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The Effects on Waterbirds of Dredging at the Cardiff Bay Barrage Interim Report January 2002

Authors

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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. 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 and May 2001 and 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. The ornithological significance of the mudflats that adjoin the barrage is assessed by comparing counts made between August and November 2001 with historic data collected prior to the construction of the barrage and with concurrent count data from two adjacent areas of mudflat.

4. Five of the seven species of waterbird recorded in the autumns of 1989-1993 on the mudflats that were subsequently dissected by the barrage were seen on the equivalent mudflats between August and November 2001. These were Shelduck, Mallard, Oystercatcher, Curlew and Redshank. In addition, the mudflats were utilised by Black-headed and Lesser Black-backed Gulls.

5. Densities of Shelduck, Mallard, Curlew and Redshank were lower on these mudflats than in five autumns prior to construction of the barrage in 1994.

6. Although the overall numbers of wildfowl and waders using the mudflats affected by dredging were low, average densities were not dissimilar to those on two comparative areas of mudflat. The maintenance dredging undertaken so far, therefore, seems to have had no appreciable impact on these species. Densities of the two gull species on these comparative mudflats were considerably higher, however.

7. Future dredging will again remove the majority of the mudflat formed within the barrage's outer harbour (see Fig. 2.2.1) and thus may temporarily affect the few Mallard and Black-headed Gulls that use this area. Peaks of just 12 Mallard and 28 Black-headed Gulls were recorded between August and November 2001. Provided that food supplies are not diminished, numbers should return to such levels once dredging operations are complete and as mudflats reform.

8. Provided dredging of the channel from the outer harbour to the sea does not affect the overall area of adjacent mudflats, it should not affect waders, as these tend to be found away from the water. Gulls and wildfowl, however, may be affected by the short-term loss of feeding opportunities along the channel edge.

9. This interim report will be updated following the completion of counts over the winter of 2001/02 and a fuller assessment made of the impacts of any future dredging.

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. 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 and May 2001. In future dredging will typically take place twice a year, usually in February and August.

The ornithological significance of these mudflats is assessed by comparing counts made between August and November 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 and waders) 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.* 2001). (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

2.1 Analysis of Historic Datasets

The mudflats that now adjoin the Cardiff Bay barrage historically formed part of the intertidal mudflats of the bay and the waterbirds that used them were monitored by the BTO as part of the programme set up to investigate the impacts of the bay's impoundment. Counts of the intertidal mudflats began in 1989 and continued until barrage-closure in November 1999. To facilitate counting, the intertidal area was divided into 19 count areas. Three of these were subsequently dissected by the construction of the barrage – mudflats A1, A5 and A18 (Fig. 2.1.1). Birds were counted on the mudflats at hourly intervals through two complete tidal cycles per month (with the exception of April when just a single count took place) from August to May each year (Burton *et al.* 2001). The counts included wildfowl and waders, but not other waterbirds or gulls.

To provide a comparison with the numbers of birds recorded on the mudflats by the barrage this autumn, the mean densities (birds/ha) of birds using mudflats A1, A5 and A18 at low tide were calculated for each autumn (August to November) prior to the start of barrage construction in 1994. (The mudflats at the mouth of the bay were only exposed for a few hours around low tide.) Estimated numbers of birds using those areas of mudflat that lay beyond the future position of the barrage were also calculated. These areas comprised 7.8 ha (21%) of the 37.6 ha of mudflats A1, A5 and A18.

2.2 Waterbird Monitoring between August and November 2001

Figure 2.2.1 shows the areas subject to maintenance dredging and Figure 2.2.2, the numbered mudflat count areas surveyed between August and November 2001. 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. 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 and gulls using mudflats B1-B4 were counted at hourly intervals (relative to low water) over the time that the mudflats were exposed, twice a month from August to November 2001. 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 twice a month at low tide and high tide from October.

Gulls and Cormorants *Phalacrocorax carbo* were first monitored in September 2001.

