# Broad scale mapping of the Estuary of the Heathcote and Avon Rivers/Ihutai

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## Background

Broad scale habitat mapping is a method that is used to document the key habitats within an estuary. This mapping also provides data that allow for an assessment of sedimentation, eutrophication and habitat loss of an estuary.

The mapping of the Estuary of the Heathcote and Avon Rivers/Ihutai (Figure 1) was carried out as part of an Environment Canterbury project. This project is the broad-scale habitat mapping of the non-vegetated areas of estuarine intertidal flats in Canterbury. Saltmarsh vegetation and vegetated margins were not included in this mapping. Saltmarsh vegetation and vegetated margins for Canterbury estuaries were mapped by Environment Canterbury in 2004-2011 (Grove *et al*., 2012).

To date such mapping has been carried out in Te Akaaka (Ashley River/Rakahuri Saltwater Creek Estuary), Brooklands Lagoon, the mudflats of upper Lyttelton Harbour/Whakaraupō, the mudlfats of Port Levy/Koukourararata, Okains Bay, Le Bons Bay and the mudflats of upper Akaroa Harbour. The Estuary of the Heathcote and Avon Rivers/Ihutai is the final estuary to be mapped as part of this project.

This broadscale habitat mapping Canterbury estuaries aims to:

1 Provide broadscale habitat data for the non-vegetated intertidal zone in each estuary.

2 Assess the present sedimentary and eutrophic status of the non-vegetated zone of each estuary.

3 Identify potentially at-risk estuaries in Canterbury.

4 Provide broad scale habitat mapping data for use in conjunction with fine scale intertidal data, water quality data and broad scale vegetation mapping to classify ecosystem health and prioritise estuaries for monitoring.

5 Provide baseline data against which future broadscale habitat mapping can be compared.

6 Provide data that will allow planners and decision makers to make informed decisions relating to estuarine health in Canterbury.

## Broad scale habitat mapping

Broad scale habitat mapping is one of the tools described in the national Estuary Monitoring Protocol (EMP) (Robertson *et al.,* 2002). The EMP provides standardised processes and methodologies for assessing the status of and then monitoring of estuaries. The broad scale habitat mapping was designed to map the spatial distribution of substrate within the non-vegetated intertidal areas of an estuary. Substrate is classified by particle size, biogenic habitat such as shell bank and dominant species, such as seagrass and macroalgae. The classification used to define the substrate types (Table 1) is the adapted version of the UNEP-GRID classification.

**Table 1: Estuarine substrate and habitat type classifications used in this study**
(from Appendix 1, Robertson *et al*. 2002)

| Level I Hydrosystem | Level IA Sub-System | Level II Class | Level III Structural Class |
|---|---|---|---|
| Estuary (alternating saline and freshwater) | Intertidal/ supratidal | Macroalgal bed | Macroalgal bed<br>-High cover<br>-Medium cover<br>-Low Cover |
| | | Saltmarsh Vegetation | |
| | | Seagrass Meadow | Seagrass Meadow |
| | | Mud/ sandflat | Firm mud/sand<br>Firm sand<br>Firm mud/sand/clay<br>Mobile sand<br>Mobile firm mud/sand<br>Mobile soft mud/sand<br>Soft mud/sand<br>Soft sand<br>Very soft mud/sand |
| | | Stonefield | Stone/cobble<br>Stone/cobble/sand<br>Firm sand/gravel |
| | | Boulderfield | Boulder/cobble<br>Boulder/cobble/sand |
| | | Rocky Shore<br>Shell Bank | Rocky Shore<br>Shell Bank |
| | Subtidal | Water | Water |

In 2002, a broad-scale map of Estuary of the Heathcote and Avon Rivers/Ihutai was produced (Robertson *et al.,* 2002). This map is shown in Figure 2. Since 2002 there has been a significant change in estuary bathmetry and hydrodynamics as a consequence of the 2010-2011 earthquake series. By repeating the broad scale mapping it is possible to assess how these changes have influenced the seabed sediments within the estuary.

