



BTO Research Report No. 553

**The Effects on Waterbirds
of Dredging at the
Cardiff Bay Barrage
Report for 2009/10**

Authors

A.S.C.P. Cook & N.H.K. Burton

April 2010

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CONTENTS

	Page No.
List of Tables	3
List of Figures	3
List of Appendices	3
EXECUTIVE SUMMARY	5
1. INTRODUCTION	7
2. METHODS	9
3. RESULTS	11
4. ASSESSMENT OF THE ORNITHOLOGICAL IMPORTANCE OF THE STUDY AREA AND THE POTENTIAL EFFECT OF DREDGING	13
Acknowledgements	15
References	17
Tables	19
Figures	25
Appendices	27

List of Tables

	Page No.
Table 3.1	Mean low tide numbers and densities of waterbirds using mudflats near the Cardiff Bay barrage at low tide in January and March 2010.....19
Table 3.2	Mean numbers of bird hours per tidal cycle recorded on mudflats near the Cardiff Bay barrage in January and March 2010.....21
Table 3.3	Peak numbers of waterbirds recorded on mudflats near the Cardiff Bay barrage in January and March 2010.....23

List of Figures

	Page No.
Figure 2.1	The Cardiff Bay barrage showing areas subject to maintenance dredging.....25
Figure 2.2	The Cardiff Bay barrage showing numbered mudflat count areas monitored between August 2001 and March 201026

List of Appendices

	Page No.
Appendix 1	National importance thresholds for waterbird species referred to in this report.....27

EXECUTIVE SUMMARY

1. This study reports on the effects of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected in January and March 2010. Results are compared to those reported between 2002 and 2009. Dredging is required to maintain a channel from the outer harbour to the sea and to prevent sediment build up within this harbour. Initial dredging took place during the construction of the barrage and since August 2000 has usually taken place twice annually (in February and August). During the period of study, mudflats were dredged between 27 January and 8 February 2010. Within the outer harbour, mudflats reform naturally after dredging.
2. Cardiff Bay was formed by the combined estuaries of the Rivers Taff and Ely and is situated at the mouth of the larger Severn Estuary. The bay was impounded by a barrage constructed at its mouth in November 1999. The mudflats that now adjoin the Cardiff Bay barrage historically formed part of the intertidal mudflats of the bay.
3. Data are presented for the months of January 2010, before the latest dredging commenced, and March 2010, after dredging operations had been completed.
4. Twelve waterbird species were recorded using the mudflats affected by dredging in January and March 2010. These included five of the 10 species of wildfowl and wader that had been recorded on the equivalent mudflats prior to barrage construction – Shelduck, Mallard, Oystercatcher, Curlew and Redshank – together with Cormorant, Coot, and five species of gull – Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull, and Great Black-backed Gull. With the exception of Coot, all these species had been recorded on these mudflats during previous periods of post-barrage fieldwork.
5. By far the most numerous species on the mudflats affected by dredging were Black-headed Gull, Lesser Black-backed Gull and Herring Gull. Aside from these, only Cormorant and Mallard were recorded in numbers of greater than 10 on any one of these mudflats, Black-headed Gull, Herring Gull, Lesser Black-backed Gull and Great Black-backed Gull utilised all three mudflats.
6. The overall numbers of wildfowl and waders using the mudflats affected by dredging were very low. Low tide densities of Shelduck, Lesser Black-backed Gull and Herring Gull were greater on the comparative mudflats.
7. There is only limited evidence that the dredging in late January / early February 2010 might have had an effect in the short term, with numbers of Redshank and Mallard declining on the mudflats by the barrage between January and March. These declines were countered by slight increases in the numbers of Black-headed Gull, Lesser Black-backed Gull and Herring Gull following the operations.
8. Evidence that dredging has had a long-term effect on the numbers of birds using the mudflats by the barrage is also limited. Over the nine years of monitoring, numbers of Black-headed Gull have shown a non-significant decline on the mudflats affected by dredging. This might suggest that the regular dredging that has occurred since the barrage was completed has had a limited effect on the long-term development of invertebrate food supplies – if so, this would be an inevitable consequence of complying with the statutory requirements of the Cardiff Bay Barrage Act 1993. However, it should also be noted that in Black-headed Gull numbers also declined significantly on adjacent mudflats, suggesting that changes were part of a wider trend. Numbers of Cormorant and Herring Gull have actually increased on the mudflats affected by dredging and this would suggest that waterbird food supplies have not been detrimentally affected by the operations in the long-term.

9. Densities of wader and wildfowl species on the mudflats affected by dredging are lower than those found prior to construction of the barrage and this may in part be due to disturbance. Overall, the numbers of birds that might be affected by dredging are very small in relation to the substantial populations found locally.
10. Further monitoring is recommended in order to allow future assessment of the effects of dredging over both the short and long term.

