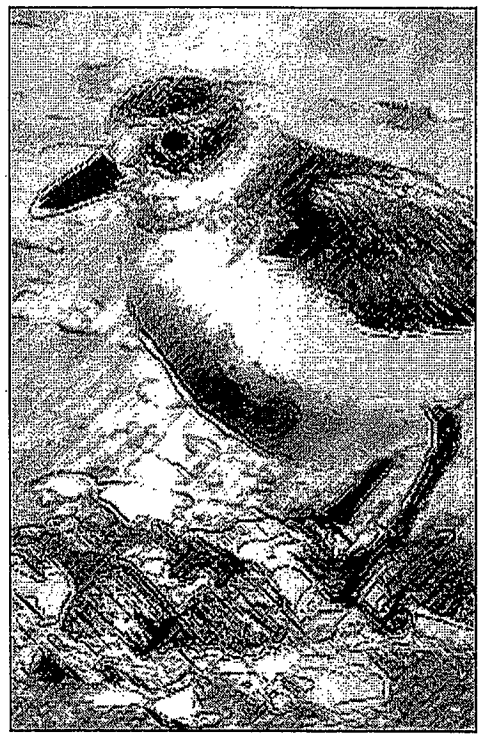
# Potential impacts on shorebirds of a proposed subdivision at Te Arai, North Auckland



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# Contents

# 1 Introduction

## 1.1 BACKGROUND

A joint venture between Te Uri o Hau and New Zealand Land Trust proposes to develop a subdivision and other amenities ("Te Arai Coastal Forest Community") on coastal land between Mangawhai Sandspit and Te Arai Point on the North Auckland east coast (Darby Partners 2005).

The land itself occupies about 620 ha, and occupies the northern block of Mangawhai State Forest. The seaward boundary of the block is a little over 5 km in length and runs from just north of the Eyres Point car park in the south to the southern boundary of the Mangawhai Wildlife Refuge in the north.

The northern part of the Mangawhai-Pakiri embayment has significant avifauna values. In particular, it is known to contain important breeding populations of a number of charadriiform birds (shorebirds and terns), some of them threatened. There is clearly the potential for the proposed development to have negative impacts on these birds.

As part of their assessment of environmental effects, Darby Partners commissioned a report from Wildland Consultants to assess the potential impacts of the proposed development on avifauna values in the area and to evaluate means of avoiding negative impacts on fairy terns and other shorebirds. As a result of that evaluation, the report (Pierce 2005) included an Action Plan for protection of shorebirds at Te Arai.

It is clear that a subdivision of the size proposed (*c.* 1400 dwellings, two campgrounds and a range of facilities open to the public) (Darby Partners 2005) would result in a very large increase in the human population locally. Given that the primary interest for many of these people would be a range of recreational activities on the beaches and dunes of the area, it is obvious that the potential environmental impacts of the development will extend well beyond the footprint of the subdivision itself. There is a clear expectation for example that there will be a large increase in foot traffic to the Mangawhai sandspit and to Te Arai Stream, and possibly further afield (Pierce 2005; Darby Partners 2005).

## 1.2 BRIEF FOR THIS REPORT

The present report was commissioned by Auckland Conservancy of the Department of Conservation. The brief for the report was as follows:

1 Provide information on the shorebird values at the location (Te Arai Point to Mangawhai Sandspit) and comment on the significance of the location for shorebird species in a local, national, and international context.

2 Review the report by RJ Pierce entitled '*Opportunities for Shorebird Protection Associated with Proposed Coastal Community at Te Arai, Northland*' (August 2005) and provide comments on the recommendations and Action Plan outlined in that report.

# 2 Shorebird values of the Mangawhai-Te Arai area

This section identifies the shorebird species (in this context the term includes the typical waders and terns) that are known to occur in or near the area of the proposed subdivision. For each taxon, there is a brief outline of total population size, threat status, and threatening agents, where these are known. The significance of the area for each taxon is assessed, based on the number of pairs breeding and/or numbers of individuals feeding, roosting or flocking in the area. The site has been deemed significant habitat for a taxon if it holds 1% or more of that taxon (Ramsar Convention 1971).

