BTO Research Report No. 309

The Effects on Waterbirds of Dredging at the Cardiff Bay Barrage Report for April to December 2002

Authors

N.H.K. Burton, S.J. Holloway & N.A. Clark

January 2003

Report of work carried out by The British Trust for Ornithology
under contract to Cardiff Harbour Authority

The National Centre for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU
Registered Charity No. 216652

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EXECUTIVE SUMMARY

1. This report investigates the potential impact of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected between April and December 2002. Results are compared to those reported in March 2002. Dredging is required to maintain a channel from the outer harbour to the sea and to prevent sediment build up within this harbour. Dredging took place in August 2000, May 2001, in February and March 2002 and, during the period of study, between 8 and 31 August 2002. Dredging will be undertaken twice a year henceforth. 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 separately for April to May 2002 and August to December 2002. Additionally, data are presented for August 2002 alone, when counts were undertaken during a period when dredging operations were being undertaken. Comparative data are presented for August 2001 and August to December 2001.

4. Nine waterbird species were recorded using the mudflats affected by dredging between April and December 2002. 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 – three species of gull – Black-headed Gull, Lesser Black-backed Gull and Herring Gull – and Cormorant. These species, and also Mute Swan *Cygnus olor* and Great Black-backed Gull *L. marinus*, had been recorded on these mudflats during the previous year's fieldwork

5. By far the most numerous species on the mudflats affected by dredging were Black-headed Gull and Lesser Black-backed Gull. Aside from these, only Mallard and Herring Gull were recorded in numbers of greater than 10 on any one of the mudflats. Black-headed and Lesser Black-backed Gulls utilised all three mudflat areas, whilst Mallard particularly favoured the area within the outer harbour.

6. Although the overall numbers of wildfowl and waders using the mudflats affected by dredging are very low, the average low tide densities of four of the species found on these mudflats were higher than those on comparative areas of mudflat nearby. Densities of both Black-headed Gull and Lesser Black-backed Gull, the most numerous species on the mudflats by the barrage, were greater on the comparative mudflats, however.

7. Black-headed Gulls and Herring Gulls occurred in higher numbers on the mudflats by the barrage in 2002 than in 2001. Mallard numbers, in contrast, were lower on the mudflat area within the outer harbour in 2002.

8. There is no evidence for the dredging in August 2002 (like that in February/March 2002) having an effect on the numbers of birds using the mudflats. Indeed, numbers of the three most numerous species – Mallard, Black-headed Gull and Lesser Black-backed Gull – were higher on average than over August to December as a whole. Numbers of Mallard in August 2002 were also greater than those found the previous August.

9. This report will be updated again in March 2003 following the completion of counts over the winter of 2002/03 and a further period of dredging scheduled for February. This will allow a more complete assessment of the impacts of dredging to be made.

1. INTRODUCTION

This report investigates the potential impact of maintenance dredging on the birds utilising mudflats within and adjoining the outer harbour of the Cardiff Bay barrage using data collected between April and December 2002. Results are compared to and presented in a similar format to those reported in January and March 2002 (Burton & Clark 2002a, 2002b). 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 has since taken place in August 2000, May 2001, in February and March 2002 and, during the period of study, between 8 and 31 August 2002. In future, dredging will typically take place twice a year, usually in February and August.

Data are presented separately for April to May 2002 and August to December 2002. Additionally, data are presented for August 2002 alone, when counts were undertaken during a period when dredging operations were being undertaken. Comparative data are presented for August 2001 and August to December 2001.

The ornithological significance of these mudflats was assessed in previous reports (Burton & Clark 2002a, 2002b) by comparing counts made between August 2001 and March 2001 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 European White-fronted Goose *Anser albifrons albifrons*, Shelduck *Tadorna tadorna*, Gadwall *Anas strepera*, Dunlin *Calidris alpina* and Redshank *Tringa totanus* (Musgrove *et al.* 2001) and Cardiff Bay itself formerly held nationally important numbers of Dunlin (Burton *et al.* 2002). (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 December 2002. 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 was similar to B2, both being entirely muddy, whilst mudflats B3 and B4 contained a mix of mud and rocky substrate. The five mudflats were 4.8, 11.9, 7.0, 19.8 and 3.3 ha in size, respectively.

The waterbirds using mudflats B1-B4 were counted at hourly intervals (relative to low water) over the time that the mudflats were exposed, three times in April and May 2002 and twice a month from August to December 2002. (Dates of counts are given in Appendix 2). The mudflats became exposed between 3 and 2 hours before low tide and became inundated again 2 to 3 hours afterwards.