1. INTRODUCTION

This study reports on the effects of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected in January and March 2010. Dredging is required to maintain a channel from the outer harbour to the sea and to prevent sediment build up within the harbour. Within the outer harbour, mudflats reform naturally after dredging. Initial dredging took place during the construction of the barrage and since August 2000 has usually taken place twice annually (in February and August). During the period of study, mudflats were dredged between 27 January and 8 February 2010.

Data are presented separately for periods immediately before and after dredging, in January and March 2010, so as to assess whether there were any short-term effects of the operations. Longer-term effects are assessed through comparison with the data collected for previous reports (Burton & Clark 2002a, 2002b, Burton *et al.* 2003a, 2003b, 2005, Burton & Holloway 2006, Holloway *et al.* 2004, Burton & Maclean 2007, Cook & Burton 2009).

The ornithological significance of the mudflats by the barrage was assessed in previous reports (Burton & Clark 2002a, 2002b) by comparing counts made between August 2001 and March 2002 with historic data collected prior to the construction of the barrage and with concurrent count data from two adjacent areas of mudflat.

Cardiff Bay was formed by the combined estuaries of the Rivers Taff and Ely and is situated at the mouth of the larger Severn Estuary. The bay was impounded by a barrage constructed at its mouth in November 1999. The Severn Estuary is ornithologically important because of the populations of waterbirds (i.e. grebes, cormorants, herons, rails, wildfowl, waders, gulls and terns) that it supports in winter and as a result is designated as a Special Protection Area (SPA). Some of the mudflats beside the Cardiff Bay barrage are included in this area.

The Severn Estuary currently holds internationally important numbers of Mute Swan *Cygnus olor*, Bewick's Swan *Cygnus columbianus*, Shelduck *Tadorna tadorna*, Pintail *A. acuta*, Shoveler *Anas clypeata*, Ringed Plover *Charadrius hiaticula* and Dunlin *Calidris alpina* (Holt *et al.* 2009) and Cardiff Bay itself formerly held nationally important numbers of Dunlin (Burton *et al.* 2003c). Sites are considered internationally important for a species if they regularly hold at least 1% of the individuals in a population of that species. Sites within Britain are considered nationally important for a species if they regularly hold 1% or more of the estimated British population of that species. Current national importance thresholds for the waterbird species referred to in this report are shown in Appendix 1.

2. METHODS

Figure 2.1 shows the areas subject to maintenance dredging and Figure 2.2, the numbered mudflat count areas that have been surveyed between August 2001 and March 2010. Areas B2 and B3 include remnants of the mudflats of the bay that were dissected by the building of the barrage. Accretion of sediments has enlarged these mudflats and also occurs naturally within the barrage's outer harbour – 'mudflat' B5. This area would also previously have formed part of the bay's intertidal area. Dredging of these three mudflats is required to allow continued passage of boats from the barrage gates to the sea. Two further areas of mudflat – areas B1 and B4 – were also surveyed to provide comparative counts. Mudflat B1 is similar to B2, both being entirely muddy, whilst mudflats B3 and B4 contain a mix of mud and rocky substrate. The five mudflats are, respectively, 4.8, 11.9, 7.0, 19.8 and 3.3 ha in size at mean low tide.

The waterbirds using mudflats B1-B5 were counted at hourly intervals (relative to low tide) over the time that the mudflats were exposed, twice in both January and March 2010. Counts were undertaken on 15-16 January and 1-2 March. The mudflats became exposed around 3 hours before low tide and became inundated around 3 hours afterwards. The counts made in January were before the latest dredging took place, whilst those in March were made after dredging operations had finished.

Counts of area B5 within the barrage's outer harbour included birds on the water and on the small area of mudflat that formed at low tide.

The mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low tide are tabulated for both January and March 2010. Further tables provide information on the mean bird hours recorded per tidal cycle (i.e. the sum of the average number of birds each hour) on mudflats B1-B5 and the peak numbers of each species recorded on each mudflat. By tabulating the data in this way, it is possible to assess whether the numbers of birds occurring on the mudflats after dredging differed from those that occurred prior to operations.

The longer term effects of dredging were considered by looking for trends in waterbird numbers over the nine winters since monitoring began in 2001/02. Analyses were only undertaken for those species that had been regularly recorded on the mudflats affected by dredging in numbers of greater than 10, i.e. Cormorant *Phalacrocorax carbo*, Mallard *Anas platyrhynchos*, Black-headed Gull *Larus ridibundus*, Lesser Black-backed Gull *L. fuscus* and Herring Gull *L. argentatus*.

