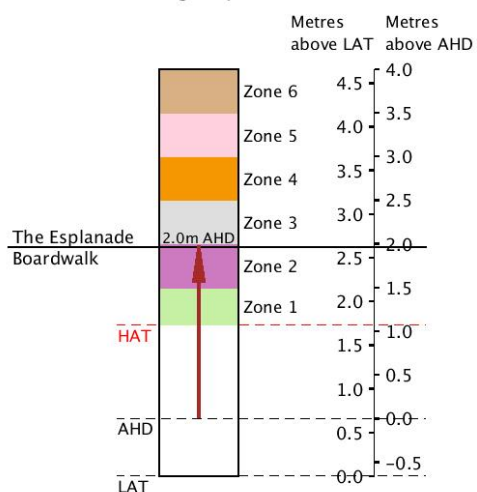


Storm Tide Warning Graphic for Golden Beach



Storm Tide Reference Landmarks Queensland



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Introduction

Extreme storm tide events are considered one of the most devastating natural disasters affecting the rapidly growing coastal population (Clark & Johnston, 2016; Needham et al, 2015). Storm tide is defined as the sum of the astronomical tide and the 'surge' in water level caused by a storm event of Queensland. The surge is a product of a low pressure system and extreme winds resulting in a localised elevation in sea level. The most severe impacts are usually felt when a surge event coincides with a high tide. In the case of a tropical cyclone the surge is driven by the intensity of a storm, the radius of maximum winds, storm direction, and the speed of the weather system. The shape of the coastline, and sea floor at the point of landfall also play a significant role in determining the amount of inundation (Azam et al, 2004; Oliver, 1989). Barriers such as higher foredunes and to a lesser extent mangroves and wetland ecosystems are able to prevent the water from propagating further inland (McIvor et al 2012; Narayan, et al., 2016). The primary storm tide risk in Queensland is caused by tropical cyclones; however, east coast lows are also a driver of such events. East coast lows, while often less intense, may last for longer periods than cyclone driven surges and, therefore, still have the potential to cause serious damage onshore. Due to the severity of impacts that can occur through such events, promoting an increased awareness in the general community and the development of a robust framework for a state-wide advice system; are key elements for reducing the damage risk to coastal communities in Queensland.

In 2015 the Queensland Tropical Cyclone Storm Tide Warning and Response System (Queensland Fire and Emergency Services and The Australian Bureau of Meteorology, 2015) was updated to include a list of 64 locations along the Queensland coast for which the Bureau of Meteorology (BoM) will issue storm tide warnings. This was aimed at increasing the spatial resolution of the advice system in order to provide meaningful storm tide advice to smaller towns and communities. A storm tide advice is issued with an accompanying graphic referred to as a 'totem pole'. These totem poles are used to display the normal tidal range in a discrete area, in addition to the most likely predicted and worst case storm tide scenarios, which give an indication to the level of inundation that could occur as a result of storm tide. The advice is issued to local disaster co-ordinators who in turn relate the information to detailed local maps of the evacuation zones. The colours currently used by the BoM are taken from the National Storm Tide Mapping Model for Emergency Response (Department of Emergency Services Queensland; The Queensland Regional Office of the Bureau of Meteorology, 2002). The Bureau has, for some time, had the capability to issue advice with an accompanying landmark level, however these levels have had some ambiguity surrounding the exact location of the elevation provided. Hence improvement to the current system is required in order to create a more robust framework for the communication of a storm tide threat throughout Queensland.

1.1 Purpose

This project aimed to expand the current storm tide advice system to include the elevation levels of recognisable local landmarks, in order to provide a more localised understanding of the inundation risk posed by extreme storm tide events. There has been an identified lack of uniformity between council flood maps; datum utilised; and warning information issued (Burston et al, 2015). The confusion caused by this lack of cohesion within critical emergency response procedures may reduce the forewarning given to communities to prepare for these events. This project was undertaken to provide additional local knowledge to the totem poles in order to decrease the ambiguity of advice systems and help local disaster co-ordinators relay information received by the BoM directly to their local community. The use of local features was proposed to reduce confusion around the different datum used in the warning system; Lowest Astronomical Tide (LAT); Australian Height Datum (AHD); and Highest Astronomical Tide (HAT). Providing a tangible level that local communities can relate to within their region, enables a rapid gauge for the potential level of inundation in a particular area. These local landmark levels (see Section 1.2) also enabled a greater understanding at district and state levels of local regions and their individual vulnerability to storm tide inundation.

1.2 Scope

A maximum of three local landmarks were to be identified and surveyed for each of the 64 storm tide advice locations detailed in the Tropical Storm Tide Warning and Response System handbook. The surveys were conducted throughout 2017 (refer to Section 3 for dates) where Real Time Kinematic (RTK) surveying equipment was used to record local elevations at identified landmarks. The end product was compiled into a Google Earth map file (.KMZ) to be made accessible to local disaster co-ordinators and relevant stakeholders. The use of this medium ensures that smaller councils would be able to access the information without licensing issues and additional monetary costs associated with other, more comprehensive mapping packages. The file displays the landmarks in each region with horizontal accuracy, marking each point with an icon where upon selecting it displays; the height of the landmark plotted on the BoM's totem pole; the local LAT/HAT levels, and an accompanying photograph showing the exact location. Subsequent feedback was sought from relevant regional councils as to the suitability of the landmarks surveyed and any additional improvements. The final product is available on the Queensland Governments Open Data Portal (Queensland Government, 2017).

In 2021, Douglas Shire Council, commissioned Department of Environment and Science for additional landmarks to be included in this project to coincide with the 2022 installation of a new storm tide gauge (STG) at Mossman. As a result, the section in the appendix, formerly titled 'A19 Port Douglas' has been renamed 'A19 Douglas Shire Council', and now includes Port Douglas, as well as the newly included locales of Wonga, Newell and Cooya Beach, referenced to the Mossman STG.

1.3 Relevant Definitions

For the purpose of this report the terms listed below apply, those marked with a * have been extracted from the *Guideline for Control Surveys by GNSS*.

Term/Acronym	Definition
Storm Tide	The storm tide (ST) is the total water level obtained by adding storm surge to the height of the astronomical tide. The Storm Tide Advice issued by BOM also incorporates wave set up.
HAT (Highest Astronomical Tide)	The highest level of water that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. This level may not be reached every year.
LAT (Lowest Astronomical Tide)	The lowest tide level that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. This level may not be reached every year.
AHD (Australia Height Datum.)	This datum has been adopted by the National Mapping Council as the datum to which all vertical control for mapping is to be referred.
PSM (Permanent Survey Mark)	Permanent survey marks located in Queensland are registered in the Survey Control Database (SCDB). Important points that are recorded as part of a PSM include, coordinates, height, and access notes.
AUSPOS	This is a free service provided by Geoscience Australia that processes static logged GPS data in the form of RINEX files providing the coordinates in a report format
CORS (Continuously Operating Reference Stations)	A survey control mark hosting a permanent GNSS station

RINEX (Receiver INdependent EXchange)*	An internationally accepted format for the exchange of GNSS data between software applications and for GNSS data archiving.
NRTK (Network Real-time Kinematic)*	A technique which produces real-time corrections from a network of CORS, to reduce the uncertainty in the position of the rover.
RTK (Real-time Kinematic)*	A technique which uses real-time corrections from reference stations, either as a temporary setup or as a CORS, to reduce the uncertainty in the position of the rover.

Methods

2.1 Landmark Selection

Suitable reference landmarks were selected utilising the following criteria:

- easily identifiable, recognisable and relatable
- stable and not likely to move, be dismantled or destroyed
- distinct in terms of height reference
- greater than 0m HAT and less than 2.5m HAT
- not landwards of a geological feature that is elevated higher (e.g. large foredunes)
- meaningful for disaster management practitioners; preferably a location known to be affected by storm tide inundation.

While every effort was made to select landmarks meeting all of the given criteria, not every location along the coast had such distinct features falling within the required bounds. As a result some discretionary decisions were made to include information outside the set scope.

2.2 Local Involvement

The project team sought to liaise with local councils, disaster co-ordinators and other stakeholders associated with each of the 64 storm tide advice sites in order to identify suitably recognisable landmark locations. The liaison also served to promote awareness of the Tropical Cyclone Storm Tide Warning Response System and any changes to locations that will now be included in the warnings.

While some landmarks were able to be identified remotely utilising coastal inundation mapping, local knowledge was a key factor in selecting the most appropriate landmarks. For regions where the co-ordinators were unable to advise suggestions ahead of the survey time, selections were made based on current potential tidal inundation maps, combined with selections made by on-ground personnel who were able to access the nature of the coastal landscape and identify distinct local features. After the surveys were conducted, further participation from the stakeholders was requested to confirm the relevance of selected landmarks for each site in order to retain the two or three most suitable.

2.3 GPS Survey

The survey work was conducted using common place GPS surveying practices utilising either a Continuously Operating Reference Stations (CORS) network within the major regions (Department of Transport and Main Roads, 2016), or a base/rover setup coupled with AUSPOS where there was doubt around the accuracy of the vertical component.

Where the CORS network was available, personnel ensured that the network was operating accurately by checking at least two local PSM's with known reliable vertical and horizontal values, using the rover set up to utilise the CORS network. The base/rover setup was used where permanent survey marks (PSM's) with reliable vertical and horizontal

values were available. In these circumstances the base station was set up over a known PSM and UHF radio was used to communicate to the rover and accurately measure locations.

Where possible ICSM standards were adhered to; however, some sites in regional coastal areas presented poor satellite coverage or excessive levels of interference. Therefore some of the limits needed to be flexible in order to collect data.

Survey validation was undertaken by storing points on other known PSMs in the area with a recorded minimum target variance of 30 mm between the survey value and that assigned to the PSM. A minimum of two PSMs were required to consider the survey valid. Some exceptions were made to accommodate island regions where there were either no PSMs available to check against, or their quality was questionable. In these cases the base was used to log RINEX data in order to retrieve an AUSPOS from Geoscience Australia. A minimum of four hours of data logged at one second intervals was collected to gain confidence in the survey quality, the longer the time the more accurate the results were. Adjustments were made to the surveyed heights accordingly.

In areas where GPS reception was weak or not available at the desired survey point, a laser level was used to offset the location of the rover away from any interference to GPS reception and later related back to the desired point. This was particularly useful for buildings where standing underneath an awning would interfere with the GPS signal.

2.3.1 Tidal Elevation

Tidal information was sourced from the Natural Disaster Resilience Program Storm Tide Hazard Interpolation Study, 2014 as specified by the Tropical Storm Tide Warning Response System Handbook Ed. 12. Some HAT levels were revised and updated after the surveys were completed.

2.3.2 Accuracy Goals

The primary quality control concern for this project is in the vertical uncertainty. While care has been taken to ensure horizontal accuracy, the majority of the efforts were focused on establishing vertical accuracy. The survey techniques used throughout this project included single reference station RTK and NRTK methods. Use of these methods in accordance with their relevant procedures can expect survey accuracies within 0.020-0.030m for ellipsoidal heights (Intergovernmental Committee on Surveying and Mapping, 2014). AUSGeoid09 was the model used to convert the ellipsoidal heights from the GPS surveys into AHD. Where the CORS network was utilized this transformation to AHD was recorded live, where CORS was unavailable readings were taken and the transformed in post processing using AUSPOS (Geoscience Australia, 2014). The accuracy achievable from this service is dependent on the observation times, with greater accuracy coming from data logged over an extended period of time. For a file logged for six hours an estimated accuracy within 0.030m for elevation would be expected.

Data Presentation

From the surveys undertaken, a maximum of two or three landmark sites for each region were produced. The results of these surveys are presented below, where the data can be viewed in a tabulated format. Key pieces of information produced for each landmark are: elevation; co-ordinates; tidal range; date surveyed; and the origin of the survey. A photo of each landmark and the corresponding Storm Tide Advice Graphic can be found in *Appendix 1*.

In addition to the information provided in this report, the aforementioned (Section 1.2 Scope) Google Earth map file (.KMZ) has been created in order to provide a more comprehensive and interactive medium. This is accessible on the Queensland Government Open Data Portal:

<https://data.qld.gov.au/dataset/stormtide-reference-landmarks/>

Results

Table 1 Storm tide reference landmark details: site name, date surveyed, landmark, elevation (m AHD), latitude, longitude, site HAT (m LAT), site AHD (m LAT), survey method, and survey origin.

Site Number	Site	Date Surveyed	Landmark	Elevation (AHD)	Latitude	Longitude	Site HAT (m LAT)	Site AHD (m LAT)	Site HAT (m AHD)
1	Mornington Island	29/06/2017	Boat Ramp	2.043	-16°40'05.18577"	139°10'34.73608"	3.91	2.00	1.91
1	Mornington Island	29/06/2017	Jetty	2.976	-16°40'03.03218"	139°10'15.83535"	3.91	2.00	1.91
1	Mornington Island	29/06/2017	Shed at Jetty	3.405	-16°40'01.66679"	139°10'15.20305"	3.91	2.00	1.91
2	Karumba	27/06/2017	Boat Ramp	4.087	-17°29'07.18902"	140°50'14.96424"	4.88	2.18	2.70
2	Karumba	27/06/2017	Police Station	4.149	-17°29'10.04471"	140°50'17.42692"	4.88	2.18	2.70
2	Karumba	27/06/2017	Karumba Point Boat Ramp	3.250	-17°27'54.12191"	140°49'42.38454"	4.88	2.18	2.70
3	Albert River	28/06/2017	Burketown Airport Road	4.578	-17°44'38.69541"	139°32'19.47182"	4.80	1.99	2.81
3	Albert River	28/06/2017	Burketown Police	5.357	-17°44'35.86000"	139°32'50.26388"	4.80	1.99	2.81
3	Albert River	28/06/2017	Burketown Pub	6.214	-17°44'26.13458"	139°32'52.30875"	4.80	1.99	2.81
4	Pormpuraaw	18/07/2017	Airstrip	3.066	-14°53'54.45743"	141°36'37.41271"	3.18	1.30	1.88
4	Pormpuraaw	18/07/2017	Council Office	4.697	-14°54'00.47949"	141°37'09.85250"	3.18	1.30	1.88
4	Pormpuraaw	18/07/2017	Police Stn Road Intersection	2.777	-14°54'02.75882"	141°37'02.61368"	3.18	1.30	1.88
5	Aurukun (Archer River)	15/07/2017	Public Boat Ramp	2.484	-13°22'00.03882"	141°43'22.21211"	2.78	1.18	1.60
5	Aurukun (Archer River)	15/07/2017	Old Toilet Block	4.048	-13°21'57.90998"	141°43'22.66187"	2.78	1.18	1.60
5	Aurukun (Archer River)	15/07/2017	Shelter	2.327	-13°22'00.14731"	141°43'23.64877"	2.78	1.18	1.60
6	Weipa	14/07/2017	Napranum War Memorial	4.426	-12°41'03.86842"	141°53'09.95205"	3.38	1.75	1.63
6	Weipa	14/07/2017	Evans Landing Boat Ramp	3.833	-12°39'51.12902"	141°50'59.74732"	3.38	1.75	1.63
6	Weipa	14/07/2017	Caravan Park	4.188	-12°38'18.68878"	141°51'38.75284"	3.38	1.75	1.63
7	Mapoon	12/07/2017	Memorial First Contact	3.791	-11°57'34.71985"	141°54'03.59703"	3.38	1.75	1.63
7	Mapoon	12/07/2017	Cookies Ranch Road Floodway	3.250	-11°59'05.95108"	141°53'08.13038"	3.38	1.75	1.63
7	Mapoon	12/07/2017	School Gate Adj. Flagpoles	6.936	-12°00'58.98824"	141°54'00.08094"	3.38	1.75	1.63
8	Thursday Island	12/05/2017	Custom House	4.873	-10°35'05.61617"	142°13'15.35662"	3.86	1.77	2.09
8	Thursday Island	12/05/2017	Hospital	4.991	-10°35'17.18336"	142°12'38.36242"	3.86	1.77	2.09
8	Thursday Island	12/05/2017	Tagai State College	4.352	-10°34'38.71006"	142°12'49.78627"	3.86	1.77	2.09
9	Moa-Kubin	08/05/2017	Airport Terminal	3.978	-10°13'44.06281"	142°13'23.89688"	3.98	1.95	2.03
9	Moa-Kubin	08/05/2017	Jetty	3.082	-10°14'08.97814"	142°12'54.12174"	3.98	1.95	2.03
9	Moa-Kubin	08/05/2017	Motel	3.823	-10°13'54.15722"	142°13'21.87009"	3.98	1.95	2.03
10	Moa-St Pauls	12/05/2017	Boat Ramp	3.230	-10°11'44.28843"	142°20'01.45486"	4.05	1.89	2.16
10	Moa-St Pauls	12/05/2017	Monument 1st Missionary	3.288	-10°11'13.25006"	142°20'07.45680"	4.05	1.89	2.16
10	Moa-St Pauls	12/05/2017	School Gate	4.939	-10°11'15.64137"	142°20'02.66606"	4.05	1.89	2.16
11	Boigu	10/05/2017	Airstrip	3.047	-9°13'58.02620"	142°13'06.42456"	4.66	1.90	2.76
11	Boigu	10/05/2017	Church	2.993	-9°13'46.53285"	142°13'20.74268"	4.66	1.90	2.76
11	Boigu	10/05/2017	Health Centre	2.917	-9°13'49.82227"	142°13'15.19871"	4.66	1.90	2.76
12	Dauan	12/10/2017	Barge Ramp	2.853	-9°24'41.00244"	142°32'16.97596"	3.95	1.86	2.09
12	Dauan	12/10/2017	Fuel pump	3.934	-9°24'42.50022"	142°32'16.03409"	3.95	1.86	2.09
12	Dauan	12/10/2017	Helipad	6.561	-9°24'39.97633"	142°32'11.16585"	3.95	1.86	2.09
13	Ugar	09/05/2017	Boat Ramp	2.626	-9°30'18.72622"	143°32'48.30292"	4.07	1.98	2.09
13	Ugar	09/05/2017	Church	3.350	-9°30'18.18999"	143°32'46.51146"	4.07	1.98	2.09
13	Ugar	09/05/2017	IBIS Store	4.204	-9°30'19.31061"	143°32'48.58640"	4.07	1.98	2.09
14	Iama	11/05/2017	Airstrip	3.664	-9°53'53.44982"	142°46'17.43166"	4.16	2.02	2.14
14	Iama	11/05/2017	Boat Ramp	2.430	-9°53'57.05730"	142°45'59.14463"	4.16	2.02	2.14
14	Iama	11/05/2017	Council Building	2.230	-9°53'55.95424"	142°46'05.74631"	4.16	2.02	2.14
15	Cooktown	22/04/2017	Boat Ramp	2.288	-15°27'40.03621"	145°14'58.28712"	3.20	1.48	1.72
15	Cooktown	22/04/2017	Bowls Club	3.414	-15°27'54.09243"	145°14'59.57107"	3.20	1.48	1.72
15	Cooktown	22/04/2017	Post Office Step	4.460	-15°27'56.39555"	145°14'58.99469"	3.20	1.48	1.72
16	Lockhart River	16/07/2017	Jetty	2.634	-12°47'41.40419"	143°21'36.47350"	3.35	1.63	1.72
16	Lockhart River	16/07/2017	Esplanade	2.473	-12°47'38.09032"	143°21'36.10166"	3.35	1.63	1.72
16	Lockhart River	16/07/2017	Public Boat Ramp	1.504	-12°49'25.59986"	143°20'42.07617"	3.35	1.63	1.72

Storm Tide Reference Landmarks Queensland

17 Bloomfield	21/04/2017	Wharf Shed	2.270	-15°55'34.60771"	145°21'07.52262"	3.16	1.48	1.68
17 Bloomfield	21/04/2017	CNR Esplanade & Weary Bay Rd	4.007	-15°54'16.27824"	145°21'20.07870"	3.16	1.48	1.68
17 Bloomfield	21/04/2017	Wujal Wujal Douglas St Floodway	4.019	-15°57'04.72664"	145°19'09.56745"	3.16	1.48	1.68
18 Lizard Island	11/10/2017	The Beach Club	3.481	-14°40'04.87"	145°26'43.86"	2.92	1.34	1.58
18 Lizard Island	11/10/2017	Research Station Aquarium	3.904	-14°40'43.28"	145°26'53.53"	2.92	1.34	1.58
18 Lizard Island	11/10/2017	Marlin Bar	6.600	-14° 39' 59.17"	145°26'55.74"	2.92	1.34	1.58
19 Wonga Beach	16/20/2022	Wonga Beach Esplanade Bridge	2.311	-16° 20' 29.85764"	145° 24' 55.10124"	3.05	1.31	1.75
19 Wonga Beach	16/20/2022	Bells Park	2.622	-16° 20' 38.71138"	145° 24' 47.70443"	3.05	1.31	1.75
19 Wonga Beach	16/20/2022	Corner Oleander and Marlin	2.566	-16° 21' 24.66521"	145° 24' 50.40241"	3.05	1.31	1.75
19 Wonga Beach	16/20/2022	QFES Bus stop	2.763	-16° 21' 30.75755"	145° 24' 42.44471"	3.05	1.31	1.75
19 Wonga Beach	16/20/2022	Skate Park	3.807	-16° 21' 50.71477"	145° 24' 45.69048"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Corner Coulthard and Lematy	3.368	-16° 25' 20.23178"	145° 24' 18.81289"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Corner Andrews and Lematy	4.777	-16° 25' 20.81772"	145° 24' 22.22890"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Newell Beach Shop	3.763	-16° 25' 32.17378"	145° 24' 22.38232"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Marine Parade Toilet Block	3.117	-16° 25' 34.22070"	145° 24' 23.10982"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Corner Newell and Rankin (PSM-96081)	2.903	-16° 25' 46.11021"	145° 24' 18.19345"	3.05	1.31	1.75
19 Newell Beach	16/20/2022	Boat Ramp Fishing Club House	2.192	-16° 26' 1.26183"	145° 24' 16.34461"	3.05	1.31	1.75
19 Cooya Beach	16/20/2022	Boat Ramp Toilet Block	3.097	-16° 26' 28.76411"	145° 24' 23.75461"	3.05	1.31	1.75
19 Cooya Beach	16/20/2022	Playground Near 13 Bougainvillea st	2.945	-16° 26' 33.34336"	145° 24' 25.70757"	3.05	1.31	1.75
19 Cooya Beach	16/20/2022	Playground Near 115 Bougainvillea st	2.562	-16° 27' 5.26594"	145° 24' 29.92643"	3.05	1.31	1.75
19 Port Douglas	20/04/2017	Reef Marina	3.179	-16°29'03.36563"	145°27'37.75792"	3.36	1.58	1.78
19 Port Douglas	20/04/2017	Four Mile Beach Park Toilets	2.436	-16°31'11.15142"	145°28'20.56139"	3.36	1.58	1.78
19 Port Douglas	20/04/2017	St Mary's by the sea	2.571	-16°28'51.15977"	145°27'41.19243"	3.36	1.58	1.78
20 Palm Cove	20/04/2017	Jetty	3.042	-16°44'23.26688"	145°40'18.60062"	3.28	1.60	1.68
20 Palm Cove	20/04/2017	Public Toilets 131 Williams Esp	2.727	-16°44'34.39941"	145°40'16.86842"	3.28	1.60	1.68
21 Cairns Harbour	10/10/2017	Lagoon Pathway	2.146	-16°55'08.63"	145°46'41.28"	3.49	1.64	1.85
21 Cairns Harbour	10/10/2017	Promenade	2.508	-16°54'43.05"	145°46'13.26"	3.49	1.64	1.85
21 Cairns Harbour	10/10/2017	Airport Runway South	2.410	-16°53'31.12"	145°45'19.38"	3.49	1.64	1.85
22 Green Island	19/04/2017	Helipad	2.980	-16°45'37.18371"	145°58'18.99821"	3.27	1.54	1.73
22 Green Island	19/04/2017	Jetty	2.665	-16°45'28.56247"	145°58'12.63212"	3.27	1.54	1.73
22 Green Island	19/04/2017	Seawall	3.354	-16°45'29.85092"	145°58'19.50972"	3.27	1.54	1.73
23 Yarrabah	18/04/2017	Church	3.412	-16°54'23.20276"	145°52'00.72397"	3.40	1.64	1.76
23 Yarrabah	18/04/2017	Community Centre	3.727	-16°54'29.53945"	145°52'31.52733"	3.40	1.64	1.76
23 Yarrabah	18/04/2017	Monument J.B. Gribble	3.059	-16°54'19.01521"	145°51'54.50154"	3.40	1.64	1.76
24 Flying Fish Point	22/09/2017	Public Boat Ramp	2.337	-17°30'16.13449"	146°04'34.11731"	3.47	1.63	1.84
24 Flying Fish Point	22/09/2017	Coconuts Boat Ramp	4.548	-17°30'25.19435"	146°03'46.26496"	3.47	1.63	1.84
24 Flying Fish Point	22/09/2017	Tourist Park	2.779	-17°29'55.77798"	146°04'34.54178"	3.47	1.63	1.84
25 Clump Point	21/09/2017	Public Jetty	2.898	-17°51'01.58266"	146°06'20.02544"	3.58	1.68	1.90
25 Clump Point	21/09/2017	Shrubbery Tavern	3.151	-17°52'02.92704"	146°06'29.13060"	3.58	1.68	1.90
25 Clump Point	21/09/2017	Bingil Bay Beach Carpark	4.204	-17°49'50.91340"	146°05'58.57774"	3.58	1.68	1.90
26 Cardwell	21/09/2017	Coast Guard Tower	3.988	-18°16'58.71859"	146°02'38.41339"	4.16	1.86	2.30
26 Cardwell	21/09/2017	Public Boat Ramp	3.944	-18°15'24.43763"	146°01'15.09503"	4.16	1.86	2.30
26 Cardwell	21/09/2017	Public Jetty	3.449	-18°15'47.39715"	146°01'32.74109"	4.16	1.86	2.30
27 Lucinda	21/09/2017	Public Jetty	3.007	-18°31'24.80080"	146°19'52.16963"	3.96	1.84	2.12
27 Lucinda	21/09/2017	Public Boat Ramp	2.353	-18°31'24.61315"	146°19'04.88670"	3.96	1.84	2.12
27 Lucinda	21/09/2017	Borello Park Monument	3.986	-18°31'30.15069"	146°20'02.87388"	3.96	1.84	2.12
28 Palm Island	20/09/2017	Public Boat Ramp	2.739	-18°44'08.32000"	146°34'36.24674"	3.96	1.86	2.10
28 Palm Island	20/09/2017	Colgaree Bay Hotel	4.945	-18°43'59.46336"	146°34'38.60958"	3.96	1.86	2.10
28 Palm Island	20/09/2017	Helipad	3.431	-18°43'57.06323"	146°34'39.80880"	3.96	1.86	2.10

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29 Townsville	07/08/2017	Strand Pier	4.992	-19°14'40.33318"	146°48'39.18366"	4.09	1.86	2.23
29 Townsville	07/08/2017	Pallarenda Foreshore	3.615	-19°11'56.79762"	146°46'28.22255"	4.09	1.86	2.23
29 Townsville	07/08/2017	Marina ANZAC Park	3.767	-19°15'16.26022"	146°49'19.23445"	4.09	1.86	2.23
30 Nelly Bay	08/08/2017	Jetty Picnic Bay	2.693	-19°10'48.55916"	146°50'17.50395"	3.94	1.84	2.10
30 Nelly Bay	08/08/2017	Acardia Bowls Club	3.125	-19°09'04.39419"	146°51'49.53928"	3.94	1.84	2.10
30 Nelly Bay	08/08/2017	Nelly Bay Ferry Terminal	4.309	-19°09'31.93083"	146°51'19.74923"	3.94	1.84	2.10
31 Alva	09/08/2017	Surf Life Saving Club	2.750	-19°27'14.51645"	147°28'54.79478"	3.67	1.69	1.98
31 Alva	09/08/2017	Public Toilets	2.524	-19°27'16.38709"	147°28'55.36046"	3.67	1.69	1.98
31 Alva	09/08/2017	Caravan Park	2.536	-19°27'31.35624"	147°28'49.77098"	3.67	1.69	1.98
32 Molongle Creek	09/08/2017	Boat Ramp	2.354	-19°50'04.02276"	147°41'59.65790"	3.78	1.80	1.98
32 Molongle Creek	09/08/2017	Caravan Park	2.694	-19°50'09.09722"	147°41'57.65720"	3.78	1.80	1.98
32 Molongle Creek	09/08/2017	Boat Club	2.643	-19°50'05.04184"	147°41'58.97228"	3.78	1.80	1.98
33 Abbot Point	10/08/2017	Marine Offloading Facility	3.421	-19°52'59.56715"	148°04'54.94289"	3.60	1.63	1.97
33 Abbot Point	10/08/2017	Abbot Point Rd. Bridge	4.045	-19°56'49.45276"	148°06'20.77079"	3.60	1.63	1.97
34 Bowen	09/04/2017	Jetty	2.760	-20°01'03.48749"	148°14'54.42189"	3.74	1.78	1.96
34 Bowen	09/04/2017	Queens Beach SLSC	4.491	-19°58'42.26204"	148°13'55.86413"	3.74	1.78	1.96
35 Brisk Bay	10/08/2017	Causeway	2.535	-20°06'15.61008"	148°16'40.09096"	3.74	1.78	1.96
35 Brisk Bay	10/08/2017	Edwards St cul-de-sac	4.152	-20°06'39.18540"	148°18'06.57733"	3.74	1.78	1.96
35 Brisk Bay	10/08/2017	Pitcairn Ave Culvert	4.813	-20°06'35.68927"	148°17'45.58987"	3.74	1.78	1.96
36 Dingo Beach	15/02/2017	Dingo Pub	4.073	-20°05'28.36597"	148°29'57.95670"	3.79	1.80	1.99
36 Dingo Beach	15/02/2017	Fire Service Driveway	4.313	-20°05'33.83772"	148°29'49.74454"	3.79	1.80	1.99
37 Airlie Beach	16/02/2017	Shute Hbr Terminal	3.376	-20°17'34.65452"	148°47'08.42664"	4.02	1.75	2.27
37 Airlie Beach	16/02/2017	Airlie Beach Hotel	3.801	-20°16'08.51061"	148°43'16.67327"	4.02	1.75	2.27
38 Conway Beach	16/02/2017	Penhallurick Esp	5.119	-20°28'46.63701"	148°44'18.48063"	6.14	2.81	3.33
38 Conway Beach	11/08/2017	Wilson Beach Toilet Block	4.588	-20°28'19.47568"	148°43'26.16060"	6.14	2.81	3.33
38 Conway Beach	16/02/2017	Wilson Beach BBQ Area	4.552	-20°28'21.05653"	148°43'25.54740"	6.14	2.81	3.33
39 Hayman Island	30/08/2017	Resort Pool Deck	3.375	-20°03'29.21"	148°53'04.39"	4.33	1.93	2.40
39 Hayman Island	30/08/2017	Marina Office	3.331	-20°03'38.17"	148°52'50.75"	4.33	1.93	2.40
39 Hayman Island	30/08/2017	Helipad	3.292	-20°03'35.84"	148°53'00.86"	4.33	1.93	2.40
40 Hamilton Island	30/08/2017	Post Office	3.110	-20°20'47.40"	148°57'08.18"	4.79	2.10	2.69
40 Hamilton Island	30/08/2017	Resort Pool Deck	5.212	-20°20'42.13"	148°57'20.71"	4.79	2.10	2.69
40 Hamilton Island	30/08/2017	Airport Ferry Entrance	2.671	-20°21'03.78"	148°56'54.67"	4.79	2.10	2.69
41 Laguna Quay	17/02/2017	STG Jetty	4.624	-20°36'12.73832"	148°40'48.02605"	6.27	2.81	3.46
41 Laguna Quay	17/02/2017	Nielsen P de Midgeton	4.570	-20°38'55.32857"	148°43'21.46310"	6.27	2.81	3.46
42 Mackay	21/08/2017	Lighthouse	6.446	-21°06'37.58645"	149°13'29.45926"	6.62	2.94	3.68
42 Mackay	21/08/2017	Slade Point State School	3.603	-21°04'26.01977"	149°12'53.06942"	6.62	2.94	3.68
42 Mackay	21/08/2017	Forgar Bridge South	6.274	-21°08'21.63579"	149°11'15.44345"	6.62	2.94	3.68
43 Hay Point	22/08/2017	Pacific Dr Spillway	5.677	-21°17'59.15962"	149°17'31.60625"	7.15	3.34	3.81
43 Hay Point	22/08/2017	Esplanade Beach Stairs	5.567	-21°17'51.03373"	149°17'33.42339"	7.15	3.34	3.81
43 Hay Point	22/08/2017	Edmunds Ave & Louisa Creek Rd	6.379	-21°16'44.69245"	149°16'21.64497"	7.15	3.34	3.81
44 St Lawrence	22/08/2017	Police Station	8.459	-22°20'40.25878"	149°31'43.27178"	8.70	3.63	5.07
44 St Lawrence	22/08/2017	MacCartney Street Culvert	7.449	-22°20'42.30450"	149°31'55.13183"	8.70	3.63	5.07
44 St Lawrence	22/08/2017	Margs Park	5.533	-22°20'33.44499"	149°31'24.40609"	8.70	3.63	5.07
45 Broad Sound	23/08/2017	Halfway Creek	6.346	-22°37'42.17130"	150°05'23.54244"	9.20	4.10	5.10
45 Broad Sound	23/08/2017	Stanage Bay Coast Guard	5.764	-22°08'12.11347"	150°01'53.68698"	9.20	4.10	5.10
45 Broad Sound	23/08/2017	Stanage Bay Boat Ramp	3.605	-22°08'12.97828"	150°01'52.70810"	9.20	4.10	5.10
46 Shoalwater Bay	24/08/2017	Sabina Point Boat Ramp	3.813	-22°24'03.32982"	150°17'55.18540"	8.10	3.70	4.40
47 Yeppoon	25/08/2017	Rosslyn Bay Public Boat Ramp	3.108	-23°09'50.36893"	150°47'20.22273"	5.14	2.36	2.78
47 Yeppoon	25/08/2017	Causeway Lake Bridge	3.661	-23°12'01.14330"	150°47'18.19900"	5.14	2.36	2.78