## Study Area


**Figure 1: Estuary of the Heathcote and Avon Rivers/Ihutai (2012, aerial view)**

## Field Procedure

The estuary was sampled on foot between January and June 2016. To reach the middle areas, kayaks were used as the channels were too deep to wade across. A health and safety plan was implemented in regard to the use of kayaks for this work.

In order to record the substrate boundaries, GPS point data was collected on iPads using the Collector app. Aerial photographs were used as background imagery to help map the boundaries. A polygon shapefile was created using the point data in ArcMap 10.3.

Details on the categories used to map the substrates are provided in Table 1. Details on the categories used to assess macroalgae cover are provided in Table 2.

**Table 2: Categories used to describe macroalgae per cent cover**

| Category | Percent Cover |
|---|---|
| Low | ≤ 30% |
| Medium | 30% - 70% |
| High | ≥70% |

## 2002 results

In 2002, the total mapped intertidal area in estuary was 493.8 ha. The dominant intertidal substrates were firm/mud sand, mobile sand and firm sand (Table 3, Figures 2 and 3).

Substrates characterised by high silt content (soft mud/sand and very soft mud/sand) were most common at the river mouths, where they enter the estuary. In comparison, the firmer substrates were closer to the estuary mouth and the water's edge. A large portion of the middle of the estuary was characterised by shell banks and mobile sand. Most of the vegetation/rushland was found on the peripheries near the Avon River/Ōtākaro and Heathcote River/Ōpāwaho mouths.

