

**BEFORE THE OTAGO REGIONAL
COUNCIL**

IN THE MATTER of the Resource Management Act
1991

AND

IN THE MATTER of an application for resource
consents for Project Next
Generation

BY **PORT OTAGO LIMITED**
Applicant

**AFFIDAVIT OF PAUL MICHAEL SAGAR
ON BEHALF OF PORT OTAGO LIMITED**

PMS *15* April 2011

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I, **PAUL MICHAEL SAGAR**, of Christchurch, Scientist, swear:

INTRODUCTION, QUALIFICATIONS & EXPERIENCE

1. My full name is Paul Michael Sagar. I have a Bachelor of Science in Botany and Zoology and a Master of Science in Zoology, both from the University of Canterbury.
2. I am a member of the Ornithological Society of New Zealand, the British Ornithologists' Union, American Ornithologists' Union, Royal Australasian Ornithologists' Union, New Zealand Ecological Society, International Wader Study Group, and Australasian Wader Study Group.
3. From 1978 to 1992 I was employed as a scientist with the Fisheries Research Division of the Ministry of agriculture and fisheries. Since 1992 I have been employed by the National Institute of Water & Atmospheric Research Limited as a scientist. During my employment with both organisations I have undertaken research into a range of environmental impact studies involving birds in marine, estuarine and freshwater environments. I have considerable experience, over nearly 40 years with the study of seabirds (including population dynamics and foraging movements of Adélie Penguin, Rockhopper Penguin, Antarctic Tern, and various albatross, shearwater and petrel species) in New Zealand and elsewhere. In addition, I have made a major study of the distribution and numbers of shorebirds in New Zealand and completed a long-term study of the population dynamics of Pied Oystercatchers. The results of these studies have been published in over 30 scientific papers in refereed New Zealand and international journals, plus contributions in several books. Some references relevant to the current project are listed in Appendix 1.
4. I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Consolidated Practice Note 2006 and I agree to comply with it. I have complied with in the preparation of this evidence.

BACKGROUND INFORMATION

5. I have been involved in the following work in relation to Port Otago Limited's Project Next Generation:
 - a. A desk-top review of the occurrence and distribution of marine and estuarine birds from Otago Harbour, Tairaroa Head and the nearshore environment and the likely effects of the proposed dredging and discharge of sediment on these birds;
 - b. An observational survey was carried out in March 2008 to examine foraging behaviour of wading birds through a complete tidal cycle in the vicinity of the Aramoana Ecological Area and to assess the significance of roosting sites on high shell banks in the vicinity of Port Chalmers. These areas were identified by the Department of Conservation as important areas that needed further work. The results of this field work are reported in Sagar (2008);
 - c. A summary of this review (pp. 22-23) and results of the survey (Appendix 1) were incorporated into the description of the existing environment and the assessment of environmental effects on the environment (pp. 40-42 and 50-51) in the Assessment of Environmental Effects.
6. I have prepared my statement of evidence in reliance on this work, in particular, together with general background information, resources and knowledge relevant to my area of expertise.
7. I have also reviewed the reports and statements of evidence of other experts giving evidence on behalf of Port Otago Limited relevant to my area of expertise, including:

- a. Bell, R.G.; Hart, C. (2008). Offshore ADCP deployments (Otago Peninsula) for Port Otago dredging programme. *NIWA Client Report HAM2008-178*;
- b. Bell, R.; Oldman, J.; Beamsley, B.; Green, M.O.; Pritchard, M.; Johnson, D.; McComb, P.; Hancock, N.; Grant, D.; Zyngfogel, R (2009). Port Otago dredging project: Harbour and offshore modelling. *NIWA Client Report HAM2008-179*;
- c. Bell, R.G.; Reeve, G. (2010). Sediment plume dispersion modelling: Comparison of a larger dredger and the *New Era*. *NIWA Client Report HAM-2010-119*;
- d. James, M. (2011). Statement of evidence of Mark Richard James on behalf of Port Otago Limited;
- e. James, M.; Probert, K.; Boyd, R.; John, A. (2007). Summary of existing ecological information and scoping of further assessments for Port Otago dredging project. *NIWA Client Report HAM2007-156*;
- f. James, M.; Probert, K.; Boyd, R.; Sagar, P. (2009). Biological resources of Otago Harbour and offshore: assessments of effects of proposed dredging and disposal by Port Otago Ltd. *NIWA Client Report HAM2008-152*.