The mean numbers and densities of waterbirds and gulls recorded on mudflats B1-B5 at low tide are tabulated for comparison with the historic data. 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.

3. RESULTS

3.1 Analysis of Historic Datasets

Table 3.1.1 shows the mean densities of waterbirds recorded at low tide in the autumns of 1989-1993 on mudflats A1, A5 and A18 of Cardiff Bay, i.e. those that were subsequently dissected by the building of the barrage. The table also indicates the numbers of birds that would have been found on those areas of mudflat that, though part of the bay's intertidal area, lay beyond the future position of the barrage. (In calculating these figures, it is assumed that birds were evenly distributed across the three mudflats).

In total, seven species of waterbird were recorded in autumn on these three mudflats prior to the start of construction work on the barrage: Shelduck, Mallard *Anas platyrhynchos*, Teal *Anas crecca*, Oystercatcher *Haematopus ostralegus*, Dunlin, Curlew *Numenius arquata* and Redshank. Redshank were the most numerous (density = 1.13 birds/ha), whilst Shelduck and Dunlin also occurred in densities of around 0.4 birds per hectare.

3.2 Waterbird Monitoring between August and November 2001

Table 3.2.1 reports the mean numbers and densities of waterbirds and gulls recorded on mudflats B1-B5 at low water between August and November 2001 and Table 3.2.2, numbers and densities using 'mudflat' B5 at high tide. Table 3.2.3 indicates the overall usage of mudflats B1-B4 through the tidal cycle and Table 3.2.4, the peak numbers of birds recorded on each mudflat.

Only four of the seven species of waterbird recorded on mudflats A1, A5 and A18 prior to barrage construction were seen at low tide on the equivalent mudflats, B2 and B3, between August and November 2001. These were Shelduck, Mallard, Oystercatcher and Curlew. (Redshank were also recorded on mudflat B2 on the rising tide.) Comparison between Tables 3.1.1 and 3.2.1 also indicates that the densities of birds recorded on mudflats B2 and B3 were, on the whole, lower than those previously recorded on mudflats A1, A5 and A18. Mudflats A1, A5 and A18 formerly held densities of 0.42 Shelduck, 0.45 Dunlin and 1.13 Redshank per ha at low tide in the autumn. In comparison, between August and November 2001, only 1 Shelduck was recorded on mudflats B2 and B3 at low tide and no Dunlin or Redshank.

Of those mudflats affected by dredging, mudflat B5 was particularly favoured by Mallard and Black-headed Gulls *Larus ridibundus*, whilst mudflats B2 and B3 were favoured by Lesser Black-backed Gulls *L. fuscus*. Oystercatchers and Curlew were only recorded on mudflat B3, whilst a single flock of five Redshank was seen on mudflat B2 in November and occasional Cormorants recorded by mudflats B2 and B3. 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 3.2.1 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 the two wading species recorded in the area at low tide – Oystercatcher and Curlew – were similar on mudflats B3 and B4 (neither species was recorded on the muddier sediments of mudflats B1 and B2). In contrast, Shelduck and Mallard were not recorded on either mudflat B1 or B4 at low tide.

In comparison to mudflats B2, B3 and B5, however, mudflats B1 and B4 held much higher densities of Black-headed and Lesser Black-backed Gulls. In addition to the species recorded on mudflats B2, B3 and B5, mudflats B1 and B4 also supported Common Gulls *Larus canus*, Herring Gulls *L. argentatus* and Great Black-backed Gulls *L. marinus*.

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

Five waterbird species – Shelduck, Mallard, Oystercatcher, Curlew and Redshank – and two species of gull – Black-headed Gull and Lesser Black-backed Gull – were recorded on the mudflats by the Cardiff Bay barrage affected by dredging. Densities of Shelduck, Mallard, Curlew and Redshank were lower than on equivalent mudflats in autumns prior to construction of the barrage. Counts for the rest of the winter will enable a more thorough comparison with data from the winters of 1989/90-1993/94. It is clear from this initial comparison, however, that much of the study area's value has been lost due to the building of the barrage and the displacement of intertidal waterbirds from the bay (Burton *et al.* 2001).