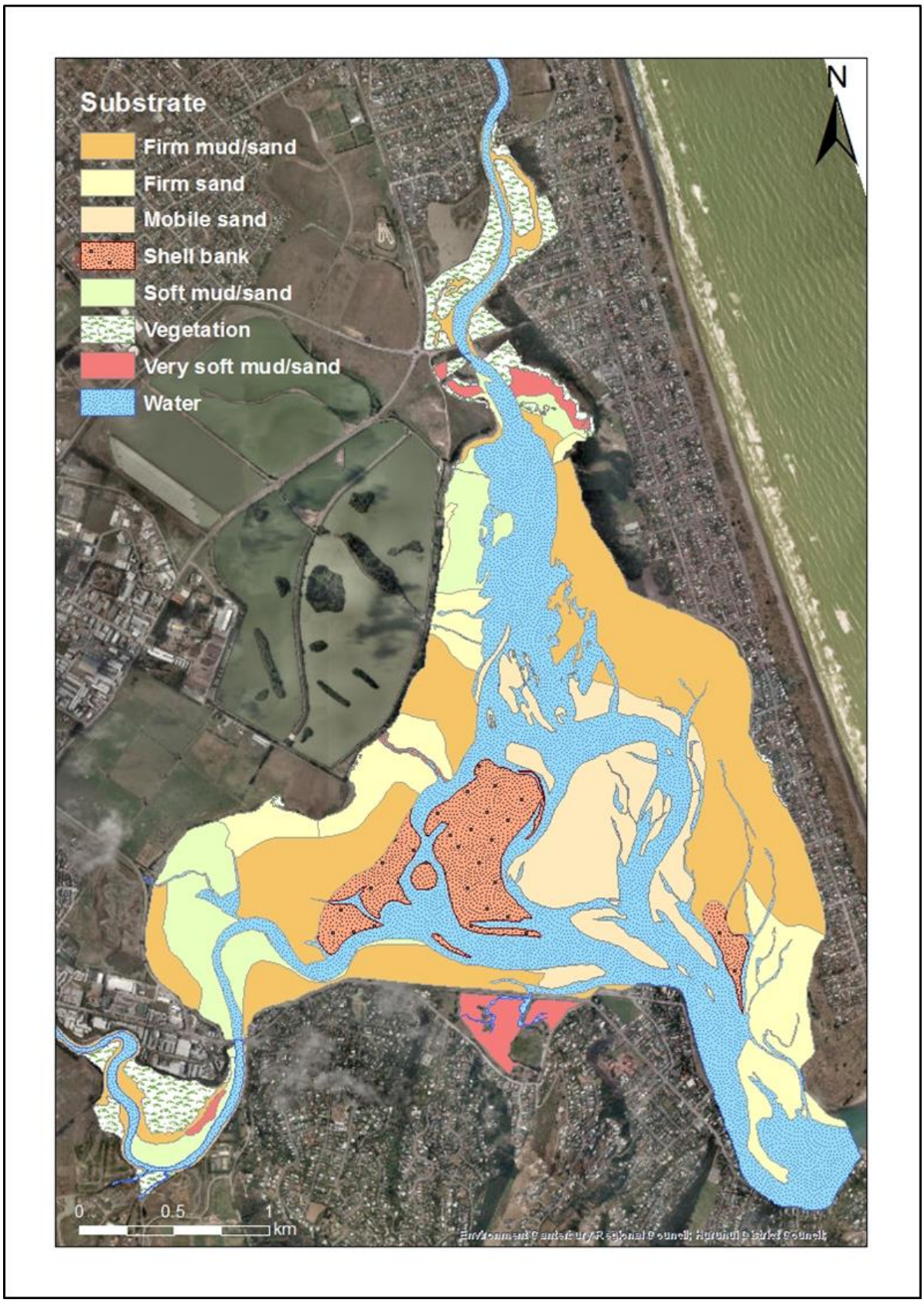


**Figure 2: The intertidal substrates of the Estuary of the Heathcote and Avon Rivers/Ihutai, 2002**

**Table 3: Summary of the area of intertidal substrates of the Estuary of the Heathcote and Avon Rivers/Ihutai, 2002**

The area of aquatic vegetation and water cover are not included in this analysis

| Dominant substrate | Area Ha | % | Comments |
|---|---|---|---|
| Firm mud/sand | 209.5 | 42.4 | Widespread distribution across estuary, mainly found on the east side and on edges of Heathcote River/Ōpāwaho |
| Firm sand | 74.6 | 15.1 | Found at estuary mouth and at Sandy Point |
| Mobile sand | 78.6 | 15.9 | Inner parts of estuary- middle bars |
| Shell bank | 54.3 | 11.0 | Western middle bars and opposite Tern St near water's edge |
| Soft mud/sand | 58.7 | 11.9 | Near Heathcote River/Ōpāwaho mouth, and Avon River/ Ōtākaro mouth (South New Brighton Park) |
| Very soft mud/sand | 18.2 | 3.7 | McCormacks Bay, South New Brighton Park, old Pleasant Point yacht club site |
| **Total** | **493.8** | **100** | |