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. This area was counted at low tide and high tide, again three times in April and May 2002 and twice a month between August and December 2002.

The mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low tide were tabulated for August to December 2001, August 2001, April to May 2002, August to December 2002 and August 2002. Further tables provide information on the numbers and densities of birds using 'mudflat' B5 at high tide, the mean bird hours recorded per tidal cycle (i.e. the sum of the average number of birds each hour) on mudflats B1-B4 and the peak numbers of each species recorded on each mudflat. Data for August 2002 are listed separately as they were collected during a period of dredging (see Appendix 2). Data for August to December 2001 and August 2001 are provided for comparative purposes. By tabulating the data in this way, it is possible to assess whether the numbers of birds occurring on the mudflats during the period of dredging differed from those that usually occur at this time of year and over the autumn and early winter as a whole.

3. RESULTS

Table 3.1 reports the mean numbers and densities of waterbirds recorded on mudflats B1-B5 at low water between August and December 2001, in August 2001 alone, in April and May 2002, between August and December 2002 and in August 2002 alone. Table 3.2 similarly reports the numbers and densities using 'mudflat' B5 at high tide. Table 3.3 indicates the overall usage of mudflats B1-B4 through the tidal cycle and Table 3.4, the peak numbers of birds recorded on each mudflat.

A total of nine waterbird species were recorded using the mudflats affected by dredging, i.e. B2, B3 and B5, between April and December 2002. These included five species of wildfowl and wader that had been recorded on the equivalent mudflats prior to barrage construction – Shelduck, Mallard *Anas platyrhynchos*, Oystercatcher *Haematopus ostralegus*, Curlew *Numenius arquata* and Redshank. In addition, three species of gull – Black-headed Gull *Larus ridibundus*, Lesser Black-backed Gull *L. fuscus* and Herring Gull *L. argentatus* – and Cormorants *Phalacrocorax carbo* were recorded on these mudflats. These species, and also Mute Swan *Cygnus olor* and Great Black-backed Gull *L. marinus*, had been recorded on these mudflats during the previous year's fieldwork (Burton & Clark 2002b).

By far the most numerous species on these mudflats were Black-headed Gull and Lesser Black-backed Gull. Aside from these, only Mallard and Herring Gull were recorded in numbers of greater than 10 on any one of the mudflats. Tables 3.1 and 3.4 show that Black-headed and Lesser Black-backed Gulls utilised all three mudflats, whilst mudflat B5 – within the outer harbour – was particularly favoured by Mallard. The latter mudflat was also used by Cormorants and Herring Gulls and in April and May by Shelducks. Oystercatcher, Curlew and Redshank were only recorded outwith the outer harbour.

Gulls were particularly associated with the channel and seaward edge of mudflats, whilst wildfowl and waders were found higher up the mudflats. The overwhelming majority of the birds that were recorded on these mudflats were feeding.

Table 3.1 also allows comparison to be made between the densities found on these mudflats at low tide and those found on mudflats B1 and B4, which were not affected by the building of the barrage and will not be affected by dredging. Densities of Shelduck were much greater on mudflats B2, B3 and B5 in April and May 2002, though the species was not recorded here at low tide between August and December 2002. In contrast, Oystercatcher were not recorded on the study site in spring, but were found in slightly greater (though still low) densities on the mudflats affected by dredging between August and December. Neither Mallard nor Redshank were recorded on either mudflat B1 or B4 at low tide. Densities of Curlew were similar across the two sets of mudflats (though as with Oystercatcher, also low)

In comparison to mudflats B2, B3 and B5, mudflats B1 and B4 held much higher densities of Black-headed, Lesser Black-backed and Herring Gulls between August and December 2002. In addition, these mudflats also supported occasional Common Gulls *L. canus* and Great Black-backed Gulls.

The counts undertaken between August and December 2002 show some differences with those undertaken between August and December 2001. Examination of all four tables shows that both Black-headed Gulls and Herring Gulls occurred in higher numbers on mudflats B2, B3 and B5 in 2002 than in 2001. Mallard numbers, in contrast were lower on mudflat B5 in 2002.

