

# Construct an initial baseline habitat map using existing information

## Objective

To collect and interpret environmental information that is available for your estuary. Use this information to construct an initial baseline habitat map by recording it on a **topographic** map or aerial photograph of the estuary. The process of making your initial habitat map will also be helpful in developing an Estuary Monitoring Action Plan (E-MAP in the **Getting started** module).

## Background

An initial baseline habitat map can be developed based on existing information. Reliable sources of information include aerial photographs, **topographic** maps, and **hydrographic** (navigation) charts. You can also contact your regional or district/city council and government departments (e.g., the Department of Conservation) who may have undertaken studies of the estuary or its catchment. Councils will also have information on discharge points for stormwater pipes and resource consents. This type of information can be useful for identifying potential monitoring sites. Information on historical changes in the estuary and its land catchment is also very useful and aerial photographs provide some of the best information. Your local historical society or museum may have old maps and photographs. Other useful sources of historical information include government geological survey reports, some of which date back to the late 1800s. Members of your own hapū and local community may also have useful recollections and old photos. Where possible, use supporting information to confirm oral histories. These historical records can help you form an initial picture of how estuary habitats have changed over the last 50–100 years or so. This published information, as well as local knowledge of where habitats are or were in the past, will enable you to build your initial habitat map and reconstruct the pattern of past habitat changes.

In this section we will explain in detail the different types of existing information you can use to construct your baseline habitat map. We will also show you how to build an initial baseline habitat map using a real-world example.

## Topographic maps

Topographic maps of the land and hydrographic charts of the coast can be valuable sources of information on habitat types. Topographic maps include a wealth of information on catchment features such as vegetation types, land relief features (e.g., height contours), water features (e.g., rivers and streams, lakes, springs, waterfalls) and constructed features (e.g., roads, railways, tracks, bridges, towns, buildings, powerlines, pipelines, dams, etc.). Topographic maps may also include general information on estuaries such as: seabed type (e.g., reefs, gravel, sand, mud), marine structures (e.g., boat ramps, wharves, breakwaters, marine farms) and mangrove forest locations. The most useful topo maps are the 1:50,000 scale map series published by LINZ. Note that the old 260 series maps were replaced by the NZTopo50 series maps in 2009. The new NZTopo50 maps use a different coordinate system to the 260 series. This is something that you need to be mindful of if you intend to use topographic maps and/or GPS to construct your estuary habitat map and/or locate monitoring sites, benchmarks and other features.