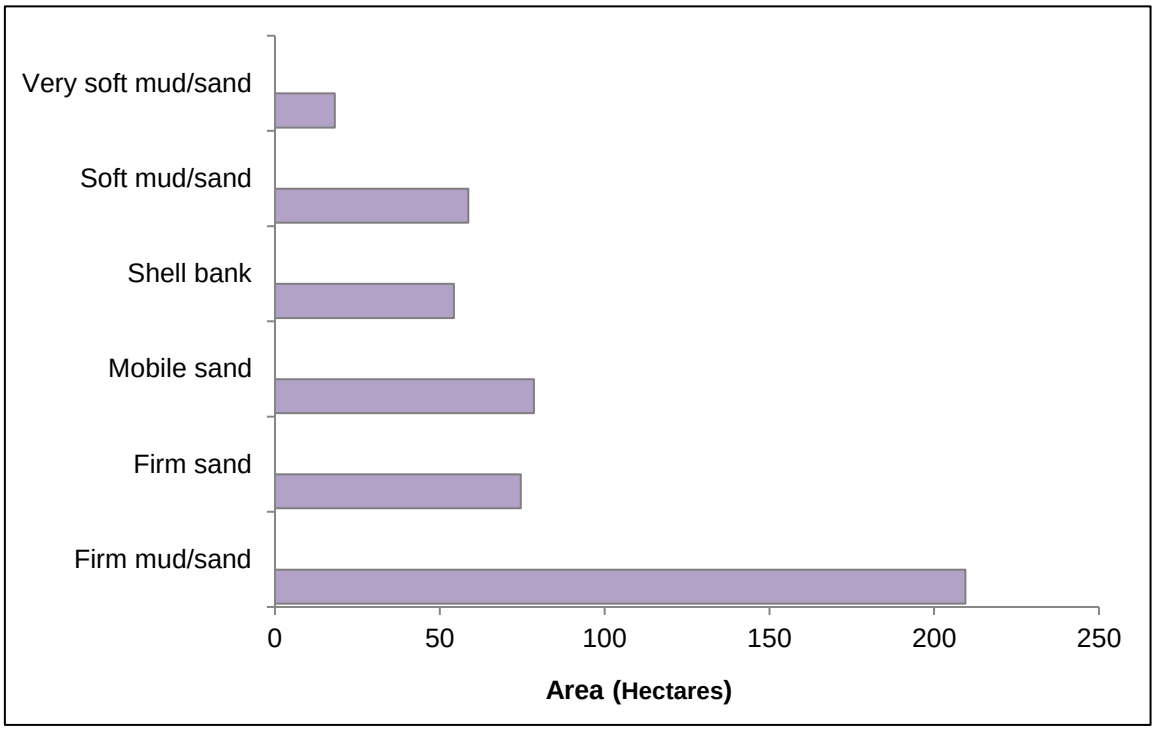


**Figure 3: Area of the intertidal substrates in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2002**

## 2016 results

509.2 ha of intertidal area was mapped between January and June 2016 (Figures 4 and 5). The mapped area follows the coastal marine boundary area, as described in the Canterbury Regional Policy Statement on 16 April 2016.

The dominant intertidal substrates present were firm mud/sand, soft mud/sand, firm sand and very soft mud/sand (Table 4, Figure 4). The shell banks were also mapped on top of the intertidal substrate (Figure 5, Table 5). This method of mapping the shell banks differs from the method used in 2002.

**Table 4: Summary of dominant intertidal substrate in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**
The area of vegetation, shell bank and water cover are not included in analysis

| Dominant substrate | Area Ha | % | Comments |
|---|---|---|---|
| Boulder/cobble | 0.5 | 0.1 | Sparsely found on outer extremities of estuary |
| Boulder/cobble/sand | 0.2 | 0.04 | Uncommon, small area found near Main Rd, opposite Mount Pleasant Road |
| Firm mud/sand | 180.6 | 35.5 | Widespread throughout estuary, mainly on eastern side and near the Heathcote River/Ōpāwaho mouth, follows the water's edge |
| Firm mud/sand/gravel | 0.9 | 0.2 | Uncommon, found on the west side of the Avon River/Ōtākaro mouth at the former Pleasant Point Yacht Club site |
| Firm sand | 64.0 | 12.6 | Common at Sandy Point, and near the estuary mouth |
| Mobile firm mud/sand | 54.3 | 10.7 | Found at water's edge, mainly in the middle of the estuary, largest area found north of Sandy Point |
| Mobile soft mud/sand | 10.3 | 2.0 | Widespread, mainly found opposite the wastewater treatment ponds |
| Mobile sand | 39.7 | 7.8 | Main areas include Sandy Point, the middle bars (bordering the water edge) and close to estuary mouth |
| Stone/cobble | 1.5 | 0.3 | Sparsely found on western edge of estuary from Humphreys Drive to Avon river/Ōtākaro mouth |
| Seagrass | 35.0 | 6.9 | Dense seagrass meadow found on eastern side of estuary |
| Soft mud/sand | 65.4 | 12.8 | Commonly widespread across estuary, large section found near Humphrey's Drive and at South New Brighton Park. Other areas close to the wastewater treatment ponds or near water |
| Very soft mud/sand | 56.3 | 11.1 | Areas concentrated at McCormacks Bay, Humphreys Drive and either side of Bridge Street |
| Very soft/mud/sand/clay | 0.5 | 0.1 | Uncommon, small area found at former wastewater treatment pond discharge point |
| **Total** | **509.2** | **100** | |

