Environmentally
Sustainable Systems Ltd

KENTISH FLATS WIND FARM FOURTH ORNITHOLOGICAL MONITORING REPORT

Report to Kentish Flats Ltd

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1 EXECUTIVE SUMMARY

This Fourth Ornithological Monitoring report which covers Year 5 of an ongoing monitoring programme, presents and analyses the results of the 16 boat surveys from 7th December 2005 to 1st December 2006 for the Kentish Flats Wind Farm, and aerial data collected over four surveys from December 2005 to February 2006 in the area surrounding the wind farm. The purpose of this report is to meet the FEPA license monitoring requirements determined by DEFRA (following advice from English Nature, now Natural England) as a planning consent condition for the construction of the Kentish Flats project.

Population estimates with means and standard errors for the wind farm site and buffer zone and for the control site have been calculated using the data collected during each of the 90 boat surveys since October 2001. Standard errors have been updated and improved by the larger (5-year) dataset. Relative abundance indices have been calculated with standard errors for all WWT aerial surveys covering Kentish Flats.

The statistical comparisons of the boat and aerial survey data have not revealed any statistically significant changes in the abundances of bird populations (FEPA Objective 1) between the preconstruction, construction and operational periods. In particular the aerial data analyses provided no evidence of displacement of birds from the region that includes the Kentish Flats wind farm. As in previous years the boat analyses are somewhat restricted by the lack of comparable data from the control area, especially during the peak diver period, and the lack of consistency in the dates on which surveys were completed, together with the natural and in some cases extensive seasonal and inter-annual variation in the numbers and distributions of bird populations. Patterns of use and passage in and around the Kentish Flats wind farm, revealed by the mapped distributions of birds seen, do show some changes between years but in most cases it is not possible to attribute these changes to the construction or operation of the wind farm. In particular it is apparent that divers have not been seen within the wind farm site during the current reporting period and this may indicate some displacement of divers from the Kentish Flats wind turbine array. While no divers were seen within the operational wind farm a number were seen in flight or on the water very close to the outside edge of the wind farm, (some sitting less than 100m from a turbine). Even though no changes in bird abundance were statistically significant, the density estimates and mapped distributions suggest that the numbers of red-throated divers were lower during the operational phase than during pre-construction.

Cormorant numbers were lower between December and April since the wind farm became operational, but not at other times of year. Lesser black-backed gull numbers in February were lower in the construction and operational phases. There were suggestions of differences in other months for this species and possible reductions for greater black-backed and herring gulls, but no consistent patterns were detected. Gannet and common tern numbers show no evidence of changes. As in the previous reporting period there was a suggestion from the surveyors reports that fewer common tern flights passed through the wind farm site (although no statistical difference in populations is apparent). The numbers of guillemot appear to be lower since the wind farm became operational.

Objective 2 of the FEPA license primarily concerns terns, and possibly also wildfowl and waders. The pattern of common tern flights, recorded in previous years, regularly passing through the southern part of the turbine area carrying fish to their breeding Medway colonies, was less pronounced in 2006 and 2005 than previously. This was the only example of a regularly used flight line detected by boat surveys before construction commenced. While there is no evidence that any other species used regular flight lines through the boat survey area, or that the common tern flight line has been disrupted there is an indication that terns are now flying north and south of the turbines (see Figure 107).

Objective 3 is primarily met by maps showing accumulated diver distributions (Figures 105, 110, 112, 114 & 116) along with wildfowl and wader records (Figure 106), within this reporting period. Both boat and aerial survey data have been used to address Objective 3, and continue to suggest a minor importance of the wind farm site and buffer zone for wintering wildfowl and other species qualifying the coastal SPA sites surrounding the Thames Estuary. The most frequently seen wildfowl during the boat surveys in Year 5 were again common scoter, with numbers seen not quite at the same level as in Year 4, and none were seen within the turbine area, though some were recorded within the buffer zone and control site (see Figure 106). No geese were seen from the air near the wind farm. Figure 106

shows that goose flights seen during the boat surveys were less frequent in this reporting year than previously for geese (with three groups of Brent geese totalling sixteen individuals and two greylag geese seen within the buffer zone and one and four Brent geese seen within the control site). The two greylag geese hesitated before flying at rotor height through the wind farm. On 9th October 2006 eight Brent geese flew through the wind farm below the turbines. Other geese skirted the edges of the wind farm. The only waders seen were a grey plover and two curlews.

Fewer divers were seen than in previous years, and none were seen during either boat or aerial surveys within the Kentish Flats turbine array. The importance of the Kentish Flats wind farm site for wintering divers which will qualify the planned Thames SPA remains low in relation to the buffer zone (especially Pan Sands to the east), other parts of the TH1 aerial survey area (Figure 116) and the outer Thames.

Objective 4 relates to the rate of bird collision. No formal assessment of collision risk has been made in this report since the number of divers, gannets, wildfowl, waders and terns seen flying at rotor height through the wind farm continues to be very low and no divers have been seen within the wind farm at all (see Figure 105). Very few of these species have been seen at rotor height above 20m asl (see Table 27).

Mitigation referred to in Objective 5 of the FEPA license is no longer relevant having been addressed in the previous monitoring report following completion of construction.

2 INTRODUCTION

This Fourth Monitoring Report analyses the results of the 12 months of boat data collected from December 2005 to November 2006 for the Kentish Flats wind farm project, and aerial data collected from 13th November 2005 to 18th February 2006 over the area immediately surrounding the Kentish Flats wind farm site. The aerial surveys cover a much greater area extending far beyond the wind farm site, and are part of the wider aerial bird survey regime that covers the Thames strategic offshore wind farm area.

The purpose of this report is to meet the monitoring requirements set out by DEFRA (with advice from English Nature, now Natural England) as a condition for the FEPA consent for the Kentish Flats project. The objectives of the pre-, during and post-construction monitoring program are quoted below from Annex 2 of the Schedule to FEPA Licence No. 31780/03/0, dated March 7th, 2003:

1. **Determine whether there is change in bird use and passage through the wind farm site, measured by species, abundance and behaviour.**
2. **Determine whether there is disruption to bird flight lines.**
3. **Determine the distribution of wildfowl and divers in the Thames Estuary, covering the Kentish Flats study area. This will include movements of wildfowl to and from the coastal SPA sites surrounding the Thames Estuary.**
4. **Determine the rate of bird collision at the Kentish Flats site.**
5. **Determine the effectiveness of mitigation measures implemented during wind farm construction.**

In this report, Objective 1 is addressed by statistical and visual comparisons of birds detected by boat and aerial surveys during the "Preconstruction Period" from October 2001 to July 2004, the "Construction Period" from August 2004 to August 2005 and the "Operational Period" after late August 2005. Construction of the Kentish Flats monopile foundations extended from August to November 2004. The last turbine was erected 22nd August 2005, and the largest installation vessel left the area shortly thereafter. Accordingly, boat surveys 1-51 (named A to AX) have been assigned as being pre-construction (last 29th July 2004) and visits 52-68 (AY to BP) as being during the construction phase (26th August 2004 to 1st August 2005). The remaining twenty two visits BQ to CL (75-90) have been assigned to the site being in operation. The use of the data in this way has permitted a before-after-control-impact (BACI) analysis.

Objective 2 is addressed by examination of the patterns of SPA wildfowl, wader and tern flights (see Figures 106, 111, 113 & 115).

Objective 3 is addressed by the mapping and description of birds seen during the surveys (see Figures 89-116). All Figures referred to in the report, including Figures 1-88 from previous monitoring reports are on the CD inserted at the back of this report.

Objective 4 can in principle be addressed by monitoring bird collisions directly, and/or by modelling collision risk through the monitoring and analysis of bird flight heights and directions during the operational phase of the wind farm, as well as during construction and pre-construction phases (on the unlikely assumption that bird flight behaviour is unaffected by the presence of turbines). There has been no attempt to apply the former approach at any UK offshore wind farm, and few proven technologies exist at present. No formal assessment of collision risk has been made in this report since the number of divers, gannets, wildfowl, waders and terns seen flying at rotor height through the wind farm continues to be very low and no divers have been seen within the wind farm at all (see Figure 105). However the number of birds recorded above 20 asl (i.e. at rotor height) has been tabulated in Table 27). The numbers if species of conservation concern recorded in 2005/6 at rotor height is too low for any collision risk modelling to be meaningful.

Objective 5 is to determine the effectiveness of mitigation measures to reduce potential impacts upon wintering birds during monopiling operations. This was fully discussed as part of the Second Monitoring Report (Gill, Sales & Beasley 2005) and briefly referred to in the Third Monitoring Report (Gill, Sales & Beasley 2006). It was concluded that disturbance to populations of divers at the Kentish Flats site had been avoided by scheduling pile-driving operations to avoid the peak diver period. No further ornithological mitigation was considered necessary following consultation with English Nature and DEFRA so this objective should be removed from future FEPA license reporting requirements.

3 METHODOLOGIES

3.1 BOAT SURVEY METHODOLOGY

During the Kentish Flats ornithological boat surveys, two surveying techniques are used simultaneously:

- A continuous 90 degree scan with a 300m band transect of birds on-sea and in-flight
- A 90 degree snapshot every 2 minutes of birds in-flight.

The details of the boat survey methodology used have remained as presented in the Third Monitoring Report (Gill, Sales & Beasley 2006).

The survey boat used at the Kentish Flats is an 18m former beam trawler, now a full time survey vessel. Using its Differential GPS (DGPS) Track Plotter, the boat travels accurately along pre-determined transects at an average speed of 8 knots.

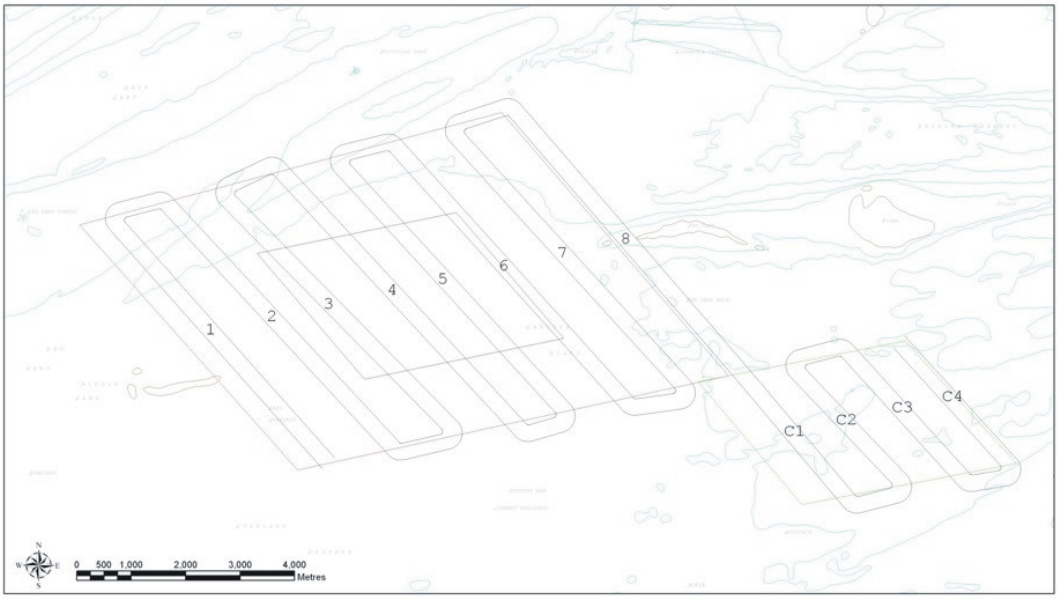
Two surveyors are employed during the Kentish Flats surveys, both JNCC-accredited seabird surveyors who have each logged 1000+ hours surveying seabirds at sea.

