Saving Clubs, for every hour of every day typically patrolled. The annual number of rescues calculated by the *Supervision and Surveillance Model* for all sites was 5,397. This was compared to the average number of rescues recorded by these services per year from 1 July 2005 to 30 June 2022 (5,589). Therefore, there is a 3.44% (192) difference in the calculated number of rescues from the model compared to the average number of rescues per year. This demonstrates that the model closely replicates the influence of the different factors on the probability of rescue.

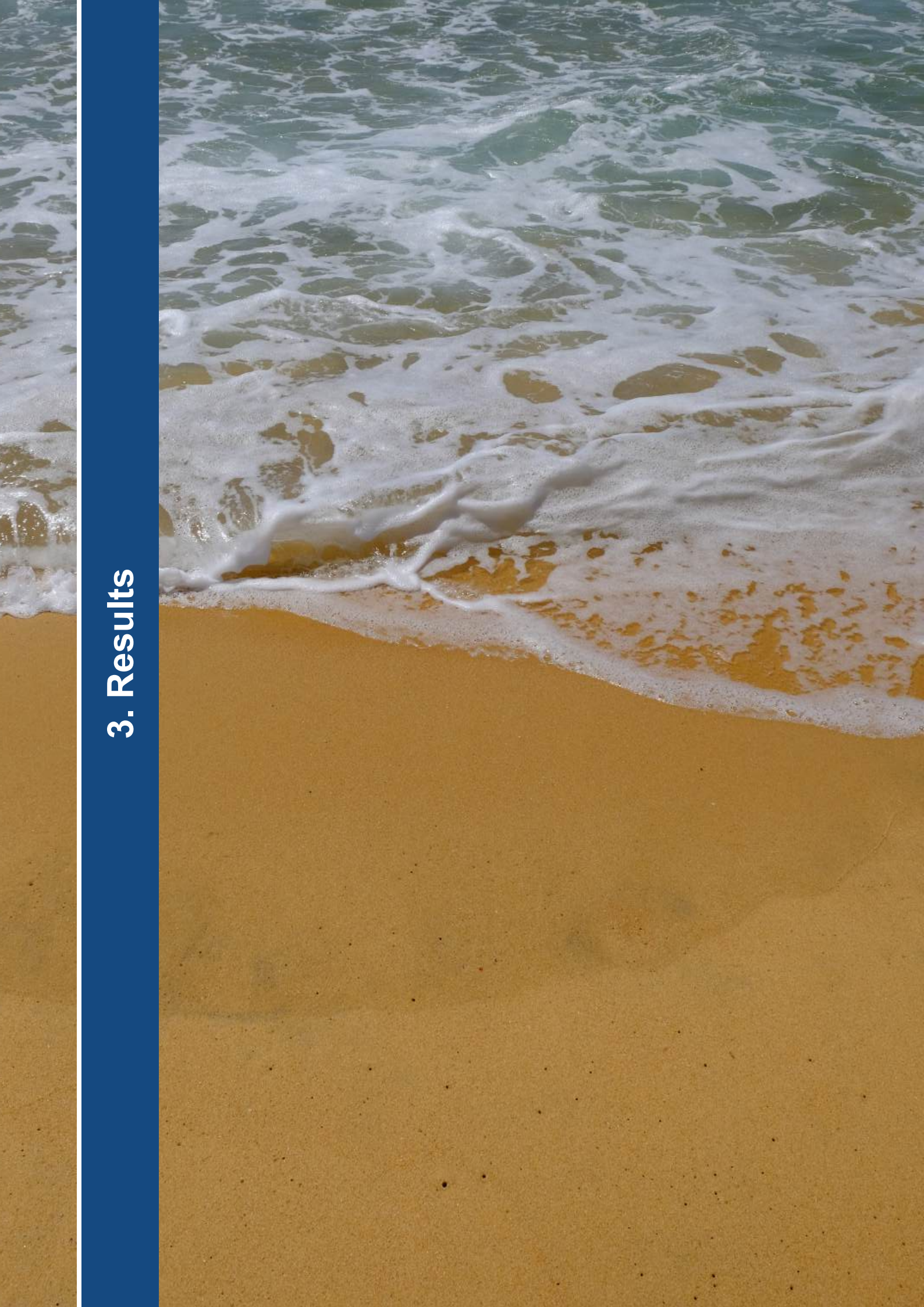
The model thus enables the probability of rescue to be calculated at any site on the New South Wales coastline, where the relevant inputs are available. This enables the risk of drowning and injury to be compared at different times of the year and different times of the day at individual sites, as well as between sites. The site-specific data for Shellharbour North Beach was input into the *Supervision and Surveillance Model* and is presented in this *Supervision and Surveillance Report*.

$$\text{Probability of rescue} = \left(\begin{array}{c} \text{Coastal morphology factor} \\ \times \\ \text{Wave height factor} \end{array} \right) \times \left(\begin{array}{c} \text{Number of water users} \\ \times \\ \text{Per person probability of rescue} \end{array} \right) \times \left(\begin{array}{c} \text{Proportion of swimmers to surf craft users} \end{array} \right)$$

Figure 2-4: Supervision and Surveillance Model.



3. Results



Results

Site-specific information on the beach morphology and hydrodynamics, volume and frequency of water use, patterns and distribution of site use and recreation, preventative safety interventions, and incidents at Shellharbour North Beach was analysed.

Beach morphology and hydrodynamics

Shellharbour North Beach typically adopts a transverse bar and rip beach morphology (see page 12), which is an intermediate beach state. As such, the nearshore zone is typically characterised by shore-attached sand bars separated by channels and rip currents every 100 m to 300 m alongshore. Rip currents can develop anywhere along the beach, shift frequently, and are stronger during lower tides and/or larger surf.

Shellharbour North Beach is exposed to median significant wave heights of 0.80 m (10 m water depth), with a peak wave period of 9.16 seconds, and peak wave direction of 99.71 degrees (east). However, wave height, wave period, and wave direction are variable (see Figure 3-1). As shown in Figure 2-2, changes in wave height directly affect the risk of drowning and injury.

Volume and frequency of water use

Shellharbour North Beach is used by a considerable number of water users throughout the year (see Figure 3-2).

Water use is typically highest from mid-December to the end of February and is busiest from late morning to the mid-afternoon. A moderate number of people use the water in spring and autumn with water use peaking in the late morning and gradually declining into the early evening.

Site use and recreation

Members of the public use Shellharbour North Beach for a wide range of recreational activities. Beach users typically comprise over 60% of those using Shellharbour North Beach. There are typically more swimmers than surf craft users throughout summer with numbers peaking in the mid-morning till mid-afternoon. During spring and autumn, surf craft use is proportionally higher, particularly in the mornings (see Figure 3-3).

In addition, the analysis of high-resolution aerial imagery provides information on the spatial distribution of recreational activities at Shellharbour North Beach; see page 16.

Safety interventions

A considerable number of preventative safety interventions and incidents have been recorded at Shellharbour North Beach from 1 July 2005 to 30 June 2022.

Preventative safety interventions

Preventative safety interventions (where surf lifesavers identify a hazard and take action to reduce the risk of harm to members of the public) are most often undertaken from late December to early February; 15 to 30 preventative safety interventions are typically recorded weekly (see Figure 3-4). There are 5 to 10 preventative safety interventions recorded weekly from mid-October to mid-December, and from mid-February to the end of April.

Rescues

Surf lifesavers at Shellharbour North Beach rescue an average of 32 people per year. Rescues are most likely to occur from early January to early February, with a small number of rescues also recorded from October to the end of December. (see Figure 3-5). During summer, rescues are most likely from the mid-morning through to the mid-afternoon. In spring, rescue numbers peak at mid-morning and drop away in the afternoon.

Fewer rescues have been recorded at other times of the year.

Injuries and/or medical incidents

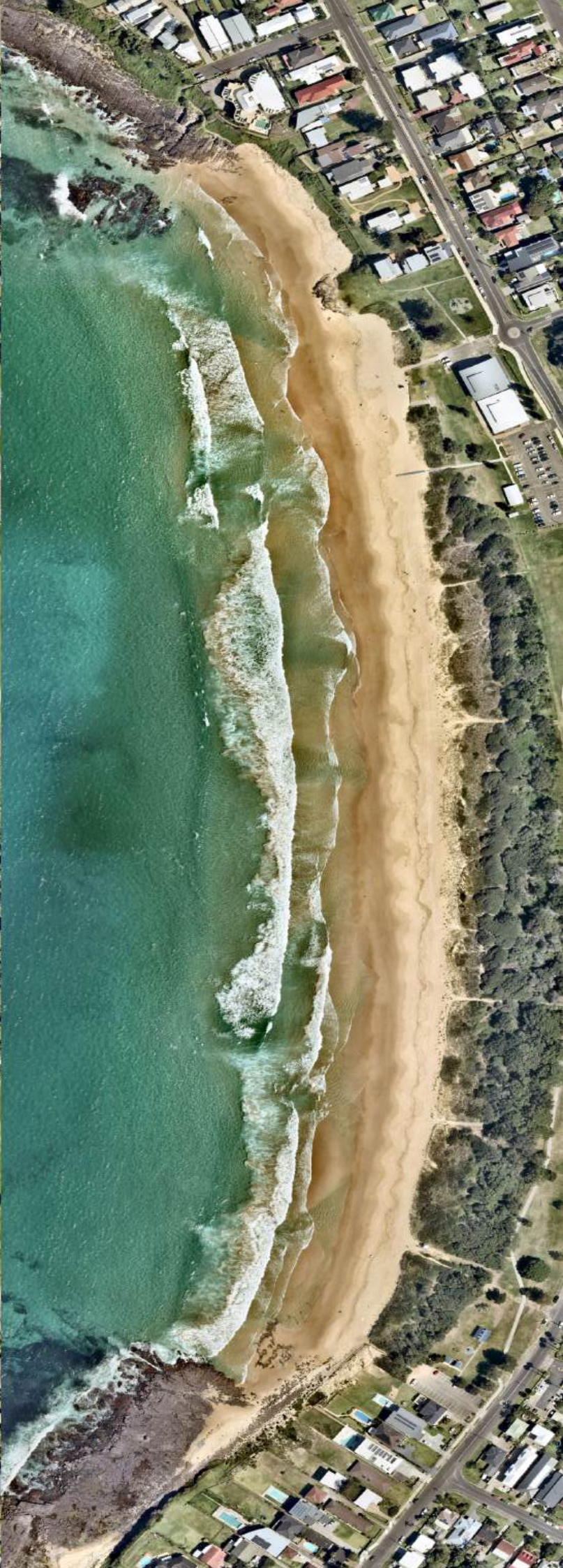
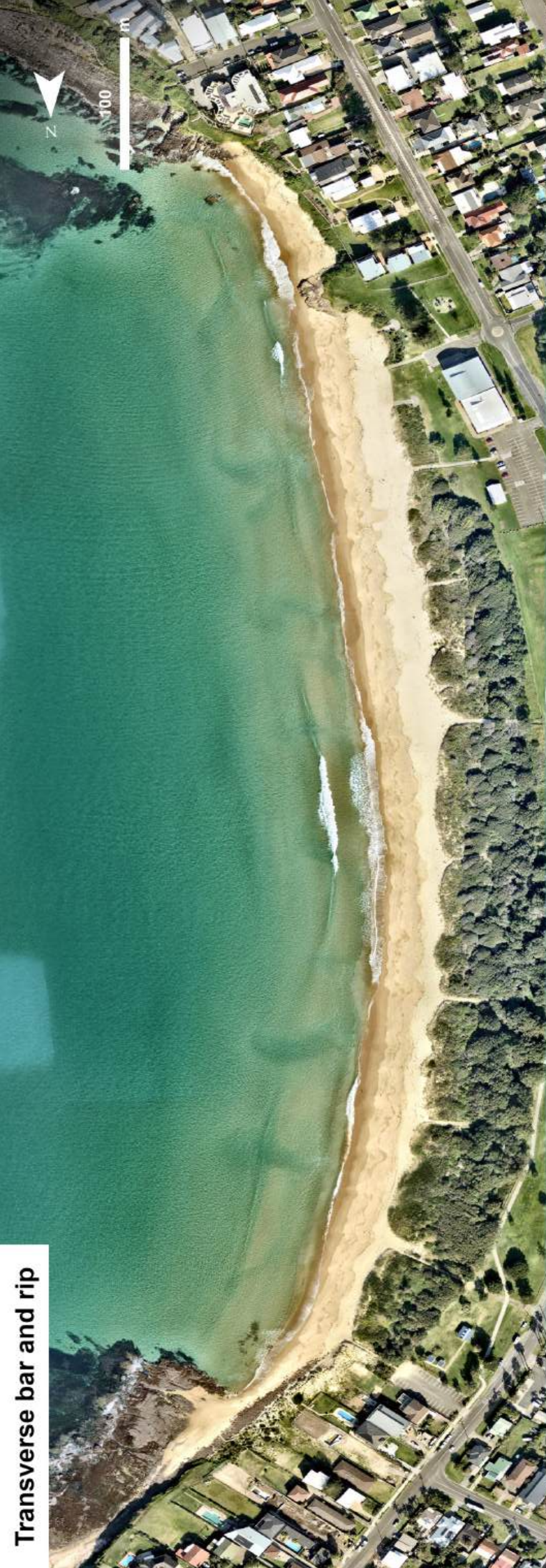
Those using Shellharbour North Beach most frequently require treatment by surf lifesavers from late December to early February, with a small number of incidents also recorded in spring and autumn (see Figure 3-6).

Marine creature stings and wounds were the most common injuries sustained by those using Shellharbour North Beach.