Although the overall numbers of wildfowl and waders using the mudflats affected by dredging were low, average densities were not dissimilar to those on two comparative areas of mudflat. The maintenance dredging undertaken so far, therefore, seems to have had no appreciable impact on these species. Densities of Black-headed and Lesser Black-backed Gulls on these comparative mudflats were considerably higher, however. Lesser Black-backed Gulls were most numerous in September and declined thereafter, as birds moved away from their breeding colonies within Cardiff and on Steep Holm and Flat Holm (Poulding 1954).

Future dredging will again remove the majority of the mudflat formed within the barrage's outer harbour, i.e. 'mudflat' B5 and thus may affect the Mallard and Black-headed Gulls that use this area. Impacts may be only temporary, however. The food resources taken by Black-headed Gulls foraging on the open water within the outer harbour should not be affected by dredging and so their numbers should return to their previous levels once operations are complete. Mallard should also return as mudflats reform, provided that their vegetable and invertebrate food supplies are not diminished (though it should be noted that the levels of these resources are not being measured).

Beyond the outer harbour, dredging is also needed to maintain the channel between mudflats B2 and B3, though this should not affect the overall area of these mudflats. Provided this is the case, it is probable that waders would not be affected by dredging, though gulls (and the few wildfowl that use these mudflats) may be affected by the short-term loss of feeding opportunities along the channel edge.

The numbers of birds which might be affected by dredging are likely to be very small in relation to the substantial populations found locally (see Burton *et al.* 2001). However, further monitoring is required to determine the numbers of birds that use the area, not just in the autumn, but also through the winter. This will allow a proper assessment of the impacts of any future dredging.

Acknowledgements

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	1989/90		1990/91		1991/92		1992/93		1993/94		**All Years**	
	n	d	n	d		n	n	d	n	d	**n**	**d**
SU	3.21	0.41	1.86	0.24	3.21	0.41	4.76	0.61	3.41	0.44	**3.29**	**0.42**
MA	0.00	0.00	2.07	0.27	0.21	0.03	0.00	0.00	4.55	0.58	**1.37**	**0.18**
T.	0.41	0.05	0.00	0.00	0.41	0.05	0.00	0.00	1.14	0.15	**0.39**	**0.05**
OC	0.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.06**	**0.01**
DN	0.00	0.00	12.41	1.59	3.83	0.49	1.34	0.17	0.00	0.00	**3.52**	**0.45**
CU	1.66	0.21	1.66	0.21	0.52	0.07	1.14	0.15	1.66	0.21	**1.32**	**0.17**
RK	10.14	1.30	11.17	1.43	1.34	0.17	8.69	1.11	12.83	1.64	**8.83**	**1.13**

Table 3.1.1 Mean low tide densities (d) (birds/ha) and estimated numbers (n) of waterbirds using those areas of mudflats A1, A5 and A18 of Cardiff Bay, which lay beyond the future position of the barrage.

Data are from the autumns of 1989-1993. SU = Shelduck, MA = Mallard, T. = Teal, OC = Oystercatcher, DN = Dunlin, CU = Curlew, RK = Redshank.