SCOPE OF EVIDENCE

8. I have been asked by Port Otago Limited (POL) to prepare evidence in respect of the effects of Project Next Generation on the existing seabird and shorebird communities. In my evidence I discuss:
 - a. Background information on the seabirds and shorebirds reported from Otago Harbour and the adjacent coastal area;

- b. Identification of potential adverse effects of project Next Generation on seabirds and shorebirds of Otago Harbour, Taiaroa Head and the nearshore area;
- c. Responses to issues raised by submitters in respect of the Project Next Generation; and
- d. Conclusions.

EXECUTIVE SUMMARY

- 9. Within Otago Harbour the birdlife is dominated numerically by gulls, waders (such as oystercatchers and godwits) and shags whilst outside the harbour shearwaters, terns, penguins, gulls and albatrosses predominate. Of these, three (Grey-headed Mollymawk, Black-billed Gull and Black-fronted Tern) are considered to be nationally significant, while further 12 are of conservation concern.
- 10. There is a large body of information available, extending over several decades, about the abundance and occurrence of birds within the harbour and the adjacent coast. This shows that the abundance of each species varies with season and between years. Relatively few birds breed within the harbour or along the adjacent coast, and so those that do not are usually absent from the area during their various breeding seasons.
- 11. Within the Harbour, most birds feed either from the surface waters (e.g., gulls and terns), intertidal flats (e.g. gulls and waders), or underwater (e.g., shags). Off the adjacent coast, birds feed from the surface waters (e.g., gulls, terns and albatrosses), midwater (e.g., shearwaters and Blue Penguins), or close to the bottom (e.g., Stewart Island Shag and Yellow-eyed Penguin).
- 12. Potential adverse effects from dredging and disposal of dredged material will vary according to the type of vessel used and the feeding strategy of the birds. In my opinion, incremental capital dredging using

the smaller *New Era* dredge is unlikely to have any discernible adverse effects against a background of natural variation on any of the birds in the area under consideration. This is based on the estimate that except in the immediate vicinity of the disposal site the suspended sediment concentrations predicted would not be expected to affect planktonic animals (food for seabirds and fish) and will be below the level set in the Port of Melbourne case to protect birds such as terns and gannets (25 mg/l).

13. Major capital dredging will result in higher suspended sediment concentrations at the proposed A0 disposal area, and disposal of the seabed will smother benthic communities, until they are recolonised. Seabirds may be adversely affected if the sediment plume reduces their ability to see their prey and reduce the abundance of their prey in the area because fish, squid and crustaceans will tend to avoid the affected area. However, most seabirds found in the area off Otago feed well offshore (e.g., Sooty Shearwater and Northern Royal Albatross) or are predominantly bottom feeders at depths over 40 m (e.g., Sooty Shearwaters and Yellow-eyed Penguins), and so the affected area represents a relatively small proportion of their foraging area.
14. Some species, such as Blue Penguins, shags and gulls may feed in the disposal area and along with some fish species that feed on plankton or benthic biota may be affected in the immediate area, for several years, and so may have to forage more widely during and immediately following major capital dredging.
15. The species of most concern during major capital dredging is the Blue Penguin. This species is likely to feed in the proposed A0 disposal area and to have a more restricted foraging range than other species. The most sensitive time would be during the chick-rearing stage (the core period of which is October-December inclusive), when the parents need to find food not only for themselves, but also for their 1-2 chicks. Consequently, any reduction in their foraging ability could result in them providing insufficient food to their chicks, resulting in reduced breeding success. Such an outcome is only of potential

concern during the period of major capital dredging and will have no long term or population level effects.

16. In a wider sense, mitigation measures related to potential effects on seabirds that I have recommended include managing the dredging operation where possible to avoid the critical part of the recruitment and breeding period for birds over spring and summer at Aramoana and off Taiaroa Head. This will also help mitigate impacts on benthic biota in the region if they were to occur. It is also proposed that when godwits are foraging on the intertidal flats at Aramoana in February and March that capital dredging is only undertaken when tidal height is above half-tide.

THE PROPOSAL

17. My evidence relates to the Project Next Generation proposal to:
 - a. Deepen, widen and dredge the Otago Harbour channel, swinging areas and berths;
 - b. Dispose of dredge material at sea;
 - c. Construct a wharf extension and fishing platform.

