INTERNAL

WAITANGI ESTUARY ECOLOGICAL MONITORING 2006

June 2007
EMI 0709
HBRC Plan No. 3948

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Environmental Management Group
Technical Report

Internal

Environmental Monitoring Section

Waitangi Estuary Ecological Monitoring 2006

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Report prepared for Hawke's Bay Regional Council

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April 2006

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Cover photo: Muddy Creek on the south side of the causeway. A slow moving stretch of Muddy Creek above the flood gate on the causeway. The area is home to a great number of water birds and indigenous plants including a good population of the threatened plant *Mimulus repens.* The causeway culverts are barriers to inanga.

INTRODUCTION

Regular monitoring of ecological condition and trend is built into the planned management of Waitangi Estuary, Hawke's Bay, by the Hawke's Bay Regional Council.

In December 2000, a regime for monitoring the ecological condition and trend of the estuary was set up on contract for the Hawke's Bay Regional Council by Geoff Walls. This was done using the experience gained in establishing a similar monitoring regime in Pekapeka Swamp in 1998, and in Whakaki Lagoon, Lake Poukawa and Lake Hatuma in 1999. It also had the benefit of the local knowledge of Department of Conservation staff. Baseline surveys of vegetation and fauna were carried out at the same time.

The results of the baseline survey and monitoring establishment were reported on (Walls 2000b: Waitangi Estuary Ecological Monitoring 2000). A companion report provided more background information and formed a plan for ongoing monitoring (Walls 2000a: Waitangi Estuary Ecological Monitoring Plan). Hawke's Bay Regional Council produced a management plan for Waitangi Estuary in May 2002 (Cheyne & Addenbrooke, 2002). Ecological monitoring is factored into that plan.

In late November 2002 and 2004, the estuary was revisited and the monitoring carried out for the second time, to determine the ecological condition and trend after two years. The findings were reported upon (Walls 2002: Waitangi Estuary Ecological Monitoring 2002), and (Walls 2004: Waitangi Estuary Ecological Monitoring 2004),

In November 2006, the estuary was revisited and the monitoring carried out for a third time. This document reports on the findings.

1. VEGETATION

1.1 Terrestrial vegetation

There were two aspects to monitoring of the terrestrial vegetation of the estuary in the monitoring plan: mapping of the current vegetation cover; monitoring of photopoints.

1.1.1 Vegetation map

Method:

The patterns of terrestrial vegetation were mapped in December 2000 using recent colour aerial photos. A copy of this map is shown in Appendix 1.

Observations:

Mapping was not repeated in 2002, 2004, or 2006 because it was not considered that there would have been sufficient change to show on aerial photos.

Next monitoring:

In two years' time (2008).

1.1.2 Photopoints

Method:

21 photopoints were set up the length and breadth of the wetland in December 2000. Each was marked with an aluminium label attached to a post, mostly an existing fence post. The photopoints were chosen to represent the spectrum of terrestrial vegetation types and situations around the wetland. They were also selected to be readily relocated. Photos were taken from the standing position at each photopoint: mostly panoramas of the vegetation; some more localised and specific. A SLR camera with a 50mm lens was used. Film was Kodak colour print, 200asa.

This procedure was repeated in late November 2002 and 2004. In addition, four extra photopoints were established in sites where significant management changes are planned for the near future. All photopoints were revisited and described again in November 2006. The photos, in order, are in the album that accompanies this document.

The location of each photopoint is marked on the map (Appendix 1). It is also described on the photopoint recording sheet (one for each photopoint, Appendix 2). Also on each sheet is a description of the vegetation and the ecological patterns and processes occurring there, and observations on changes noted.

Observations:

Photopoint 1:

Sited on a small lobed gravel headland on the western side of the gravel spit enclosing the estuary. Chosen to study the vegetation of the spit and its wet estuarine edge.

Occasionally storm-swept and flooded. The gravel lobes and bar have been considerably re-shaped by floods and storms since 2000.
In 2006, buddleia and gorse are now absent from the site with exception of one small remaining gorse bush, however Bone seed is becoming widespread at this site. Ephemeral plants and shore convolvulus had increased somewhat.

Photopoint 2:

Sited on the seaward side of the vehicle track along the raised beach east of lower Muddy Creek. Chosen to monitor the boxthorn shrubland on the gravel. The boxthorn appears to have displaced or replaced native vegetation including taupata and shore bindweed in the past. In 2002, not much change was noted except for some boxthorn growth and the removal (harvesting) of driftwood that would otherwise be habitat for lizards, invertebrates and nesting birds. There was much vehicle use and it was rubbishy. In 2004, the site had been affected by high seas, knocking some of the boxthorn flat. There was no sign of native vegetation, but vehicle use had more or less ceased because of the main access being blocked off.

In 2006 the reduction in Boxthorn had continued with most plants now in a seriously reduced state due to both wave effects and fire. No extra driftwood appears to have accumulated other than now dead boxthorn. No native plant species have established.

Photopoint 3:

Sited on the causeway across lower Muddy Creek, to monitor the estuarine vegetation above and below the eastern culvert. There were some woody weeds present in 2000 that had since been removed. In 2002, the two main changes in the native vegetation were that the saltmarsh ribbonwood had grown significantly and that the expanses of marsh clubrush (*Bolboschoenus fluviatilis*) looked unusually brown, probably the result of unseasonal spring frosts. In 2004, saltmarsh ribbonwood had continued to bulk up, marsh clubrush was green again and had invaded salt turf, *Mimulus repens* was common and lupins had expanded on the rear beach gravel. Tamarisk and silver willow had grown noticeably and should be controlled.

Mimulus repens is very common in this site. Silver willows appear to have been controlled to some extent. Some losses of Salt Marsh Ribbon wood have died due to raised water levels. Many waterbirds at this site. There is some risk of garden escapees at this site

Photopoint 4:

Sited on the causeway across lower Muddy Creek, to monitor the estuarine vegetation above and below the western culvert. Also Aquatic Site 1. Changes as for Photopoint 3, and a recent massive growth in water celery.

In 2006 the *Mimulus repens* continues to be a significant component of the vegetation, with some reduction in the cover of Water Celery. The roadway has been freshly graded with some losses of Saltmarsh ribbonwood as a result, loss of plants have also occurred though an apparent rise in the water level in the upstream area.

Photopoint 5:

Sited on the true left bank of lower Muddy Creek, to monitor the expanse of estuarine vegetation on the other side of the channel. Changes as for Photopoints 3 and 4. Numerous birds (pukeko, ducks and shags) using the site in 2004.

In 2006 large rafts of green filamentous algae are evident, water celery is slightly reduced and *Bolboschoenus fluviatlis* is expanding in this unit. Tamarisk and silver willow are still present but do not appear to have increased in cover.

Photopoint 6:

Sited on the true left bank of Muddy Creek near its mouth, to monitor the expanse of estuarine vegetation and weedy mosaic on the other side of the channel. Tamarisk and silver willow appeared to be threats in 2000. By 2002, the silver willow had laudably mostly been cut; just a few trees and saplings remained. Gorse had been controlled too. However the tamarisk, that still appeared to pose the threat of invasion/expansion, had not been controlled. In 2004 the silver willow and tamarisk had regrown rapidly, to the point that the control job is now considerable. Otherwise, in the native vegetation changes noted were as for Photopoints 3-5.

In 2006 the level of Tamarisk and silver willow continue to expand, tamarisk especially so. Saltmarsh Ribbonwood is in excellent health. No frogs were recorded as in previous years.

Photopoint 7:

Sited on the stop-bank on the true right bank of the lower Clive River, an area that lends itself to restoration/amenity planting. In 2002, the riparian vegetation fringe appeared to have thickened. Wash from watercraft did not appear to have caused undue shore erosion. In 2004 things were much the same.

In 2006 wind and chop driven floatsam appears to be suppressing growth of shoreline plants. Sarcocornia beads are well established amongst the tufts of rank grasses, namely, tall fescue.

Photopoint 8:

Sited on the beach near Photopoint 7, to study the shore situation. In 2002, sea rush (*Juncus maritimus*), three-square (*Schoenoplectus pungens*) and low wet turf had all grown and thickened. The regime of vigorous wash from boats and jet skis had not affected the vegetation adversely but there was evidence of some accelerated shore erosion. In 2004, the same processes had continued.

In 2006 the estuarine rushes have continued to expand and thicken, along with the associated wet turf species. Some suppression of plants by wash from vessels is evident in some embayments.

Photopoint 9:

Sited on the true right bank of the lower Clive River, an area that lends itself to restoration/amenity planting and a shore exposed to frequent wash from boats and jet skis. In 2002, little vegetation change was noted but the bank appeared to be considerably undercut. A cheap easy way of mitigating the erosion was suggested: to plant harakeke (lowland flax), toetoe, sea rush and jointed rush on the bank. In 2004, erosion of the bank had continued, but it was partly mitigated by the development of the fringe vegetation. The restrictions on boating activity appeared to be working in part, but the planting suggestions still apply.

In 2006 *Bolboschoenus fluviatilis* is being suppressed by wave action possibly from boating/ jet ski activity. Undercutting of the bank has continued with areas devoid of plant growth suffering most.

Photopoint 10:

Sited on the stop-bank on the true left bank of the lower Clive River, to monitor the expanse of estuarine vegetation there. Most notably the saltmarsh ribbonwood had grown, following exclusion of stock. Weeds evident in 2000 were gorse and tamarisk. In 2002, both had laudably been controlled, and a new potential weed had appeared: karo (*Pittosporum crassifolium*). In 2004, the processes had continued. The karo had grown considerably. Although a NZ native, this plant is not native to Hawke's Bay. It therefore poses the same management dilemma on the coast that pohutukawa does. It contributes a valuable structural element, and substitutes for lost native trees of the past, but is a foreigner. However, it is far less foreign than plants of overseas origin and unless a philosophy of ecological purity in restoration is being pursued it could be regarded as an asset. Since it is in widespread use in private plantings on the Hawke's Bay coast it will continue to put in an appearance even if a control programme is instituted. So my recommendation at this stage is to monitor it closely at this site. If it is decided to get rid of it, it could be replaced with ngaio, akiraho and *Pittosporum ralphii*.

In 2006 there is a sparse cover of gorse and a considerable expansion in the coverage of Saltmarsh Ribbonwood. The wet turf appears to be under threat from the expansion of tall fescue and options may need to be looked at to minimize this effect. Tamarisk continues to expand and a lone pampas has become established but the number of lupins has reduced.

Photopoint 11:

Sited on the stop-bank overlooking a small backwater fenced off to protect whitebait spawning habitat. Chosen to observe the riparian recovery process. Little change was noted in 2002. In 2004, marsh clubrush had expanded right into the channel.

In 2006, *Bolboschoenus fluviatilis* has continued to expand but Ruppia is not as dominant. Blackberry appeared to be absent or much reduced from previous years. Tamarisk appears to be expanding and is shading out lower stature plants and a young eucalyptus sapling has established near the adult tree in this site.