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47 Yeppoon	25/08/2017	Ross Creek Henry Beak Bridge	5.077	-23°08'18.44949"	150°45'06.23914"	5.14	2.36	2.78
48 Great Keppel Island	05/09/2017	Hideaway	5.660	-23°10'43.99709"	150°56'00.38896"	5.00	2.36	2.64
48 Great Keppel Island	05/09/2017	Rainbow Hut	5.048	-23°10'47.48960"	150°56'08.06960"	5.00	2.36	2.64
48 Great Keppel Island	05/09/2017	Water Sports Hut	4.663	-23°10'51.88731"	150°56'10.02113"	5.00	2.36	2.64
49 Port Alma	06/09/2017	Public Boat Ramp	2.913	-23°35'12.97646"	150°51'39.25354"	5.89	2.85	3.04
49 Port Alma	06/09/2017	Wharf	4.013	-23°34'58.98418"	150°51'46.61141"	5.89	2.85	3.04
50 Gladstone	06/09/2017	Information Centre	4.026	-23°50'02.55805"	151°14'48.78422"	4.71	2.21	2.50
50 Gladstone	06/09/2017	Sailing Club	2.938	-23°50'16.55301"	151°15'08.17833"	4.71	2.21	2.50
50 Gladstone	06/09/2017	Tannum Sands SLSC	4.731	-23°56'49.95506"	151°22'32.28267"	4.71	2.21	2.50
51 Agnes Water	07/09/2017	State Emergency Services	3.813	-24°10'57.70719"	151°52'59.69412"	3.57	1.61	1.96
51 Agnes Water	07/09/2017	Volunteer Marine Rescue	2.738	-24°10'15.62897"	151°52'59.85553"	3.57	1.61	1.96
51 Agnes Water	07/09/2017	1770 Camping Ground	2.484	-24°09'45.66936"	151°53'05.80844"	3.57	1.61	1.96
52 Burnett Heads	07/09/2017	Wharf	4.156	-24°46'17.35283"	152°22'57.37562"	3.69	1.69	2.00
52 Burnett Heads	07/09/2017	State Emergency Services	3.983	-24°45'49.58432"	152°24'36.51090"	3.69	1.69	2.00
52 Burnett Heads	07/09/2017	Moneys Creek Causeway	2.441	-24°49'34.98899"	152°27'49.53718"	3.69	1.69	2.00
53 Urangan	08/09/2017	Public Boat Ramp	2.423	-25°17'46.45859"	152°54'30.23722"	4.32	2.04	2.28
53 Urangan	08/09/2017	Pier	4.149	-25°16'58.14037"	152°54'12.78122"	4.32	2.04	2.28
53 Urangan	08/09/2017	Sailing Club	4.084	-25°17'02.33272"	152°52'17.47477"	4.32	2.04	2.28
54 Rainbow Beach	05/10/2017	4WD Beach Access	4.472	-25°54'02.83749"	153°05'32.21359"	2.37	1.12	1.25
54 Rainbow Beach	05/10/2017	Inskip Point Turnaround	2.147	-25°48'34.82470"	153°03'03.28845"	2.37	1.12	1.25
54 Rainbow Beach	05/10/2017	Carlo Point Boat Ramp	1.738	-25°53'53.32861"	153°03'26.19949"	2.37	1.12	1.25
55 Cooloolia Beach	04/10/2017	Teewah Helipad	5.560	-26°16'43.64769"	153°03'49.52297"	2.33	1.12	1.21
56 Noosa Heads	04/10/2017	Yacht and Rowing Club	1.369	-26°23'50.52819"	153°03'19.45608"	2.28	1.12	1.16
56 Noosa Heads	04/10/2017	Noosaville Boat Ramp	1.197	-26°23'50.58284"	153°03'47.48536"	2.28	1.12	1.16
56 Noosa Heads	04/10/2017	Noosa Surf Club	4.681	-26°23'11.63127"	153°05'31.26916"	2.28	1.12	1.16
57 Mooloolaba	03/11/2017	Sunshine Coast Water Police	2.774	-26°41'00.09115"	153°07'59.50569"	2.17	0.99	1.18
57 Mooloolaba	03/11/2017	SLSC Tower	4.863	-26°40'53.12627"	153°07'18.95974"	2.17	0.99	1.18
57 Mooloolaba	03/11/2017	Cotton Tree Eastern Pier	1.920	-26°39'14.98682"	153°05'50.76164"	2.17	0.99	1.18
58 Golden Beach	03/11/2017	Military Jetty	1.181	-26°50'00.21971"	153°07'09.43109"	1.73	0.66	1.07
58 Golden Beach	03/11/2017	Caloundra SLSC	4.201	-26°48'13.75824"	153°08'28.50110"	1.73	0.66	1.07
58 Golden Beach	03/11/2017	The Esplanade Boardwalk	1.963	-26°48'21.19528"	153°07'47.53021"	1.73	0.66	1.07
59 Scarborough Boat Harbour	30/06/2017	Scarborough Public Jetty	2.199	-27°11'36.86"	153°06'33.45"	2.44	1.17	1.27
59 Scarborough Boat Harbour	30/06/2017	Redcliffe Public Jetty	3.549	-27°13'34.75"	153°06'57.54"	2.44	1.17	1.27
59 Scarborough Boat Harbour	30/06/2017	Woody Point Jetty	2.776	-27°15'48.10"	153°06'13.31"	2.44	1.17	1.27
60 Brisbane River	26/09/2017	Tenneriffe Ferry Terminal	1.754	-27°27'07.41105"	153°02'56.86840"	2.77	1.24	1.53
60 Brisbane River	26/09/2017	Nudgee Road Ped X-ing	1.815	-27°21'10.38158"	153°06'18.08795"	2.77	1.24	1.53
60 Brisbane River	26/09/2017	BNE Domestic Terminal	3.730	-27°23'03.42585"	153°07'10.72830"	2.77	1.24	1.53
61 Redland Bay	26/09/2017	Raby Bay VMR	2.820	-27°30'53.74959"	153°17'11.82572"	2.97	1.41	1.56
61 Redland Bay	26/09/2017	Victoria Point Barge Ramp	1.962	-27°34'55.41094"	153°19'04.75378"	2.97	1.41	1.56
61 Redland Bay	26/09/2017	Redland Bay Marina Bus Stop	2.347	-27°37'05.47728"	153°18'40.92268"	2.97	1.41	1.56
62 Southport (inside Broadwater)	01/06/2017	Pier	2.650	-27°57'55.77"	153°25'04.58"	1.91	0.76	1.15
62 Southport (inside Broadwater)	01/06/2017	Boat Ramp	1.759	-27°57'30.76"	153°24'48.98"	1.91	0.76	1.15
62 Southport (inside Broadwater)	01/06/2017	Sundale Bridge Underpass Footpath	1.392	-27°58'29.81"	153°25'15.96"	1.91	0.76	1.15
63 Main Beach	01/06/2017	View Avenue Beach Access	5.996	-27°59'52.59"	153°25'51.51"	1.91	0.76	1.15
63 Main Beach	01/06/2017	John Kemp Avenue Beach Access	5.680	-27°58'40.93"	153°25'46.22"	1.91	0.76	1.15
63 Main Beach	01/06/2017	Southport SLSC	6.030	-27°58'29.92"	153°25'45.31"	1.91	0.76	1.15
64 Coolangatta	01/06/2017	SLSC Beach Access Ramp	3.205	-28°09'59.87"	153°32'38.62"	2.10	0.97	1.13
64 Coolangatta	01/06/2017	Kirra SLSC Pavilion	3.476	-28°10'01.73"	153°31'55.60"	2.10	0.97	1.13
64 Coolangatta	01/06/2017	Groyne Helipad	4.657	-28°09'54.77"	153°32'10.73"	2.10	0.97	1.13

Summary

This project has delivered between one and three reference landmarks for each of the 64 locations outlined in the Queensland Tropical Cyclone Storm Tide Warning and Response System Handbook. These landmarks will prove useful in gaining a rapid understanding of the risks of an issued storm tide advice, and act as a tool to better understand the elevations of the coastal communities covered by this project. The Google Earth map that has been developed to display the information gathered from this project has been made available through the Queensland Government Open Data Portal (Queensland Government, 2017) and should be considered as a tool for disaster management practitioners throughout the relevant council bodies.

Some of the larger cities covered in this project may not find the use of landmarks to gauge potential storm tide elevations as valuable as the smaller towns and councils that have been surveyed. This is to be expected, as the area of these cities is too broad to be covered by three reference landmarks. At a base level, however, the landmark levels may give a rapid understanding of the different datum used in these warnings and provide some clarity in that regard. Through consultation with some of the larger councils, an effort has been made to capture at risk areas, as well as sites that align with their pre-existing storm tide advice systems in order to make this project useful and relevant. However, the greatest benefit will likely be for smaller coastal regions where storm tide risk assessments and extensive flood mapping has not been conducted to a level equivalent to larger regional centres. It should be noted that this is a State-wide tool and as such the standardisation of this information and the delivery needs to remain intact in order to maintain consistency in the advice issued.

Through consultation with numerous local disaster managers at multiple councils, concerns have been raised regarding differences in mapping regimes, in particular discrepancies in colours used between councils and state. The national storm tide colours were developed as a means of standardising storm tide maps to reduce confusion when communicating risk to the wider community. The contour lines from this model, however, do not represent any real assessment of risk in the individual regions, and are set up solely as a guideline. Due to this, most councils throughout Queensland have developed their own storm tide mapping regime. While this is acknowledged as a significant barrier in clearly communicating the risk of inundation posed to a particular region, this is outside the scope of this project.

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Appendix 1: Storm Tide Advice Graphics and Landmarks

A1 Mornington Island

Mornington Island is located within the Gulf of Carpentaria in close proximity to the Northern Territory border. The main settlement for Mornington Island is located on the South Western tip, along a narrow channel adjacent to Denham Island. The majority of the island is flat with extensive mangrove forests along the coastline. Landmarks selected are located on the coast with the town set back slightly from the shoreline.

A1.1 Public Boat Ramp

Storm Tide Warning Graphic for Mornington Island

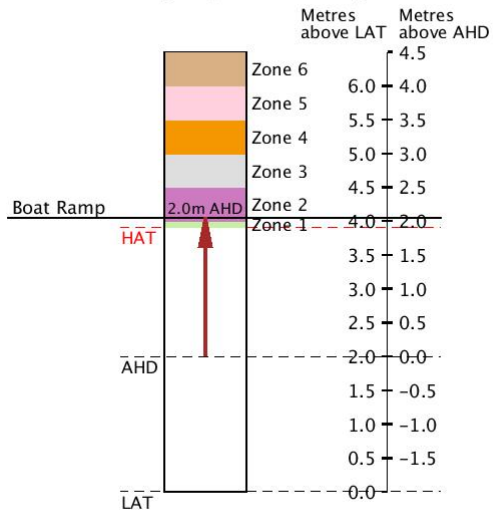


Figure 1. Public boat ramp: Mornington Island, Qld 4892

A1.2 Jetty

Storm Tide Warning Graphic for Mornington Island

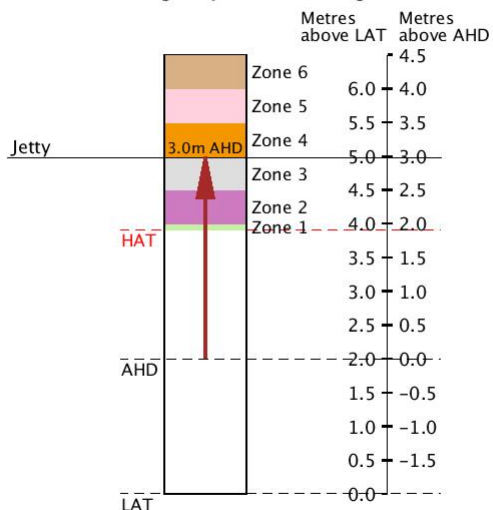
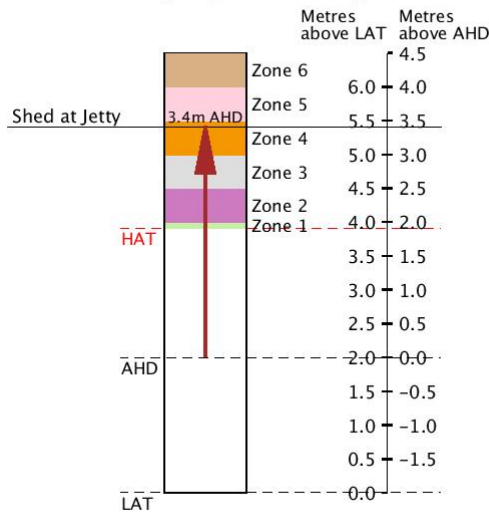


Figure 2. Public jetty, Jetty Rd, Mornington Island, Qld 4892

A1.3 Shed at Jetty

Storm Tide Warning Graphic for Mornington Island



A2.2 Police Station

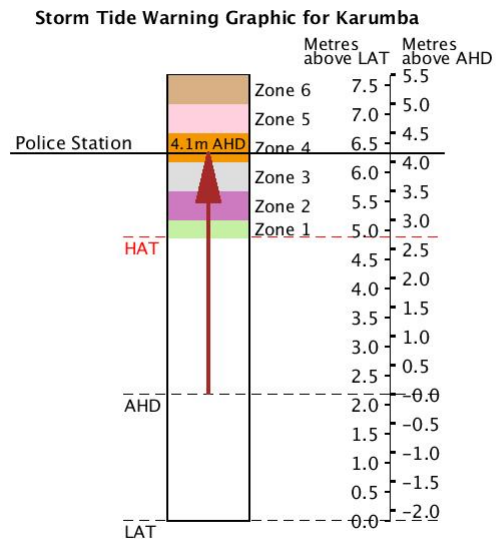


Figure 5. Police Station: 51 Yapper Street, Karumba Qld, 4891

A2.3 Karumba Point Boat Ramp

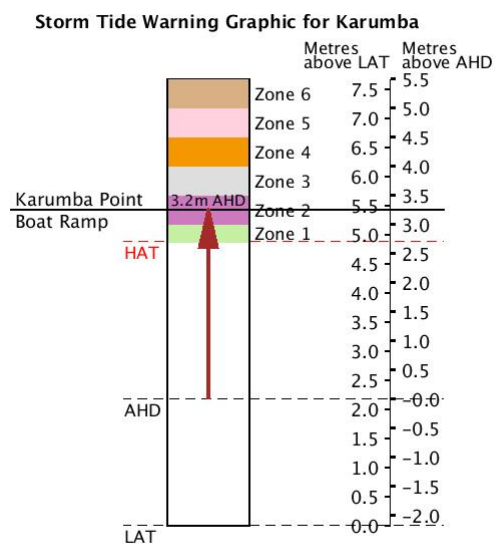


Figure 6. Karumba Point boat ramp: Palmer Street, Karumba Qld, 4891

A3 Albert River

The major settlement at Albert River is Burketown. Located within the Gulf of Carpentaria the town is approximately 29 km from the coast along the Albert River. The region is dominated by flood plains, however the town itself is set at a higher elevation than the surrounding land.

A3.1 Burketown Airport Road

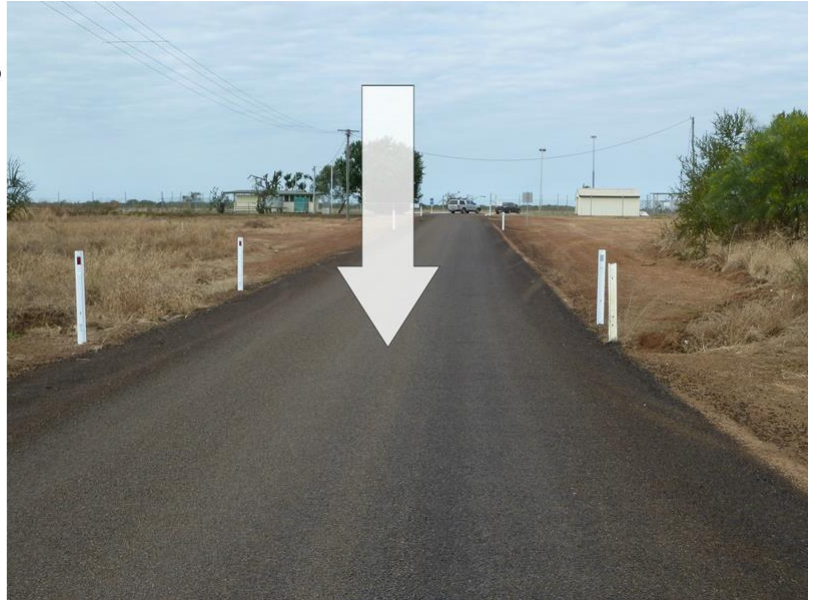
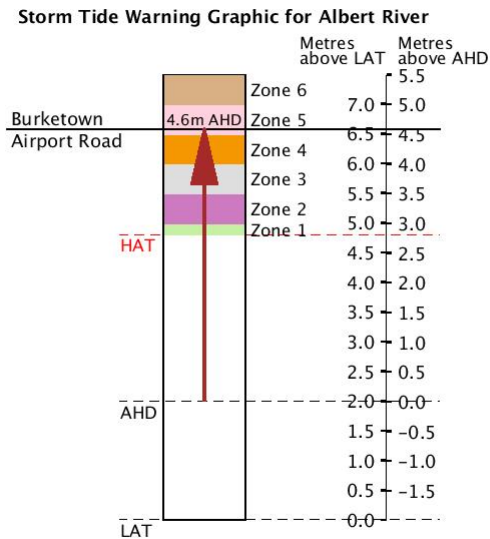


Figure 7. Airport Road, Burketown, Qld, 4830

A3.2 Burketown Police Station

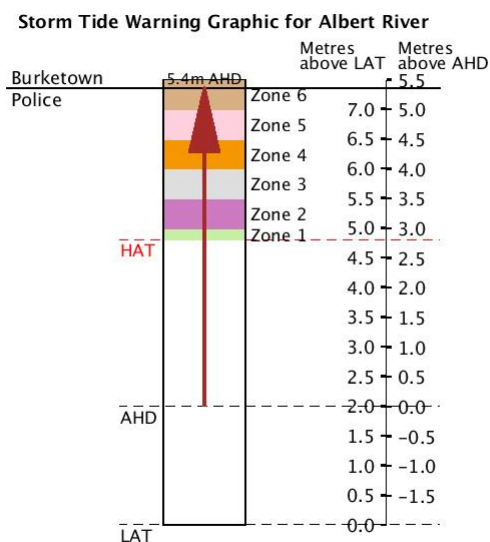


Figure 8. Police Station: Gregory Street, Burketown, Qld, 4830

A3.3 Burketown Pub

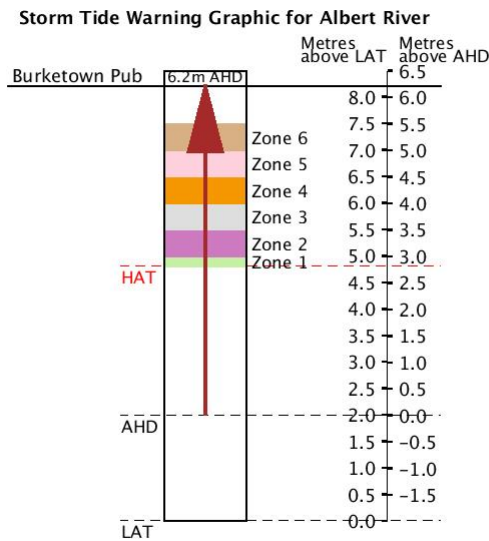


Figure 9. Burketown Pub: Beames Street, Qld, 4830

A4 Pormpuraaw

Pormpuraaw is located on the west coast of Cape York Peninsula. The airstrip is located directly on the coast, while the main section of town is situated at a higher elevation set back from the coast. Landmarks were selected to illustrate this difference in elevation.

A4.1 Airstrip

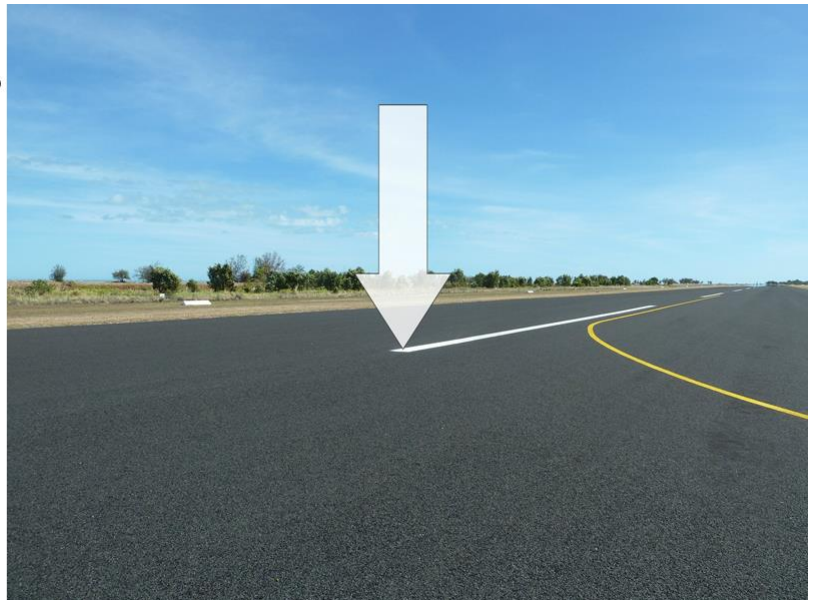
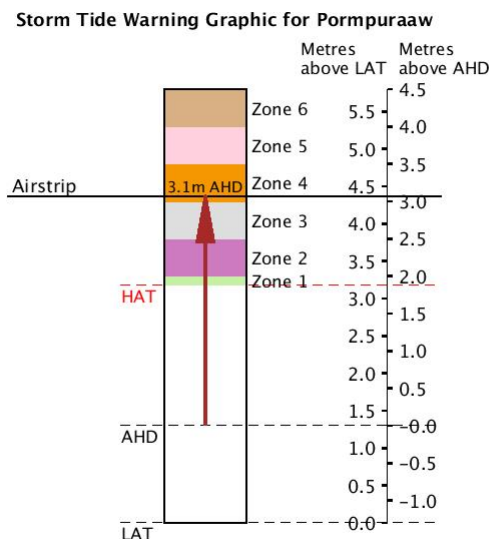


Figure 10. Airstrip: Wirran Street, Pormpuraaw, Qld, 4892

A4.2 Council Office

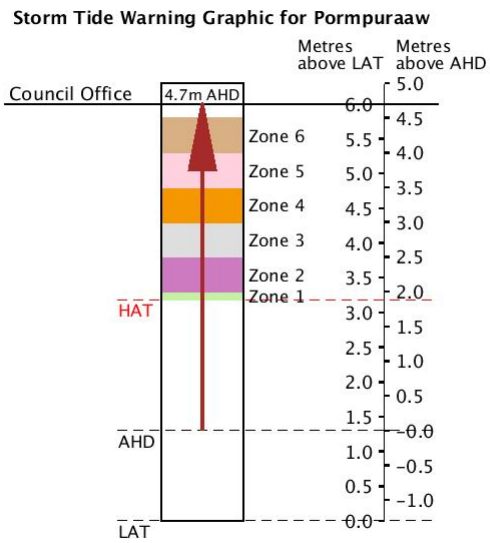


Figure 11. Council office: Corner of Thinraathin Street and Matpi Street, Pormpuraaw, Qld, 4892

A4.3 Police Station Road Intersection

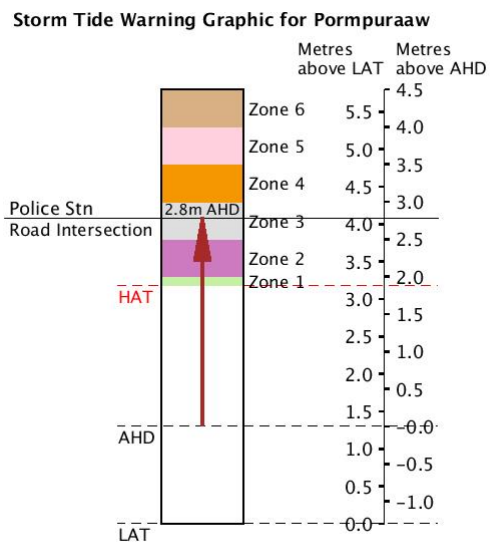


Figure 12. Police Station Road Intersection: Intersection of Wirran Street and Unnamed road, Pormpuraaw, Qld, 4892

A5 Aurukun (Archer River)

Aurukun is a small town located on the west coast of Cape York Peninsula located within a bay at the terminus of the Watson River. The town itself is set back from the coast at a higher elevation. Landmarks were limited to the boat ramp and surrounding features due to the higher elevation of the town.

A5.1 Public Boat Ramp

Storm Tide Warning Graphic for Aurukun (Archer River)

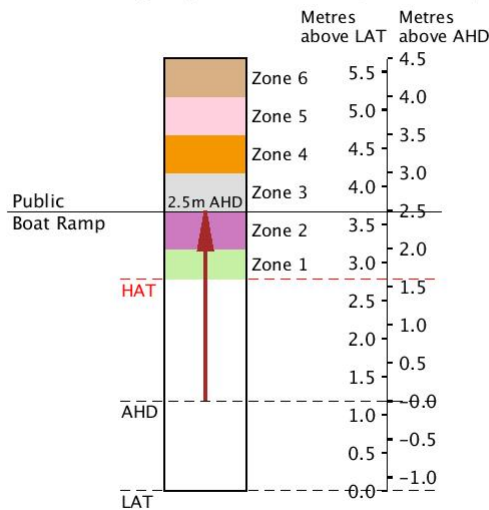


Figure 13. Public Boat Ramp: McKenzie Drive, Aurukun, Qld, 4892

A5.2 Old Toilet Block

Storm Tide Warning Graphic for Aurukun (Archer River)

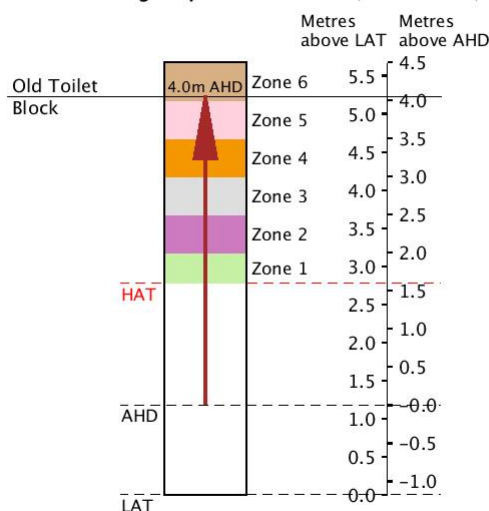


Figure 14. Old Toilet Block: McKenzie Drive, Aurukun, Qld, 4892

A5.3 Shelter

Storm Tide Warning Graphic for Aurukun (Archer River)

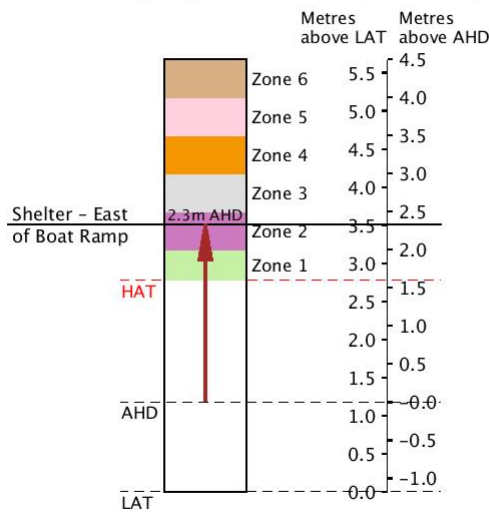


Figure 15. Shelter: McKenzie Drive, Aurukun, Qld, 4892

A6 Weipa

Weipa is located in between the mouths of Mission and Embley rivers on the west coast of Cape York Peninsula. There are large bauxite mining operations at Weipa with a major port on the coast dedicated to this resource. The town has been developed along the coastline: due to this, the landmarks were selected in order to reflect elevations directly along the coastline.

A6.1 Naprunum War Memorial

Storm Tide Warning Graphic for Weipa

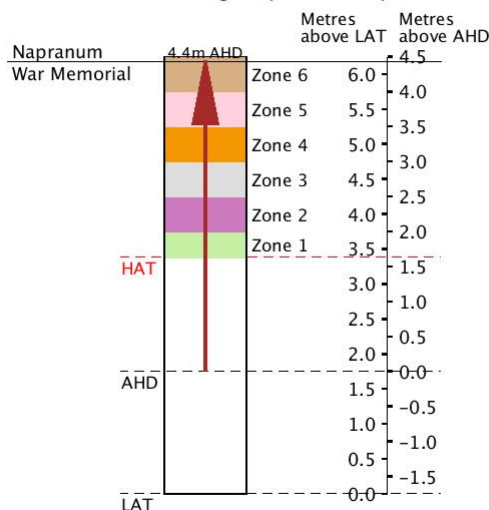


Figure 16. Naprunum War Memorial: 320 Wa Tyne Street, Mission River, Qld, 4874

A6.2 Evans Landing Boat Ramp

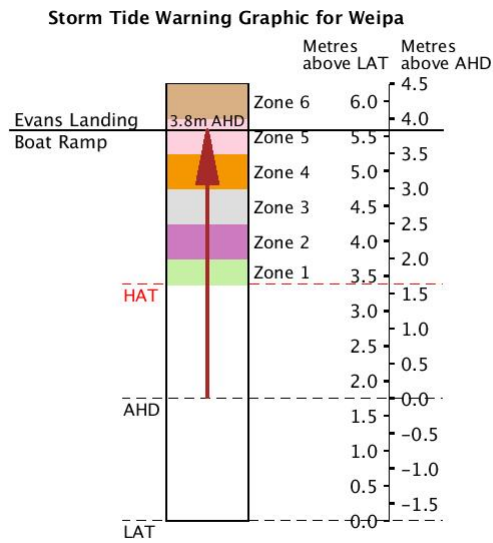


Figure 17. Evans Landing Boat Ramp: Landing Drive, Evans Landing, Qld, 4874

A6.3 Caravan Park

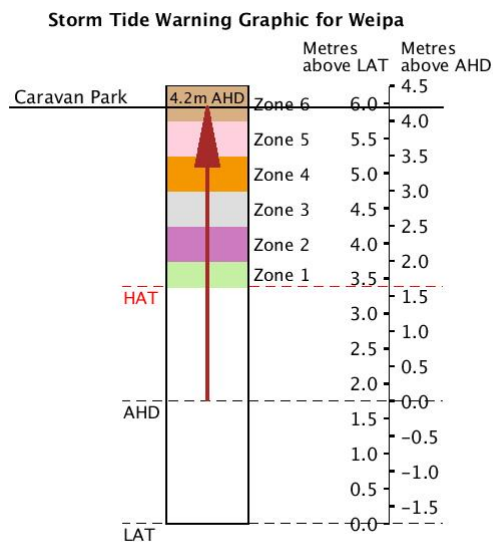


Figure 18. Caravan Park: LOT 7024 Kerr Point Drive, Nanum, Qld, 4874

A7 Mapoon

Mapoon is a small town located on the north-west coast of Cape York Peninsula at the mouths of the Wenlock and Ducie rivers. The main section of town is at a higher elevation than the surrounding regions. Landmarks were selected to show the elevation of the town in addition to the surrounding areas towards Cullen Point.

A7.1 First Contact Memorial

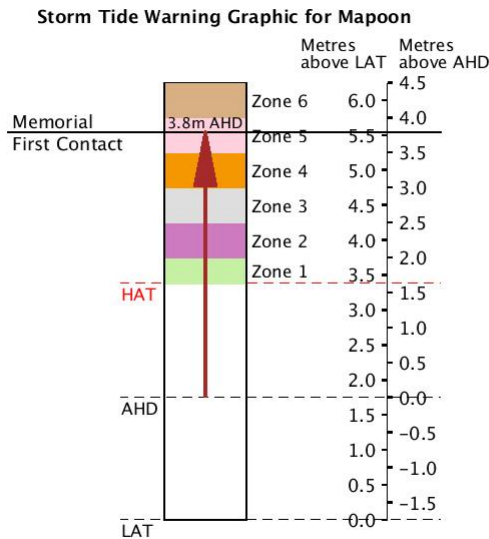


Figure 19. First Contact Memorial: Mapoon, Qld, 4874

A7.2 Cookies Ranch Road Floodway

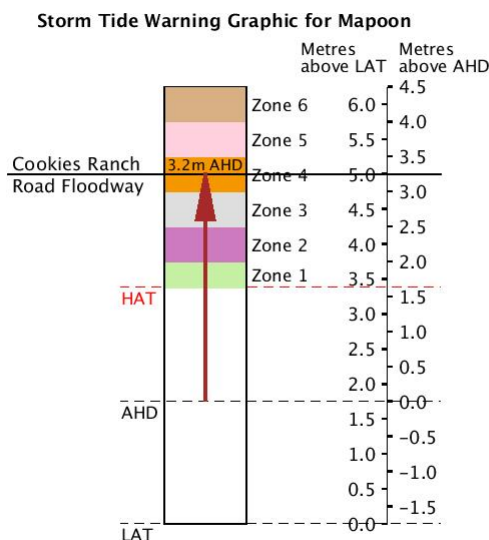


Figure 20. Cookie's Ranch Road floodway: Mapoon, Qld, 4874

A7.3 School gate adjacent flagpoles

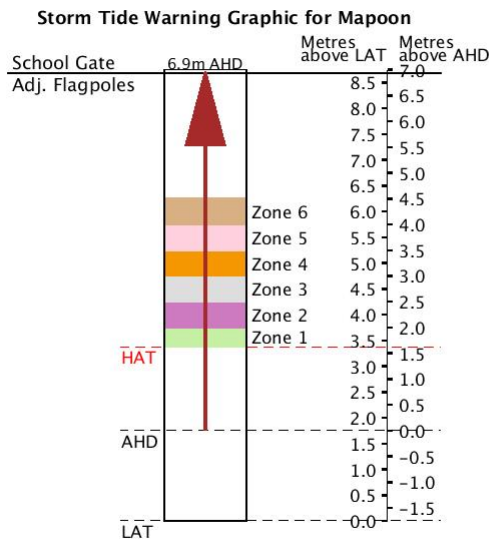


Figure 21. School Gate: Western Cape College, Mapoon, Qld, 4874

A8 Thursday Island

Thursday Island is located within the Torres Strait, off the coast to the north of Cape York Peninsula. The island is the middle island in a group consisting of Hammond Island, Horn Island, Friday Island, and Prince of Wales Island. It is the major hub for the Torres Strait and as such is extensively developed. Landmarks were selected to display key pieces of infrastructure along the coastline.