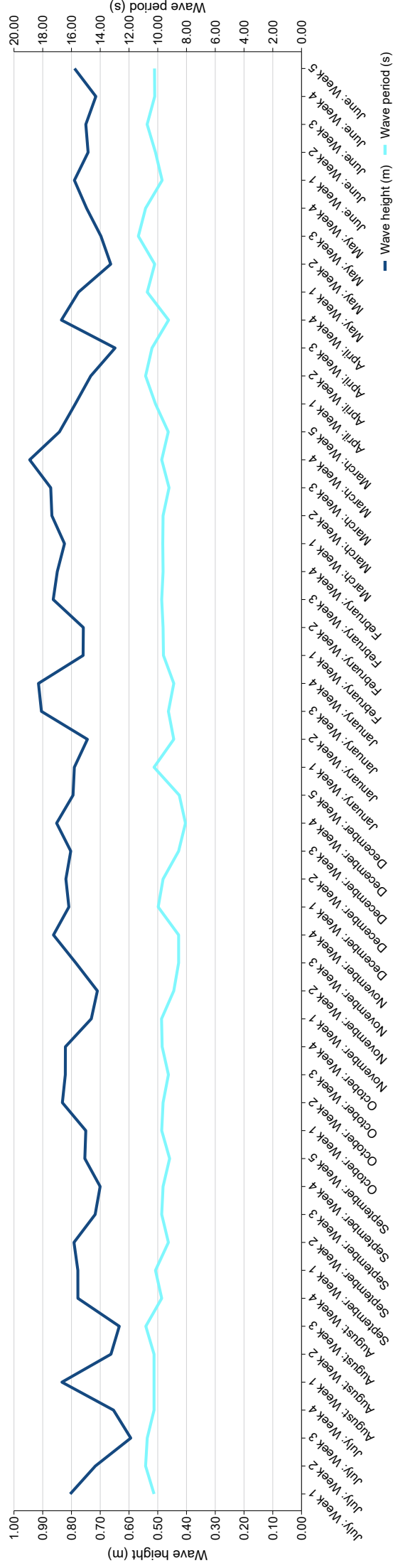
‘15 to 30 preventative safety interventions are typically recorded weekly from late December to early February; rescues are most likely to occur from early January to early February’



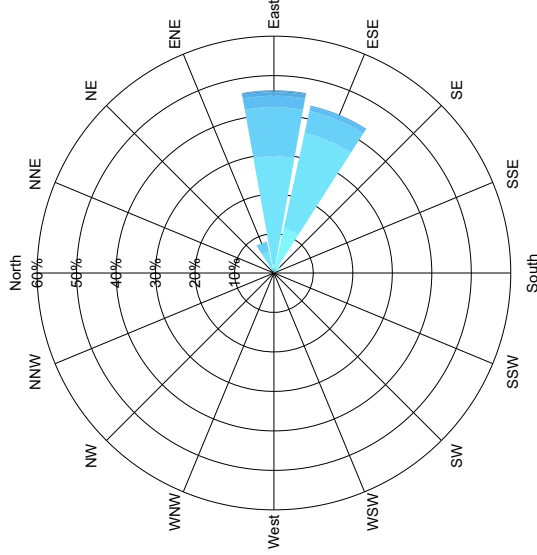
Transverse bar and rip



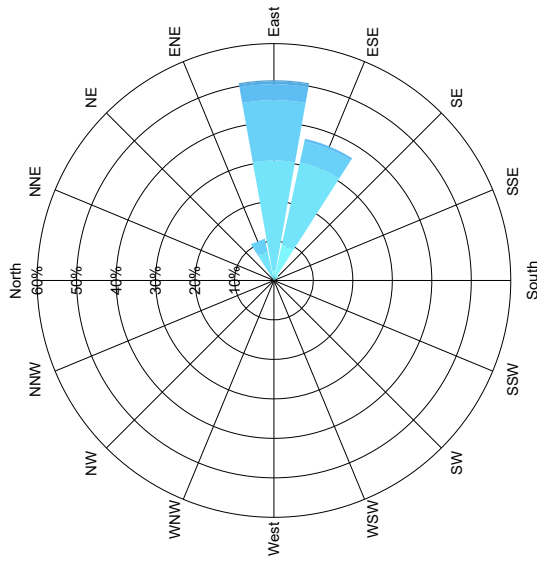
Wave height, wave period, and wave direction



Mid-September to mid-December



Mid-December to late February



Early March to late April

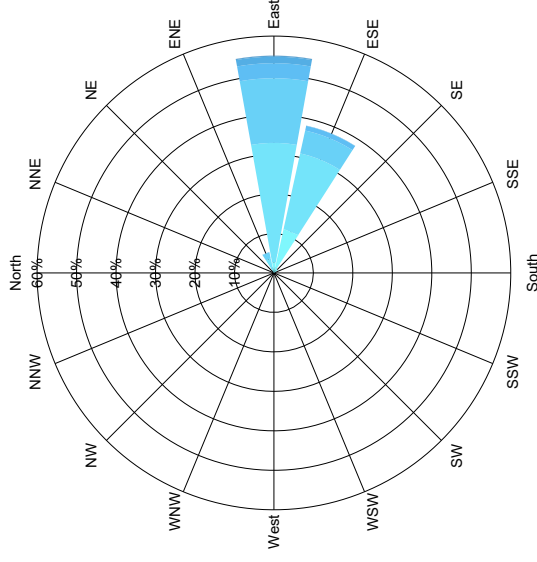


Figure 3-1: The significant wave height and peak wave period at Shellharbour North Beach, displayed weekly from July to June, and wave roses (significant wave height and peak wave direction) from mid-September to mid-December, mid-December to late February, and early March to late April.

Volume and frequency of water use

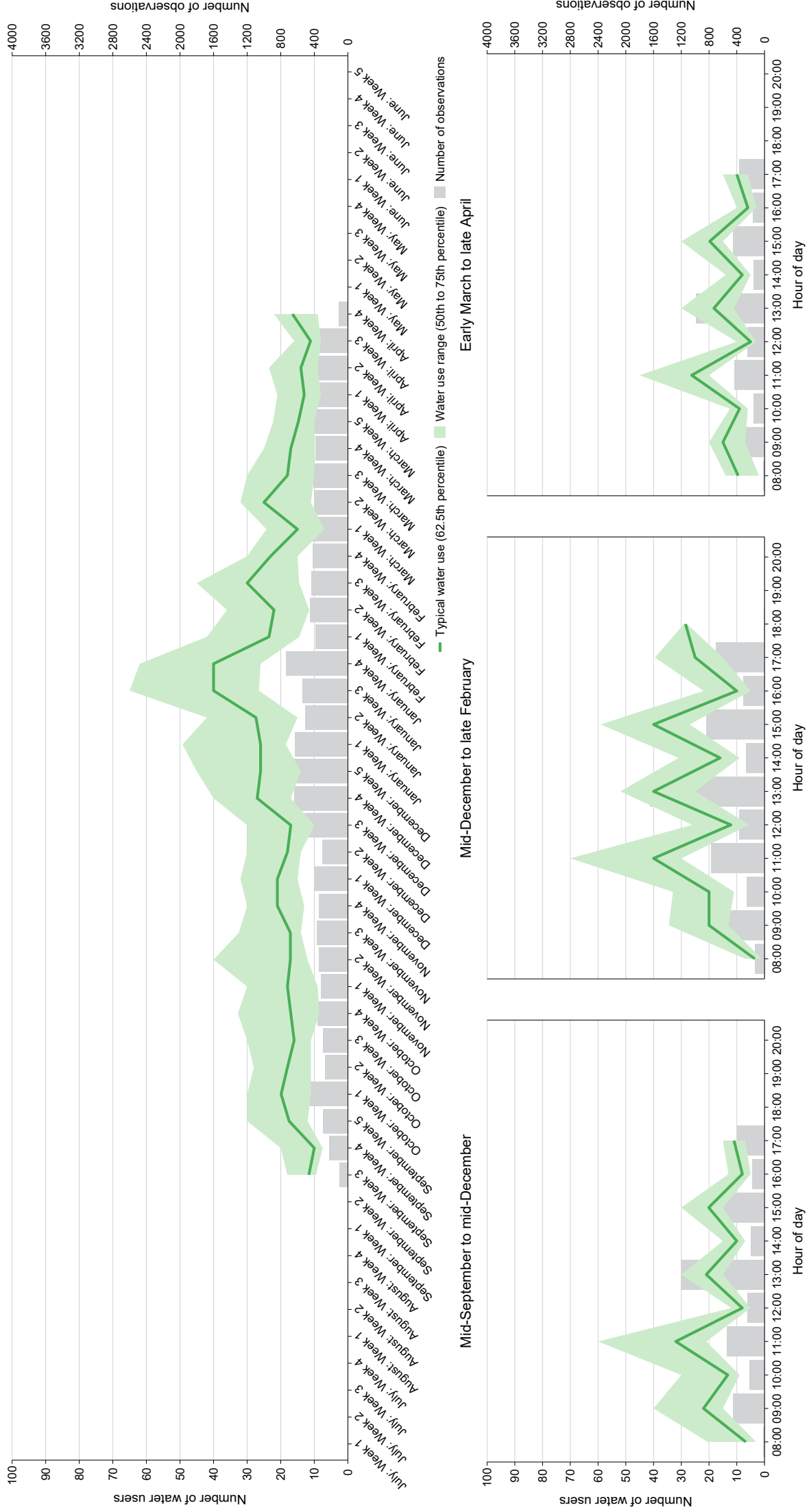


Figure 3-2: The typical number of water users recorded by surf lifesavers at Shellharbour North Beach, displayed weekly from July to June, and hourly from 8:00 am to 8:00 pm from mid-September to mid-December, mid-December to late February, and early March to late April.

Site use and recreational activities

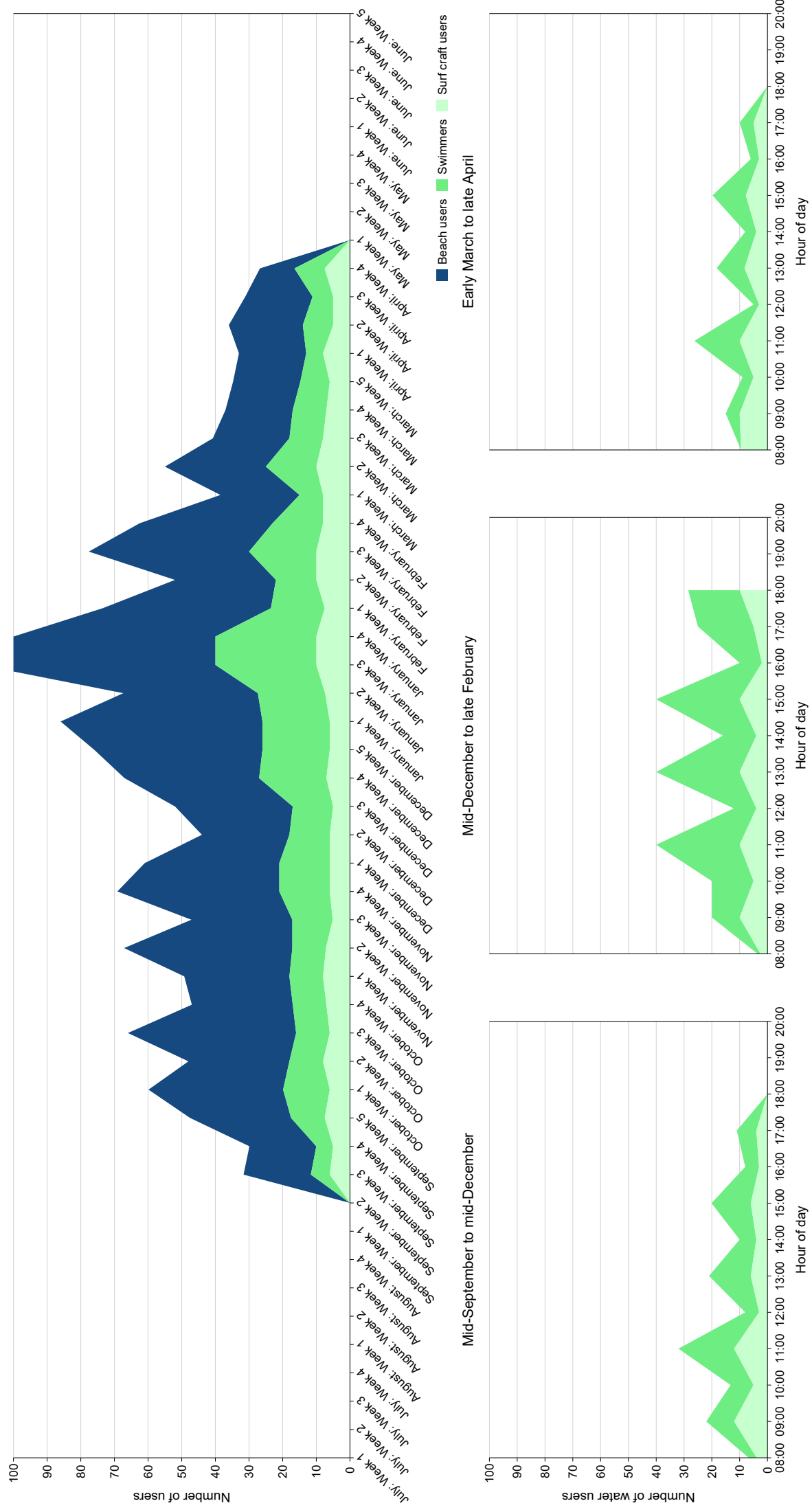
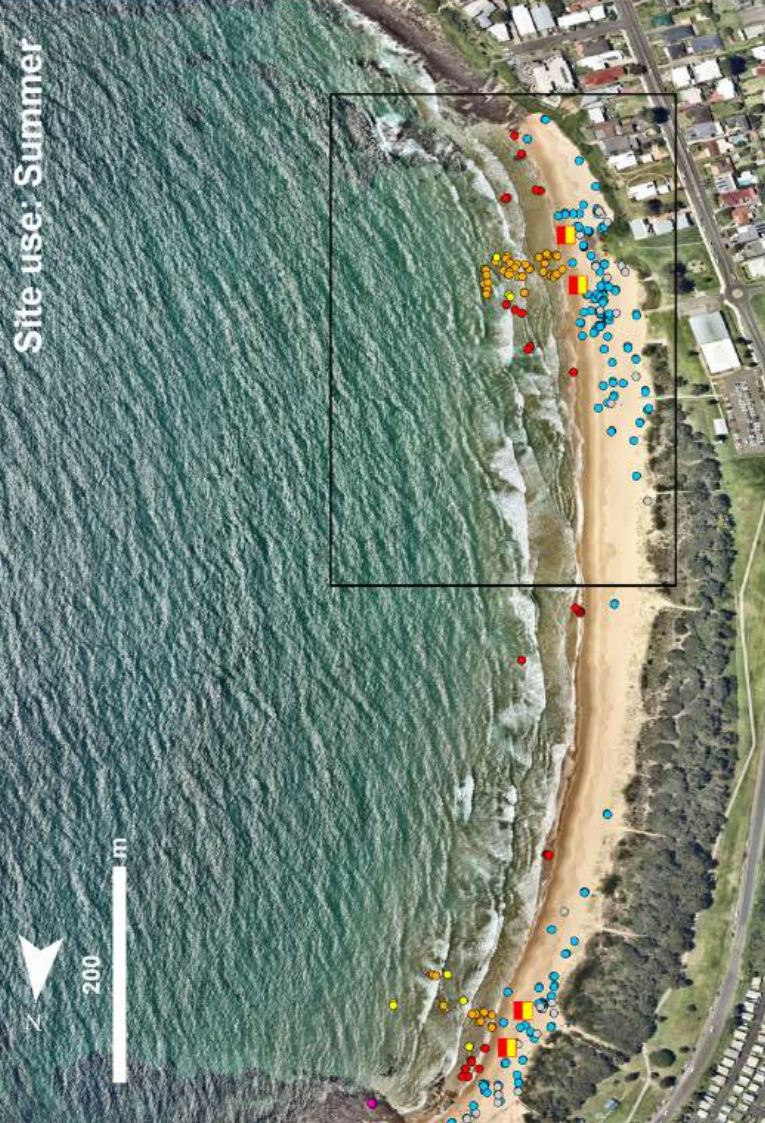


Figure 3-3: The typical number of beach users, swimmers, and surf craft users recorded by surf lifesavers at Shellharbour North Beach, displayed weekly from July to June, and hourly from 8:00 am to 8:00 pm from mid-September to mid-December, mid-December to late February, and early March to late April.