## 2.1 BREEDING SHOREBIRDS

### Variable oystercatcher (*Haematopus unicolor*) [ENDEMIC]

*Numbers, status and threats*

The total population of this species was recently estimated at about 4500 individuals. The effective population seems likely to number about 2000 pairs. It is increasing in numbers and is classified as Not Threatened (Hitchmough & Bull 2004). Adult variable oystercatchers are relatively large, aggressive birds and their survival is generally high (Dowding, unpubl. data). However, breeding attempts are vulnerable to predation, trampling, disturbance, and flooding, and breeding success at unmanaged sites is often low. In some areas, habitat continues to be degraded by development and recreational use of beaches.

*Significance of the area*

About 35-40 pairs of variable oystercatchers normally nest on Mangawhai Sandspit and around the harbour. A further 5-8 pairs nest around Te Arai Stream. Together, these constitute about 2.0-2.3% of the effective population. Post-breeding counts at Mangawhai in recent years have been in the range 150-250 birds, or about 3.3-5.6% of the total population. The area is therefore a site of regional, national and international significance for the species.

### Pied stilt (*Himantopus himantopus*) [NATIVE]

*Numbers, status and threats*

The total New Zealand population is estimated at about 30,000 individuals (Heather & Robertson 1996). Pied stilts are classified as Not Threatened (Hitchmough & Bull 2004). The main threats are predation of eggs, chicks and adults, loss of nests to trampling and flooding, and loss and degradation of habitat (Marchant & Higgins 1993)

*Significance of the area*

One or two pairs of pied stilts often breed at the mouth of Te Arai Stream. Small groups are also regularly seen at HW on Mangawhai Sandspit, and a few pairs probably also nest there. However, these birds constitute a very small fraction of the total population and the area is not significant for the species regionally or nationally.

### Northern New Zealand dotterel (*Charadrius obscurus aquilonius*) [ENDEMIC]

*Numbers, status and threats*

In October 2004, the population numbered about 1700 birds, including about 700 pairs (Dowding & Davis 2005). The northern New Zealand dotterel is an Acutely Threatened taxon, with a threat classification of 3 Nationally Vulnerable (Hitchmough & Bull 2004). It has the CD (Conservation Dependent) Qualifier, meaning that the taxon is likely to move

to a higher threat category if current management ceases. Internationally, the species as a whole is classified as Endangered (BirdLife International 2005). The main threats to the taxon are predation, disturbance, and loss and degradation of habitat (Dowding & Davis 2005).

*Significance of the area*
In recent years, 30-40 pairs of New Zealand dotterels have bred on Mangawhai Sandspit and around the harbour (the figure of 8 pairs given by Walls (2005) and cited by Pierce (2005) appears to be a serious under-estimate). With this number of pairs, Mangawhai Sandspit is the most important breeding site for this taxon in the world. A further 8-9 pairs breed at Te Arai Stream; this constitutes 1.1-1.3% of the effective population and makes Te Arai Stream a site of national significance for New Zealand dotterels in its own right. In recent years, the number of pairs at this site has increased, and pairs now breed in the dunes up to 1 km south of the stream (and close to the southern boundary of the forest block). South of Te Arai Point, 2-3 pairs breed at the mouth of Poutawa Stream, and a further 7-8 pairs currently breed at Pakiri River mouth.

The critical area between Mangawhai Sandspit and Te Arai Point therefore contains about 40-45 breeding pairs, or about 6% of the entire population. This area is clearly one of national and international importance for the taxon.

**Banded dotterel (*Charadrius bicinctus*)** [ENDEMIC]

*Numbers, status and threats*
There is no accurate recent estimate of the size of the banded dotterel population; in recent decades, estimates have been in the range 12,500-50,000. The banded dotterel has the threat classification 5 Gradual Decline (Hitchmough & Bull 2004). The main causes of breeding failure are predation (by mammalian and avian predators), and loss of nests to trampling and flooding (Marchant & Higgins 1993). There is also loss and degradation of habitat in some areas.

*Significance of the area*
Only 1-3 pairs of banded dotterels have been recorded breeding in the Mangawhai Refuge and the area is not important for the species as a breeding site. A post-breeding flock forms in late summer, and typically contains 50-150 birds. In the absence of a reliable estimate of the total population, assessing significance of the site is difficult. The site is probably not significant at a national level on a regular basis, but probably is at a regional level.