A8.1 Custom House

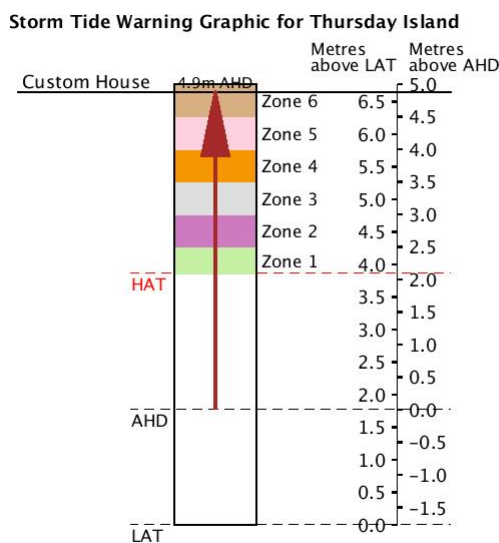


Figure 22. Custom House: 2 Victoria Parade, Thursday Island, Qld, 4875

A8.2 Hospital

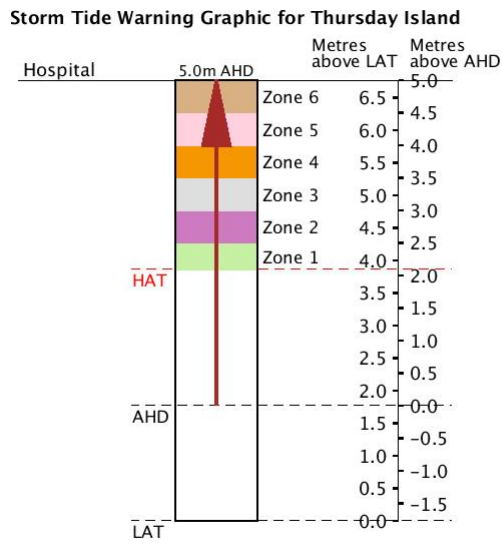


Figure 23. Hospital: 163 Douglas Street, Thursday Island, Qld, 4875

A8.3 Tagai State College

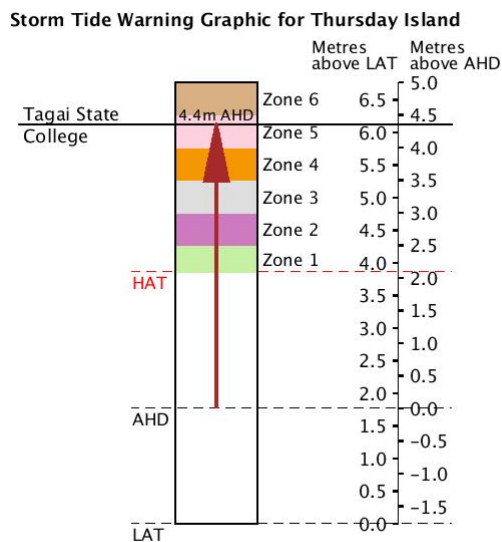


Figure 24. Tagai State College: Aplin Road, Thursday Island, Qld 4875

A9 Moa – Kubin

Kubin is a small community on Moa Island in the Torres Strait. The island is located next to Badu Island and is the larger of the two. The town is located on a headland with coastal wetland communities on either side. The landmarks selected show key pieces of infrastructure on the coast that fall within the storm tide risk zones.

A9.1 Airport Terminal

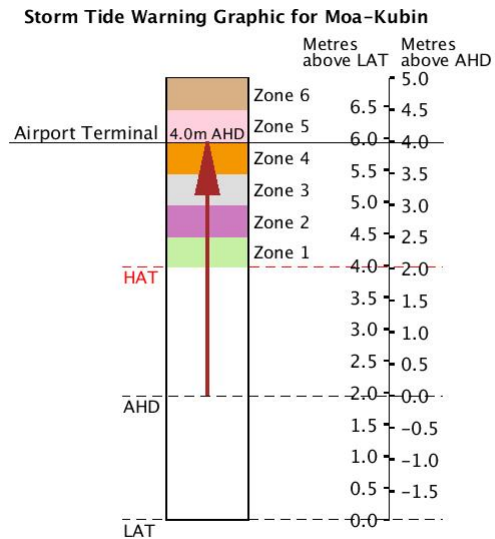


Figure 25. Airport Terminal: Wagalgau Yabu, Moa Island, Qld, 4875

A9.2 Jetty

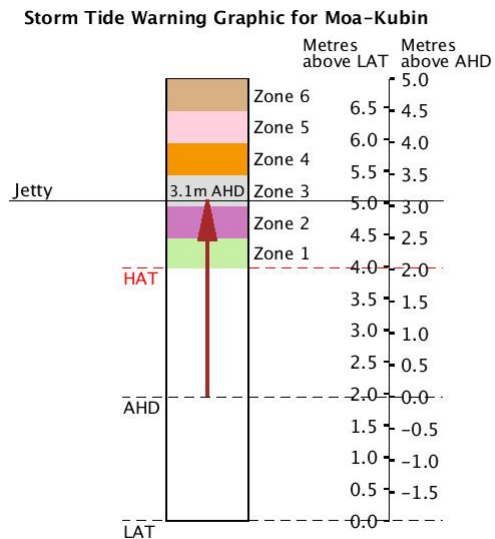


Figure 26. Jetty: Mualgau Yabu, Moa Island, Qld, 4875

A9.3 Motel

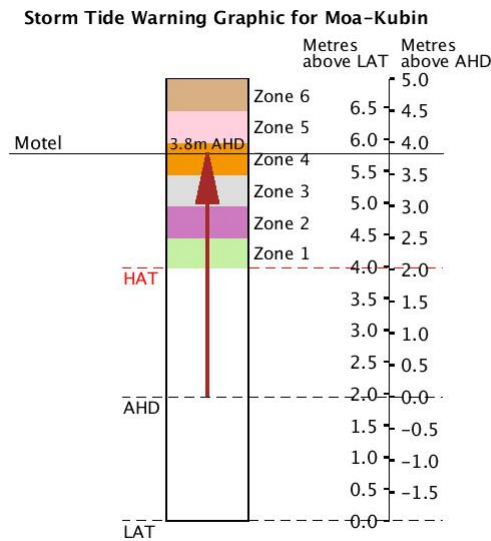


Figure 27. Motel: Wagalgau Yabu, Moa Island, Qld, 4875

A10 Moa – St Pauls

St Pauls is a small community on Moa Island in the Torres Strait to the north-east of Kubin connected via dirt and gravel roads. The town is located directly on the coast along an open beach fringed by coral reef ecosystems. Landmarks were selected to show the elevation along the foreshore.

A10.1 Boat Ramp

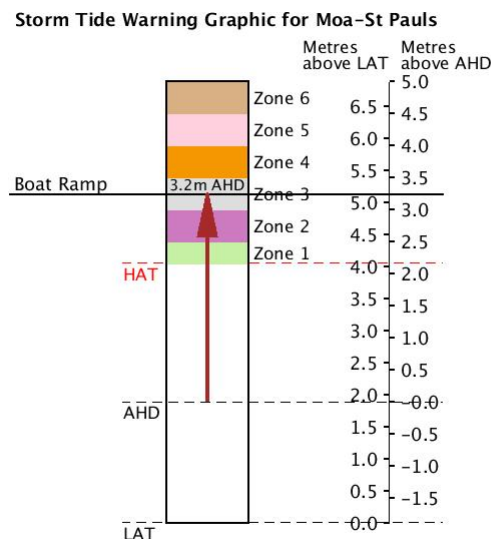


Figure 28. Boat Ramp: St Pauls, Moa Island, Qld, 4875

A10.2 Monument 1st Missionary

Storm Tide Warning Graphic for Moa–St Pauls

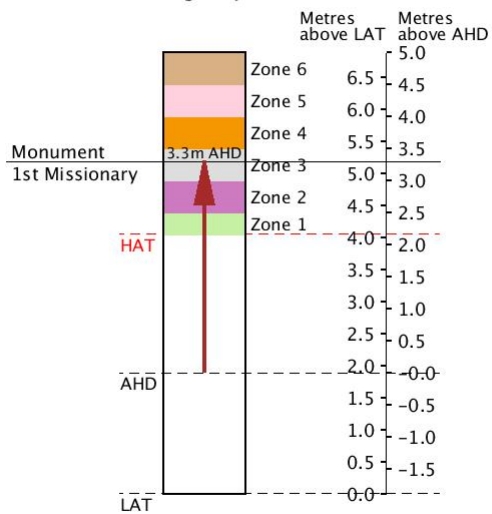


Figure 29. Monument 1st Missionary: St Pauls, Moa Island, Qld, 4875

A10.3 School Gate

Storm Tide Warning Graphic for Moa–St Pauls

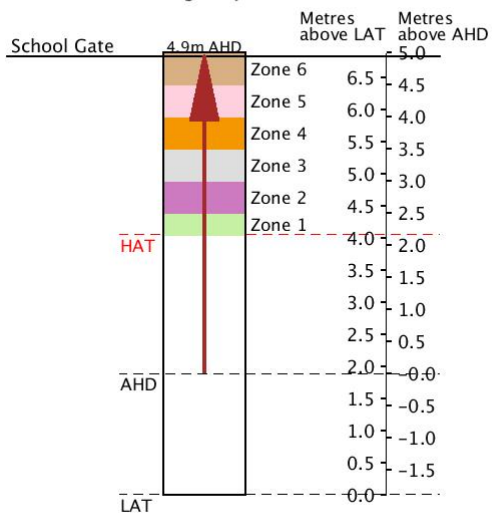


Figure 30. School Gate: St Pauls, Moa Island, Qld, 4875

A11 Boigu

Boigu is the northern most inhabited island in the Torres Strait. Formed by alluvial sediments the island is quite low lying. The community is located on the coast on the northern face of the island. The landmarks were selected to show key pieces of infrastructure in the town, particularly the airport as it would be crucial to any evacuation or supply efforts.

A11.1 Airstrip

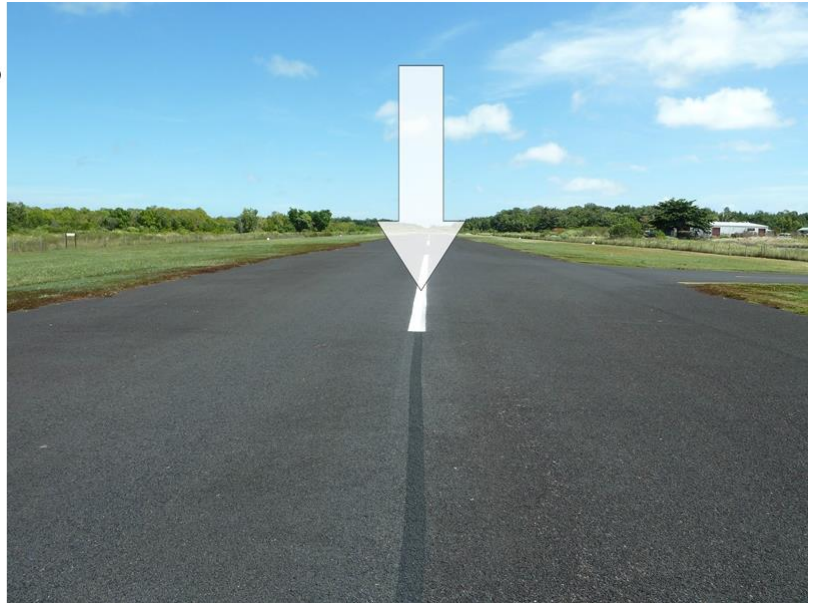
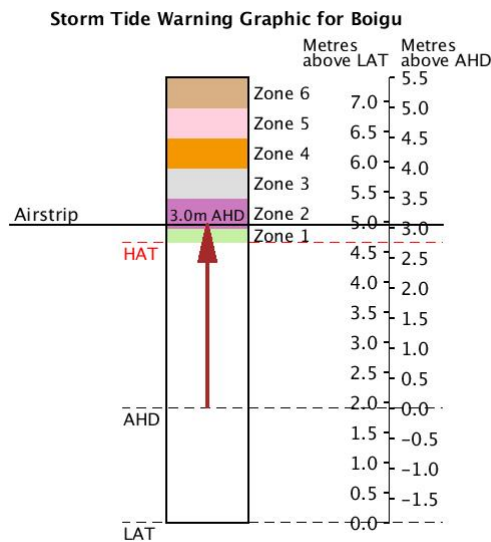


Figure 31. Airstrip: Boigu Island, Qld, 4875

A11.2 Church

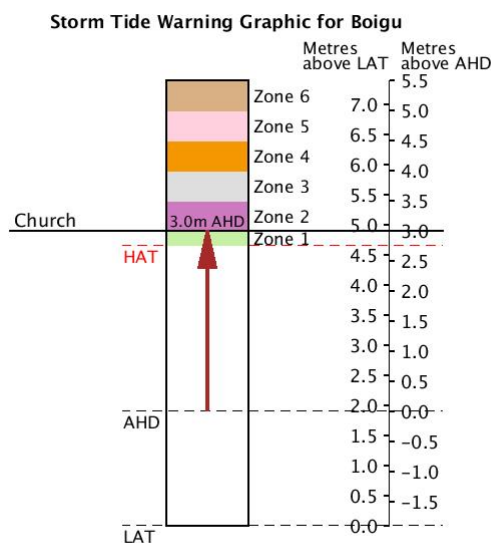


Figure 32. Church: Boigu Island, Qld, 4875

A11.3 Health Centre

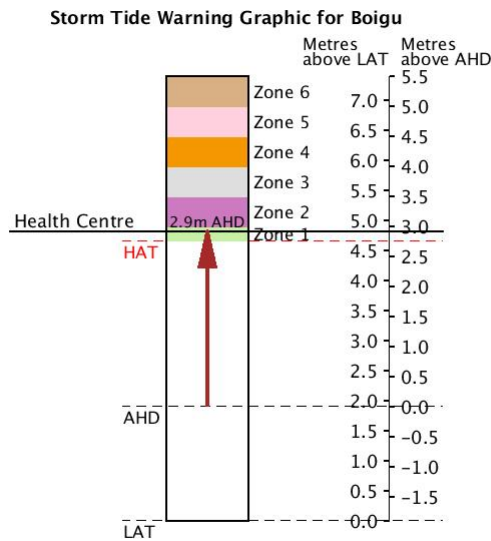


Figure 33. Health Centre: Boigu Island, Qld, 4875

A12 Dauan

Dauan Island is located within the northern reaches of the Torres Strait. The island is considered the most northerly part of the Great Dividing Range; therefore, the island has some steep rocky terrain. The township is situated on the northern side of the island with all the infrastructure along the coastline. Landmarks were selected to show key pieces of infrastructure, particularly the helipad as it is a key evacuation point for the town.

A12.1 Barge Ramp

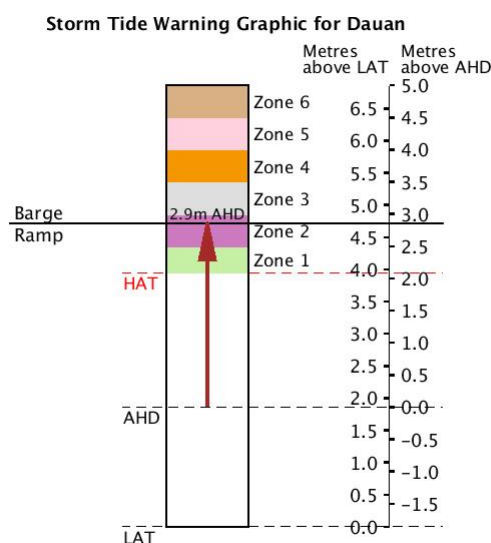


Figure 34. Barge Ramp: Dauan Island, Qld, 4875

A12.2 Fuel Pump

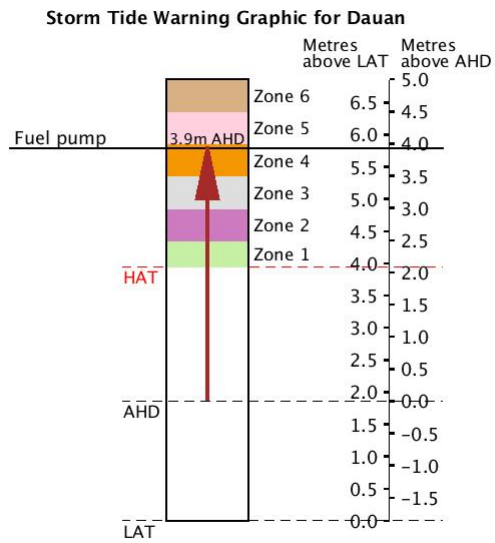


Figure 35. Fuel Pump: Dauan Island, Qld, 4875

A12.3 Helipad

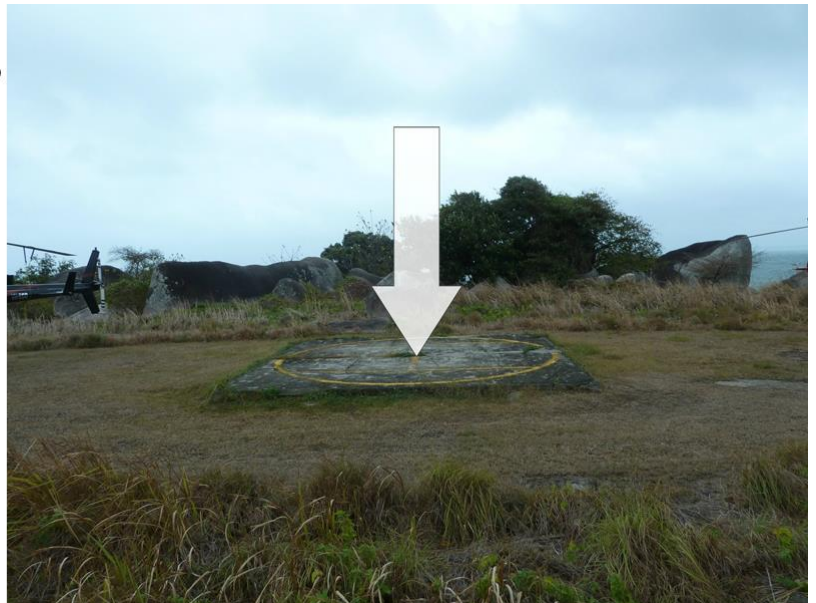
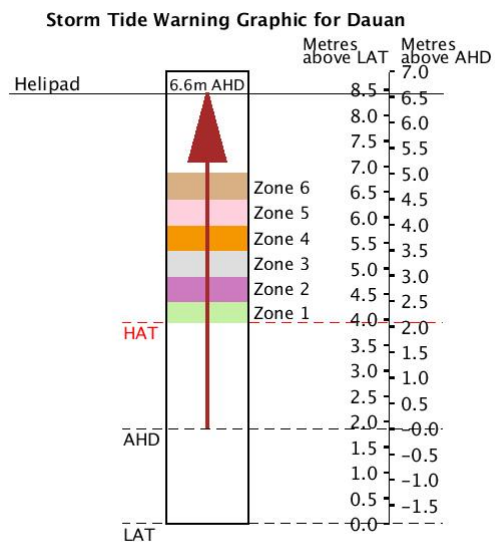


Figure 36. Helipad: Dauan Island, Qld, 4875

A13 Ugar

Ugar is a small island in the middle of the Torres Strait with limited access by boat or helicopter. The landmarks selected were on the northern coast of the island at the foreshore.

A13.1 Boat Ramp

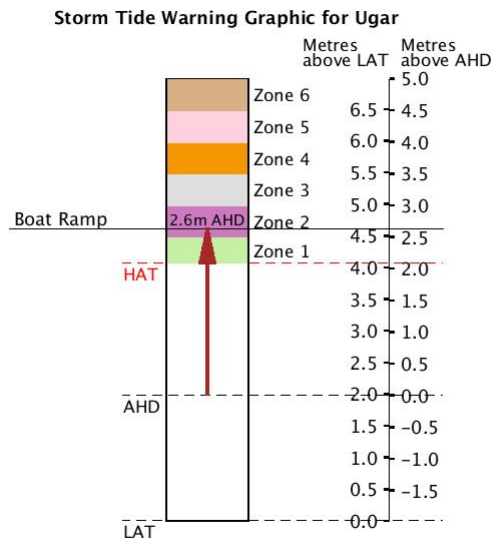


Figure 37. Boat Ramp: Ugar Island, Qld, 4805

A13.2 Church

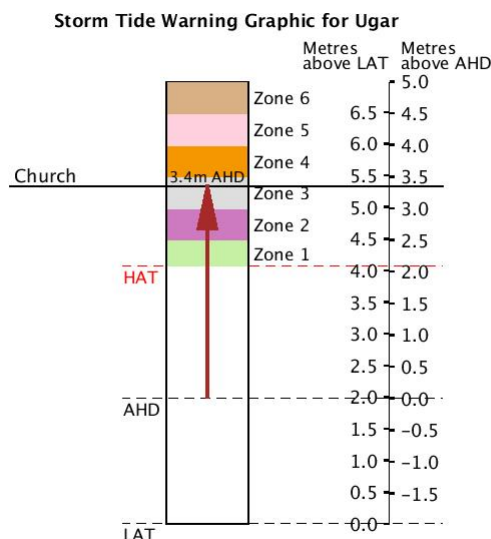
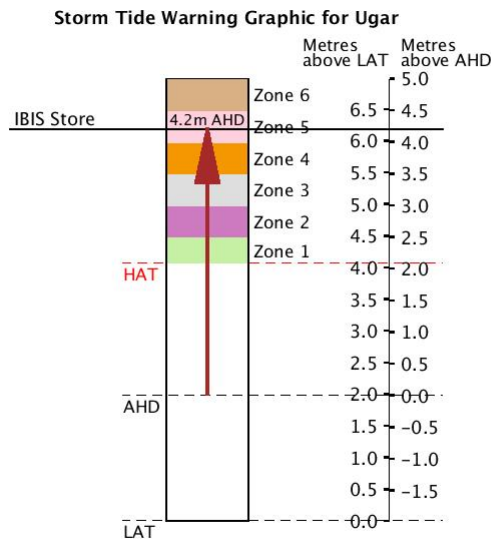


Figure 38. Church: Ugar Island, Qld, 4805

A13.3 IBIS Store



A14.2 Boat Ramp

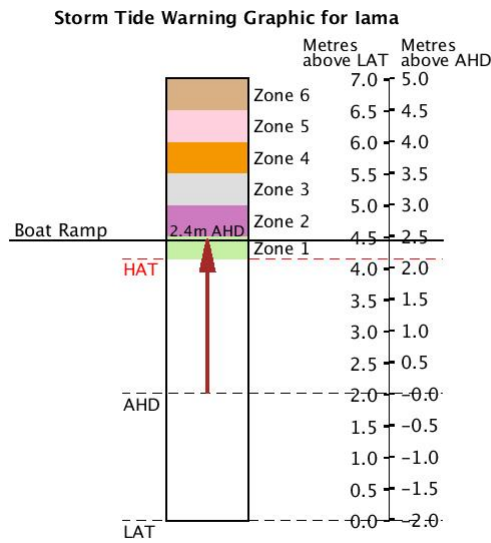


Figure 41. Boat Ramp: Corner of Mabuiag Point Road and Mosby Street, Iama Island, QLD, 4875

A14.3 Council Building

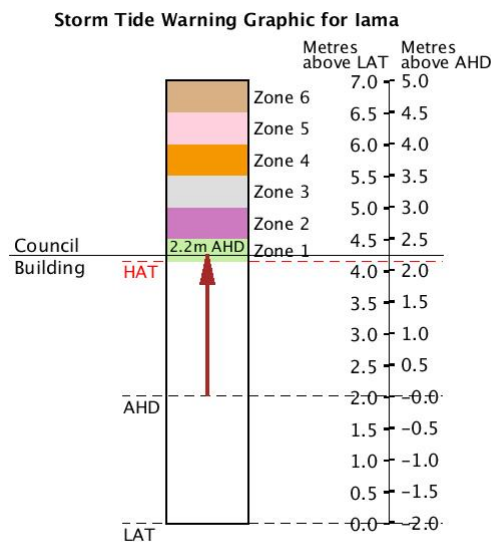


Figure 42. Council Building: Mosby Street, Iama Island, QLD, 4875

A15 Cooktown

Cooktown is located at the mouth of the Endeavour River on the east coast of Cape York Peninsula. Extensive wetland ecosystems exist on the banks of the river and the river also has a number of tributaries meandering into it. The town, itself, set back from the coast, is somewhat protected by a rocky headland to the east. However, we have focused our landmark selection on the section of the town that is directly on the bank of the Endeavour River.

A15.1 Boat Ramp

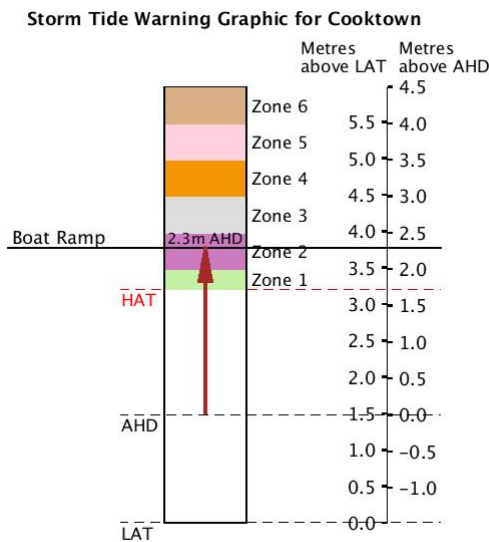


Figure 43. Boat Ramp: Charlotte Street, Cooktown, Qld, 4895

A15.2 Bowls Club

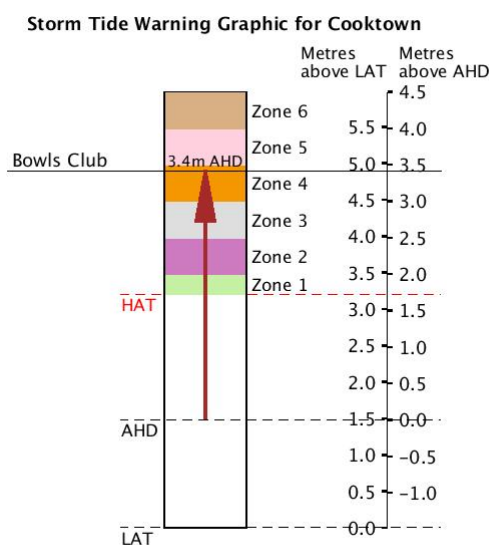


Figure 44. Bowls Club: 129 Charlotte Street, Cooktown, Qld, 4895

A15.3 Post Office Step

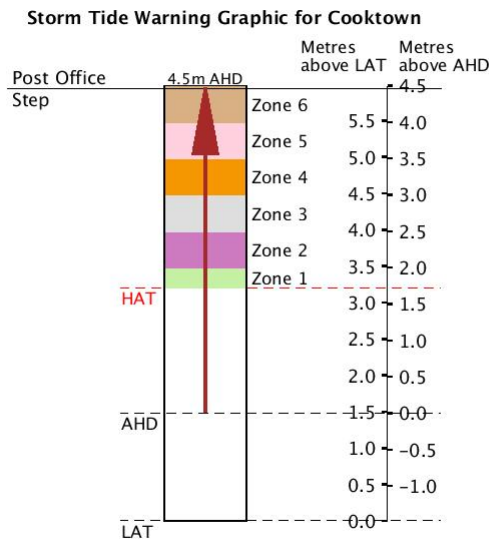


Figure 45. Australia Post: 123 Charlotte Street, Cooktown, Qld, 4895

A16 Lockhart River

Lockhart River is a small community located on the east coast of Cape York Peninsula. The town itself is set inland from the coast. There is some infrastructure located along the coast, and this is where the focus was placed for landmark selections in addition to the one within Lockhart River town.

A16.1 Jetty

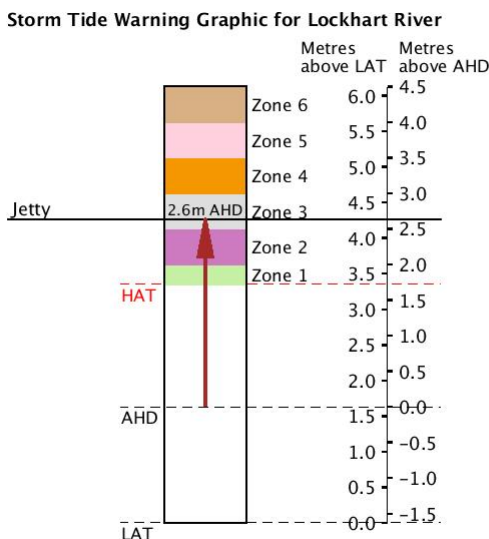


Figure 46. Jetty: Esplanade, Lockhart River, Qld, 4892

A16.2 Esplanade

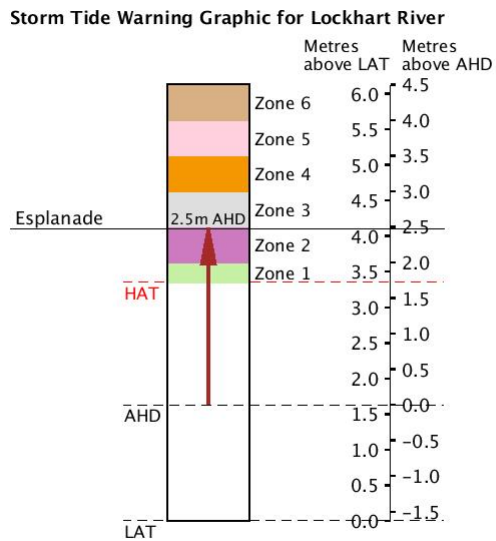


Figure 47. Esplanade: Lockhart River, Qld, 4892

A16.3 Public Boat Ramp

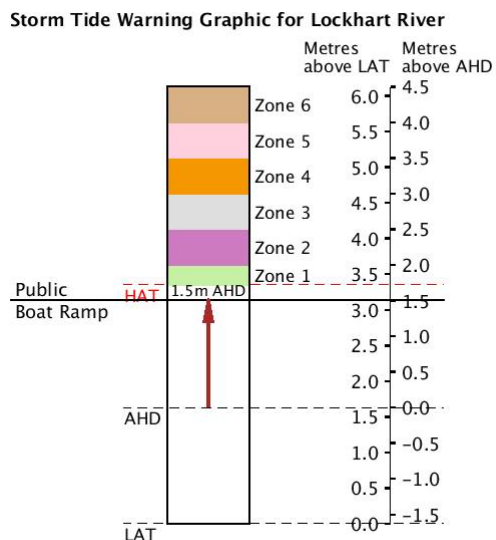


Figure 48. Public Boat Ramp: Lockhart River, Qld, 4892

A17 Bloomfield

Bloomfield is located on the north side of the Bloomfield River on the east coast of Cape York Peninsula. The main section of town, separated by coastal wetlands, is set back from the coast. There is a street directly along the coastline, at which a landmark was selected. The smaller community of Wujal Wujal, also included, is located further upstream.

A17.1 Wharf Shed

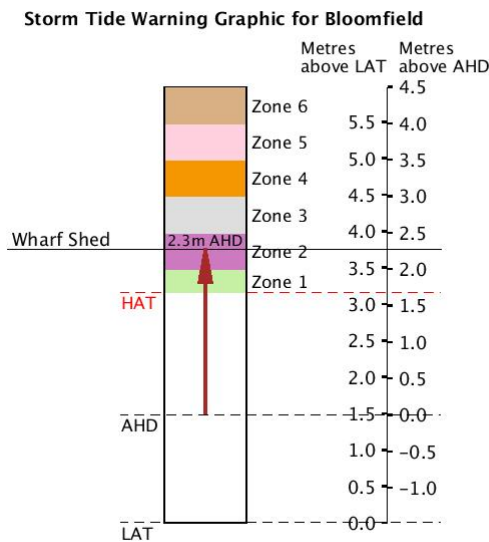


Figure 49. Wharf Shed: 31 Norman Street, Bloomfield, Qld, 4895

A17.2 Corner of Esplanade and Weary Bay Road

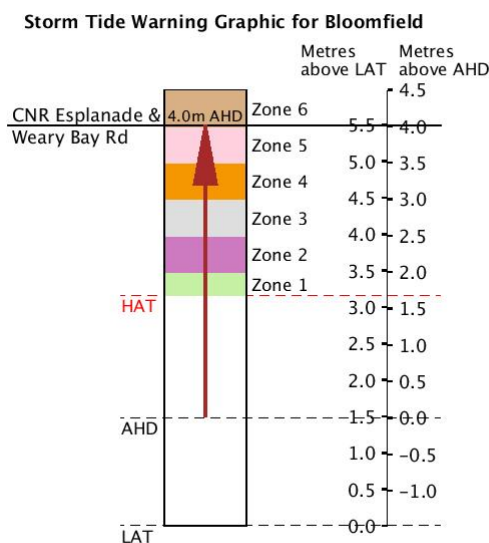


Figure 50. Intersection of Esplanade and Weary Bay Road, Bloomfield, Qld, 4895

A17.3 Douglas Street Floodway, Wujal Wujal

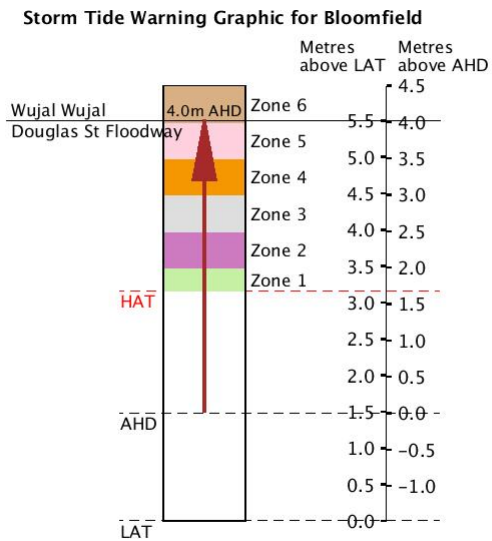


Figure 51. Douglas Street Floodway, Wujal Wujal, Qld, 4895

A18 Lizard Island

Lizard Island is a granite island located in the Great Barrier Reef of northern Queensland. The island is encircled by well-developed fringing reefs and is home to a luxury tourist resort and research facility. Landmarks were selected to display both areas of the island. Due to there being no valid PSMs available on the Island to base the survey upon, an AUSPOS was performed over PSM105606 (no elevation level).