Photopoint 12:

Sited on a small causeway across a small drainage channel. Also Aquatic Site 2. Chosen to monitor changes in the event of the removal of stock. Little change was noted in 2002 other than growth in the willows. In 2004, marsh clubrush had expanded on the banks and into the channel, water buttercup and *Schoenoplectus validus* had appeared and the willows upstream had grown.

In 2006, the impacts of grazing are obvious with pugging reducing the integrity of the wet turf upstream of the culvert. Some bank erosion downstream of the culvert is occurring.

Photopoint 13:

Sited at the tip of the tongue of land between the lower Ngaruroro River and a side channel. Chosen to monitor the various riverbanks here: some grazed, others not, steeply eroding in places. In 2002, the beds of sedges and rushes had already bulked up and a turf of arrow grass had established following recent stock exclusion. This process was expected to continue, and in 2004 that was the case, the site probably becoming increasingly favourable as a whitebait spawning area.

In 2006, *Bolboschoenus fluviatilis* continues to expand, and crack willow seedlings have established throughout much of the site. Erosion is still occurring on the true left bank as there is no instream vegetation and vertical silt banks.

Photopoint 14:

Sited where the lower Ngaruroro and Tutaekuri meet, on the true right riverbank. Badly eroding and impacted upon by cattle in 2000, but by 2002 the process of recovery following recent stock exclusion had begun. On the river bank the exotic grasses had begun to go rank and marsh clubrush had appeared. In 2004, the process of recovery had continued, but the bank was still being eroded by the river.

In 2006 *Bolboschoenus fluviatilis* continues to expand whilst lupin continues to increase in cover also. *Bolboschoenus fluviatilis* beds have become established on Tutaekuri True Left Bank.

Photopoint 15:

Sited on the true left of the old Tutaekuri channel. Also Aquatic Site 3. Chosen to monitor changes in the event of the removal of stock, the effects were already noticeable by 2002. The marsh clubrush had thickened and broadened and the grasses had gone rank on the true left bank. On the true right bank cattle were still present, so no ecological improvement was evident. In 2004, the situation was similar, although wet turf had been overtaken by taller sedges and rushes. The willows had grown.

In 2006, willows have continued to establish with both rooted segments and seedlings. The previously noted turf has been completely lost, now replaced with Indian Doab. *Bolboschoenus fluviatilis* has been severely grazed where cattle have access.

Photopoint 16:

Sited at the mouth of a small backwater fenced off to protect whitebait spawning habitat. Also Aquatic Site 4. Chosen to observe the riparian recovery process. In 2002, significant ecological recovery was noted upstream following fencing of the river edge: rank pasture growth and bulking of marsh clubrush. Downstream little change was evident. In 2004, there appeared to have been some deterioration of the riparian vegetation downstream, possibly because of flooding (or storm-induced salt water incursion), but upstream the riparian fringe had dramatically bulked up.

In 2006, raupo has become established alongside the *Bolboschoenus fluviatilis* with little bank erosion noted. With no grazing pressure these plants are attaining heights of 2.5 and 1.8 metres respectively.

Photopoint 17:

Sited opposite the road entrance to the Colenso mission station monument. Chosen to monitor the changes amongst a distinctive mixture of planted and natural vegetation in a site long free of grazing. Little change noted other than some growth in the flaxes, poplars and willows.

In 2006 large swathes of *Bolboschoenus fluviatilis* have become established with open water areas under a 100% cover of *Azolla filiculoides, Lemna minor,* and *Wolfia australiana* the riparian margin is totally dominated by ephemeral weeds, especially fennel.

Photopoint 18:

Sited at the very mouth of the old Tutaekuri channel. Chosen to monitor the raupo beds, also the gravel beach ridge that looked likely to be colonised by boxthorn and already had some other weeds, but considered to be a good place to reintroduce *Muehlenbeckia ephedroides*. In 2002 the raupo beds were looking rather tatty, possibly because of spring frost. The area to seaward had undergone major re-shaping by floodwaters and storm action, scouring out gravel from the beach ridge and removing colonising vegetation. It was now considered too unstable to be a site for reintroduction of *Muehlenbeckia ephedroides*. In 2004, the raupo had recovered but there had been still more change wrought by floods and storms.

In 2006, the raupo has recovered to form extensive swathes along with *Bolboschoenus fluviatilis* . lupins, Crack willow, boxthorn, and buddleia are all established in the rank riparian grasses. Boxthorn on the bolder bank has been severely effected my flooding and is now much reduced in both coverage and stature. Tasmanian Ngaio has become established under the frames of now dead boxthorn. Introduced ice plant has become well established on the boulder bank and appears to be expanding rapidly smothering other low growing plants.

Photopoint 19:

Sited at the seaward end of the stop-bank on the true left of the Ngaruroro mouth. Chosen to observe the impacts of heavy recreational use and periodic flooding. In 2002, the lower ground had been silted up or scoured by flooding, but higher ground was unaffected. Rubbish was minimal, a tribute to Council management. In 2004 it was much the same.

In 2006, the wet turf has been degraded through vehicle damage with glasswort severely reduced to isolated remnants, *Mimulus repens* undetectable and *Samolus radicans* reduced in cover. *Juncus kraussii* has expanded a little.

Photopoint 20:

Sited at a small freshwater pond used for hunting waterfowl. Used also by cattle. Chosen to monitor changes over time, with or without the removal of stock. In 2002, the pond was far bigger and water filled, allowing raupo growth out of reach of cattle. Most other vegetation was still kept down by cattle. There were many wetland birds present, suggesting that stock removal and pond embellishment could be positive. In 2004, the area had been retired from intensive grazing and the pond looked to be permanent. The vegetation in and around the pond had bulked up and grown denser.

In 2006, the riparian vegetation continues to expand and thicken. *Schoenoplectus tabermontani*i is established sparsely in the water with two distinct clumps of raupo showing signs of spray damage are well established also.

Photopoint 21:

Sited on the riverbank near Photopoint 20. Chosen to monitor badly eroding banks on each side of the river; one grazed, the other fenced off. In 2002, the banks had continued to erode regardless of stock management, suggesting that the bank is subject to much impact of floodwater flow. It was suggested that full retirement from grazing and planting of harakeke and native trees could usefully mitigate the impacts. In 2004, "cliff" erosion of the true left bank had continued, despite the absence of stock, whilst the true right bank was stable and a buffering fringe of vegetation was developing.

In 2006, erosion still continues to be a major modifying factor with no reeds in or at the waters edge, only tall fescue clumps that have fallen and partially re-rooted providing a buffer against flows.

Photopoint 22:

Newly established in 2002. Sited at the northern side of newly created ponds and chosen to monitor their progress. Stock excluded. In 2004, riparian vegetation had established and water birds were using the ponds. This site could be further enhanced by planting native trees, shrubs and harakeke.

In 2006, Ruppia and green filamentous algae dominate the water body, with *Bolboschoenus fluviatilis* and *Juncus kraussii* established. The fringing turf is dominated by *Mimulus repens* and *Isolepsis cernua*, with areas of Bachelors Button. The surrounding eucalyptus trees are providing a valuable roosting habitat for both Black and Little Shags. Stock now have access to this site but as yet have had little effect other than isolated pugging.

Photopoint 23:

Newly established in 2002. Sited upriver of Photopoint 14 and chosen to observe the regeneration at a shallow pond following stock exclusion, particularly of the aquatic plant water plantain (*Alisma plantago-aquatica*) that could become a weed. In 2004, the channel was much more vegetated now, especially in creeping bent, *Juncus articulatus* and water buttercup; *Ruppia* and curly pondweed had been squeezed out. Water plantain had expanded a little, but not as much as expected.

In 2006, Water plantain was not noted as a significant component of the site with areas dominated more by *Juncus articulatus,* and creeping bent. Some crack willow has become established along with *Isolepsis nodosa* and *Cyperus ustulatus. Bolboschoenus fluviatilis* and raupo have a scattered present in the lower lecel area but are in very poor health possibly due to the site becoming increasingly dry.

Photopoint 24:

Newly established in 2002. Sited at the western side of the curving stop-bank and chosen to monitor the results of planned works (pond creation, stock exclusion, etc).

In 2004, scrapes had been recently created within the area enclosed by a stopbank and the railway line and deliberately flooded to recreate wetland habitat. They were being used by wading birds and wetland vegetation was just beginning to establish. Upstream, the grass was now rank in the absence of intensive grazing. In 2006, the restoration plantings have in general become quite well established following some losses due to stock incursions, and are now beginning to suppress the rank pasture grasses in places.

Photopoint 25:

Newly established in 2002. Sited on the northern stop-bank and chosen to track ecological changes if developments occur. In 2004, marsh clubrush had continued to bulk up on the channel banks. The pasture was lightly grazed so had gone rank.

In 2006, the *Bolboschoenus fluviatilis* continues to thicken to form a near complete riparian margin with some raupo extending up the Waitangi stream. The remaining vegetation is generally the same as previously described with ragwort and great bind weed becoming established.

Next monitoring:

November-December 2008; thence every second year. Photos to be repeated; recording sheets to be used.

Aquatic vegetation

Method:

The composition of the aquatic vegetation was assessed at four sites, chosen to represent the main parts of the estuary shore. Macroinvertebrate sampling was done at these sites too. The site locations are marked on the map (Appendix 1) and described on the combined aquatic vegetation and macroinvertebrate recording sheets (one for each site, Appendix 3).

Sampling at each site was done by observing the aquatic vegetation from the banks and winnowing available vegetation in water into a collecting tray. The samples were examined in the field. The aquatic macrophytes present were identified, and their relative abundances were recorded. Macroinvertebrates were searched for in each sample (see 2.4), and their standard sensitivity scores recorded to give a measure of water quality.

Observations:

Aquatic site 1:

Curly pondweed (*Potamogeton crispus*), hornwort (*Ceratophyllum demersum*) and egeria (*Egeria densa*) were not detected in 2002, despite being present in 2000. Green algae were in considerably greater quantities, forming dense blankets possibly reflecting heightened nutrient loading, and could have been responsible. In 2004, hornwort was common but curly pondweed and egeria were not seen. The interaction between macrophytes is evidently quite dynamic and probably reflects the water levels and nutrient regime. In 2006, Ruppia polycarpa was reduced in cover as was Hornwort, but there were increases in the coverage of Bachelors Button. Water Celery which was not previously recorded is now common at the site. Other species previously recorded seem to be static in their coverage.

Aquatic site 2:

In 2002, no changes were observed from the 2000 condition. In 2004, little had changed except that creeping bent and water buttercup had appeared and *Mimulus repens* had diminished through competition. In 2006, most species remained static in their coverage with the exception of Green algae which had increased and *Bolboschoenus fluviatilis* which had also thickened and extended. Creeping bent has continued to increase as in previous years. The threatened plant *Mimulus repens* was undetected which follows a pathway of decline in previous years.