The effects of dredging in August 2002 can be examined by comparing counts from this month with those the previous August and with the average for August to December 2002. Gulls and Cormorants were not counted in August 2001 and neither was mudflat B5. Tables 3.1, 3.3 and 3.4 indicate that Mallard, Oystercatcher and Curlew numbers were greater in August 2002 on mudflats B2 and B3 than the previous August, but that neither Shelduck nor Redshank were recorded on these mudflats in either period. It should be noted, however, that numbers of Oystercatcher and Curlew were very small in both years. Numbers of Mallard, Black-headed and Lesser Black-backed Gull at low tide and across the tidal cycle were also greater in August 2002 than over August to December that year as a whole. No birds were recorded at high tide within the outer harbour in August 2002, however.

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

Nine waterbird species – Cormorant, Shelduck, Mallard, Oystercatcher, Curlew, Redshank, Black-headed Gull, Lesser Black-backed Gull, Herring Gull and Great Black-backed Gull – were recorded between August 2001 and March 2002 on the mudflats by the Cardiff Bay barrage affected by dredging. Mute Swan and Great Black-backed Gull were also recorded on these mudflats the previous year (Burton & Clark 2002b).

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). However, though the overall numbers of wildfowl and waders using the mudflats affected by dredging are now very low, the average low tide densities of four of the species found on these mudflats in the study period were higher than those on comparative areas of mudflat nearby. Numbers of both Black-headed Gull and Lesser Black-backed Gull, the most numerous species on the mudflats by the barrage were greater on the comparative mudflats, however. Lesser Black-backed Gulls were most numerous in August and September and declined thereafter, as birds moved away from their breeding colonies within Cardiff and on Steep Holm and Flat Holm (Poulding 1954).

The report for 2001/02 also found little evidence that densities of waterbirds had been affected by the dredging undertaken between February and March 2002. Although there was a short-term decrease in the numbers of Mallard, Black-headed Gull and Lesser Black-backed Gull using mudflats B2, B3 and B5 by the barrage, it was noted that this would have been partly or wholly due to movements of birds away from the area to breeding grounds elsewhere.

There is, likewise, no evidence for the dredging in August 2002 having an effect on the numbers of birds using the mudflats. Indeed, numbers of the three most numerous species – Mallard, Black-headed and Lesser Black-backed Gull – at low tide and across the tidal cycle were higher on average than over August to December as a whole. Numbers of Mallard in August 2002 were also greater than those found the previous August. It is possible that dredging may have made some food resources temporarily more available to these species, which often forage over the open water. As the levels of the food resources in the water and sediments are not being measured, however, it is not possible to say whether they will be affected by dredging in the longer-term.

The numbers of birds which might be affected by dredging are very small in relation to the substantial populations found locally (see Burton *et al.* 2002). Further monitoring over the winter of 2002/03, will allow a more complete assessment of the impacts of dredging to be made.

Acknowledgements

Thanks are due to David Lowe, John Williams, Simon Macdonald and Martin Morgans of Cardiff Harbour Authority who provided plans of the study area and barrage and information of the timing of dredging. Heidi Mellan helped to finalise the report.

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	Aug-Dec 2001		Aug 2001		Apr-May 2001		Aug-Dec 2002		Aug 2002	
	n	d	n	d	n	d	n	d	n	d
CA										
Mudflat B2	0	0			0	0	0	0	0	0
Mudflat B3	0	0			0	0	0	0	0	0
Mudflat B5	0	0			0	0	0.1	0.03	0	0
Mudflat B1	0.5	0.10			0	0	0.1	0.02	0	0
Mudflat B4	5.3	0.27			0	0	0.3	0.02	0	0
Mudflats B2, B3, B5	**0**	**0**			**0**	**0**	**0.1**	**0**	**0**	**0**
Mudflats B1, B4	**5.8**	**0.23**			**0**	**0**	**0.4**	**0.02**	**0**	**0**
MS										
Mudflat B2	0	0	0	0	0	0	0	0	0	0
Mudflat B3	0	0	0	0	0	0	0	0	0	0
Mudflat B5	0	0			0	0	0	0	0	0
Mudflat B1	0	0	0	0	0	0	0	0	0	0
Mudflat B4	0	0	0	0	0	0	0	0	0	0
Mudflats B2, B3, B5	**0**	**0**			**0**	**0**	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SU										
Mudflat B2	0.1	0.01	0	0	2.0	0.17	0	0	0	0
Mudflat B3	0	0	0	0	3.5	0.50	0	0	0	0
Mudflat B5	0	0			0.5	0.15	0	0	0	0
Mudflat B1	0	0	0	0	0.5	0.10	0.2	0.04	0	0
Mudflat B4	0	0	0	0	0	0	0.9	0.05	3.0	0.15
Mudflats B2, B3, B5	**0.1**	**0**			**6.0**	**0.27**	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0**	**0**	**0.5**	**0.02**	**1.1**	**0.04**	**3.0**	**0.12**
MA										
Mudflat B2	0	0	0	0	0	0	0	0	0	0
Mudflat B3	0.3	0.04	0	0	0	0	0.6	0.09	3.0	0.43
Mudflat B5	2.3	0.71			0	0	0.2	0.06	1.0	0.30
Mudflat B1	0	0	0	0	0	0	0	0	0	0
Mudflat B4	0	0	0	0	0	0	0	0	0	0
Mudflats B2, B3, B5	**2.6**	**0.12**			**0**	**0**	**0.8**	**0.04**	**4.0**	**0.18**
Mudflats B1, B4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
OC										
Mudflat B2	0	0	0	0	0	0	0	0	0	0
Mudflat B3	0.2	0.03	0.5	0.07	0	0	0.4	0.06	1.5	0.21
Mudflat B5	0	0			0	0	0	0	0	0
Mudflat B1	0	0	0	0	0	0	0	0	0	0
Mudflat B4	0.4	0.02	1.5	0.08	0	0	0.2	0.01	0	0
Mudflats B2, B3, B5	**0.2**	**0.01**			**0**	**0**	**0.4**	**0.02**	**1.5**	**0.07**
Mudflats B1, B4	**0.4**	**0.02**	**1.5**	**0.06**	**0**	**0**	**0.2**	**0.01**	**0**	**0**