Site use: Summer

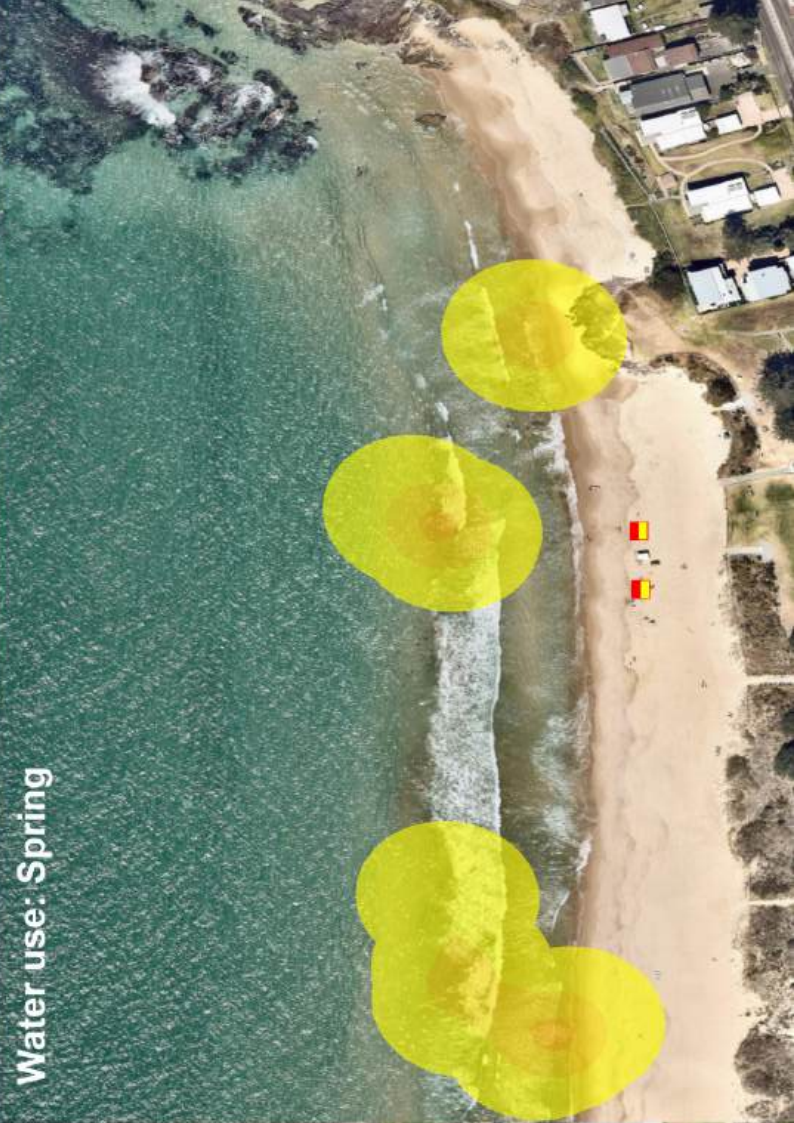
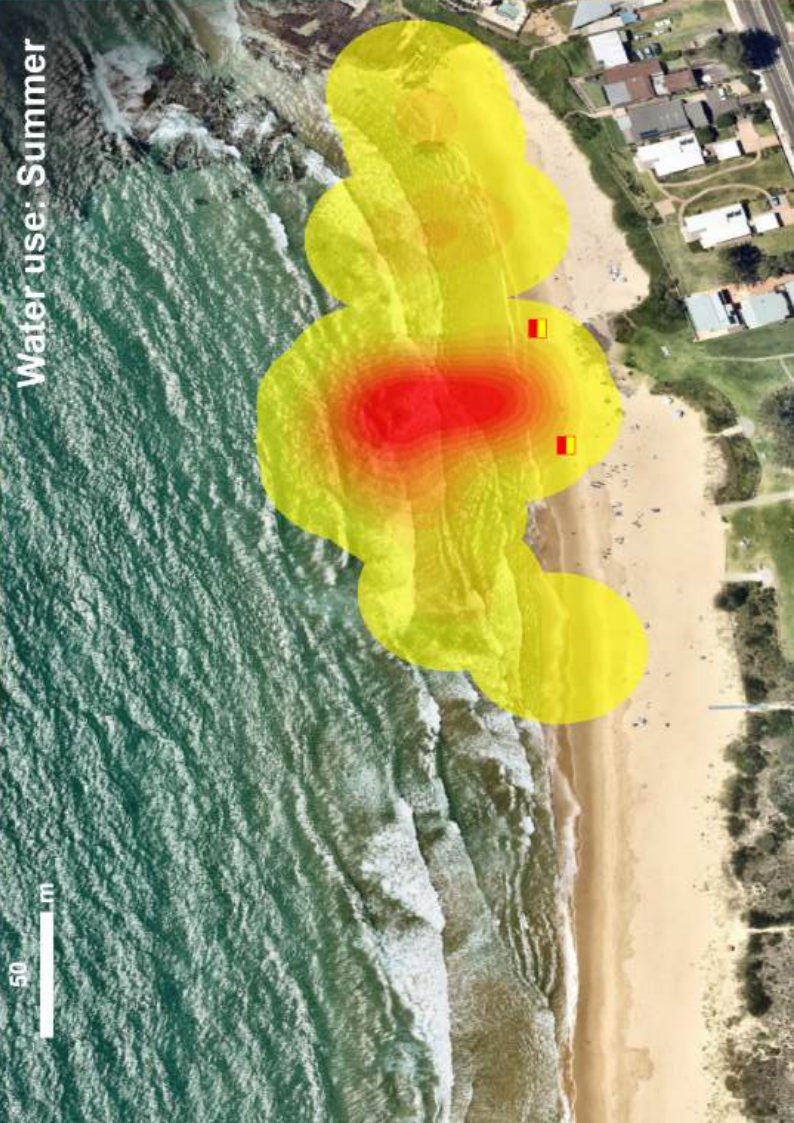
Site use: Spring

- Beach user
- Shade structure
- Shore platform user
- Wader or swimmer inside the red and yellow flags
- Wader or swimmer outside the red and yellow flags
- Surf craft user
- Red and yellow flag

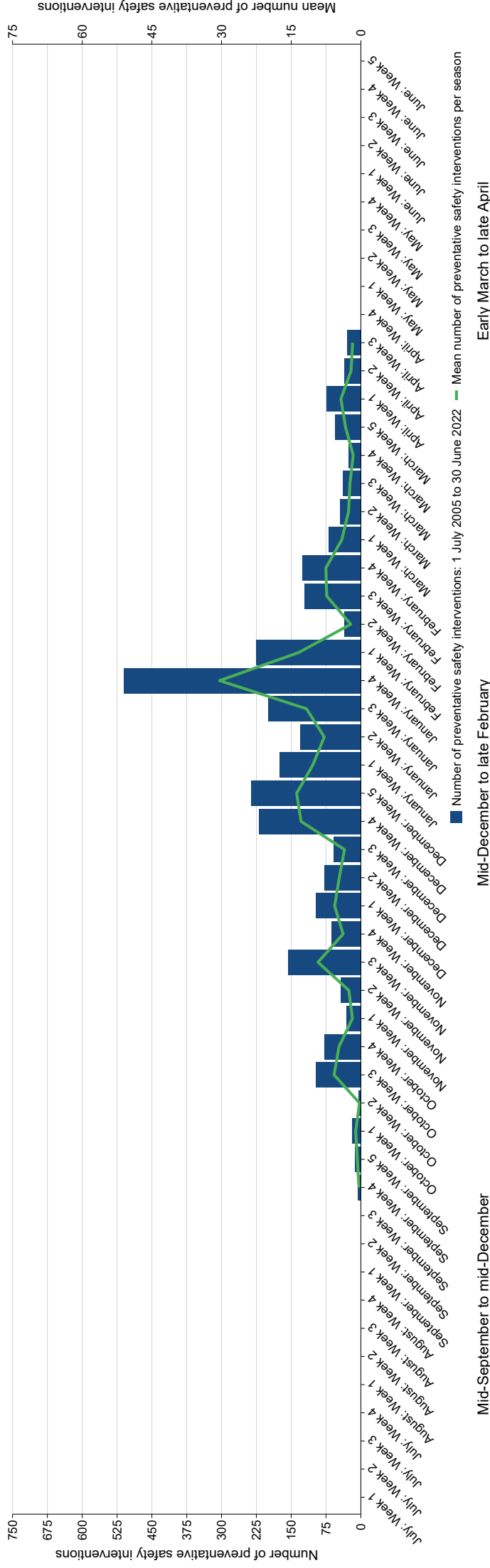


Water use: Summer

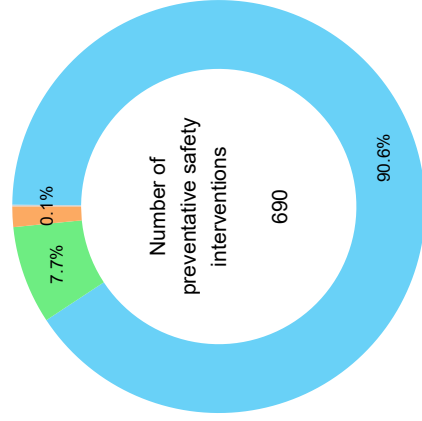
Water use: Spring



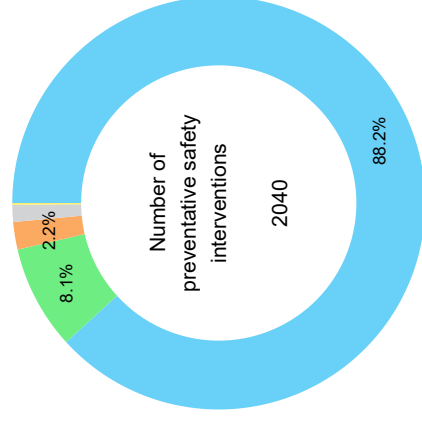
Preventative safety interventions



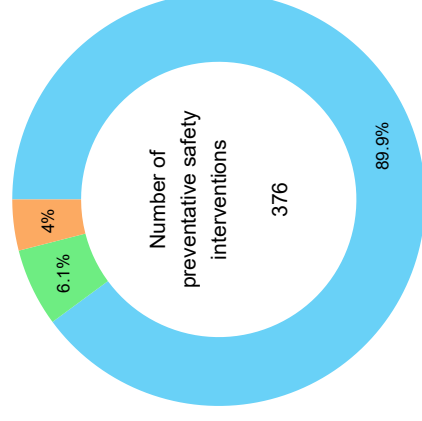
Mid-September to mid-December



Mid-December to late February



Early March to late April



Legend: ■ Removal or isolation of the hazard(s) ■ Site user(s) warned of hazard(s) ■ Site user(s) educated on hazard(s) ■ Management of act or regulation ■ Closure of the site

Figure 3-4: The number of preventative safety interventions recorded by surf lifesavers at Shellharbour North Beach, displayed weekly from July to June, and by type of preventative safety intervention from mid-September to mid-December, mid-December to late February, and early March to late April.