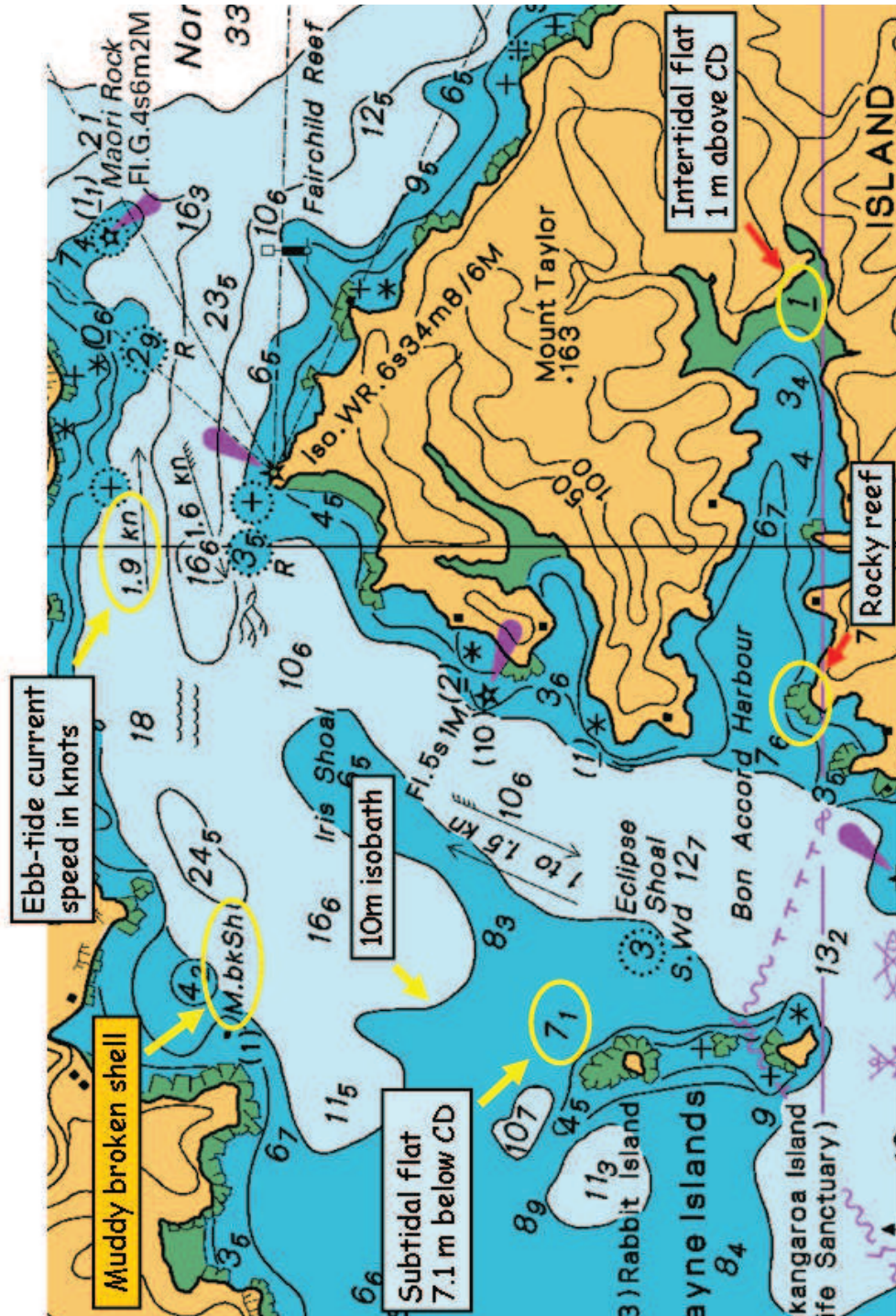
Electronic versions of the NZTopo50 maps can be downloaded from the LINZ website at [www.linz.govt.nz/topography/topo-maps/map-chooser/](http://www.linz.govt.nz/topography/topo-maps/map-chooser/) be sure to select the version "Full map with legend". The LINZ website also includes a useful guide to the NZTopo50 maps called "*How to use a Topographic map*" ([www.linz.govt.nz/sites/default/files/topography/publications-faqs/topo50-map-guide.pdf](http://www.linz.govt.nz/sites/default/files/topography/publications-faqs/topo50-map-guide.pdf)).

## Hydrographic charts

Hydrographic charts include information on water depths (underwater depth contours are called **isobaths**), location of intertidal and subtidal flats, seabed type, rocky reefs, mangrove forests and tidal current speeds in navigation channels. Intertidal areas (above low tide) are generally coloured light green and subtidal areas are coloured blue. The elevation of the seabed is represented by isobath contours as well as single values at particular locations, and are given relative to **chart datum** (CD). The CD is usually defined as the lowest astronomical tide observed at a nearby tide gauge. Intertidal areas are, therefore, above CD and are expressed with an underbar; for example, a 'water depth' value of  $\underline{1.2}$  represents a seabed at elevation 1.2 m above CD, whereas  $1.2$  indicates subtidal seabed that is at an elevation of 1.2 m below CD. (The relationship between elevation of the seabed expressed in this way and water depth can be tricky. For instance, when the tide is at that lowest astronomical level, the water depth at the subtidal site is 1.2 m, but at high tide it will be greater than that.) Hydrographic charts by their nature are intended to provide navigation information for mariners. This means that hydrographic information for most smaller estuaries that do not have a commercial port or marina(s) is often limited.

Electronic versions hydrographic charts can also be downloaded from the LINZ, (<https://data.linz.govt.nz/data/category/hydrographic-maritime/chart-images/>).

You should note that the information on topographic maps and hydrographic charts may be based on aerial photographs and surveys made many years ago. Hydrographic charts include a diagram or statement about when the survey information on which the chart is based was collected. This can be important for mapping present-day habitat types in your estuary as these can change over time. However, many natural/artificial structures, such as rocky reefs and wharves are unlikely to change their size or location over time.



Example of a hydrographic chart.