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 between August and December 2001, in August 2001 alone, in April and May 2002, between August and December 2002 and in August 2002 alone.

Only species recorded since August 2001 at low tide 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. CA = Cormorant, MS = Mute Swan, SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, RK = Redshank, BH = Black-headed Gull, LB = Lesser Black-backed Gull, HG = Herring Gull, GB = Great Black-backed Gull.

	Aug-Dec 2001		Aug 2001		Apr-May 2001		Aug-Dec 2002		Aug 2002	
	n	d	n	d	n	d	n	d	n	d
CU										
Mudflat B2	0.2	0.02	0	0	0.3	0.02	0	0	0	0
Mudflat B3	0.7	0.10	1.0	0.14	0.3	0.04	0.8	0.11	1.0	0.14
Mudflat B5	0	0			0	0	0	0	0	0
Mudflat B1	0	0	0	0	0	0	0.2	0.04	0	0
Mudflat B4	1.2	0.06	0.5	0.03	0	0	1.0	0.05	2.5	0.13
Mudflats B2, B3, B5	**0.9**	**0.04**			**0.6**	**0.02**	**0.8**	**0.04**	**1.0**	**0.05**
Mudflats B1, B4	**1.2**	**0.05**	**0.5**	**0.02**	**0**	**0**	**1.2**	**0.05**	**2.5**	**0.10**
RK										
Mudflat B2	0.1	0.01	0	0	0	0	0.2	0.02	0	0
Mudflat B3	0	0	0	0	0	0	0	0	0	0
Mudflat B5	0	0			0	0	0	0	0	0
Mudflat B1	0	0	0	0	0	0	0	0	0	0
Mudflat B4	0	0	0	0	0	0	0	0	0	0
Mudflats B2, B3, B5	**0.1**	**0**			**0**	**0**	**0.2**	**0**	**0**	**0**
Mudflats B1, B4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
BH										
Mudflat B2	0	0			4.3	0.36	10.8	0.91	20.0	1.68
Mudflat B3	7.9	1.13			6.0	0.86	10.6	1.51	50.0	7.14
Mudflat B5	8.3	2.53			1.5	0.45	7.2	2.18	15.5	4.70
Mudflat B1	1.8	0.36			0	0	2.7	0.56	7.5	1.56
Mudflat B4	60.0	3.03			0.5	0.03	95.6	4.83	42.5	2.15
Mudflats B2, B3, B5	**16.2**	**0.73**			**11.8**	**0.53**	**28.6**	**1.29**	**85.5**	**3.85**
Mudflats B1, B4	**61.8**	**2.51**			**0.5**	**0.02**	**98.3**	**4.00**	**50.0**	**2.03**
LB										
Mudflat B2	9.1	0.77			6.8	0.57	5.4	0.45	7.5	0.63
Mudflat B3	2.9	0.41			2.0	0.29	7.0	1.00	17.0	2.43
Mudflat B5	0.2	0.05			5.8	1.74	0	0	0	0
Mudflat B1	2.8	0.57			1.3	0.26	0.7	0.15	2.0	0.42
Mudflat B4	59.6	3.01			38.8	1.96	58.0	2.93	38.5	1.94
Mudflats B2, B3, B5	**12.2**	**0.55**			**14.5**	**0.65**	**12.4**	**0.56**	**24.5**	**1.10**
Mudflats B1, B4	**62.4**	**2.54**			**40.0**	**1.63**	**58.7**	**2.39**	**40.5**	**1.65**
HG										
Mudflat B2	0	0			0	0	0	0	0	0
Mudflat B3	0	0			0	0	0.4	0.06	0	0
Mudflat B5	0	0			5.3	1.59	0	0	0	0
Mudflat B1	0	0			0	0	0	0	0	0
Mudflat B4	5.3	0.27			37.0	1.87	28.4	1.43	28.0	1.41
Mudflats B2, B3, B5	**0**	**0**			**5.3**	**0.24**	**0.4**	**0.02**	**0**	**0**
Mudflats B1, B4	**5.3**	**0.21**			**37.0**	**1.50**	**28.4**	**1.15**	**28.0**	**1.14**
GB										
Mudflat B2	0	0			0	0	0	0	0	0
Mudflat B3	0	0			0	0	0	0	0	0
Mudflat B5	0	0			0	0	0	0	0	0
Mudflat B1	0	0			0	0	0	0	0	0
Mudflat B4	0.3	0.01			0	0	0.5	0.03	0	0
Mudflats B2, B3, B5	**0**	**0**			**0**	**0**	**0**	**0**	**0**	**0**
Mudflats B1, B4	**0.3**	**0.01**			**0**	**0**	**0.5**	**0.02**	**0**	**0**