A18.1 The Beach Club

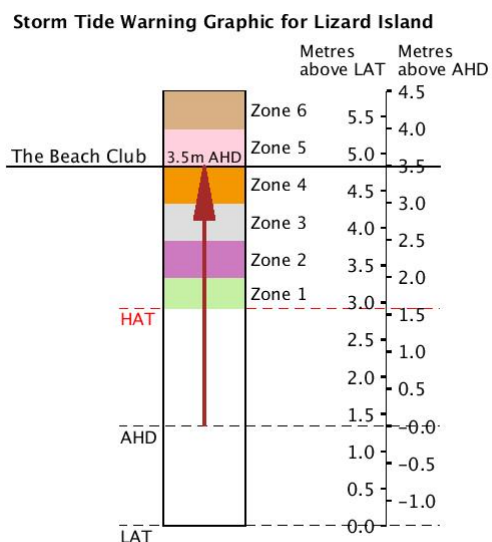


Figure 52. The Beach Club: Lizard Island Resort, Lizard Island, Qld, 4892

A18.2 Research Station Aquarium

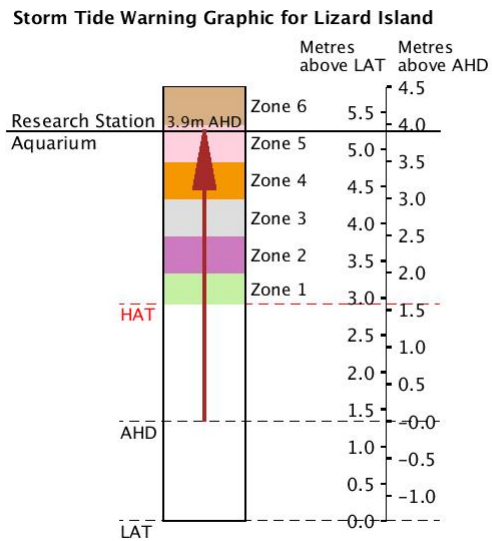


Figure 53. Research Station Aquarium: Lizard Island, Qld, 4892

A18.3 Marlin Bar

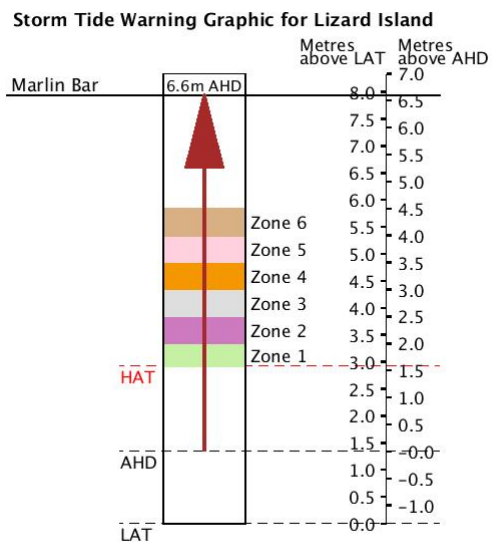


Figure 54. Marlin Bar: Lizard Island Resort, Lizard Island, Qld, 4892

A19 Douglas Shire Council

In 2021, Douglas Shire Council, commissioned Department of Environment and Science for additional landmarks to be included for the locales of Wonga Beach, Newell Beach and Cooya Beach, all referenced to a new storm tide gauge at Mossman. Douglas shire council is located on the east coast of northern Queensland bordering the Great Barrier Reef marine park.

Wonga, Mossman STG

The town of Wonga is situated on the beach backed closely, for the most part, by the elevated terrain of the Daintree National Park.

A19.1 Giblin Bridge

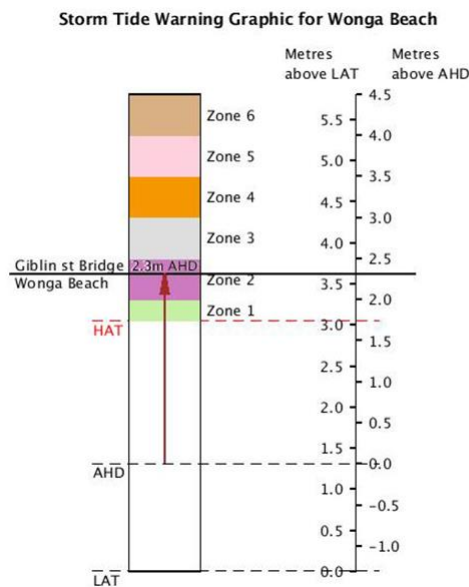


Figure 55. Giblin St Bridge, Wonga Beach, Qld, 4873

A19.2 Bells Park

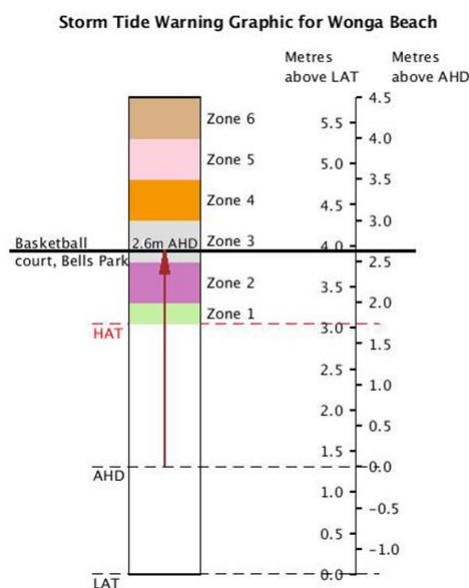


Figure 56. Bells Park, Wonga Beach, Qld, 4873

A19.3 Corner of Oleander and Marlin

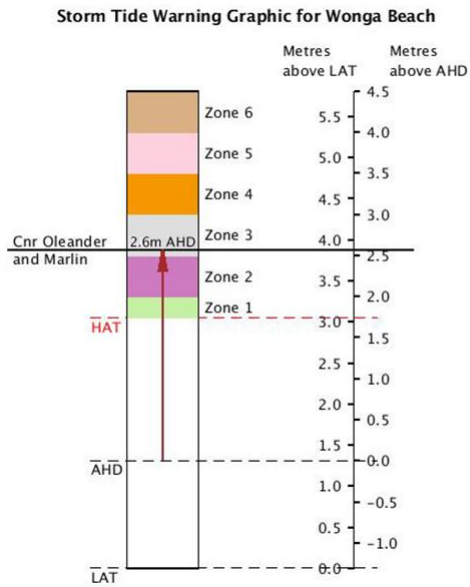


Figure 57. Corner of Oleander Dr and Marlin Dr, Wonga Beach, Qld, 4873

A19.4 QFES bus Stop

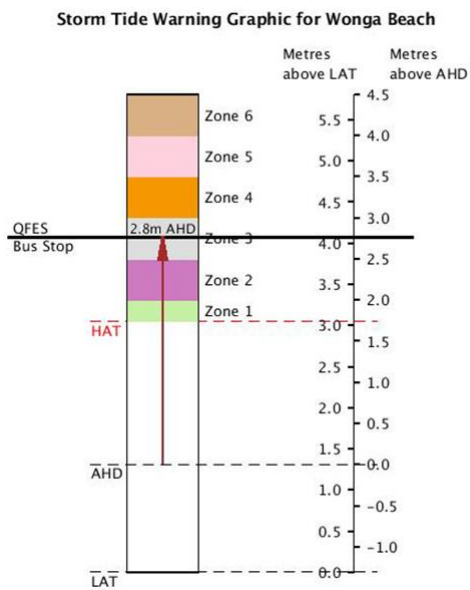


Figure 58. Bus Stop at Qld Fire and Emergency Services, Oleander Dr, Wonga Beach, Qld, 4873

A19.5 Skate Park Toilet block

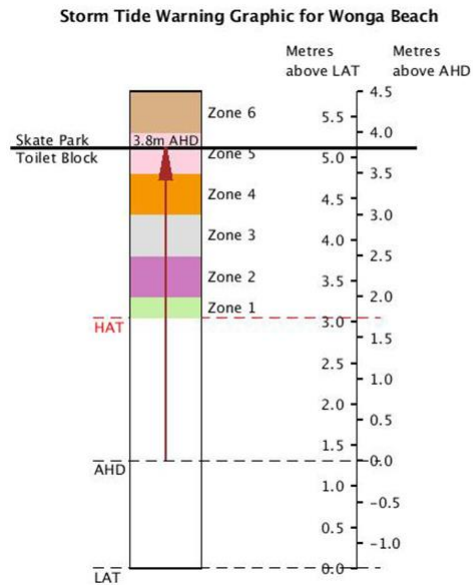


Figure 59. Toilet Block at the Skate Park, Wonga Beach, Qld, 4873

Newell, Mossman STG

Newell is a town situated along the beach in a narrow band, capped to the North by wetlands and Salt Water Creek and South by wetlands and the Mossman River.

A19.6 Corner Lematy and Coulthard

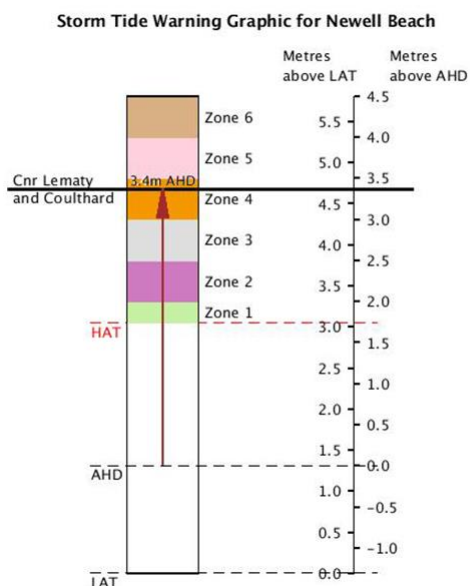


Figure 60. Corner of Lematy St and Coulthard Cl, Newell Beach, Qld, 4873

A19.7 Corner Lematy and Andrews

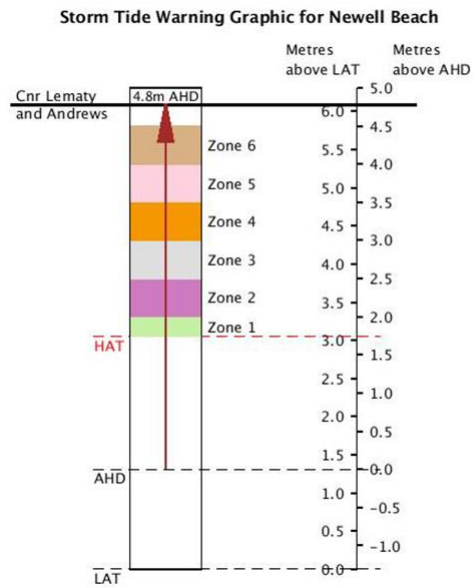


Figure 61. Corner Lematy St and Andrews St, Newell Beach, Qld, 4873

A19.8 Newell Beach Shop

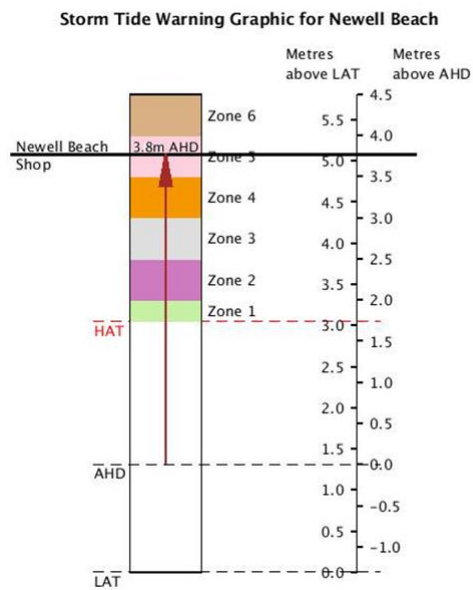


Figure 62. Takeaway shop, Marine Parade, Newell Beach, Qld, 4873

A19.9 Marine Parade Toilet Block

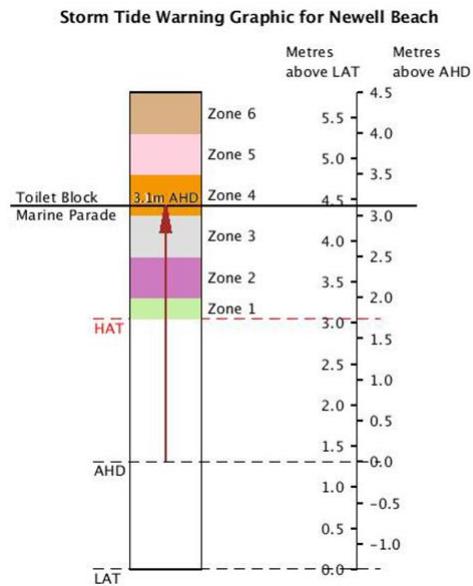


Figure 63. Marine Parade Toilet Block, Newell Beach, Qld, 4873

A19.10 Corner Newell and Rankin

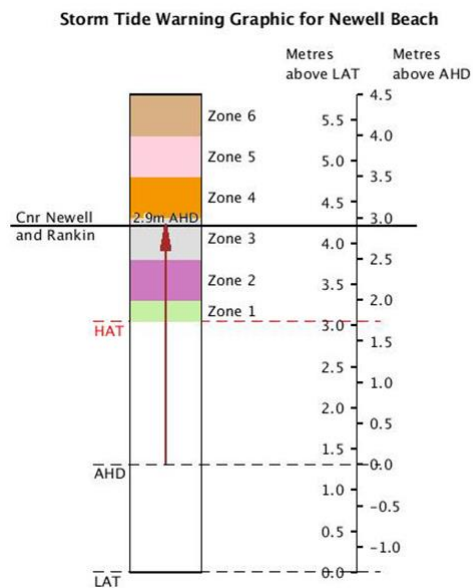


Figure 64. Corner of Newell Rd and Rankin St, Newell Beach, Qld, 4873

A19.11 Boat Ramp Fishing Club

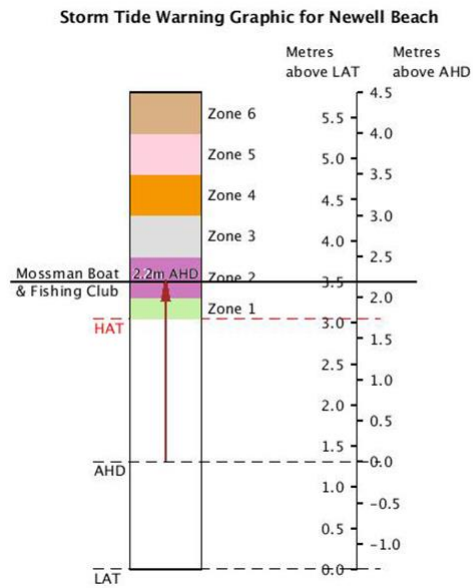


Figure 65. Mossman Boat & Fishing Club, Club House, Newell Beach, Qld, 4873

Cooya Beach, Mossman STG

The main part of Cooya Beach is situated along the east coast and is backed largely by the Mossman River and wetlands to the North and Northwest.

A19.12 Boat Ramp Toilet Block

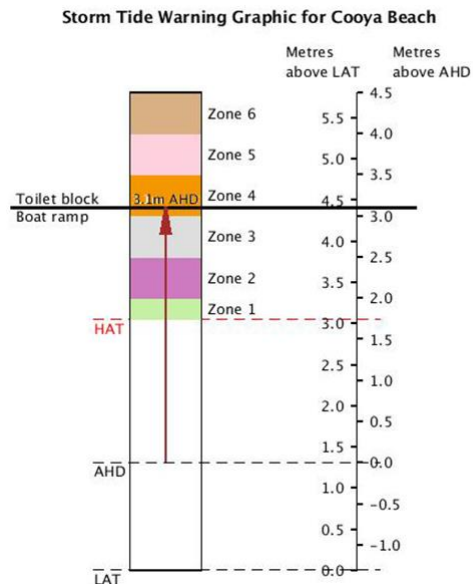


Figure 66. Toilet block near Boat Ramp, Cooya Beach, Qld, 4873

A19.13 Playground Opposite 13 Bougainvillea st

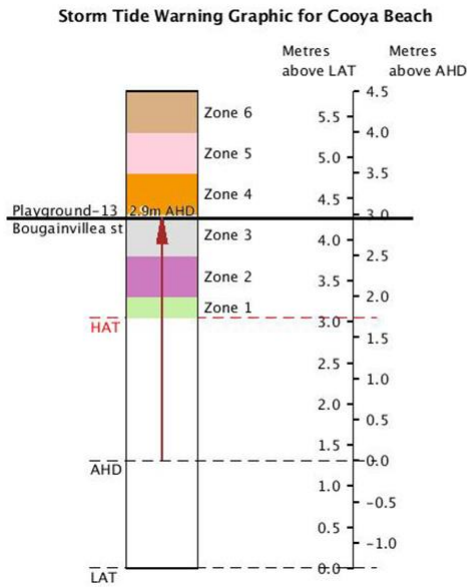


Figure 67. Playground opposite 13 Bougainvillea St, Cooya Beach, Qld, 4873

A19.14 Playground Opposite 115 Bougainvillea st

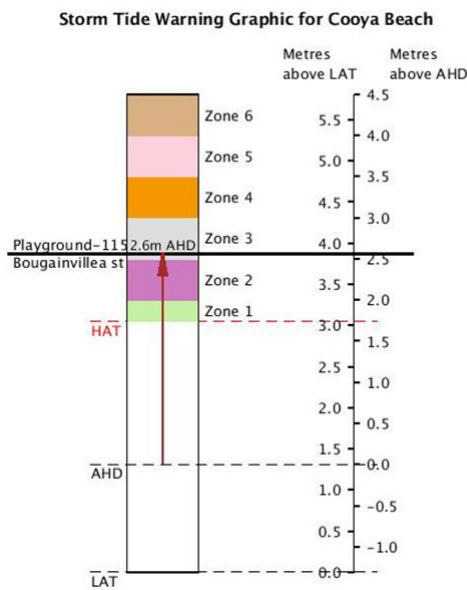


Figure 68. Playground opposite 115 Bougainvillea St, Cooya Beach, Qld, 4873

Port Douglas, Port Douglas STG

The main section of the town of Port Douglas, is situated along the open beach face. There are some substantial wetlands regions backing the town. The landmarks selected show the elevations at the marina and headland areas, as well as a point along the beachfront. Port Douglas has its own STG.

A19.15 Reef Marina

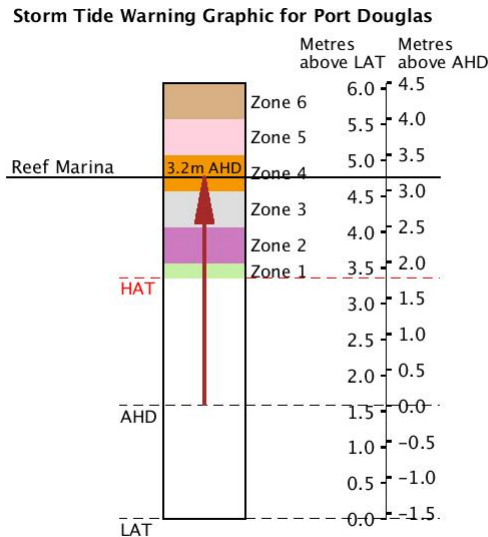


Figure 69. Reef Marina: Inlet Street, Port Douglas, Qld, 4877

A19.16 Four Mile Beach Toilets

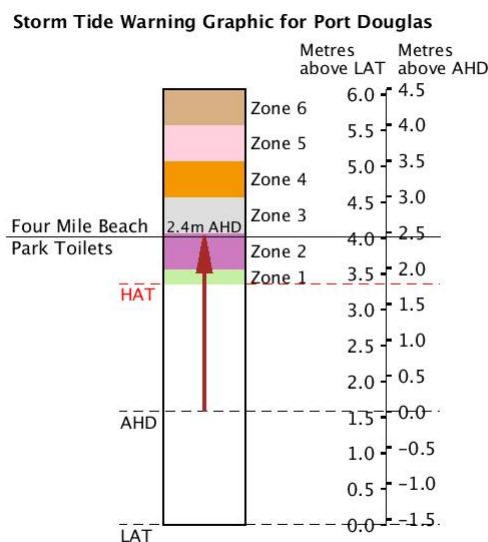


Figure 70. Four Mile Beach toilet block: 22 Reef Street, Port Douglas, Qld, 4877

A19.17 St Mary's by the sea

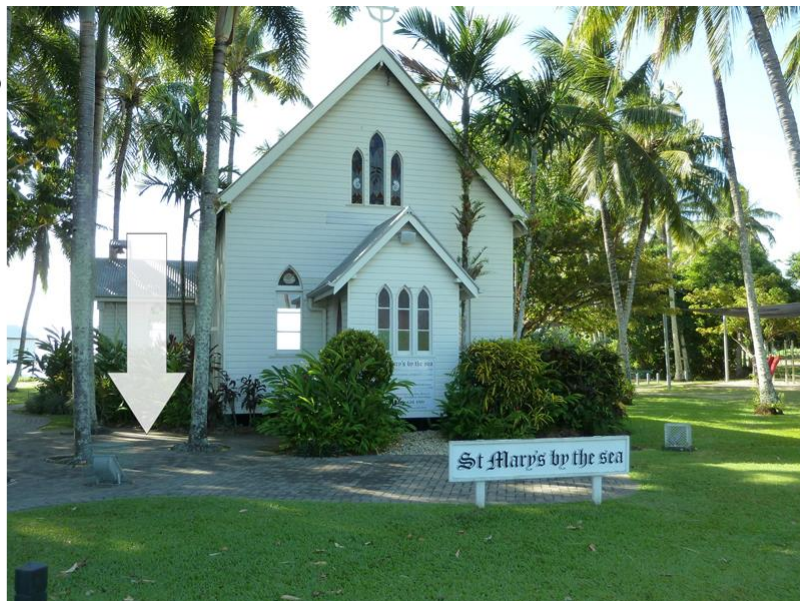
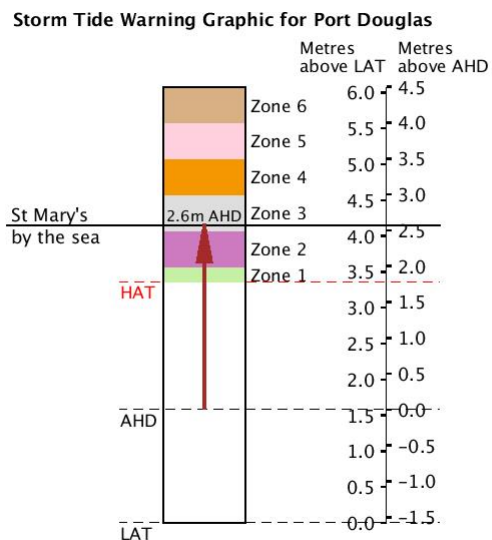


Figure 71. St Mary's: Dixie st, Port Douglas, QLD, 4877

A20 Palm Cove

Palm Cove is a small coastal town just north of Cairns. The town is mostly flat along the foreshore, while the headland to the north and mountains to the west have greater elevations. Landmarks were selected along the foreshore as this is the main area at risk from storm tide inundation.

A20.1 Jetty

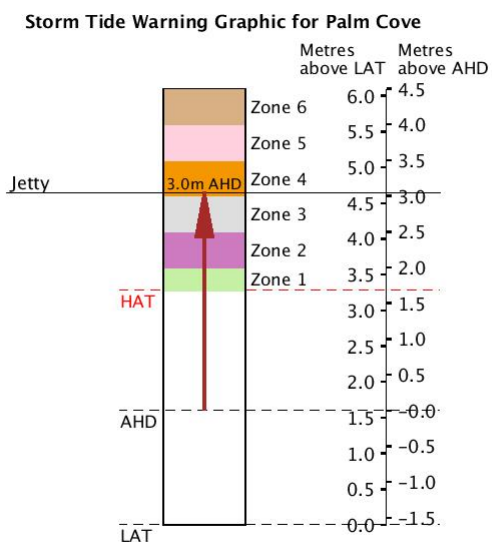


Figure 72. Public Jetty: Williams Esplanade, Palm Cove, Qld, 4879

A20.2 Public Toilets

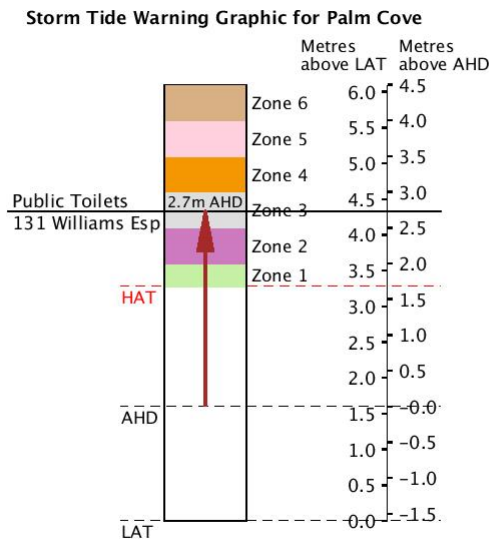


Figure 73. Public Toilets: 131 Williams Esplanade, Palm Cove, Qld, 4879

A21 Cairns Harbour

Cairns is a city on the coast of far north Queensland and is a major hub for the region and a popular tourist destination. The main section of the city is located within a bay at the inlet of Chinaman Creek. The Cairns City Council has its own storm tide advice system in place, and, as such, efforts have been made to align the landmarks selected by this project with the existing works for the region.

A21.1 Lagoon Pathway

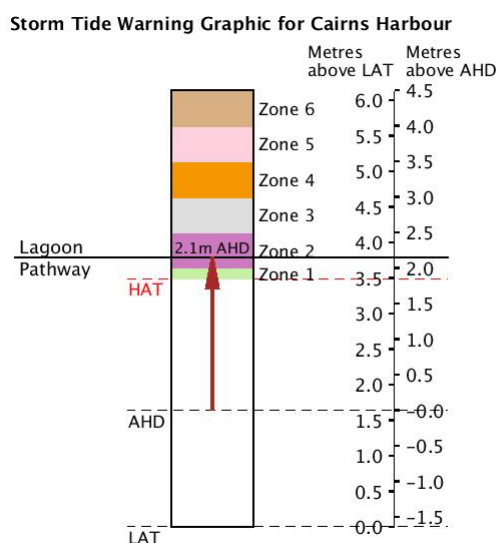


Figure 74. Lagoon pathway: 52/54 Esplanade, Cairns City Qld, 4870

A21.2 Promenade

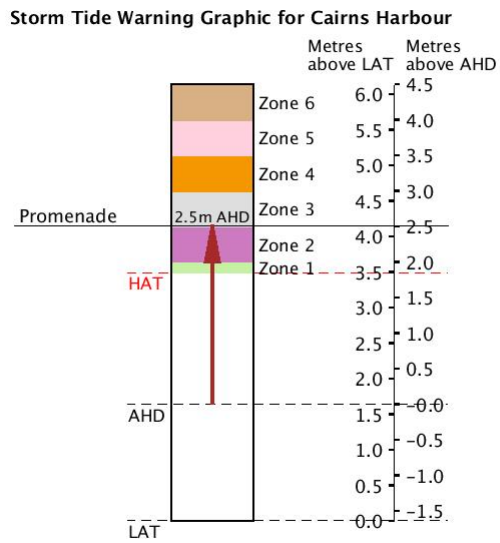


Figure 75. Promenade: Esplanade, Cairns North Qld 4870

A21.3 Airport Runway, South

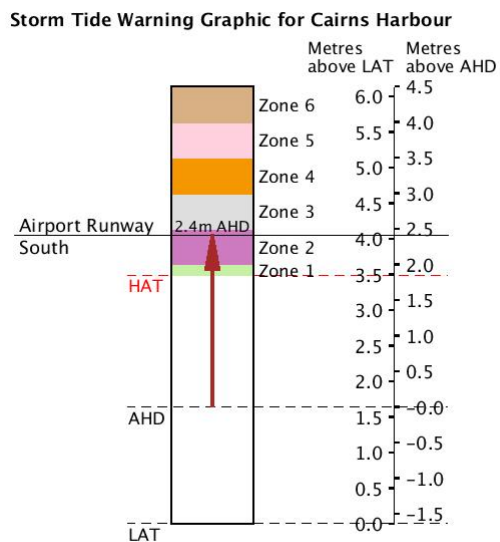


Figure 76. Airport runway, Southern end: Airport Ave, Cairns City, Qld 4870

A22 Green Island

Green Island is a coral cay located off the coast of Cairns in northern Queensland. There is a luxury resort on the island and it is part of its own protected marine park. The landmarks selected display key pieces of infrastructure located around the edge of the island.

A22.1 Helipad

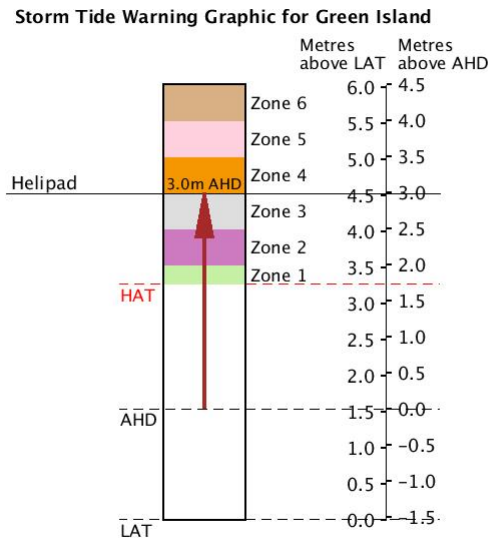


Figure 77. Helipad: Green Island, Qld, 4871

A22.2 Jetty

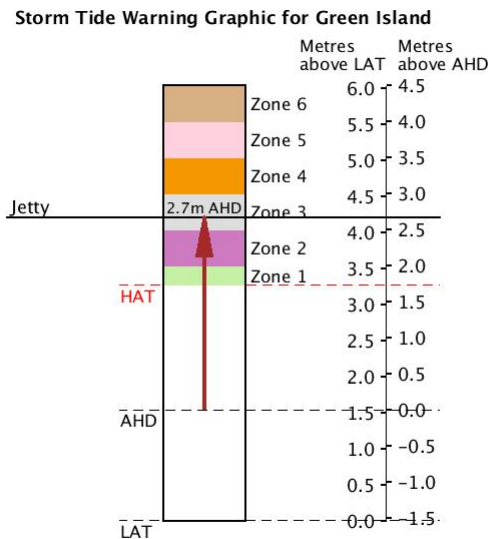


Figure 78. Jetty: Green Island, Qld, 4871

A22.3 Seawall

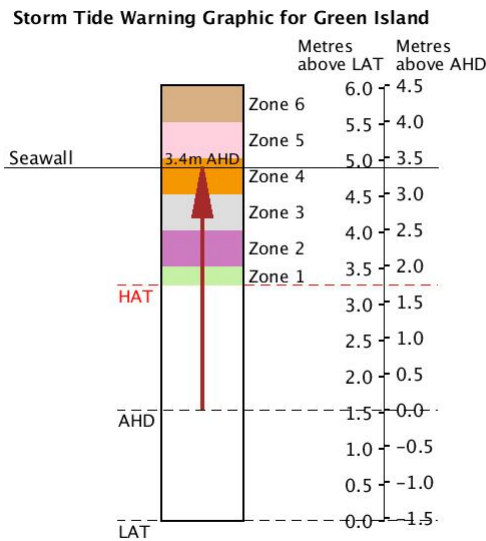


Figure 79. Seawall: Green Island, Qld, 4871

A23 Yarrabah

Yarrabah is a small community located to the east of Cairns in northern Queensland. The township is situated directly on the coast within a bay. The landmarks selected are spread along the length of the town in hopes to give an adequate representation of the elevation.

A23.1 Church

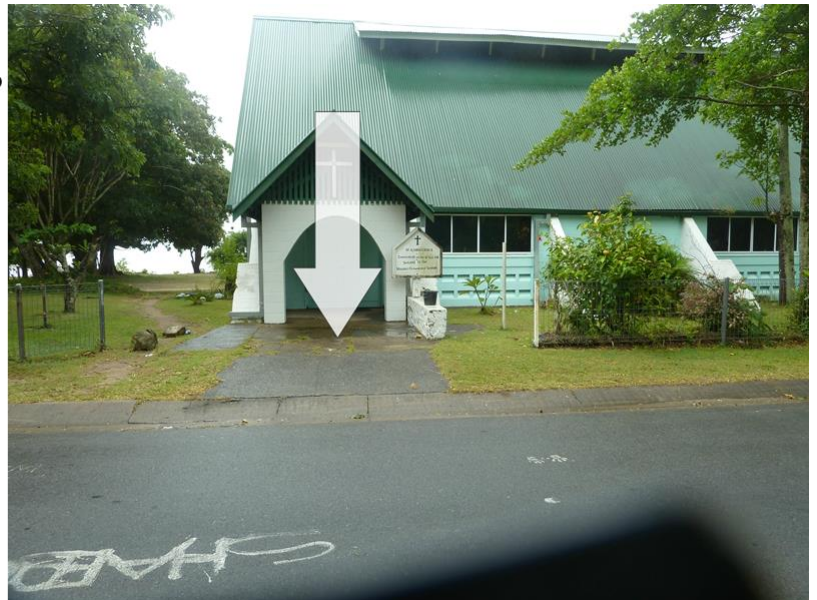
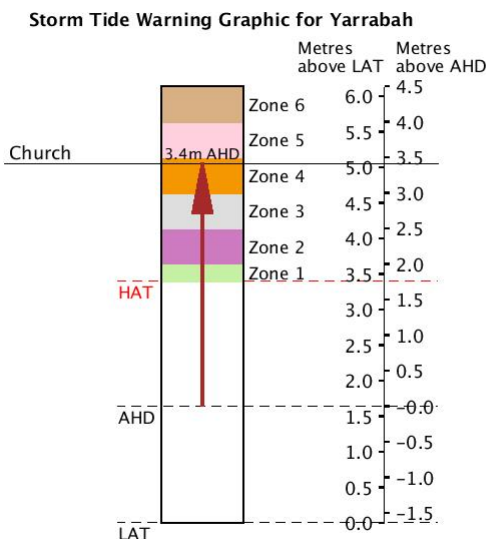


Figure 80. Church: 1 Gribble Street, Yarrabah, Qld, 4871

A23.2 Community Centre

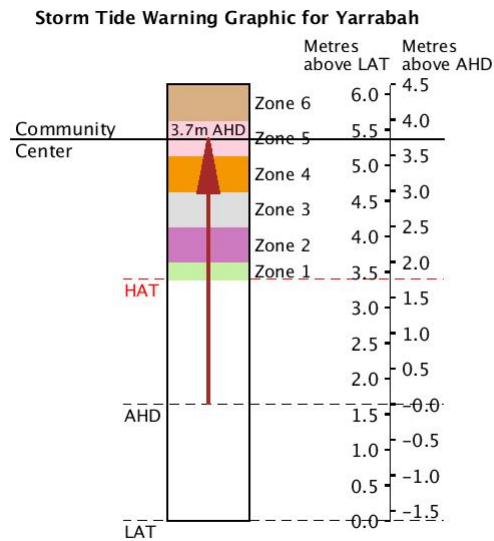


Figure 81. Community Centre: Beach Street, Yarrabah, Qld, 4871

A23.3 Monument J.B. Gribble

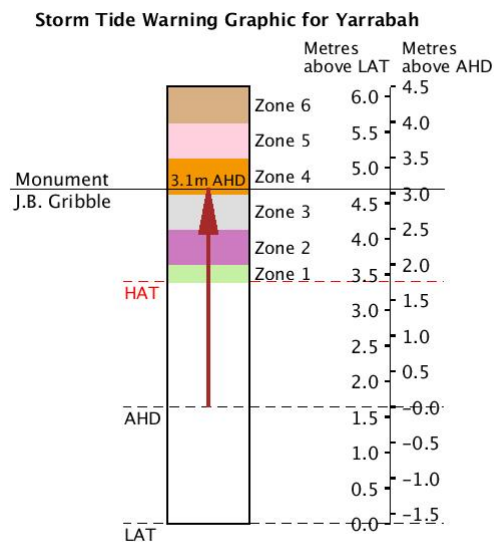


Figure 82. J.B. Gribble Monument: Point Road, Yarrabah, Qld, 4871

A24 Flying Fish Point

Flying Fish Point is a small town located on the coast north east of Innisfail in northern Queensland. The eastern coastline at the town has been reinforced with a rock wall to prevent significant dune erosion. The town itself is mostly flat, with some large hills and dense rainforest on the western side. The landmark selected at the tourist park is mostly representative of the streets along the front of the coast directly behind the rock wall.