EVIDENCE

18. **Existing environment**
 - 18.1 There is an extensive body of information available about the numbers and diversity of birds that utilise Otago Harbour and the adjacent offshore marine environment, some of the earliest being that of Dr L.E. Richdale, who completed internationally renown studies of seabirds on Otago Peninsula commencing more than 70 years ago (e.g. Richdale 1939, 1950, 1957). More recent information comes primarily through the studies completed by the Ornithological Society of New Zealand (e.g., Sagar et al. 1999; newsletters of the Otago Region Ornithological Society of New Zealand), Department of Conservation and University of Otago. Several of these studies provide information over several decades, and so allow changes over time to be

assessed. For example, members of the Ornithological Society of New Zealand (OSNZ) divided the Harbour into seven areas and completed monthly, high-tide counts of birds in 1977-78, 1987-88 and 2009-2010.

- 18.2 All these studies show that Otago Harbour and the adjacent offshore marine environment support a diverse array of birdlife, including one nationally critically, two nationally endangered, six nationally vulnerable species, and six species in decline (Table 1). Consequently, these areas are at least of national importance for the birdlife that they support.

Table 1. Bird species of special conservation status found in the Otago region. (After Miskelly et al. 2008 and based on criteria detailed in Townsend et al. 2008).

Common name	Taxon	Conservation status
Grey-headed Mollymawk	<i>Thalassarche chrysostoma</i>	Nationally critical
Black-fronted Tern	<i>Sterna albobriata</i>	Nationally endangered
Black-billed Gull	<i>Larus bulleri</i>	Nationally endangered
Banded Dotterel	<i>Charadrius bicincta</i>	Nationally vulnerable
Caspian Tern	<i>Sterna caspia</i>	Nationally vulnerable
White-fronted Tern	<i>Sterna striata</i>	Nationally vulnerable
Red-billed Gull	<i>Larus novaehollandiae scopulinus</i>	Nationally vulnerable
Yellow-eyed Penguin	<i>Megadyptes antipodes</i>	Nationally vulnerable
Stewart Island Shag	<i>Leucocarbo chalconotus</i>	Nationally vulnerable
Hutton's Shearwater	<i>Puffinus huttoni</i>	At Risk – Declining
Flesh-footed Shearwater	<i>Puffinus carneipes</i>	At Risk – Declining
Sooty Shearwater	<i>Puffinus griseus</i>	At Risk – Declining
Southern Blue Penguin	<i>Eudyptula minor minor</i>	At Risk – Declining
South Island Pied Oystercatcher	<i>Haematopus finschi</i>	At Risk – Declining
Pied Stilt	<i>Himantopus himantopus leucocephalus</i>	At Risk - Declining
NZ Black-browed Mollymawk	<i>Thalassarche impavida</i>	Naturally uncommon
Northern Royal Albatross	<i>Diomedea sanfordi</i>	Naturally uncommon
Erect-crested Penguin	<i>Eudyptes sclateri</i>	Naturally uncommon
Black Shag	<i>Phalacrocorax carbo novaehollandiae</i>	Naturally uncommon
Little Shag	<i>Phalacrocorax melanoleucos</i> <i>brevirostris</i>	Naturally uncommon

- 18.3 Each bird species has its own habitat requirements and these determine just where they occur in the area, and so some species occur just within Otago Harbour, others within the coastal area, and others in all areas (Table 2).

OTAGO HARBOUR BIRDLIFE

19. *Species composition and numbers*

- 19.1 Within Otago Harbour, the birdlife is dominated numerically by gulls (primarily black-backed gulls and red-billed gulls), waders (primarily South Island Pied Oystercatchers, Variable Oystercatchers, and Bar-tailed Godwits), shags (primarily Little Shags, Black Shags and Stewart Island Shags), waterfowl (mainly Mallards, Black Swans and Paradise Shelducks) and terns (primarily White-fronted Terns, Black-fronted Terns and Caspian Terns). (Otago Region OSNZ monthly newsletters 2009-2010).
- 19.2 The abundance of most of these bird species varies markedly with the time of year. For example, during the period August-December most South Island Pied Oystercatchers are away breeding on farmland and riverbeds, and so numbers counted in Otago Harbour decline from the 1000+ birds present at other times of the year to 200-300 (Sagar et al. 1999; Otago Region OSNZ monthly newsletters 2009-2010). Similarly, Bar-tailed Godwits breed in Alaska during the northern summer, and so numbers in Otago Harbour during the period March-September are usually much lower than during the period October-February (Sagar et al. 1999; Otago Region OSNZ monthly newsletters 2009-2010).
- 19.3 In addition to variation in numbers within a year there are variations between years and where counts are continued over several years it may be possible to detect a trend in numbers. Within Otago Harbour the starkest example of this is the endemic Black-billed Gull which breeds on braided rivers and moves to coastal areas after breeding. Counts of this species in the Harbour during the period December-June (which is usually after the breeding season) have declined from over 14,000 birds during March 1977/78 to no more than 16 birds

during April 2010 (Otago Region OSNZ newsletter); the main causes of such a decline in numbers are attributed to changes in land use and predation at their breeding sites (Miskelly et al. 2008) a phenomenon that exists for many of our bird species.