Table 3.1 Continued.

	Aug-Dec 2001		Apr-May 2001		Aug-Dec 2002		Aug 2002	
	n	d	n	d	n	d	n	d
CA	0.2	0.05	0	0	0.2	0.06	0	0
SU	0	0	0	0	0	0	0	0
MA	4.5	1.36	1.0	0.30	2.1	0.64	0	0
CU	0.2	0.05	0	0	0	0	0	0
BH	16.3	4.95	1.8	0.53	22.8	6.91	0	0
LB	0.2	0.05	0.8	0.23	0.8	0.24	0	0
HG	0	0	3.3	0.98	0.1	0.03	0	0

Table 3.2 Mean high tide numbers and densities (birds/ha) of waterbirds using 'mudflat' B5 within the outer harbour of the Cardiff Bay barrage between August and December 2001, in April and May 2002, between August and December 2002 and in August 2002 alone.

Only species recorded since August 2001 in this count area are included. CA = Cormorant, SU = Shelduck, MA = Mallard, CU = Curlew, BH = Black-headed Gull, LB = Lesser Black-backed Gull, HG = Herring Gull.

	Aug-Dec 2001	Aug 2001	Apr-May 2001	Aug-Dec 2002	Aug 2002
CA					
Mudflat B2	0.9		0	0.3	1.0
Mudflat B3	0.2		0	0	0
Mudflat B1	2.2		0.3	1.0	2.0
Mudflat B4	8.4		0	4.9	1.0
MS					
Mudflat B2	0	0	0	0	0
Mudflat B3	0	0	0	0	0
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0
SU					
Mudflat B2	0.1	0	9.5	0	0
Mudflat B3	0.1	0	9.0	0.5	0
Mudflat B1	0.2	0	1.0	1.1	1.0
Mudflat B4	0	0	11.0	1.3	3.0
MA					
Mudflat B2	0.1	0.5	0	0	0
Mudflat B3	0.6	0	0	0.6	3.0
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0
OC					
Mudflat B2	0	0	0	0	0
Mudflat B3	0.7	1.5	0.5	2.0	7.5
Mudflat B1	0	0	0	0.2	0
Mudflat B4	1.1	3.0	0	1.2	0
CU					
Mudflat B2	0.8	0	1.5	0	0
Mudflat B3	3.8	3.0	0.5	3.9	5.5
Mudflat B1	0	0	0	0.7	1.0
Mudflat B4	7.5	7.0	0	5.2	10.5
RK					
Mudflat B2	1.7	0	0	0.2	0
Mudflat B3	0	0	0	0	0
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0

Table 3.3 The mean number of bird hours per tidal cycle recorded on mudflats near the Cardiff Bay barrage between August and December 2001, in August 2001 alone, in April and May 2002, between August and December 2002 and in August 2002 alone.