	August		September		October		November		**Average**	
	Number	Density	Number	Density	Number	Density	Number	Density	**Number**	**Density**
SU										
Mudflat B2	0	0	0	0	0	0	0.5	0.04	**0.1**	**0.01**
Mudflat B3	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat B5	-	-	-	-	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**
MA										
Mudflat B2	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat B3	0	0	0	0	1.5	0.21	0	0	**0.4**	**0.05**
Mudflat B5	-	-	-	-	5.0	1.52	0	0	**2.5**	**0.76**
Mudflat B1	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat 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	0.5	0.07	0	0	0.5	0.07	0	0	**0.3**	**0.04**
Mudflat B5	-	-	-	-	0	0	0	0	**0**	**0**
Mudflat B1	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat B4	1.5	0.08	0.5	0.03	0	0	0	0	**0.5**	**0.03**
CU										
Mudflat B2	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat B3	1.0	0.14	1.0	0.14	0	0	0	0	**0.5**	**0.07**
Mudflat B5	-	-	-	-	0	0	0	0	**0**	**0**
Mudflat B1	0	0	0	0	0	0	0	0	**0**	**0**
Mudflat B4	0.5	0.03	0.5	0.03	0	0	3.5	0.18	**1.1**	**0.06**
BH										
Mudflat B2	-	-	0	0	0	0	0	0	**0**	**0**
Mudflat B3	-	-	14.0	1.99	7.5	1.07	9.0	1.28	**7.6**	**1.08**
Mudflat B5	-	-	-	-	13.5	4.09	4.0	1.21	**8.8**	**2.65**
Mudflat B1	-	-	4.0	0.83	0	0	0.5	0.10	**1.1**	**0.23**
Mudflat B4	-	-	50.0	2.53	112.5	5.70	57.5	2.91	**55.0**	**2.78**
LB										
Mudflat B2	-	-	22.5	1.90	12.0	1.01	0.5	0.04	**8.8**	**0.74**
Mudflat B3	-	-	4.0	0.57	7.5	1.07	0	0	**2.9**	**0.41**
Mudflat B5	-	-	-	-	0	0	0	0	**0**	**0**
Mudflat B1	-	-	1.0	0.21	1.5	0.31	2.5	0.52	**1.3**	**0.26**
Mudflat B4	-	-	60.0	3.04	82.5	4.18	45.0	2.28	**46.9**	**2.37**

Table 3.2.1 Mean low tide numbers and densities (birds/ha) of waterbirds and gulls using mudflats near the Cardiff Bay barrage at low tide between August and November 2001.

Only species recorded on mudflats affected by dredging (shown italicised) are included. SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, BH = Black-headed Gull, LB = Lesser Black-backed Gull.

	October		November		**Average**	
	Number	Density	Number	Density	**Number**	**Density**
CA	0.5	0.15	0	0	**0.3**	**0.08**
MA	7.5	2.27	2.5	0.76	**5.0**	**1.52**
BH	12.5	3.79	16.0	4.85	**14.3**	**4.32**

Table 3.2.2 Mean high tide numbers and densities (birds/ha) of waterbirds and gulls using 'mudflat' B5 within the outer gate of the Cardiff Bay barrage between August and November 2001.

Only species recorded in this count area are included. CA = Cormorant, MA = Mallard, BH = Black-headed Gull.

	August	September	October	November	**Average**
CA					
Mudflat B2	-	0.5	2.0	0	**0.8**
Mudflat B3	-	0.5	0.5	0	**0.3**
Mudflat B1	-	1.0	5.0	0	**2.0**
Mudflat B4	-	7.5	11.5	12.5	**10.5**
SU					
Mudflat B2	0	0	0	0.5	**0.1**
Mudflat B3	0	0	0	0.5	**0.1**
Mudflat B1	0	1.0	0	0	**0.3**
Mudflat B4	0	0	0	0	**0**
MA					
Mudflat B2	0.5	0	0	0	**0.1**
Mudflat B3	0	0	3.0	0	**0.8**
Mudflat B1	0	0	0	0	**0**
Mudflat B4	0	0	0	0	**0**
OC					
Mudflat B2	0	0	0	0	**0**
Mudflat B3	1.5	0.5	1.5	0	**0.9**
Mudflat B1	0	0	0	0	**0**
Mudflat B4	2.5	1.0	0	1.0	**1.1**
CU					
Mudflat B2	0	0	0	0.5	**0.1**
Mudflat B3	3.0	5.0	3.5	4.0	**3.9**
Mudflat B1	0	0	0	0	**0**
Mudflat B4	5.5	9.5	0	12.0	**6.8**
RK					
Mudflat B2	0	0	0	2.5	**0.6**
Mudflat B3	0	0	0	0	**0**
Mudflat B1	0	0	0	0	**0**
Mudflat B4	0	0	0	0	**0**
BH					
Mudflat B2	-	27.0	0	0	**9.0**
Mudflat B3	-	31.0	18.5	9.0	**19.5**
Mudflat B1	-	23.0	6.5	0.5	**10.0**
Mudflat B4	-	97.0	233.5	305.5	**212.0**
LB					
Mudflat B2	-	51.5	32.5	4.0	**29.3**
Mudflat B3	-	55.5	51.0	25.0	**43.8**
Mudflat B1	-	12.5	12.0	4.5	**9.7**
Mudflat B4	-	413.0	188.5	228.0	**276.5**