COASTAL OTAGO BIRDLIFE

20. *Species composition and numbers*

20.1 Thirty-four species of seabirds have been recorded from or are likely to occur frequently in Otago coastal waters (Sagar et al. 2002). This report showed that the birdlife is dominated by shearwaters (primarily Sooty Shearwater, also known as muttonbirds), Fairy Prions, albatrosses (mainly Northern Royal Albatrosses and Buller's Albatrosses), penguins (mainly Yellow-eyed Penguins and Southern Blue Penguin), shags (mainly Stewart Island Shags, Spotted Shags and Black Shags), gulls (primarily Black-backed Gulls and Red-billed Gulls), and terns (primarily White-fronted Terns, Black-fronted Terns and Caspian Terns).

20.2 The occurrence and abundance of some of these seabirds varies seasonally. For example, sooty shearwaters arrive in New Zealand waters from the northern hemisphere in September and breed here until May, when they depart northwards. Similarly, Black-fronted Terns breed on braided riverbeds during our spring and summer then move to coastal areas to feed during the remainder of the year.

21. *General habitat requirements of birds*

21.1 Each species of bird has particular conditions under which they prefer to live. Thus, some species are found primarily outside the harbour whilst others occur only within the harbour (Table 2). In addition, within each of these areas each species has a preferred habitat where they feed (Table 3). For example, wading birds, such as Banded Dotterels and Bar-tailed Godwits, primarily feed in intertidal areas within the harbour and terns feed in surface waters by flying along and then plunge diving to about 1 m depth in open water both within the harbour and nearshore whilst shearwaters fly in nearshore and offshore areas

and take food from the surface or by diving to over 40 m depth (Table 3).

21.2 All of the birds are visual feeders i.e. they detect their prey by sight.

Table 2 Primary foraging areas and distribution of bird species of special conservation.

Nearshore = up to 15 km, Offshore >15 km

Common name	Otago Harbour	Nearshore	Offshore
Grey-headed Mollmawk			Yes
Black-fronted Tern	Yes	Yes	
Black-billed Gull	Yes	Yes	
Banded Dotterel	Yes		
Caspian Tern	Yes	Yes	
White-fronted Tern	Yes	Yes	
Red-billed Gull	Yes	Yes	
Yellow-eyed Penguin		Yes	
Stewart Island Shag		Yes	
Hutton's Shearwater		Yes	Yes
Flesh-footed Shearwater		Yes	Yes
Sooty Shearwater		Yes	Yes
Southern Blue Penguin	Yes	Yes	
South Island Pied Oystercatcher	Yes		
Pied Stilt	Yes		
NZ Black-browed Mollmawk		Yes	Yes
Northern Royal Albatross		Yes	Yes
Erect-crested Penguin		Yes	Yes
Black Shag	Yes	Yes	
Little Shag	Yes		

Table 3 Primary habitats favoured for feeding by bird species of special conservation.

Surface waters = surface to 1 m depth

Common name	Intertidal	Surface waters	Midwater	Bottom
Grey-headed Mollmawk		Yes		
Black-fronted Tern		Yes		
Black-billed Gull	Yes	Yes		
Banded Dotterel	Yes			
Caspian Tern		Yes		
White-fronted Tern		Yes		
Red-billed Gull	Yes	Yes		
Yellow-eyed Penguin				Yes
Stewart Island Shag				Yes
Hutton's Shearwater		Yes	Yes	
Flesh-footed Shearwater		Yes	Yes	
Sooty Shearwater		Yes	Yes	
Southern Blue Penguin		Yes	Yes	
South Island Pied Oystercatcher	Yes			
Pied Stilt	Yes			
NZ Black-browed Mollmawk		Yes		
Northern Royal Albatross		Yes		
Erect-crested Penguin			Not known	Not known
Black Shag			Yes	Yes
Little Shag				Yes

EFFECTS OF DREDGING AND DISPOSAL ON BIRDLIFE

22. *Effects of dredging on birdlife in the harbour*

22.1 Dredging activities are such that the following issues need to be assessed:

- a. removal of intertidal invertebrates as a food source due to widening of the channels;
- b. settlement of sediments in intertidal areas, and so affecting the productivity of invertebrate prey;
- c. increasing turbidity levels throughout the harbour;
- d. removal of roosting sites; and
- e. disturbance of breeding and feeding birds by the dredge and blasting.