The surveyors sit on a purpose built platform at the front of the survey vessel. The platform raises the surveyors' eye-height to 5m above sea level. When on transect, one surveyor observes continuously, while the other acts as scribe, writing down what is seen. When not writing (which is most of the time), the scribe also observes.

3.1.1 Study Areas and Transects

The wind farm and buffer study area and control site, shown below in Figure 1, have remained identical throughout the Kentish Flats ornithological survey program, having been agreed with English Nature and DEFRA. These have been previously described in the Potential Ornithological Impact Report (Gill, Kemsley & Sales 2002) and the First Monitoring Report (Gill, Sales & Pullinger 2004).

Figure 1: Positions of Wind Farm, Buffer Zone and Control Areas within Study Area



Eight transects cover the main survey area (*i.e.* the main Kentish Flats wind farm area and a suitable buffer area around this) and four transects cover the smaller control site, which lies to the southeast of the main survey area (see Figures 1-24, 31-50, 59-78, 89-107). All of the transects are orientated in a southeast - northwest and northwest - southeast direction.

The main survey area transects are 6000m long and 1000m apart. The control area transects are 3000m long and are 875m apart.

3.1.2 Survey Programme

Sixteen surveys were conducted in Year 5 between 7th December 2005 and 1st December 2006. These surveys are referred to as surveys BW to CL, following on from the boat surveys reported on the in the Third Monitoring Report (surveys BF to BV). The dates, start times finish times and tidal conditions of all surveys are given in Table 1 below.

Table 1Boat Survey Details

Date	Survey	Time		Start from	Control Studied	Wind Dir	Wind Force	High Tide 1		High Tide 2	
		Start	End					Time	M	Time	m
15/11/2002	U	7.58	12.05	N/K	No	S	1-2	08:50	3.9	21:34	4.1
14/12/2002	V	8.26	13.50	N/K	Yes	E-NE	2-3	07:48	3.9	21:38	4.0
22/01/2003	W	8.07	12.29	N/K	No	NW	3	02:42	5.3	15:13	5.2
10/02/2003	X	8.52	14.03	N/K	Yes	S	2-3	05:43	4.1	18:24	3.9
21/02/2003	Y	6.48	11.21	N/K	No	SE	0-1	03:09	5.6	15:39	5.3
06/03/2003	Z	12.26	16.29	N/K	No	W	0-3	02:05	5.1	14:28	5.0
23/03/2003	AA	6.40	11.56	N/K	Yes	SE	0-2	03:34	5.4	16:00	5.0
07/04/2003	AB	7.59	12.23	N/K	No	E	3-4	04:12	4.7	16:31	4.5
15/04/2003	AC	10.20	14.32	N/K	No	SE	2	-	-	12:12	5.1
06/05/2003	AD	8.17	14.15	N/K	Yes	W	1-3	03:49	4.7	16:05	4.6
19/05/2003	AE	5.41	10.41	N/K	No	SW	3	03:13	5.4	15:34	5.2
04/06/2003	AF	7.47	12.40	N/K	No	NW	0-1	03:35	4.7	15:49	4.7
22/06/2003	AG	10.10	15.37	N/K	Yes	SW	2-4	07:16	4.1	19:26	4.1
22/08/2003	AH	6.41	10.36	N/K	No	SW	4-5	08:09	3.7	20:37	3.8
08/09/2003	AI	9.31	13.30	N/K	No	SE-E	1-3	11:26	4.4	-	-
22/09/2003	AJ	12.15	18.43	N/K	Yes	SW-NE	4-8	09:49	3.9	22:32	4.1
12/10 2003	AK	7.00	11.39	N/K	No	SE	4-5	02:07	5.1	14:18	5.1
26/10/2003	AL	13.04	16.47	N/K	No	N	3-4	00:16	5.6	12:32	5.7
06/11/2003	AM	10.51	16.42	N/K	Yes	S-E	2	10:28	4.4	22;58	4.6
08/12/2003	AO	10:46	15:08	N/K	No	SE	4-3	11:51	4.6	-	-
18/12/2003	AP	09:35	14:45	N/K	Yes	SE	3	06:44	4.3	19:37	4.3
03/01/2004	AQ	10:19	14:51	N/K	No	SW	2	08:59	4.1	21:40	4.2
06/02/2004	AR	10:26	16:00	N/K	Yes	W	4-5	00:11	4.8	12:37	4.9
05/03/2004	AS	09:55	14:00	N/K	No	E	1-2	11:33	4.7	23:45	4.9
07/04/2004	AT	12:07	17:45	N/K	Yes	NW	4	02:18	5.8	14:44	5.7
12/05/2004	AU	05:09	09:10	N/K	No	N	4	07:30	4.3	19:48	4.3
28/05/2004	AV	10:29	15:16	N/K	No	S	3	07:41	4.2	19:50	4.3
08/06/2004	AW	08:46	14:40	N/K	Yes	S	1-3	05:06	5.0	17:22	4.9
29/07/2004	AX	08:29	12:41	N/K	No	SE	3	10:44	4.7	23:17	4.8
26/08/2004	AY	10:19	16:24	N/K	Yes	NW	3-4	09:15	4.3	21:59	4.4
03/09/2004	AZ	07:07	11:57	N/K	No	SW	<1	03:48	5.3	16:00	5.3
29/09/2004	BA	06:52	11:44	N/K	No	NW	1-2	01:30	5.3	13:41	5.5
15/10/2004	BB	11:56	16:13	N/K	No	W-NW	3	01:39	5.5	13:51	5.7
27/10/2004	BC	10:15	13:34	N/K	No	SE	4-7	00:24	5.1	12:35	5.2
14/11/2004	BD	11:00	15:17	N/K	No	NW	2-3	01:54	5.6	13:15	5.7
26/11/2004	BE	10:25	15:54	N/K	Yes	SW; W	4-5; 2-3	11:46	5.0	-	-
11/12/2004	BF	08:26	12:43	East	No	SW	1	11:20	5.3	23:49	5.4
19/01/2005	BG	09:34	15:14	East	Yes	W	3-5	07:00	4.2	19:48	4.1
07/02/2005	BH	08:51	13:10	East	No	SW	1-3	10:55	4.9	23:19	5.1
08/03/2005	BI	10:06	15:23	West	Yes	NW	2-4	10:48	4.9	23:08	5.0
03/04/2005	BJ	10:33	15:07	East	No	S	1-3	07:43	4.3	20:13	4.2
22/04/2005	BK	09:58	14:20	East	No	SE	2-4	12:06	4.8	-	-
10/05/2005	BL	05:39	09:44	West	No	N	3-4	02:11	5.3	14:30	5.2
29/05/2005	BM	07:00	12:42	West	Yes	N	0-1	05:19	4.9	17:34	4.9
15/06/2005	BN	10:31	14:47	East	No	S	4-5	06:51	4.2	18:56	4.3
08/07/2005	BO	05:42	11:23	West	Yes	N	4	02:11	4.8	14:24	4.9
01/08/2005	BP	10:24	14:33	West	No	E	3-4	10:24	4.1	22:49	4.1
06/09/2005	BQ	08:27	13:39	East	Yes	E-NE	0-1	02:38	5.2	14:44	5.3

27/09/2005	BR	11:04	15:18	East	No	W	3-4	07:51	3.7	20:50	3.8
03/10/2005	BS	11:22	15:33	West	No	N-NW	2	01:01	5	13:09	5.1
14/10/2005	BT	08:28	12:37	East	No	NE	3	10:15	4.6	23:01	4.8
12/11/2005	BU	10:08	15:29	West	Yes	W	2-3	08:48	4.6	21:36	4.8
17/11/2005	BV	11:00	15:16	West	No	NW	5	00:34	5.3	12:51	5.3
07/12/2005	BW	07:28	12:15	East	No	NW	2-3	04:00	4.9	16:55	4.9
13/01/2006	BX	08:06	13:09	East	Yes	S	3	12:09	4.9	-	-
17/02/2006	BY	12:19	16:24	West	No	W	2-3	02.41	5.1	15.02	5.1
02/03/2006	BZ	06:52	12:10	East	Yes	NW	3	01:57	5.6	14:37	5.5
13/04/2006	CA	09:02	13:08	West	No	W	3-5	13:49	5.0	-	-
19/04/2006	CB	14:43	18:44	East	No	W	4	04:41	4.9	16:52	4.7
02/05/2006	CC	07:10	11:23	West	No	S	2	04:19	5.2	16:33	4.9
23/05/2006	CD	11:08	16:45	East	Yes	W-SW	2-3	10:13	4.9	22:17	4.9
02/06/2006	CE	08:08	12:18	West	No	SW	0-1	05:30	4.7	17:35	4.7
21/07/2006	CF	11:40	17:21	East	Yes	SE	1-2	10:05	4.6	22:30	4.6
07/08/2006	CG	11:48	16:56	West	Yes	N	1-2	11:40	4.8	-	-
18/09/2006	CH	07:56	12:03	East	No	W	3	10:39	4.5	23:32	4.7
29/09/2006	CI	07:36	13:03	East	No	SW	1-4	04:46	4.8	17:10	4.8
09/10/2006	CJ	12:04	17:17	West	Yes	SW	2	02:44	5.5	14:47	5.7
04/11/2006	CK	08:28	12:34	East	No	W-NW	3-4	11:04	5.3	23:50	5.3
01/12/2006	CL	10:32	14:46	West	No	S-SW	4-5	08:31	4.9	21:31	4.9

N//K = Not known

In year 5 there have been seven control site surveys, which means that the control site was surveyed on 44% of the visits. This increase in control site survey frequency was in response to a recommendation from ESS's Statistician made in the Third Monitoring Report (Gill *et al* 2006). In Years 4, 3 and 2 the control site was surveyed on 35% of the visits. In Year 5 the longest gap was from 2nd March to 23rd May 2006. In Year 4 the longest gap between control site surveys was of the same duration, from 8th March to 29th May 2005.