Table 3.2.3 The mean number of bird hours per tidal cycle recorded on mudflats near the Cardiff Bay barrage between August and November 2001.

Only species recorded on mudflats affected by dredging (shown italicised) are included. SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, RK = Redshank, BH = Black-headed Gull, LB = Lesser Black-backed Gull.

	Peak Number	Month
CA		
Mudflat B2	2	October
Mudflat B3	1	September / October
Mudflat B5	0	-
Mudflat B1	3	October
Mudflat B4	12	October
SU		
Mudflat B2	1	November
Mudflat B3	1	November
Mudflat B5	0	-
Mudflat B1	2	September
Mudflat B4	0	-
MA		
Mudflat B2	1	August
Mudflat B3	3	October
Mudflat B5	12	October
Mudflat B1	0	-
Mudflat B4	0	-
OC		
Mudflat B2	0	-
Mudflat B3	2	August
Mudflat B5	0	-
Mudflat B1	0	-
Mudflat B4	3	August
CU		
Mudflat B2	1	November
Mudflat B3	2	September-November
Mudflat B5	0	-
Mudflat B1	0	-
Mudflat B4	6	September
RK		
Mudflat B2	5	November
Mudflat B3	0	-
Mudflat B5	0	-
Mudflat B1	0	-
Mudflat B4	0	-

Table 3.2.4 Peak numbers of waterbirds and gulls recorded on mudflats near the Cardiff Bay barrage between August and November 2001.

Only species recorded on mudflats affected by dredging (shown italicised) are included. SU = Shelduck, MA = Mallard, OC = Oystercatcher, CU = Curlew, RK = Redshank, BH = Black-headed Gull, LB = Lesser Black-backed Gull.

	Peak Number	Month
BH		
Mudflat B2	31	September
Mudflat B3	17	September
Mudflat B5	28	November
Mudflat B1	13	October
Mudflat B4	180	November
LB		
Mudflat B2	39	September
Mudflat B3	54	September
Mudflat B5	0	-
Mudflat B1	18	October
Mudflat B4	205	September

Table 3.2.4 Continued.