22.2 I will discuss each of these in turn:

22.2.1 *Removal of intertidal invertebrates due to widening of channels:*

- a. The level of any impact on birds that feed in the intertidal zone through reduction in feeding habitat will depend upon the proportion of area lost as a result of channel widening and the time taken for sessile (fixed in location) animals to recolonise disturbed areas.
- b. The estimated intertidal area that is likely to be directly impacted under this proposal is about 0.8 ha (about 8,000 m²), most of which is in the upper harbour near Port Chalmers. With a mean surface area of 46 km² at spring high tides, the affected area represents a very small proportion of the total and I do not consider it to be significant

- c. In addition, disturbance of the substrate by dredging will remove areas of invertebrate prey in the short term. It is estimated that smaller polychaete worms are likely to recolonise in a matter of months, with large molluscs and other sessile invertebrates taking longer as outlined by Dr James. Again, I do not consider this to be significant.

22.2.2 Settlement of sediments in intertidal areas and effects on the productivity of invertebrate prey:

- a. Overall, the degree and duration of any adverse effects from dredging activity in Otago Harbour on fish and shellfish resources in intertidal areas, and hence potentially the birds that feed upon them, will depend on the duration of dredging, the quantity and particle size of material to be removed and the dispersion of suspended sediments as they settle out of the water column.
- b. Bell et al. (2009) and Bell & Reeve (2010) provide details of the proposed dredging operation and modelling of suspended sediments. A mid-size trailing suction hopper dredge vessel is proposed to undertake the majority of dredging to deepen the shipping channel. In such vessels a suction pipe, which terminates in a draghead, is lowered to the seabed and operates very much like a vacuum cleaner. Sources of turbidity as a result of this dredging operation are from the draghead and from the ship's propellers, which also produce high-energy water movement. However, most of the material loosened and put into suspension by the draghead will be sucked into the ship's hopper and a relatively low volume of loosened material is estimated to be put into suspension by the ship's propellers (Bell et al 2009).
- c. Sediment plume modelling shows that suspended sediment concentrations will be higher towards the seabed and lower towards the surface, and so there would be only limited opportunities around high tide periods for the deeper layers of

suspended sediment plumes to disperse onto adjacent intertidal flats. Also, dispersion of sediment plumes is likely to be dominated by material being transported up and down the main channels by tidal currents rather by more dispersive or spreading processes (Bell et al 2009; Bell & Reeve 2010).

- d. Modelling indicates that deposition of suspended sediments into intertidal areas and increases in turbidity are likely to be at levels sufficiently low to avoid disruption to intertidal communities that form the predominant prey of species of conservation concern, such as Pied Oystercatcher, Bar-tailed Godwit and Banded Dotterel.

- e. The proposed *New Era* dredging operation is likely to increase suspended sediment concentrations in intertidal areas, mostly only reaching 20 mg/L, with some limited areas adjacent to the channels of up to 50 mg/L (Bell & Reeve 2010). Therefore, they are unlikely to significantly impact the filtering ability of intertidal invertebrates such as cockles, other bivalves and polychaete worms. In addition, most of the eastern parts of the Lower and Upper Harbour would be subject to negligible or no deposition (Bell & Reeve 2010) and deposition in areas such as the Aramoana Ecological Area are predicted to be less than 1 mm over the entire dredging period (James et al 2009), and so are highly unlikely to have significant adverse effects on the intertidal benthic communities.

22.2.3 Increasing turbidity levels throughout the harbour:

- a. The dredging operation will have some potential effects on fishery use of the harbour because fish are likely to avoid high suspended sediment levels. In turn this could have an effect on the birds that feed on fish, such as shags and Blue Penguins. Gulls and terns are most likely to be affected by any reduction in the abundance of small fish due to reduced ability of the birds to see fish and invertebrate prey because of turbid water.

In addition, little blue penguins also feed in the harbour, particularly around the entrance and could be affected if suspended sediment levels are increased there.