Each transect within the main survey area takes approximately 25 minutes whilst every control area transect takes approximately 10 minutes to complete. The time taken to travel between the end of one transect and start of the next is approximately five minutes. Data are not systematically collected during these transect tails. Surveying the main area therefore takes approximately 4 hours whilst the control area takes approximately one hour.

Generally 16-17 surveys are undertaken per year. The timing has varied from year to year, but averages approximately one (January, February, March, June, July, August and December) or two visits per month (April, May, September, October and November). Over the five years the numbers of surveys completed per month are 4 in January, 5 in February, 5 in March, 7 in April, 8 in May, 5 in June, 3 in July, 4 in August, 8 in Sep, 7 in October, 7 in November, and 6 in December.

The main area is surveyed during every visit, whilst the control area is generally surveyed at least once every other month, either immediately before or immediately after the survey of the main area. This programme and location and frequency of visits to the control site were agreed at the start of the Kentish Flats ornithological monitoring program following discussions between the project developer and English Nature in 2001.

Whenever possible, surveys are scheduled so as to vary factors such as time of day, state of tide, sea state, weather, and the sequence in which transects are surveyed *i.e.* west to east or east to west, corresponding to transect 1 or transect 8/control transect 4 first (see 0and Figure 1 above).

3.1.3 Influence of Weather, Tides, Vessels and Fishing Gear

Surveys are not undertaken in thick fog, continuous heavy rain, or sea states greater then 5, nor are surveys ever undertaken before sunrise or after sunset. The dates and timings of surveys are carefully scheduled to avoid unsuitable weather.

COWRIE (NIOZ 2004) recommends no bird survey data should be analysed in sea states of 5 or above, due to the unsuitability of such data for assessment and statistical comparisons. Consequently, any sustained force 5-6 winds, which would produce a sea state of 5, have been avoided. No such conditions occurred during the current reporting period.

On those occasions when conditions deteriorate after a survey has started, the survey would either halt temporarily until conditions improve, or would be abandoned completely and repeated. In Year 5, due to careful scheduling no survey attempts had to be abandoned due to deteriorating weather, visibility or sea state. Surveys are never continued over more than one day.

On 7th December 2005 the survey had to be temporarily halted when the boat went aground on a sandbank in transect 1 but was resumed in 15 minutes when the rising tide floated the vessel free. A small deviation from the line was then also required to navigate shallow water. On 2nd March 2006 due to particularly strong spring tides and a deviation from the line was required in transect 8 to navigate shallow water. On 23rd May a small deviation from the line was required at the northern end of transect 8 to avoid shipping. On 2nd June a small deviation from the line was required near the southern end of transect 3 due to the proximity of a dive boat and a diversion was also required in transect 8 to navigate shallow water. On 21st July 2006 the line had to be cut a little short at the northern end of transect 8 because of shipping and a small deviation from the line was required near the southern end of transect 1 to avoid static fishing gear fixed in shallow water on the line. On 1st December 2006 a small deviation from the line was required in transect 8 to navigate shallow water.

3.1.4 Direction of Scan and of Survey

Observations are always made to the eastern side of the boat - *i.e.* when the boat is travelling NW along a transect, the 90 degree scan is NW to NE and when the boat is travelling SE along a transect, the 90 degree scan is SE to NE.

This protocol was decided upon at the start of the Kentish Flats ornithological monitoring program and agreed with English Nature. It has remained unchanged to ensure the consistency of the long term data sets.

The wind farm and buffer zone may be surveyed from west to east or vice versa. The end of this area at which transects started and therefore the direction of survey is stated in the fifth column of Table 1 above. The control site may have been surveyed before or after this.

3.1.5 Sampling Method

Field methods used during the Year 5 monitoring surveys were identical to those agreed with English Nature and described previously in the Potential Ornithological Impact Report (Gill, Kemsley & Sales 2002) with the following exceptions:

- The method for distance estimation was as described in 3.3.1 of the Third Monitoring Report (Gill, Sales & Beasley 2006)

- Height estimates were no longer calibrated after survey AA on 23rd March 2003

Birds are scanned for using the naked eye. Once a bird has been detected, binoculars may be used to assist with identification of species and age. The one exception to this is the special case of scanning for divers. Divers, especially red-throated divers, almost always flush from the sea at distances too far ahead of the approaching survey vessel to be reliably seen by the naked eye. Therefore, whenever divers are in the area the approach adopted is to quickly, and frequently, scan ahead with binoculars, with less frequent rapid scans through 180 degrees for any divers. For divers, the distance bands A-D are considered to continue up to estimated edge of study area whether seen on sea or in flight; this is the special case treatment for divers.

When a bird is seen, details of where it was seen and what it was doing at the moment it was first detected are recorded. Any birds associating with the survey boat are ignored or recorded in the Notes field of the field forms indicating that they are "ship associated".

The information recorded for each observation is as follows

TIME
SPECIES
AGE
NUMBER
DISTANCE BAND
DIRECTION
IN-FLIGHT
ON-SEA
HEIGHT
IN-TRANSECT
NOTES

TIME is documented over a recording interval of 2 minutes[1]

SPECIES has been recorded using two letter BTO codes since 29th May 2005 (up to 10th May 2005 five letter European ESAS codes were used). If a precise identification of the species cannot be made then the most precise identification possible is written down (*e.g.* auk, gul, sea; prior to 29th May 2005 Auk, Gull or Seal).

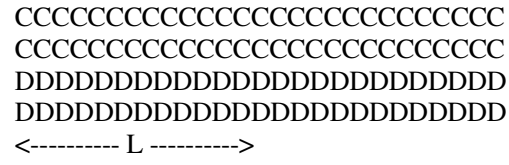
AGE is recorded as adult or immature or left blank if not obvious.

NUMBER is the number of birds the record refers to. It is almost always a precise count of the individuals. However, when there are a large number of birds to be recorded quickly, *e.g.* a flyby flock of 250 starlings, then it is an estimate and entered as *e.g.* c250.

DISTANCE BAND is either A B C D or E. Distance bands run parallel to the direction of travel of the vessel.
A is 0-50m (measured perpendicular to the direction of travel of the vessel)
B is 50-100m
C is 100-200m
D is 200-300m
E is >300m

When recording birds on-sea or in snapshot each band is considered to be 480m in length (when travelling at 8 knots). When recording birds in-flight each band is considered to continue ahead to the edge of the survey area.

[1] up to and including 29th May 2005. Thereafter a recording interval on 1 minute has been used.



Where === is the boat
- -> is the direction of travel of the boat
L is 480m (at 8 knots) when recording birds on-sea or in snapshot
and edge of survey area when recording birds for birds recorded in-flight
A is 50m wide
B is 50m wide
C is 100m wide
D is 100m wide

DIRECTION of flight is recorded for birds in-flight.
Direction has recorded as either: *e.g.* N, NE, E, SE, S, SW, W, NW *etc* or as compass points in degrees *e.g.* 0, 45, 90, 135 *etc.,* with circling or variable.

IN-FLIGHT is ticked if the bird was in-flight.

ON-SEA is ticked if the bird was on-sea, though feeding birds have both boxes ticked if they were observed in flight and touching or entering the water. Whenever the first sighting of a bird is of it taking off and it is judged to be taking off because of the approach of the survey boat, that bird is recorded as being on the sea and "Flushed" is written in the Notes field. Apart from this, no note is made of birds taking off or alighting.

HEIGHT is recorded for birds in-flight. It is estimated in metres.

IN-TRANSECT is ticked if either the bird was on-sea in band A B C or D and no further ahead than 480m (at 8 knots), or at snapshot time the bird was in-flight in band A B C or D and no further ahead than 480m (at 8 knots). Note this protocol applies to all birds except the special case of divers (see above), in which case the distance bands A-D are considered to continue up to the estimated edge of study area whether seen on sea or in flight.

NOTES records any additional information such as "bird feeding" or "bird flushed" or the presence of other vessels, especially fishing boats. It is also used to indicate any association between individual records. This is done by placing brackets around the relevant records to group them together. Concentrations of fish seen on the boat's fish finder are also noted, as are any marine mammal sightings.

Priority is given to both the order in which information is recorded and to the order in which different species are recorded. However, in practice, the order in which information and different species are recorded is rarely an issue since two observers almost always have sufficient time to write down the required information.

In addition, the surveyors carry a hand-held GPS which logs (with a 1 minute recording interval) the approximate course taken by the boat on each survey. This GPS is switched on before the start of each survey, and at the start and end of each transect the surveyors enter a waypoint marker into its log. Also at the beginning of each transect, the time and environmental data such as wind speed and direction, wave height, cloud cover, sun glare, precipitation, and temperature are recorded. At the end of each transect the time is also recorded.

In addition to the constant 90 degree scanning of the transects described above, snapshot observations of birds in-flight are undertaken every 2 minutes. These snapshots are scheduled using a digital alarm that sounds for 10 seconds every 2 minutes. On hearing the alarm the surveyors use the 10 seconds for which the alarm sounds to scan for flying birds in the 90 degree scan sector. On the instant the alarm

stops sounding they record as "being in snapshot" those birds that were observed flying in sector at that instant. Birds that are recorded in snapshot are recorded by ticking the In-transect column.

Combining the "continuous 90 degree scan with a 300m band transect of birds on-sea and in-flight" and the "90 degree snapshot of birds in-flight every 2 minutes", produces the following short set of rules for the surveyors and condenses the method statement, as follows:

AT ANY TIME, WHEN ON A TRANSECT ...
Rule 1: Any bird in-flight or on-sea in 90 degree scan -> record it.
Birds on sea should be recorded with slightly higher priority than those in-flight since primary assumption of distance analysis is that all birds on water in band A are detected.

Rule 2: If bird is on-sea in band A B C or D and no further ahead than 480m (at 8 knots)
-> tick In-transect column of record produced by rule 1

AT SNAPSHOT TIME, WHEN ON A TRANSECT ...
Rule 3: If bird is in-flight in band A B C or D and no further ahead than 480m (at 8 knots)
-> tick In-transect column of record produced by rule 1

ANYTIME, ANYWHERE ...
Rule 4: Anything of interest, that usually would not be recorded is indicated as an "incidental record"

Surveyor's reports (see Appendix A3) are produced immediately after each survey to summarise the main findings of each survey. These are used to inform the description of bird movements, and in the description and assessment of boat survey data (see 5.1).