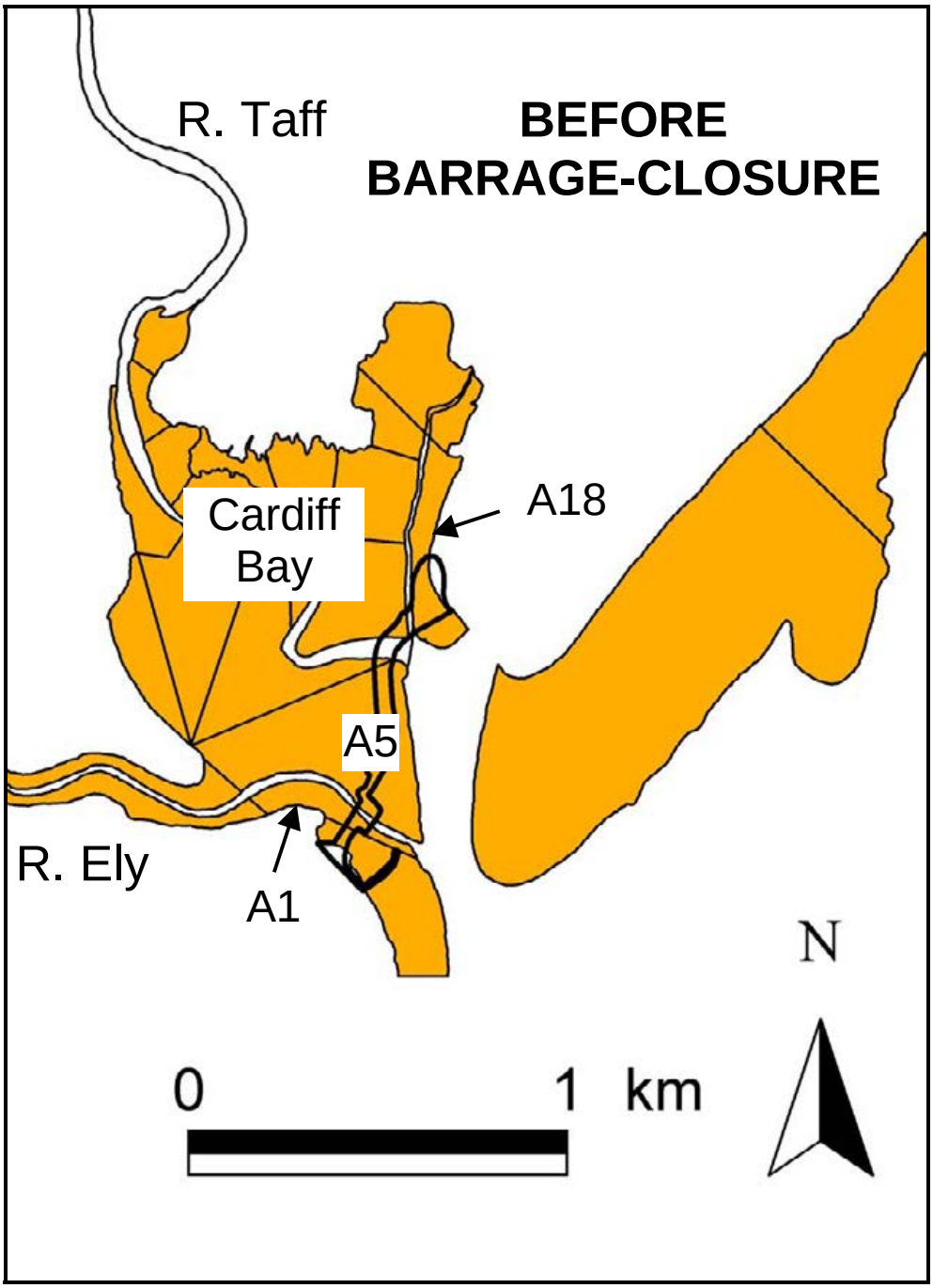

Figure 2.1.1 Cardiff Bay prior to barrage-closure showing numbered mudflat count areas subsequently dissected by the Barrage (highlighted in bold).