Rescues

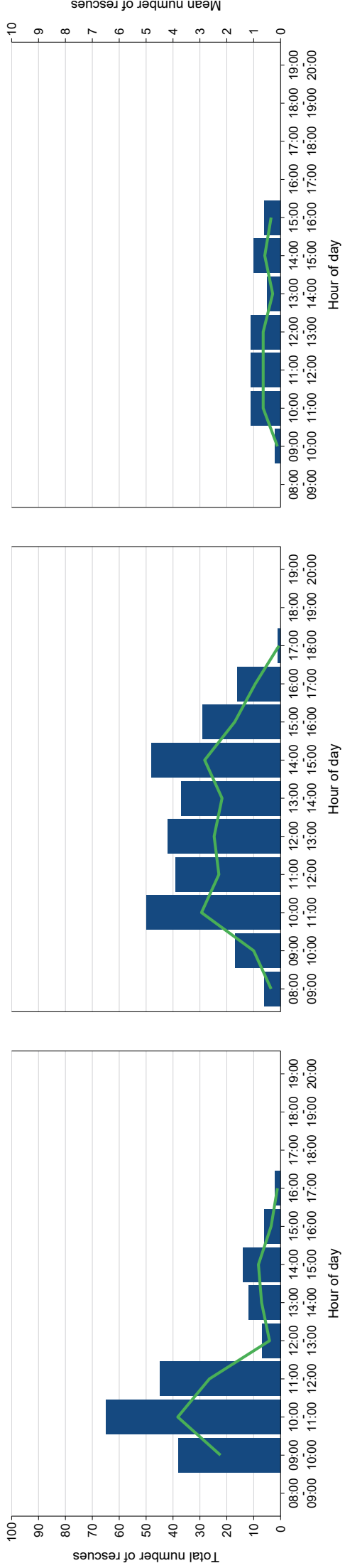
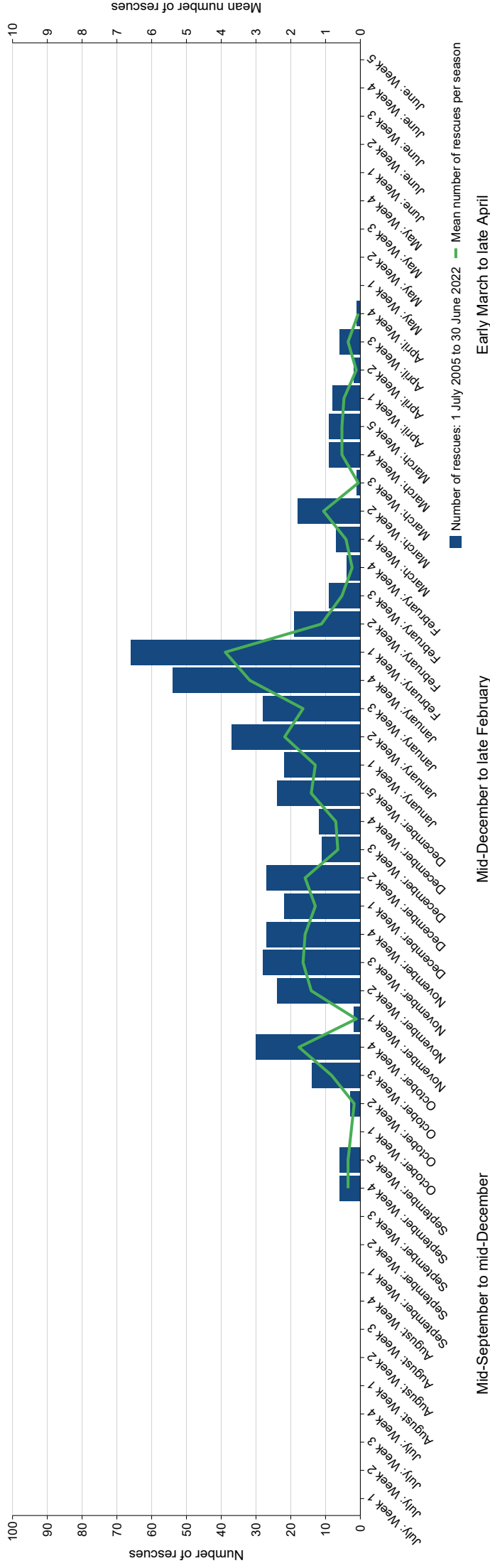
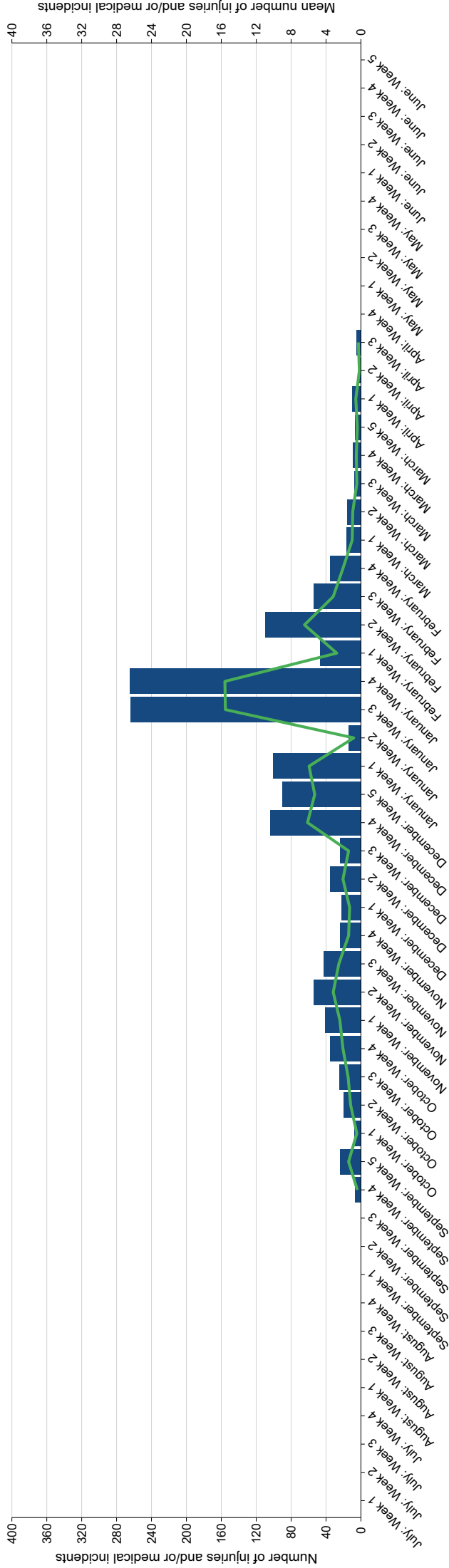
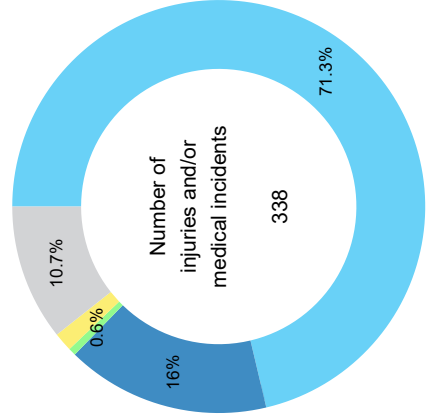


Figure 3-5: The number of rescues recorded by surf lifesavers at Shellharbour North Beach, displayed weekly from July to June, and hourly from 8:00 am to 8:00 pm from mid-September to mid-December, mid-December to late February, and early March to late April.

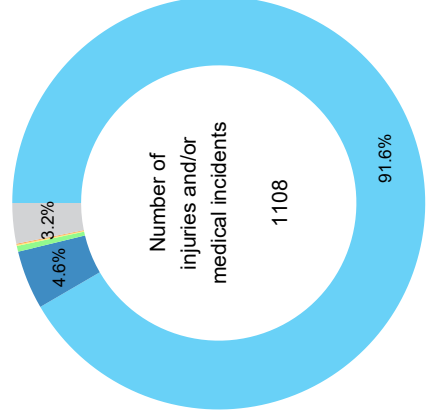
Injuries and/or medical incidents



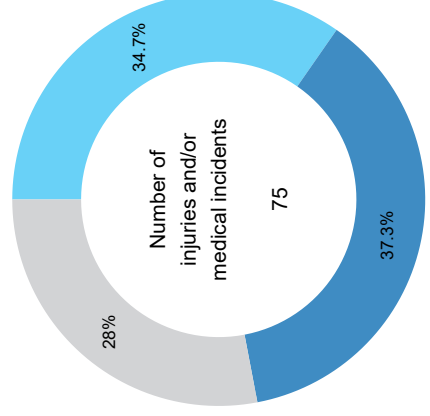
Mid-September to mid-December



Mid-December to late February



Early March to late April



Legend: ■ Marine creature stings ■ Wounds ■ Sprains, dislocations, and fractures ■ Head and facial injuries ■ Spinal cord injuries ■ Respiratory impairment ■ Cardiac issues ■ Other

Figure 3-6: The number of injuries and/or medical incidents recorded by surf lifesavers at Shellharbour North Beach, displayed weekly from July to June, and by type of injury and/or medical incident from mid-September to mid-December, mid-December to late February, and early March to late April.

4. Quantifying the risk of drowning and injury



Quantifying the risk of drowning and injury

Site-specific information on the beach morphology, median weekly significant wave height, typical water use (62.5th percentile), and the relative proportion of swimmers to surf craft users was input into the *Supervision and Surveillance Model* to calculate the probability of rescue for Shellharbour North Beach; this is used as the proxy for the risk of drowning and injury.

Calculating the probability of rescue

The probability of rescue was calculated hourly for each week throughout the year. The probability of rescue should be interpreted as the likelihood that a rescue will occur within the specified hour on each day within that week. For example, if the probability of rescue is 0.1000, there is a 1 in 10 chance that a rescue will occur.

The probability of rescue was calculated for Shellharbour North Beach for every week and hour where the required data was available (Table 4-4). The lowest value (0.0015) equates to a 1 in 656 probability of rescue, while the highest value (0.0541) equates to a 1 in 18 probability of rescue.

A colour scale (Table 4-1) was applied to visualise the varying probability of rescue at different times of the year and different times of the day at Shellharbour North Beach.

Table 4-1: Range of values and colour scale used to display the calculated probability of rescue at Shellharbour North Beach.

0.0015 - 0.0068	
0.0068 - 0.0120	
0.0120 - 0.0173	
0.0173 - 0.0226	
0.0226 - 0.0278	
0.0278 - 0.0331	
0.0331 - 0.0384	
0.0384 - 0.0436	
0.0436 - 0.0489	
0.0489 - 0.0541	

Probability of preventative safety intervention

The probability of preventative safety intervention was also calculated for Shellharbour North Beach. From 1 July 2005 to 30 June 2022, 95,023 rescues were recorded throughout New South Wales by the Australian Lifeguard Service and Surf Life Saving Clubs, while 7,426,945 preventative safety interventions were recorded. As such, there were 78.2 preventative safety interventions for every rescue. The probability of preventative safety intervention was therefore calculated for Shellharbour North Beach by multiplying the probability of rescue by 78.2. The probability of preventative safety intervention at different times of the year and different times of the day for Shellharbour North Beach is displayed in Table 4-5.

A colour scale (Table 4-2) was applied to visualise the varying probability of preventative safety intervention at different times of the year and different times of the day.

Table 4-2: Range of values and colour scale used to display the calculated probability of preventative safety intervention at Shellharbour North Beach.

0.12 - 0.53	
0.53 - 0.94	
0.94 - 1.35	
1.35 - 1.76	
1.76 - 2.18	
2.18 - 2.59	
2.59 - 3.00	
3.00 - 3.41	
3.41 - 3.82	
3.82 - 4.23	

Quantifying the relative risk of drowning and injury

The probability of rescue for all patrolled sites in the City of Shellharbour was calculated, ranked in order of magnitude, and assigned a corresponding percentile; the lower the percentile, the higher the priority. This ranking has been calculated for all sites, weeks, and hours of day where the required data is available.

These rankings enable quantitative comparison and prioritisation between sites in the City of Shellharbour throughout the year and across different times of the day. The rankings for Shellharbour North Beach are presented in Table 4-6. The colour scale used in the rankings is displayed in Table 4-3.

Table 4-3: Colour scale used in the priority ranking of patrolled sites in the City of Shellharbour.

0% - 10%	
10% - 20%	
20% - 30%	
30% - 40%	
40% - 50%	
50% - 60%	
60% - 70%	
70% - 80%	
80% - 90%	
90% - 100%	

Of note, the asterisks (*) in the following tables indicate times when data on water use was absent; these values have been calculated as the mean of the values for the preceding and proceeding hours. Values were not calculated where there was only a preceding or proceeding value.



Probability of rescue

Table 4-4: Weekly and hourly probability of rescue calculated for Shellharbour North Beach.

Date / Time		08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
Off-peak period	July: Week 1														
	July: Week 2														
	July: Week 3														
	July: Week 4														
	August: Week 1														
	August: Week 2														
	August: Week 3														
	August: Week 4														
	September: Week 1														
	September: Week 2														
Pre-peak period	September: Week 3		0.0077	0.0055	0.0112	0.0092	0.0134	0.0096	0.0114	0.0089	0.0050				
	September: Week 4		0.0087	0.0054	0.0101	0.0039	0.0114	0.0050	0.0092	0.0040	0.0037				
	September: Week 5		0.0110	0.0089	0.0264	0.0224	0.0233	0.0171	0.0118	0.0098	0.0098				
	October: Week 1		0.0158	0.0149	0.0251	0.0243	0.0197	0.0239	0.0156	0.0150	0.0088				
	October: Week 2	0.0171	0.0147	0.0117	0.0412	0.0092	0.0190	0.0107	0.0176	0.0065	0.0070				
	October: Week 3	0.0020	0.0243	0.0148	0.0256	0.0119	0.0161	0.0122	0.0133	0.0061	0.0057				
	October: Week 4	0.0052	0.0209	0.0200	0.0326	0.0065	0.0181	0.0120	0.0190	0.0067	0.0092				
	November: Week 1		0.0139	0.0209	0.0331	0.0047	0.0157	0.0080	0.0141	0.0070	0.0065				
	November: Week 2	0.0408	0.0224	0.0321	0.0441	0.0157	0.0209	0.0160	0.0249	0.0131	0.0100				
	November: Week 3	0.0105	0.0265	0.0446	0.0222	0.0102	0.0178	0.0094	0.0197	0.0121	0.0097				
	November: Week 4		0.0342	0.0244	0.0274	0.0113	0.0217	0.0169	0.0192	0.0100	0.0111				
	December: Week 1		0.0125	0.0309	0.0352	0.0137	0.0206	0.0138	0.0271	0.0118	0.0129				
December: Week 2		0.0246	0.0189	0.0244	0.0131	0.0108	0.0103	0.0184	0.0123	0.0105					
Peak period	December: Week 3	0.0052	0.0124	0.0114	0.0281	0.0101	0.0180	0.0152	0.0251	0.0142	0.0153				
	December: Week 4	0.0031	0.0185	0.0198	0.0289	0.0279	0.0243	0.0219	0.0272	0.0310	0.0210				
	December: Week 5	0.0015	0.0106	0.0105	0.0323	0.0102	0.0346	0.0152	0.0317	0.0109	0.0245				
	January: Week 1	0.0055	0.0117	0.0272	0.0324	0.0225	0.0369	0.0235	0.0381	0.0213	0.0210	0.0292			
	January: Week 2	0.0049	0.0112	0.0461	0.0309	0.0184	0.0251	0.0294	0.0280	0.0142	0.0184				
	January: Week 3	0.0069	0.0225	0.0286	0.0431	0.0279	0.0433	0.0422	0.0456	0.0288	0.0296				
	January: Week 4	0.0020	0.0242	0.0327	0.0541	0.0469	0.0405	0.0402	0.0423	0.0297	0.0280				
	February: Week 1		0.0159	0.0100	0.0323	0.0038	0.0250	0.0081	0.0250	0.0058	0.0180				
	February: Week 2		0.0109	0.0166	0.0202	0.0116	0.0250	0.0202	0.0186	0.0086	0.0125				
	February: Week 3		0.0164	0.0158	0.0352	0.0068	0.0268	0.0269	0.0281	0.0147	0.0187				
	February: Week 4	0.0520	0.0118	0.0170	0.0288	0.0149	0.0217	0.0182	0.0214	0.0143	0.0149				
	Post-peak period	March: Week 1	0.0017	0.0118	0.0065	0.0298	0.0069	0.0154	0.0095	0.0192	0.0090	0.0102			
		March: Week 2		0.0200	0.0194	0.0377	0.0055	0.0200	0.0040	0.0230	0.0048	0.0150			
		March: Week 3		0.0126	0.0070	0.0285	0.0093	0.0218	0.0203	0.0199	0.0160	0.0101			
March: Week 4			0.0132	0.0041	0.0210	0.0053	0.0162	0.0081	0.0169	0.0074	0.0196				
March: Week 5		0.0045	0.0079	0.0095	0.0158	0.0107	0.0166	0.0097	0.0153	0.0111	0.0084				
April: Week 1		0.0212	0.0085	0.0074	0.0178	0.0042	0.0114	0.0095	0.0145	0.0041	0.0060				
April: Week 2			0.0064	0.0095	0.0193	0.0148	0.0148	0.0163	0.0157	0.0101	0.0063				
April: Week 3			0.0044	0.0096	0.0119	0.0091	0.0110	0.0120	0.0098	0.0096	0.0036				
April: Week 4		0.0120	0.0038	0.0171	0.0023	0.0112	0.0040	0.0132	0.0027	0.0040					
Off-peak period	May: Week 1														
	May: Week 2														
	May: Week 3														
	May: Week 4														
	June: Week 1														
	June: Week 2														
	June: Week 3														
	June: Week 4														
	June: Week 5														



Probability of preventative safety intervention

Table 4-5: Weekly and hourly probability of preventative safety intervention calculated for Shellharbour North Beach.