For each of these species, generalized linear models (GLMs) were used to relate the number of birds on each count to the year, period (pre-dredging or post-dredging), state of tide (hour relative to low water at which the count was undertaken) and the mudflat count section. Models assumed a Poisson distribution and a log link function, treated period, state of tide and mudflat count section as class variables and used the PSCALE option to account for overdispersion (SAS Institute Inc. 1999-2001). To avoid problems of pseudoreplication, counts of the same count section undertaken at the same state of tide and within the same period and year were summed and the natural logarithm of the number of counts as an offset. Pre-dredging counts used in the analyses were undertaken in January in each of the six years of monitoring; post-dredging counts were undertaken either in late February or early March. Analyses were undertaken separately for the mudflats affected by dredging (B2, B3 and B5) and those not (B1 and B4). In each analysis, models were initially fitted with all variables included. A backward deletion method was then used to sequentially remove those variables with the largest *P* value based on likelihood-ratio tests (Crawley 1993). A final model was reached when no variables could be deleted from the model without causing a significant change based on $P = 0.05$.

3. RESULTS

Table 3.1 reports the mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low tide in January and March 2010. Table 3.2 indicates the overall usage of mudflats B1-B5 through the tidal cycle and Table 3.3, the peak numbers of birds recorded on each mudflat.

A total of 12 waterbird species were recorded using the mudflats affected by dredging, i.e. B2, B3 and B5, in January and March 2010. These included five species of wildfowl and wader – Shelduck, Mallard, Oystercatcher *Haematopus ostralegus*, Curlew *Numenius arquata* and Redshank *Tringa totanus* – and in addition, Cormorant, Coot *Fulicra atra* and five species of gull – Black-headed Gull, Common Gull *Larus canus*, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull *L. marinus*. Two other species – Mute Swan and Kittiwake *Rissa tridactyla* – have been recorded on the mudflats affected by dredging since August 2001.

By far the most numerous species on the mudflats affected by dredging were Black-headed Gull, Lesser Black-backed Gull and Herring Gull. Aside from these, only Cormorant and Mallard were recorded in numbers of greater than 10 on any one of these mudflats (Table 3.3). Tables 3.2 and 3.3 show that Black-headed, Lesser Black-backed, Herring and Great Black-backed Gulls utilised all three mudflats.

Gulls were particularly associated with the channel and seaward edge of mudflats, whilst other species were found higher up the mudflats. Typically, the overwhelming majority of the waders and wildfowl that were recorded on these mudflats were feeding, though many gulls also used the mudflats to loaf or rest. Cormorants also rested on metal structures around the outer harbour.

Table 3.1 also allows comparison to be made between the low tide densities found on the mudflats affected by the dredging (B2, B3 & B5) and those found on mudflats B1 and B4, which have not been affected by dredging. In comparison to mudflats B2, B3 and B5, mudflats B1 and B4 held higher low tide densities of Shelduck, Lesser Black-backed Gull and Herring Gull. In contrast, few Mallard or Redshank were recorded on mudflats B1 or B4 either at low tide or any other stage of the tidal cycle

The possible short term effects of dredging can be examined by comparing the numbers of birds recorded in January 2010 (pre-dredging) with those in March 2010 (post-dredging). On the mudflats affected by operations, numbers of Mallard and Redshank were lower following the dredging in late January / early February 2010. In contrast, there were slight increases in the numbers of Black-headed Gull, Lesser Black-backed Gull and Herring Gull following the operations.

Over the longer term, numbers of Cormorant have shown a significant increase on the mudflats affected by dredging ($F_{1,282} = 83.06$, $P < 0.0001$). This trend was not repeated on the other mudflats monitored ($F_{1,182} = 0.84$, $P = 0.36$). In contrast, numbers of Mallard have shown no significant trend on the mudflats affected by dredging ($F_{1,281} = 1.96$, $P = 0.16$).

Gull species have typically shown much greater year-to-year fluctuations in their numbers. Black-headed Gull numbers showed a slight, non-significant downward trend over the nine year period on the mudflats affected by dredging ($F_{1,275} = 2.98$, $P = 0.09$) and a significant decline on adjacent mudflats ($F_{1,182} = 10.73$, $P = 0.001$). In contrast, numbers of Herring Gull have increased significantly both on the mudflats affected by dredging ($F_{1,275} = 18.16$, $P < 0.0001$) as well as those adjacent ($F_{1,182} = 74.64$, $P < 0.0001$). Numbers of Lesser Black-backed Gull have shown no trend on the mudflats affected by dredging ($F_{1,277} = 0.29$, $P = 0.59$) or those adjacent ($F_{1,182} = 0.06$, $P = 0.80$).