Aquatic site 3:

In 2002, there was little change except for more green algae and the appearance of water speedwell (*Veronica anagallis-aquatica*). The effects of cattle exclusion had yet to show. In 2004, Canadian pondweed was detected for the first time at the site .In 2006, the previously recorded *Schoenoplectus tabermontani* was not recorded but this may have been a typographical error as the closely related *Schoenoplectus pungens* was found. Raupo has become established at his site and will provide an interesting component to track with time. Canadian Pond weed, Isolepsis prolifer and Curly pond weed were not detected

Aquatic site 4:
In 2002, Canadian pondweed (*Elodea canadensis*) was not detected despite being present in 2000. The low water clarity at the time of visit may have had something to do with it. In 2004, Canadian pondweed was present but curly pondweed was not detected and water buttercup had diminished. In 2006, the situation remained much the same as in 2004 with the inclusion of Bachelors Button into the matrix at low levels.

Next monitoring:
November-December 2008; thence every second year. Sampling to be repeated; recording sheets to be used.

1.2 Weeds

Method:
Weeds were searched for during the survey and monitoring of both the terrestrial and aquatic vegetation (1.1, 1.2). Their presence and impact were noted.

Observations:
The following terrestrial weeds were regarded in 2000 as requiring surveillance. They still are.

Silver willow (*Salix alba* var. *alba*), well established in the saline flats east of lower Muddy Creek; partially controlled in the past, but not adequately followed up, therefore vigorously regenerating and apparently spreading;
Crack willow (*Salix fragilis*), established in various places and capable of spreading around the estuary shores; also considered an aquatic weed; should be controlled;
Silver poplar (*Populus alba*), well established and spreading on the true left of the lower Clive River; should be controlled;
Gorse (*Ulex europaeus*), a minor threat to the rear beach and some estuary margins; recently controlled;
Pampas grass (*Cortaderia selloana*), becoming established in places; recently controlled but requires vigilance;
Chinese tamarisk (*Tamarix chinensis*), spreading in saline flats; outlier plants recently controlled but main population in lower Muddy Creek still requires control;
Boxthorn (*Lycium ferocissimum*), invading the rear gravel beaches and some banks; controllable at present; preferably removed and replaced by native shrubs; should be kept in check at least;
Lupin (*Lupinus arboreus*), invading the gravel beaches in places; not a serious threat but could be a problem for shore bindweed (and *Muehlenbeckia ephedroides* if reintroduced);
Indian doab (*Cynodon dactylon*), a creeping grass invading the rear gravel beach system; a definite potential threat to shore bindweed and *Muehlenbeckia ephedroides*; difficult to control;
Convolvulus (***Calystegia silvatica*** and ***Convolvulus arvensis*)**, abundant around the margins;
Blackberry (***Rubus fruticosus* agg.)**, common in mosaic communities; not considered an ecological problem.

Iceplant (*Carpobrotus edulis*), established on the rear of the beach at the southern end of the wetland system and a threat to native shore plants.

As discussed in relation to Photopoint 10 above, **karo** (*Pittosporum crassifolium*) could be regarded as a weed. It should be monitored at least.

To this list can be added from 2006 observations:

Bone Seed, *(Chrysanthemoides monilifera)* becoming established on the gravel bank near the mouth of the Estuary at Photopoint 1. This species is currently having biological control trials performed upon it and may be less of a threat than is currently predicted.

There are no additions to this list from the 2006 monitoring but all previously noted species still present a threat to the Estuary and require continuing surveillance.

The following aquatic weeds are regarded as requiring surveillance:

Hornwort (*Ceratophyllum demersum*), **curly pondweed** (*Potamogeton crispus*), **Canadian pondweed** (*Elodea canadensis*), **water buttercup** (*Ranunculus trichophyllus*) and **Egeria** (*Egeria densa*), all common throughout the estuarine backwaters;
Cord grass (*Spartina anglica, S.* x*townsendii*), recently reported from nearby Ahuriri Estuary, and possibly already present (some small tufts which could have been cord grass were seen from a distance in upper Muddy Creek in 2002, but not seen in 2004); a serious threat to the saline flats vegetation, especially the wet turfs; should be searched for and eradicated immediately if discovered;
Water net (*Hydrodictyon reticulatum*), reported in 1999 from the Clive River and present in Lake Poukawa, that eventually drains into the Waitangi Estuary via Karamu Stream and the Clive River; a smothering alga that could severely affect the aquatic ecology.

Next monitoring:

November-December 2008, along with other vegetation monitoring; thence every second year.

1.3 Notable flora

Method:

Plants of note were searched for, as during baseline survey and monitoring set-up.

Observations:

To date, only one native plant listed within the Department of Conservation's Threat Classification System (Hitchmough 2002) is known from Waitangi Estuary: *Mimulus repens*, an estuarine turf herb with a pretty pink flower. It is quite common in places, but appears to fluctuate in abundance from place to place and should continue to be

monitored. It has been reported as being slightly ephemeral in nature often appearing rapidly and declining at a similar rate of a period of years. It appears to need a regular supply of disturbed land to maintain its population. In some areas this plant has been completely exclude via either competition or stock/ vehicle pressure whilst in others the cover of *Mimulus repens* is excellent.

The area of dense saltmarsh ribbonwood (*Plagianthus divaricatus*) in lower Muddy Creek is equally significant: it is the best area of that species in Hawke's Bay. This species appears to be in excellent health in this area and has shown some expansion in area as well as good recovery from disturbance events.

Not far to the south on the raised gravel beach at Te Awanga is the nationally threatened prostrate creeper *Muehlenbeckia ephedroides*, in very precarious circumstances. The stable gravel beaches at the estuary are good potential habitat for that species, which was probably formerly present and could be reintroduced. Should any other notable plants be detected or introduced in future, extra monitoring will be needed.

Next monitoring:

November-December 2006; thence every second year.

2. FAUNA

2.1 Waterbirds

Method:

Two methods were used:

1. **Directed searches**, whereby a number of sites around the estuary were visited to listen and look for crakes, rails and bitterns.
2. **General fauna survey**, whereby waterbirds were searched for during other survey and monitoring activities.

However, since OSNZ and Department of Conservation regularly survey the estuary for birds, this aspect of the monitoring is not given a high degree of attention. In this report a departure from using the standard Department of Conservation fauna survey cards has been made, simply for ease of compilation. The lists in Appendices 4 and 5 are based on the standard cards.

Observations:

A great range of species of waterbirds has been recorded from the Waitangi Estuary (OSNZ and Department of Conservation records). They include migrant waders (including kotuku, godwit, knot and wrybill), nesting seabirds (including the only Hawke's Bay colonies of white-fronted tern and black-billed gull) and resident species. Not all may still be present. The list also includes Australasian bittern, a native listed as threatened by the Department of Conservation (Hitchmough 2002), and spotless crake, now rare in Hawke's Bay.

The other wetland birds include swans, ducks, geese, shelducks, shags, red-billed and black-backed gulls, Caspian tern, gannet, pied stilt, variable oystercatcher, banded dotterel, royal spoonbill, cattle egret, pukeko, Australasian harrier, NZ kingfisher and welcome swallow. The swans, ducks, shelducks and pukeko are seasonally hunted in the wetland. Although it is the nature of waterbirds to be somewhat shy, they are extremely wary, suggesting that hunting and human disturbance are making it difficult for them to feed, roost and breed in safety.

In late November 2002 much the same suite of water birds was detected as in December 2000 (Appendix 4). Additions were Pacific golden plover, kotuku (white heron) and paradise shelduck. Overall numbers were similar except for much lower numbers of black shag and larger numbers of waders, particularly white-faced heron, banded dotterel and spur-winged plover. No signs of either Australasian bittern or spotless crake were found, although these birds are hard to detect and could well have been present. I received reports during the monitoring from members of the public that birds were being disturbed by off-road vehicles and shot at. I also observed people walking and exercising dogs near colonies of white-fronted terns and pied stilts, causing considerable disturbance. I was further informed of predation of nesting ducks, probably by feral cats, stoats or ferrets. No doubt control of human disturbance and predators would benefit the water birds immensely.

In November 2004, the suite of water birds was essentially the same, although godwit, golden plover, black-billed gull, gannet and kotuku were not seen (possibly because of the slightly earlier survey time, missing these migratory birds). The numbers of NZ shoveler, paradise shelduck, grey teal, banded dotterel, white-faced heron, Caspian tern and pukeko appeared higher than in 2002, whilst those of spur-winged plover were lower.

The 2006 survey recorded no departures in the species list of previous years, no White heron, Golden Plover, or Royal Spoonbill were recorded in the monitoring period but had been seen at the site previously in 2006 by the Author. Numbers were generally lower across the board for bird species with the exception of the Shag species which both seem to be on the increase. As higher order predators of the estuary system this can be seen as a good indication of the overall health of the estuary. Stoats are present in the system and will be causing a considerable damage to the nesting bird population as well as affecting ground based and roosting birds. Vehicle and human, typically dog walking, disturbance remains an issue affecting the well being of the bird populations in this area.

Next monitoring:

November-December 2008; thence every second year.

2.2 Other birds

Method:

General fauna survey, whereby birds other than waterbirds were searched for during other survey and monitoring activities.

Observations:

Many other species of birds have been recorded at the estuary. A few are common natives, such as kahu, pipit and silvereye, whilst the remainder are common introduced species typical of the Hawke's Bay rural scene. There were no significant differences between the suites of birds recorded during 2000, 2002, 2004 and 2006. The full list of birds noted during the survey and their estimated numbers is in Appendix 4.

Next monitoring:

November-December 2006; thence every second year.

2.3 Fish

Method:

Fish were surveyed only as part of other monitoring work. This is because the HBRC and Department of Conservation have duties and interests regarding the fish of the estuary, particularly in relation to the whitebait fishery.

Observations:

Waitangi Estuary is regionally significant for native freshwater and estuarine fish. It is a traditional and important harvesting site for eels and whitebait (mostly juvenile inanga, the adults of which spawn in the estuary). It is a breeding, feeding and nursery area for mullet, flounders and kahawai. Mosquito fish, an introduced pest, is resident and was seen in December 2000 at the mouth of the old Tutaekuri River channel. They were found in abundance in Muddy Creek, at Aquatic Monitoring Site 1, in November 2004 and again in 2006. Large grey mullet (feeding voraciously among the macrophytes) and inanga were seen at the mouth of the old Tutaekuri River channel in December 2000. Neither was seen there in November 2002 or November 2004, but have been noted further upstream in the karamu catchment which feeds into the estuary. Adult inanga were seen though at a number of other sites in 2002, and whitebait fishermen were pretty happy with their catches, indicating that protection of the spawning habitat in the estuary is already paying handsome dividends. In 2004, and again in 2006, inanga were seen in congregations just below the weir or culvert in Muddy Creek, clearly unable to pass this barrier. For them to be able to live and spawn upstream the weir/culvert will have to be altered. Elvers 5-8cm long were found at Aquatic Monitoring Site 4 in 2004, but not recorded in 2006. Introduced goldfish may be present: it is apparently in the nearby lower Tukituki River.