Only species recorded since August 2001 on mudflats affected by dredging (shown italicised) are included. CA = Cormorant, MS = Mute Swan, SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, RK = Redshank, BH = Black-headed Gull, LB = Lesser Black-backed Gull, HG = Herring Gull, GB = Great Black-backed Gull.

	Aug-Dec 2001	Aug 2001	Apr-May 2001	Aug-Dec 2002	Aug 2002
BH					
Mudflat B2	6.0		35.0	37.1	85.5
Mudflat B3	12.2		34.0	40.6	150.5
Mudflat B1	9.3		0.0	17.1	38.5
Mudflat B4	158.1		8.3	282.3	190.5
LB					
Mudflat B2	20.1		15.8	24.1	41.0
Mudflat B3	28.6		12.8	39.6	57.0
Mudflat B1	10.8		3.0	6.4	20.0
Mudflat B4	199.9		117.0	233.1	299.5
HG					
Mudflat B2	0		0.5	0.3	0
Mudflat B3	0		3.5	4.0	0
Mudflat B1	0		0	0.3	0
Mudflat B4	22.5		82.3	109.0	55.0
GB					
Mudflat B2	0		0	0	0
Mudflat B3	0		0	0	0
Mudflat B1	0		0	0	0
Mudflat B4	1.1		0	1.1	0

Table 3.3 Continued.

	Aug-Dec 2001	Aug 2001	Apr-May 2001	Aug-Dec 2002	Aug 2002
CA					
Mudflat B2	2		0	2	2
Mudflat B3	1		0	0	0
Mudflat B5	1		0	2	0
Mudflat B1	3		1	4	4
Mudflat B4	12		0	20	1
MS					
Mudflat B2	0	0	0	0	0
Mudflat B3	0	0	0	0	0
Mudflat B5	0		0	0	0
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0
SU					
Mudflat B2	1	0	6	0	0
Mudflat B3	1	0	6	3	0
Mudflat B5	0		2	0	0
Mudflat B1	2	0	2	3	2
Mudflat B4	0	0	11	4	4
MA					
Mudflat B2	1	1	0	0	0
Mudflat B3	3	0	0	6	6
Mudflat B5	12		2	20	2
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0
OC					
Mudflat B2	0	0	0	0	0
Mudflat B3	2	2	2	3	3
Mudflat B5	0		0	0	0
Mudflat B1	0	0	0	1	0
Mudflat B4	3	3	0	4	0
CU					
Mudflat B2	2	0	2	0	0
Mudflat B3	2	1	1	2	2
Mudflat B5	1		0	0	0
Mudflat B1	0	0	0	1	1
Mudflat B4	7	4	0	5	5
RK					
Mudflat B2	5	0	0	2	0
Mudflat B3	0	0	0	0	0
Mudflat B5	0		0	0	0
Mudflat B1	0	0	0	0	0
Mudflat B4	0	0	0	0	0

Table 3.4 Peak numbers of waterbirds recorded on mudflats near the Cardiff Bay barrage between August and December 2001, in August 2001 alone, in April and May 2002, between August and December 2002 and in August 2002 alone.

Only species recorded since August 2001 on mudflats affected by dredging (shown italicised) are included. CA = Cormorant, MS = Mute Swan, SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, RK = Redshank, BH = Black-headed Gull, LB = Lesser Black-backed Gull, HG = Herring Gull, GB = Great Black-backed Gull.

	Aug-Dec 2001	Aug 2001	Apr-May 2001	Aug-Dec 2002	Aug 2002
BH					
Mudflat B2	31		42	42	36
Mudflat B3	17		18	50	50
Mudflat B5	28		7	99	31
Mudflat B1	13		0	35	24
Mudflat B4	180		26	550	165
LB					
Mudflat B2	39		10	29	29
Mudflat B3	54		22	40	28
Mudflat B5	1		23	4	0
Mudflat B1	18		6	25	25
Mudflat B4	205		60	180	180
HG					
Mudflat B2	0		2	2	0
Mudflat B3	0		6	31	0
Mudflat B5	0		13	1	0
Mudflat B1	0		0	2	0
Mudflat B4	4		66	110	55
GB					
Mudflat B2	0		0	0	0
Mudflat B3	0		0	0	0
Mudflat B5	0		0	0	0
Mudflat B1	0		0	0	0
Mudflat B4	2		0	2	0

Table 3.4 Continued.