## Aerial photographs

Aerial photographs can often be used to identify historical patterns of environmental changes in estuaries and their land catchments. In New Zealand, aerial photographic surveys began in the 1940s and continue to the present time. These photo surveys provide some of the best records of past habitat changes in estuaries. Some of these aerial photographs can be sourced from regional and district councils and government departments, such as Land Information New Zealand (LINZ). For example, the LINZ website generally includes electronic versions of aerial photographs taken at 1:25,000 scale ([www.linz.govt.nz/topography/aerial-images/index.aspx](http://www.linz.govt.nz/topography/aerial-images/index.aspx)). The coverage is not complete and the oldest images available were taken in the 1990s. Regional and district councils are likely to be the best source of aerial photographs taken before the 1980s. Contact these agencies directly if aerial photographs are not available via their websites. Several photographic survey companies also hold historical aerial photos, however you will generally have to pay to access these historical photo records. Google Earth ([earth.google.com](http://earth.google.com)) is another source of aerial photographs, although the quality is not always good, depending on the location. Photos taken at low tide are the most useful as they will show the location and extent of the estuary habitats that are submerged at high tide and, therefore, not visible in aerial photos unless the water is shallow and very clear.

Aerial photographs are taken at a range of scales, typically anything from 1:5,000 to 1:50,000 being common. The scale indicates the conversion of distance on the photo to the real world. For example, a photo scale of 1:5,000 indicates that a 1 mm distance on the photo is equal to 5,000 mm (i.e., 5 m) on the ground. Ideally you should use aerial photos taken at 1:10,000 scale or better (1 mm = 10 m) to map saltmarsh and mangrove habitats. However, most aerial photos that are readily available are taken at scales of between 1:25,000 and 1:50,000. Use the largest scale aerial photos (i.e., smallest on the ground distance) that are available.

You should also be aware that the photo scale determines the accuracy with which you can measure the size, location or distance of an object. For example, you measure the distance from the start of a **transect** (drawn on a 1:20,000 scale photo) to the seaward edge of a mangrove forest as being 25 mm. The photo scale is 1:20,000, therefore, the distance to the seaward edge of the mangrove forest is  $(25 \times 20,000)/1000 = 500$  m. Most people can accurately measure distances on photos to no better than 0.5 mm, which is equivalent to  $(0.5 \text{ mm} \times 20,000)/1000 = 10$  m at a scale of 1:20,000. Therefore, the distance to the seaward edge of the mangrove stand is 500 m  $\pm$  10 m. The  $\pm$  symbol means plus or minus, so that the actual distance is somewhere between 490 and 510 m. You can obtain a more accurate measurement by measuring this directly in the field.

Becoming confident at identifying the different types of estuary habitats from aerial photos does take some practice. Colour photos are best as differences in vegetation and sediment types stand out much more than in black and white photos. Vegetation types can usually be identified from black and white photos



by differences in texture, but sediment types may be hard to identify apart from sandflats or shell banks. Sun reflecting off these sediment types at low tide make them look white, whereas muds or muddy sands are grey in appearance. In colour photographs, mudflats will typically have a yellow/brown appearance.

Note that where aerial photographs or any other images are reproduced or copied you should always acknowledge the source. For example, LINZ requests the following acknowledgement when aerial photographs are used: “Sourced from Aerial photography S.N. XYZ. Crown Copyright Reserved”, where S.N. XYZ is the geographic area and/or serial number of the photo(s) used.

## Historical information

The local historical knowledge of your hapū and local community can also be used along with the historical aerial photos, topographic maps and hydrographic charts to map where habitat changes have occurred in the past. Historical photographs can also be useful, for example in showing the past extent of different habitat types. Vegetated habitats, such as saltmarsh, seagrass meadows and mangrove forests are generally easier to identify than unvegetated habitats such as mudflats and sandflats because they have different textures. This is particularly true of older black and white photos, where colour differences are absent. Changes in tidal channel size and/or location can also be identified using aerial photographs taken at low tide. Historical photographs taken at ground level or low-level aerial oblique photos can provide more information about particular sites because they contain more close-up detail. Historical survey (cadastral) maps and reports can also be useful sources of information. Your local museum, library, historical society and council are likely to have this type of information.

## Local knowledge and other sources of information

Your kaumātua and kuia will also be good sources of information on environmental changes that have occurred in your estuary during their lifetimes. Also, hapū members that have lived away for many years but have then returned may more readily notice environmental changes that have resulted in noticeable habitat changes. Your estuary may also contain special ecological, cultural or historical sites of value to your hapū and/or local community. This could include the location of your marae and areas that provide kaimoana. You should include these sites of significance on your estuary habitat map.

Because the activities on land create some of the major sources of pollution in estuaries, it is useful to map potential pollution sources and outlets (discharge points) to the estuary. Topographic maps, recent aerial photographs, council stormwater plans, and resource consents can provide this information.