**Spur-winged plover (*Vanellus miles novaehollandiae*)** [NATIVE]

*Numbers, status and threats*
This Australian species has colonised New Zealand in the past 75 years, and is now widespread and common in this country. There is no estimate of the size of the population nationally, but the species has increased rapidly in range and numbers in recent decades and is ranked Not Threatened (Hitchmough & Bull 2004). There is some loss of nests to trampling by stock (and probably to mammalian predators) and nests may be abandoned following disturbance (Marchant & Higgins 1993).

*Significance of the area*
Small groups of spur-winged plovers are recorded at Te Arai Stream and at Mangawhai Sandspit, and a few pairs probably breed at both locations. Numbers are low however, and the area is not of regional or national significance for the species.

**Caspian tern (*Sterna caspia*)** [NATIVE]

*Numbers, status and threats*
The New Zealand population of this species numbers about 3000 birds and is Acutely Threatened, being ranked 3 Nationally Vulnerable (Hitchmough & Bull 2004). It is considered secure overseas. Breeding success is often low as a result of disturbance and predation (notably by cats and dogs, but also by other mammals and by avian predators). Trampling of nests and flooding also have an impact. Degradation of breeding habitat has also occurred (Heather & Robertson 1996).

*Significance of the area*
There is a well-established colony in the low dunes near the base of Mangawhai Sandspit. In recent decades, this has typically contained 80-100 pairs but numbers appear to be declining; in recent seasons, 25-60 pairs have been recorded (Walls 2005). These counts suggest that the site currently contains about 2-4% of the New Zealand Caspian tern population, making Mangawhai Sandspit a site of national significance for the species.

**White-fronted tern (*Sterna striata*)** [NATIVE]
*Numbers, status and threats*
There is no reliable estimate of population size; colonies are highly capricious and monitoring trends is therefore very difficult. However there is evidence of decline in some areas and the taxon is ranked 5 Gradual Decline (Hitchmough & Bull 2004). Mainland colonies are often raided by mammalian and avian predators, with loss of eggs, chicks and adult birds. Disturbance may increase the incidence of predation, especially by gulls, and there are records of vandalism by humans. There are also losses to flooding and storms.

*Significance of the area*
There is normally a colony of white-fronted terns on Mangawhai Sandspit, but its size is very variable. In the past decade, there have been up to 500-1000 pairs, but in 2005/06 there were only 28 pairs (Williams 2006). Assessing the significance of the area for this species is difficult, but when a large colony is present, it is almost certainly at least regionally important.

**New Zealand fairy tern (*Sterna nereis davisae*)** [ENDEMIC]
*Numbers, status and threats*
The New Zealand fairy tern population currently numbers about 35-40 individuals, making it New Zealand's rarest breeding bird. During the 2005/06 season, there were 11 known breeding pairs. The New Zealand fairy tern is an Acutely Threatened taxon, with the highest possible threat classification of 1 Nationally Critical (Hitchmough & Bull 2004). It has the CD (Conservation Dependent) Qualifier. The Nationally Critical category is equivalent to the international (IUCN) category Critically Endangered (Molloy *et al.* 2002). The main agents of decline are thought to be predation, disturbance caused by human recreational activities, extreme environmental events, and habitat depletion (Parrish & Honnor 1997).

*Significance of the area*
The New Zealand fairy tern was formerly widespread, but now has a very small population and a very restricted range (Heather & Robertson 1996). It currently breeds at only four sites, all in the North Auckland region. Two of these sites are in the Pakiri-Mangawhai embayment.

Mangawhai Sandspit is the single most important breeding site for the taxon, with 5 of the11 pairs breeding there in 2005/06. With almost half of the effective population, the site is clearly of crucial importance to the taxon.

Te Arai Stream is also an important site for fairy terns, which use the beach around the stream mouth as a post-breeding flock site in late summer-autumn each year, before moving to the Kaipara Harbour for the winter. Over the past 5 years, peak counts at the site have been in the range 6-14. These birds constitute about 15-35% of the world population, making the area one of international significance for the taxon. Fairy terns are seen again at Te Arai in late winter / early spring when birds that breed on the east coast return from the Kaipara Harbour (Parrish & Honnor 1997). At other times, fairy terns also feed over Slipper Lake and Spectacle Lake (2-3 km south of Te Arai Stream mouth) and use the beach at the stream mouth as a roost site.