3.1.6 Mapping of Location of Birds

The time of observation of each bird/species group seen is recorded during each survey. Use of a Differential Global Positioning System (DGPS) from the vessel ensures the vessel stays on the pre-determined transect whilst a handheld GPS device as backup provides a track of the boat's route which records its position at one minute intervals.

The time of each bird observation can subsequently be linked to the position of the vessel at that instant, and using trigonometric calculations on the perpendicular distance of the bird from the path of the boat at the time of recording, the bird's approximate position can be located. Use of ESS' in-house database facilitates this procedure, generating OSGB coordinates for all of the birds and mammals observed which are then plotted in ArcGIS 8.3 software.

It should be noted that birds are only approximately located. This is for two reasons. Firstly, the distance of the bird from the path of travel of the boat is known, as is the position of the boat, but the distance the bird is ahead of the boat remains unknown. This distance could be 1-480m, or in the case of divers, it could be even further ahead. Hence the plotted locations of birds are only indicative and are more likely to be accurate for birds seen on the water. Secondly, there may be discrepancies between the maps and the data since some ArcGIS records overlie others. Any apparently overlain mapped locations are moved slightly away from the overlying ones, generally along the path of the boat, though it is sometimes necessary to change the distance band.

On June 11th 2007 ESS was notified that there appeared to be four false records of ruff (RU) recorded on the survey conducted on 13th January 2006. The birds had been recorded using BTO code 'RU' for the wader ruff) instead of code RH (for red-throated diver). This has been corrected by removing the ruff records from Figure 106 Accumulated Duck, Wader, Goose and Scoter Distribution Map, Surveys BW - CL and the associated database and shapefiles and replacing them on Figure 105 Accumulated Diver Distribution Map, Boat Surveys BW - CL with point data for red-throated diver. However the alterations have not be included in the statistics associated with this report (as these were completed in April 2007) and have instead been deferred for inclusion in the 2008 analysis.

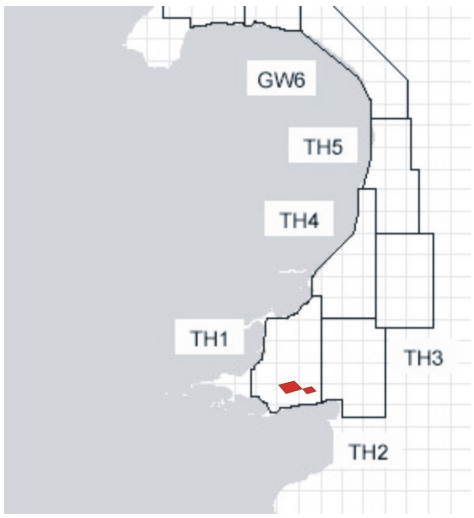
3.2 AERIAL SURVEY METHODOLOGY

The aerial surveys described here cover a wider area extending far beyond the wind farm site, and are part of the wider aerial bird survey regime that covers the Thames strategic offshore wind farm area. Only data potentially relevant to monitoring changes in bird abundance have been analysed and mapped. Thus data from more than 10km east or west of the wind farm are likely to diminish the statistical power of the analyses have not been included.

Aerial survey methods applied by the Wildfowl and Wetland Trust (WWT) have broadly remained the same as those described as in the First Monitoring Report (Gill, Sales & Pullinger 2004). However, since large scale surveys of strategic wind farm areas have been organised by WWT with the assistance of the Department of Trade and Industry (DTI), protocols have been clarified (*e.g.* WWT 2005) and are summarised below.

A programme of aerial surveys has been undertaken by the WWT's Wetlands Advisory Service (WAS) from winter 2004/05 through to February 2006 with financial contributions from offshore wind farm developers, and with financial assistance from the Department of Trade and Industry (DTI). This programme has been designed to provide large-scale survey data covering the nearshore waters in Northwest England (from Anglesey to the Solway Firth), in the Greater Wash and in the Thames (from Flamborough Head, Yorkshire, to Sandwich Bay, Kent). These data are being used to inform the environmental impact assessments of Round II offshore wind farms, fulfil some of the FEPA license monitoring requirements for Round I projects such as Kentish Flats, and to aid marine SPA identification.

Illustration 1: Thames strategic offshore wind farm survey areas in relation to Kentish Flats wind farm, and control site



Apart from survey 1 on 10th-11th January 2002, carried out by the Joint Nature Conservation Committee (JNCC), all the aerial surveys have been conducted by the WWT using north-south transects, divided into four distance bands (see Illustration 2 below). Following the WWT August 2002 survey, which used three (slightly different) distance bands, all subsequent surveys to date have used four distance bands. Because the earlier band B extended 164 to 432 metres from the plane's track, whereas the current band B extends 163-282m, and band C extends 282-426m from the track (see Illustration 2), survey 2 may have slightly higher numbers of some birds, since the current band C (and D) data has been excluded from the population analyses.

3.2.1 Study Areas and Transects

A series of north-south transects spaced 2 km apart are orientated perpendicular to the major environmental gradients in the Thames strategic area (primarily water depth), this orientation also reduces the effect of glare. Surveys are generally conducted over a four-hour period centred on midday GMT, primarily to minimise the effects of glare on counts. Surveys are undertaken in good weather conditions, generally with winds of 15 knots or less. Observations are not made during the turns between the end of one transect and the start of the next, though significant observations, *e.g.* cetaceans or large flocks of birds, are sometimes recorded on an ad hoc basis. The transects sampled by each WWT survey have remained in the same east-west (with aerial transects themselves running north-south) positions throughout the study, although some have varied in length. In some years the overall Thames region study area has varied, but the Kentish Flats study area and control site have been sampled by very similar transects since August 2002.

3.2.2 Mapping of Location of Birds

Using a combination of the time at which birds were encountered and the track flown by the plane (recorded using a GPS), the locations of observed birds can be calculated (in most cases, to within a few hundred metres). The locations of each observation are subsequently plotted digitally in ArcGIS 8.3 software. The results of surveys 9 to 14 for Thames Area TH1, conducted during Year 4 of the Kentish Flats monitoring program, are presented in Figures 57, 58, and 79-88. The dates of all of the aerial surveys conducted to date are presented in Table 2 below.

Table 2 Aerial Survey Details for Years 1 to 4

Date	Surveyed By	Survey	Survey Start Time	Survey Finish Time	First High Tide Time	Second High Tide Time	Tide Range (low to high) Herne Bay datum (m)
11/01/2002	JNCC	1	10.55	15.08	N/K	N/K	N/K
21/08/2002	WWT	2	10.10	15.09	N/K	N/K	N/K
18/01/2003	WWT	3	10.56	14.47	-	12.18	4.0
19/01/2003	WWT	3 continued	11.48	14.43	0.36	13.02	4.5
28/08/2003	WWT	4	11.05	14.20	1.24	13.37	4.7
29/08/2003	WWT	4 continued	9.49	13.46	2.05	14.18	4.9
27/11/2003	WWT	5	11.03	14.46	2.10	14.37	5.1
17/12/2003	WWT	6	10:18	14:30	05:40	18:30	4.3
15/02/2004	WWT	7 (west)	11:35	15:34	06:50	19:35	4.3
16/02/2004	WWT	7 (central)	10:55	14:59	08:12	20:56	4.2
26/02/2004	WWT	7 (east)	11:30	16:31	03:49	16:15	4.8
30/10/2004	WWT	8	11:06	15:06	02:08	14:21	5.1
05/12/2004	WWT	9	10:05	13:49	05:18	18:09	4.1
15/01/2005	WWT	10	10:27	14:14	03:36	16:11	5.0
06/03/2005	WWT	11	11:42	15:31	08:14	20:51	2.7
13/03/2005	WWT	12	10:13	14:02	02:06	14:31	5.6
31/07/2005	WWT	13	10:10	14:00	09:21	21:46	2.5
13/11/2005	WWT	14	10:23	14:12	09:48	22:27	4.3
11/12/2005	WWT	15	10:48	14:35	04:00	16:55	4.9
14/01/2006	WWT	16	10:51	14:42	-	12:09	4.9
18/02/2006	WWT	17	10:42	14:16	02:41	15:02	5.1

Note: For ease of data comparisons surveys undertaken in years 2 and 4 are shaded. N/K = not known

3.2.3 Sampling Methods

The methodology used for the Thames strategic area aerial surveys closely follows that developed by the National Environment Research Institute (NERI) in Denmark (Kahlert *et al.*2000, see also NIOZ 2004). A Partenavia PN68 aircraft is used, flying at an altitude of 250 ft and at a speed of approximately 200 kmh^{-1}. The location of the plane is recorded every five seconds using a GPS.

All waterbirds and seabirds, cetaceans and human activity are recorded. For each observation, the species, number, behaviour, distance band and the time at which it was perpendicular to the flight path of the plane are recorded using a dictaphone.

The surveys employ a distance sampling approach, whereby the distance to each bird/flock of birds is estimated using a clinometer. Birds are located in one of four distance bands covering an area from 44 m to 1000 m either the side of the plane. The survey method assumes that all birds in distance Band A are detected, and effort is concentrated on this band. Inevitably, birds further from the plane in other bands (especially C and D) may be missed owing to distance and the need for the observers to concentrate observation on the area of sea nearest the flight line.

A cautionary approach is taken with regard to species identification, such that only those individuals that are observed clearly are identified to species level; otherwise, birds are identified as being in a species group. Many divers and gulls can be identified to species from the air, but auks are very difficult to distinguish except using binoculars.

3.3 POPULATION ASSESSMENT METHODOLOGY

3.3.1 Distance Estimation

The 'caliper' method was used to estimate for each bird and marine mammal seen, the distance band parallel to the path of the survey vessel during boat surveys (Komdeur *et al* 1992, Heineman 1981) in which it was first seen. This method was used in an unconventional way during the first 41 boat surveys up to and including the 8th December 2003 survey AO. In this period surveyors were assigning records of birds on the sea to radial distance bands rather than to distance bands parallel to the path of the boat. The effect of this approach to distance estimation has been taken account of in analysing the Year 1-3 data sets from the previous surveys at Kentish Flats through a process of scaling population estimates by 2.04 (see section 3.3.3 below and in Gill *et al* 2006) to compensate for the difference in areas within which distances were estimated (see Section 3.3.3 below).

3.3.2 Distance Band Correction

During bird surveys at sea, some birds furthest from the boat or aeroplane are less visible and inevitably missed.

For boat surveys the visibility depends upon the distance of the bird from the observer, whether the birds are on the water or flying, the height of the observer, and upon the sea state. The tendency to under-record the numbers of birds in the distance bands furthest from the boat therefore means that population estimates could be under-estimated. This potential error is rectified using correction factors applicable to these furthest distance bands (C and D) (as in Table 3.5 of Stone *et al* 1995). These published correction factors continue to be used in this Monitoring Report, as they have in previous Kentish Flats reports.