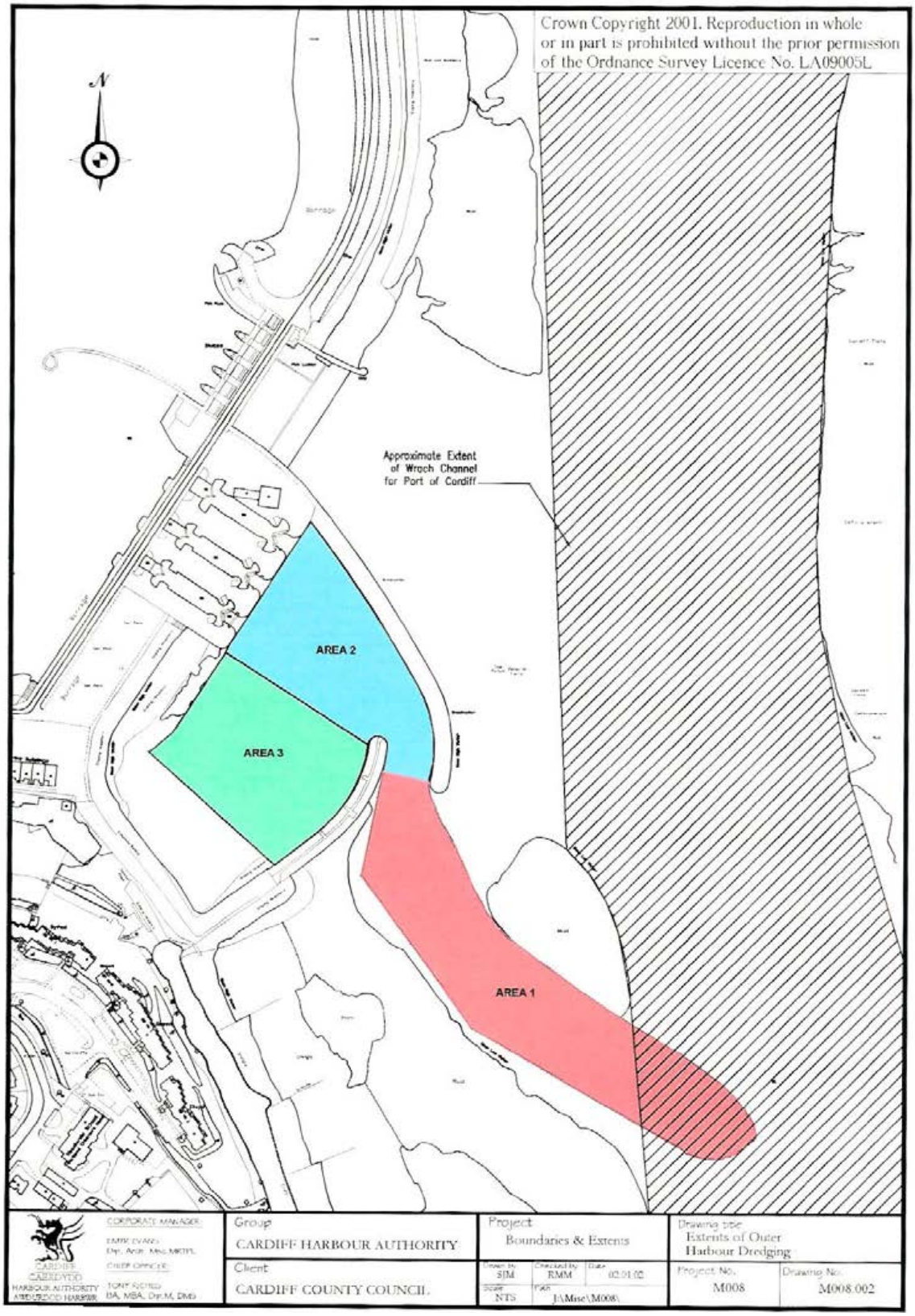

Figure 2.1 The Cardiff Bay barrage showing areas (shaded grey) subject to maintenance dredging.