A24.1 Public Boat Ramp

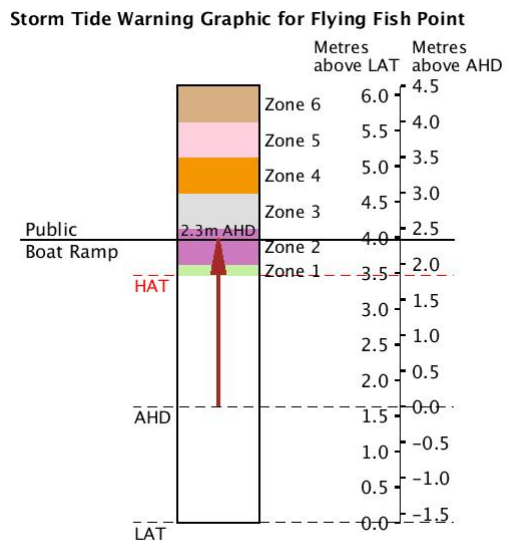


Figure 83. Public Boat Ramp: Esplanade, Flying Fish Point, Qld, 4860

A24.2 Coconuts Boat Ramp

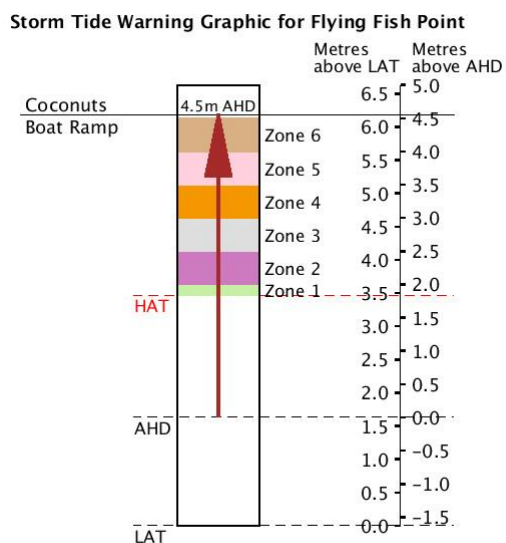


Figure 84. Boat Ramp: 2 the Esplanade, Coconuts, Qld, 4860

A24.3 Tourist Park

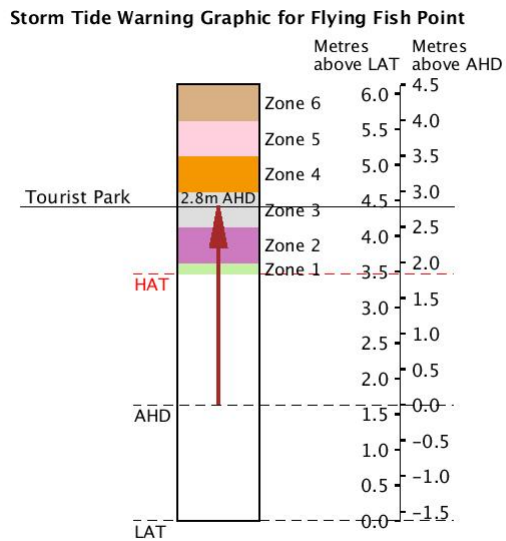


Figure 85. Tourist Park: Edwards Street, Flying Fish Point, Qld, 4860

A25 Clump Point

Clump Point is a locality of the Mission Beach Township in northern Queensland. Clump Point itself is on a rocky outcrop where the primary infrastructure is a boat ramp. The efforts for the survey were focused on the surrounding community along the coast. The area has sandy beaches separated by tall rocky headlands. The landmark selected at Bingil Bay was included so to show the level required to cut off the road along the coast.

A25.1 Public Jetty

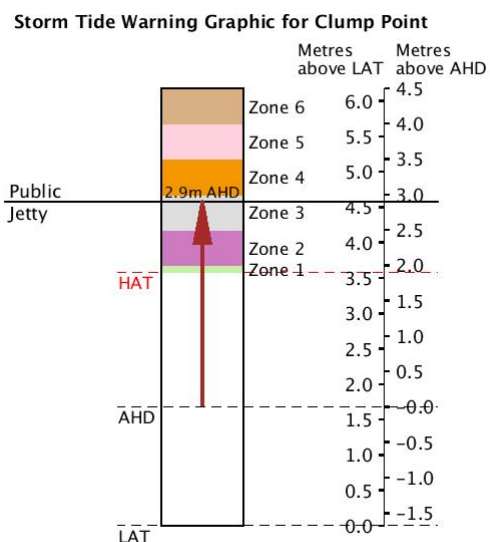


Figure 86. Public Jetty: Alexander Drive, Mission Beach, Qld, 4852

A25.2 Shrubbery Tavern

Storm Tide Warning Graphic for Clump Point

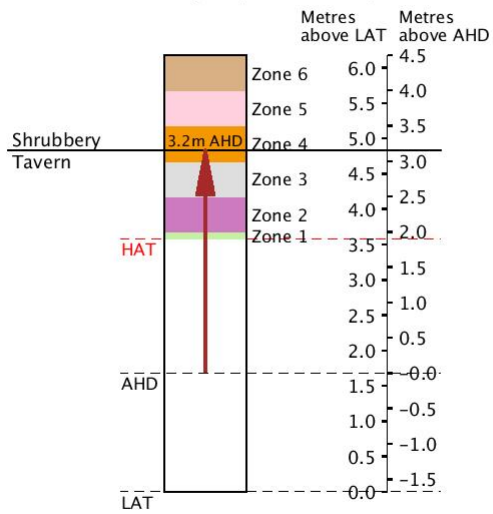


Figure 87. Shrubbery Tavern: 44 Marine Parade, Mission Beach, Qld, 4852

A25.3 Bingil Bay Carpark

Storm Tide Warning Graphic for Clump Point

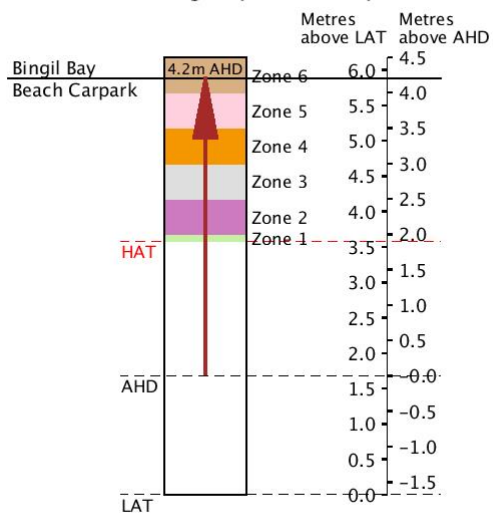


Figure 88. Bingil Bay Beach carpark: Corner of Cutten street and Alexander Drive, Bingil Bay, Qld, 4852

A26 Cardwell

Cardwell is located on the mainland adjacent the northern tip of Hinchinbrook Island. This stretch of coast is primarily coastal floodplains with a mountain range to the West of the settlement (Rogencamp, Huxley, & Teakle, 2008). The town itself is located directly on the coast and is quite flat. The landmarks selected show the levels in the harbour (coast guard tower) as well as the levels seen along the foreshore.

A26.1 Coast Guard Tower

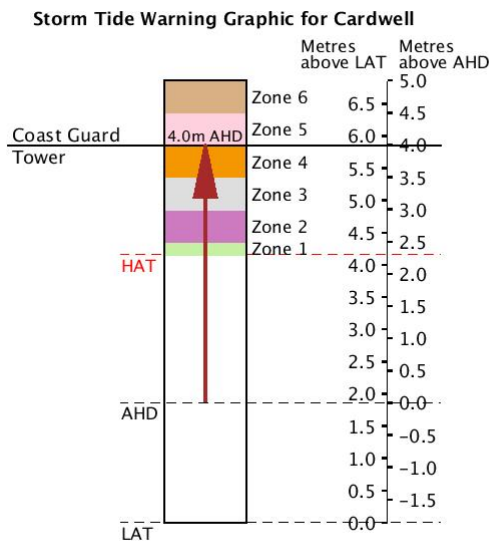


Figure 89. Coast guard tower: Foxtail Avenue, Cardwell, Qld, 4849

A26.2 Public Boat Ramp

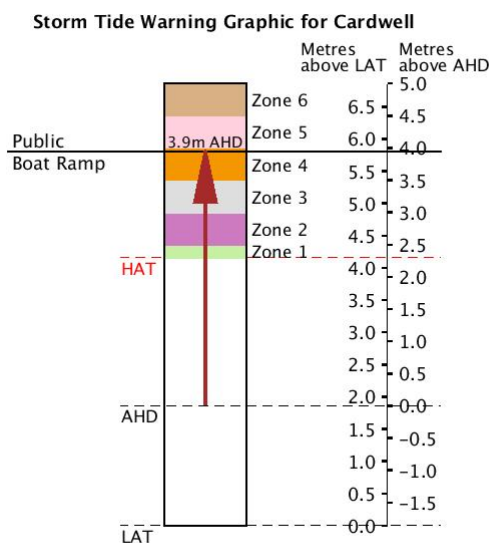


Figure 90. Boat Ramp: Marine Parade, Cardwell, Qld, 4849

A26.3 Public Jetty

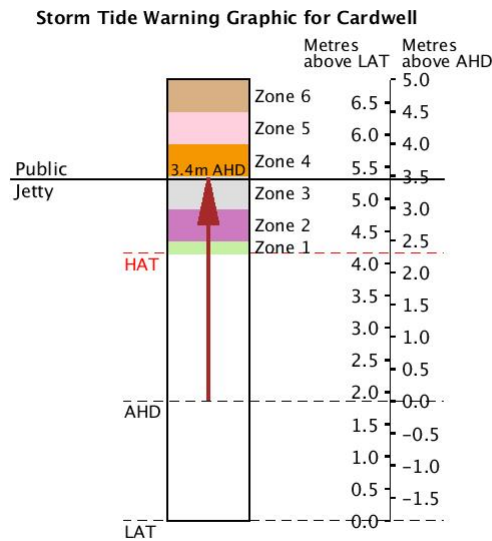


Figure 91. Public Jetty: Victoria Street, Cardwell, Qld, 4849

A27 Lucinda

Lucinda has the largest bulk sugar loading facility in the world, with a 6 km long jetty extending out into deeper waters. It is located at the southern end of the Hinchinbrook channel and the coastline around the town is primarily comprised of open coast beaches, with a number of rock groynes extending south down the eastern beach. The town is mostly flat in elevation with the majority of the town located below 1.5m HAT. It should be noted that the Borello Park Monument landmark is at a higher elevation to the land further back from the coastline.

A27.1 Public Jetty

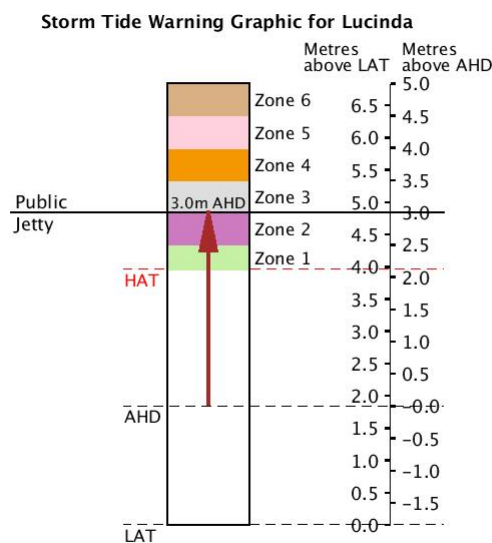


Figure 92. Public Jetty: Lucinda Terminal, Lucinda, Qld, 4850

A27.2 Public boat ramp

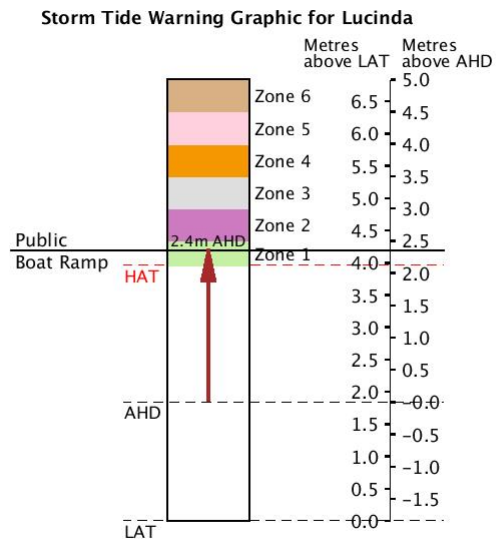


Figure 93. Public boat ramp: Dungeness Road, Lucinda, Qld, 4850

A27.3 Borello Park Monument

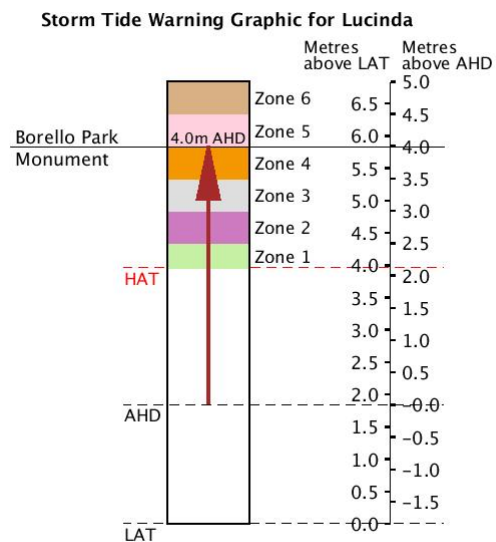


Figure 94. Borello park monument: Rigby Street, Lucinda, Qld, 4850

A28 Palm Island

Palm Island is located on the Great Barrier Reef in northern Queensland and is part of the Greater Palm group. The main community is located on the western side of the island. A seawall has been erected along the foreshore, building up the community from the beach face. The wall covers the main section of town, continuing south past the main jetty with a rock wall installation. The landscape of the town slopes upwards in elevation towards the large mountains in the middle of the island.

A28.1 Public boat ramp

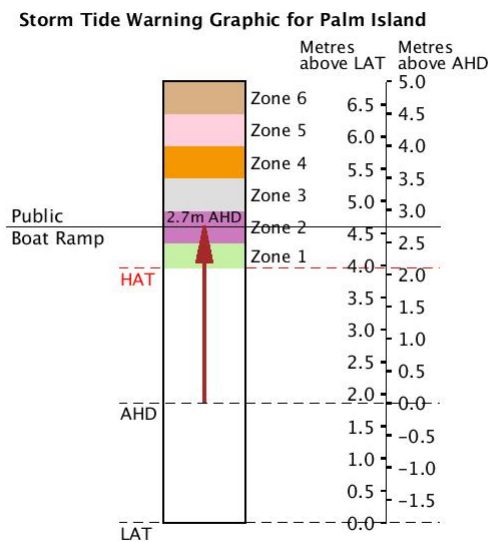


Figure 95. Public boat ramp: Esplanade, Palm Island, Qld, 4816

A28.2 Coolgaree Bay Hotel

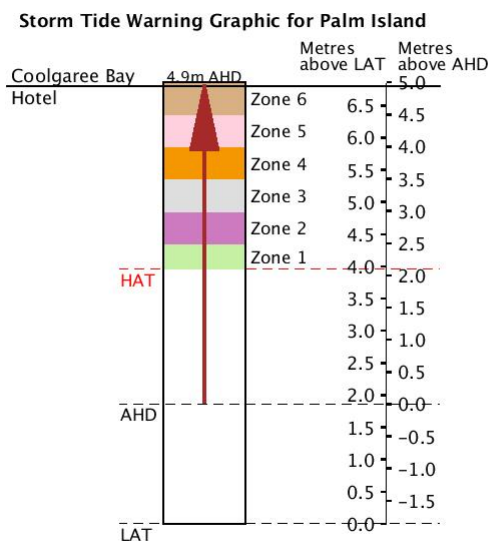


Figure 96. Coolgaree Bay Hotel: Beach Road, Palm Island, Qld, 4816

A28.3 Helipad

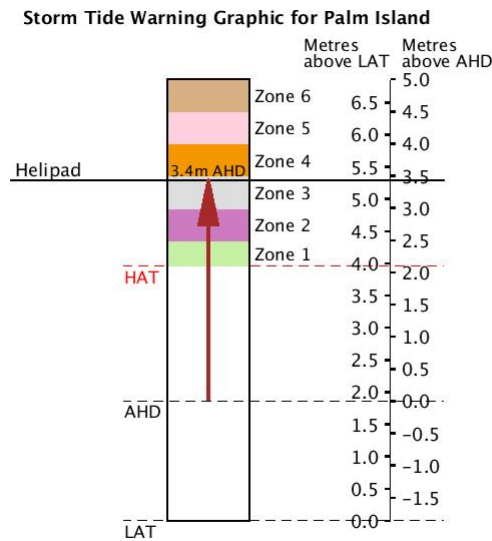


Figure 97. Helipad: Beach Road, Palm Island, 4816

A29 Townsville

Townsville is a major city on the coast in northern Queensland in line with the central Great Barrier Reef. The region has a high occurrence of tropical cyclones (GHD, 2007) and therefore has its own cyclone response system in place. The majority of Townsville residents live on the north side of the Ross River which is predominantly flat. There's a short rock wall along most of the foreshore.

A29.1 Strand Pier

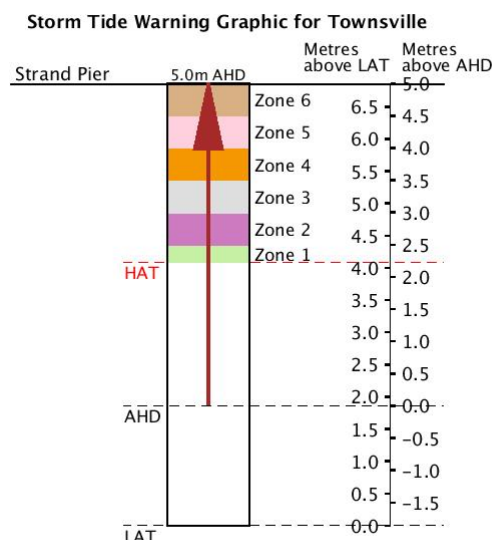


Figure 98. Pier: The Strand, North Ward, Qld, 4810

A29.2 Pallarenda Foreshore

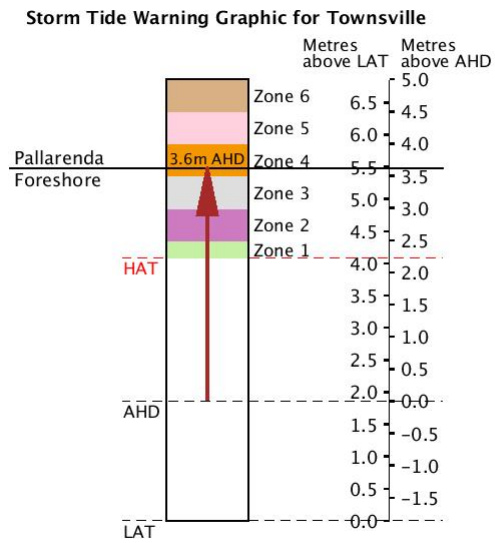


Figure 99. Foreshore: The Esplanade, Pallarenda, Qld, 4810

A29.3 Marina ANZAC Park

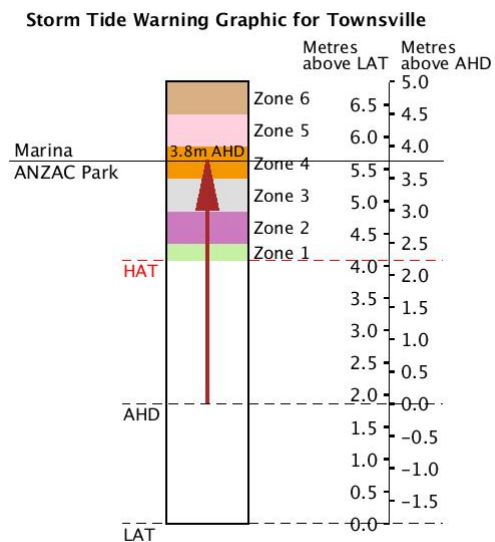


Figure 100. Marina ANZAC Park: The Strand, Townsville City, Qld, 4810

A30 Nelly Bay

Nelly bay is a community located on Magnetic Island off the coast from Townsville in northern Queensland. The community itself is located on the south-eastern side of the island. The coastline consists of sandy beaches separated by rocky headlands. The ferry terminal is a particularly important landmark as it is the main mode of transport between the island and Townsville on the mainland.

A30.1 Jetty Picnic Bay

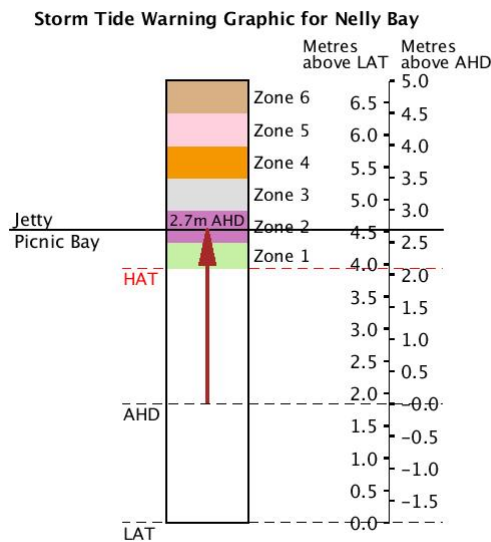


Figure 101. Jetty: The Esplanade, Picnic Bay, Qld, 4819

A30.2 Arcadia Bowls Club

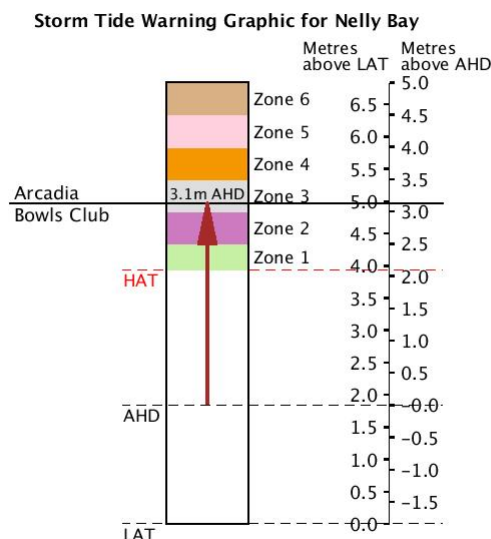


Figure 102. Arcadia bowls club: 18 Marine Parade, Arcadia, Qld, 4819

A30.3 Ferry Terminal

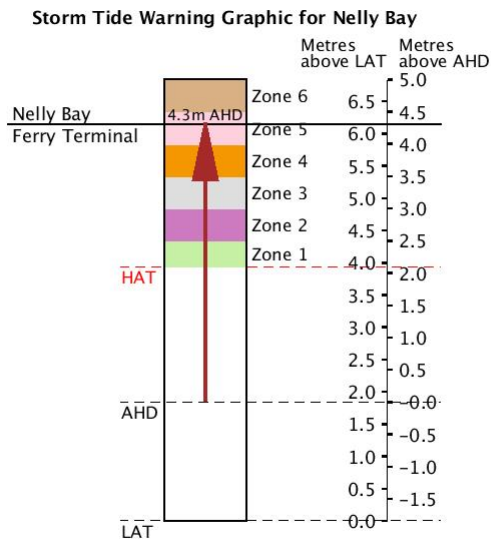


Figure 103. Ferry Terminal: Harbour Drive, Nelly Bay, Qld, 4819

A31 Alva

Alva is a small community on the coast north east of Ayr, Queensland. The area is surrounded by coastal wetlands and a number of estuaries.

A31.1 Surf lifesaving club

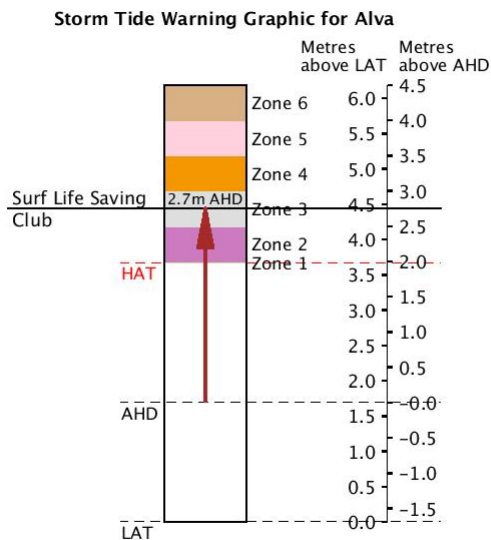


Figure 104. Ayr Surf Life Saving Club: 1–9 Sandowns Street, Alva, Qld, 4807

A31.2 Public toilets

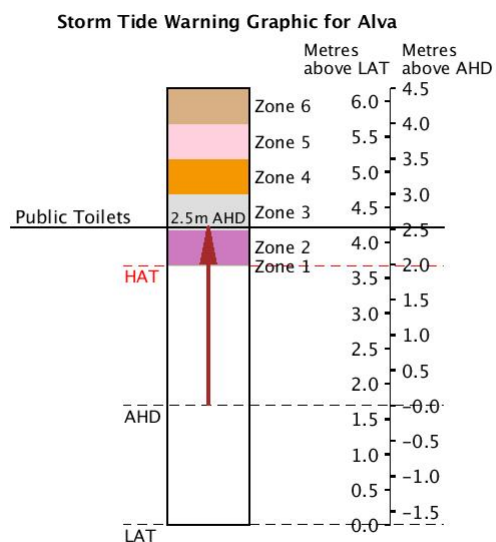


Figure 105. Public toilets: 1–9 Sandowns Street, Alva, Qld, 4807

A31.3 Caravan Park

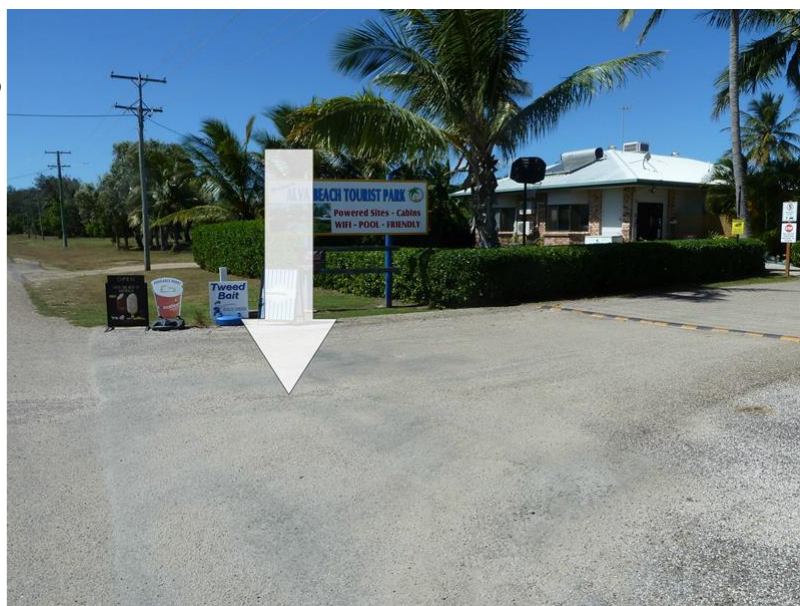
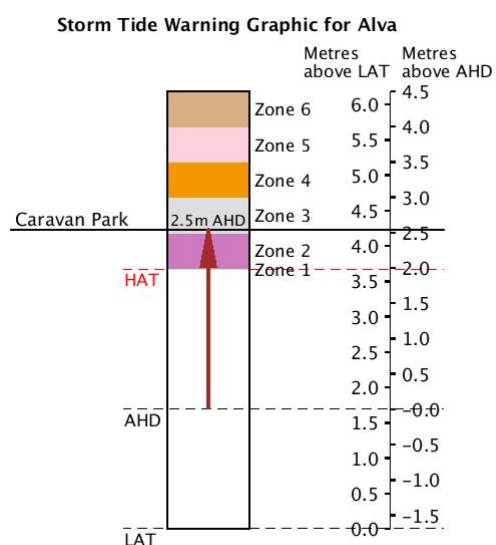


Figure 106. Caravan Park: 20-36 Braby Street, Alva, Qld, 4807

A32 Molongle Creek

Molongle Creek is a small township located at the mouth of the creek of the same name. The community is set back from the coast along the creek. The surrounding area is dominated by coastal wetlands.

A32.1 Boat Ramp

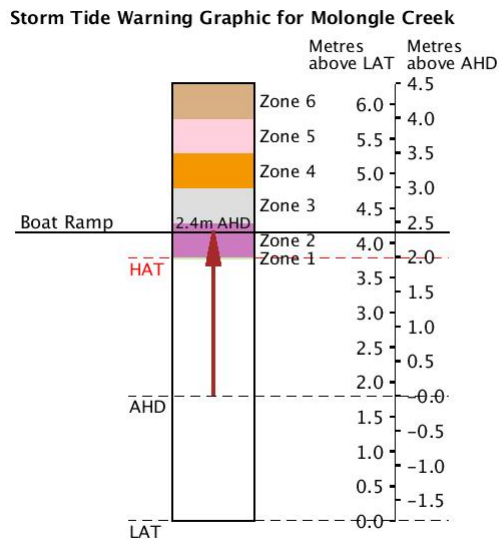


Figure 107. Boat ramp: Gumlu, Qld, 4805

A32.2 Caravan Park

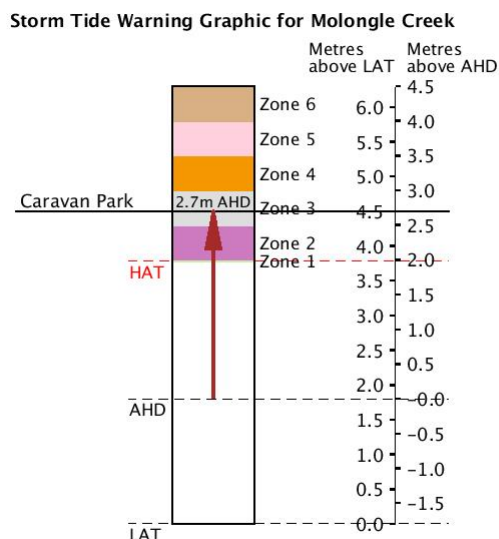


Figure 108. Caravan Park: 573 Molongle Beach Rd, Gumlu, Qld, 4805

A32.3 Boat Club

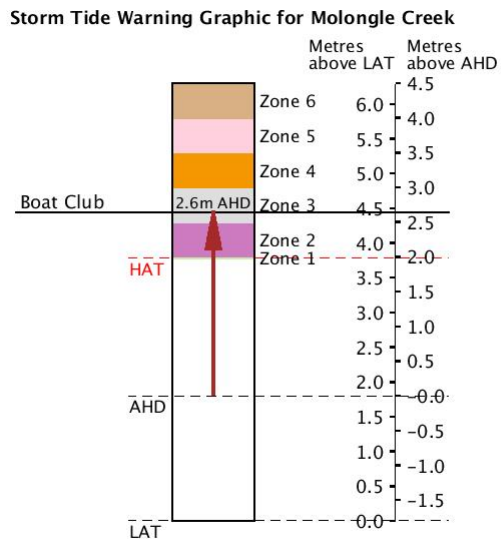


Figure 109. Boat Club, Gumlu, Qld, 4805

A33 Abbot Point

Abbot Point is a large coal port north of Bowen on Queensland's east coast. On the eastern side of the port there is a long open coast beach which runs almost parallel to the only road in and out of the port. The landmarks selected were chosen to reflect some of the levels seen by the infrastructure at the port, as well as a potential cut-off point along the main road.

A33.1 Marine Offloading Facility

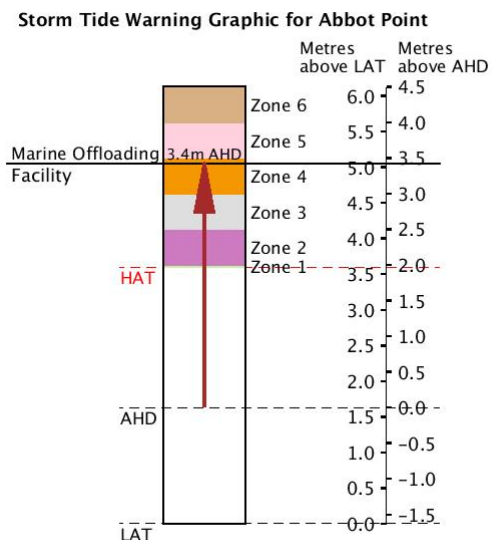


Figure 110. Marine offloading facility: Abbot Point, Qld, 4805

A33.2 Abbot Point Road Bridge

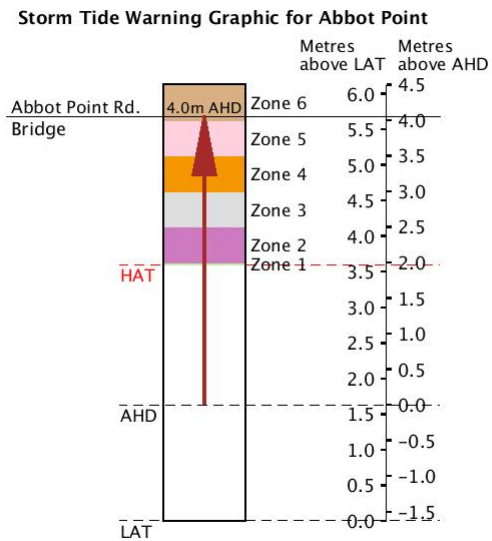


Figure 111. Bridge: Abbot Point Road, Bowen, Qld, 4805

A34 Bowen

Bowen is located on a square peninsula on the north east coast of Queensland. The town spans the width of the peninsula with a lot of beachside infrastructure. Landmarks were selected at either side of the peninsula in order to cover the spread of the town.