- b. The turbidity levels predicted to result from the proposed dredging operations are within the natural range reported from Otago Harbour (James et al. 2009). Consequently, the level of any impact depends upon whether the dredging operation extends the duration of high suspended sediment levels that are avoided by small fish, and so both reduce the availability of prey to the birds and inhibit the ability of birds to see their potential prey.
- c. In the Port of Melbourne situation 25 mg/l and 17 NTU ambient suspended sediment concentrations were set as the thresholds to protect Crested Terns (*Sterna cristata*) and Australasian Gannets *Morus serrator* (the same species that occurs in New Zealand). The predicted levels of on the intertidal flats of the Aramoana Ecological Area and other intertidal areas during dredging would only exceed this level for less than 0.5% of the time.
- d. Most areas would be subjected to turbidity levels below that recommended in the Port of Melbourne case to protect seabirds, as indicated by the modelling study of Bell et al. (2009). I do not consider the minor exceedance of this level to be of any consequence here.

22.2.4 Removal of roosting sites

- a. Roosting sites are usually used during high tides, when many birds are unable to feed because water covers their potential prey. Such sites are important for providing refuge from terrestrial predators and disturbance.
- b. Large numbers of birds use the sand islands and shellbanks opposite Port Chalmers for roosting at high tide (Sagar 2008;

James et al. 2009). Other locations in the lower (outer) harbour are also used for roosting (Hamel 1991), but the removal of any sand islands opposite Port Chalmers during the proposed dredging operation could have a negative impact on the birds that use the harbour. Consequently, it is recommended that if any such islands are removed, then new island roosting sites should be created. An example of the utility of creating artificial roosting sites is at nearby Andersons Bay Inlet where a roost was built in June 2009 and is now used by a variety of wading birds and gulls (Otago Region OSNZ Newsletter February 2011).

22.2.5 *Disturbance of breeding and feeding birds by the dredge and blasting*

- a. The main effects on birds of the proposed dredging could be excessive noise, lights and the occurrence of large vessels. However, birds in the harbour are acclimatised to regular ship movement and maintenance dredging and showed no response to ship movements during observations at the Aramoana Ecological Area (Sagar 2008).
- b. Likewise, surveys before and after blasting by Port Otago Limited at the Beach Street Wharf, Port Chalmers, in 1993 documented the presence and effects on shags over the three-month operation. The report (Stewart 1993) concluded that marine birdlife appeared to be totally unaffected by the blasting.
- c. Potential direct effects of dredging include disturbance of breeding and feeding birds through the presence of the dredge in the vicinity of breeding or feeding birds. The Department of Conservation has identified potential disturbance to feeding Bar-tailed Godwits in the Aramoana Ecological Area as species and location of particular concern in this respect. Avoiding dredging in the Aramoana area when godwits are preparing for their migration would eliminate entirely any potential impacts on birdlife, if they were to occur. Therefore, the following condition (consent 2010.193, condition 9)

has been agreed in discussions between Port Otago Limited and the Department of Conservation and has been included in the consent conditions recommended and published by the Otago Regional Council in March 2011. Specifically, condition 9 states :

If the migratory population of godwits are (sic) present and feeding in the immediate area of the Aramoana sand flats shown in Appendix 5 (sic) of this consent, during the period 1 February to 31 March of each year that Incremental Capital Works or Major Capital Works in the vicinity of the Aramoana sand flats are to be undertaken only when the tidal height is above half-tide (>1.0 metre above Chart Datum), except with the approval of the Consent authority in consultation with the Department of Conservation.

- d. In addition, of particular concern are Blue Penguins breeding at Pilots Beach and Otekiho Reserve; the core breeding season of this species extends from September to February (Marchant & Higgins 1990).
- e. However, conditions 7 and 8 recommended and published by Otago Regional Council in March 2011 state:

7. The consent holder shall not undertake Incremental Capital Works or Major Capital Works in the area adjacent to Taiaroa Head, and shown in Appendix 5 (sic) of this consent between 20 December and 10 January of the following year (inclusive).

And

8. The consent holder shall not undertake Incremental Capital Works or Major Capital Works in the area adjacent to Taiaroa Head, and shown in Appendix 5 (sic) of this consent, between 1 October and 30 November and 1 January and 14 February of each year, except with the approval of the Consent authority in consultation with the Department of Conservation.

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- f. Therefore, these two conditions combined restrict dredging in these areas over most of the breeding period of Blue Penguins. In addition, it is my understanding that dredging would not be undertaken during a 3-week period in December-January (to allow undisturbed recreational use of Otago Harbour), and so would further mitigate any potential effects.
- g. On the basis of my experience with both the species of concern, I believe that these conditions are more than sufficient to avoid impacts that may have otherwise occurred during dredging operations.