Next monitoring:

November-December 2008; thence every second year.

2.4 Aquatic invertebrates

Method:

Macroinvertebrates (invertebrates big enough to see with the naked eye) were sampled along with aquatic vegetation at four representative sites (see 1.2; locations marked on the map, Appendix 1, and described in the aquatic vegetation and macroinvertebrate recording sheets, Appendix 3). Aquatic vegetation and substrate were winnowed in the water into a plastic tray. The samples were examined with the use of a hand lens. Invertebrates were identified using the Taranaki Regional Council guidebook (1997) and Parkinson and Cox (1990). Sensitivity scores, indicative of water quality, were assigned from the Taranaki Regional Council guidebook (1997), with more recent updates. Species found and their scores are listed in the aquatic vegetation and macroinvertebrate recording sheets (Appendix 3). There is some debate whether or not this is a suitable index to use for estuarine waters as the index has been primarily developed to reflect health in freshwater steams and rivers. The sensitivity scores therefore may be biased against estuarine waters which have a suite of different physical and chemical parameters. However for the sake of repeatability it has been decided to continue with this measure in the meantime, or until a more targeted form of assessment is developed to reflect the unique environment of estuarine areas.

Observations:

In all four sites, as in 2000, 2002, 2004, and 2006 the invertebrates found had a maximum sensitivity score of 5 (moderate water quality; 10 is very high water quality). The ranges and averages of the scores are tabulated below. They show that at none of the sites was the water of very good quality in comparison to a stream environment. The number of species found in 2000 ranged from 4 to 9, which

indicates quite low diversity. In 2002, the range was from 3 to 12. In 2004, the range was from 4 to 11. The most diverse site was above the causeway across Muddy Creek.

	Number of species found				Range of sensitivity scores			
	2000	2002	2004	2006	2000	2002	2004	2006
Site 1	9	12	11	12	1-5	1-5	1-5	1-5
Site 2	5	7	8	7	3-5	3-5	3-5	3-5
Site 3	4	3	4	3	3-5	3-5	3-5	3-5
Site 4	6	4	9	7	1-5	3-5	1-5	1-5

Next monitoring:

November-December 2008; thence every second year. Sampling to be repeated; recording sheets to be used.

Options for a targeted Estuarine MCI to be investigated

2.5 Mammalian pests

Method:

General fauna survey, whereby signs of mammalian pests were searched for during other survey and monitoring activities.

Observations:

The same suite of eight mammals that can be regarded as pests in the wetland were detected as during the baseline survey and monitoring set-up (Appendix 5) with the addition of Stoats in 2006:

- Domestic cattle: present in various places and very damaging to riparian margins. Sheep would do far less damage, but neither would be compatible with revegetation of the estuarine margins.
- Rabbit and hare: present right around the margins, although not in great numbers; would require control if known to be threatening valuable vegetation.
- Possum: present around the estuary margins, though not in high numbers.
- Hedgehog: present around the estuary margins.
- Mouse: known predator of invertebrates.
- Feral and domestic cat: present around the estuary margins.
- Domestic dog: regularly present; a threat to breeding, feeding and roosting birds.
- Stoat; known predator of birds, lizards and invertebrates; good swimmers.

Other mammalian pests probably present but not detected include:

- Ship rat and Norway rat: known predators of birds, lizards and invertebrates.
- Ferret and weasel: known predators of birds, lizards and invertebrates; good swimmers.

Next monitoring:

November-December 2008; thence every second year.

2.6 Terrestrial invertebrates

Not deliberately surveyed or included in the monitoring plan, but worthy of separate study. The suite of invertebrates living in driftwood is noteworthy. Rapid examination showed that as in 2000, 2002, and 2004 few native species were present: they appeared to have been largely displaced by exotic invertebrates.

2.7 Reptiles and amphibians

Also not deliberately surveyed or included in the monitoring plan, but worthy of separate study. Despite some searching, no signs of skinks or geckos were found, as in the past two monitoring visits. As in November 2004 southern bell frogs were seen and heard in abundance in Muddy Creek in the 2006 monitoring, but were absent in earlier monitoring periods. Although introduced, they are not regarded as an ecological threat and given their drastic decline in recent years because of disease they are perhaps to be celebrated.

CONCLUSIONS

The key natural features of Waitangi Estuary and its surrounds are:

- Estuary: outstanding habitat for wetland birds, including several rare and iconic species; inanga, mullet, eels and other native fish; fringes of primarily native vegetation, including shore ribbonwood, marsh clubrush and the threatened turf plant *Mimulus repens*;

- Gravel beach ridge and bar system: nesting and roosting habitat for birds (dotterels, stilts and terns);

- River and backwaters/channels and ponds: outstanding spawning habitat for whitebait species; nesting and feeding habitat for wetland birds;

- Overall restoration potential: wetland and coastal shrubland and forest, flax, rushlands and sedgelands, estuarine turfs, wetland and coastal bird populations.

In addition, there is a strong tradition of use by whitebaiters and the local community. Therefore there are bright prospects for restoration and enhancement of the natural features of the wetland system. The monitoring regime has allowed a series of conclusions to be drawn about various aspects of the ecological condition and trend of the wetland system, and the efficacy of management. Out of these conclusions flow a consequent series of recommendations, which are reported upon in a companion document, Waitangi estuary Management Recommendations 2006. They build on those from the 2002 and 2004 baseline survey but are essentially similar.

1. State of the Environment (SOE) monitoring and reporting

Parameters used in this monitoring regime are directly applicable to State of the Environment (SOE) monitoring and reporting. Using a basic assessment of status (or condition) and trend for each parameter, they can be used as environmental indicators, and an overall condition and trend rating for the wetland as at November 2006 can be arrived at:

Indicator	Status/Condition (**H**igh, **M**edium, **L**ow	Trend (**I**mproving, **S**table, **D**eteriorating)
Native vegetation	M	I
Native flora	L	S
Native birds	M	S-I
Native fish	L-M	I
Native macroinvertebrates	L-M	S
Water levels/supply/habitats	M	I
Water flows	M	S
Water quality parameters	?	?
Weed control	M	I
Animal pest control	L	S
Human disturbance control	M	I
Overall ecology	**L-M**	**S-I**

The wetland is very convoluted and disjoint so in some aspects it would be advisable to treat it as several unrelated wetland units. For example the condition and impacts in upstream areas of the Ngaruroro are very removed from those in the Muddy Creek arm of the wetland. As such it is difficult to give a generalised report of the overall ecology of the site. The Muddy creek portion of the wetland can be said to have high ecological values in terms of vegetation and avifauna but is somewhat hindered in having fish barriers. Whereas the upper Ngaruroro has no such barriers but has a severely degraded vegetation component.

The conclusion is that the wetland is in a low-moderate natural state and is stable or improving in condition in most key aspects. It is expected that restoration management will produce further marked improvement in status/condition in targeted areas into the future.

> *Recommendation: That a similar tabulation of ecological condition and trend be used as part of the regular monitoring reporting for the wetland.*

2. Monitoring techniques and frequency

In the light of seven years' experience in Pekapeka Swamp and other wetlands in Hawke's Bay, the suite of techniques being used to monitor the ecological condition and trend of Waitangi Estuary appears to be appropriate and valuable. The only issues are the difficulty of detecting rare water birds and the lack of monitoring of water quality parameters (see above). In view of the relative stability of the wetland but some pressing management needs, monitoring at two-yearly intervals seems sensible.

> *Recommendation: That the current ecological monitoring programme be continued.*

ACKNOWLEDGEMENTS

For their help, interest and support in carrying out this monitoring, my thanks go to: Geoff Walls, Ecologist Christchurch. Anna Madarasz, Brett Stansfield, Graham Sevicke-Jones and Garth Eyles, of Hawke's Bay Regional Council, Napier; Hans Rook and John Adams of the Department of Conservation, Napier; John Cheyne, Napier; Taranaki Regional Council (freshwater invertebrates guide);

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APPENDIX 1: Map of Waitangi Estuary, showing vegetation types and monitoring site locations

Vegetation types

G Raised gravel beach; **Gb** with much boxthorn
W Water: **Wo** open riverine/tidal water; **Wp** ponded (fresh or brackish) water
S Saline flats vegetation, containing turf communities: **Sb** *Bolboschoenus fluviatilis* dominant; **Sj** *Juncus maritimus* dominant; **Sp** *Plagianthus divaricatus* dominant; **Sm** mosaic
R Riparian vegetation: **Rw** wet fringe (mainly *Bolboschoenus fluviatilis)*; **Rd** dry fringe (exotic grasses with shrub weeds in places); **Ra** raupo
T Treelands of planted exotic trees (willows, poplars, gums, tamarisk, macrocarpa, etc.)
P Pasture (includes cropping land)
Mw Mixed weedy vegetation : combinations of shrubs, trees, grasses, herbs, etc. (mainly exotic)

Monitoring sites

- Photopoints
- Aquatic sampling sites

APPENDIX 2: Photopoint recording sheets, late November 2002

- Photopoint no. 1
- Photopoint no. 2
- Photopoint no. 3
- Photopoint no. 4
- Photopoint no. 5
- Photopoint no. 6
- Photopoint no. 7
- Photopoint no. 8
- Photopoint no. 9
- Photopoint no. 10
- Photopoint no. 11
- Photopoint no. 12
- Photopoint no. 13
- Photopoint no. 14
- Photopoint no. 15
- Photopoint no. 16
- Photopoint no. 17
- Photopoint no. 18
- Photopoint no. 19
- Photopoint no. 20
- Photopoint no. 21
- Photopoint no. 22
- Photopoint no. 23
- Photopoint no. 24
- Photopoint no. 25

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 1**
Grid reference: V21/E284755 N6174241
Establishment date: 2/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
On small lobed gravel headland on west side of spit enclosing estuary. No post or tag, just a small stake to mark site.