## Links to other modules and methods

- Sediment module
- Plant module
- Shellfish module
- Fish module
- Water Quality module

## Summary of method

Prepare your initial baseline habitat map using existing information that you have collected from various sources. Information sources include topographic maps, hydrographic charts, aerial photographs, and local knowledge. Record the habitat information on a topographic map or aerial photograph of your estuary.

## Equipment needed

To construct your initial baseline habitat map you will need:

- a topographic map and/or recent aerial photograph of the estuary to record information on.

We recommend that you use the most recent colour aerial photo taken near low tide. If possible, print at least two A3 colour copies. Use one copy for your draft baseline habitat map and use the other copy to draw your 'good' version.

If the estuary is large then you may not be able to see enough detail on an A3 size map. Avoid this problem by dividing your estuary into smaller areas and prepare a baseline habitat map for each area. This is also recommended when “Ground truthing your baseline habitat map” (outlined in the section that follows).

If you can we recommend that you laminate the topographic map or aerial photograph. You will take this waterproof version into the field to make notes, change habitat boundaries, etc., when you ground-truth the map.

- any existing sources of information you can access (e.g., topographic maps, historical aerial photographs, hydrographic charts, historical photographs, council stormwater plans and reports, resource consents, local knowledge).
- felt-tip pens (waterproof, various colours), pencils, etc.

## Data collection and management

Use a topographical map or aerial photograph to record your baseline habitat map.

## How to: Build your initial baseline habitat map

- 1 Sit at a large table or on the floor and spread all your information out in front of you.
- 2 Using the aerial photograph or topographic map of your estuary as a base map, start to add information. It can be helpful to colour code the information. For example, record all of the kaimoana beds as red circles and colour all of the saltmarsh habitats in green.
- 3 The first information that you might want to record is the location of all the kaimoana beds.
  - Draw a line around all the kaimoana beds on your base map. You could also record whether they are historical shellfish beds or shellfish beds that your hapū currently harvest
  - Note the type of kaimoana bed (e.g., Pipi, Pūpū, Tuangi)
  - Has the size of the kaimoana bed increased or decreased over time? If the answer is yes and you have the historical information, then you can draw the approximate past and present boundaries of the kaimoana bed on your base map. Record the year(s) next to each of these boundaries (e.g., 1950s, 2010).



Using an aerial photograph to build your baseline habitat map.

- 4 The next information you might want to record on your base map is the different plant habitat types as these are usually the easiest habitat to identify. These habitats include saltmarsh, seagrass meadows and mangroves (refer to the **Habitat Field ID Guide** for detailed descriptions). Use a different colour or shading for each of these habitat types. Once again, if you have historical information, draw the approximate past and present boundaries of the mangroves on your base map. Old black-and-white aerial photos taken during the 1940s–70s may be the best source of historical information.
- 5 Now add the boundaries of the tidal channels at low tide. The location of tidal channels is best seen on recent aerial photos taken at low tide. Hydrographic charts can also provide useful information, such as the water depths in the channels.
- 6 Next draw in the bare tidal flat habitats. These occur between the low tide channels and the lower boundaries of the saltmarsh and/or mangrove habitats. These tidal flat habitats include sandflats, mudflats and muddy-sandflats. Shell banks may also occur in some estuaries. Large-scale colour aerial photos are best for identifying the boundaries between these bare tidal flat habitats.
- 7 Record the locations of discharge points where potential pollution sources enter the estuary. These include river and stream mouths, drain outlets and stormwater pipes. Other potential pollution sources include septic tanks and landfills (historical and active).
- 8 Draw boundaries around any landuses within the catchment, e.g., forestry, dairy farming, industry.
- 9 You can also map the state of your estuary's shoreline, such as areas that have been modified by the construction of sea walls, reclamations, boat ramps, wharves, marine farms, urban areas, and roads.
- 10 You should also record important access point like boat ramps. This will help when your selecting transect sites.
- 11 Lastly, add any local and/or historical information collected from your hapū or local community that you think is useful or relevant.
- 12 Once you have built your baseline habitat map using all your available information, you then need to ground-thruth your map to check its accuracy.
- 13 The next section of the habitat module outlines how to select your survey sites, select your transect sites, install marker pegs, establish transect lines and ground-truth your habitat map.



## Case study: Building a baseline estuary habitat map

So far we have described the various types and sources of information that you can use to build a baseline estuary habitat map using existing information. In this section we will show you how to build the habitat map using a real-world example. The Whangateau estuary on Auckland's east coast is one of many small estuaries that border the shore of the Hauraki Gulf.