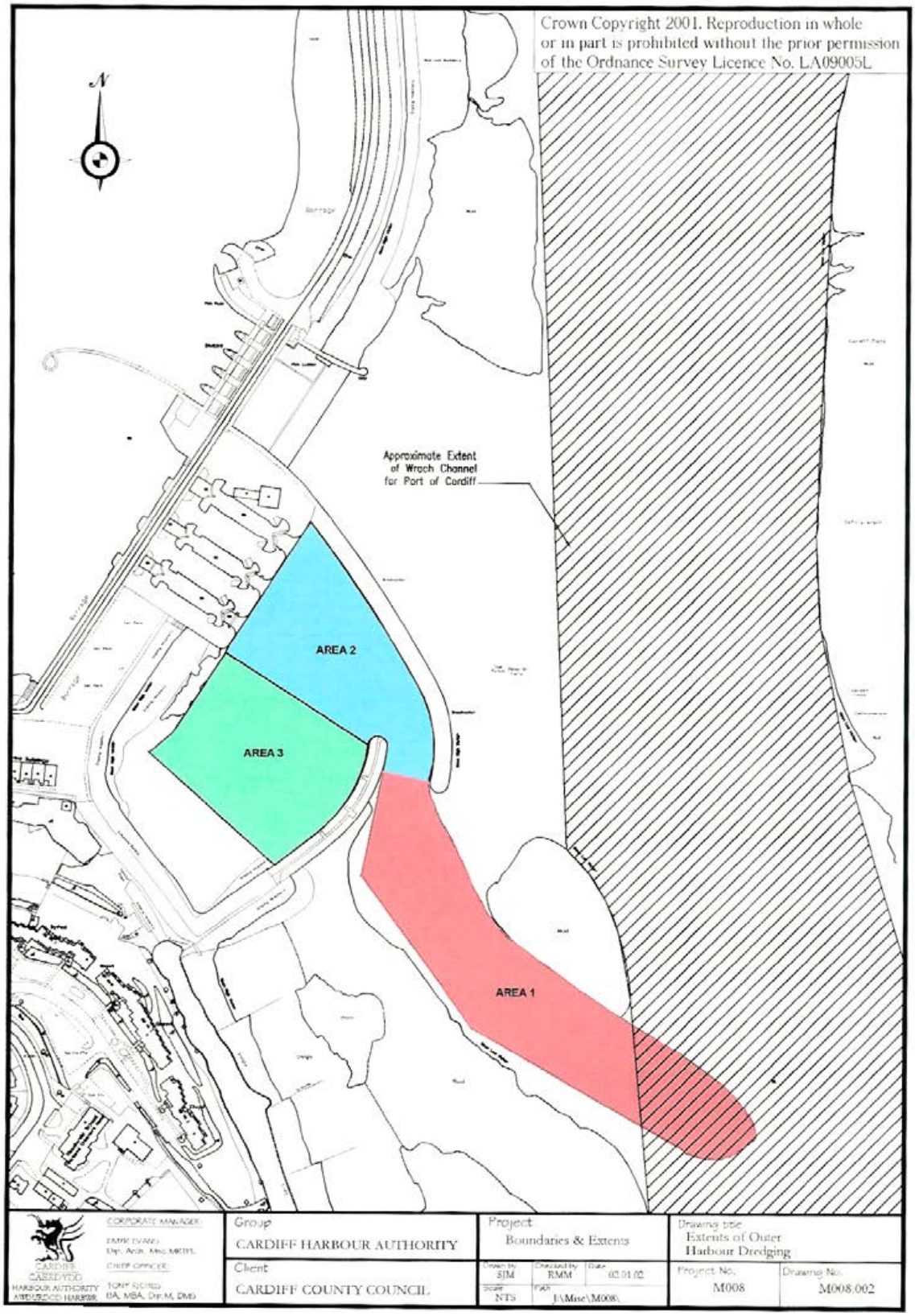

Figure 2.2.1 The Cardiff Bay Barrage showing areas (shaded grey) subject to maintenance dredging.