Direction from marker/post (magnetic bearing): 4 photos taken: N, E, S, SW
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Herbfield of exotic plants (silverbeet, brassicas, fathen and grasses); a little saline turf of Selliera radicans, Isolepis cernua, Samolus repens, arrow-grass, sea spurrey and glasswort. Storm-swept and periodically flooded, therefore dynamic and open to invasion by weeds such as boxthorn. Valuable area for seabirds, waders and ducks.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Considerable gravel movement by sea and river action, re-shaping the estuarine gravel lobes and the bar - even tall piles of gravel have been wave-swept. Floods and storms are significant agents in the dynamic nature of this part of the system. Buddleia and gorse are at the site and may spread. Otherwise, little vegetation change of note. Very birdy (plovers, ducks, stilts, dotterels, gulls). Roosts appear to be at a premium and the birds would undoubtedly use them if more were provided. Much rubbish on the bar and much 4WD vehicle use, which must be disturbing to birds.
10/11/04	Geoff Walls	A very dynamic site. Beaches, gravel islands and bar lobes reshaped by floods and storms. Buddleia and gorse still present (have not yet spread). Ephemeral plants have increased, as has shore bindweed. A little trail bike use, otherwise fairly vehicle free. Many birds on lagoon shore.
25/11/06	Andrew Lamason	As in previous years this is a highly dynamic site. Buddleia is no longer present and only a single gorse bush was observed, but boneseed has become established on higher gravel mounds as has Vipers Bugloss (*Echium vulgare).* Shorebind weed cover is patchy at best. Many birds continue to use this site including Bar tailed Godwit, pied Stilt and Spur winged Plover. Little evidence of vehicle use and litter mostly from within the catchment and deposited during high flows and wind.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 2**

Grid reference: V21/E2847670 N6173661

Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the seaward side of the vehicle track along the raised beach east of lower Muddy Creek. C.30m to seaward of a large marker pole; tag nailed to pole.

Direction from marker/post (magnetic bearing): 3 photos (N, S, NW)
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Shrubland of boxthorn up to 3m tall on rear of raised gravel beach. Little other vegetation other than small shore bindweed. The boxthorn appears to have displaced or replaced native vegetation including taupata and shore bindweed.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Gravel has been moved by storms/waves on the raised beach (level appears to be lower now). Much vehicle use and rubbishy. Boxthorn has grown a little. Driftwood has been 'harvested', ie not available for birds, invertebrates, etc. Shore bindweed still present but not thriving.
10/11/04	Geoff Walls	High seas have pounded this beach, sweeping right into the boxthorn and flattening some. No sign of shore bindweed or taupata. Little vehicle use (access blocked).
25/11/06	Andrew Lamason	As above, Boxthorn has been almost completely destroyed by surf with very little regrowth. Some remnant bushes have been recently partially burnt. No bindweed or Taupata, and no actual driftwood other than the remaining frames of now dead boxthorn. Some 4WD tracking is evident.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 3**
Grid reference: V21/E2847642 N6173397
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the causeway across lower Muddy Creek, to monitor the estuarine vegetation above and below the eastern culvert. Tag on biggish leaning tamarisk nearby.

Direction from marker/post (magnetic bearing): 4 photos: 2 upstream; 2 downstream
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Upstream: channel flanked by narrow fringe of sea rush with some saltmarsh ribbonwood. Some boxthorn. Beyond on beach, scattered taupata, gorse and boxthorn.
Downstream: expanse of *Bolboschoenus fluviatilis* with some sea rush and saltmarsh ribbonwood. Much boxthorn on beach ridge beyond.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Upstream: saltmarsh ribbonwood has grown significantly, otherwise little change. Downstream: very noticeable that the *Bolboschoenus fluviatilis* is retarded in terms of spring regeneration following winter die-off; probably the result of a frosty spring.
10/11/04	Geoff Walls & Anna Madarasz	Upstream: saltmarsh ribbonwood has bulked up notably; lupins have expanded on rear beach gravel. Downstream: *Bolboschoenus fluviatilis* has invaded salt turf substantially; saltmarsh ribbonwood has grown a little, as has tamarisk. Silver willows have expanded and should be controlled.
25/11/06	Andrew Lamason	Upstream: Silver willows have been much reduced but some remnant trees are still evident. Some saltmarsh ribbonwood has died back possibly due to permanently raised water levels in this section but generally it is in good health and continues to expand in this unit. Downstream: *Bolboschoenus* ***fluviatilis*** continues to displace the wet turf. The saltmarsh ribbonwood has increased in cover and stature

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 4**
Grid reference: V21/E2847603 N6173355
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the causeway across lower Muddy Creek, to monitor the estuarine vegetation above and below the western culvert. Also Aquatic Site 1. Tags on post-and-rail fence nearby.
Direction from marker/post (magnetic bearing): 2 photos: upstream, downstream
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Upstream: broad channel flanked by *Bolboschoenus fluviatilis,* sea rush and saltmarsh ribbonwood. Quite a lot of tall fescue behind, and a line of silver willow (probably expanding).
Downstream: expanse of *Bolboschoenus fluviatilis* with some sea rush and saltmarsh ribbonwood. Tamarisk a threat.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Upstream: saltmarsh ribbonwood has thickened up and grown. *Bolboschoenus fluviatilis* mostly regrown except where badly frosted. Silver willows have been cut out. Downstream: *Bolboschoenus fluviatilis* retarded in regrowth; saltmarsh ribbonwood has thickened up.
10/11/04	Geoff Walls & Anna Madarasz	Upstream: greater water retention than before (deliberately raised barrier at weir); vegetation on fringes therefore pinned back, though *Bolboschoenus fluviatilis* increased. Silver willows need control. Downstream: saltmarsh ribbonwood has continued to bulk and thicken; massive growth of water celery nearby.
25/11/06	Andrew Lamason	Upstream: Some saltmarsh ribbonwood has died back possibly due to permanently raised water levels in this section but generally it is in good health and continues to expand in this unit. Tamarisk appears to be spreading a little and bamboo, Cape Ivy, and Blackberry are possible threats from the nearby garden areas. Silver willow appears to have been controlled with only one tree in poor health evident. Downstream: Saltmarsh ribbonwood has continued to bulk up and *Mimulus repens* has formed extensive patches.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 5**
Grid reference: V21/E2847432 N6173569
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
True left of lower Muddy Creek at tall marker pole; tag on pole.

Direction from marker/post (magnetic bearing): 6-photo panorama
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Wetland of extensive *Bolboschoenus fluviatilis* with some sea rush and saltmarsh ribbonwood. Also some wet turf and dry riparian tall fescue. Backing that is an extensive area of saltmarsh ribbonwood, with tamarisk and silver willow requiring surveillance and control.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	*Bolboschoenus fluviatilis* retarded in regrowth; saltmarsh ribbonwood has grown discernibly. Silver willows cut out.
10/11/04	Geoff Walls	*Bolboschoenus fluviatilis* has bounced back from its setback 2 years ago and is flourishing. Wet turfs in good condition. Silver willows have apparently regrown rapidly after being cut in past. Many birds (pukeko, ducks, shags).
25/11/06	Andrew Lamason	Willows regrowth is continuing in patches. Saltmarsh ribbonwood continues to thicken to a near continuous cover fringed by very healthy *Bolboschoenus fluviatilis* which forms a near complete margin dissected by side streams only. *Mimulus repens* and *Samolus repens* are found throughout the drier *Bolboschoenus fluviatilis* tall fescue interface. *Juncus kraussii* and *Isolepsis cernua* now contribute a significant portion of the vegetation in this unit.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 6**
Grid reference: V21/E2847341 N6173820
Establishment date: 3/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the stop-bank on the true left bank of Muddy Creek near its mouth. Tag on post with stay opposite maimai.

Direction from marker/post (magnetic bearing): 6-photo panorama
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
As Photopoint 5. Tamarisk and silver willow a threat.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	*Bolboschoenus fluviatilis* retarded in regrowth; saltmarsh ribbonwood has grown discernibly. Silver willows cut out, but a few trees and occasional sapling still to be removed. Gorse has been controlled. Tamarisk should be controlled too. Rubbish dumped opposite.
10/11/04	Geoff Walls	As for Photopoint 5. Saltmarsh ribbonwood has continued to grow markedly. Silver willows and tamarisk have bounced back from previous control and now the task is considerable (first efforts haven't been adequately followed up). Frogs present.
25/11/06	Andrew Lamason	Tamarisk continues to expand al be it slowly but willows are much reduced. Glasswort and Buckshorn plantain are the dominant ground cover amongst the tall fescue. The saltmarsh ribbonwood has bulked up and is in very good health. Taupata are in good health. No forgs were record during the site visit but conditions were windy which may have reduced their vocalisations.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 7**
Grid reference: V21/E2847181 N6173841
Establishment date: 3/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the stop-bank on the true right bank of the lower Clive River. Tag on nearest fencepost, at a distinct angle.

Direction from marker/post (magnetic bearing): 3 photos: SW, NE, W
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Rank and mown grasses on stop-bank; riparian fringe of 3-square, occasional sea rush and turf of arrow-grass and *Isolepis cernua*. Some silver beet, lupin and brassicas between. Could be planted in future; wash from boats and jet skis may erode shore.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Riparian fringe appears to have thickened, as have the rank grasses on the stop-bank. Wash from watercraft doesn't appear to have caused undue erosion. Good wader habitat.
10/11/04	Geoff Walls	Riparian vegetation has continued to thicken and advance. Little evident effects of boat wash now.
25/11/06	Andrew Lamason	Wind driven floatsam is suppressing the riparian vegetation in areas. No silverbeet was recorded but Tree Lucerne has established. *Sarcocornia quinqueflora* has established between the bases of the tall fescue on the wetter margins.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 8**
Grid reference: V21/E2847134 N6173842
Establishment date: 3/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the beach near Photopoint 7. Tag on post with Photopoint 8's tag.

Direction from marker/post (magnetic bearing): 2 photos: upriver and downriver
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Sea rush (*Juncus maritimus*), three-square (*Schoenoplectus pungens*) and low wet turf are present. How they will fare under a regime of vigorous wash from boats and jet skis will be interesting. Backed by rank grassland and some silver beet, lupin and brassicas.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Sea rush, three-square and turf of arrow grass, etc have all grown and thickened. There appears to be physical evidence of wash erosion; could be from watercraft or floods.
10/11/04	Geoff Walls	Sea rush has thickened and advanced; 3-square has become denser and taller. Arrow grass turf in good condition. Little shore erosion.
25/11/06	Andrew Lamason	Sea rush and 3-square continue to expand but arrow grass has been reduced somewhat by erosion in patches. The wet turf areas are particularly covered by floatsam, possibly from the wash of power boats. This vegetation is generally in good health despite this coverage.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 9**
Grid reference: V21/E2846524 N6173150
Establishment date: 3/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the true right bank of the lower Clive River, just downstream of the road bridge, at a fence that defines the end of the public recreation area. Tag on end post of fence.