Once sufficient distance band data have been collected (possibly by the sixth year of the monitoring program), dedicated correction factors may be estimated and applied to all the boat survey data collected specifically at the Kentish Flats site.

For the aerial surveys, visibility also depends upon the distance of the bird from the observer, whether the birds are on the water or flying, the altitude of the plane, and upon the sea state and as such birds seen farther from the plane may also tend to be under-recorded. However, currently, no correction factors have been produced by WWT. Therefore, to compensate for these potential under-recording effects, as in all previous reports, the population estimates for Years 4 and 5 have been presented as numbers of birds per transect rather than densities, and are based solely on data from bands A and B. This is justified since data collected within bands C and D reveals significant under-recording.

3.3.3 Distance Band Compensation

The first 41 Kentish Flats boat surveys (up to and including survey AO on 8th December 2003) used an unconventional method of distance estimation, based upon surveyors assigning birds to radial distance bands extending from the survey vessel. As described in the previous Third Monitoring Report (Gill, Sales & Beasley 2006), the results of surveys A to AO have been scaled by 2.04 to permit comparison (with the assumption that a single compensation factor is appropriate).

All surveys since then have used the conventional approach (Komdeur *et al* 1992, Heineman 1981) to distance estimation, assigning all birds seen on the water into distance bands running parallel to the path of the boat.

3.4 BIRD ABUNDANCE ESTIMATES

As in the previous Kentish Flats monitoring reports, the scan and snapshot boat survey data have been analysed to produce bird species and group abundances. The other birds recorded out of transect have not been used in the extrapolated bird population estimates, but have been used in the description and visual analyses of the diver, seaduck, other wildfowl, wader, tern and other bird data (see section 5.1).

The boat survey analyses used published distance band correction factors. Published correction factors (Stone *et al* 1995) have been used to allow for the reduced visibility of birds on the water at distances of more than 100m as described previously under Section 3.3.2. For the boat survey data, the total numbers of birds seen within the 300m wide transects were scaled according to the proportion of the overall areas surveyed to produce population estimates as the appropriate measure of bird abundance. Standard errors were based on a regression model relating the variance to the mean.

The analysis of aerial data did not use band correction factors. They are not necessary for monitoring changes over time provided data are collected and analysed consistently between years. They are only needed for an unbiased estimate of numbers present. This is desirable for an initial assessment of what is present within planned wind farm sites for EIA purposes, but there is never enough data within such small areas to estimate correction factors. Thus the total numbers of birds seen in aerial survey transect distance bands A and B, extending 44-163m and 163-282m from the plane have been consistently analysed for transects traversing the wind farm and buffer to give indices of bird abundance relative to the reference transects to the east and west of the wind farm and buffer. It is important to appreciate however, that these relative abundance indices include birds seen outside the wind farm buffer, both to the north and south of the boat survey area.

3.4.1 Bird Population Estimates from the Boat Data

Each survey visit records birds on eight transects at the wind farm and buffer and an additional four transects when the control site is surveyed. For each species, the count for a single transect is taken as the sampling unit. Sample means and standard deviations of these were calculated. These are related to each other: higher sample means are associated with higher standard deviations. There is now sufficient data to build reasonable models for the relationship between the mean and the standard deviation for the frequently observed species. These species are red-throated diver, cormorant,

common tern, guillemot and four gull species (great black backed, lesser black backed, herring and common). This modelling is necessary to obtain realistic standard errors for the population estimates.

The population estimates for all 90 surveys conducted to date at the Kentish Flats site (up to survey CL) are presented. Estimates of population size and standard errors are included for all species that were recorded on more than 25% of surveys. Population estimates have been used for consistency with previous monitoring reports. To produce population densities, both the estimated totals and their standard errors should be scaled by dividing by the area of the wind farm and buffer (43.91 km^2) or of the control site (10.43 km^2).

These population estimates differ from those presented in the Potential Ornithological Impact Technical Addendum Report (Gill, Sales, Pullinger & Durwood, 2002) and the First, Second and Third Monitoring Reports (Gill, Sales & Pullinger 2004 and Gill, Sales & Beasley 2005 & 2006). This is both because of compensation for the distance estimation differences (see Section 3.3.3), and because the standard errors are derived from the variance model which now includes all five years of data.

Means of the data collected are also presented in Tables 13 to 20 as monthly means for all species that were recorded during at least a quarter of the boat surveys. These are presented in a similar way to those used in the Second and Third Monitoring Reports (Gill, Sales & Beasley 2005 & 2006). These monthly estimates are not ideal as they ignore inter-annual variation, which appears to be important for some species (including divers).

A total of ten surveys have been completed in the months of December and January over the five year monitoring period, the peak period for divers. In addition a further fourteen surveys have been completed during the months of February and March. The highest population estimate has been 918 (± 299.5) red-throated divers made on 7th February 2005. This differs from the population estimate presented in previous reports because the standard errors are derived from the variance model which now includes all four years of data. The surveys in Year 5 produced much lower population estimates (see Table 5).

In spite of restricted access to the site during winter months when wave activity or visibility can limit the safety and effectiveness of boat surveys, a total of 35 surveys have now been completed that cover the broad period of diver presence from November to March over Years 1 to 5 of the Kentish Flats monitoring period.

3.4.2 Abundance Estimates from the Aerial Data

Aerial data from Thames strategic offshore wind farm area TH1 were compared statistically as described below. It would be possible to obtain population estimates for the wind farm site and buffer zone, and control site areas from the information available, but without standard errors. The numbers would be very low, and without standard errors no comment on their accuracy could be made.

The survey data from Thames strategic offshore wind farm area TH1 covering the Kentish Flats site, used in the Third Monitoring Report (Gill *et al* 2006) has been analysed. All the aerial surveys since 30th October 2004 for Thames survey area TH1 have covered the same 16 transects.

For the purposes of the current analyses, the TH1 survey area has been subdivided into three sections (see Figures 110 to 116):

1. wind farm and buffer area
2. a reference area to the west of the wind farm
3. a reference area to the east of the wind farm (which includes the control site surveyed by the boat surveys)

The subdivision of the aerial data sets into these three comparative areas means that, over time, any changes in bird populations within the wind farm site can be reasonably assessed following the standard Before-After-Control-Impact (BACI) approach, as further data become available during the operational phase.

Four of the TH1 transects are west of the wind farm site, seven include sections over the wind farm site/buffer zone and five are to the east over the boat control site (see Figures 110 to 116). The westerly transects are rather shorter than the others and all of the transects cover a significant area outside of the wind farm (both to the south and more extensively to the north). This means that birds many kilometres to the north, unaffected by the wind farm, have been included in the relative abundance indices.

The analyses have used transects as sampling units and produced means and standard errors for the number of birds seen in bands A and B per transect within the three areas described above. The results from earlier years have been reanalysed to ensure that consistent groupings of transects are used.

The means and standard errors have been calculated for each species group with summary results presented for divers, cormorant, seaduck, waders, other wildfowl, gulls, terns and auks. These are based on numbers in bands A (all of which are assumed in distance sampling to have been detected) and B (some birds will have been missed), with no corrections applied for band B birds. B and C and D records were omitted from the calculations to reduce the effect of missing birds at greater distances. The omission of these records together with the lack of correction factors for distance band B (163-282 metres from the flight line) may result in an under-estimate of numbers of diver and scoter (which flush readily in front of the plane). However for monitoring purposes this underestimation is unimportant, as long as the Bands A and B are consistently sampled.

3.4.3 Methodology used to analyse differences between development phases

Any evidence of changes in numbers/densities between the different phases of the development was examined using two different analyses for the boat surveys, and one of these analyses was also used for the aerial surveys.

The first boat method looked at the estimates of densities for all 90 visits for which data was available. The data for each month (treating 1st December 2006 as November) was analysed separately. Means and standard errors were calculated for each of the three phases of the development: pre-construction, construction and operation. For each species, tests were carried out comparing the construction phase with the pre-construction phase and the operational phase with the pre-construction.

The second more satisfactory analysis was carried out by comparing the wind farm site with the control area. This should eliminate most of the variation in numbers between different years. There is less information available for this analysis because the control site was visited on only 31 of the 90 site surveys. The control site is also smaller, so estimates for it are less precise.

The analysis used only those visits on which a species was recorded at both wind farm/buffer zone and control site. These ratios were then logarithmically converted (a standard way to deal with ratios). The logarithm of the ratio of the estimated densities was analysed using analysis of variance (ANOVA). The number of visits available are given in Table 3 below; no other species had more than two visits on which they were recorded at both sites.

Table 3 Number of available visits for analysis

	Pre-construction	Construction	Operation
Red-throated Diver	5	2	1
Lesser Black-backed Gull	7	1	3
Herring Gull	10	4	4
Common Gull	3	3	2

For all four species, F tests were used to compare the three phases of the development.

As in the previous report the aerial transects were divided into three groups: those that included part of the wind farm or passed near to it; transects to the west and transects to the east. Table 4 below gives the number of flights on which the six species groups were recorded in both the first group of transects and in transects away from the wind farm site.

Table 4 No. of flights recorded in both first group of transects and transects away from site

	Pre-construction	Construction	Operation
Auk	3	3	1
Cormorant	5	4	3
Diver	4	5	4
Gull	6	6	4
Seaduck	3	3	0
Wader	2	3	2
All Birds	7	5	4

The estimated densities for the first group were compared with those from the other two groups. The logarithm of the ratio was analysed using the analysis of variance (ANOVA), as was done for the second boat analyses of wind farm/buffer and control site data.

Maps showing bird locations were also visually analysed by comparisons between years to assess whether there were any coarse changes in relation to the FEPA licence monitoring requirements 1 and 3 (see Section 2). These comparisons were intended to determine whether there has been any change in the use or passage of diver, seaduck, wildfowl, wader or tern through the wind farm site (see Figures 25-31, 51-58, 79-88 and 110-116).

Visual analyses of the boat data have included an assessment of the movements of wildfowl, potentially to and from the coastal SPA sites surrounding the Thames Estuary. However, it is not possible to determine SPA bird movements from the aerial data, since flight direction is invariably not recorded during the aerial surveys.

No aerial surveys were conducted within TH1 during July or August 2006.

4 RESULTS OF SURVEYS

As in previous monitoring reports, the bird species recorded may be divided into those species qualifying the four North Kent Special Protection Areas (SPAs) which have been termed Kent SPA species, and those not qualifying these sites as SPAs (Non Kent SPA species). Generally, this means that SPA species occur within the four nearest North Kent SPAs in nationally important numbers (greater than 1% of the British population), but also include species included within an assemblage of species whose total numbers within a wintering SPA exceed 20,000. Red-throated divers will qualify the planned Thames SPA. These SPA species have formed the focus of this and previous monitoring reports.