EFFECTS OF DISPOSAL OF DREDGED MATERIAL ON BIRDS

- 23. Previously, constraints mapping and modelling indicated that disposal of dredged material NE of Taiaroa Head would have the least impact on a range of activities. Subsequently, the preferred disposal area was narrowed to Site A0 (about 6.5 km NE of Taiaroa Head) where the potential for disposal material to impact on Blueskin Bay, the northern Otago coastline and Otago Peninsula, fisheries, and an area of unique bryozoan communities would be minimised (James et al. 2009). Consequently, I have based my assessment of potential effects of disposal at Site A0.
- 24. Disposal of the dredged material at this site could have a number of potential short- (up to several months) and long-term (>1 year) effects on birdlife in the region. In particular, these are:
 - a. reduced ability of birds using vision to detect prey through a decrease in water clarity;
 - b. a reduction in available prey through blanketing of the seafloor by disposal material or avoidance of suspended sediments by prey species; and

- c. disturbance of breeding and feeding birds through the presence of the dredge.
25. Schooling fish, squid and swarm-forming crustaceans such as *Munida gregaria* and *Nyctiphanes* species are the principal prey of seabirds off the Otago coast. Consequently, disposal of dredge material that affects these prey species could also have flow-on effects to seabirds by reducing the abundance or distribution of food available to the birds and the ability of the birds to detect any prey that are present.
26. A sediment plume will develop in the water column as each load of dredged material is released at the disposal site. Initially, at least, surface-layer suspended sediment concentrations in the top 30% of the water column will be considerably small than for the bottom layer because the discharge hopper in both *New Era* and the larger Major Capital Dredge is about 5 m below the surface (Bell et al. 2009). At the disposal area the near-surface suspended sediment concentrations for all silt classes from *New Era* are predicted to be in the range 7-11 mg/L above background concentrations (Bell & Reeve 2010). In the more concentrated bottom-layer, predicted suspended sediment concentrations will be 47-57 mg/L above background concentrations from *New Era*.
27. Sediment plume modelling by Bell et al. (2009) and Bell & Reeves (2010) indicate that the finer sediments in this plume will be dispersed away from the site by any prevailing water currents and winds at the time of disposal and may cause a short term reduction of water clarity, depending on where the plume disperses. Such effects would be limited to the duration of dredging and disposal, but could, in theory at least, affect all seabirds close to the A0 disposal site that use vision to find their prey. The extent of the area influenced by the offshore sediment plume is similar for both *New Era* and Major Capital Dredging (Bell & Reeve 2010). However, the concentrations of suspended sediments are low enough (<20 mg/l) once you get a few kilometres away from the disposal site that they would not, in my opinion, affect foraging by seabirds.

28. Also, the main sediment plume disperses to the north rather than towards Taiaroa Head and the Otago Peninsula where a number of rare and endangered birds nest and raise their young. Although the fringes of the sediment plumes from both types of dredging will reach Otago Heads during light NNE winds, the excess suspended sediment concentrations for all silt classes will be no more than 0.6 mg/L (Bell & Reeve 2010), and this will be discernible especially against a background of natural environmental variation.

29. Because several species may be affected by the potential effects of a reduced ability to see prey and a reduction in the abundance of prey in the area affected by the disposal of dredged material, I will discuss these on a species by species basis, rather than discussing each potential effect separately as I did for Otago Harbour.

29.1 *Grey-headed Mollymawk*

29.1.1 The critically endangered Grey-headed Mollymawk breeds only on Campbell Island in the New Zealand region, is rare off the Otago coast and is considered to forage mainly off the continental shelf, over deep (>500 m) water (Marchant & Higgins 1990), and so is highly unlikely to be directly affected by disposal of dredge material.

29.2 *Northern Royal Albatross*

29.2.1 The one mainland breeding colony of Northern Royal Albatrosses is situated on Taiaroa Head, Otago Harbour. The location of the breeding colony, high on the promontory, ensures that it will not be affected directly by dredging activity. Monitoring of the feeding grounds of the Northern Royal Albatross has shown that waters within 100 km of the breeding colony were extremely important for the albatrosses (Vaugh et al. 2005). However, a large amount of foraging also occurred in areas much farther offshore and birds spent multiple

days at sea and travelled over large distances when searching for food (2-19 days at sea, travelling on average 2000 km). Consequently, because of the ability of the birds to forage over such a large area and mostly obtaining food right at the surface, potential impacts to the albatrosses due to dredging and dredged material disposal, if they were to occur, are likely to be minimal and confined to when they are traversing the disposal site and immediately downstream.