Direction from marker/post (magnetic bearing): 1 photo, downstream
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Riverbank with dense tall fescue below which is a patch of *Bolboschoenus fluviatilis* emergent from a sward of arrow-grass. Some silver poplar and pampas. Much used by ducks. Bank undercut by wash from boats and jet skis.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Looks as though the bank has continued to be undercut: wash from boats and jet skis is having a significant impact. Vegetation otherwise little changed. Planting flax (and toetoe, sea rush, jointed rush) on the bank could help erosion control without the need for costly works.
11/11/04	Geoff Walls	Considerable development of fringe vegetation: arrow grass turf and colonising *Bolboschoenus fluviatilis*, also water celery. Erosion from powerboat wash still occurring, but mitigated by the vegetation. Controls on boats in place now. Planting as suggested in 2002 still a good idea.
25/11/06	Andrew Lamason	Erosion is continuing at this site with the end post of the fence where the photopoint is located now swinging freely above the bed. *Bolboschoenus fluviatilis* and *Isolepsis cernua* beds are partially covered by floatsam but are holding their own against the erosion. *Schoenoplectus pungens* beds are also beginning to establish and these may ameliorate erosive effects. Large rafts of water celery have become established possibly also wind driven into this site.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 10**
Grid reference: V21/E2846969 N6174094
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the stop-bank on the true left bank of the lower Clive River, by the Hohepa milking shed. Tag on new lone post on seaward side of stop-bank, 27m SE of the 2 'gate' posts.

Direction from marker/post (magnetic bearing): 6-photo panorama
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Second-best area of estuarine vegetation: dominated by sea rush, with some *Bolboschoenus fluviatilis* and saltmarsh ribbonwood. Saline turf of glasswort, bachelor's buttons, arrow-grass, *Samolus repens*, *Mimulus repens* and buck's horn plantain scattered throughout. Formerly grazed but now recovering. A little gorse and some tamarisk of concern. Lupins and much gorse on drier land near river to the north.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Photopoint post missing: rediscovered and reinstalled! Gorse has been sprayed. Saltmarsh ribbonwood has grown markedly in places. Karo poses a philosophical conundrum. There is a small patch on raised ground about 50m N of the photopoint. It has grown up rapidly and needs to be watched because it could become rampant around the dry shores of the estuary. It is a NZ native but not native to Hawkes Bay. It is providing welcome structural diversity, but if in the interests of ecological purity the decision is made that it is a weed to be controlled it would be far easier and cheaper if done sooner than later.
10/11/04	Geoff Walls	Overall, the area is looking very healthy. Saltmarsh ribbonwood has continued to regenerate spectacularly. The karo patch has grown significantly and should be watched as it has high weed potential. Could be replaced with ngaio, akiraho and *Pittosporum ralphii*. Gorse has been well controlled.
25/11/06	Andrew Lamason	Karo continues to expand slowly at this site as is the Saltmarsh Ribbonwood, with only sparse patches of gorse remaining. The turf is under threat via tall fescue expansion and is expected to be altered as light demanding species are replaced by shade tolerant turf species. Tamarisk continues to expand and a lone pampas has become established. These weeds will need to be watched for expansion into the vulnerable turf zone and Saltmarsh Ribbonwood. Lupins are no longer a significant component.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 11**
Grid reference: V21/E2846297 N6174372
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the stop-bank overlooking a small backwater fenced off to protect whitebait spawning habitat. Tag on nearest post.

Direction from marker/post (magnetic bearing): 1 photo, looking N.
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Muddy tidal channel flanked with dense *Bolboschoenus fluviatilis*. Rank grass and blackberry in places behind. Curly pondweed common in water, which is fairly stagnant with much green algae. Chosen to observe recovery following fencing from stock.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Little change except fringe of *Bolboschoenus fluviatilis* and rank grass has thickened and widened in places; part of the recovery process following fencing off.
10/11/04	Geoff Walls	Continuation of regeneration process following fencing of the channel. *Bolboschoenus fluviatilis* has continued to expand; now encroaching on the channel from the sides and from within. Much *Ruppia* in the water.
25/11/06	Andrew Lamason	Expansion of *Bolboschoenus fluviatilis* has continued as a change in the fence position has reduced the level of grazing via stock. Although there is no longer any obvious blackberry the tamarisk has expanded in both coverage and stature. A young eucalyptus tree has established near an adult of the same species. These trees form part of a grove that is being used as a roost by a shag colony and should be preserved as such. The shags tend to eventually kill their host trees so any new recruitment into the grove should be allowed to continue. Ruppia has reduced somewhat to be replaced by Curl Pondweed.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 12**
Grid reference: V21/E2846240 N6174478
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on a small causeway across a small double drainage channel. Also Aquatic Site 2. New post with tags inserted into E side of vehicle track. Gate erected since.

Direction from marker/post (magnetic bearing): 2 photos: 1 up channel, 1 down channel
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Fairly stagnant water but with tidal flow and occasional flooding. Site used by cattle. On banks, exotic grasses, sea rush and *Bolboschoenus fluviatilis*. Small fringe of wet turf (arrow-grass, bachelor's buttons and *Mimulus repens* (much). Dense bed of *Ruppia polycarpa* upstream of culvert. Site and vegetation would recover if stock excluded. A contrast to the nearby fenced whitebait spawning area.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Still grazed in last two years so little change except growth in willows. Looks as though grazing has ceased N of the site, so ecological recovery should follow.
10/11/04	Geoff Walls	Changes as above have continued. *Bolboschoenus fluviatilis* has appeared in the channel. Schoenoplectus validus and water buttercup have appeared. Willows upstream have grown.
25/11/06	Andrew Lamason	Stock access and grazing continues on the upstream side of the culvert and have severely reduced the turf community in this site. *Mimulus repens* which was initially plentiful at the site could no longer be found probably due to excessive trampling. *Bolboschoenus fluviatilis* and *Juncus kraussii* continue to thisken except adjacent to the stock camp beneath a nearby tamarisk where all vegetation has been destroyed. Bachelors button is the sole remaining turf plant and appears to be more immune to trampling pressure, than others. Downstream of the culvert supports and expanding population of *Bolboschoenus fluviatilis* and *Juncus kraussii* on the true left but some erosion on the true right has reduced the vegetation to rank grasses on the bank top only.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 13**
Grid reference: V21/E2846764 N6174513
Establishment date: 5/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited at the tip of the tongue of land between the lower Ngaruroro River and a side channel. New post with tag inserted at site (though not expected to last!).
Direction from marker/post (magnetic bearing): 4 photos: 2 downstream, 2 upstream (1 from whitebait stand)
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to monitor the various riverbanks here: some grazed, others not, steeply eroding in places. Beds of sedges (3-square and *Bolboschoenus fluviatilis*) and rushes would recover if stock were excluded.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Beds of arrow grass have developed, and three-square and *Bolboschoenus fluviatilis* have bulked up. Only a little flood erosion. With destocking, banks will continue to recover and stabilise, and will become increasingly suitable for whitebait spawning.
10/11/04	Geoff Walls	Continuation of processes noted in 2002. Arrow grass, *Schoenoplectus validus* (rather than 3-square) and *Bolboschoenus fluviatilis* have continued to bulk up, as predicted (good recovery following destocking).
25/11/06	Andrew Lamason	*Bolboschoenus fluviatilis* continues to expand and is encroaching upon a small area of *Schoenoplectus tabermontani* which is restricted to only the deeper water areas. Scattered crack willow saplings are evident. Arrow grass beds continue to colonise new ground with scattered clumps of *Juncus articulatus, Schoenoplectus tabermontani* and *Schoenoplectus pungens* upon the true right of the tongue upstream of the rail bridge. Sheep now have access to the site so some loss of cover is expected to occur if this situation continues.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 14**
Grid reference: V21/E2846142 N6174632
Establishment date: 3/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited where the lower Ngaruroro and Tutaekuri meet, on the true right riverbank. New post with tag put in on bank on a tiny rise.

Direction from marker/post (magnetic bearing): 2 photos: upstream and downstream
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Badly eroding and impacted upon by cattle. Rushes and sedges (3-square, *Bolboschoenus fluviatilis*, *Juncus articulatus* and *Eleocharis acuta*) would probably recover if they were excluded. Should be fenced off.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Has been recently destocked, so recovery beginning: grasses going rank, *Bolboschoenus fluviatilis* has appeared.
10/11/04	Geoff Walls	Downstream, considerable change following destocking: a fringe of *Schoenoplectus validus* and *Bolboschoenus fluviatilis* has begun to establish. Upstream, little change except rank grass and lupins have appeared; bank still being eroded by the river.
25/11/06	Andrew Lamason	Vegetative cover is following a similar process to that in 2004 with expansion of reed beds of *Bolboschoenus fluviatilis* and *Schoenoplectus tabermontani* as well as reduced bank collapse. Lupins are expanding in coverage and stature.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 15**
Grid reference: V21/E2846196 N6175128
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the true left of the old Tutaekuri channel. Also Aquatic Site 3. Tags on new post put in on bank near top in small hollow.

Direction from marker/post (magnetic bearing): 2 photos: upstream and downstream
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Flood channel with relatively low flow. Fairly stagnant and used by cattle. Many ducks. Banks with quite extensive *Bolboschoenus fluviatilis*, though fairly degraded by cattle. Small areas of turf (arrow-grass, *Limosella lineata*, bachelor's buttons, etc.) also chopped up by cattle. Crack willow fragments taking root.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	*Bolboschoenus fluviatilis* on true left bank has thickened and broadened significantly since stock fenced out; pasture grasses have gone rank. On true right, cattle still present, so no improvement. Turf of Bachelors buttons has established on the spoil from previous earthworks.
11/11/04	Geoff Walls	Cattle still in channel and using banks (managed with light grazing). As a result the vegetation, especially beds of *Bolboschoenus fluviatilis*, are hampered and locally trashed. Turf vegetation has nevertheless been overtaken by taller sedges and rushes. Willows have grown.
25/11/06	Andrew Lamason	Cattle grazing is continuing to retard *Bolboschoenus fluviatilis* growth but this species is reaching to over 1m in height and achieving 80% cover where stock access is restricted. The turf community has been completely lost through trampling and replaced by the more resistant mercer grass.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 16**
Grid reference: V21/E2846878 N6175294
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited at the mouth of a small backwater fenced off to protect whitebait spawning habitat. Also Aquatic Site 4. Tags on big strainer post.
Direction from marker/post (magnetic bearing): 2 photos: upstream and downstream, taken c.15m apart
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to observe the riparian recovery process. On the downstream bank is a riparian fringe of raupo with *Bolboschoenus fluviatilis*, backed by rank grassland and a few willows. Not accessible to stock. Upstream is a narrow fringe of *Bolboschoenus fluviatilis*, accessible to stock.
Water here is stagnant and full of weedy macrophytes and green algae.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Significant improvement upstream following fencing of river edge: rank growth of pasture grasses and herbs and bulking of *Bolboschoenus fluviatilis*. Downstream, little change.
11/11/04	Geoff Walls	Downstream, the fringe of raupo and *Bolboschoenus fluviatilis* has declined, possibly because of flood impact. Upstream, the fringe of *Bolboschoenus fluviatilis* has dramatically developed as a result of grazing relief; (bank fenced recently) therefore there is much less bank erosion.
25/11/06	Andrew Lamason	Raupo and *Bolboschoenus fluviatilis* continue to thicken and grow in stature with only small un-vegetated beaches evident. Bank erosion appears to have ceased

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 17**
Grid reference: V21/E2846964 N6174895
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited opposite the road entrance to the Colenso mission station monument. No tag or post.