### What information is available to help build up a picture of the Whangateau estuary?

The topographic map Topo50 map AZ32 Kawau Island (1:50,000) scale includes the Whangateau estuary (refer to the image on following page). The topographic map shows the land contours around the estuary, the locations of streams, the types of landuse, and the locations of townships, roads, bridges, and other man-made features. The main settlement of Omaha was built on the sandspit in the mid 1970s. The map also shows buildings/dwellings (small black squares) spread around the shoreline. A causeway built across the southern arm of the estuary links Omaha township to the main access road, and restricts tidal flows in and out of the southern arm of the estuary. The map also provides basic information about habitat types in the estuary, such as areas of mangrove and sediment type (sand, mud and sand, rocks).

Potential sources of pollution include the freshwater streams that discharge to the estuary. Streams discharge at nine locations, six of which are in the northern arm of the estuary. Stormwater runoff from roads in and around Omaha township also discharge to the estuary through stormwater pipes and drains. However, the locations of these pipes/drains are not shown on the topographic map. Septic tanks for older holiday homes/bachs are another potential source of pollution. This information can be obtained from the district council and/or a walk around the estuary shore to locate the stormwater pipe/drain outlets. The topographic map also shows that more than half of the catchment is farmed, so runoff from pasture used by cattle and/or sheep is another potential source of pollution. Most of this farmland discharges to the northern arm of the harbour via the Omaha River.

As previously mentioned, environmental monitoring and technical studies undertaken by regional and district councils can be a useful source of additional information. In this Whangateau estuary example, the regional council website has an electronic library of technical reports that can be downloaded free of charge. A technical report (ARC Technical Report 2009/004) which reviewed environmental information relating to the Whangateau estuary was obtained. Although the report concluded that water quality in the estuary was very good, it did identify potential sources of pollution discharging to the estuary:

- **leachate** from the historic Ti Point landfill site
- septic tank overflow from Point Wells when groundwater levels are high during extreme high tides and after heavy rainfall. The septic tank leakage was detected by high concentrations of faecal indicator bacteria in shellfish after rainstorms.

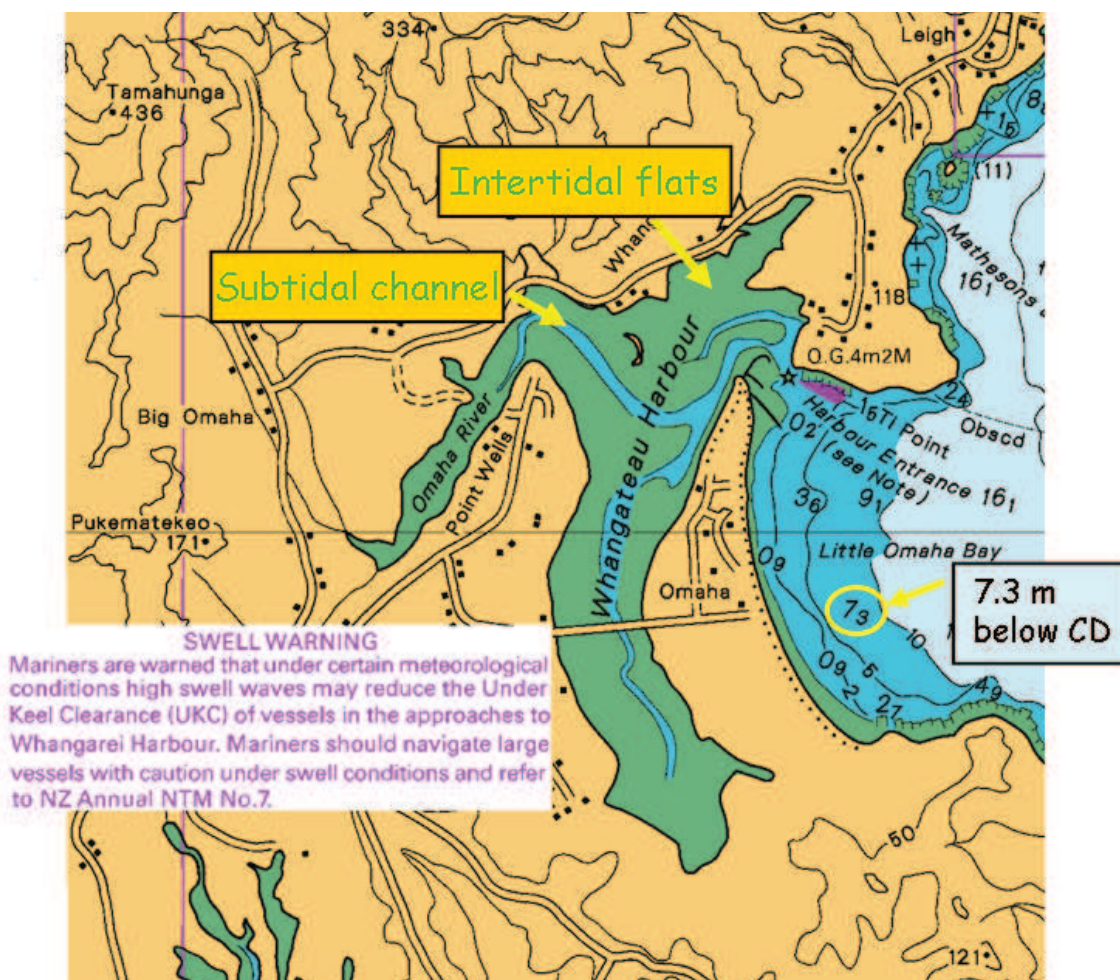
This type of information can be included in the design of your E-MAP.