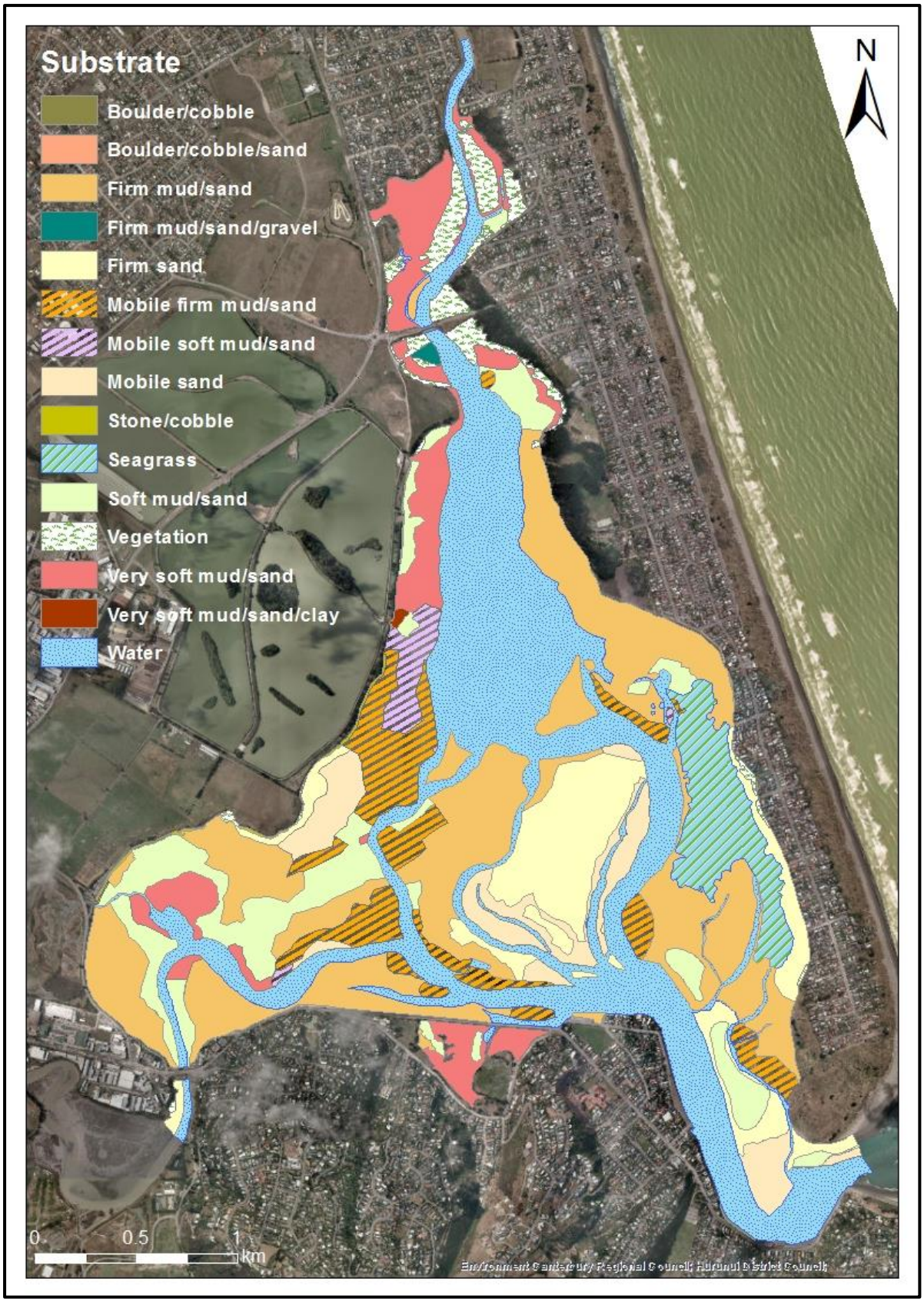


**Figure 4: The intertidal substrates of the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**

Substrates characterised by high silt content (soft mud/sand and very soft mud/sand) were most common where the Avon River/Ōtākaro and Heathcote River/Ōpāwaho enter the estuary. This is in contrast to the middle of the estuary and areas near the estuary mouth which are dominated by sand-based substrates (firm sand and mobile sand). In the eastern section of the estuary, close to the spit, a seagrass meadow covers 35 ha.