Direction from marker/post (magnetic bearing): 1 photo, looking W
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to monitor the changes amongst a distinctive mixture of planted and natural vegetation in a site long free of grazing. Poplars, willows, rank grasses, blackberry, sweet pea, convolvulus, harakeke and *Bolboschoenus fluviatilis*.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Little change: flaxes, willows and poplars have grown somewhat.
11/11/04	Geoff Walls	As before. Willows and poplars have continued to grow; blackberry is well controlled now; harakeke healthy.
25/11/06	Andrew Lamason	As before. Some yellowing of willow and poplar trees accompanied by newly established saplings of these species. Large swathes of *Bolboschoenus fluviatilis* have become established with 100% cover of the water surface by *Azolla filiculoides*, *Lemna minor* and *Wolfia australiana*. Harakeke is in good health with many flowering spikes. The riparian margin is dominated by thick growths of fennel which is obscuring views into the wetland.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 18**
Grid reference: V21/E2847160 N6175120
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited at the very mouth of the old Tutaekuri channel. Tag on corner fence post; photopoint c.20m to N on the water's edge.

Direction from marker/post (magnetic bearing): 3 photos: 2 upriver, 1 NE
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to monitor the raupo beds, also the gravel beach ridge that looks likely to be colonised by boxthorn and already has some other weeds (iceplant and Indian doab in particular), but would be a good place to reintroduce *Muehlenbeckia ephedroides*.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Raupo beds look a bit tattier than before; could be frost damage. The area has undergone major re-shaping from flood/storm, scouring out gravel from the beach ridge in a major way (floodwater has flowed/pushed northwards from the main channel), thereby removing any colonising vegetation. A very dynamic site, and therefore no longer recommended as a good place to reintroduce *Muehlenbeckia ephedroides*.
11/11/04	Geoff Walls	More change since 2002 from floods and storms. Raupo fringe has thickened and looks healthy. Gravel beach ridge is too dynamic at present to be at risk from boxthorn, iceplant, etc.
25/11/06	Andrew Lamason	Raupo continues to expand alongside *Bolboschoenus fluviatilis* to be the dominant secies in this unit. Crack willow and Buddelia are becoming established in the rank pasture grasses beyond the waters edge. Boxthorn have been severly effected by flooding and storm surge damage and now most appear dead. Young Tasmanian ngaio have become established amongst the boxthorn with the introduced ice plant *Carpobrotus australe* and *Atriplex prostrate.* The aquatic vegetation is dominated by thick growths of Curled pond weed

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 19**
Grid reference: V21/E2847164 N6174704
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited at the seaward end of the stop-bank on the true left of the Ngaruroro mouth, in the recreational area. Tag on nearby vehicle barrier (which has been removed since!).

Direction from marker/post (magnetic bearing): 7-photo panorama
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to observe the impacts of heavy recreational use (it is probably the most heavily used part of the estuary system) and periodic flooding. Quite a range of vegetation: rank (but grazed) grassland; estuary edge of sea rush, 3-square and *Bolboschoenus fluviatilis*; low wet turf of glasswort, sea spurrey, arrow-grass, bachelor's buttons, *Selliera radicans*, *Mimulus repens*, fathen and buck's horn plantain; raised gravel beach with little vegetation.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
25/11/02	Geoff Walls	Considerable change in channel to seaward. Much of area has been inundated with floods. Higher ground has been relatively unaffected; otherwise silted up or scoured.
11/11/04	Geoff Walls	As before, much change in channel and gravel to seaward through flooding and high seas. Not much vegetation change, though some localised sea rush expansion.
25/11/06	Andrew Lamason	*Sarcocornia quinqueflora* has been reduced to a few isolated remnants and *Mimulus repens* was undetected with *Selliera repens* being the dominant remaining turf species. This site has been heavy tracked and compacted by vehicles presumably avoiding lying water.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 20**
Grid reference: V21/E2846650 N6174721
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited at a small freshwater pond used for hunting waterfowl. Just N of the furthest a vehicle can be taken before meeting a fence. Tag on strainer post for electric fence.

Direction from marker/post (magnetic bearing): 2 photos: N, NW
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Small shallow (artificial?) pond with maimai. Used by cattle. Almost entirely vegetated with *Schoenoplectus validus*, *Bolboschoenus fluviatilis*, *Glyceria maxima* and water buttercup, with some *Juncus articulatus*, creeping bent, raupo and floating azolla and *Lemna minor*. Chosen to monitor changes over time, with or without the removal of stock. Raupo, rushes and sedges would bulk dramatically if cattle were removed.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Quite different. Still grazed and used by cattle, but much more ponded water than in 2000. Raupo has grown up in middle of pond; *Schoenoplectus validus* and *Bolboschoenus fluviatilis* kept down by cattle. *Glyceria maxima*, curly pondweed and water buttercup common in water. Much used by stilts, herons, swallows and ducks.
11/11/04	Geoff Walls	No stock now, and evidently the pond is permanent. *Schoenoplectus validus* has grown up in the pond much. Raupo taller than before. Shore fringe of *Bolboschoenus fluviatilis* and creeping bent is developing. Much curly pondweed in the water.
25/11/06	Andrew Lamason	*Schoenoplectus tabermontani* has a patchy coverage throughout the pond and is now a secondary component behind that of raupo which dominates the open water. *Bolboschoenus fluviatilis* has thickened considerably on the margins and *Juncus articulatus* is becoming widespread amongst the rank pasture grasses. *Glyceria maxima* and Curled pondweed are still the main macrophyte components in the water body.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 21**
Grid reference: V21/E2846639 N6174695
Establishment date: 4/12/00 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Sited on the riverbank near Photopoint 20. Tag on end fencepost.

Direction from marker/post (magnetic bearing): 3 photos: upstream, downstream and across river.
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to monitor badly eroding banks on each side of the river; one grazed, the other fenced off. The true left bank may need re-shaping to allow re-establishment of riparian rushes and sedges and prevent on-going erosion.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
26/11/02	Geoff Walls	Riverbanks here have continued to erode and are undercut now cf in 2000. Grazing doesn't seem to be the major influence, as erosion under both grazed and ungrazed regimes here.
11/11/04	Geoff Walls	On the true left bank grass and exotic herbs have gone rank in the absence of grazing. However, erosion has continued, creating a small cliff system with no buffering. On the true right is a well graded bank upon which buffering vegetation (*Bolboschoenus fluviatilis*) is developing well.
25/11/06	Andrew Lamason	Banks are continuing to erode as above as no vegetative buffer has been allowed to establish. Only tall fescue clumps that appear to have fallen and rerooted in the sediment are providing any cohesive force. No woody species have developed. On the opposite bank *Bolboschoenus fluviatilis* is providing a valuable buffer and the banks are of an easy contour.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 22**

Grid reference: V21/E2846452 N6174577

Establishment date: 26/11/02 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
N side of newly created pond system, more or less central. Near old hut. No post or tag.

Direction from marker/post (magnetic bearing): 5-photo panorama.
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Newly created pond with islets. Fed by tidal flow and probably also subject to floodwaters. A weir is to be established to keep water in the pond. Bare shores are vegetating in turf of exotic grasses, Bachelors button, *Mimulus repens,* etc. Should eventually be clad in *Bolboschoenus fluviatilis*, three-square, arrow grass, etc. Much used already by ducks and waders. Stock excluded.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
10/11/04	Geoff Walls	Around the scrapes, fringing vegetation forming turf has become dominated by buck's horn plantain, bachelor's buttons, arrow grass and creeping bent (the latter two have much increased). *Bolboschoenus fluviatilis* has appeared in places. In the water, *Ruppia* is abundant and water buttercup has established. On the islands and dry ground, exotic grasses have gone rank. This site could be enhanced by planting native trees, shrubs and harakeke.
25/11/06	Andrew Lamason	*Bolboschoenus fluviatilis* has expanded considerably from the previous survey and *Schoenoplectus pungens* and *Juncus kraussii*. Ruppia and green filamentous algae dominate the open water with a well developed turf of *Mimulus repens Isolepsis cernua* and bachelors button on the riparian margin. Plantings of flax and toetoe have begun to become obvious with some flowering taking place.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 23**
Grid reference: V21/E2845940 N6174494
Establishment date: 26/11/02 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
On main track upriver from Photopoint 14, at white gate post. Blue permalat tag on post.

Direction from marker/post (magnetic bearing): 1 photo (NE).
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Old meander channel or dug channel. Much water buttercup. *Ruppia polycarpa* and curly pondweed in ponded areas, surrounded by dense *Juncus articulatus* and creeping bent, in turn surrounded by rank pasture grasses. Clumps of water plantain (*Alisma plantago-aquatica*, a native of Europe, Asia, Africa and Australia) present; will probably proliferate now stock are excluded.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
10/11/04	Geoff Walls	The channel is much more vegetated now, especially in creeping bent, Juncus articulatus and water buttercup; Ruppia and curly pondweed has been squeezed out. Less open water now as a result. Water plantain has expanded a little, but not as much as expected. Dock has invaded a little.
25/11/06	Andrew Lamason	Creeping bent and *Juncus articulatus* are dominant in the unit with little evidence of water plantain and water buttercup. This is probably reflecting the continued drying of the site. Some crack willow, *Cyperus ustulatus* and *Isolepsis nodosa* are becoming established, with *Bolboschoenus fluviatilis* and raupo being restricted to the dampest remaining points. These plants are of low stature and poor health and are not expected to remain in this unit.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 24**
Grid reference: V21/E2846620 N6174903
Establishment date: 26/11/02 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
On curving stop-bank, at its western point. A small waratah has been banged in on the seaward side near the top. Otherwise no post or tag.

Direction from marker/post (magnetic bearing): 4 photos in E sector (panorama); 2 photos upriver (W).
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Chosen to follow changes after proposed destocking, pond establishment, etc.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
11/11/04	Geoff Walls	Scrapes have been recently created within the area enclosed by a stopbank and the railway line. Deliberately flooded to recreate wetland habitat. Being used by wading birds; wetland vegetation just beginning to establish. Upstream, the grass is now rank in the absence of intensive grazing.
25/11/06	Andrew Lamason	Restoration plantings are now well established and is beginning to overtop the rank pasture grasses. Extensive rafts of *Azolla filiculoides* over curled pondweed dominate the open water. *Bolboschoenus fluviatilis* is becoming established at the waters edge as well as *Juncus kraussii*. Large numbers of water fowl are inhabiting the pond now including Black shag, white faced heron Pukeko and over 100 mallard ducks.

PHOTOPOINT RECORDING SHEET

Location/Area: Waitangi Estuary **Photopoint no: 25**
Grid reference: V21/E2846843 N6175458
Establishment date: 26/11/02 **Observer/Photographer: G. Walls**

Photopoint relocation notes:
Just through gate on top of stop-bank, at wooden fence. Blue permalat tag on post with wires.