A34.1 Jetty

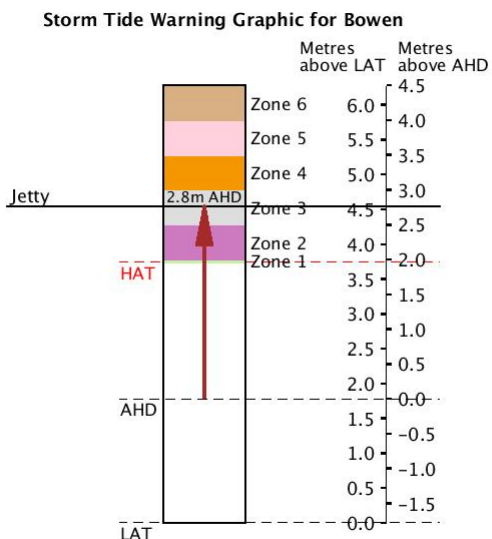


Figure 112. Jetty: Santa Barbara Parade, Bowen, Qld, 4805

A34.2 Queens Beach Surf Life Saving Club

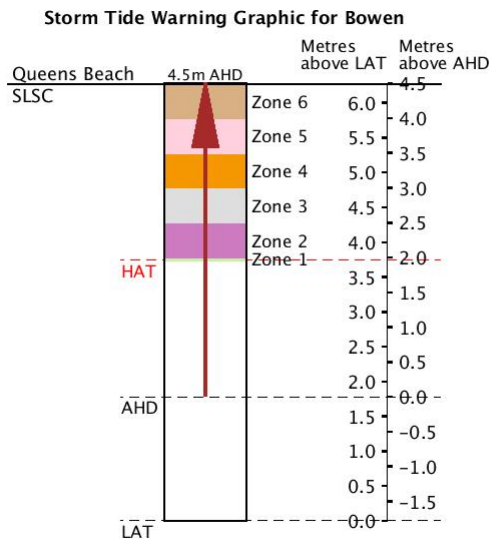


Figure 113. Queens Beach SLSC: Mount Nutt Road, Bowen, Qld, 4805

A35 Brisk Bay

Brisk Bay is a small township located on the coast to the south of Bowen. The community is located along the beachfront with a single road in and out of town. Landmarks were selected to show the height of the foredune as well as some potential cut-off points along the main road.

A35.1 Causeway

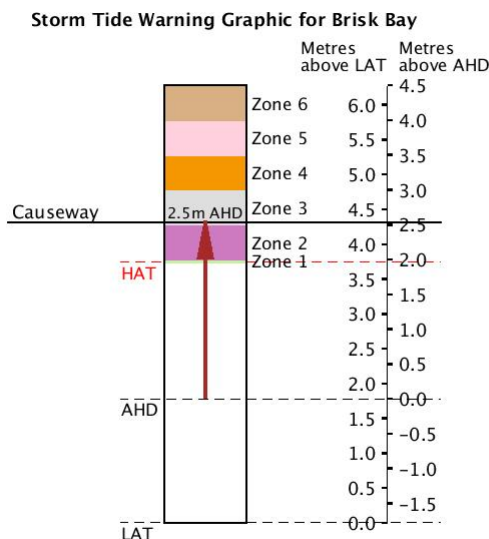


Figure 114. Causeway: Heronvale Road, Bowen, Qld, 4805

A35.2 Edwards Street cul-de-sac

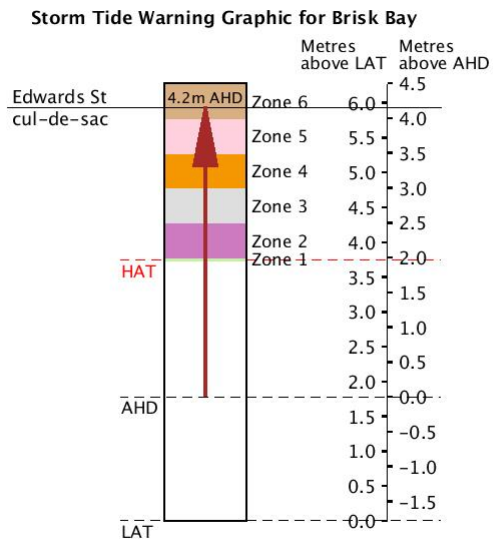


Figure 115. Cul-de-sac: Edwards Street, Bowen, Qld, 4805

A35.3 Pitcairn Avenue Culvert

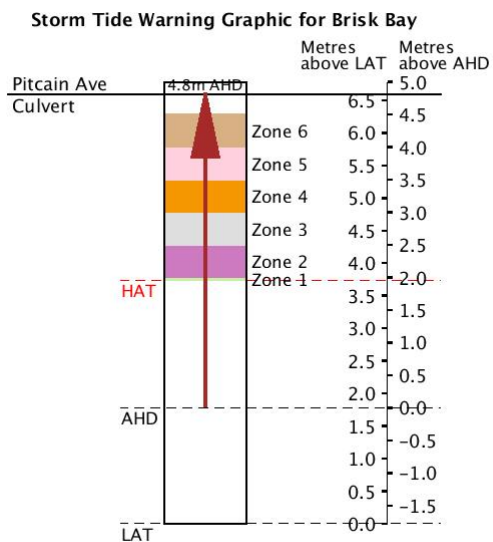


Figure 116. Culvert: 11-23 Pitcairn Avenue, Bowen Qld, 4805

A36 Dingo Beach

Dingo Beach is a small town on the east coast of Queensland in the Whitsunday region. The town itself is located within a bay with a number of small islands off the coast. There is a low lying area backing the town which is connected to the beach through a small estuary.

A36.1 Dingo Pub

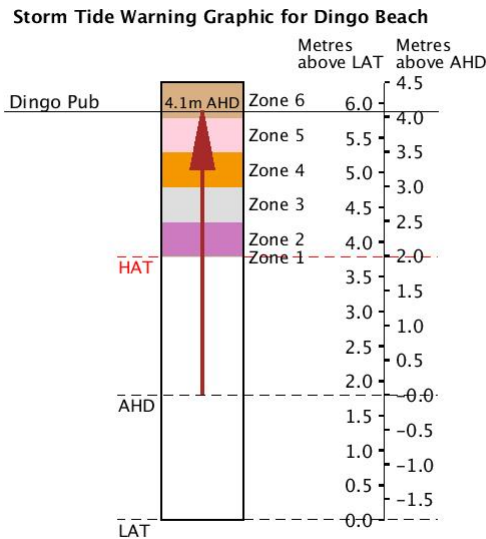


Figure 117. Dingo Pub: 1 Diecke Crescent, Dingo Beach, Qld, 4800

A36.2 Fire Service Driveway

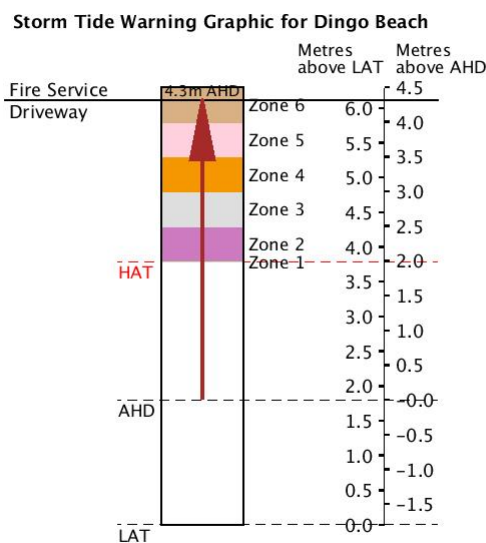


Figure 118. Fire Service Driveway: 8 Beach Road, Dingo Beach, Qld, 4800

A37 Airlie Beach

Airlie beach is a major tourist destination along the east coast, often considered the gateway to the Whitsunday island group. The coastline is made up of a series of bays, with small stretches of sandy beach between headlands and estuaries. Shute Harbour was included with a landmark, due to a local history of storm tide inundation.

A37.1 Shute Harbour Terminal

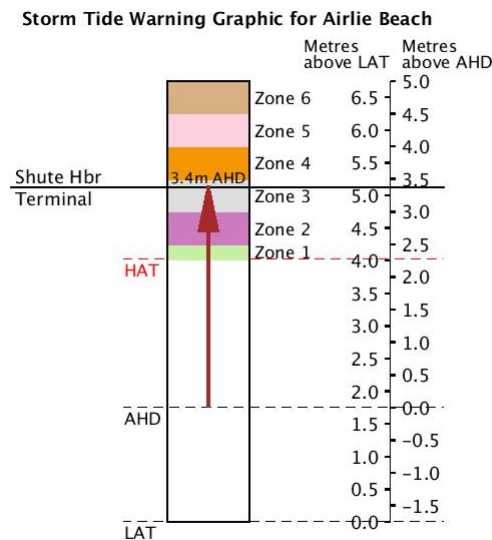


Figure 119. Shute Harbour Terminal: Whitsunday Drive, Shute Harbour Qld, 4802

A37.2 Airlie Beach Hotel

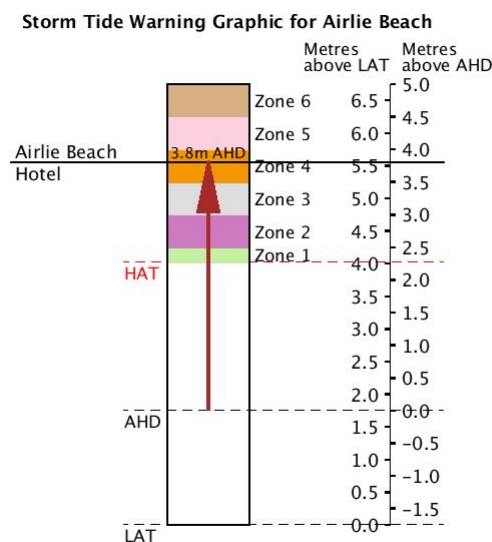


Figure 120. Airlie Beach Hotel: 16 Esplanade, Airlie Beach, Qld, 4802

A38 Conway Beach

Conway Beach is a small coastal community south of Airlie Beach. The township is located at the mouth of the Proserpine River directly on the coast. First efforts in surveying this area were impacted by Tropical Cyclone Debbie, which destroyed the original landmark selection for Wilson Beach: a BBQ area. Due to this, the current landmark, the toilet block, was re-surveyed following the event.

A38.1 Penhallurick Esplanade

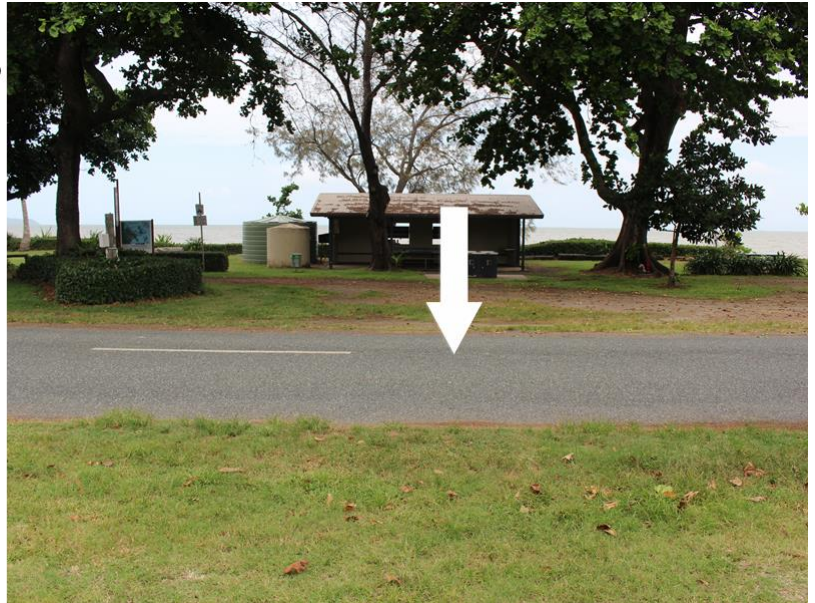
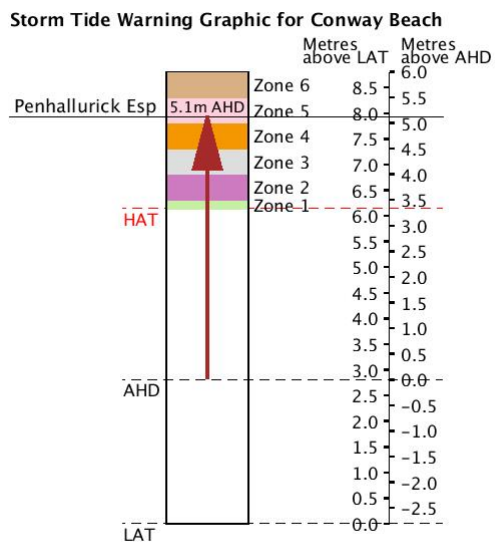


Figure 121. Penhallurick Esplanade, Conway Beach, Qld, 4800

A38.2 Wilson Beach Toilet Block

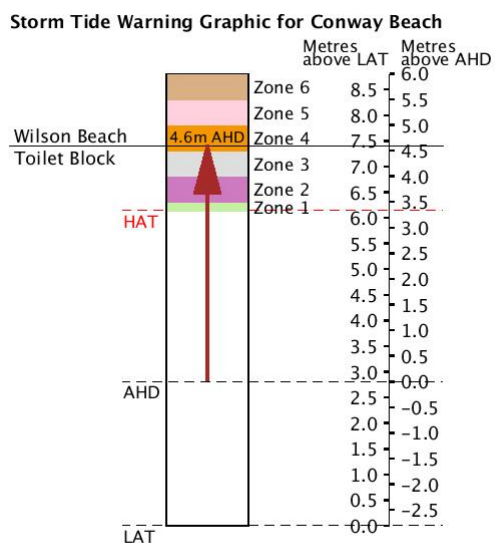


Figure 122. Toilet block: 16 Davison Road, Wilson Beach, Qld, 4800

A39 Hayman Island

Hayman Island is the northern most Island in the Whitsunday chain, and as it is home to a luxury resort it is a significant tourism point for the region. Being a continental island, there is a steep incline from the coast to the centre of the island. Key infrastructure were considered when selecting landmarks, particularly evacuation points as well as the resort.

A39.1 Resort Pool Deck

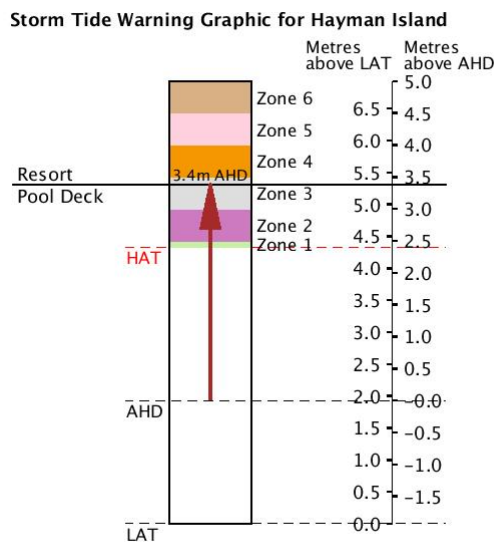


Figure 123. Resort Pool Deck, Hayman Island Qld, 4801

A39.2 Marina Office

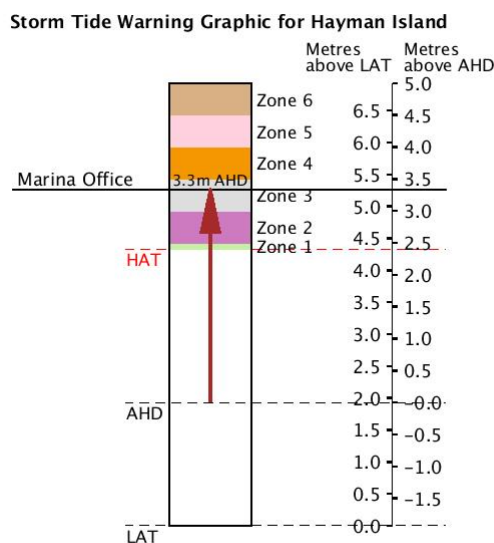


Figure 124. Marina Office, Hayman Island Qld, 4801

A39.3 Helipad

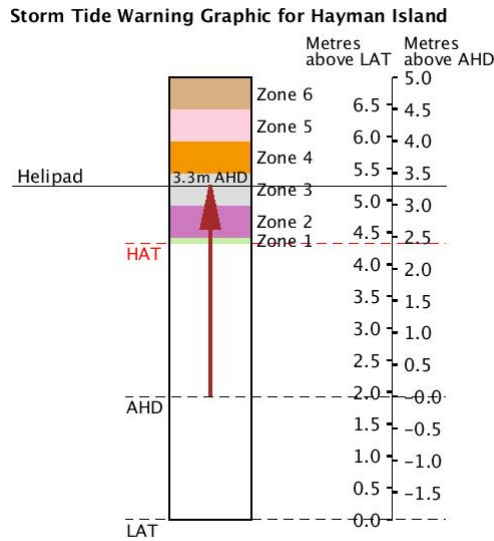


Figure 125. Helipad, Hayman Island Qld, 4801

A40 Hamilton Island

Hamilton Island is the largest inhabited Island in the Whitsundays group and is a popular tourist destination. The coastline of the Island is made up of rocky outcrops with a number of sandy pocket beaches around the perimeter. The Island houses a large resort, harbour and airstrip, the landmarks were chosen to reflect these key pieces of infrastructure.

A40.1 Post Office

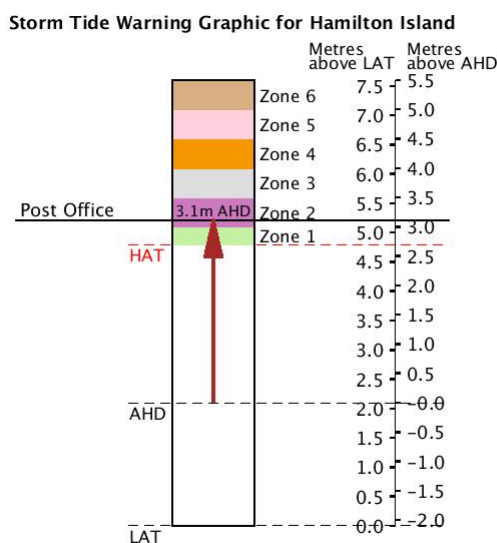


Figure 126. Post Office: Front Street, Hamilton Island Qld, 4803

A40.2 Resort Pool Deck

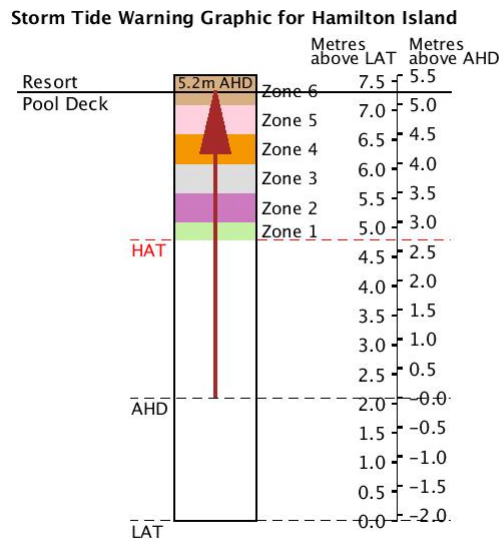


Figure 127. Resort Pool Deck: Resort Drive, Hamilton Island Qld, 4803

A40.3 Airport Ferry Entrance

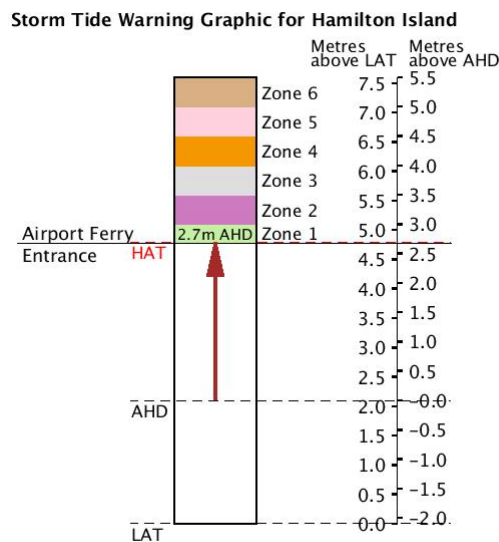


Figure 128. Airport ferry entrance: Airport Drive, Hamilton Island Qld, 4803

A41 Laguna Quays

Laguna Quay is the locality of a since closed resort at the southern end of the Whitsunday region. The region is mostly abandoned leaving behind an unmanned marina and resort further inland. Due to this a landmark was selected to reflect the elevation of the harbour, as well as a landmark in the adjacent town of Midge Point.

A41.1 Storm Tide Gauge Jetty

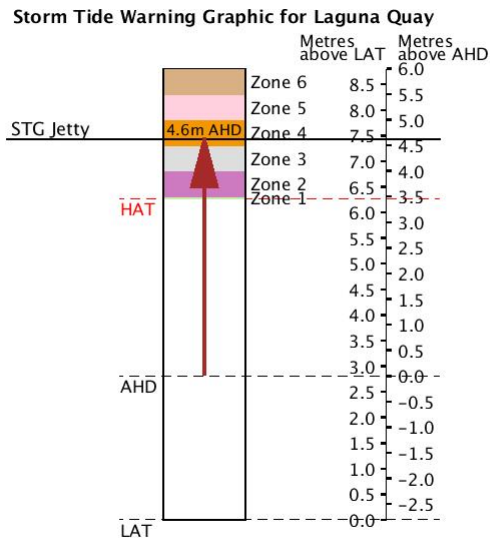


Figure 129. Storm tide gauge jetty, Laguna Quay Qld, 4800

A41.2 Nielsen Parade Midgeton

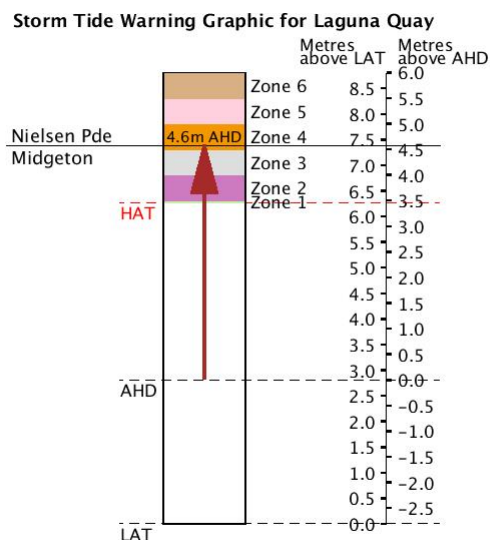


Figure 130. Nielsen Parade, Midge Point Qld, 4799

A42 Mackay

Mackay is a city located on the north/central Queensland coast at the mouth of the Pioneer River. It has one of the largest tidal ranges in Queensland and, therefore, has its own storm tide response systems in place. Most of the urbanised areas are located within close proximity of coastal wetland areas which are prone to storm tide inundation.

A42.1 Lighthouse

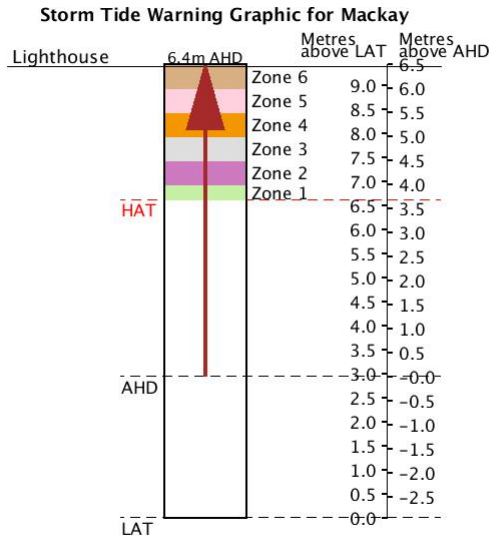


Figure 131. Lighthouse: Mulherin Drive, Mackay Marina, Mackay Harbour Qld, 4740

A42.2 Slade Point State School

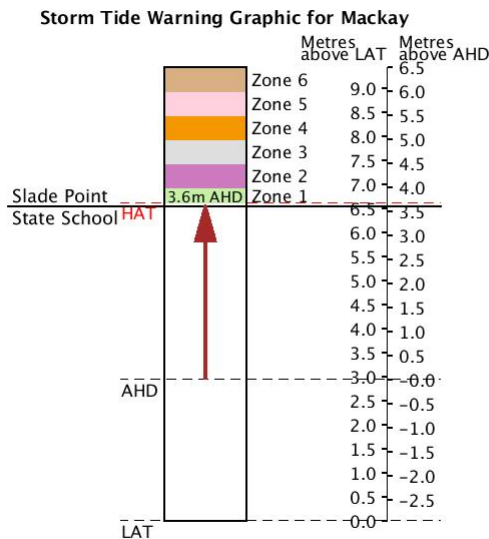


Figure 132. Slade Point state school: Slade Point Road, Slade Point, Qld, 4740

A42.3 Forgan Bridge South

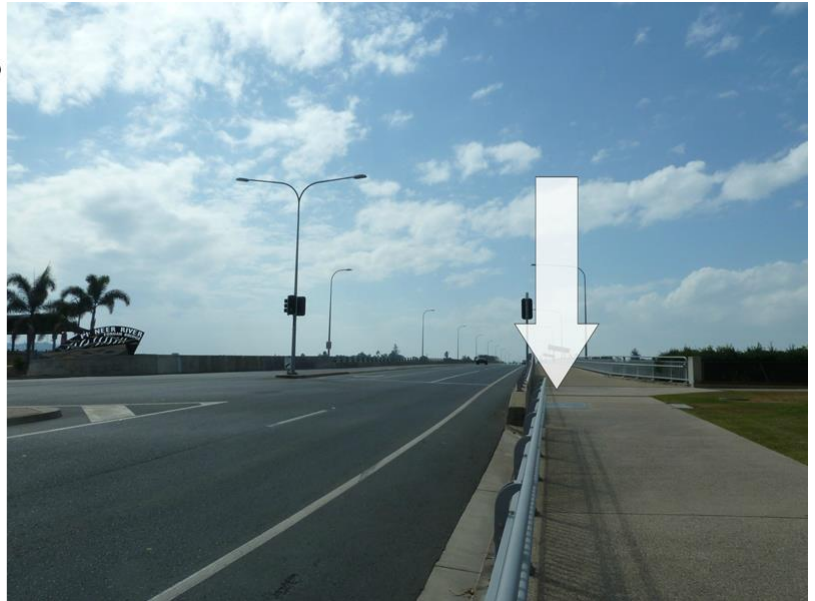
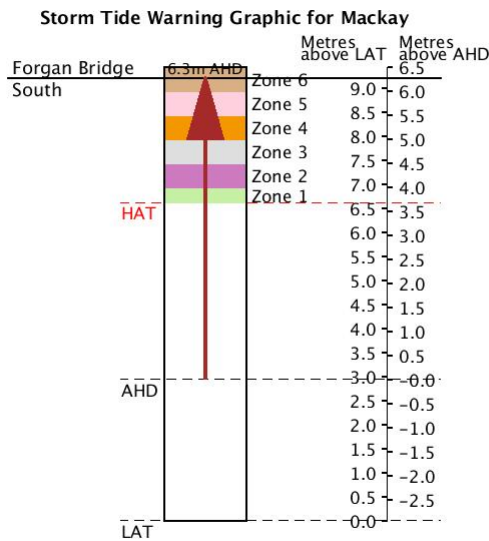


Figure 133. Forgan Smith Bridge, Mackay Qld, 4740

A43 Hay Point

Hay Point is a small town in the Mackay region and is home to two bulk coal terminals. The residential communities are backed by low lying wetlands which are partially joined to the sea via estuary channels. The landmark at Pacific Drive was selected as it is a potential cut-off point for the residential community on the southern side. The other two points were selected to give an indication of the elevations at each of the residential areas at Hay Point.

A43.1 Pacific Drive Spillway

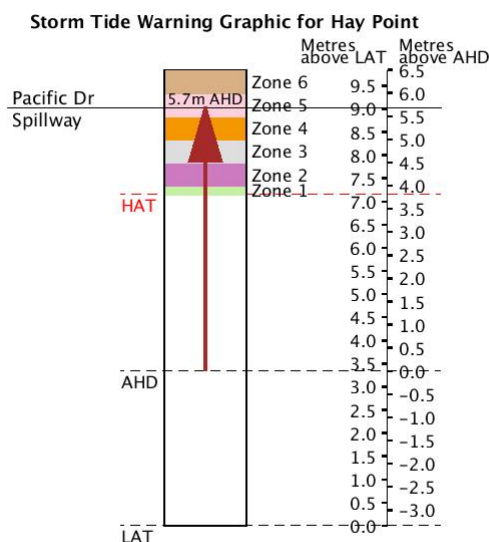


Figure 134. Pacific Drive, Hay Point Qld, 4740

A43.2 Esplanade Beach Stairs

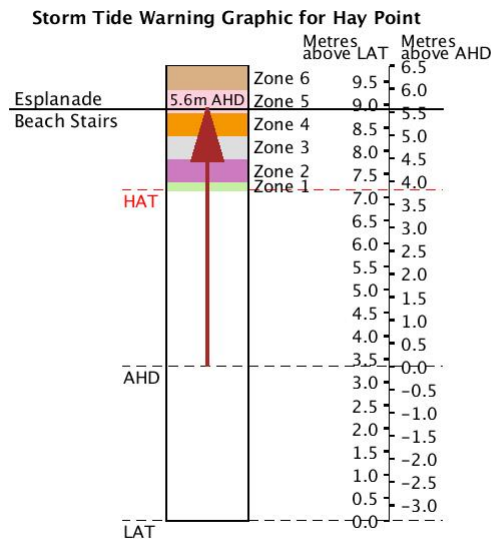


Figure 135. Beach Stairs: Esplanade, Hay Point Qld, 4740

A43.3 Intersection of Edmunds Avenue and Louisa Creek Road

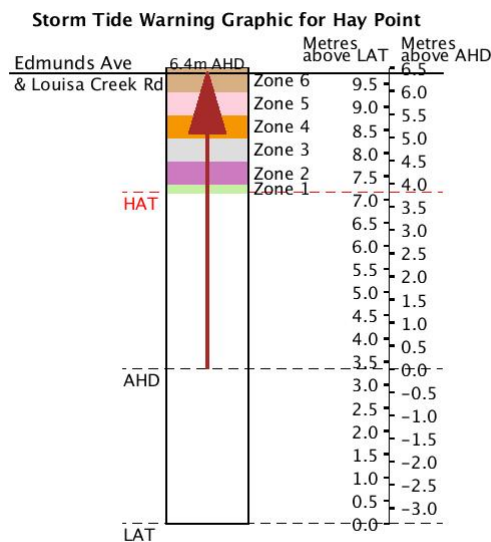
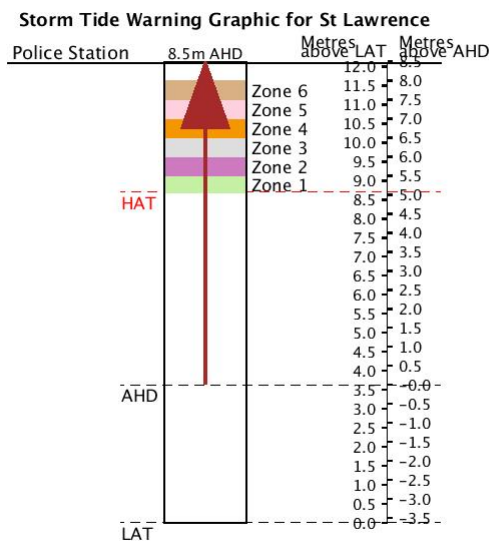


Figure 136. Intersection of Edmunds Avenue and Louisa Creek Road, Hay Point Qld, 4740

A44 St Lawrence

St Lawrence is a small town located near the mouth of St Lawrence Creek at the coast. It is surrounded by extensive mudflats, estuaries, and areas of mangroves. The town itself is located at a higher elevation than the surrounding area. The landmarks were selected in order to reflect a possible cut-off point in the town (MacCartney Street culvert) and to show a general elevation for some key infrastructure bordering on the St Lawrence Creek. It should be noted that the Margs Park landmark is not indicative of the township, however is better representative of the surrounding floodplains.

A44.1 Police Station



A44.3 Margs Park

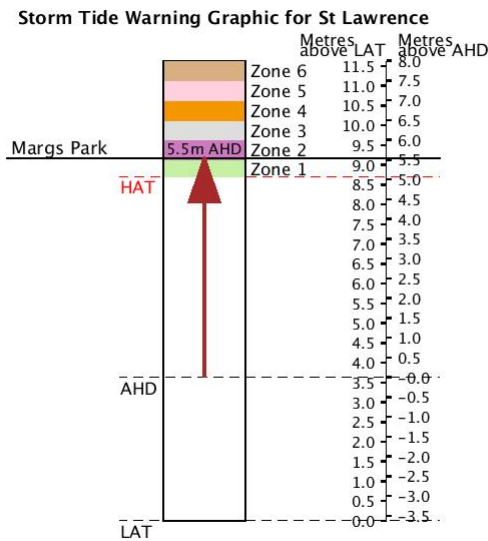


Figure 139. Margs Park: St Lawrence Qld, 4707

A45 Broad Sound

Broad Sound is a large bay on the coast in Central Queensland, sharing the Torilla Peninsula with Shoalwater Bay to the east. The area on the coast is low-lying with many estuaries and rivers lining the bay as well as extensive mudflats and mangrove communities. The main landmark for Broad Sound is Halfway Creek as it is a significant choke point for locals of Stanage Bay who may be isolated in the event of a storm tide pushing up the tidal creek. Other points were selected at Stanage Bay as it contains the only significant population located on the coast within the region. It should be noted, however, that the tidal range for Broad Sound may not be true for Stanage Bay.