Date / Time		08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
Off-peak period	July: Week 1														
	July: Week 2														
	July: Week 3														
	July: Week 4														
	August: Week 1														
	August: Week 2														
	August: Week 3														
	August: Week 4														
	September: Week 1														
	September: Week 2														
Pre-peak period	September: Week 3		0.60	0.43	0.87	0.72	1.04	0.75	0.89	0.69	0.39				
	September: Week 4		0.68	0.42	0.79	0.30	0.89	0.39	0.72	0.31	0.29				
	September: Week 5		0.86	0.70	2.06	1.75	1.82	1.34	0.92	0.76	0.76				
	October: Week 1		1.24	1.16	1.96	1.90	1.54	1.87	1.22	1.17	0.69				
	October: Week 2	1.34	1.15	0.91	3.22	0.72	1.48	0.84	1.37	0.51	0.55				
	October: Week 3	0.16	1.90	1.16	2.00	0.93	1.26	0.96	1.04	0.47	0.45				
	October: Week 4	0.41	1.64	1.56	2.55	0.50	1.42	0.94	1.49	0.52	0.72				
	November: Week 1		1.09	1.64	2.59	0.37	1.23	0.63	1.11	0.55	0.51				
	November: Week 2	3.19	1.75	2.51	3.45	1.22	1.63	1.25	1.95	1.02	0.78				
	November: Week 3	0.82	2.07	3.48	1.73	0.80	1.39	0.73	1.54	0.94	0.76				
	November: Week 4		2.67	1.91	2.15	0.88	1.70	1.32	1.50	0.78	0.87				
	December: Week 1		0.98	2.42	2.75	1.07	1.61	1.08	2.12	0.92	1.01				
December: Week 2		1.92	1.47	1.91	1.02	0.85	0.80	1.44	0.96	0.82					
Peak period	December: Week 3	0.40	0.97	0.89	2.19	0.79	1.41	1.18	1.96	1.11	1.20				
	December: Week 4	0.24	1.44	1.54	2.26	2.18	1.90	1.71	2.12	2.42	1.64				
	December: Week 5	0.12	0.83	0.82	2.52	0.80	2.71	1.19	2.48	0.85	1.91				
	January: Week 1	0.43	0.91	2.13	2.53	1.76	2.88	1.84	2.98	1.67	1.64	2.28			
	January: Week 2	0.38	0.87	3.60	2.42	1.44	1.97	2.30	2.19	1.11	1.44				
	January: Week 3	0.54	1.76	2.24	3.37	2.18	3.38	3.30	3.56	2.25	2.32				
	January: Week 4	0.16	1.89	2.55	4.23	3.66	3.16	3.14	3.31	2.32	2.19				
	February: Week 1		1.25	0.78	2.52	0.30	1.95	0.64	1.95	0.45	1.40				
	February: Week 2		0.85	1.30	1.58	0.90	1.95	1.58	1.46	0.67	0.97				
	February: Week 3		1.28	1.24	2.75	0.53	2.09	2.10	2.19	1.15	1.46				
	February: Week 4	4.06	0.92	1.33	2.25	1.17	1.69	1.43	1.67	1.12	1.16				
	Post-peak period	March: Week 1	0.13	0.92	0.51	2.33	0.54	1.20	0.74	1.50	0.71	0.80			
		March: Week 2		1.56	1.52	2.94	0.43	1.56	0.31	1.80	0.37	1.17			
		March: Week 3		0.98	0.55	2.23	0.73	1.71	1.58	1.55	1.25	0.79			
March: Week 4			1.03	0.32	1.64	0.42	1.27	0.64	1.32	0.57	1.53				
March: Week 5		0.35	0.62	0.74	1.24	0.84	1.30	0.76	1.20	0.87	0.66				
April: Week 1		1.65	0.67	0.58	1.39	0.33	0.89	0.75	1.13	0.32	0.47				
April: Week 2			0.50	0.74	1.51	1.16	1.15	1.28	1.23	0.79	0.50				
April: Week 3			0.34	0.75	0.93	0.71	0.86	0.94	0.76	0.75	0.28				
April: Week 4		0.94	0.30	1.34	0.18	0.88	0.32	1.03	0.21	0.31					
Off-peak period	May: Week 1														
	May: Week 2														
	May: Week 3														
	May: Week 4														
	June: Week 1														
	June: Week 2														
	June: Week 3														
	June: Week 4														
	June: Week 5														



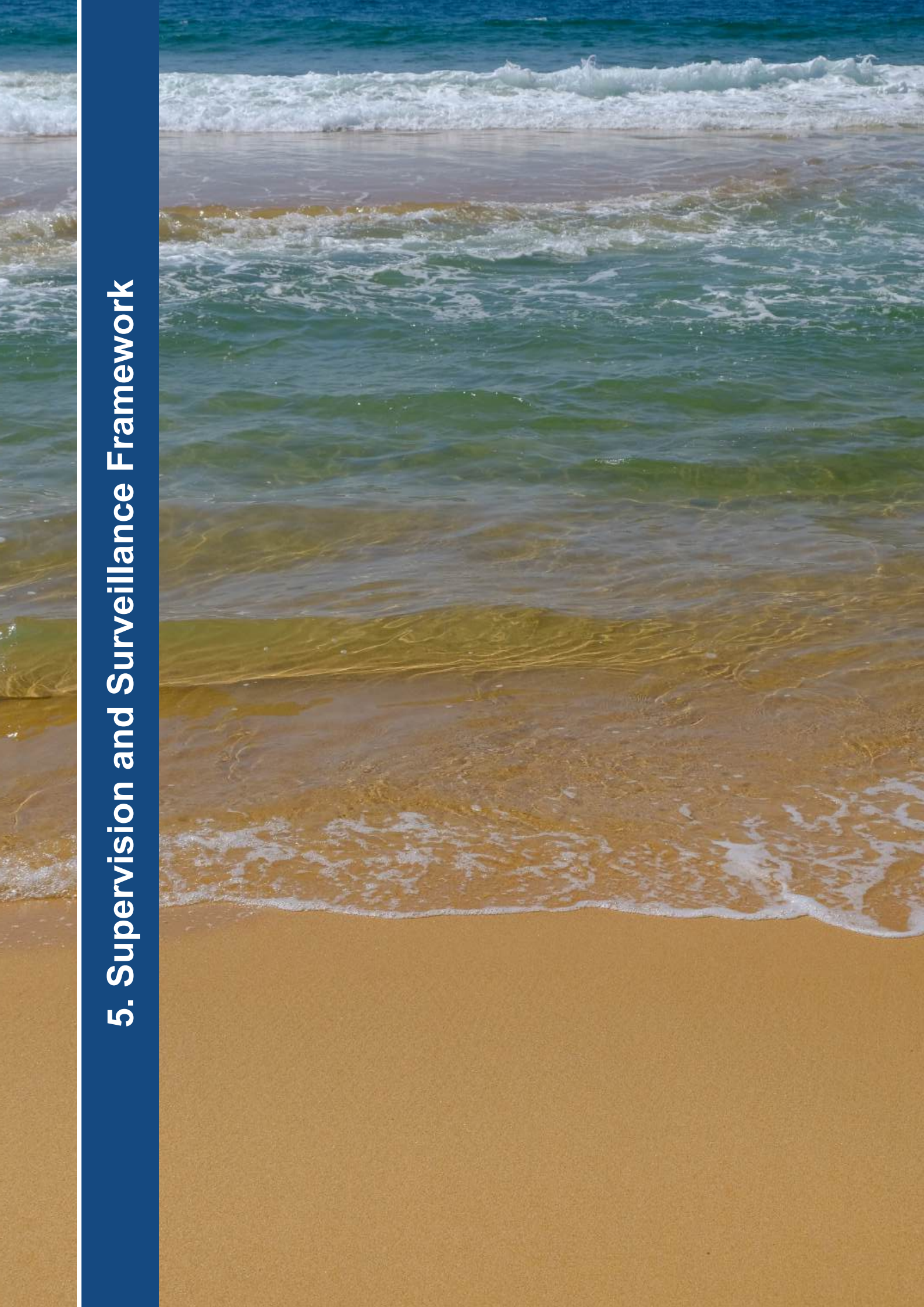
Relative risk within the City of Shellharbour

Table 4-6: Weekly and hourly relative risk for Shellharbour North Beach within the context of patrolled sites in the City of Shellharbour.

Date / Time		08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
Off-peak period	July: Week 1														
	July: Week 2														
	July: Week 3														
	July: Week 4														
	August: Week 1														
	August: Week 2														
	August: Week 3														
	August: Week 4														
	September: Week 1														
	September: Week 2														
Pre-peak period	September: Week 3		79%	88%	62%	73%	50%	70%	61%	74%	90%				
	September: Week 4		75%	88%	67%	94%	60%	90%	72%	94%	95%				
	September: Week 5		62%	74%	15%	22%	20%	36%	59%	69%	69%				
	October: Week 1		41%	45%	16%	18%	28%	19%	42%	44%	75%				
	October: Week 2	37%	47%	59%	2%	72%	30%	64%	36%	84%	82%				
	October: Week 3	99%	19%	45%	16%	58%	39%	56%	51%	86%	87%				
	October: Week 4	89%	24%	27%	7%	85%	33%	57%	29%	83%	73%				
	November: Week 1		49%	24%	6%	91%	41%	78%	48%	82%	84%				
	November: Week 2	2%	21%	8%	1%	42%	25%	40%	17%	52%	68%				
	November: Week 3	65%	15%	1%	22%	66%	35%	72%	28%	56%	69%				
	November: Week 4		6%	18%	14%	61%	23%	37%	29%	68%	62%				
	December: Week 1		54%	9%	5%	50%	25%	49%	14%	59%	53%				
December: Week 2		18%	30%	18%	52%	64%	66%	32%	55%	65%					
Peak period	December: Week 3	89%	55%	60%	12%	67%	34%	44%	16%	48%	43%				
	December: Week 4	96%	32%	28%	11%	13%	18%	22%	14%	8%	24%				
	December: Week 5	100%	65%	65%	7%	67%	5%	43%	8%	63%	18%				
	January: Week 1	88%	60%	14%	7%	21%	4%	20%	4%	23%	24%	10%			
	January: Week 2	90%	62%	1%	9%	33%	16%	10%	13%	48%	32%				
	January: Week 3	83%	21%	11%	2%	13%	1%	2%	1%	11%	10%				
	January: Week 4	99%	19%	7%	0%	1%	3%	3%	2%	10%	13%				
	February: Week 1		40%	68%	8%	95%	17%	77%	17%	87%	34%				
	February: Week 2		63%	38%	26%	60%	17%	26%	31%	75%	55%				
	February: Week 3		38%	41%	5%	83%	15%	14%	12%	46%	31%				
	February: Week 4	0%	59%	37%	11%	45%	23%	33%	23%	47%	45%				
	Post-peak period	March: Week 1	99%	59%	85%	10%	82%	43%	71%	29%	74%	67%			
March: Week 2			27%	29%	4%	88%	27%	94%	20%	91%	44%				
March: Week 3			54%	82%	12%	72%	22%	26%	27%	40%	68%				
March: Week 4			52%	93%	24%	89%	39%	78%	37%	80%	28%				
March: Week 5		92%	78%	70%	41%	64%	38%	69%	43%	62%	76%				
April: Week 1		24%	76%	80%	35%	92%	61%	70%	47%	93%	86%				
April: Week 2			85%	71%	29%	45%	46%	38%	41%	67%	85%				
April: Week 3			92%	70%	58%	73%	63%	58%	69%	70%	95%				
April: Week 4		57%	94%	37%	98%	61%	93%	51%	97%	93%					
Off-peak period	May: Week 1														
	May: Week 2														
	May: Week 3														
	May: Week 4														
	June: Week 1														
	June: Week 2														
	June: Week 3														
	June: Week 4														
	June: Week 5														



5. Supervision and Surveillance Framework



Supervision and Surveillance Framework

The provision of lifeguard services and surf lifesaving services at beaches on the New South Wales coastline is highly effective at reducing the risk of drowning and injury. However, with over 1,590 km of coastline, many fatal and non-fatal incidents occur at unpatrolled beaches. Fatal and non-fatal incidents also occur on shore platforms and in coastal waterways, but no supervision or surveillance is provided.

The provision of lifeguard services and surf lifesaving services is currently the only type of site-specific supervision and surveillance in New South Wales: a patrolled area is defined using red and yellow flags, and a number of highly trained and well-resourced personnel provide a service. Alternatively, no supervision or surveillance is provided. In addition, at sites where services are provided, they are often delivered with the same level of resourcing throughout the year and across the hours of the day, despite the risk of drowning and injury fluctuating considerably.

As a result, some sites may be over-resourced at times, while other sites may be under-resourced, and many sites have no form of supervision or surveillance at all. However, the expansion of lifeguard services and surf lifesaving services to a considerable number of additional sites would be challenging and resource-intensive. Furthermore, a traditional type of service would not be fit-for-purpose for different environments, such as shore platforms and coastal waterways.