Over the nine years of study, the numbers of Cormorants have been similar before and after dredging both on affected mudflats ($F_{1,281} = 0.50$, $P = 0.48$) and on adjacent sites ($F_{1,182} = 0.00$, $P = 0.97$). Mallard (MA), Black-headed Gull (BH) and Lesser Black-backed Gull (LB) on affected mudflats have been consistently lower following dredging (MA: $F_{1,282} = 31.54$, $P < 0.0001$ BH: $F_{1,276} = 20.50$, $P < 0.0001$ LB: $F_{1,278} = 4.10$, $P = 0.04$). The numbers of Black-headed and Lesser Black-backed Gulls

have also shown consistent declines on adjacent sites following dredging (BH: $F_{1,182} = 17.40$, $P < 0.0001$ LB: $F_{1,183} = 35.36$, $P < 0.0001$). In contrast, numbers of Herring Gull (HG) have shown consistent increases both on affected sections following dredging (HG: $F_{1,275} = 11.15$, $P < 0.0001$) as well as those adjacent ($F_{1,182} = 15.32$, $P < 0.0001$).

4. ASSESSMENT OF THE ORNITHOLOGICAL IMPORTANCE OF THE STUDY AREA AND THE POTENTIAL EFFECT OF DREDGING

A total of 12 waterbird species were recorded using the mudflats affected by dredging, i.e. B2, B3 and B5, in January and March 2010. These included five species of wildfowl and wader that had been recorded on the equivalent mudflats prior to barrage construction (Burton & Clark 2002a, 2002b) – Shelduck, Mallard, Oystercatcher, Curlew and Redshank. In addition, Cormorant, Coot and five species of gull – Black-headed Gull, Common Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull were also recorded on these mudflats. With the exception of Coot, all these species had been recorded on these mudflats during previous fieldwork (Cook & Burton 2009).

The report for 2001/02 found that the densities of Shelduck, Mallard, Oystercatcher, Curlew and Redshank were less than those found in the four years immediately prior to construction of the barrage and that five species of wildfowl and wader recorded in those years were absent (Burton & Clark 2002b). Although the overall numbers of wildfowl and waders using the mudflats affected by dredging are now very low, two species found on these mudflats in January / March 2010 and other recent winters – Mallard and Redshank – have not typically been recorded on the comparative areas of mudflat nearby. However, low tide densities of Shelduck, Lesser Black-backed Gull and Herring Gull were greater on the comparative mudflats. These findings are similar to those of August 2001 to March 2009 (Burton & Clark 2002a, 2002b, Burton *et al.* 2003a, 2003b, 2005, Burton & Holloway 2006, Burton & Maclean 2007, Holloway *et al.* 2004, Cook & Burton 2009).

The reports for previous winters found some evidence that numbers of waterbirds might have been affected by dredging operations in the short term. For example, numbers of Cormorant, Mallard, Redshank, Black-headed Gull and Lesser Black-backed Gull have all decreased after dredging in some, though not all, of the years of study. Results of analyses also show that numbers of Mallard, Black-headed Gull and Lesser Black-backed Gull on affected mudflats are consistently significantly lower following dredging, though numbers of the latter two species are also lower following dredging on the comparative mudflats. It is possible that declines in waterbird numbers in those years were linked to a short-term decline in food resources, possibly as a result of dredging activities. However, as the levels of the food resources in the water and sediments were not measured, it is not possible to say for sure.

This winter, there was only limited evidence that the dredging had any effects in the short-term. Numbers of both Mallard and Redshank fell on the mudflats affected by operations following dredging. However, these declines were countered by slight increases in the numbers of Black-headed Gull, Lesser Black-backed Gull and Herring Gull following the operations.

There was little evidence that dredging has had a long-term effect on the numbers of birds using mudflats by the barrage. Over the nine years of monitoring, only numbers of Black-headed Gull – the most numerous species in the area have shown a slight, but non-significant decline on the mudflats affected by dredging. This might suggest that the regular dredging that has occurred since the barrage was completed has had a limited effect on the long-term development of invertebrate food supplies in these areas. If so, this would be an inevitable consequence of complying with the statutory requirements of the Cardiff Bay Barrage Act 1993. It should also be noted, though, that there was a much larger, significant decrease in Black-headed Gull numbers on adjacent mudflats, suggesting that these changes were part of a wider trend.

In contrast, numbers of Cormorant and Herring Gull have actually increased on the mudflats affected by dredging. This would suggest that waterbird food supplies have not been detrimentally affected by the operations in the long-term.

As reported previously, densities of wader and wildfowl species on the mudflats affected by dredging are lower than those found prior to construction of the barrage (Burton & Clark 2002b) and this may in

part be due to disturbance. Overall, the numbers of birds that might be affected by dredging are very small in relation to the substantial populations found locally (see Burton *et al.* 2003c).

Further monitoring is recommended in order to allow future assessment of the effects of dredging over both the short and long term.