## 2.2 NON-BREEDING SHOREBIRDS

**Pied oystercatcher (*Haematopus finschi*)** [ENDEMIC]
This internal migrant has an estimated population of about 130,000 individuals. It is considered Not Threatened (Hitchmough & Bull 2004). Autumn and winter counts of pied oystercatcher at Mangawhai are typically in the range 50-300, and the site is not considered a significant one for this species.

**Wrybill (*Anarhynchus frontalis*)** [ENDEMIC]
Small numbers of this internal migrant over-winter at Mangawhai. This species is classified as 3 Nationally Vulnerable (Hitchmough & Bull 2004). There is a record of 31 birds in March 1998, but the 2-6 individuals present in most years constitute less than 1% of the population (which numbers about 5000 birds). Most wrybills over-winter in harbours around Auckland, and Mangawhai is therefore not a regionally or nationally significant site for this species.

Three Arctic migrant shorebird species are regular annual visitors to Mangawhai.

**Turnstone (*Arenaria interpres*)** [MIGRANT]
About 10-40 turnstones are counted at Mangawhai annually; this is not a significant proportion of the estimated 5000-7000 birds that visit New Zealand each year.

**Lesser knot (*Calidris canutus*)** [MIGRANT]
Counts of knots at Mangawhai are normally in the range 250-500. This constitutes about 0.4-0.8% of the estimated 60,000 knots that visit New Zealand annually. The Mangawhai flock is not nationally significant; it is probably regionally significant, although a large majority of the knots in this country are found in the Northland-Auckland area (Sagar *et al.* 1999).

**Bar-tailed godwit (*Limosa lapponica*)** [MIGRANT]
Summer counts of bar-tailed godwits at Mangawhai are normally in the range 400-800. This constitutes about 0.4-0.8% of the estimated 100,000 godwits visiting New Zealand each year. Godwits are generally more widespread in New Zealand than knots, and the Mangawhai counts make the area one of regional significance for this species.

# 3 Review of Pierce report

The report by Pierce (2005) has five main sections. It
(a) outlines the avifauna values of the Mangawhai-Te Arai area,
(b) discusses threats to shorebirds and terns,
(c) describes the management programme undertaken for fairy terns to date and considers the taxon's response to it,
(d) lists potential negative effects of the proposed development on shorebirds, and
(e) evaluates various management options and, based on that evaluation, proposes an action plan for protection of shorebirds at Te Arai.

## 3.1 AVIFAUNA VALUES

In general, the report identifies the important avifauna values of the area, although several shorebird species that breed in small numbers are missing from Table 1, and one of the threat rankings in Table 1 appears to be incorrect. The importance of the area at the regional and national levels for most of the taxa is not explicitly quantified, but there is clear acknowledgement that Mangawhai and Te Arai are sites of high significance for fairy terns. In my opinion, the significance of the area as a whole for New Zealand dotterels is under-estimated (or under-stated) by Pierce (2005) – the taxon is endemic, conservation-dependent and Acutely Threatened, and Mangawhai is the single most important breeding site and the site of the largest flock in the taxon's range (section 2.1 above). Overall, the area is of national significance for four taxa, three of them Acutely Threatened.

Given these facts, I suggest that Pierce's conclusion (section 7) that "The Te Arai-Mangawhai area has high conservation values..." is also a substantial understatement. I believe the area must be described as having 'Outstanding' values as shorebird habitat. I note that elsewhere in the AEE (Appendix 3, p. 12, Table 3 in Darby Partners 2005), Mangawhai Sandspit is assessed as having 'Outstanding' ecological significance.

## 3.2 THREATS TO SHOREBIRDS

This section identifies the major threats to shorebirds as predation (of all life stages), disturbance during breeding, and weather and tidal flooding. Infertility is also listed, but this is mainly an issue for fairy terns (Parrish & Honnor 1997) and not for the other species considered here.

One general threatening process that affects a number of New Zealand shorebirds that is not considered by Pierce (2005) is loss and degradation of habitat. This is an ongoing threat to northern New Zealand dotterels, particularly on the North Island east coast (Dowding & Davis 2005).

## 3.3 MANAGEMENT OF FAIRY TERNS

This section contains a brief summary of management to date. It concentrates on predator control techniques, and provide little detail of some other management actions that have been undertaken, e.g. captive rearing and protection of nests against flooding. However, these techniques are relatively well documented (e.g. Honnor & Hansen 1998).