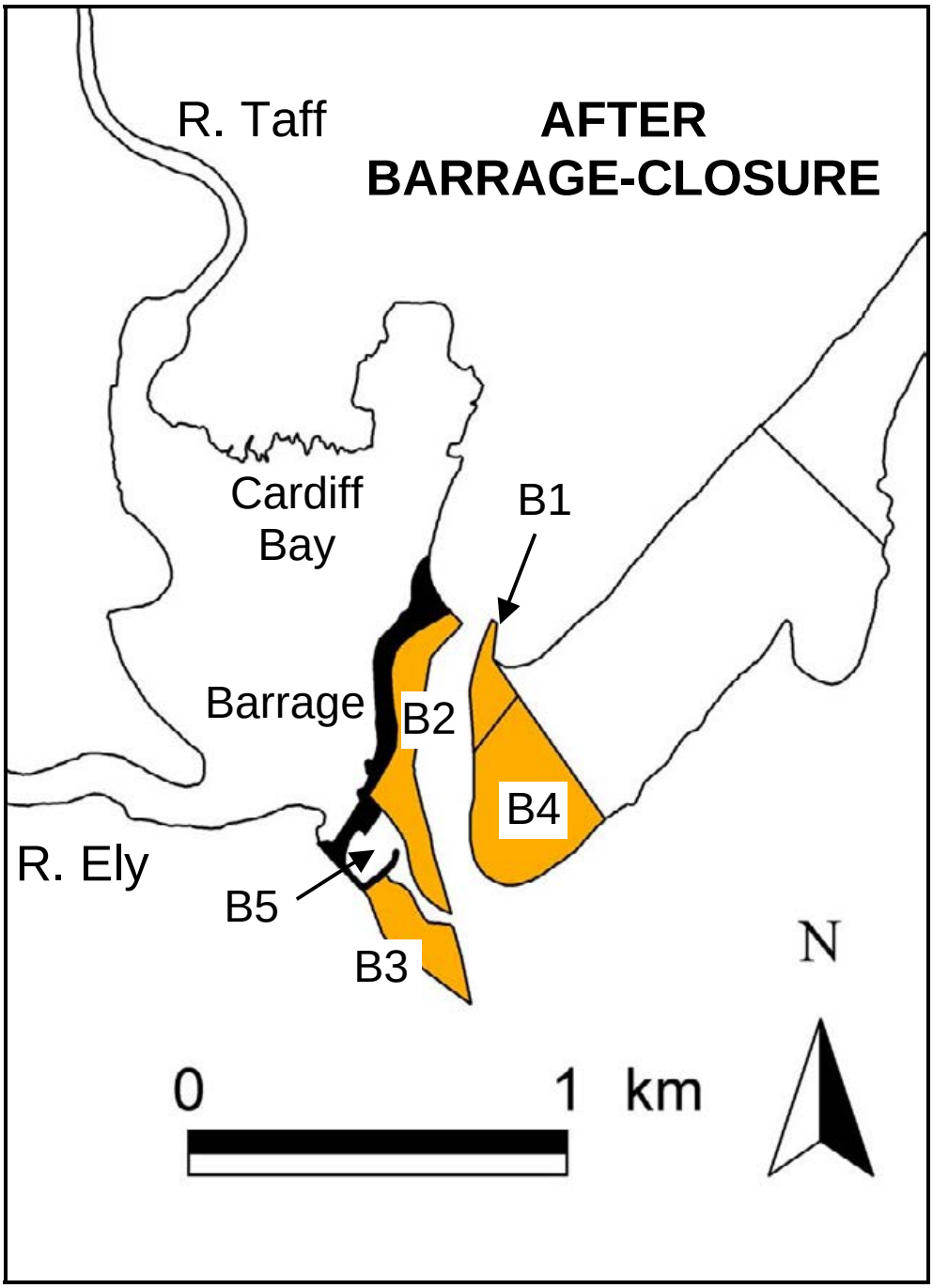

Figure 2.2.2 The Cardiff Bay Barrage showing numbered mudflat count areas (shaded grey) used between August and November 2001.

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

European White-fronted Goose *Anser albifrons albifrons*	6000
Shelduck *Tadorna tadorna*	750
Gadwall *Anas strepera*	300
Teal *Anas crecca*	1400
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