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	Jan 2010		Mar 2010	
	n	d	n	d
Cormorant				
Mudflat B1	0	0	3	0.62
<i>Mudflat B2</i>	6.5	0.55	5.5	0.46
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0.5	0.03	0	0
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0.5	0.02	3	0.12
Mudflats B2, B3, B5	6.5	0.29	5.5	0.25
Shelduck				
Mudflat B1	0	0	8.5	1.76
<i>Mudflat B2</i>	0	0	1	0.08
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	8.5	0.43	2.5	0.13
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	8.5	0.35	11	0.45
Mudflats B2, B3, B5	0	0	1	0.05
Mallard				
Mudflat B1	0	0	0	0
<i>Mudflat B2</i>	0	0	0	0
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0	0	1	0.05
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0	0	1	0.04
Mudflats B2, B3, B5	0	0	0	0
Coot				
Mudflat B1	0	0	0	0
<i>Mudflat B2</i>	0.5	0.04	0	0
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0.5	0.03	0	0
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0.5	0.02	0	0
Mudflats B2, B3, B5	0.5	0.02	0	0
Oystercatcher				
Mudflat B1	0	0	0	0
<i>Mudflat B2</i>	0	0	0	0
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0.5	0.03	2.5	0.13
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0.5	0.02	2.5	0.10
Mudflats B2, B3, B5	0	0	0	0
Curlew				
Mudflat B1	0	0	0	0
<i>Mudflat B2</i>	0	0	0	0
<i>Mudflat B3</i>	0	0	0.5	0.07
Mudflat B4	0.5	0.03	3.5	0.18
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0.5	0.02	3.5	0.14
Mudflats B2, B3, B5	0	0	0.5	0.02

Table 3.1 Mean low tide numbers (n) and densities (d) (birds/ha) of waterbirds using mudflats near the Cardiff Bay barrage at low tide in January and March 2010.

Only species recorded between January and March 2010 on mudflats affected by dredging (shown italicised) are included. Figures in bold are total numbers and densities for mudflats B2, B3 and B5 combined and for mudflats B1 and B4 combined.

	Jan 2010		Mar 2010	
	N	d	n	d
Redshank				
Mudflat B1	0	0	0	0
<i>Mudflat B2</i>	3	0.25	0	0
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0	0	0	0
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0	0	0	0
Mudflats B2, B3, B5	3	0.14	0	0
Black-headed Gull				
Mudflat B1	2	0.41	5.5	1.14
<i>Mudflat B2</i>	18	1.52	10.5	0.89
<i>Mudflat B3</i>	18	2.56	25	3.56
Mudflat B4	36.5	1.85	0.5	0.03
<i>Mudflat B5</i>	5	1.52	6	1.82
Mudflats B1, B4	38.5	1.57	6	0.24
Mudflats B2, B3, B5	41	1.85	41.5	1.87
Common Gull				
Mudflat B1	0	0	0.5	0.10
<i>Mudflat B2</i>	0	0	0	0
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0	0	0	0
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0	0	0.5	0.02
Mudflats B2, B3, B5	0	0	0	0
Lesser Black-backed Gull				
Mudflat B1	0	0	0.5	0.10
<i>Mudflat B2</i>	1.5	0.13	0	0
<i>Mudflat B3</i>	14	1.99	25	3.56
Mudflat B4	24	1.22	41	2.08
<i>Mudflat B5</i>	4	1.21	2.5	0.76
Mudflats B1, B4	24	0.98	41.5	1.69
Mudflats B2, B3, B5	19.5	0.88	27.5	1.24
Herring Gull				
Mudflat B1	0.5	0.10	0	0
<i>Mudflat B2</i>	0	0	0	0
<i>Mudflat B3</i>	6	0.85	59	8.39
Mudflat B4	30.5	1.54	220.5	11.16
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	31	1.26	220.5	8.97
Mudflats B2, B3, B5	6	0.27	59	2.66
Great Black-backed Gull				
Mudflat B1	0	0	1	0.21
<i>Mudflat B2</i>	0	0	0.5	0.04
<i>Mudflat B3</i>	0	0	0	0
Mudflat B4	0	0	1	0.05
<i>Mudflat B5</i>	0	0	0	0
Mudflats B1, B4	0	0	2	0.08
Mudflats B2, B3, B5	0	0	0.5	0.02

Table 3.1 Continued.

	Jan 2010	Mar 2010
Cormorant		
Mudflat B1	0	4.5
<i>Mudflat B2</i>	48.5	53
<i>Mudflat B3</i>	0	0
Mudflat B4	1.5	0.5
<i>Mudflat B5</i>	0	1.5
Shelduck		
Mudflat B1	0	51
<i>Mudflat B2</i>	0.5	2
<i>Mudflat B3</i>	0	0
Mudflat B4	30	34
<i>Mudflat B5</i>	0	0
Mallard		
Mudflat B1	0	0
<i>Mudflat B2</i>	0	0
<i>Mudflat B3</i>	0	0
Mudflat B4	0	2
<i>Mudflat B5</i>	8	3.5
Coot		
Mudflat B1	0	0
<i>Mudflat B2</i>	0.5	0
<i>Mudflat B3</i>	0	0
Mudflat B4	0.5	0
<i>Mudflat B5</i>	0	0
Oystercatcher		
Mudflat B1	0	0
<i>Mudflat B2</i>	0.5	0
<i>Mudflat B3</i>	3.5	1.5
Mudflat B4	1	4.5
<i>Mudflat B5</i>	0	0
Curlew		
Mudflat B1	0	0
<i>Mudflat B2</i>	0	0
<i>Mudflat B3</i>	0	0.5
Mudflat B4	1.5	16
<i>Mudflat B5</i>	0	0
Redshank		
Mudflat B1	0	0.5
<i>Mudflat B2</i>	10	0
<i>Mudflat B3</i>	0	0
Mudflat B4	0	0
<i>Mudflat B5</i>	0.5	0