The assessment of the response of the population to management notes that in spite of 15 years of intensive management, the New Zealand fairy tern population is only stable and concludes "...the situation for this species is still clearly very precarious." A number of

possible reasons for this very slow response are listed. Pierce (2005) indicates that some failures are probably due to ineffective predator control and describes the trapping regime at Mangawhai Sandspit as "...modest for such a threatened species...".

## 3.4 POTENTIAL NEGATIVE EFFECTS

Pierce (2005) clearly recognises that the proposed development "...has potentially significant implications for shorebirds..." and lists the potential impacts as including "...predation by cats, predation and disturbance by dogs, increased rodent and predator numbers, and increased human disturbance".

He identifies predation by house-based cats as a major issue and I agree. He notes that they would not be acceptable and that they are to be banned from the subdivision. This is clearly essential.

Pierce (2005) notes that dogs pose a significant threat to shorebirds (especially chicks), that they can roam "vast distances", and that they could gain access to breeding areas at Mangawhai Sandspit and Te Arai Stream "...in a very short period of time". He also states "Experience with kiwi management in Northland indicates that, even with the best of intentions, predation events do happen..." Pierce (2005) also notes that "...there is little or no capacity for reduced productivity of New Zealand dotterels, Caspian terns, and, especially, the precarious fairy tern population...".

The report acknowledges that rodents could increase in numbers, either because they are attracted to dwellings or because pressure on them is reduced when top predators are removed. While this is true, the potential threat to shorebirds at Mangawhai Sandspit and Te Arai Stream from rodents is probably much less important than the threats posed by larger predators and by human activities in the area.

In discussing the potential impacts of human disturbance, the report acknowledges that "The development...would be accompanied by a large increase in foot traffic to the Mangawhai Wildlife Refuge (sandspit) and the Te Arai Stream, and possibly the Pakiri Stream. Unless visitors are carefully "managed", this is almost certain to have significant negative impacts on the sand-dune environment and fairy terns in particular...".

In my opinion, the discussion of potential impacts of the development is not sufficiently thorough, particularly with regard to some of the human activities that are likely to occur when the human population in the area expands to the extent proposed. These omissions are considered in the following section.

## 3.5 EVALUATION OF MANAGEMENT OPTIONS

In the Pierce (2005) report, section 6 (Evaluation of Proposed Management Approach) and Appendix 1 (Action Plan) are closely related, with the Plan being largely derived from the discussion in Section 6. They will be considered together here.

**Cats**

As noted above, it is intended to exclude cats from the proposed subdivision.

Comment I agree that this would be essential. However, enforcement of this ban is not considered in detail and Pierce (2005) only notes that "It is envisaged that the community will police this and a ranger will be appointed to undertake enforcement...". In my opinion, policing by the community would be insufficient.

**Dogs**
Pierce (2005) states that "The simplest and most effective way of overcoming the risk of dog predation would be to place a dog-free covenant on the property...". However, it appears that dogs would be allowed in the proposed subdivision, and Pierce recommends "...tight regulations..." and "Ranger and community to ensure total compliance".
Comment Given the risks, including those identified in Pierce's own report, I believe that excluding dogs would be essential. Expecting total compliance from the community (and visitors) is simply unrealistic. As Pierce himself notes earlier with regard to dogs "...even with the best of intentions, predation events do happen...". In section 5.2, Pierce (2005) states "Dogs on a leash would not represent a threat to shorebirds at Te Arai if owners act responsibly". I believe this statement is debatable.

**Predators**
A suggested predator control programme is outlined in sections 2.1-2.4 of the Action Plan.
Comment The discussion of mammalian predators (other than cats and dogs) and predator control appears thorough and sound, and the methods given should, if implemented carefully and as proposed, reduce densities of all significant mammalian predators to low levels. There is much less consideration given to avian predators. Black-backed gulls are mentioned briefly in section 2.2, but there is no mention of harriers or red-billed gulls. Avian predators may be difficult to control to low levels and, in the case of protected species, a permit is required. However, they can be of particular importance where disturbance levels are high; they are generally most active in daylight (when highest numbers of people are on beaches) and often operate opportunistically. Disturbance by humans usually results in shorebirds leaving nests or chicks and displaying; while they are thus occupied, avian predators may take their eggs or chicks.