Supervision and Surveillance Framework

The *Supervision and Surveillance Framework* has therefore been developed (Mulcahy, 2023c), to conceptualise different types of supervision and surveillance that are risk-appropriate and fit-for-purpose for different environments (beaches, shore platforms, and coastal waterways), and different levels of risk. This follows the approach of Mulcahy and Lowe (2019b) for beaches, rivers, and inland waterways in New Zealand.

The framework consists of four types of supervision and surveillance (and sub-types). The first two types should be provided by highly trained personnel, such as lifeguards and/or surf lifesavers, and provided where the risk of drowning and injury is highest:

- On-site supervision
- On-site, remote, and/or periodic surveillance

The other two types of surveillance may be delivered by community members, and should be provided where the risk of drowning and injury is not as high:

- Semi-structured surveillance
- Incidental surveillance

The different types of supervision and surveillance are conceptualised in Figure 5-1.

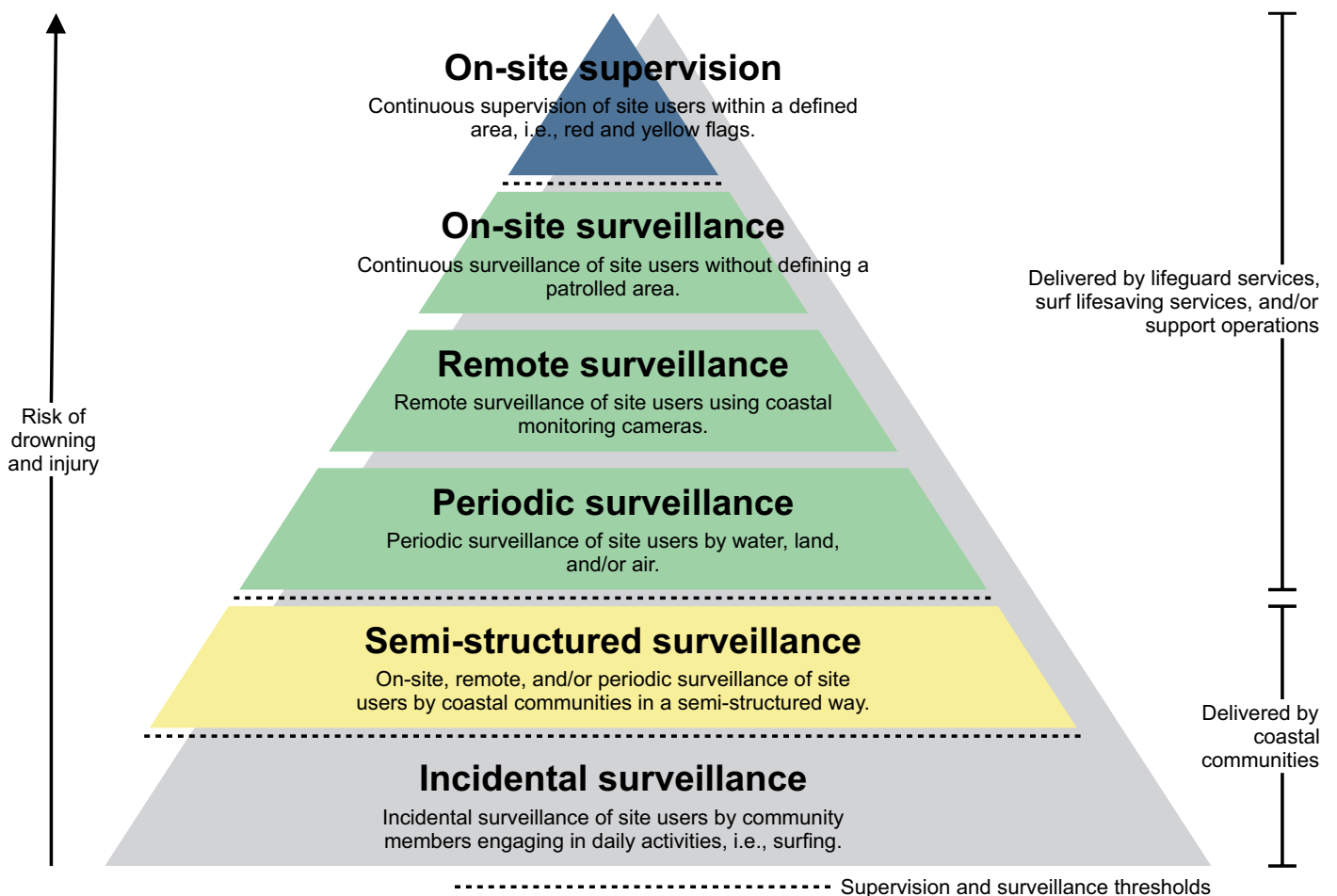


Figure 5-1: Supervision and Surveillance Framework.



On-site supervision

On-site supervision involves the continuous supervision of site users in a defined area, i.e., red and yellow flags, by highly trained and well-resourced personnel. This type of service should be provided at sites where the risk of drowning and injury is highest. On-site supervision should be recommended when the probability of rescue (calculated using the *Supervision and Surveillance Model*) regularly exceeds the on-site supervision threshold (see Table 5-1).

On-site, remote, and periodic surveillance

Surveillance may be provided by highly trained personnel on-site, remotely, and/or periodically, and should be provided where the relevant threshold is regularly exceeded and/or where these types of service are fit-for-purpose for the site.

- **On-site surveillance** involves the continuous surveillance of site users without defining a patrolled area. The risk of drowning and injury may be high, but surveillance may be more appropriate than on-site supervision. This may be where the coastal morphology is not suitable for on-site supervision (i.e., shore platforms), at lower energy beaches where site users are spread alongshore, or where site users are engaged in recreational activities that are not suited to a defined area.
- **Remote surveillance** is where personnel monitor site users remotely using coastal monitoring cameras. This may be suited to sites where use is typically concentrated in a particular area, the on-site surveillance threshold is not often exceeded, but where the risk increases significantly with small increases in wave height and site use. These sites should ideally be within close proximity of a supervision or surveillance service that could prevent and/or respond to an incident.
- **Periodic surveillance** is where personnel rove alongshore on water or land, or provide surveillance via air, i.e., Uncrewed Aerial Systems. This may be provided where site use is spread along a long stretch of coastline in relatively small numbers.

Semi-structured surveillance

On-site, remote, and periodic surveillance could also be provided by coastal communities at lower-risk sites, lower-risk times of year, and/or lower-risk times of day, where they have been appropriately trained.

Those providing semi-structured surveillance could focus on improving site users' awareness of hazards, educating site users on ways to manage their safety, identifying those at risk and/or in difficulty, activating lifeguard services, surf lifesaving services, support operations, and/or emergency services (as required), and providing initial response and/or treatment (where trained, competent, and not exposed to undue risk). An appropriate level of organisation, oversight, and risk management for this type of service should be determined and implemented depending on the site and community characteristics.

Furthermore, personnel could help manage safety by erecting warning signs and liaising with lifeguard services and/or surf lifesaving services. Risk-appropriate and fit-for-purpose rescue equipment (i.e., U SAFE) and first aid equipment should be available, and could be stored adjacent to public facilities at the site.

The provision of semi-structure surveillance would require less human and financial resources, thus enabling easier formation, greater sustainability, and fostering resilient communities. These services could be associated with (and supported by) nearby lifeguard services, surf lifesaving services, and/or support operations.

Incidental surveillance

Members of the public inherently provide some surveillance of other site users, and some will assist people they see in difficulty; for example, surfers rescue a number of water users every year.

This incidental surveillance should be encouraged and supported, where possible. Members of coastal communities could be engaged and upskilled to advise, educate, and/or assist site users while they are engaging in their day-to-day activities on the coastline. These members of the community would not require any association with other supervision or surveillance services.

Supervision and surveillance thresholds

The supervision and surveillance thresholds (Table 5-1) represent exceedance values that have been established to enable the probability of rescue (the proxy for the risk of drowning and injury) to be aligned to risk-appropriate supervision and surveillance. This helps ensure limited human and financial resources are used efficiently and effectively from a site-specific, to multi-site (i.e., Local Government Area), to state-wide scale.

Table 5-1: Supervision and surveillance thresholds.

Type of supervision or surveillance	Probability of rescue		
On-site supervision	0.0100	1.00%	1 in 100
*On-site, remote, and periodic surveillance	0.0025	0.25%	1 in 400
*Semi-structured surveillance	0.0010	0.10%	1 in 1,000
Incidental surveillance	> 0.0000	> 0.00%	-

*Additional thresholds differentiate between the sub-types.





Semi-structured surveillance and incidental surveillance

As part of *Coastal insights: safer coasts for the future*, we are developing and trialling risk-appropriate and fit-for-purpose types of supervision and surveillance to meet the needs of different sites. In particular, members of coastal communities interested in providing semi-structured surveillance and/or incidental surveillance could be trained to advise, educate, and provide surveillance of site users.

Three proposed roles for semi-structured surveillance and/or incidental surveillance are as follows:

- **Responders:** identify hazards, educate site users, activate lifeguard services, surf lifesaving services, support operations, and/or emergency services (as required), and provide initial water-based response and/or treatment (where trained, competent, and not exposed to undue risk). Those in the community that are competent in the surf, but without the capacity or interest to be involved in lifeguard services and/or surf lifesaving services could be targeted, i.e., former lifeguards, former surf lifesavers, and surf craft users.
- **Advisors:** identify hazards, educate site users, activate lifeguard services, surf lifesaving services, support operations, and/or emergency services (as required), and provide initial land-based response and/or treatment (where trained, competent, and not exposed to undue risk). Those in the community that use the site often and enjoy speaking with members of their community could be targeted.
- **Ambassadors:** advise site users of hazards and ways to manage their safety. Those that frequently interact with site users, particularly in their day-to-day activities, could be targeted, i.e., staff at accommodation outlets.

Members of coastal communities that use the site often should be targeted, as well as those with some existing knowledge, skills, and competencies. Those from organisations, agencies, and/or commercial operators could also be engaged, i.e., instructors of surf schools, relevant staff from Local Government Areas, park rangers from NSW National Parks and Wildlife Service, members of Coastcare groups, and a wide range of other stakeholders.

Fixed, flexible, and on-call

As part of the *Supervision and Surveillance Framework*, it is also proposed that supervision and surveillance could be provided in a fixed, flexible, and/or on-call manner to ensure services are fit-for-purpose.

- **Fixed:** Supervision or surveillance is provided at set times of the year and hours of the day. This is most appropriate where the probability of rescue consistently exceeds the relevant supervision or surveillance threshold.
- **Flexible:** Services are provided at set times of year; however, the type of supervision or surveillance (i.e., on-site supervision or on-site surveillance), hours of the day, number of personnel, and equipment may be adjusted to meet the changing needs of the site. This may be appropriate at times of year and times of day that usually exceed the relevant supervision or surveillance threshold, but where the probability of rescue fluctuates substantially depending on the weather and/or surf conditions.
- **On-call:** Times of the year and/or hours of the day when the exceedance of relevant supervision and/or surveillance thresholds is highly dependent on the weather and surf conditions. This is typically appropriate when the probability of rescue is lower. Services could be mobilised during hazardous conditions and/or at times when favourable weather and surf conditions may attract site users.

‘Supervision and surveillance could be provided in a fixed, flexible, and/or on-call manner to ensure services are fit-for-purpose’

Roles and responsibilities

The following roles and responsibilities should be considered as part of the provision of supervision and/or surveillance, and should be scalable and fit-for-purpose for the site:

Manage hazards

- Define patrolled areas (where appropriate), zone recreational activities, and reduce the interaction of non-compatible recreational activities.
- Remove hazards (where possible), install barriers, and/or erect signage to isolate site users from hazards.
- Monitor the weather, surf conditions, water quality, sharks, and jellyfish, and close the site as appropriate.

Awareness, education, and compliance

- Proactively engage site users to increase their awareness and understanding of hazards, ways to manage their safety, and strategies to use if they get into difficulty.
- Collaborate with relevant organisations to inform site users of the risks posed by poor water quality, sharks, jellyfish, and ultraviolet radiation. Manage the compliance with relevant acts, regulations, and policies, including litter, alcohol, animals, vehicles, safety and navigation, and fisheries.

Identify, respond, and rescue

- Identify or search for site users in difficulty, respond efficiently and effectively, and return them to a place of safety.
- Where the patient is immersed, response could be provided from shore, i.e., using public rescue equipment, or by entering the water using fit-for-purpose rescue equipment.
- Activate other water-based services and/or emergency services to assist with the response as required.

Treatment, care, and recovery

- Provide treatment and care for site users that have sustained injuries and/or experienced a medical incident.
- Activate emergency services to provide further treatment and care as required.
- Where appropriate, assist emergency services with the recovery of site users that have succumbed to fatal drowning, injury, and/or a medical incident.



Application of the Supervision and Surveillance Framework

Probability of rescue

The thresholds from the *Supervision and Surveillance Framework* were applied to the probabilities of rescue calculated for Shellharbour North Beach to identify the types of supervision and/or surveillance that may be risk-appropriate at different times of year and different times of day. Table 5-3 displays these values, with different colours to indicate the type of supervision or surveillance. Progressively darker shades of colour are used to indicate times of higher probability of rescue, within each type of supervision or surveillance. The types of supervision and surveillance, with the corresponding probability of rescue and colour, are displayed in Table 5-2.

Number of lifeguards and/or surf lifesavers

The numbers of lifeguards and/or surf lifesavers were also modelled for Shellharbour North Beach at different times of year and different times of day. In conjunction with the respective thresholds (see Table 5-2), the numbers of lifeguards and/or surf lifesavers increase with increasing probability of rescue, but at a decreasing rate (calculated using Equation 5-1, a third order polynomial).

The modelled numbers of lifeguards and/or surf lifesavers for Shellharbour North Beach are shown in Table 5-4.

Of note, the equivalent of 0.50 lifeguards or surf lifesavers is considered the minimum appropriate resourcing for periodic surveillance, 0.75 lifeguards or surf lifesavers for remote surveillance, and 1.00 lifeguard or surf lifesaver for on-site surveillance. For on-site supervision, a minimum of two lifeguards and/or surf lifesavers is recommended.

When interpreting the modelled number of lifeguards and/or surf lifesavers, site-specific factors should be considered, including the length and configuration of the coastline where services are provided, the skills and competencies of the lifeguards and/or surf lifesavers, and the proximity to other lifeguard services, surf lifesaving services, support operations, and/or emergency services. Additional personnel may be required to facilitate appropriate breaks, and (particularly for services delivered by surf lifesavers) to provide opportunities to upskill personnel, and foster a strong sense of community.

$$\text{Probability of rescue} = 0.0006104450 \times SL^3 - 0.0014527477 \times SL^2 + 0.0054837947 \times SL$$

Equation 5-1: Relationship between the calculated probability of rescue and the modelled number of lifeguards and/or surf lifesavers (SL).