Table 3.2 Mean numbers of bird hours per tidal cycle recorded on mudflats near the Cardiff Bay barrage in January and March 2010.

Only species recorded between January and March 2010 on mudflats affected by dredging (shown italicised) are included.

	Jan 2010	Mar 2010
Black-headed Gull		
Mudflat B1	6	71.5
<i>Mudflat B2</i>	63	149
<i>Mudflat B3</i>	68.5	75.5
Mudflat B4	180	116.5
<i>Mudflat B5</i>	37	89
Common Gull		
Mudflat B1	0	2.5
<i>Mudflat B2</i>	0	2
<i>Mudflat B3</i>	0	0
Mudflat B4	0	0
<i>Mudflat B5</i>	0	0
Lesser Black-backed Gull		
Mudflat B1	0.5	3.5
<i>Mudflat B2</i>	4	4.5
<i>Mudflat B3</i>	29.5	43.5
Mudflat B4	108.5	152.5
<i>Mudflat B5</i>	12	14
Herring Gull		
Mudflat B1	5	0.5
<i>Mudflat B2</i>	0	0.5
<i>Mudflat B3</i>	35	79.5
Mudflat B4	114	469.5
<i>Mudflat B5</i>	0	0.5
Great Black-backed Gull		
Mudflat B1	0	2
<i>Mudflat B2</i>	0	0.5
<i>Mudflat B3</i>	0	1
Mudflat B4	0	4.5
<i>Mudflat B5</i>	0	2

Table 3.2 Continued.

	Jan 2010	Mar 2010
Cormorant		
Mudflat B1	0	5
<i>Mudflat B2</i>	17	26
<i>Mudflat B3</i>	0	0
Mudflat B4	1	1
<i>Mudflat B5</i>	0	3
Shelduck		
Mudflat B1	0	17
<i>Mudflat B2</i>	1	2
<i>Mudflat B3</i>	0	0
Mudflat B4	23	17
<i>Mudflat B5</i>	0	0
Mallard		
Mudflat B1	0	0
<i>Mudflat B2</i>	0	0
<i>Mudflat B3</i>	0	0
Mudflat B4	0	2
<i>Mudflat B5</i>	16	4
Coot		
Mudflat B1	0	0
<i>Mudflat B2</i>	1	0
<i>Mudflat B3</i>	0	0
Mudflat B4	1	0
<i>Mudflat B5</i>	0	0
Oystercatcher		
Mudflat B1	0	0
<i>Mudflat B2</i>	1	0
<i>Mudflat B3</i>	3	1
Mudflat B4	1	4
<i>Mudflat B5</i>	0	0
Curlew		
Mudflat B1	0	0
<i>Mudflat B2</i>	0	0
<i>Mudflat B3</i>	0	1
Mudflat B4	2	7
<i>Mudflat B5</i>	0	0
Redshank		
Mudflat B1	0	1
<i>Mudflat B2</i>	6	0
<i>Mudflat B3</i>	0	0
Mudflat B4	0	0
<i>Mudflat B5</i>	1	0

Table 3.3 Peak numbers of waterbirds recorded on mudflats near the Cardiff Bay barrage in January and March 2010.

Only species recorded between January and March 2010 on mudflats affected by dredging (shown italicised) are included.

	Jan 2010	Mar 2010
Black-headed Gull		
Mudflat B1	4	44
<i>Mudflat B2</i>	43	50
<i>Mudflat B3</i>	56	35
Mudflat B4	94	83
<i>Mudflat B5</i>	16	44
Common Gull		
Mudflat B1	0	4
<i>Mudflat B2</i>	0	3
<i>Mudflat B3</i>	0	0
Mudflat B4	0	0
<i>Mudflat B5</i>	0	0
Lesser Black-backed Gull		
Mudflat B1	1	3
<i>Mudflat B2</i>	3	6
<i>Mudflat B3</i>	24	44
Mudflat B4	38	61
<i>Mudflat B5</i>	8	4
Herring Gull		
Mudflat B1	6	1
<i>Mudflat B2</i>	0	1
<i>Mudflat B3</i>	20	59
Mudflat B4	40	222
<i>Mudflat B5</i>	0	1
Great Black-backed Gull		
Mudflat B1	0	2
<i>Mudflat B2</i>	0	1
<i>Mudflat B3</i>	0	2
Mudflat B4	0	2
<i>Mudflat B5</i>	0	2

Table 3.3 Continued.