The shell banks were sporadic across the central part of the estuary, covering 49.4 ha of the estuary (Table 5). The shell banks were mainly bordering the water channels, however a large area of shell bank was present on the middle bars, on top of firm sand (Figure 5).

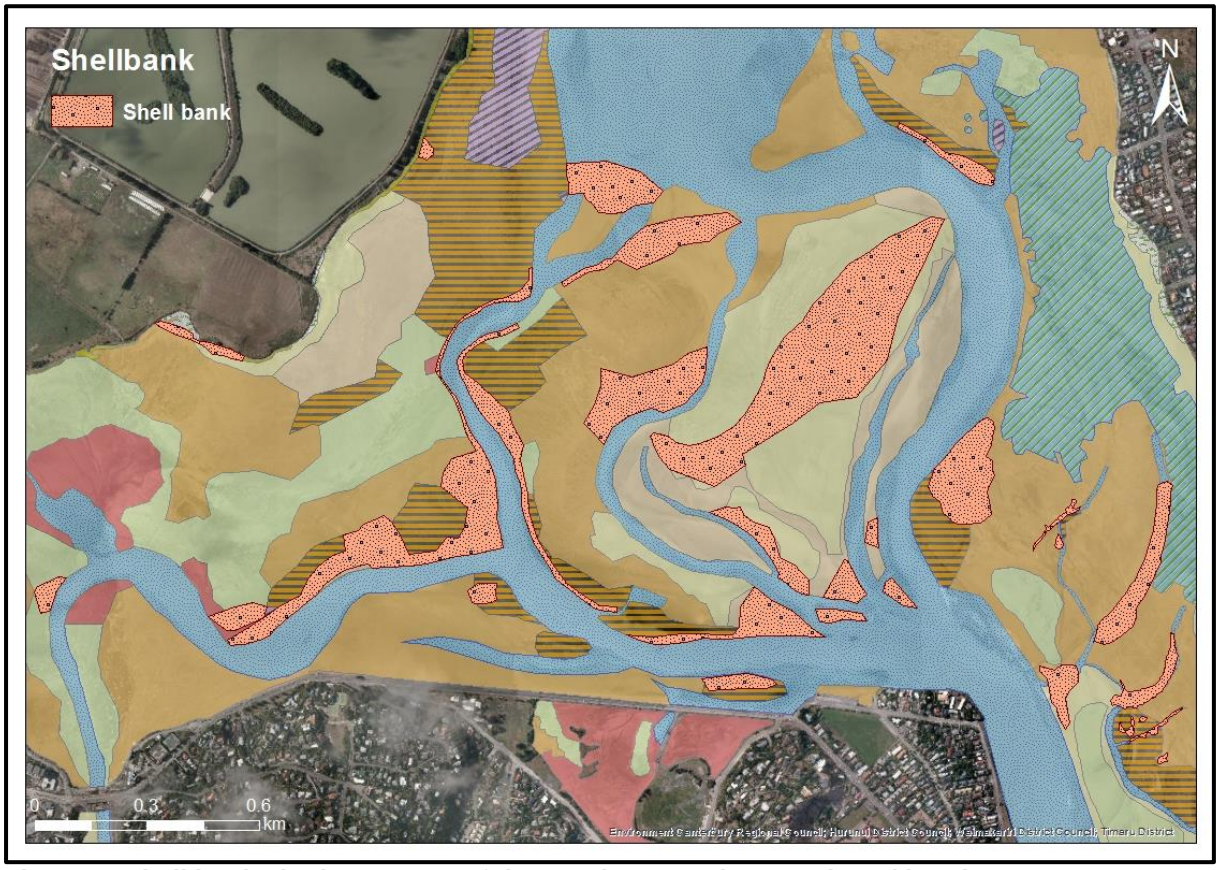


**Figure 5: Shell banks in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**

Macroalgae covered a total of 144.5 ha (28.4%) of the intertidal substrate (Figures 6 and 7, Table 6). The main species included *Ulva compressa* and *Gracilaria chilensis*. Extensive macroalgae blooms grew on the seagrass meadow, on the eastern side of the Estuary. Upstream of Bridge Street, *Gracilaria* was the only macroalage found. However, in the main section of the estuary, most of the macroalgae was *Ulva*, with sparse sections of *Gracilaria* (Figure 6). Note: Macroalgae cover does vary with the seasons. Therefore some of the differences in % cover between areas (Figure 6) could well reflect seasonal differences (mapping was undertaken between January and June, 2016).


**Figure 6: Macroalgae cover in the Estuary of the Heathcote and Avon Rivers/ Ihutai, 2016**
Algae species included *Gracilaria chilensis* and *Ulva compressa*