**Human disturbance**
There are a number of proposals to reduce disturbance. They include:

1. Prohibit pedestrian access to a defined area around Te Arai Stream mouth during the shorebird nesting season. This zone would extend 500 m south from the stream mouth, and no designated beach access will be closer than 500 m from the stream mouth.
Comment There are two concerns here. The first is that New Zealand dotterels now nest on the beach and in the dunes from the stream southwards almost to the Eyres Point car-park. It would therefore be difficult to find access points that do not result in disturbance, and these would be further south than envisaged in the proposal. In addition, the precise territory occupied by each pair will differ slightly between seasons, so that access at a particular point may cause disturbance in one season, when it did not in another. Second, if walkways are infrequent, or too far from dwellings, experience shows that people will simply make their own tracks to the beach. In this situation, even low levels of non-compliance will result in disturbance and possible crushing of nests or chicks.

2. There will be one point of arrival in the community for visitors, who "can be advised...to keep out of the designated nesting sites...".
Comment It is common behaviour for people to spread out on beaches, seeking quieter areas with lower human density, or going to areas that are particularly suitable for their chosen recreational activity (e.g. fishing). "Advising" visitors is likely to have little actual impact on behaviour. With the large proposed population in the area, the density of people on the beach at peak times will be very high, and may easily result in impacts along the entire beach. It is also human nature to gravitate towards focal points or landscape features; unfortunately, Te Arai Stream and Mangawhai Sandspit are two such features in this area.

3. Appoint wardens and manage behaviour of visitors.
Comment There are two major concerns. First, the plan proposes the appointment of 4 part-time wardens, in addition to the full-time ranger. With the potential for (literally) thousands of people on the beach between Mangawhai Harbour and Te Arai Point, there will be times when all visitors simply cannot be managed successfully. Again, there is a focus on fairy terns, with a suggestion that each pair has a warden assigned to monitor and reduce disturbance. While this is admirable, it suggests that the large majority of New Zealand dotterels and other shorebirds, particularly on Mangawhai Sandspit, will not be effectively protected from potentially very high levels of disturbance.

The second problem in managing human behaviour is that there is never total compliance; there is always a proportion of the population that is disinterested, ignorant, careless or (occasionally) deliberately difficult, defiant or abusive. Even a low level of non-compliance can have disproportionate negative impacts.

A related problem noted at some other sites is that residents quickly learn the timetable and routine of the warden, and then flout the regulations when the warden is off-duty. I have particular concerns about night-time activities on the beach in the Mangawhai-Te Arai area should the proposal proceed. Human activities at night might include walking, jogging, exercising dogs, fishing, and beach parties (sometimes with fires), but use of vehicles (particularly quads and trail bikes) is also a significant concern. Crushing of nests or chicks is more likely at night, and disturbance to chicks feeding under cover of darkness would also be of real concern. Such activities would be outside normal ranger hours, but even if staff were on duty 24 hours a day, it would be very difficult to detect many of the activities under cover of darkness and virtually impossible to undertake enforcement.

4. Gazette Mangawhai Wildlife Refuge a Nature Reserve.
Comment This action is outside the control of the developers, and it seems very likely that such a move would be strongly opposed by residents at Mangawhai and Tern Point, as it would remove their existing right to enter the Refuge. While the suggestion might, if implemented, assist with protection of shorebirds at Mangawhai Sandspit, it seems unlikely to occur, and presumably could not be made a condition for the subdivision to proceed. It should probably not therefore be considered by the Department (or the consent authority) as likely to be one of the measures that would be put into place were the proposed development to proceed.

5. Monitor operational efficiency and outcomes
Comment This is clearly essential. Operational efficiency will be monitored by trap-catch records and sightings. It would seem useful to add tracking tunnels, which can be run periodically with little effort and can indicate the presence of rodents, mustelids and hedgehogs; this may be useful to indicate when and where extra trapping effort is needed. To judge the annual success or otherwise of the programme, outcome monitoring should ideally be seen to be independent, i.e. it should be undertaken or at least confirmed by the Department of Conservation.