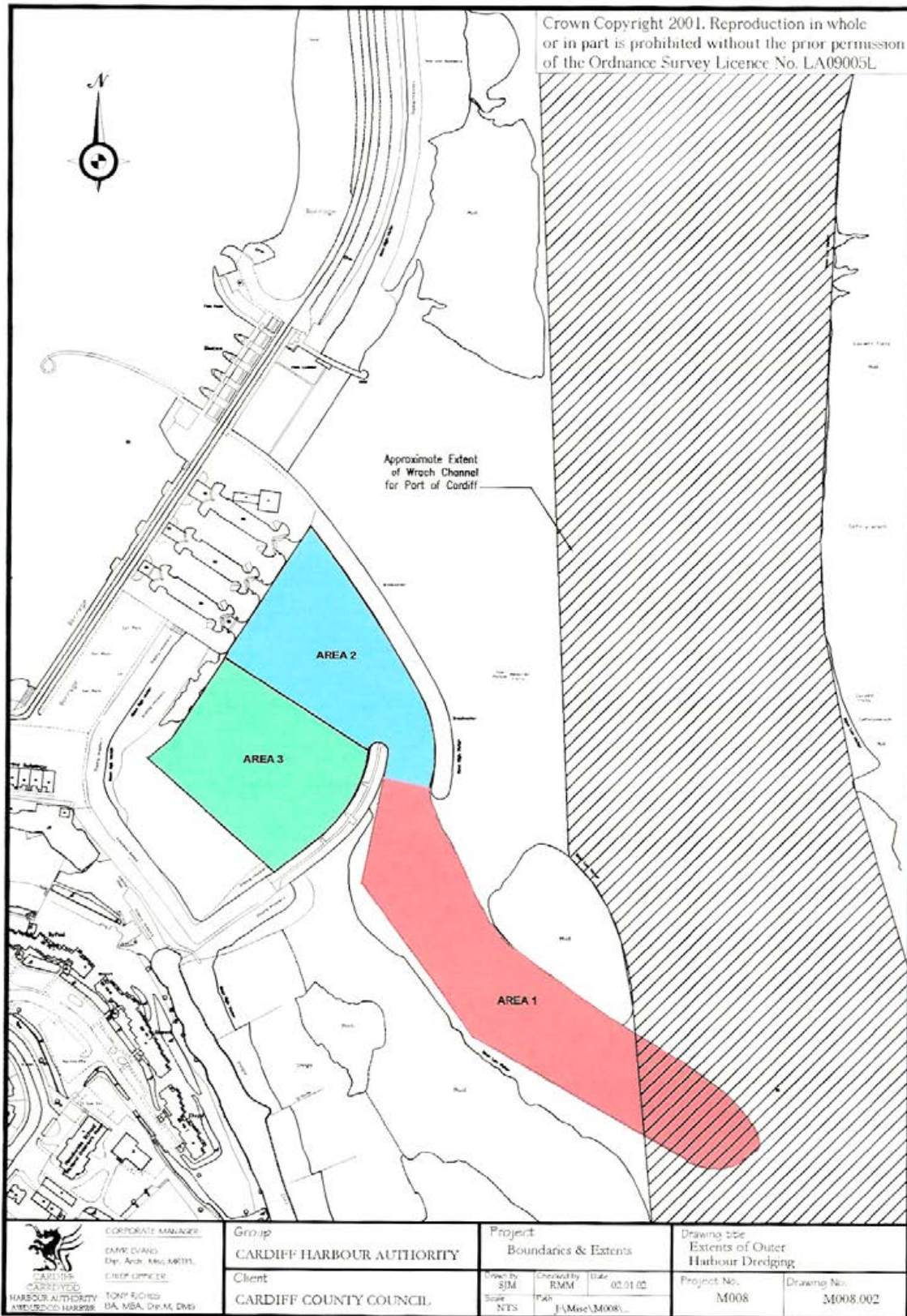


Figure 2.1 The Cardiff Bay barrage showing areas subject to maintenance dredging.