**Figure 7: Macroalgae cover north of Bridge Street, June 2016**

The algae species was *Gracilaria chilensis*

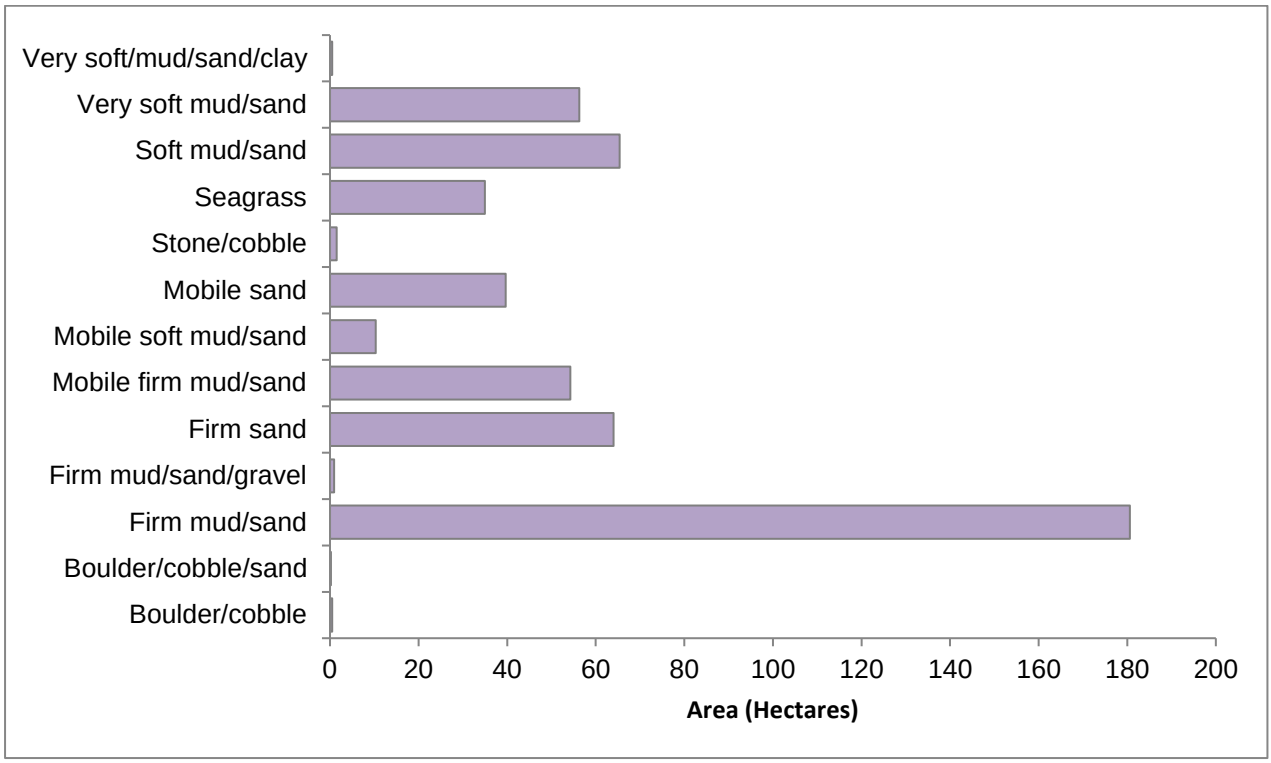


**Figure 8: Area of dominant intertidal substrates in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**

**Table 5: Shell bank cover in in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**

| Substrate | Area Ha | % of total area (ha) | Comments |
|---|---|---|---|
| Shell bank | 49.4 | 9.7 | Widespread across the estuary, mainly on the middle bars and bordering water channels. Dense shellbanks in small channels close to the estuary mouth |

**Table 6: Macroalgae cover in the Estuary of the Heathcote and Avon Rivers/Ihutai, 2016**
High cover ≥ 70%; Medium cover 30 -70%; Low cover ≤ 30%

| Algae Cover | Area of algae (ha) | % of area of algae | % of total area (ha) | Comments |
|---|---|---|---|---|
| Low | 48.8 | 33.7 | 9.6 | Scattered throughout estuary, large section found on the eastern middle bar |
| Medium | 75.7 | 52.4 | 14.9 | Large section found on eastern side of estuary- corresponds with seagrass substrate |
| High | 20.1 | 13.9 | 3.9 | Spread throughout estuary- higher percentage towards Humphrey's Drive |
| **Total** | **144.5** | **100.0** | **28.4** | |

## Comparison between 2002 and 2016

A comparison of the 2002 mapping results to the 2016 results reveals many similarities as well as differences in the types and proportion of the different intertidal substrates in the estuary. In both years, the most dominant substrate was firm mud/sand, found in large sections on the eastern side and on the southern edge, near Main Road. The middle section of the estuary was also characterised by shell banks and mobile/firm sand.