Topographic map of the Whangateau estuary and surrounds (Topo50 map AZ32 Kawau Island) showing natural features such as the tidal flats, streams, land contours, landuse and artificial structures such as settlements, roads, causeways, buildings, and jetties. The location of stream mouths and potential pollution sources at Point Wells and Ti Point are identified. Source: LINZ.



The hydrographic chart NZ522 downloaded from the LINZ website includes the Whangateau estuary. This chart shows the extensive intertidal flats (green areas) separated by narrow subtidal channels (blue areas), which drain the two main arms of the estuary. Apart from this general description, the chart provides few other details about the estuary. Note the depth contours in Little Omaha Bay show the water depth in relation to chart datum (CD).

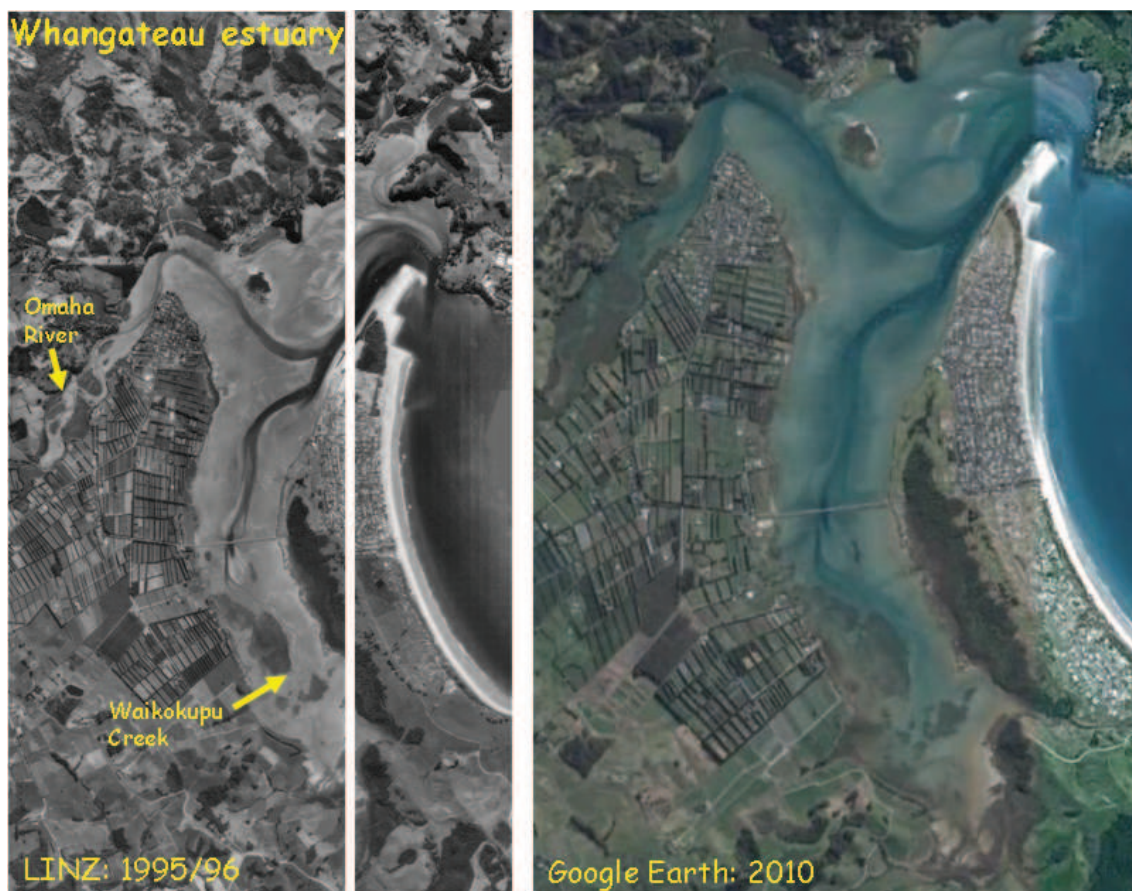



 Hydrographic chart of the Whangateau estuary (Chart NZ522) showing the extent of intertidal flats (green areas) and subtidal channels (blue areas). Water depths in Little Omaha Bay are shown in relation to chart datum (m CD). Source: LINZ.

Aerial images downloaded from the internet provide useful information on how the Whangateau estuary and catchment have changed over time. The black-and-white image below is an aerial photograph taken at low tide in 1995 and the colour image is a high-altitude Google Earth satellite image from 2010. The grey colour of the estuary sediments suggests that they are muddy sands whereas the clean quartz sands on Omaha Beach strongly reflect sunlight and appear white.

Comparison of the 1995 and 2010 images indicates two apparent habitat changes in the estuary:

- 1 an increase in the area of seagrass on the intertidal flats in the Waikokupu Creek