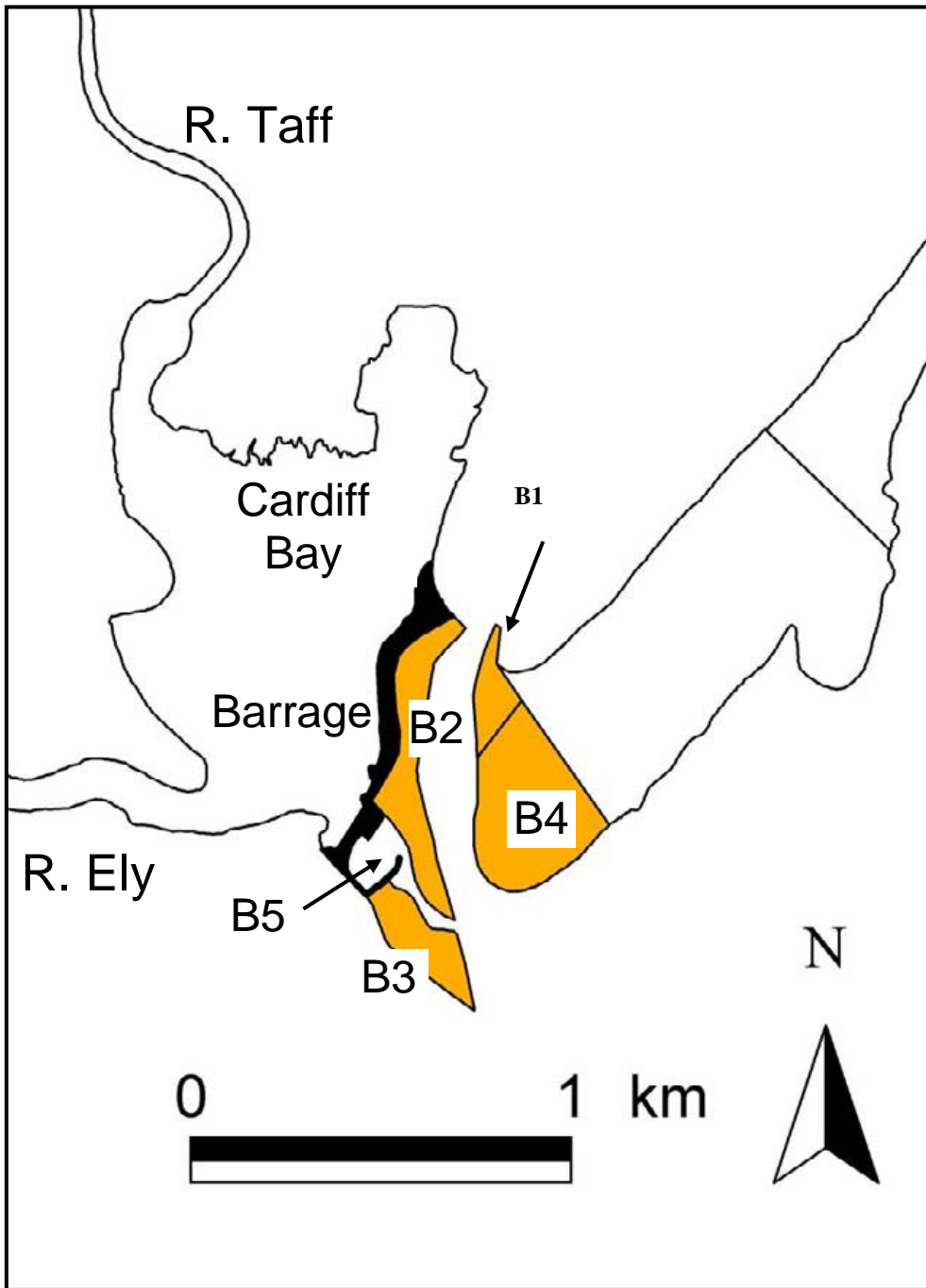


Figure 2.2 The Cardiff Bay barrage showing numbered mudflat count areas (shaded) monitored between August 2001 and March 2009.

Appendix 1 National importance thresholds for waterbird species referred to in this report (taken from Holt *et al.* 2009).

Cormorant <i>Phalacrocorax carbo</i>	230
Mute Swan <i>Cygnus olor</i>	375
Bewick's Swan <i>Cygnus columbianus</i>	81
Shelduck <i>Tadorna tadorna</i>	782
Mallard <i>Anas platyrhynchos</i>	3,520
Pintail <i>Anas acuta</i>	279
Shoveler <i>Anas clypeata</i>	148
Coot <i>Fulicra atra</i>	1730
Oystercatcher <i>Haematopus ostralegus</i>	3,200
Ringed Plover <i>Charadrius hiaticula</i>	330
Dunlin <i>Calidris alpina</i>	5,600
Curlew <i>Numenius arquata</i>	1,500
Redshank <i>Tringa totanus</i>	1,200
Black-headed Gull <i>Larus ridibundus</i>	19,000
Common Gull <i>Larus canus</i>	9,000
Lesser Black-backed Gull <i>Larus fuscus</i>	500
Herring Gull <i>Larus argentatus</i>	4,500
Great Black-backed Gull <i>Larus marinus</i>	400

* Where 1% of the British wintering population is less than 50 birds, 50 is normally used as a minimum qualifying level for national importance. No British importance threshold has been set for Kittiwake.