The main non-statistical results of the surveys are the locations of all birds seen, which have been plotted on the visit maps. In addition, records of the most important SPA species seen during boat surveys in each reporting period have been accumulated into species maps (Figures 22-24, 48-50, 76-78, and 105-107).

The results of the statistical analyses are presented and discussed below. The boat survey maps and observations are discussed in Chapter 5 for the main SPA species, and the aerial maps and data discussed in Chapter 6. Conclusions are made in Chapter 7, including a discussion of the FEPA monitoring objectives.

4.1 ESTIMATED NUMBERS OF BIRDS FROM BOAT SURVEYS, 2001-2006

Estimates of bird abundance are presented for the wind farm site and buffer zone (in Section 4.1.1) and the control site (in Section 4.1.2). These population estimates are based only on the number of birds seen within transect or during the "snapshots", and are extrapolated to the whole study area with corrections for birds missed with increasing distance from the boat.

The total number of birds and marine mammals recorded during the Year 5 surveys, by species, are presented in Appendix A1. The totals seen in transect (*i.e.* those seen within 300m from the boat path) or during snapshots are presented alongside these figures. The total number of birds and marine mammals recorded during each survey are also summarised in Appendix A1.

To comment upon the accuracy of measures of abundance it is essential that standard errors are also estimated. The standard errors presented in the sections below are statistical limits within which 95% of records would be expected to fall. For example, for the highest estimate of the numbers of red-throated divers in Year 5, on 13 January 2006 (see Table 5 below); the range within which 95% of estimates would be expected to lie is 99 ± 43.4 (*i.e.* between 56-142). These estimates are based on the number of birds seen within transect, corrected using the correction factors.

4.1.1 Wind Farm Site and Buffer Zone

Year 5 data are presented in such a way as to reveal any change in bird populations through the pre-construction, construction and operational periods. The tables below Tables 5 to 8) present the estimated number of each species in the study area (including both wind farm site and buffer zone) for all ninety boat visits, A to CL, up to and including the 1st December 2006, which was survey 90.

Standard errors have been revised and updated to include all of the boat survey data collected to date at the Kentish Flats site. These have changed because the variance-mean relationships have been recalculated because more data is available now. This particularly affects species that are observed less often. In Year 5 it has been possible to add gannet to the statistical analyses because more have been seen.

4.1.1.1 Divers and Cormorants

Population estimates and standard errors for red-throated divers, gannets and great cormorants are shown below.

Table 5 Population Estimates for Divers and Cormorants

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
January	2003	Pre-Constr.	W	22/01/03	841	343.4	0	0.7	0	0.7
	2004	Pre-Constr.	AQ	03/01/04	425	153.4	0	0.3	38	22.7
	2005	Construction	BG	19/01/05	189	76.0	0	0.3	18	11.6
	2006	Operation	BX	13/01/06	99	43.4	0	0.3	0	0.3
February	2002	Pre-Constr.	F	17/02/02	0	1.0	0	1.1	0	1.2
	2003	Pre-Constr.	X	10/02/03	118	62.3	0	0.7	6	5.5
	2003	Pre-Constr.	Y	21/02/03	213	104.2	0	0.7	0	0.7
	2004	Pre-Constr.	AR	06/02/04	79	35.5	0	0.3	9	6.6
	2005	Construction	BH	07/02/05	918	299.5	0	0.3	6	4.7
	2006	Operation	BY	17/02/06	17	9.4	0	0.3	0	0.3
March	2002	Pre-Constr.	G	19/03/02	12	8.5	0	0.7	24	18.4
	2003	Pre-Constr.	Z	06/03/03	27	17.5	0	0.7	6	5.5
	2003	Pre-Constr.	AA	23/03/03	77	43.0	0	0.7	0	0.7
	2004	Pre-Constr.	AS	05/03/04	16	8.7	0	0.3	0	0.3
	2005	Construction	BI	08/03/05	3	2.0	0	0.3	0	0.3
	2006	Operation	BZ	02/03/06	0	0.3	0	0.3	0	0.3
April	2002	Pre-Constr.	H	05/04/02	0	0.6	0	0.7	0	0.7
	2002	Pre-Constr.	I	18/04/02	0	0.6	0	0.7	13	10.9
	2003	Pre-Constr.	AB	07/04/03	18	12.0	0	0.7	6	5.5
	2003	Pre-Constr.	AC	15/04/03	0	0.6	0	0.7	0	0.7
	2004	Pre-Constr.	AT	07/04/04	9	5.5	0	0.3	0	0.3
	2005	Construction	BJ	03/04/05	35	17.6	0	0.3	12	8.0
	2005	Construction	BK	22/04/05	0	0.3	0	0.3	6	4.5
	2006	Operation	CA	13/04/06	0	0.3	0	0.3	0	0.3

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2006	Operation	CB	19/04/06	0	0.3	0	0.3	0	0.3
May	2002	Pre-Constr.	J	01/05/02	0	0.6	0	0.7	13	10.9
	2002	Pre-Constr.	K	30/05/02	0	0.6	0	0.7	0	0.7
	2003	Pre-Constr.	AD	06/05/03	0	0.6	47	40.7	6	5.5
	2003	Pre-Constr.	AE	19/05/03	0	0.6	12	11.1	18	14.3
	2004	Pre-Constr.	AU	12/05/04	0	0.3	17	13.5	3	2.6
	2004	Pre-Constr.	AV	28/05/04	0	0.3	0	0.3	16	10.4
	2005	Construction	BL	10/05/05	0	0.3	0	0.3	0	0.3
	2005	Construction	BM	29/05/05	0	0.3	0	0.3	6	4.5
	2006	Operation	CC	02/05/06	0	0.3	0	0.3	0	0.3
	2006	Operation	CD	23/05/06	0	0.3	0	0.3	6	4.6
June	2002	Pre-Constr.	L	19/06/02	0	0.6	0	0.7	18	14.7
	2003	Pre-Constr.	AF	04/06/03	0	0.6	6	5.8	6	5.5
	2004	Pre-Constr.	AW	08/06/04	0	0.3	0	0.3	15	10.2
	2005	Construction	BN	15/06/05	0	0.3	3	2.5	44	25.7
	2006	Operation	CE	02/06/06	0	0.3	0	0.3	15	10.0
July	2002	Pre-Constr.	M	22/07/02	0	0.6	0	0.7	44	31.9
	2003	Pre-Constr.	AG	22/07/03	0	0.6	0	0.7	53	37.4
	2004	Pre-Constr.	AX	29/07/04	0	0.3	3	2.5	42	24.7
	2005	Construction	BO	08/07/05	0	0.3	0	0.3	0	0.3
	2006	Operation	CF	21/07/06	0	0.3	0	0.3	62	34.6
August	2002	Pre-Constr.	N	12/08/02	0	0.6	0	0.7	41	30.0
	2002	Pre-Constr.	O	22/08/02	0	0.6	0	0.7	77	51.6
	2003	Pre-Constr.	AH	22/08/03	0	0.6	0	0.7	0	0.7
	2004	Construction	AY	26/08/04	0	0.3	0	0.3	21	13.5
	2005	Construction	BP	01/08/05	0	0.3	12	9.2	25	15.6
	2006	Operation	CG	07/08/06	0	0.3	9	7.0	25	15.5

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
September	2002	Pre-Constr.	P	11/09/02	0	0.6	12	11.1	50	35.2
	2002	Pre-Constr.	Q	24/09/02	8	5.8	0	0.7	30	22.3
	2003	Pre-Constr.	AI	09/09/03	0	0.6	0	0.7	77	51.6
	2003	Pre-Constr.	AJ	22/09/03	0	0.6	0	0.7	59	41.0
	2004	Construction	AZ	03/09/04	0	0.3	0	0.3	9	6.4
	2004	Construction	BA	29/09/04	0	0.3	9	7.0	6	4.5
	2005	Operation	BQ	06/09/05	0	0.3	0	0.3	41	24.4
	2005	Operation	BR	27/09/05	0	0.3	3	2.5	0	0.3
	2006	Operation	CH	18/09/06	0	0.3	0	0.3	46	26.8
	2006	Operation	CI	29/09/06	0	0.3	3	2.5	25	15.5
October	2001	Pre-Constr.	A	13/10/01	0	1.1	0	1.2	10	10.4
	2001	Pre-Constr.	B	25/10/01	0	2.0	0	2.2	15	18.8
	2002	Pre-Constr.	R	15/10/02	0	0.6	18	16.2	19	15.1
	2002	Pre-Constr.	S	24/10/02	45	27.0	0	0.7	13	10.9
	2003	Pre-Constr.	AK	12/10/03	0	0.6	0	0.7	20	15.5
	2003	Pre-Constr.	AL	26/10/03	6	4.6	0	0.7	0	0.7
	2004	Construction	BB	15/10/04	0	0.3	0	0.3	9	6.2
	2004	Construction	BC	27/10/04	0	0.4	19	18.3	8	6.9
	2005	Operation	BS	03/10/05	0	0.3	0	0.3	3	2.6
	2005	Operation	BT	14/10/05	0	0.3	0	0.3	0	0.3
	2006	Operation	CJ	09/10/06	0	0.3	3	2.5	34	20.5
November	2001	Pre-Constr.	C	18/11/01	0	0.8	0	0.8	0	0.9
	2001	Pre-Constr.	D	30/11/01	0	1.9	0	2.0	0	2.2
	2002	Pre-Constr.	T	04/11/02	0	0.6	0	0.7	30	22.7
	2002	Pre-Constr.	U	15/11/02	14	9.9	0	0.7	0	0.7
	2003	Pre-Constr.	AM	06/11/03	66	37.8	0	0.7	18	14.7
	2003	Pre-Constr.	AN	27/11/03	196	96.9	0	0.7	30	22.3

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2004	Construction	BD	14/11/04	15	8.2	0	0.3	29	17.8
	2004	Construction	BE	26/11/04	0	0.3	0	0.3	29	17.8
	2005	Operation	BU	12/11/05	0	0.3	0	0.3	0	0.3
	2005	Operation	BV	17/11/05	0	0.3	0	0.3	6	4.4
	2006	Operation	CK	04/11/06	0	0.3	0	0.3	49	28.3
	2006	Operation	CL	01/12/06	3	2.3	0	0.3	68	37.4
December	2001	Pre-Constr.	E	19/12/01	0	3.3	0	3.7	0	3.8
	2002	Pre-Constr.	V	14/12/02	574	246.3	0	0.7	26	20.0
	2003	Pre-Constr.	AO	08/12/03	368	167.3	0	0.7	0	0.7
	2003	Pre-Constr.	AP	18/12/03	812	332.9	0	0.7	18	14.3
	2004	Construction	BF	11/12/04	1185	373.7	0	0.3	43	25.3
	2005	Operation	BW	07/12/05	3	2.3	0	0.3	3	2.5