A45.1 Halfway Creek

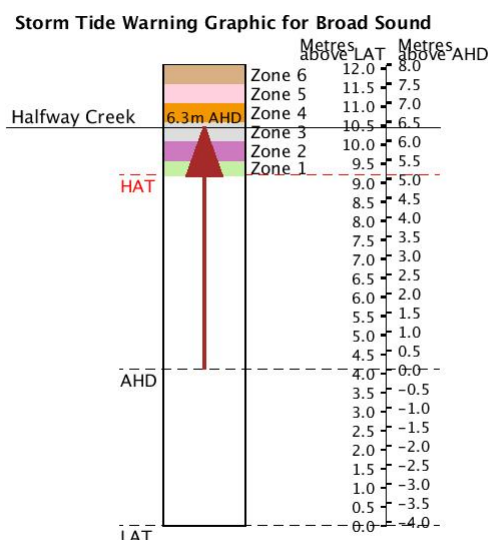


Figure 140. Halfway Creek: Stanage Bay Road, Shoalwater Qld, 4702

A45.2 Stanage Bay Coast Guard

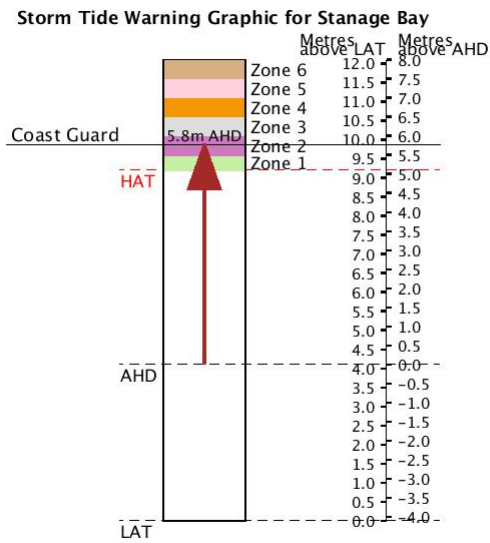


Figure 141. Coast Guard: Banksia Road, Stanage Qld, 4702

A45.3 Stanage Bay Boat Ramp

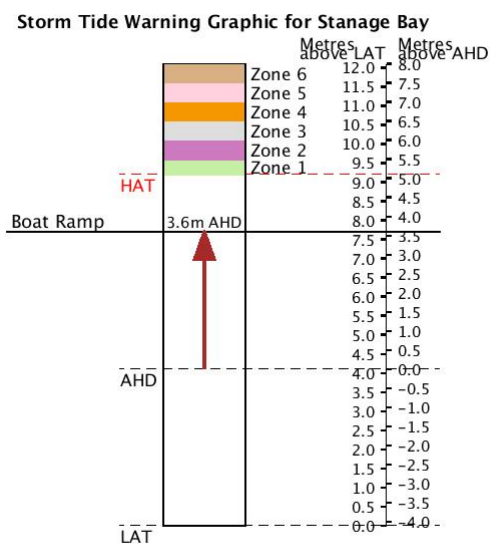


Figure 142. Boat Ramp: Banksia Road, Stanage Qld, 4702

A46 Shoalwater Bay

Shoalwater Bay is a large bay in the central Queensland region under ownership of the Australian Defence Force, who utilise the land primarily for military training exercises. There are no permanent residents within close proximity of the coast to be affected by storm tide events. The landmark selected was chosen due to accessibility constraints in the area. However the only other infrastructure along the coast are boat ramps further into the bay. The survey was completed utilising a base/rover setup utilising an AUSPOS (4 hrs logged at 30 sec intervals) for the basis of the measurements. This method was employed due to there being no registered PSM in the area to setup and check against.

A46.1 Sabina Point Boat Ramp

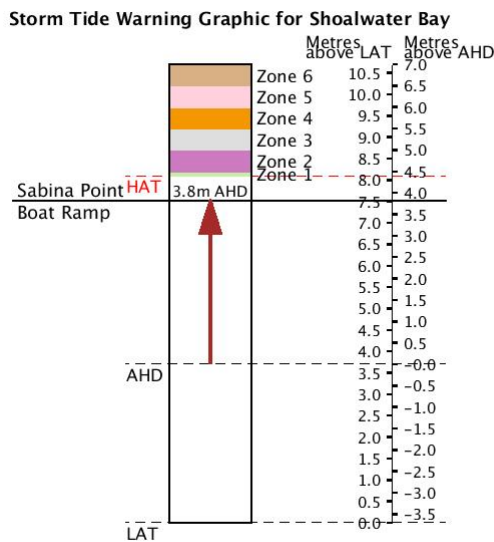


Figure 143. Sabina Point Boat Ramp, Shoalwater Qld, 4702

A47 Yeppoon

Yeppoon is a town located on the coast north east of Rockhampton and falls under the Livingstone Shire Council. The coastal formations in the area consist of sandy open coast beaches and large rocky headlands stretching to the south. The town is somewhat sheltered by the Keppel Islands and offshore reefs. Most beaches are backed by a low foredune with some regions that have had coastal protection works to prevent shoreline recession. The sites were selected to align somewhat to what the local council has produced in its own storm tide advice system.

A47.1 Rosslyn Bay Public Boat Ramp

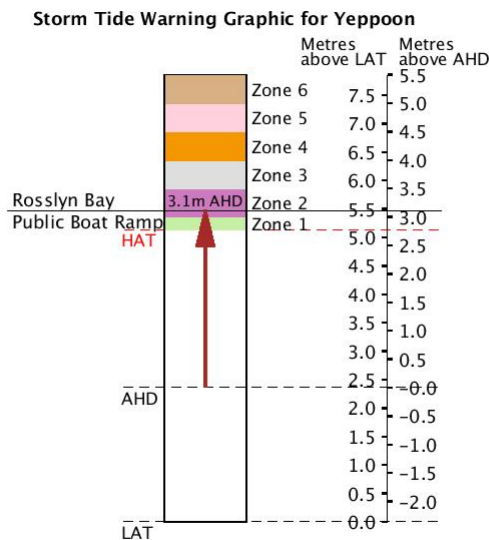


Figure 144. Public Boat Ramp: Anchor Drive, Rosslyn Qld, 4703

A47.2 Causeway Lake Bridge

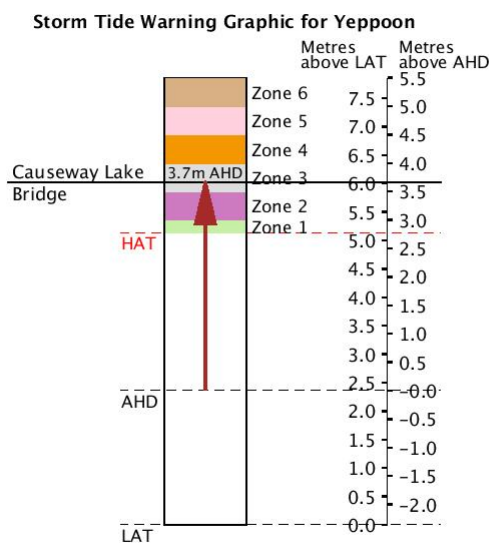


Figure 145. Causeway Lake Bridge: Scenic Highway, Kinka Beach Qld, 4703

A47.3 Ross Creek Henry Beak Bridge

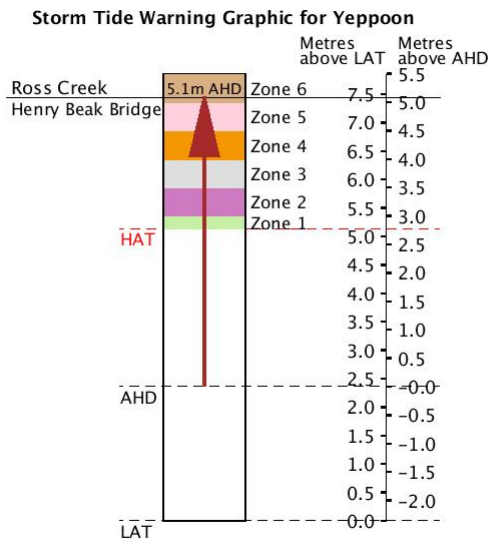


Figure 146. Henry Beak Bridge, Cooe Bay Qld, 4703

A48 Great Keppel Island

Great Keppel Island is situated off the coast from Yeppoon in central Queensland housing a small permanent community as well as many temporary visitors throughout the year. The sites selected are on the western side of the Island as this is where the primary population and infrastructure lie. There is some significant beach erosion at Putney Beach on the north side of the hideaway, and there are some extensive works underway in attempt to reclaim some of the land lost; however, it should be noted that even though the height of the infrastructure is above zone 6 on the totem pole, it may be heavily affected by erosion in the event of a significant storm tide.

A48.1 Hideaway

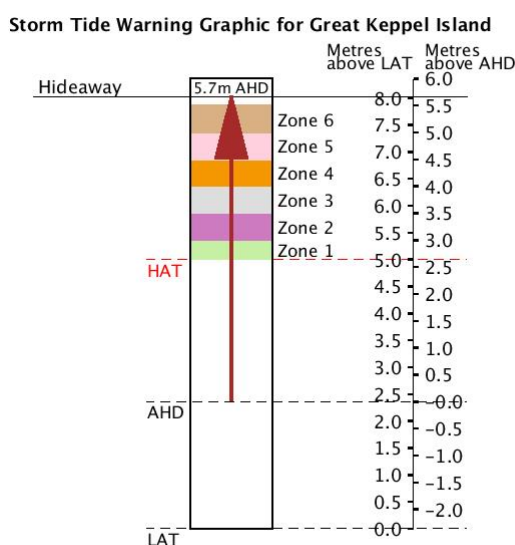


Figure 147. Hideaway: The Esplanade, Great Keppel Island Qld, 4703

A48.2 Rainbow Hut

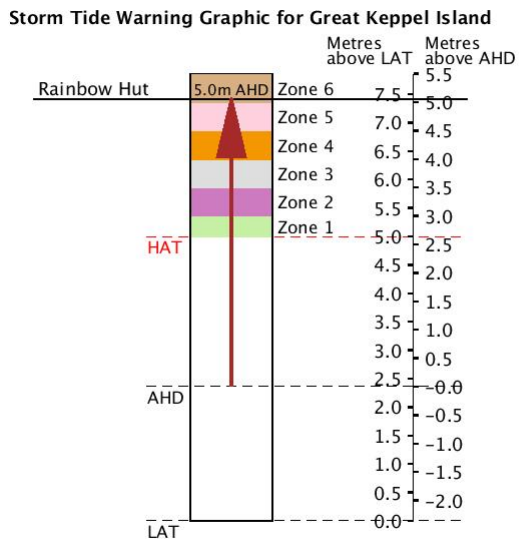


Figure 148. Rainbow Hut: The Esplanade, Great Keppel Island Qld, 4703

A48.3 Water Sports Hut

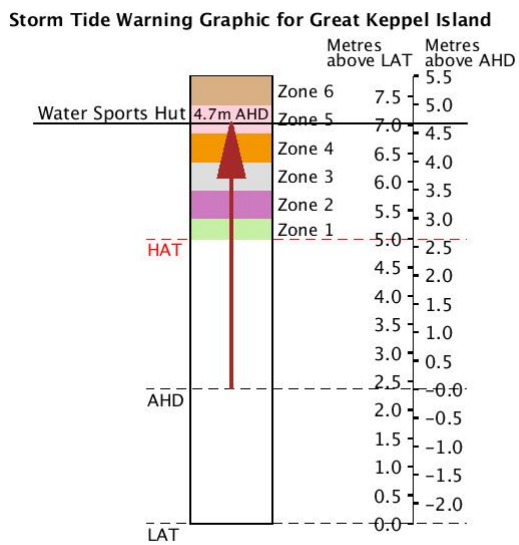


Figure 149. Water Sports Hut: Lot 1 the Esplanade, Great Keppel Island Qld, 4703

A49 Port Alma

Port Alma is located on the coast at the mouths of Raglan and Casuarina creek in the Rockhampton region. The area is primarily a port for class 1 explosives and other commodities, but it also houses extensive salt pans. There are some extensive wetland ecosystems along the coast and river systems. The landmarks selected show the levels needed to exceed the wharf and cause significant inundation to the Port, where the boat ramp shows the level of the surrounding land. It was surveyed using a base/rover setup over a local PSM (PSM67324).

A49.1 Public Boat Ramp

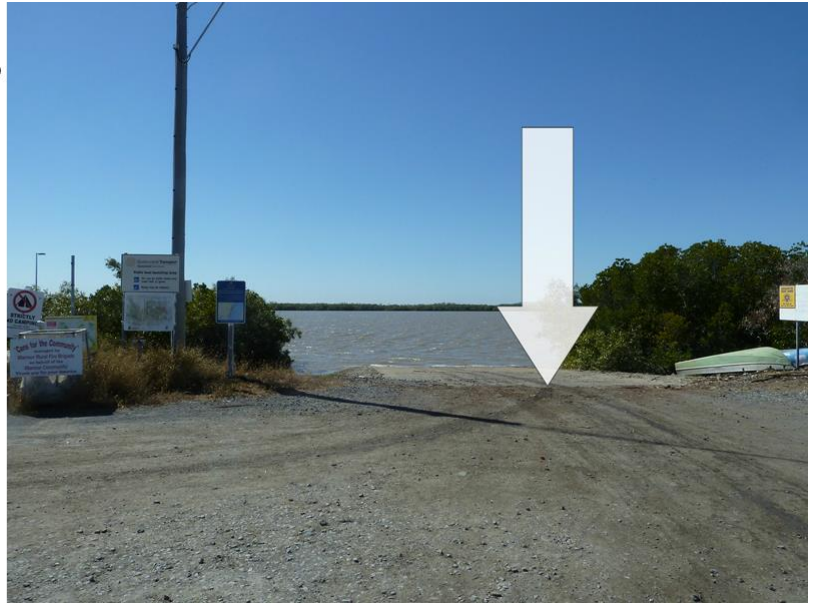
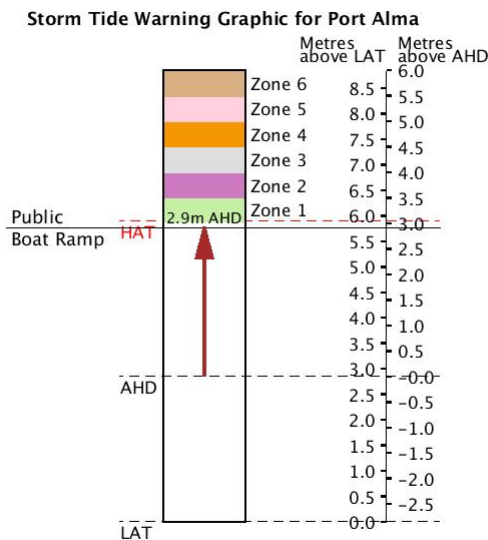


Figure 150. Public Boat Ramp: Port Alma Road, Port Alma Qld, 4699

A49.2 Wharf

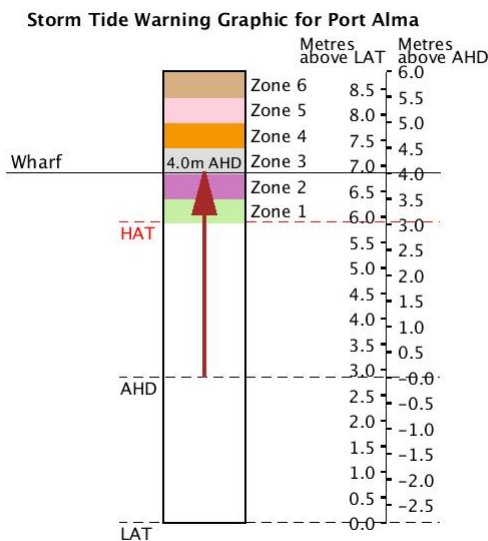


Figure 151. Wharf: Port Alma Road, Port Alma Qld, 4699

A50 Gladstone

Gladstone is a heavily industrialised city situated on the coast of central Queensland and is home to the largest multi-commodity port in the state. The city is somewhat sheltered by two large islands: Curtis Island and Facing Island. Landmarks were chosen at the harbour and in the main section of the city along Auckland Inlet. A landmark was also selected at the township of Tannum Sands at the request of Gladstone Regional Council.

A50.1 Information Centre

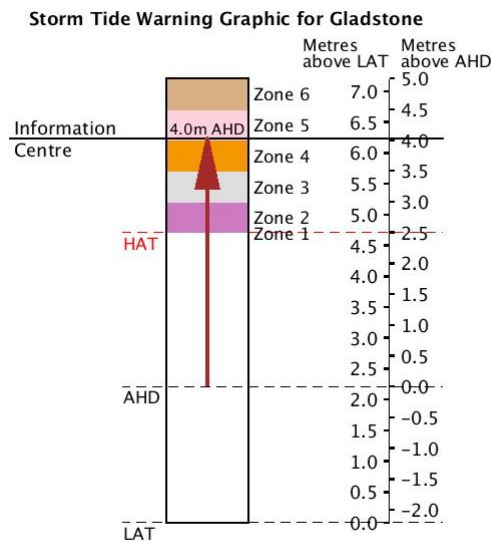


Figure 152. Information Centre: Bryan Jordan Drive, Gladstone Central Qld, 4680

A50.2 Sailing Club

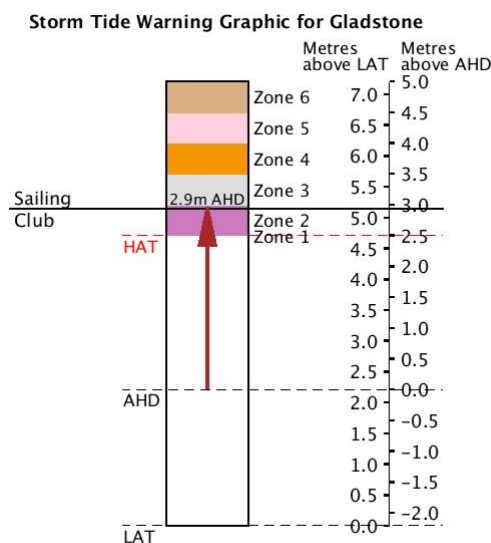


Figure 153. Sailing Club: 1 Goondoon Street, Gladstone Qld, 4680

A50.3 Tannum Sands SLSC

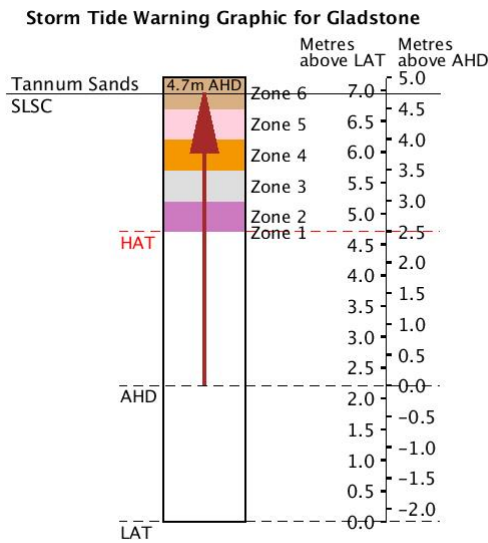


Figure 154. Surf Life Saving Club: Millenium Esplanade, Tannum Sands, Qld, 4680

A51 Agnes Water

Agnes Water is located within the Gladstone region and is considered the most northerly surf beach in Queensland. The town itself is mostly protected by a well-developed foredune along the eastern beach which extends and increases in size north towards the town of 1770. The landmarks selected lie within the inlet to the north-west. It should be noted due to the location of these sites within the inlet, predicted levels may not reflect the levels seen at the landmark sites. Also the State Emergency Services landmark has a significant vegetation barrier between it and the waterfront which should be noted when interpreting these levels.

A51.1 State Emergency Services

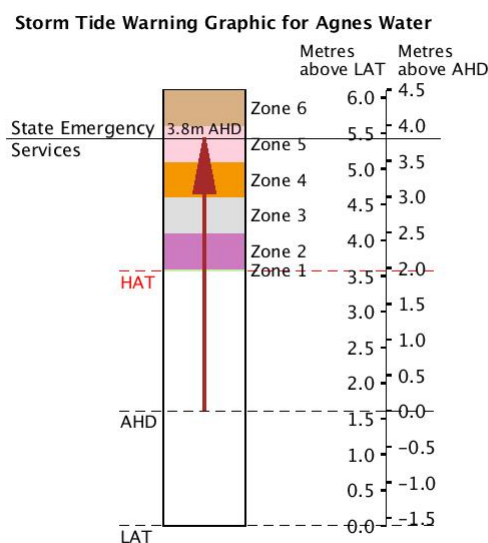


Figure 155. State Emergency Services: SES Access, 1770 Qld, 4677

A51.2 Volunteer Marine Rescue

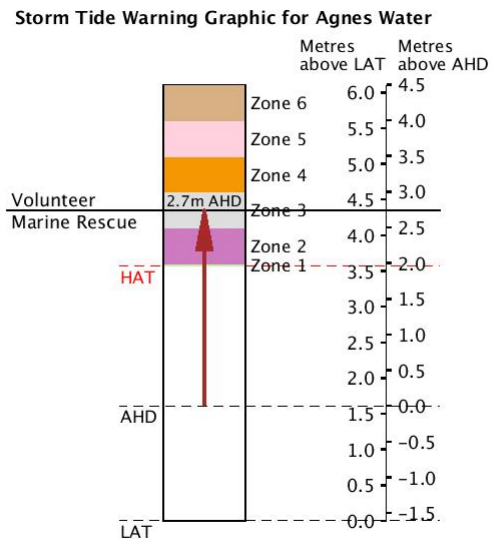


Figure 156. Volunteer Marine Rescue: 539 Captain Cook Drive, 1770 Qld, 4677

A51.3. 1770 Camping Ground

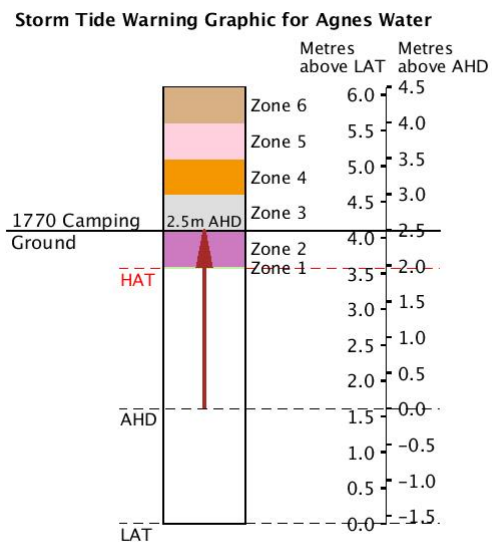


Figure 157. Camping Ground: 641 Captain Cook Drive, 1770 Qld, 4677

A52 Burnett Heads

Burnett Heads is a small township within the Bundaberg region, situated at the mouth of the Burnett River. The landmarks selected for this region were selected so to illustrate the risk to the port's infrastructure as well as the surrounding community. Due to the larger population in the Bargara region to the south a landmark was also selected there at a potential cut-off point.

A52.1 Wharf

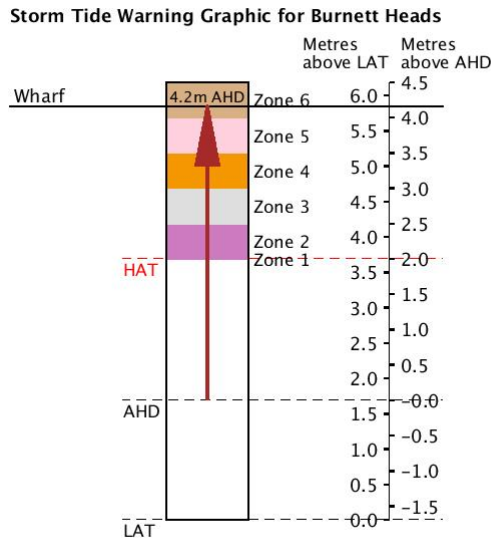


Figure 158. Wharf: 45 Wharf Drive, Burnett Heads Qld, 4670

A52.2 State Emergency Services

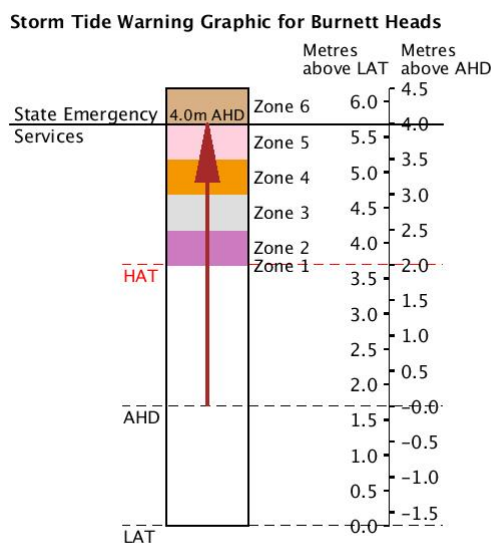


Figure 159. State Emergency Services: 13 Brewer Street, Burnett Heads Qld, 4670

A52.3 Moneys Creek Causeway

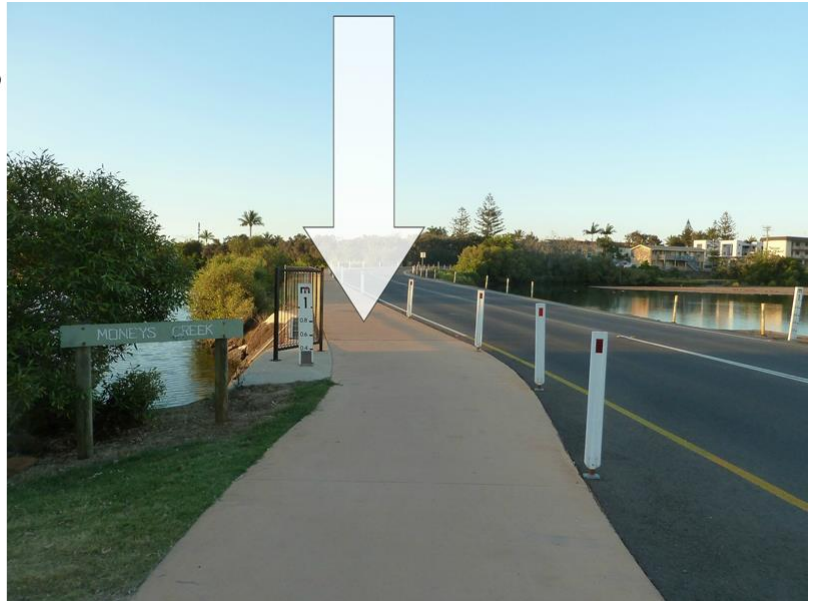
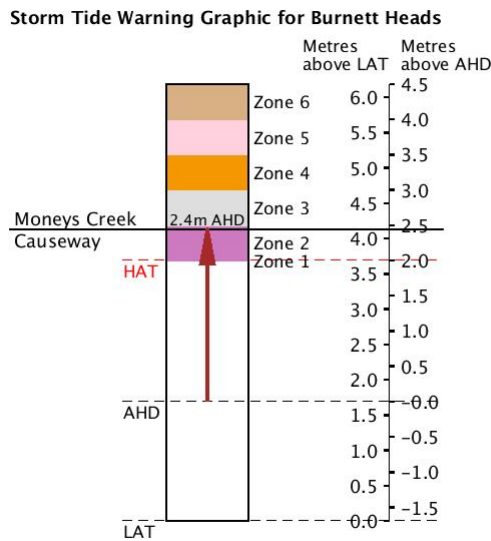


Figure 160. Moneys Creek Causeway: The Causeway, Bargara Qld, 4670

A53 Urangan

Urangan is a suburb of Hervey Bay located on the coast at the northern end of the Great Sandy Strait adjacent to Fraser Island. The region is dominated by open coast beaches with the neighbouring suburbs of Pialba and Point Vernon extending up to a headland. Most of the urbanised areas are low lying and flat (Lawson and Treloar Pty Ltd, 2001). Sites were selected to give a good spread of elevation values along the coastline at Urangan.

A53.1 Public Boat Ramp

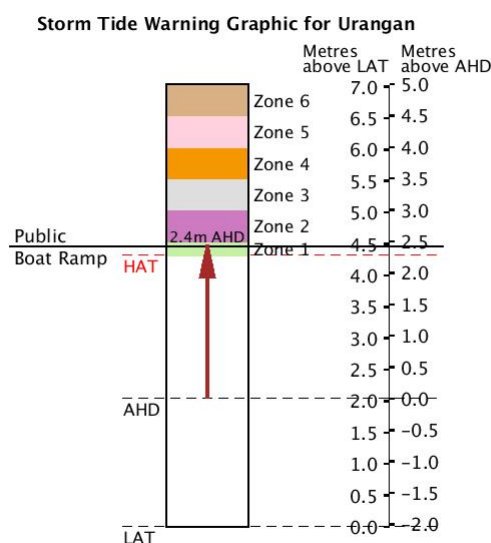


Figure 161. Public Boat Ramp: Jetty Street, Urangan Qld, 4655

A53.2 Pier

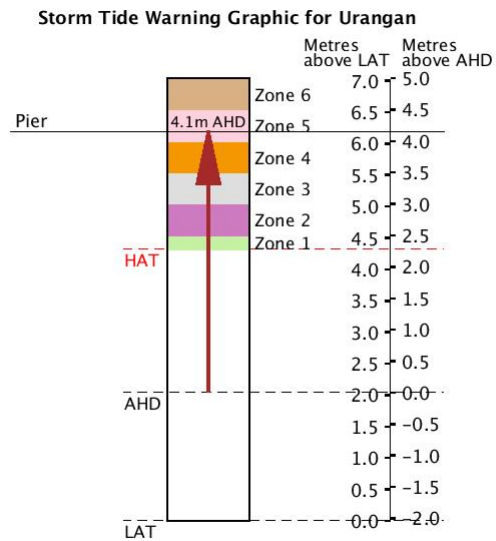


Figure 162. Pier: Pier Street, Urangan Qld, 4655

A53.3 Sailing Club

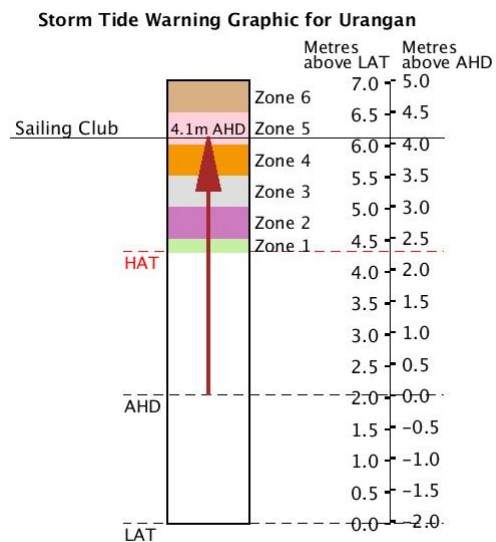


Figure 163. Sailing Club: 427 Charlton Esplanade, Hervey Bay Qld, 4655

A54 Rainbow Beach

Rainbow Beach is a small town located on the east coast just south of Fraser Island. The main section of town is built atop the large foredune that extends south towards Double Island Point. The 4WD beach access was selected to illustrate the level directly at the coast, where the town itself is much higher. Inskip Point was chosen to display the risk to the extensive camp grounds in the area, whereas the boat ramp at Carlo Point was chosen to show the elevation of areas within the bay. It should be noted, however, that regions within the bay may receive different storm tide levels than those predicted for the open ocean.

A54.1 4WD Beach Access

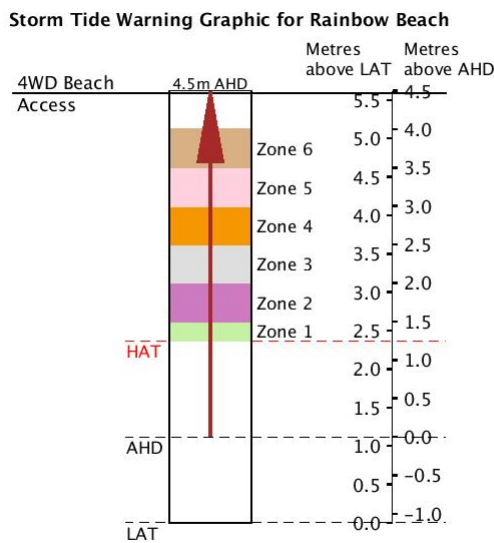


Figure 164. 4WD beach access, Rainbow Beach Qld, 4581

A54.2 Inskip Point Turnaround

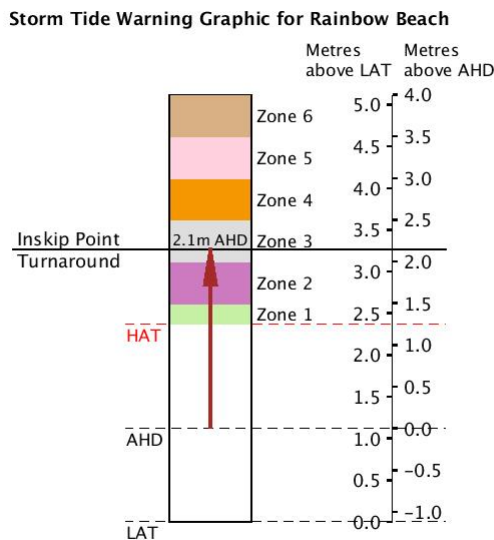


Figure 165. Inskip Point Turnaround: Inskip Point Road, Inskip Qld, 4581

A54.3 Carlo Point Boat Ramp

Storm Tide Warning Graphic for Rainbow Beach

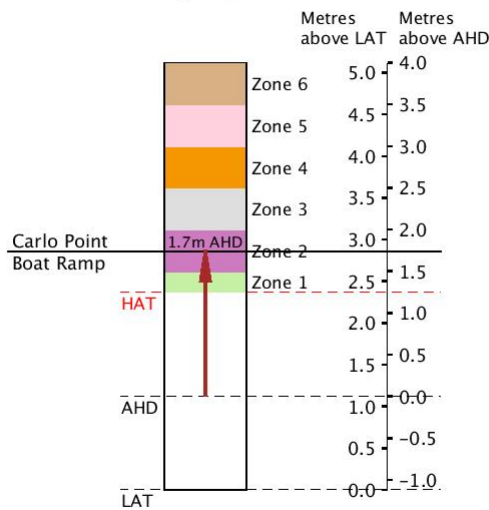


Figure 166. Public Boat Ramp: Carlo Road, Rainbow Beach, Qld, 4581

A55 Cooloola Beach

Cooloola Beach is a large area made up primarily of National Park. There are some small settlements at North Shore Noosa but these are primarily set back from the beach and at low risk. The foredunes along the beach are high and well developed. The main settlement in the area is Teewah. The site at Teewah was selected to illustrate the level of the township and the heights that would need to be reached to incur any significant inundation.