- 2 an increase in the area of mangrove habitat in the upper reaches of the Omaha River.




 Aerial photographs of the Whangateau estuary. The black and white photos (1995) were downloaded from the LINZ website. The 2010 photo is a satellite image (CNES/Spot) that was downloaded from the Google Earth website. Environmental changes, such as the spread of the Omaha township to the southern half of the sand barrier, can be identified by comparing these two images.

As it turned out, the regional council had a much better quality colour aerial photograph of the Whangateau estuary that was taken in January 2008 (see below). Although the photograph was not taken at dead low tide, the high water clarity and shallow depth of the estuary allows submerged habitats to be easily identified. We can use this photograph to demonstrate how to use aerial photographs to further inform the baseline habitat map.



Look closely at the aerial photo on the previous page. One of the easiest things to see is where the channels are, as they are often a greenish blue colour if the photo was taken at low tide. You can also usually see vegetation such as mangrove forests, seagrass meadows, and saltmarsh on very high-resolution photographs like this Whangateau example.



 Aerial photograph of the Whangateau estuary (January 2008). A variety of habitat types are visible in the photograph. The tidal channels appear greenish blue in colour. Vegetated habitats such as mangrove forests, seagrass meadows and saltmarsh can also be seen. Shell banks on top of sand banks are clearly visible as they reflect sunlight. These shell banks indicate that shellfish beds could be nearby but a field survey will be required to confirm where the present shellfish beds are located. Source of photo: Auckland Council.