A notable difference between 2002 and 2016 is the large area of very soft mud/sand above Bridge Street, in the place of the former Bexley Wetland (Figure 4). The sediment within this wetland was not mapped in 2002, whereas it was mapped in 2016 because as of 16 April 2016 it is designated as coastal marine area (http://ecan.govt.nz/our-responsibilities/regional-plans/regional-coastal-environment-plan/Pages/Default.aspx. Upstream of Bridge Street the comparison between years suggests a loss of aquatic vegetation and an increase in the extent of very soft mud/sand.

Other notable differences could be due to differences in mapping methodology and the extent of ground truthing by walking across the estuary. For example, no seagrass was mapped in 2002 whereas a considerable area of seagrass was mapped in 2016. We are not certain if this difference is due to seagrass not being present within the estuary in 2002. The difference between the 2002 and the 2016 maps of the areas of shell bank may be an example of the difference in the coverage of the estuary by walking.

## References

Robertson, B.; Gillespie, P.; Asher, R.; Frisk, S.; Keeley, N.; Hopkins, G.; Thompson, S.J.; Tuckey, B.J. 2002. Estuarine Environmental Assessment and Monitoring, A National Protocol. Part A. Development, Part B. Appendices and Part C. Application. Prepared for supporting Councils and the Ministry for the Environment, Sustainable Management Fund Contract No.5096. Part A. 93p. Part B. 159p. Part C 40p plus field sheets.

## Photos

**Macroalgae (*Ulva compressa*) cover at Ebbtide Street, May 2016**

**Shell banks bordering water edges, near Tern Street, June 2016**

**Former Bexley Wetland, looking towards the Port Hills, June 2016**

**Decaying macroalgae at Sandy Point, May 2016**

**Seagrass (Zostera muelleri) and associated macrofauna, January 2016 (photo supplied by Melissa Patterson)**

**Sand volcanoes formed by liquefaction as a consequence of the earthquakes, looking west towards the Southern Alps, August 2011**

**Mobile sand and springs within the estuary (McCormacks Bay in background), June 2016**