A55.1 Teewah Helipad

Storm Tide Warning Graphic for Cooloola Beach

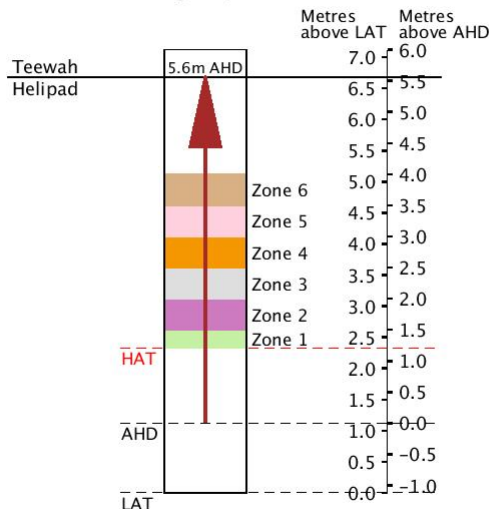


Figure 167. Teewah Helipad: Corner of Mackerel Street and Stargazer Street, Noosa North Shore Qld, 4565

A56 Noosa Heads

Noosa Heads is the northernmost region of the Sunshine Coast with the main population being located along the Noosa River. Sites were selected to illustrate the levels at the coast as well as places along the river where the main population resides.

A56.1 Yacht and Rowing Club

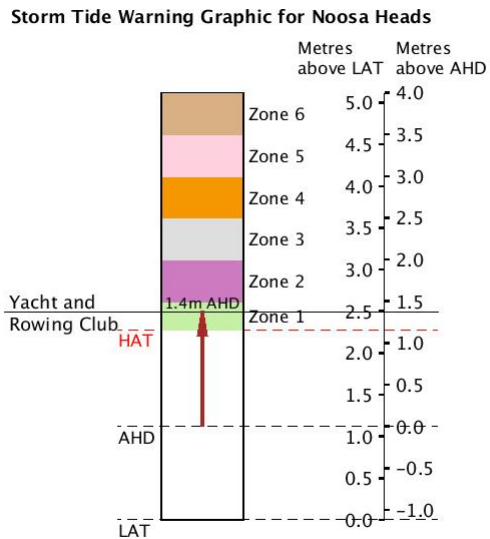


Figure 168. Yacht and rowing club: Chaplin Park, Gympie Terrace, Noosaville Qld, 4566

A56.2 Noosaville Boat Ramp

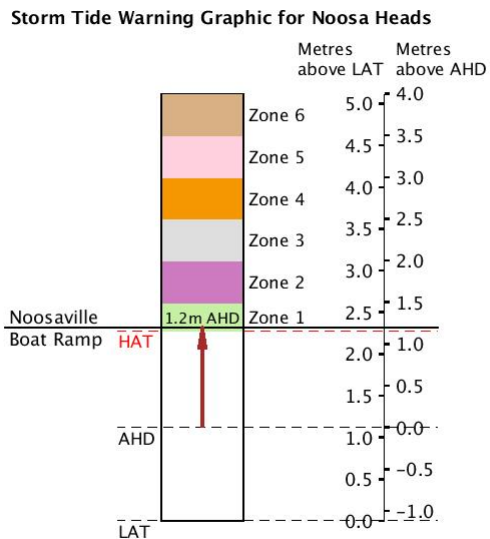


Figure 169. Public boat ramp: Gympie Terrace, Noosaville Qld, 4566

A56.3 Noosa Surf Club

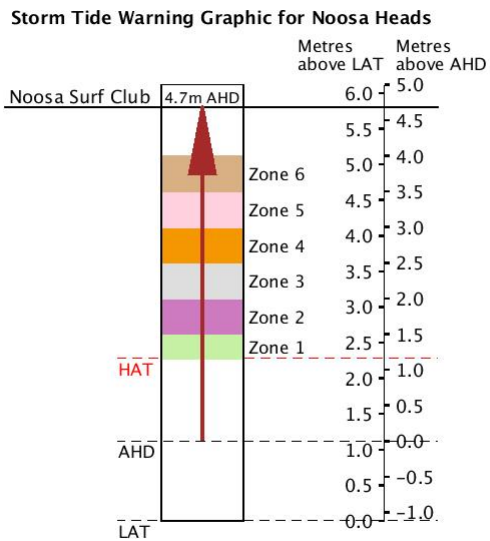


Figure 170. Surf Club: 69 Hastings Street, Noosa Qld, 4567

A57 Mooloolaba

Mooloolaba lies within the Sunshine Coast region at the mouth of the Mooloolah River. The Mooloolah River itself houses a marina as well as extensive canals with many waterfront properties built along the banks. The main commercial area of the region is located along the front of the beach. There is a reinforced foredune along the front that may provide some protection for businesses as reflected in the SLSC tower landmark. The area along the spit shows it to be lower in elevation as it extends out to the break wall which can be seen in the Sunshine Coast Water police landmark. Cotton Tree pier was included at the request of Sunshine Coast Council as it gives a gauge of the levels seen at the mouth of the Maroochy River to the north.

A57.1 Sunshine Coast Water Police

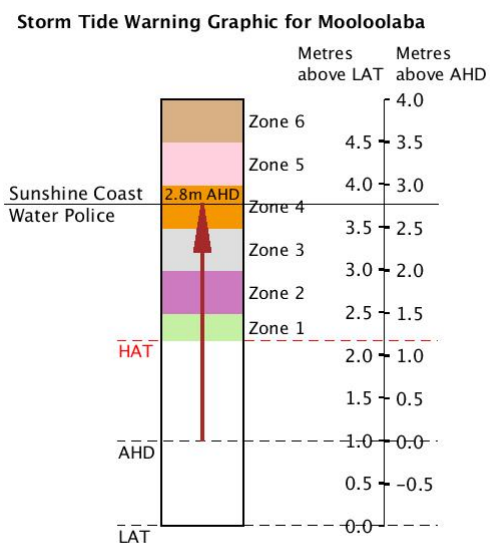


Figure 171. Sunshine Coast Water Police: Fishery – Boat Patrol, 18–20 Parkyn Parade, Mooloolaba Qld, 4557

A57.2 Surf Life Saving Tower

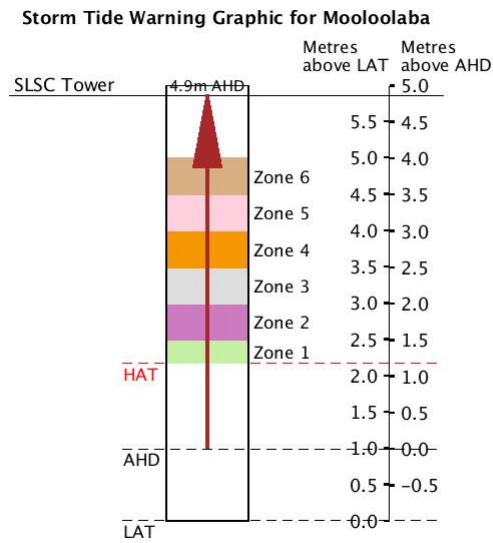


Figure 172. Surf Life Saving Tower: The Esplanade, Mooloolaba Qld, 4557

A57.3 Cotton Tree Eastern Pier

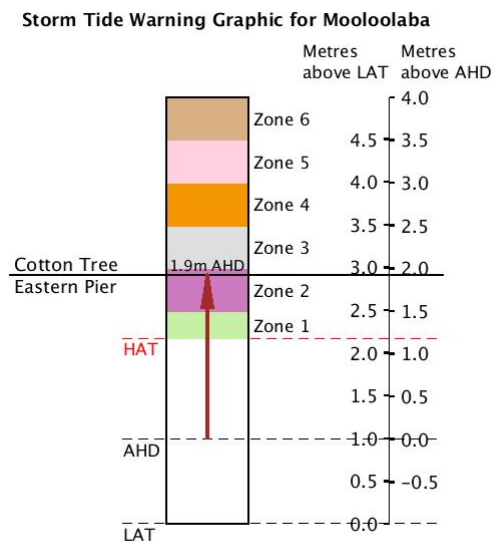


Figure 173. Cotton Tree Eastern Pier: 43 The Esplanade, Maroochydore Qld 4558

A58 Golden Beach

Golden Beach, a suburb of the Sunshine Coast, is located at the northern end of the Pumicestone Passage sheltered by Bribie Island. The area is mostly flat with a rocky headland towards Caloundra in the north. The landmarks selected were done so to illustrate the elevations seen at the coast within the passage. A landmark was also selected at Kings Beach (Caloundra SLSC), as this is a key area for the region.

A58.1 Military Jetty

Storm Tide Warning Graphic for Golden Beach

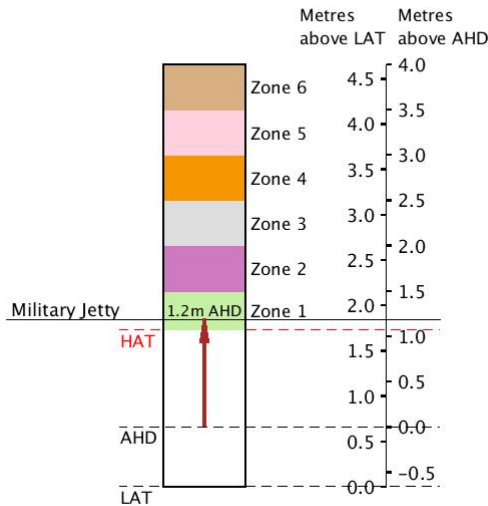


Figure 174. Military Jetty: 127 Esplanade, Golden Beach Qld, 4551

A58.2 Caloundra Surf Lifesaving Club

Storm Tide Warning Graphic for Golden Beach

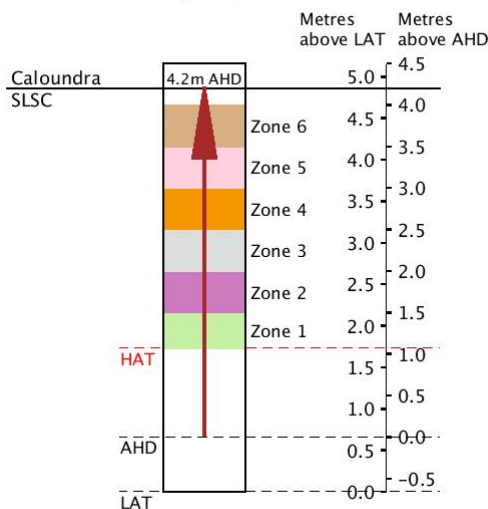


Figure 175. Surf Life Saving Club: Pedestrian, Kings Beach Qld 4551

A58.3 Caloundra Esplanade Boardwalk

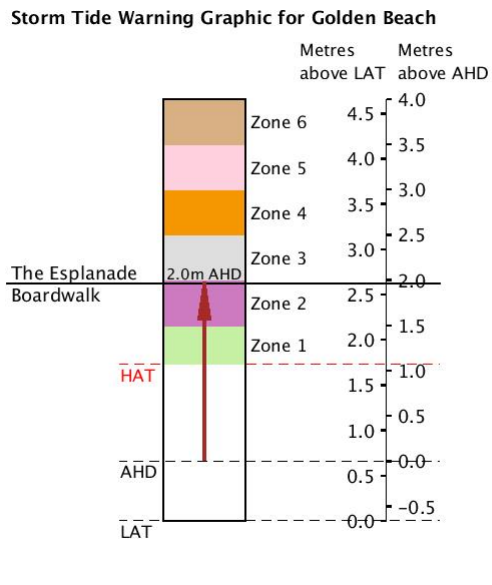


Figure 176. Caloundra Boardwalk: The Esplanade, Golden Beach Qld, 4551

A59 Scarborough Boat Harbour

Scarborough is located on the north face of the Redcliffe Peninsula protected to the east by Moreton Island. Some substantial wetland communities exist around the region, while Scarborough and the rest of the Redcliffe Peninsula are heavily developed. The chosen sites were selected to give a good indication of the coastal levels across the Redcliffe Peninsula.

A59.1 Scarborough Public Jetty

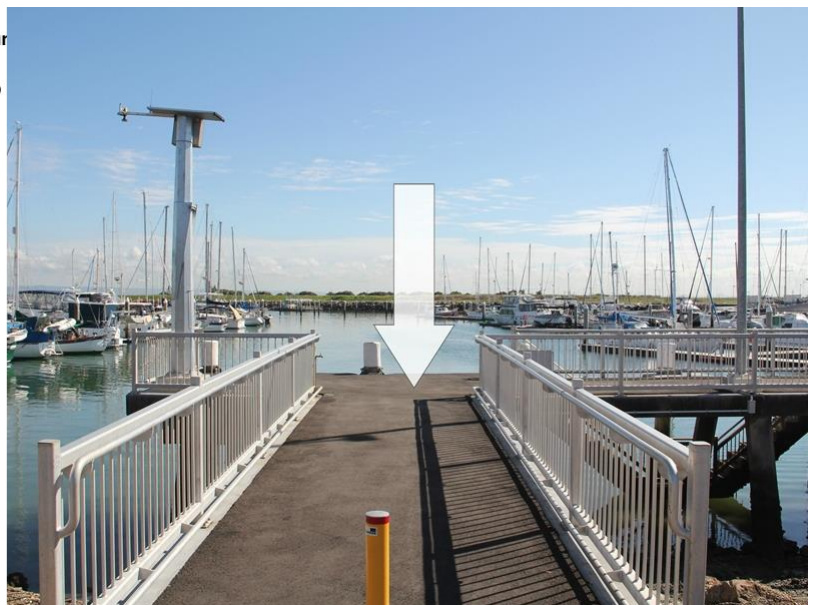
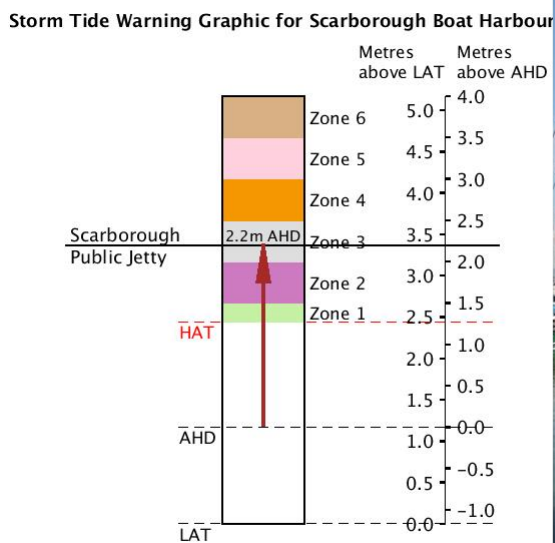


Figure 177. Public Jetty: Bird O'passage Parade, Scarborough Qld, 4020

A59.2 Redcliffe Public Jetty

Storm Tide Warning Graphic for Scarborough Boat Harbour

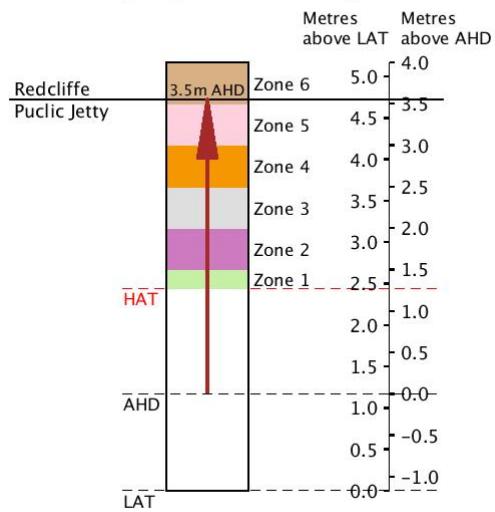


Figure 178. Public Jetty: 160 Redcliffe Parade, Redcliffe Qld, 4020

A59.3 Woody Point Jetty

Storm Tide Warning Graphic for Scarborough Boat Harbour

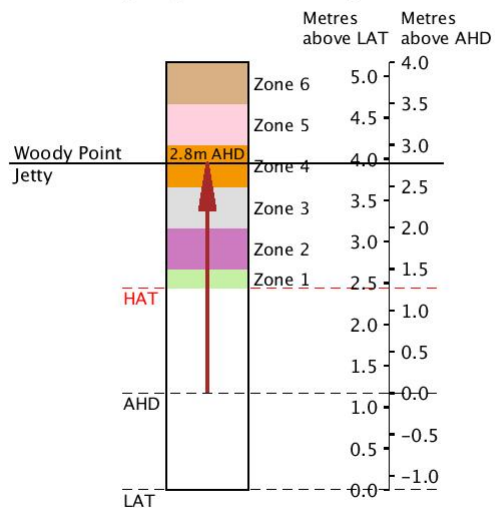


Figure 179. Public Jetty: Oxley Ave, Woody Point Qld, 4019

A60 Brisbane River

As the capital city of Queensland, Brisbane houses the largest concentration of people in the state, with the population in the city expected to increase. The river itself has significant tidal influence, however; will show difference in levels between the coast and the city. Sites were selected based on a need to convey critical information rapidly to disaster management personnel. Nudgee Beach was selected to give a rapid assessment for at risk communities, whilst Teneriffe Ferry Terminal was selected due to its proximity to the city. Information regarding the level of the Brisbane Airport runway was provided by the Brisbane Airport Corporation Pty Limited. The landmark itself was selected as it is a key piece of infrastructure along the coast that many people will recognise, and any impacts on the Brisbane Airport would be critical information for disaster management personnel.

A60.1 Teneriffe Ferry Terminal

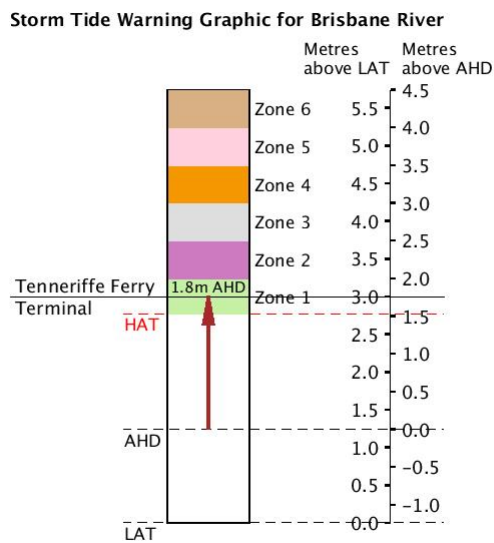


Figure 180. Teneriffe ferry terminal: Commercial Rd, Newstead Qld, 4005

A60.2 Nudgee Road, Pedestrian Crossing

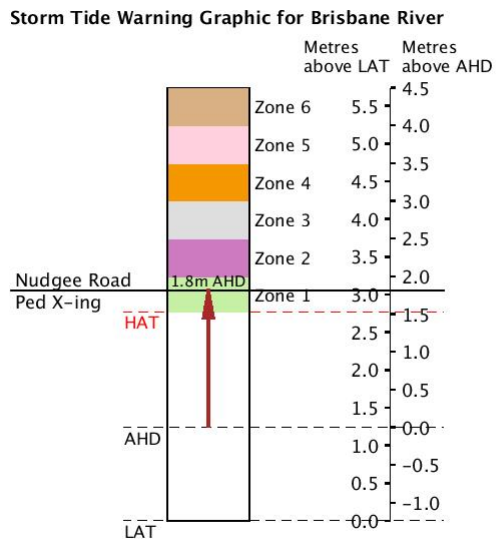


Figure 181. Pedestrian Crossing: Nudgee Road, Brisbane Airport Qld, 4008

A60.3 Brisbane Airport Runway East

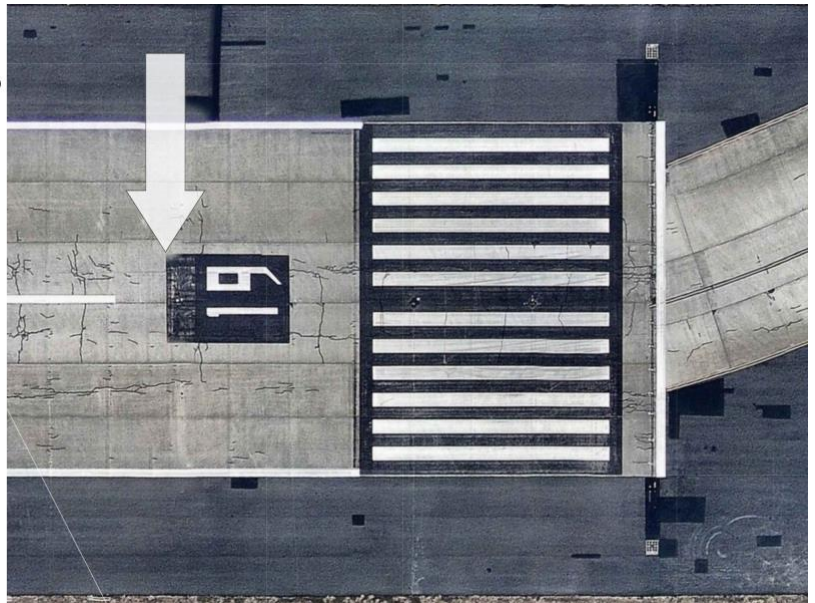
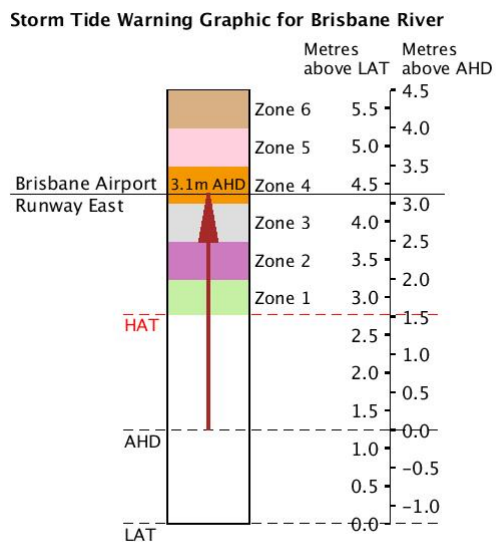
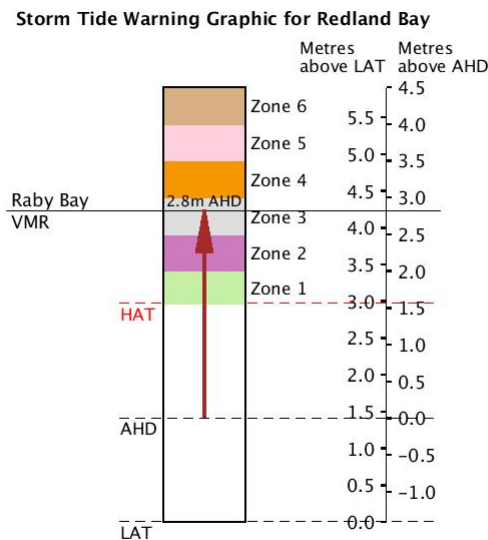


Figure 182. Brisbane Airport Runway East: Stradbroke Way, Brisbane Airport Qld, 4008

A61 Redland Bay

Redland Bay is situated on the coast eastward of Brisbane barred and is from the open ocean by North Stradbroke Island. There are a number of small islands located within the bay, some of which have substantial infrastructure and a number of permanent residents. There are a number of areas with extensive mangrove coverage along the coast. Sites were selected at Victoria Point and Redland Bay marina due to the similar elevation of the surrounding communities, in addition to being significant points for the maritime community and evacuation points to the mainland for the Island communities.

A61.1 Raby Bay VMR



A61.3 Redland Bay Marina Bus Stop

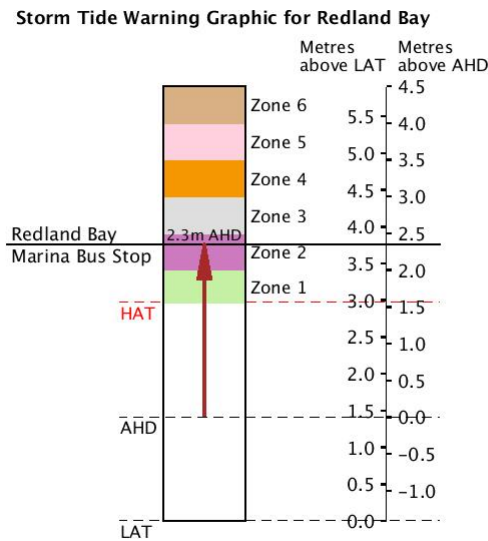


Figure 185. Marina Bus Stop: 553 Banana Street, Redland Bay Qld, 4165

A62 Southport (inside The Broadwater)

Southport is considered to be the central business district of the Gold Coast. The Broadwater is a large coastal lagoon connected to the open ocean via a channel at the northern end of the Spit. It is the terminus of a number of rivers in the region. While it is shielded by Main Beach to the east, as well as South Stradbroke Island, the area is developed on a broad floodplain (McInnes, Hubbert, Oliver, & Abbs, 2000). The landmarks selected show the levels directly at the water front of the Broadwater. Effects further upstream should also be considered.

A62.1 Pier

Storm Tide Warning Graphic for Southport (in Broadwater)

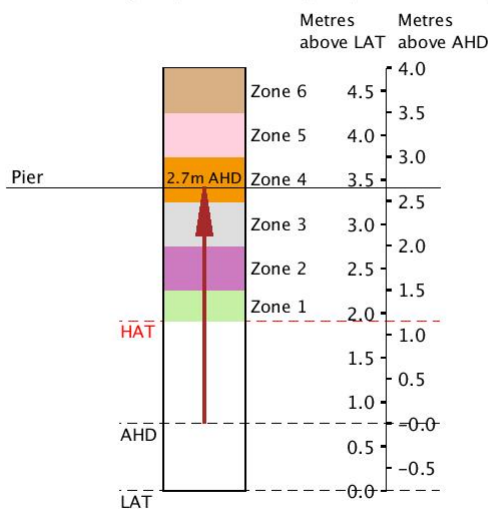


Figure 186. Pier: Marine Parade, Southport Qld, 4215

A62.2 Boat Ramp

Storm Tide Warning Graphic for Southport (in Broadwater)

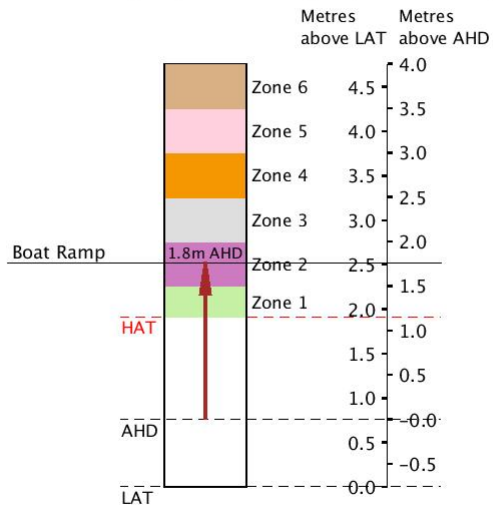


Figure 187. Boat Ramp: Marine Parade, Labrador Qld, 4215

A62.3 Sundale Bridge underpass footpath

Storm Tide Warning Graphic for Southport (in Broadwater)

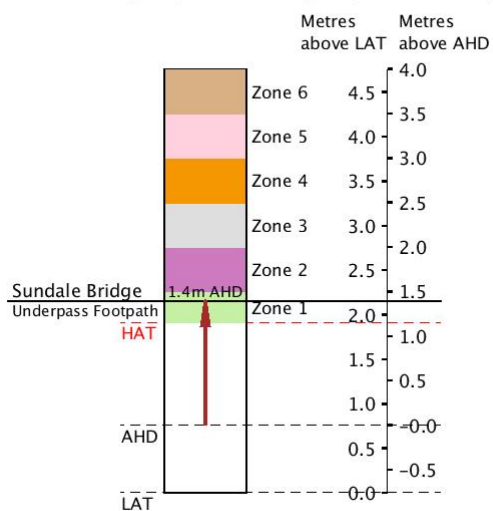


Figure 188. Sundale Bridge underpass footpath: Southport Qld, 4215

A63 Main Beach

Main Beach is a suburb of the Gold Coast situated in front of the Broadwater and the mouth of the Nerang River stretching to the area known as the Spit. This landform shields the inner waters of the region. The majority of the foreshore has been extensively developed with a number of high-rise buildings scattered throughout. On the open ocean side of the coast there has been extensive rock wall protection systems installed which have now been covered by sand (Delft, 1970). Due to this, sites were selected to display the levels required to exceed this barrier.

A63.1 View Avenue Beach Access

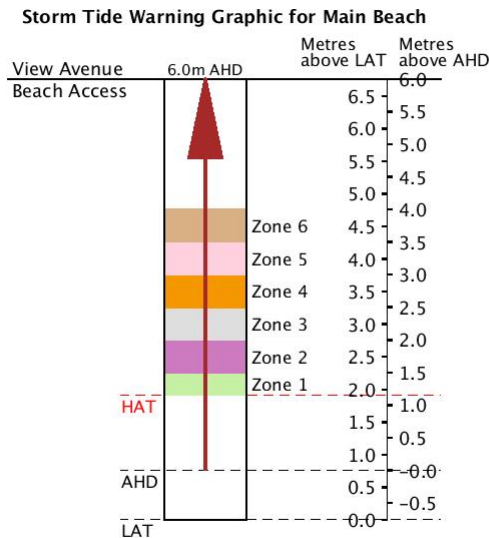


Figure 189. Beach access: Intersection of View Avenue and the Esplanade, Surfers Paradise Qld, 4217

A63.2 John Kemp Avenue Beach Access

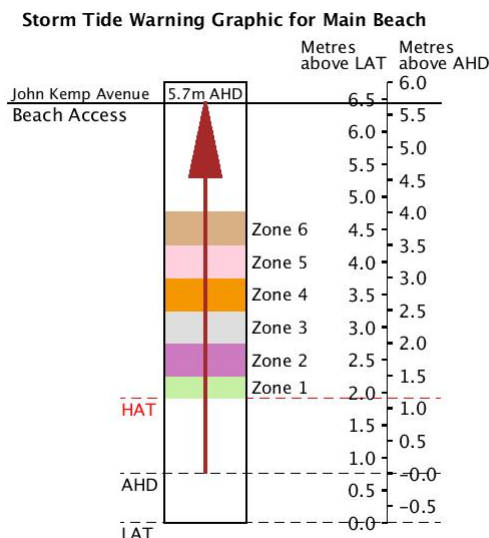


Figure 190. Beach Access: Intersection of John Kemp Street and Main Beach Parade, Main Beach, Qld, 4217

A63.3 Southport Surf Life Saving Club

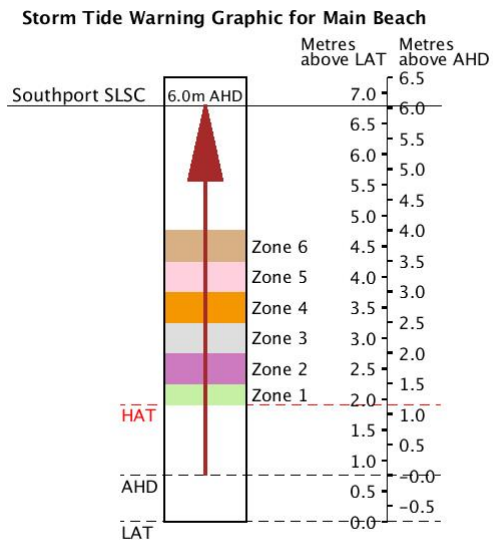


Figure 191. Surf Life Saving Club: MacArthur Parade, Main Beach Qld, 4217

A64 Coolangatta Beach

Coolangatta is the most southerly suburb of the Gold Coast and borders New South Wales. The coastline consists of sandy beaches separated by rocky headlands. The foredunes along the coast are shown to exceed HAT in most areas. Thus points were selected close to the beach in order to outline the heights that would be required to cause significant inundation in the area.

A64.1 Surf Life Saving Club Beach Access Ramp

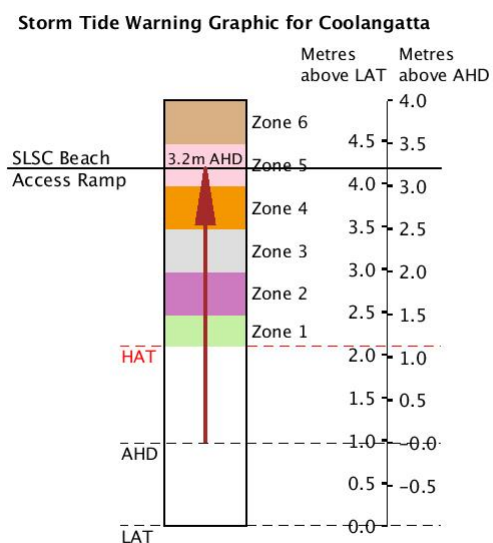


Figure 192. SLSC beach access ramp: Marine Parade & Hill Street, Coolangatta Qld, 4225

A64.2 Kirra Surf Life Saving Club Pavilion

Storm Tide Warning Graphic for Coolangatta

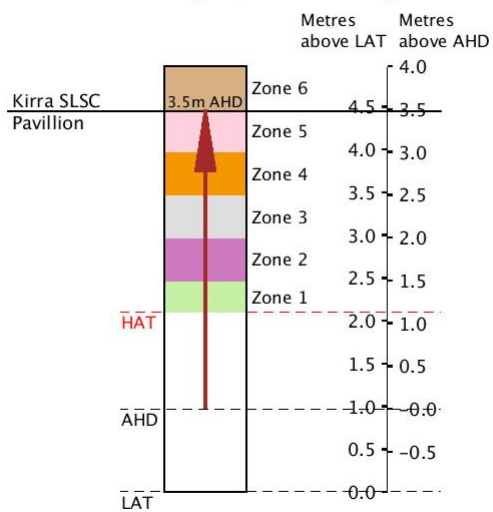


Figure 193. SLSC pavilion: 15 Marine Parade, Coolangatta Qld, 4225

A64.3 Groyne Helipad

Storm Tide Warning Graphic for Coolangatta

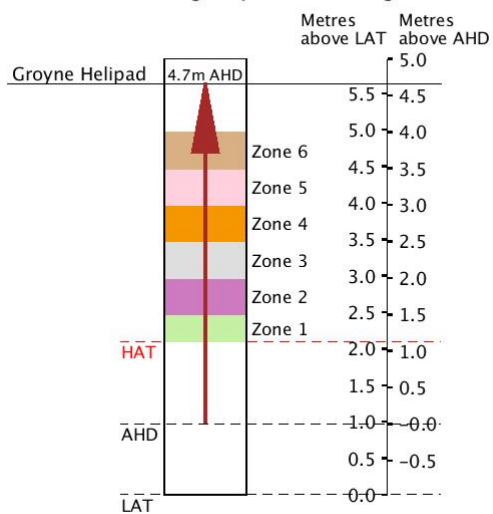


Figure 194. Groyne Helipad: Marine Parade, Coolangatta Qld, 4225