Table 5-2: Relationship between the types of supervision and surveillance, calculated probability of rescue, and modelled number of lifeguards and/or surf lifesavers.

Type of supervision or surveillance	Probability of rescue	Number of lifeguards and/or surf lifesavers
On-site supervision	> 0.5200	> 10.00
	0.3767 - 0.5200	9.00
	0.2634 - 0.3767	8.00
	0.1766 - 0.2634	7.00
	0.1125 - 0.1766	6.00
	0.0674 - 0.1125	5.00
	0.0378 - 0.0674	4.00
	0.0199 - 0.0378	3.00
	0.0100 - 0.0199	2.00
On-site surveillance	0.0046 - 0.0100	1.00
Remote surveillance	0.0036 - 0.0046	0.75
Periodic surveillance	0.0025 - 0.0036	0.50
Semi-structured surveillance	0.0020 - 0.0025	-
	0.0015 - 0.0020	-
	0.0010 - 0.0015	-
Incidental surveillance	0.0000 - 0.0010	-



Modelled supervision and surveillance

Table 5-3: Weekly and hourly supervision and surveillance recommendations modelled for Shellharbour North Beach.

Date / Time		08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
Off-peak period	July: Week 1														
	July: Week 2														
	July: Week 3														
	July: Week 4														
	August: Week 1														
	August: Week 2														
	August: Week 3														
	August: Week 4														
	September: Week 1														
	September: Week 2														
Pre-peak period	September: Week 3		0.0077	0.0055	0.0112	0.0092	0.0134	0.0096	0.0114	0.0089	0.0050				
	September: Week 4		0.0087	0.0054	0.0101	0.0039	0.0114	0.0050	0.0092	0.0040	0.0037				
	September: Week 5		0.0110	0.0089	0.0264	0.0224	0.0233	0.0171	0.0118	0.0098	0.0098				
	October: Week 1		0.0158	0.0149	0.0251	0.0243	0.0197	0.0239	0.0156	0.0150	0.0088				
	October: Week 2	0.0171	0.0147	0.0117	0.0412	0.0092	0.0190	0.0107	0.0176	0.0065	0.0070				
	October: Week 3	0.0020	0.0243	0.0148	0.0256	0.0119	0.0161	0.0122	0.0133	0.0061	0.0057				
	October: Week 4	0.0052	0.0209	0.0200	0.0326	0.0065	0.0181	0.0120	0.0190	0.0067	0.0092				
	November: Week 1		0.0139	0.0209	0.0331	0.0047	0.0157	0.0080	0.0141	0.0070	0.0065				
	November: Week 2	0.0408	0.0224	0.0321	0.0441	0.0157	0.0209	0.0160	0.0249	0.0131	0.0100				
	November: Week 3	0.0105	0.0265	0.0446	0.0222	0.0102	0.0178	0.0094	0.0197	0.0121	0.0097				
	November: Week 4		0.0342	0.0244	0.0274	0.0113	0.0217	0.0169	0.0192	0.0100	0.0111				
	December: Week 1		0.0125	0.0309	0.0352	0.0137	0.0206	0.0138	0.0271	0.0118	0.0129				
December: Week 2		0.0246	0.0189	0.0244	0.0131	0.0108	0.0103	0.0184	0.0123	0.0105					
Peak period	December: Week 3	0.0052	0.0124	0.0114	0.0281	0.0101	0.0180	0.0152	0.0251	0.0142	0.0153				
	December: Week 4	0.0031	0.0185	0.0198	0.0289	0.0279	0.0243	0.0219	0.0272	0.0310	0.0210				
	December: Week 5	0.0015	0.0106	0.0105	0.0323	0.0102	0.0346	0.0152	0.0317	0.0109	0.0245				
	January: Week 1	0.0055	0.0117	0.0272	0.0324	0.0225	0.0369	0.0235	0.0381	0.0213	0.0210	0.0292			
	January: Week 2	0.0049	0.0112	0.0461	0.0309	0.0184	0.0251	0.0294	0.0280	0.0142	0.0184				
	January: Week 3	0.0069	0.0225	0.0286	0.0431	0.0279	0.0433	0.0422	0.0456	0.0288	0.0296				
	January: Week 4	0.0020	0.0242	0.0327	0.0541	0.0469	0.0405	0.0402	0.0423	0.0297	0.0280				
	February: Week 1		0.0159	0.0100	0.0323	0.0038	0.0250	0.0081	0.0250	0.0058	0.0180				
	February: Week 2		0.0109	0.0166	0.0202	0.0116	0.0250	0.0202	0.0186	0.0086	0.0125				
	February: Week 3		0.0164	0.0158	0.0352	0.0068	0.0268	0.0269	0.0281	0.0147	0.0187				
	February: Week 4	0.0520	0.0118	0.0170	0.0288	0.0149	0.0217	0.0182	0.0214	0.0143	0.0149				
	Post-peak period	March: Week 1	0.0017	0.0118	0.0065	0.0298	0.0069	0.0154	0.0095	0.0192	0.0090	0.0102			
		March: Week 2		0.0200	0.0194	0.0377	0.0055	0.0200	0.0040	0.0230	0.0048	0.0150			
		March: Week 3		0.0126	0.0070	0.0285	0.0093	0.0218	0.0203	0.0199	0.0160	0.0101			
March: Week 4			0.0132	0.0041	0.0210	0.0053	0.0162	0.0081	0.0169	0.0074	0.0196				
March: Week 5		0.0045	0.0079	0.0095	0.0158	0.0107	0.0166	0.0097	0.0153	0.0111	0.0084				
April: Week 1		0.0212	0.0085	0.0074	0.0178	0.0042	0.0114	0.0095	0.0145	0.0041	0.0060				
April: Week 2			0.0064	0.0095	0.0193	0.0148	0.0148	0.0163	0.0157	0.0101	0.0063				
April: Week 3			0.0044	0.0096	0.0119	0.0091	0.0110	0.0120	0.0098	0.0096	0.0036				
April: Week 4		0.0120	0.0038	0.0171	0.0023	0.0112	0.0040	0.0132	0.0027	0.0040					
Off-peak period	May: Week 1														
	May: Week 2														
	May: Week 3														
	May: Week 4														
	June: Week 1														
	June: Week 2														
	June: Week 3														
	June: Week 4														
	June: Week 5														



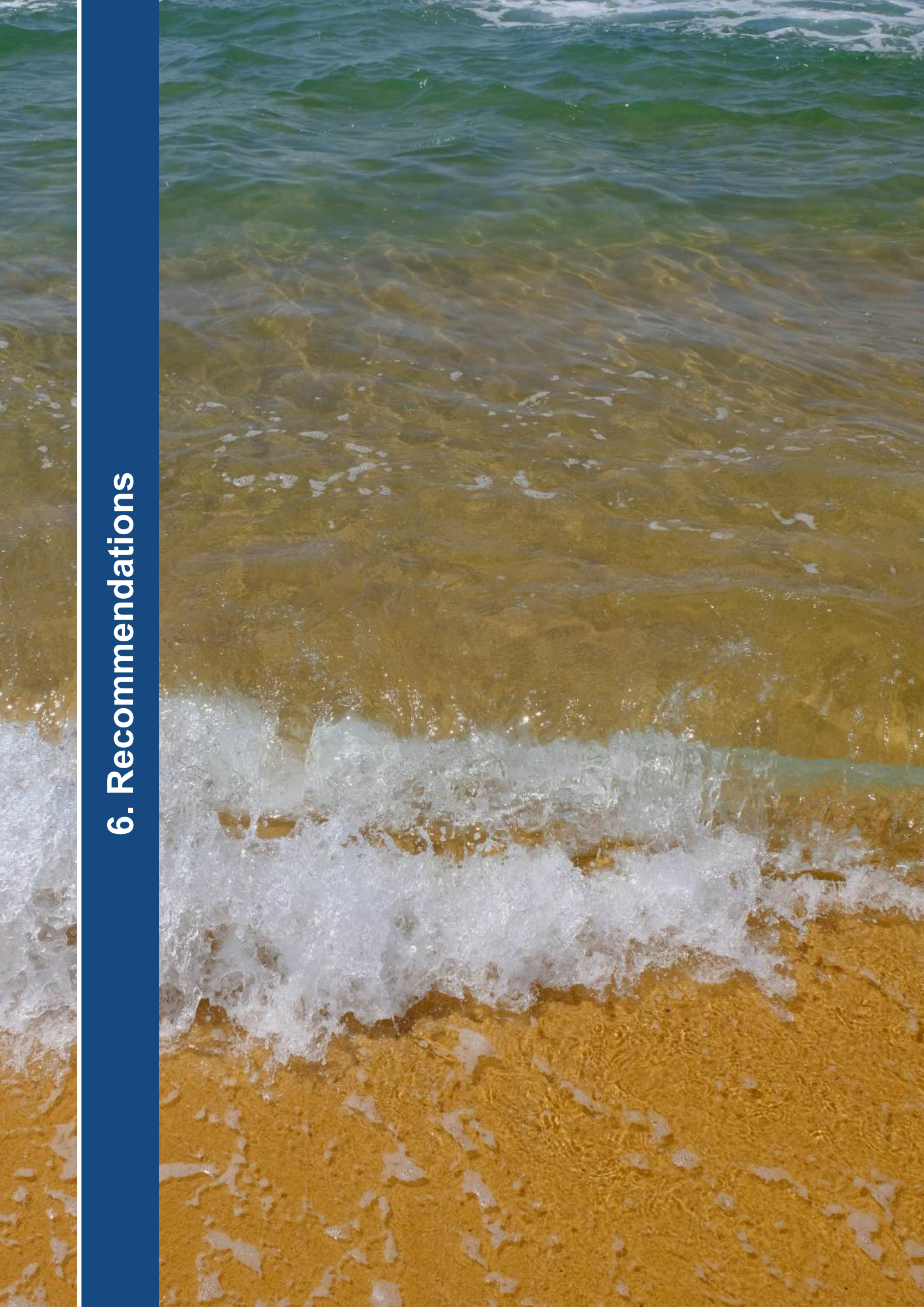
Number of lifeguards and/or surf lifesavers

Table 5-4: Number of lifeguards and/or surf lifesavers modelled for Shellharbour North Beach.

Date / Time		08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	
Off-peak period	July: Week 1														
	July: Week 2														
	July: Week 3														
	July: Week 4														
	August: Week 1														
	August: Week 2														
	August: Week 3														
	August: Week 4														
	September: Week 1														
	September: Week 2														
Pre-peak period	September: Week 3		1.63	1.19	2.15	1.87	2.41	1.94	2.18	1.82	1.08				
	September: Week 4		1.80	1.16	2.01	0.83	2.18	1.07	1.88	0.85	0.78				
	September: Week 5		2.13	1.83	3.43	3.18	3.24	2.78	2.24	1.96	1.96				
	October: Week 1		2.66	2.57	3.36	3.30	2.98	3.28	2.64	2.58	1.81				
	October: Week 2	2.78	2.55	2.22	4.14	1.87	2.93	2.09	2.82	1.40	1.50				
	October: Week 3		3.30	2.57	3.38	2.24	2.69	2.29	2.41	1.31	1.24				
	October: Week 4	1.13	3.08	3.01	3.76	1.39	2.86	2.26	2.94	1.44	1.87				
	November: Week 1		2.47	3.08	3.79	1.02	2.65	1.68	2.50	1.50	1.41				
	November: Week 2	4.13	3.18	3.74	4.26	2.65	3.08	2.68	3.34	2.38	2.00				
	November: Week 3	2.07	3.44	4.27	3.16	2.03	2.83	1.90	2.99	2.27	1.96				
	November: Week 4		3.84	3.31	3.49	2.17	3.13	2.76	2.95	2.00	2.15				
	December: Week 1		2.32	3.68	3.89	2.45	3.05	2.47	3.47	2.23	2.37				
December: Week 2		3.32	2.92	3.31	2.38	2.11	2.03	2.89	2.30	2.07					
Peak period	December: Week 3	1.12	2.30	2.18	3.53	2.01	2.85	2.60	3.35	2.51	2.62				
	December: Week 4	0.64	2.89	2.99	3.57	3.52	3.30	3.15	3.48	3.68	3.08				
	December: Week 5		2.08	2.07	3.75	2.02	3.86	2.60	3.72	2.11	3.32				
	January: Week 1	1.19	2.21	3.48	3.75	3.19	3.96	3.25	4.01	3.11	3.08	3.59			
	January: Week 2	1.06	2.15	4.33	3.68	2.88	3.36	3.60	3.52	2.50	2.89				
	January: Week 3	1.47	3.19	3.56	4.22	3.52	4.22	4.18	4.31	3.57	3.61				
	January: Week 4		3.30	3.77	4.61	4.36	4.11	4.10	4.19	3.61	3.52				
	February: Week 1		2.67	2.00	3.75	0.80	3.35	1.70	3.35	1.25	2.85				
	February: Week 2		2.12	2.74	3.03	2.20	3.35	3.02	2.90	1.78	2.31				
	February: Week 3		2.71	2.66	3.89	1.46	3.45	3.46	3.53	2.55	2.91				
	February: Week 4	4.54	2.23	2.76	3.57	2.58	3.13	2.87	3.11	2.51	2.57				
	Post-peak period	March: Week 1		2.23	1.39	3.62	1.48	2.62	1.92	2.95	1.85	2.02			
		March: Week 2		3.01	2.97	3.99	1.19	3.01	0.85	3.22	1.03	2.59			
		March: Week 3		2.33	1.49	3.55	1.90	3.14	3.03	3.00	2.68	2.00			
March: Week 4			2.39	0.87	3.08	1.15	2.70	1.70	2.76	1.56	2.98				
March: Week 5		0.97	1.66	1.92	2.66	2.09	2.73	1.94	2.61	2.14	1.75				
April: Week 1		3.09	1.77	1.57	2.84	0.91	2.18	1.93	2.53	0.87	1.29				
April: Week 2			1.37	1.91	2.96	2.57	2.56	2.71	2.65	2.01	1.37				
April: Week 3			0.95	1.93	2.24	1.85	2.13	2.25	1.96	1.93	0.77				
April: Week 4		2.25	0.81	2.78		2.16	0.86	2.40	0.55	0.85					
Off-peak period	May: Week 1														
	May: Week 2														
	May: Week 3														
	May: Week 4														
	June: Week 1														
	June: Week 2														
	June: Week 3														
	June: Week 4														
	June: Week 5														



6. Recommendations



Recommendations

This *Supervision and Surveillance Report* has provided in-depth analysis of beach morphology and hydrodynamics, volume and frequency of water use, patterns and distribution of site use and recreation, preventative safety interventions, and incidents at Shellharbour North Beach. Site-specific data were input into the *Supervision and Surveillance Model* to calculate the probability of rescue at different times of year and different times of day (see Table 4-4), which is used as the proxy for the risk of drowning and injury.