4.1.1.2 Gulls

Population estimates and standard errors for larger gulls by species are shown in Table 6 below:

Table 6 Population Estimates for larger Gulls

					Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
January	2003	Pre-Constr.	W	22/01/03	8	7.4	66	33.2	59	35.3
	2004	Pre-Constr.	AQ	03/01/04	0	0.5	27	12.6	9	5.8
	2005	Construction	BG	19/01/05	0	0.5	10	6.1	13	7.6
	2006	Operation	BX	13/01/06	3	2.8	3	2.6	6	4.2
February	2002	Pre-Constr.	F	17/02/02	0	1.7	8	8.1	20	16.5
	2003	Pre-Constr.	X	10/02/03	0	1.1	0	0.9	12	8.9
	2003	Pre-Constr.	Y	21/02/03	0	1.1	14	10.3	27	18.1
	2004	Pre-Constr.	AR	06/02/04	0	0.5	37	15.8	9	5.5
	2005	Construction	BH	07/02/05	4	3.2	0	0.4	17	9.9
	2006	Operation	BY	17/02/06	0	0.5	3	2.6	25	13.6
March	2002	Pre-Constr.	G	19/03/02	69	34.4	6	5.3	65	38.4
	2003	Pre-Constr.	Z	06/03/03	8	7.4	6	5.3	39	24.7
	2003	Pre-Constr.	AA	23/03/03	0	1.1	14	10.3	46	28.5
	2004	Pre-Constr.	AS	05/03/04	0	0.5	6	3.9	3	2.5
	2005	Construction	BI	08/03/05	0	0.5	4	3.0	101	44.6
	2006	Operation	BZ	02/03/06	0	0.5	0	0.4	23	12.7
April	2002	Pre-Constr.	H	05/04/02	0	1.1	18	12.4	6	5.0
	2002	Pre-Constr.	I	18/04/02	6	5.8	28	17.4	30	19.5
	2003	Pre-Constr.	AB	07/04/03	0	1.1	7	6.1	24	16.1
	2003	Pre-Constr.	AC	15/04/03	0	1.1	6	5.3	130	69.2
	2004	Pre-Constr.	AT	07/04/04	6	4.2	3	2.6	37	18.7
	2005	Construction	BJ	03/04/05	0	0.5	8	5.0	9	5.5
	2005	Construction	BK	22/04/05	0	0.5	0	0.4	3	2.1
	2006	Operation	CA	13/04/06	3	2.8	3	2.3	3	2.1
	2006	Operation	CB	19/04/06	0	0.5	27	12.6	28	15.0
May	2002	Pre-Constr.	J	01/05/02	0	1.1	12	8.9	69	40.0
	2002	Pre-Constr.	K	30/05/02	0	1.1	0	0.9	50	30.4
	2003	Pre-Constr.	AD	06/05/03	6	5.8	0	0.9	22	15.4
	2003	Pre-Constr.	AE	19/05/03	0	1.1	6	5.3	19	13.3
	2004	Pre-Constr.	AU	12/05/04	0	0.5	9	5.3	6	3.9
	2004	Pre-Constr.	AV	28/05/04	0	0.5	10	6.1	79	36.3
	2005	Construction	BL	10/05/05	0	0.5	3	2.3	3	2.1
	2005	Construction	BM	29/05/05	0	0.5	0	0.4	10	6.1
	2006	Operation	CC	02/05/06	0	0.5	3	2.3	20	11.3
	2006	Operation	CD	23/05/06	0	0.5	0	0.4	25	13.4
June	2002	Pre-Constr.	L	19/06/02	0	1.1	0	0.9	30	19.5
	2003	Pre-Constr.	AF	04/06/03	0	1.1	6	5.3	7	5.7
	2004	Pre-Constr.	AW	08/06/04	0	0.5	0	0.4	27	14.6
	2005	Construction	BN	15/06/05	3	2.5	12	6.6	137	57.9

					Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2006	Operation	CE	02/06/06	7	4.7	0	0.4	88	39.7
July	2002	Pre-Constr.	M	22/07/02	0	1.1	0	0.9	12	8.9
	2003	Pre-Constr.	AG	22/07/03	18	12.8	50	26.7	69	40.0
	2004	Pre-Constr.	AX	29/07/04	0	0.5	0	0.4	8	5.2
	2005	Construction	BO	08/07/05	3	2.5	9	5.3	145	60.8
	2006	Operation	CF	21/07/06	10	6.3	22	10.9	74	34.0
August	2002	Pre-Constr.	N	12/08/02	6	5.8	0	0.9	36	22.8
	2002	Pre-Constr.	O	22/08/02	0	1.1	14	10.3	0	0.7
	2003	Pre-Constr.	AH	22/08/03	0	1.1	13	9.6	0	0.7
	2004	Construction	AY	26/08/04	6	4.2	4	3.0	0	0.3
	2005	Construction	BP	01/08/05	3	2.9	12	6.6	4	2.9
	2006	Operation	CG	07/08/06	0	0.5	3	2.3	0	0.3
September	2002	Pre-Constr.	P	11/09/02	0	1.1	12	8.9	0	0.7
	2002	Pre-Constr.	Q	24/09/02	0	1.1	27	16.9	6	4.9
	2003	Pre-Constr.	AI	09/09/03	0	1.1	8	6.8	0	0.7
	2003	Pre-Constr.	AJ	22/09/03	0	1.1	81	38.5	18	12.6
	2004	Construction	AZ	03/09/04	0	0.5	76	27.6	12	7.3
	2004	Construction	BA	29/09/04	16	8.8	149	45.9	22	12.1
	2005	Operation	BQ	06/09/05	0	0.5	3	2.3	4	2.9
	2005	Operation	BR	27/09/05	0	0.5	34	15.0	12	7.0
	2006	Operation	CH	18/09/06	0	0.5	12	6.8	16	9.0
	2006	Operation	CI	29/09/06	10	6.3	12	6.8	29	15.3
October	2001	Pre-Constr.	A	13/10/01	38	27.5	0	1.6	0	1.2
	2001	Pre-Constr.	B	25/10/01	0	3.1	0	2.7	0	2.1
	2002	Pre-Constr.	R	15/10/02	0	1.1	46	25.2	0	0.7
	2002	Pre-Constr.	S	24/10/02	14	10.9	53	28.1	15	11.1
	2003	Pre-Constr.	AK	12/10/03	67	33.8	66	33.2	14	10.4
	2003	Pre-Constr.	AL	26/10/03	6	5.8	371	122.8	18	12.6
	2004	Construction	BB	15/10/04	0	0.5	63	24.0	6	3.9
	2004	Construction	BC	27/10/04	5	4.3	13	8.9	0	0.5
	2005	Operation	BS	03/10/05	0	0.5	13	7.1	3	2.1
	2005	Operation	BT	14/10/05	3	2.5	18	9.2	20	11.3
	2006	Operation	CJ	09/10/06	0	0.5	38	16.4	0	0.3
November	2001	Pre-Constr.	C	18/11/01	14	11.5	42	24.8	21	15.2
	2001	Pre-Constr.	D	30/11/01	0	3.0	14	14.9	0	2.0
	2002	Pre-Constr.	T	04/11/02	8	7.4	108	48.0	44	27.3
	2002	Pre-Constr.	U	15/11/02	111	48.6	71	35.0	12	8.9
	2003	Pre-Constr.	AM	06/11/03	0	1.1	117	51.2	118	63.8
	2003	Pre-Constr.	AN	27/11/03	6	5.8	33	19.6	14	10.4
	2004	Construction	BD	14/11/04	0	0.5	21	10.3	9	5.8
	2004	Construction	BE	26/11/04	0	0.5	7	4.5	24	12.9
	2005	Operation	BU	12/11/05	0	0.5	40	16.9	15	8.5
	2005	Operation	BV	17/11/05	3	2.5	32	14.4	9	5.5
	2006	Operation	CK	04/11/06	30	13.8	203	58.1	21	11.6
	2006	Operation	CL	01/12/06	0	0.5	3	2.3	12	7.0
December	2001	Pre-Constr.	E	19/12/01	0	4.9	20	24.8	0	3.5

Month	Year	Timing	Visit	Date	Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
					Population estimate	Standard Error	Population estimate	Standard Error	Population estimate	Standard Error
	2002	Pre-Constr.	V	14/12/02	0	1.1	31	18.5	53	32.2
	2003	Pre-Constr.	AO	08/12/03	0	1.1	78	37.6	18	12.6
	2003	Pre-Constr.	AP	18/12/03	0	1.1	40	22.7	31	20.2
	2004	Construction	BF	11/12/04	0	0.5	13	7.1	0	0.3
	2005	Operation	BW	07/12/05	6	4.4	3	2.3	22	12.0

Population estimates and standard errors for smaller gulls by species are shown in Table 7 below:

Table 7 Population Estimates for smaller Gulls

Month	Year	Timing	Visit	Date	Common Gull		Kittiwake	
					Population estimate	Standard Error	Population estimate	Standard Error
January	2003	Pre-Constr.	W	22/01/03	18	11.9	41	29.7
	2004	Pre-Constr.	AQ	03/01/04	0	0.3	3	2.1
	2005	Construction	BG	19/01/05	15	7.9	9	5.9
	2006	Operation	BX	13/01/06	18	9.3	6	4.3
February	2002	Pre-Constr.	F	17/02/02	0	1.2	0	0.9
	2003	Pre-Constr.	X	10/02/03	0	0.7	12	9.2
	2003	Pre-Constr.	Y	21/02/03	36	20.9	0	0.6
	2004	Pre-Constr.	AR	06/02/04	0	0.3	0	0.2
	2005	Construction	BH	07/02/05	46	20.2	580	294.7
	2006	Operation	BY	17/02/06	21	10.5	0	0.2
March	2002	Pre-Constr.	G	19/03/02	0	0.8	0	0.6
	2003	Pre-Constr.	Z	06/03/03	62	32.7	0	0.6
	2003	Pre-Constr.	AA	23/03/03	0	0.7	0	0.6
	2004	Pre-Constr.	AS	05/03/04	3	2.5	0	0.2
	2005	Construction	BI	08/03/05	34	15.6	0	0.2
	2006	Operation	BZ	02/03/06	60	24.8	0	0.2
April	2002	Pre-Constr.	H	05/04/02	0	0.8	0	0.6
	2002	Pre-Constr.	I	18/04/02	0	0.7	0	0.6
	2003	Pre-Constr.	AB	07/04/03	0	0.7	0	0.6
	2003	Pre-Constr.	AC	15/04/03	0	0.7	0	0.6
	2004	Pre-Constr.	AT	07/04/04	15	7.9	0	0.2
	2005	Construction	BJ	03/04/05	18	9.4	0	0.2
	2005	Construction	BK	22/04/05	3	2.1	0	0.2
	2006	Operation	CA	13/04/06	0	0.3	0	0.2
	2006	Operation	CB	19/04/06	0	0.3	0	0.2
May	2002	Pre-Constr.	J	01/05/02	0	0.7	0	0.6
	2002	Pre-Constr.	K	30/05/02	0	0.7	0	0.6
	2003	Pre-Constr.	AD	06/05/03	0	0.7	0	0.6
	2003	Pre-Constr.	AE	19/05/03	0	0.7	0	0.6
	2004	Pre-Constr.	AU	12/05/04	0	0.3	0	0.2
	2004	Pre-Constr.	AV	28/05/04	0	0.3	0	0.2