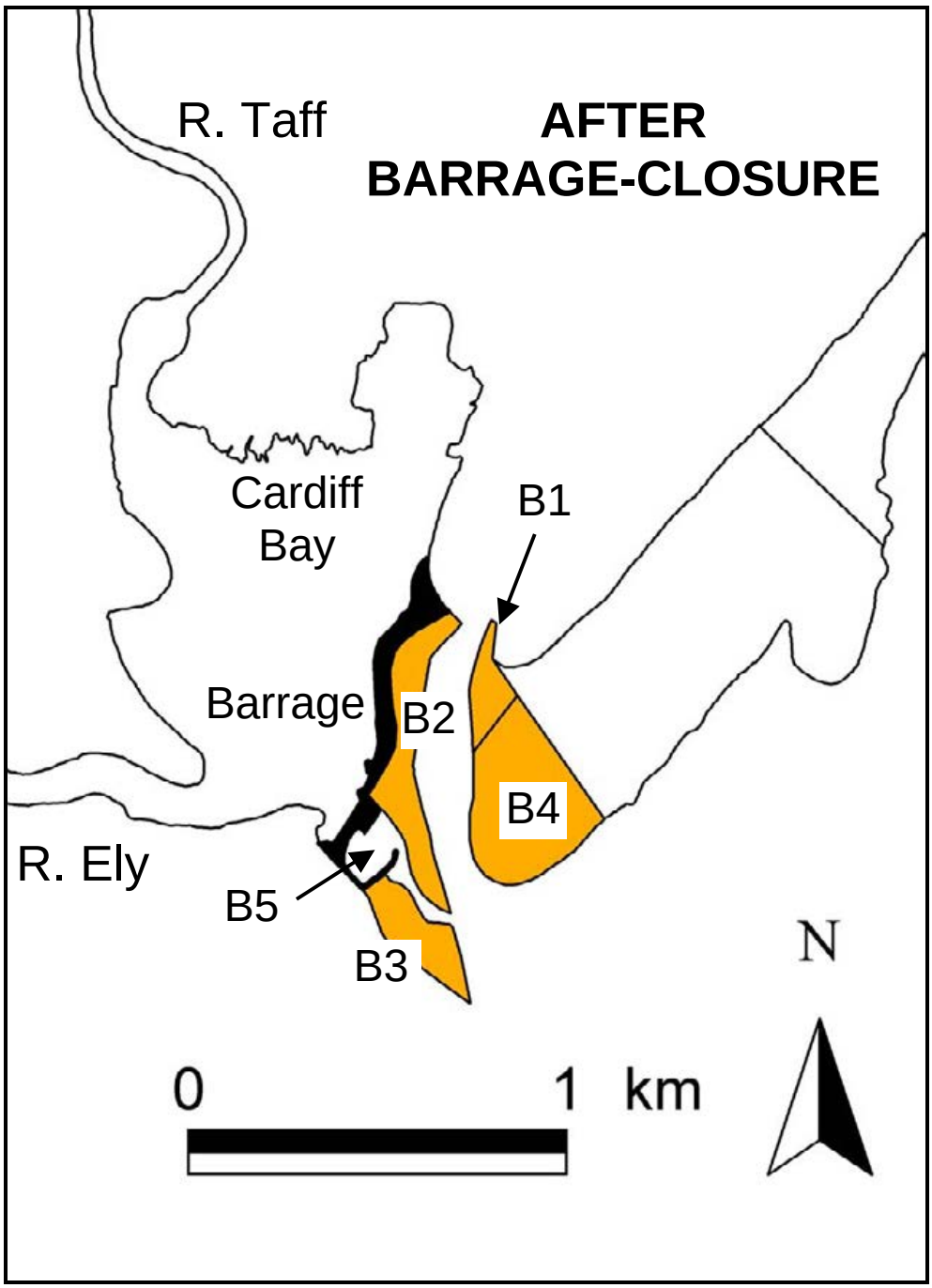

Figure 2.2 The Cardiff Bay barrage showing numbered mudflat count areas (shaded grey) used between August 2001 and December 2002.

Appendix 1 National importance thresholds for waterbird species referred to in this report (taken from Musgrove *et al.* 2001).

Cormorant *Phalacrocorax carbo*	130
Mute Swan *Cygnus olor*	260
European White-fronted Goose *Anser albifrons albifrons*	6000
Shelduck *Tadorna tadorna*	750
Gadwall *Anas strepera*	300
Mallard *Anas platyrhynchos*	5000
Oystercatcher *Haematopus ostralegus*	3600
Dunlin *Calidris alpina*	5300
Curlew *Numenius arquata*	1200
Redshank *Tringa totanus*	1100
Black-headed Gull *Larus ridibundus*	19000
Common Gull *Larus canus*	9000
Lesser Black-backed Gull *Larus fuscus*	500
Herring Gull *Larus argentatus*	4500
Great Black-backed Gull *Larus marinus*	400

Appendix 2 Dates of waterbird counts undertaken at the Cardiff Bay barrage between April and December 2002.

09-12 April 2002
01-02 May 2002
21-24 August 2002
04-07 September 2002
13-17 October 2002
19-21 November 2002
03-07 December 2002