29.3 Sooty Shearwater

29.3.1 Sooty Shearwaters breed in colonies on Otago Peninsula (Sagar et al. 2002). They feed mainly on small fish, squid, krill and other small crustaceans and collaborative research that I have been involved in clearly shows that birds from these colonies and from islands south of Otago Peninsula forage widely, obtaining their food by diving to depths of over 40 m and have the ability to cover large areas of ocean rapidly. Figure 1, taken from some of my research, shows the tracks of 28 Sooty Shearwaters during the breeding season (October-May).

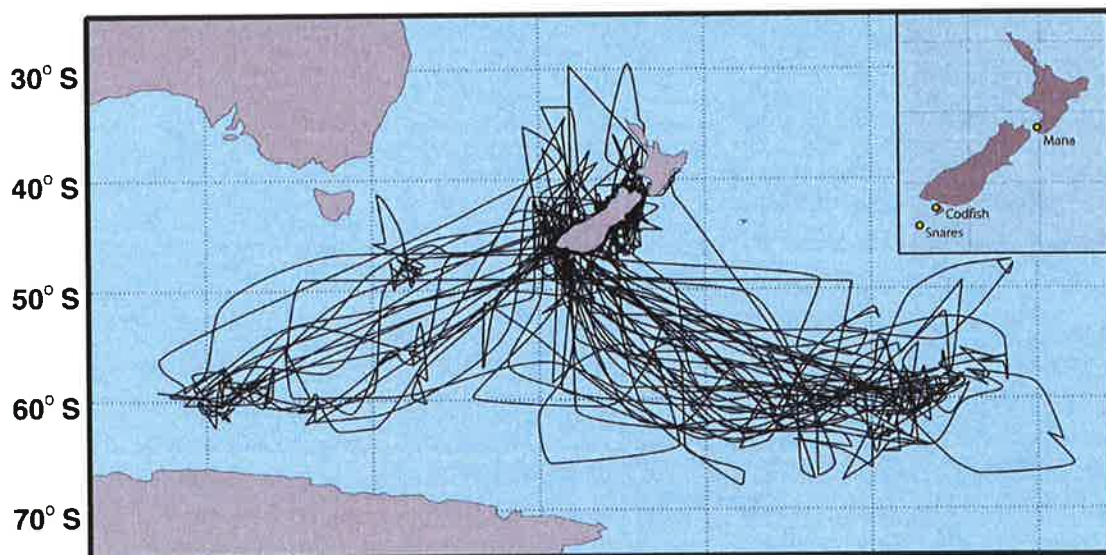


Figure 1: Tracks of individual foraging trips made by 28 different Sooty Shearwaters during the breeding season (September-April) (from Shaffer et al. 2010)

29.3.2 These tracks show that Sooty Shearwaters travel widely when foraging for food and that the proposed A0 disposal area occupies a minute fraction of the total foraging area available. All albatrosses, petrels and shearwaters reported from A0 disposal area similarly travel over extensive areas when searching for food, and so are highly unlikely to be affected by disposal of dredged material in this area.

29.3.3 The spatial distribution of Sooty Shearwaters flying or sitting on the sea off the Otago Peninsula documented in surveys in 1994-96 (O'Driscoll et al. 1998) indicated that the area of the proposed A0 disposal site is likely to be used by the birds as a route to deeper water, but a number of birds were also observed to either be resting or feeding in the vicinity of the site. Therefore, feeding and passage in the vicinity of the disposal site and immediately downstream could be affected during the actual disposal operation, but the ability of these birds to cover large areas of ocean rapidly should ensure that they are not adversely affected by the disposal of dredged material.

29.4 *Penguins*

29.4.1 Both Yellow-eyed Penguins and Blue Penguins breed on Otago Peninsula and are likely to forage at some stage within the proposed A0 disposal zone. An increase in the concentrations of suspended sediments and disruption of benthic communities and associated food sources in this zone could mean that birds would have to forage over larger distances than usual.

29.4.2 Following a study of the foraging movements of Yellow-eyed Penguins that were breeding at Oamaru, Mattern (2007) concluded that they showed very consistent foraging patterns at all stages of the breeding cycle and foraged almost exclusively at the seafloor and targeted specific areas that featured reefs or epibenthic communities. Mattern (2007) further concluded that Yellow-eyed Penguins find it difficult to react quickly to a sub-optimal food situation and overall show a specialisation for a consistent benthic environment.