The thresholds from the *Supervision and Surveillance Framework* were applied to the probabilities of rescue calculated for Shellharbour North Beach to identify the types of supervision and/or surveillance that may be risk-appropriate at different times of the year and different times of the day (see Table 5-3).

Of note, not all site-specific factors can be incorporated in the *Supervision and Surveillance Model* and *Supervision and Surveillance Framework*, but should be considered when interpreting the modelled recommendations. This includes additional site characteristics, user groups (including their hazard awareness and competence), and the proximity to other lifeguard services, surf lifesaving services, support operations, and emergency services. Furthermore, there are some data limitations, i.e., weeks and/or hours where limited data is available.

As such, the modelled recommendations have been interpreted with these considerations in mind, and subsequent recommendations for the provision of supervision and/or surveillance at Shellharbour North Beach are outlined below.

Supervision and surveillance: Shellharbour North Beach

It is recommended that on-site supervision (continuous supervision of water users in the red and yellow flags) or on-site surveillance (continuous surveillance of water users without raising red and yellow flags) be provided by lifeguard services and/or surf lifesaving services on weekends, and public holidays at Shellharbour North Beach from mid-September to late April as well as weekdays over the spring, summer, and autumn school holidays. Lifeguard services and surf lifesaving services should proactively manage the safety of those at Shellharbour North Beach, as well as provide support to services at nearby sites. In particular, the north end of Shellharbour North Beach, Shell Harbour Bay, and Shellharbour South Beach.

On-site supervision should be provided on weekdays, weekends, and public holidays from mid-December to late February, with services recommended from 9:00 am to 6:00 pm. Services may be required later into the evening on busy days. In addition, on-site supervision should be provided on weekdays, weekends, and public holidays during the spring and autumn school holidays, as well as weekends and public holidays from mid-October to mid-December, and from February through to early April.

Outside of the summer school holidays, the typical hours of service should be progressively reduced. In addition, services could be provided in a flexible manner at times, i.e., the hours of service could be adjusted according to the risk, and the type of supervision or surveillance could vary as the risk increases and decreases across the hours of the day.

Of note, the risk of drowning and injury on weekdays was not quantified due to the absence of necessary data for input into the Supervision and Surveillance Model. As such, the recommendations for weekdays should be considered provisional, and were developed while considering the risk of drowning and injury on weekends and public holidays, relevant site-specific factors, and the current provision of lifeguard services. It is recommended that data collected by lifeguard services and surf lifesaving services be aligned to the 'data standard' (see page 5); this would enable the data collected by lifeguards and surf lifesavers to be compared across patrolled sites in the City of Shellharbour throughout the year and across the hours of the day.

Lifeguard services and surf lifesaving services

The number of lifeguards and/or surf lifesavers should be scaled throughout the year and across the hours of the day according to the risk of drowning and injury. Modelled numbers of personnel are provided in Table 5-4. When determining the number of lifeguards and/or surf lifesavers, site-specific factors should be considered, including the length and configuration of the coastline where services are provided, the skills and competencies of the lifeguards and/or surf lifesavers, and the proximity to other lifeguard services, surf lifesaving services, support operations, and emergency services.

The lifeguards and/or surf lifesavers should have the appropriate skills and competencies to manage the safety of those using Shellharbour North Beach and fulfil the relevant roles and responsibilities; guidance is provided on page 29. These should be reviewed in conjunction with Shellharbour City Council, Shellharbour City Council Lifeguard Service, Shellharbour Surf Life Saving Club, Surf Life Saving South Coast, Surf Life Saving New South Wales, and other relevant coastal safety stakeholders to ensure the site is managed as effectively as possible.

The types of equipment available to the lifeguard services and/or surf lifesaving services should be commensurate with the risk of drowning and injury, the types of incidents that are likely to occur, as well as the need to provide surveillance and/or response alongshore.

Of note, the number of lifeguards and/or surf lifesavers should not be reduced to minimum capacity at Shellharbour North Beach, particularly at times when nearby sites are not patrolled. At these times, lifeguards and/or surf lifesavers at Shellharbour North Beach should also help manage safety at nearby unpatrolled sites, through remote surveillance and/or periodic surveillance.



Semi-structured surveillance and incidental surveillance

The provision of semi-structured surveillance and/or incidental surveillance by members of the community could also be beneficial at Shellharbour North Beach and elsewhere along the coastline of the City of Shellharbour.

Members of the community could be trained to advise, educate, and provide surveillance of site users. This could include the following members of the community in the City of Shellharbour:

- Former lifeguards and surf lifesavers
- Members of boardriders clubs, i.e., Southbridge Boardriders
- Surf schools, i.e., Pines Surfing Academy - The Farm
- Staff at accommodation outlets
- Relevant staff from Shellharbour City Council and NSW National Parks and Wildlife Service
- Landcare groups, i.e., Warilla Dunes BushCare
- Members of the community

Of note, these members of the community could provide surveillance at sites and/or times where lifeguard services and/or surf lifesaving services are not provided, or supplement supervision and surveillance provided by lifeguards and surf lifesavers.

Other recommendations

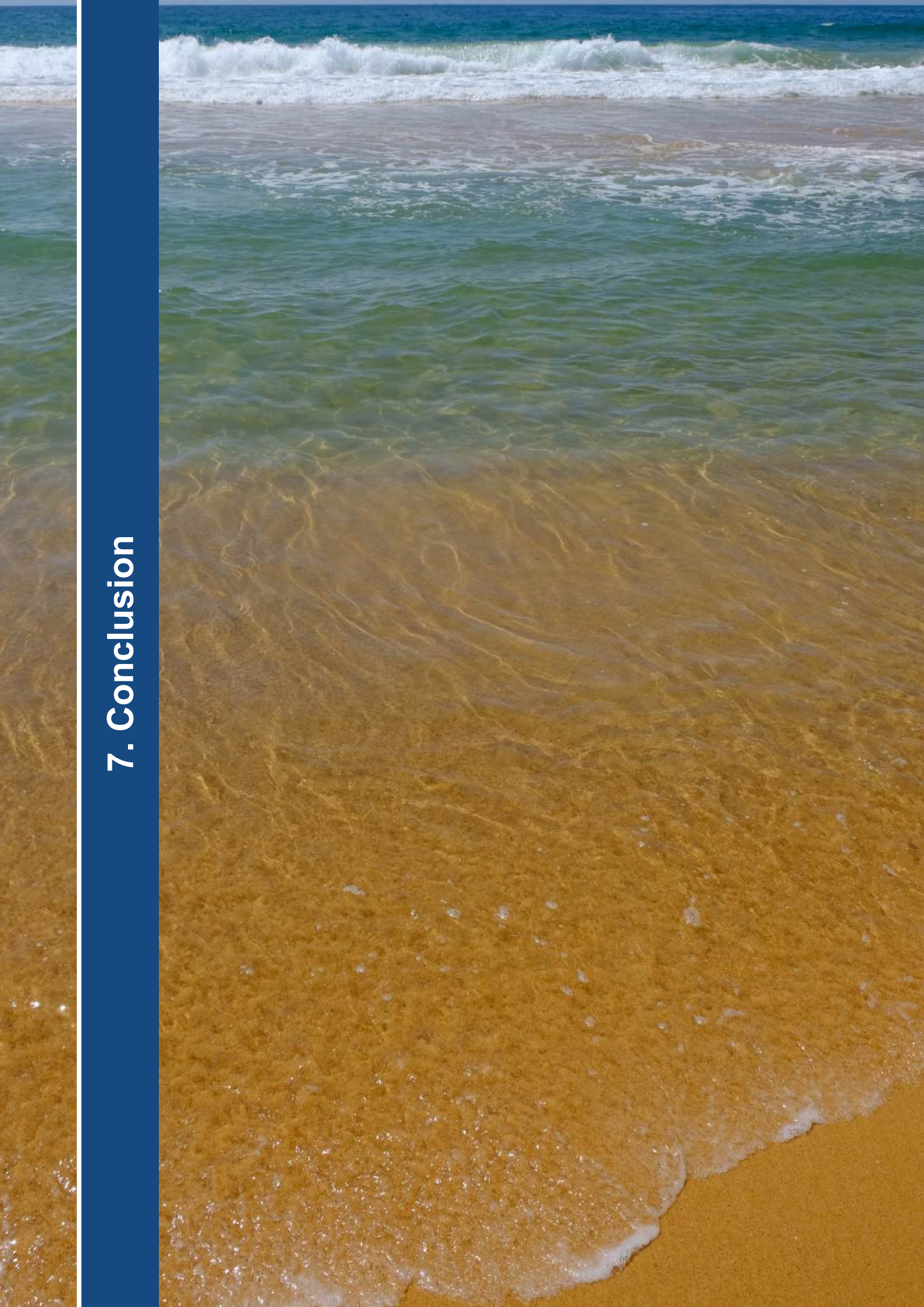
Lifeguard services, surf lifesaving services, and support operations in the City of Shellharbour should align their data collection with the 'data standard' (see page 5). Furthermore, it is recommended that personnel be upskilled to ensure the data is collected accurately and consistently throughout the City of Shellharbour.

In addition, researchers from *Coastal insights: safer coasts for the future* should be engaged to provide periodic updates on the times of highest risk of drowning and injury (particularly as additional data is collected in line with the 'data standard'). This should be used to inform the evidence-based provision of lifeguard services, surf lifesaving services, and support operations.

'On-site supervision or on-site surveillance should be provided on weekdays, weekends, and public holidays during the spring, summer, and autumn school holidays'



7. Conclusion



Conclusion

This *Supervision and Surveillance Report* has provided in-depth analysis of beach morphology and hydrodynamics, volume and frequency of water use, patterns and distribution of site use and recreation, preventative safety interventions, and incidents at Shellharbour North Beach. Site-specific data were input into the *Supervision and Surveillance Model* to calculate the probability of rescue at different times of year and different times of day, which is used as the proxy for the risk of drowning and injury.

The thresholds from the *Supervision and Surveillance Framework* were applied to the probabilities of rescue calculated for Shellharbour North Beach to identify the types of supervision and/or surveillance that may be risk-appropriate at different times of the year and different times of the day.

Modelled recommendations were produced and interpreted in conjunction with other site-specific factors to formulate risk-appropriate and fit-for-purpose supervision and surveillance recommendations for Shellharbour North Beach.

Summary of recommendations

It is recommended that on-site supervision (continuous supervision of water users in the red and yellow flags) or on-site surveillance (continuous surveillance of water users without raising red and yellow flags) be provided by lifeguard services and/or surf lifesaving services on weekends, and public holidays at Shellharbour North Beach from mid-September to late April as well as weekdays over the spring, summer, and autumn school holidays. Lifeguard services and surf lifesaving services should proactively manage the safety of those at Shellharbour North Beach, as well as provide support to services at nearby sites. In particular, the north end of Shellharbour North Beach, Shell Harbour Bay, and Shellharbour South Beach.

On-site supervision should be provided on weekdays, weekends, and public holidays from mid-December to late February, with services recommended from 9:00 am to 6:00 pm. Services may be required later into the evening on busy days. In addition, on-site supervision should be provided on weekdays, weekends, and public holidays during the spring and autumn school holidays, as well as weekends and public holidays from mid-October to mid-December, and from February through to early April.

Outside of the summer school holidays, the typical hours of service should be progressively reduced. In addition, services could be provided in a flexible manner at times, i.e., the hours of service could be adjusted according to the risk, and the type of supervision or surveillance could vary as the risk increases and decreases across the hours of the day.

Furthermore, the provision of semi-structured surveillance and/or incidental surveillance by members of the community could also be beneficial at Shellharbour North Beach and elsewhere along the coastline of the City of Shellharbour.

Finally, it is recommended that data collected by lifeguard services and surf lifesaving services be aligned to the 'data standard'; this would enable the data collected by lifeguards and surf lifesavers to be compared across patrolled sites in the City of Shellharbour throughout the year and across the hours of the day.

Reducing the risk of drowning and injury

This *Supervision and Surveillance Report* should be used by Shellharbour City Council, Shellharbour City Council Lifeguard Service, Shellharbour Surf Life Saving Club, Surf Life Saving South Coast, Surf Life Saving New South Wales, and other coastal safety stakeholders to collaboratively work towards reducing the risk of drowning and injury at Shellharbour North Beach.

In addition, researchers from *Coastal insights: safer coasts for the future* should be engaged to provide periodic updates on the times of highest risk of drowning and injury.

'This Supervision and Surveillance Report should be used by coastal safety stakeholders to collaboratively work towards reducing the risk of drowning and injury at Shellharbour North Beach'



8. References



References

Acknowledgements

Thank you to the NSW Government for funding *Coastal insights: safer coasts for the future*, and as such supporting coastal safety stakeholders to manage the risk of drowning and injury with risk-appropriate and fit-for-purpose supervision and surveillance on the New South Wales coastline.

In addition, thank you to Shellharbour City Council, Shellharbour City Council Lifeguard Service, Shellharbour Surf Life Saving Club, Surf Life Saving South Coast, and Surf Life Saving New South Wales for supporting and/or managing the safety of those using Shellharbour North Beach over a considerable number of years, as well as collecting data on the volume and frequency of use, preventative safety interventions, and incidents.

Thank you to Surf Life Saving Australia for providing data stored in *Surfguard*. We also appreciate the data provided by the NSW Department of Planning and Environment from the 'State Wide Nearshore Wave Transformation Tool'.

Finally, thank you to the researchers from *Coastal insights: safer coasts for the future* for their efforts connecting science to coastal safety outcomes for the benefit of residents and visitors using the New South Wales coastline: Chris Twine, Morgan Howard, Claire Rogers, Lily Tonks, Michael Gould, Simone Brewer, Lewis Roso, Grace Chipperfield, and Grace Bendall-Pease.

Contact information

If you would like further information on this *Supervision and Surveillance Report* and/or *Coastal insights: safer coasts for the future*, please email, coastalinsights@surflifesaving.com.au

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