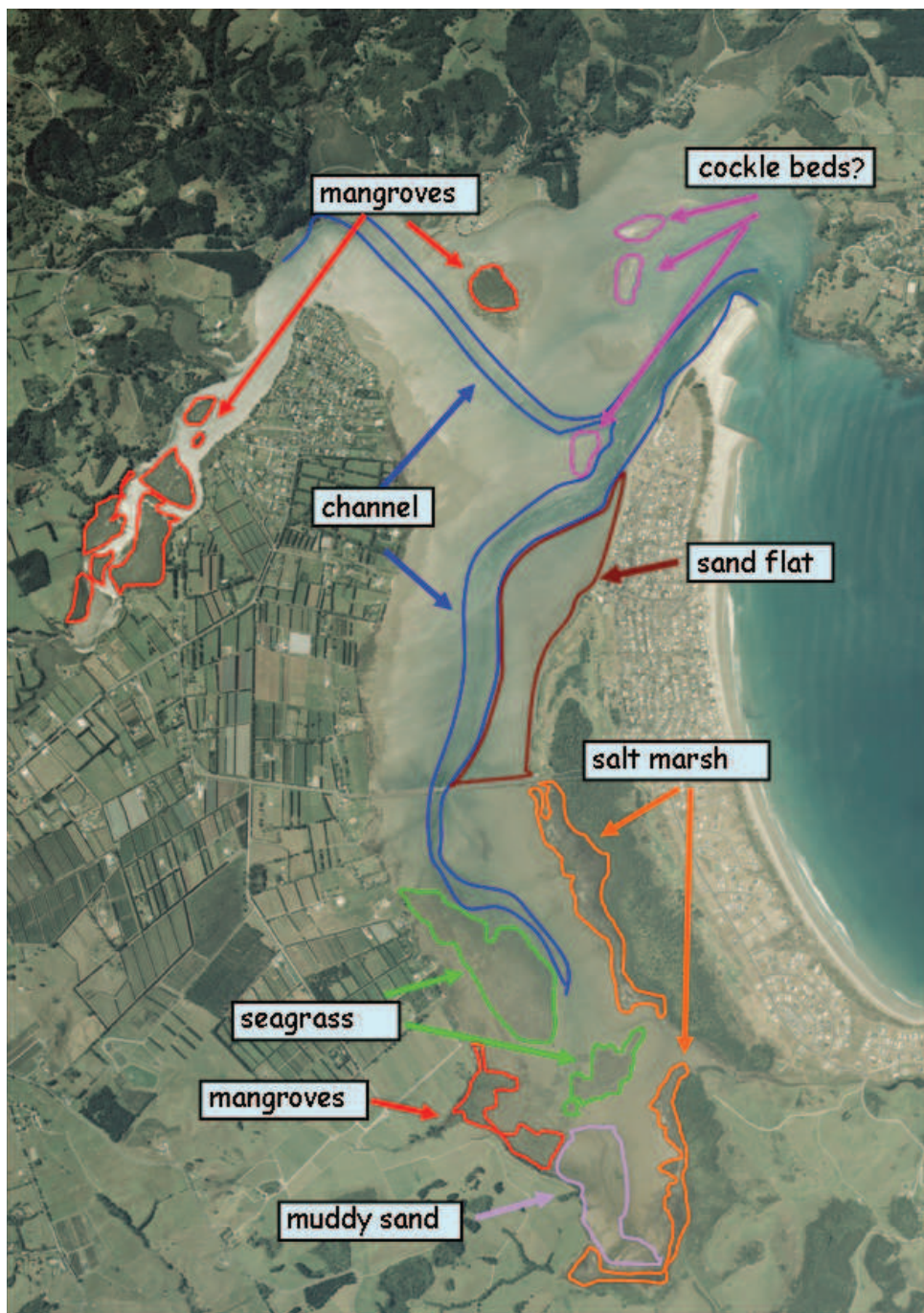
In Whangateau there are mangrove islands in the Omaha River and in the northern part of the main estuary. Also, you can see some areas with very dense mangroves, and other areas where sparse individual trees occur on the intertidal flats. If you are interested in monitoring how quickly areas of sparse mangroves become dense mangrove forest, you can separate mangroves into two habitat types such as 'dense mangrove forest' and 'sparse mangroves' and collect information on vegetation cover. The **Plant module** provides tools to do this.


Shell banks on top of sand banks may be located near shellfish beds and you can often see the white reflection of the shells on the surface in an aerial photo, like the ones circled in the photograph. If you know where other shell banks are that you can't see in the photo, circle their location as well.

Notice that you can also see many features on the land around the estuary, such as forest, pasture, vineyards, orchards, and urban areas. You may not be able to tell if the trees are native or pine forest from the photograph, but this information can be obtained from the topographic map. If you look carefully, you can identify the estuary shoreline (i.e., high-tide mark) and boundaries between vegetation types such as where the saltmarsh borders the forest on the eastern shore of the estuary and south of the causeway. If you have an electronic version of the aerial photograph, you can use these to 'zoom in' on areas that you want to look at in more detail. You should also locate where your marae is on the baseline habitat map and important access points like boat ramps.

Finally, it is often difficult to identify sediment types from aerial photographs. Mud and sand and muddy sand often look much the same, though occasionally some black sands or white beach sands (like Omaha Beach) do stand out in aerial photographs. Topographic maps and hydrographic charts may provide basic information on sediment types in your estuary but often not in sufficient detail and the information will not usually be up to date. If you know where the mudflats and sandflats are from your own knowledge of the estuary, you can label them in your habitat map. Otherwise, this task should be included in the ground-truthing exercise when you go out in your estuary so that you can confirm which areas without vegetation are muddy and which are sandflats. For consistency, use descriptions provided in the **Sediment module**.

The next section of the habitat module we will show you how to select your survey sites, select your transect sites, install marker pegs, establish transect lines and ground-truth your habitat map.



 Baseline estuary habitat map of the Whangateau estuary. This map is based on existing information including aerial photographs, a topographic map, a hydrographic chart, local knowledge and council reports. More realistic outlines of vegetation and shellfish banks are outlined. Source of photo: Auckland Council.