Direction from marker/post (magnetic bearing): 4-photo panorama, in S sector.
Camera info (lens, film, etc): 50mm, 200 asa

Vegetation (composition, structure, patterns, processes):
Rank pasture grasses and herbs, willows, lupins, hemlock, fennel and blackberry between fence and railway line. To W of fence, grazed by cattle except for banks Chosen to track changes if developments occur
.

REPHOTOGRAPHY DETAILS:

Date	Observer/ Photographer	Comments (changes, processes, etc)
11/11/04	Geoff Walls	*Bolboschoenus fluviatilis* has continued to bulk up on the channel banks. Pasture is lightly grazed so has gone rank.
25/11/06	Andrew Lamason	*Bolboschoenus fluviatilis* continues to thicken with raupo extending further up the Awatoto stream. *Lemna minor* is evident over the open water. The surrounding pasture area is dominated by tall fescue, Blackberry, fennel, Ragwort, and Great bindweed. This area would suit restoration efforts in the future.

APPENDIX 3: Aquatic vegetation and macroinvertebrate recording sheets, late November 2002

- Site no. 1
- Site no. 2
- Site no. 3
- Site no. 4

AQUATIC VEGETATION AND MACROINVERTEBRATE RECORDING SHEET

Location/Area: Waitangi Estuary **Site no: 1**

Grid reference: V21/476734

Establishment date: 5/12/00 **Observer: G Walls**

Site notes (location details, vegetation, etc):
Sited on the causeway across lower Muddy Creek, to monitor the estuarine vegetation above and below the western culvert. Also Photopoint 4. Tags on post-and-rail fence nearby. Terribly stagnant downstream; much better upstream.

SAMPLING DETAILS

Date: 25/11/06 **Observer: A Lamason & B Stansfield**

Sampling methods/notes:
Samples taken both upstream and downstream of the culvert

AQUATIC VEGETATION PRESENT			**COMMENTS**
Species	**Relative abundance***		
	2004	2006	
Green algae	M	M	Huge quantities, forming dense mats
Ruppia polycarpa	S	S	
Hornwort	M	S	Minor component in 2006
Mimulus repens	M	M	
Bolboschoenus fluviatilis	M	M	
Bachelor's buttons	S	M	Has expanding considerably
Azolla filiculoides	S	S	
Lemna minor	S	S	
Water Celery	S	A	Not recorded in 2006
Egeria	A	A	Present in 2002 not recorded since
Curley Leaved Pond weed	A	A	Present in 2002 not recorded since
*** estimated % or: a = absent u = uncommon/rare s = some m = much**			

MACROINVERTEBRATES PRESENT		**COMMENTS**		
Species	**SENSITIVITY SCORE (1-10)**	**2004**	**2006**	
Upstream:				
Isopod	5	P	P	
Dytiscus beetle	5	P	A	
Amphipod	5	P	P	
Xanthocnemis damselfly larva	5	P	A	
Potamopyrgus snail	4	P	P	
Physa snail	3	P	A	
Backswimmer	3	P	P	
Microvelia bug	3	P	P	
Shrimp	3	P	P	
Mud crab	3	P	P	
Downstream:				
Potamopyrgus snail	4	P	P	
Mud crab	3	P	P	
Shrimp	3	P	P	
Microvelia bug	3	P	P	
Chironomus midge larva	1	P	A	
Sigara bug	5	A	P	

AQUATIC VEGETATION AND MACROINVERTEBRATE RECORDING SHEET

Location/Area: Waitangi Estuary **Site no: 2**

Grid reference: V21/462745

Establishment date: 5/12/00 **Observer: G. Walls**

Site notes (location details, vegetation, etc):
Sited on a small causeway across a small double drainage channel. Also Photopoint 12. New post with tags inserted into E side of vehicle track. Fairly stagnant; used by stock and waterfowl.

SAMPLING DETAILS

Date: 25/11/06 **Observer: A Lamason & B Stansfield**

Sampling methods/notes:
Samples taken both upstream and downstream of the culvert

AQUATIC VEGETATION PRESENT			**COMMENTS**
Species	**Relative abundance***		
	2004	2006	
Green algae	S	M	Huge quantities, forming dense mats
Ruppia polycarpa	M	M	
Mimulus repens	S	A	Diminished in 2004, absent in 2006
Bolboschoenus fluviatilis	S	M	Has expanding considerably
Juncus kraussii	S	S	
Triglochin striata (arrow grass)	S	S	
Batchelor's buttons	S	S	
Azolla filiculoides	U	U	
Lemna minor	U	U	
Creeping bent	S	M	Has expanding considerably
Water buttercup	S	U	Has reduced in cover
*** estimated % or: a = absent u = uncommon/rare s = some m = much**			

MACROINVERTEBRATES PRESENT		**COMMENTS**		
Species	**SENSITIVITY SCORE (1-10)**	**2004**	**2006**	Continues to a non-diverse site
Isopod	5	P	P	
Amphipod	5	P	P	
Potamopyrgus snail	4	P	P	Not recorded in 2006
Physa snail	4	P	A	
Shrimp	3	P	P	
Sigara bug	3	P	P	
Mud crab	3	P	P	

AQUATIC VEGETATION AND MACROINVERTEBRATE RECORDING SHEET

Location/Area: Waitangi Estuary **Site no: 3**

Grid reference: V21/462751

Establishment date: 4/12/00 **Observer: G. Walls**

Site notes (location details, vegetation, etc):

Sited on the true left of the old Tutaekuri channel. Also Photopoint 15. Tags on new post put in on bank near top in small hollow.

Cattle used site in 2000, but now largely excluded except for occasional wanderer. Normal flow not great.

SAMPLING DETAILS

Date: 25/11/06 **Observer: A Lamason & B Stansfield Sampling methods/notes:**

Samples taken from edge of *Bolboschoenus fluviatilis* zone

AQUATIC VEGETATION PRESENT			**COMMENTS**
Species	**Relative abundance***		
	2004	2006	
Green algae	M	M	
Ruppia polycarpa	M	M	
Water buttercup	S	S	
Curly pondweed	S	A	Not found in 2006
Creeping bent	M	M	
Bolboschoenus fluviatilis	M	M	
Batchelor's buttons	S	S	
Juncus articulatus	S	U	
Isolepis prolifer	S	A	
Schoenoplectus pungens	A	S	Possibly misreported as Schoenoplectus tabermontani
Schoenoplectus validus (tabermontani)	S	A	Possible typographical error as Schoenoplectus pungens is here.
Veronica anagallis-aquatica	S	A	Not found in 2006
Canadian pondweed	S	U	
Raupo	A	S	Not detected here previously
*** estimated % or: a = absent u = uncommon/rare s = some m = much**			

MACROINVERTEBRATES PRESENT				**COMMENTS**
Species	**SENSITIVITY SCORE (1-10)**	**2004**	**2006**	Continues to be non-diverse site
Isopod	5	A	P	
Amphipod	5	P	P	Not recorded in 2006
Potamopyrgus snail	4	P	P	
Microvelia Bug	3	P	A	
Mosquito Larvae	3	A	P	Not detected previously
Sigara bug	3	P	P	

AQUATIC VEGETATION AND MACROINVERTEBRATE RECORDING SHEET

Location/Area: Waitangi Estuary **Site no: 4**
Grid reference: V21/469753
Establishment date: 4/12/00 **Observer: G. Walls**

Site notes (location details, vegetation, etc):
Sited at the mouth of a small backwater, Awatoto Stream, fenced off to protect whitebait spawning habitat. Also Photopoint 16. Tags on big strainer post by backwater.
Normal water flow not great; relatively stagnant, has a weak tidal influence.

SAMPLING DETAILS
Date: 25/11/06 **Observer: A Lamason & B Stansfield Sampling**
Sampling methods/notes:
Samples taken from both backwater and river side

AQUATIC VEGETATION PRESENT			**COMMENTS**
Species	**Relative abundance***		
	2004	2006	
Green algae	M	M	
Ruppia polycarpa	M	M	
Hornwort	S	S	
Lemna minor	S	A	Not found in 2006
Water buttercup	U	U	
Bachelors Button	A	U	

*** estimated % or: a = absent u = uncommon/rare s = some m = much**

MACROINVERTEBRATES PRESENT		**COMMENTS**		
Species	**SENSITIVITY SCORE (1-10)**	**2004**	**2006**	
Isopod	5	P	A	Not recorded in 2006
Amphipod	5	P	P	
Dytiscus Beetle	5	P	A	Not recorded in 2006
Xanthocnemis damselfly larva	5	P	P	
Potamopyrgus snail	3	P	P	
Mud Crab	3	P	P	
Sigara bug	3	P	P	
Mosquito Larvae	3	P	P	
Chironomus Midge larva	1	P	P	
Oligochaeta worm	1	A	P	Not detected previously

APPENDIX 4: Bird lists, Waitangi Estuary, November 2004

Water birds			Other birds		
Species	**Est. Nos.**	**Breeding (yes/no)**	**Species**	**Est. Nos.**	**Breeding (yes/no)**
Native species			**Native species**		
Black shag	30	n	Pipit	15	?
Little shag	40	n	Silvereye	20	?
Grey duck	?	?			
NZ shoveler	10	y	**Introduced species**		y
Paradise shelduck	20	y	Skylark	30	y
Grey teal	20	?	Starling	50+	y
Pied stilt	30	y	Blackbird	20	y
Var. oystercatcher	10	?	Thrush	15	?
Banded dotterel	30	y	Redpoll	50+	?
E. bar-tailed godwit	-	-	Greenfinch	50+	?
Pacific golden plover	-	-	Goldfinch	50+	?
White-faced heron	25	?	Chaffinch	20	?
Kotuku (white heron)	-	-	Yellowhammer	20	y
Spur-winged plover	20	y	House sparrow	30	y
Caspian tern	4	n	Dunnock	15	?
White-fronted tern	10	y	Magpie	10	?
Red-billed gull	20	?	Myna	30	?
Black-billed gull	-	-	Pheasant	10	
Black-backed gull	30	y			
Pukeko	15	y			
Welcome swallow	50	y			
NZ kingfisher	10	?			
Australasian harrier	10	y			
Gannet	-	-			
Introduced species					
Mallard	80	y			
Black swan	10	y			

APPENDIX 5: Other animal lists, Waitangi Estuary, late November 2002

Species	Est. Nos.	Breeding (yes/no)	Species	Est. Nos.	Breeding (yes/no)
Introduced mammals (detected)			**Native reptiles**		
Cattle		y	**Introduced reptiles**		
Rabbit	10	y			
Hare	5	y	**Introduced frogs**		
Cat		y	Southern bell frog	50+	y
Dog					
Hedgehog	50+	y			
Possum	10	y			
Mouse	>100	y			
Stoat	5	y			
Introduced mammals (probably present)					
Ferret					
Weasel					
Ship rat					
Norway rat					