One notable omission is that no targets or measures of success (in terms of hatching and fledging rates for key shorebird species) are given by Pierce (2005). Clearly there must be such measures; first, there is no point in continuing an expensive management programme if it is not achieving satisfactory outcomes, and second, the failure to reach specified targets should trigger a review of the programme and the incorporation of improvements.

# 4 Conclusions

1 The Mangawhai-Pakiri embayment is clearly an area of outstanding significance for shorebirds. Eight native shorebird taxa breed in the area; four of them are endemic and five are threatened. The area is one of national significance for four taxa.

2 The two taxa of most conservation concern are the New Zealand fairy tern and the northern New Zealand dotterel. Both are Acutely Threatened and Mangawhai Sandspit and Te Arai Stream are both areas of international significance for each taxon. Mangawhai Sandspit is also the single most important breeding site in the world for both New Zealand fairy terns and northern New Zealand dotterels.

3 The proposed development would house and attract a very large number of people. There appears to be general acceptance that it would have significant impacts on shorebirds, and Pierce's (2005) report is primarily concerned with methods to reduce those impacts.

4 While many of the techniques proposed to reduce impacts are generally sound, there must be real concern that they will simply not be effective enough at Te Arai, given the very large projected human population in the area. In my opinion, by far the most important potential impacts of the proposed development are those directly associated with human activities. Experience at many shorebird management sites in New Zealand shows clearly that human behaviour can be difficult to control effectively, and that even when programmes are long running and well established, compliance is still a significant problem.

5 Human activities and associated potential impacts of particular concern include:

(i) Non-compliance with pet regulations.
Although it is proposed to exclude cats and put tight controls on dogs, it must be recognised that there will never be 100% compliance. The proposed subdivision would, like others on the North Auckland east coast, almost certainly be occupied in part by families from Auckland during holiday periods. It is inevitable that occasionally these families will be unwilling or unable to arrange kennel accommodation for pets and will bring them to Te Arai. Even a low level of non-compliance, resulting in a small number of incidents, could have serious consequences for shorebirds.

(ii) Use of vehicles on beaches and dunes.
Quads and trail bikes are of especial concern. Trail bikes in particular can be easily manoeuvred around or under gates and other barriers designed to stop vehicles. It seems very likely that the large sand dunes in the Mangawhai Refuge will be particularly attractive to riders of quads and trail bikes. Experience shows that enforcing regulations is nearly always impossible, as the bikes have no number plates, the riders wear helmets and cannot be identified, and they can easily escape or avoid a warden, particularly one on foot.

(iii) Night-time activities that are likely to be largely uncontrollable.
These will include a wide range of activities (including some that involve dogs or vehicles) that can result in crushing of nests, and in disturbance to incubating adults and to chicks that are feeding. Many of these activities would be very difficult to detect and virtually impossible to police effectively.

(iv) Chronic disturbance to breeding birds at Mangawhai Refuge and Te Arai Stream. Fencing off nesting areas does not eliminate disturbance, it only reduces it and reduces the number of nests that are trampled. Most shorebirds still leave nests and chicks when people walk past fenced areas, so with the projected large number of people in the Refuge and at Te Arai Stream, disturbance levels will still be high even when nests are fenced. In addition, wardens are very unlikely to find all New Zealand dotterel and variable oystercatcher nests in the Refuge, so most of the nests not found will be unfenced and subjected to higher levels of disturbance and a higher chance of crushing.

6 The proposed development is likely to have impacts on shorebirds throughout the Mangawhai-Pakiri embayment (and possibly further afield), and not just at Mangawhai Sandspit and Te Arai Stream. While these are likely to be the areas with the highest beach use, some residents or visitors will probably seek quieter beaches. For example, it seems probable that some will drive south and access Pakiri Beach at the Pakiri River mouth, increasing potential impacts there. Pakiri River mouth is also a site of international significance for both fairy terns and New Zealand dotterels.

7 No targets or performance measures for shorebird breeding success are proposed in the management plan. Clearly there must be such measures.

8 There must be a very real concern that the elements of the proposed Action Plan that relate to human activities and disturbance would simply be overwhelmed by the number of people likely to be on the area's beaches. In that case, there are bound to be significant impacts on fairy terns and New Zealand dotterels; in the case of fairy terns, these are potentially catastrophic for the taxon. Should such impacts occur, it seems unlikely that the situation could be retrieved

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