					Common Gull		Kittiwake	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2005	Construction	BL	10/05/05	0	0.3	0	0.2
	2005	Construction	BM	29/05/05	0	0.3	0	0.2
	2006	Operation	CC	02/05/06	0	0.3	0	0.2
	2006	Operation	CD	23/05/06	0	0.3	0	0.2
June	2002	Pre-Constr.	L	19/06/02	0	0.7	0	0.6
	2003	Pre-Constr.	AF	04/06/03	0	0.7	0	0.6
	2004	Pre-Constr.	AW	08/06/04	0	0.3	0	0.2
	2005	Construction	BN	15/06/05	0	0.3	0	0.2
	2006	Operation	CE	02/06/06	0	0.3	0	0.2
July	2002	Pre-Constr.	M	22/07/02	0	0.7	0	0.6
	2003	Pre-Constr.	AG	22/07/03	0	0.7	0	0.6
	2004	Pre-Constr.	AX	29/07/04	0	0.3	0	0.2
	2005	Construction	BO	08/07/05	0	0.3	0	0.2
	2006	Operation	CF	21/07/06	43	19.0	0	0.2
August	2002	Pre-Constr.	N	12/08/02	0	0.7	0	0.6
	2002	Pre-Constr.	O	22/08/02	0	0.7	0	0.6
	2003	Pre-Constr.	AH	22/08/03	0	0.7	0	0.6
	2004	Construction	AY	26/08/04	0	0.3	0	0.2
	2005	Construction	BP	01/08/05	0	0.3	0	0.2
	2006	Operation	CG	07/08/06	0	0.3	0	0.2
September	2002	Pre-Constr.	P	11/09/02	0	0.7	0	0.6
	2002	Pre-Constr.	Q	24/09/02	0	0.7	0	0.6
	2003	Pre-Constr.	AI	09/09/03	0	0.7	0	0.6
	2003	Pre-Constr.	AJ	22/09/03	0	0.7	0	0.6
	2004	Construction	AZ	03/09/04	0	0.3	0	0.2
	2004	Construction	BA	29/09/04	0	0.3	0	0.2
	2005	Operation	BQ	06/09/05	0	0.3	0	0.2
	2005	Operation	BR	27/09/05	0	0.3	0	0.2
	2006	Operation	CH	18/09/06	0	0.3	0	0.2
	2006	Operation	CI	29/09/06	0	0.3	0	0.2
October	2001	Pre-Constr.	A	13/10/01	0	1.3	0	1.0
	2001	Pre-Constr.	B	25/10/01	0	2.3	0	1.9
	2002	Pre-Constr.	R	15/10/02	0	0.7	6	4.8
	2002	Pre-Constr.	S	24/10/02	14	9.9	0	0.6
	2003	Pre-Constr.	AK	12/10/03	0	0.7	6	4.8
	2003	Pre-Constr.	AL	26/10/03	0	0.7	0	0.6
	2004	Construction	BB	15/10/04	0	0.3	0	0.2
	2004	Construction	BC	27/10/04	0	0.5	15	12.3
	2005	Operation	BS	03/10/05	0	0.3	0	0.2
	2005	Operation	BT	14/10/05	3	2.1	0	0.2
	2006	Operation	CJ	09/10/06	0	0.3	0	0.2
November	2001	Pre-Constr.	C	18/11/01	7	5.9	0	0.7
	2001	Pre-Constr.	D	30/11/01	0	2.2	0	1.7
	2002	Pre-Constr.	T	04/11/02	19	12.6	25	18.4
	2002	Pre-Constr.	U	15/11/02	34	20.4	6	4.8
	2003	Pre-Constr.	AM	06/11/03	67	35.3	0	0.6
	2003	Pre-Constr.	AN	27/11/03	0	0.7	7	5.7
	2004	Construction	BD	14/11/04	0	0.3	0	0.2
	2004	Construction	BE	26/11/04	20	10.3	7	4.8

					Common Gull		Kittiwake	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2005	Operation	BU	12/11/05	0	0.3	0	0.2
	2005	Operation	BV	17/11/05	16	8.4	3	2.1
	2006	Operation	CK	04/11/06	6	3.7	3	2.1
	2006	Operation	CL	01/12/06	0	0.3	15	9.4
December	2001	Pre-Constr.	E	19/12/01	0	3.7	0	3.1
	2002	Pre-Constr.	V	14/12/02	24	15.0	0	0.6
	2003	Pre-Constr.	AO	08/12/03	0	0.7	6	4.8
	2003	Pre-Constr.	AP	18/12/03	0	0.7	0	0.6
	2004	Construction	BF	11/12/04	15	7.9	7	4.8
	2005	Operation	BW	07/12/05	6	3.7	6	4.0

4.1.1.3 Terns and Guillemot

Population estimates and standard errors for common tern and guillemot are shown in Table 8 below:

Table 8 Population Estimates for Common Tern and Guillemot

					Common Tern		Guillemot	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
January	2003	Pre-Constr.	W	22/01/03	0	0.5	30	14.8
	2004	Pre-Constr.	AQ	03/01/04	0	0.2	0	0.6
	2005	Construction	BG	19/01/05	0	0.2	19	7.4
	2006	Operation	BX	13/01/06	0	0.2	3	2.7
February	2002	Pre-Constr.	F	17/02/02	0	0.8	0	2.2
	2003	Pre-Constr.	X	10/02/03	0	0.5	0	1.5
	2003	Pre-Constr.	Y	21/02/03	0	0.5	0	1.5
	2004	Pre-Constr.	AR	06/02/04	0	0.2	6	4.0
	2005	Construction	BH	07/02/05	0	0.2	0	0.6
	2006	Operation	BY	17/02/06	0	0.2	0	0.6
March	2002	Pre-Constr.	G	19/03/02	0	0.5	0	1.5
	2003	Pre-Constr.	Z	06/03/03	0	0.5	6	5.7
	2003	Pre-Constr.	AA	23/03/03	0	0.5	0	1.5
	2004	Pre-Constr.	AS	05/03/04	0	0.2	7	4.2
	2005	Construction	BI	08/03/05	0	0.2	0	0.6
	2006	Operation	BZ	02/03/06	0	0.2	0	0.6
April	2002	Pre-Constr.	H	05/04/02	0	0.5	0	1.5
	2002	Pre-Constr.	I	18/04/02	0	0.5	0	1.5
	2003	Pre-Constr.	AB	07/04/03	12	10.2	0	1.5
	2003	Pre-Constr.	AC	15/04/03	0	0.5	0	1.5
	2004	Pre-Constr.	AT	07/04/04	0	0.2	0	0.6
	2005	Construction	BJ	03/04/05	0	0.2	0	0.6
	2005	Construction	BK	22/04/05	0	0.2	0	0.6
	2006	Operation	CA	13/04/06	0	0.2	0	0.6
	2006	Operation	CB	19/04/06	0	0.2	0	0.6

					Common Tern		Guillemot	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
May	2002	Pre-Constr.	J	01/05/02	0	0.5	7	6.4
	2002	Pre-Constr.	K	30/05/02	18	15.3	0	1.5
	2003	Pre-Constr.	AD	06/05/03	12	10.2	0	1.5
	2003	Pre-Constr.	AE	19/05/03	0	0.5	0	1.5
	2004	Pre-Constr.	AU	12/05/04	3	2.7	15	6.6
	2004	Pre-Constr.	AV	28/05/04	0	0.2	0	0.6
	2005	Construction	BL	10/05/05	0	0.2	0	0.6
	2005	Construction	BM	29/05/05	0	0.2	0	0.6
	2006	Operation	CC	02/05/06	0	0.2	0	0.6
	2006	Operation	CD	23/05/06	3	2.2	0	0.6
June	2002	Pre-Constr.	L	19/06/02	12	10.2	8	7.0
	2003	Pre-Constr.	AF	04/06/03	12	10.2	0	1.5
	2004	Pre-Constr.	AW	08/06/04	6	4.5	0	0.6
	2005	Construction	BN	15/06/05	23	17.8	0	0.6
	2006	Operation	CE	02/06/06	3	2.2	0	0.6
July	2002	Pre-Constr.	M	22/07/02	77	66.3	0	1.5
	2003	Pre-Constr.	AG	22/07/03	0	0.5	0	1.5
	2004	Pre-Constr.	AX	29/07/04	4	3.1	0	0.6
	2005	Construction	BO	08/07/05	23	17.8	0	0.6
	2006	Operation	CF	21/07/06	6	4.5	0	0.6
August	2002	Pre-Constr.	N	12/08/02	0	0.5	0	1.5
	2002	Pre-Constr.	O	22/08/02	50	43.4	0	1.5
	2003	Pre-Constr.	AH	22/08/03	0	0.5	0	1.5
	2004	Construction	AY	26/08/04	9	6.7	0	0.6
	2005	Construction	BP	01/08/05	35	26.6	0	0.6
	2006	Operation	CG	07/08/06	75	57.6	0	0.6
September	2002	Pre-Constr.	P	11/09/02	6	5.1	0	1.5
	2002	Pre-Constr.	Q	24/09/02	0	0.5	0	1.5
	2003	Pre-Constr.	AI	09/09/03	52	44.9	0	1.5
	2003	Pre-Constr.	AJ	22/09/03	0	0.5	0	1.5
	2004	Construction	AZ	03/09/04	35	26.6	0	0.6
	2004	Construction	BA	29/09/04	0	0.2	0	0.6
	2005	Operation	BQ	06/09/05	522	397.9	0	0.6
	2005	Operation	BR	27/09/05	6	4.5	0	0.6
	2006	Operation	CH	18/09/06	3	2.2	0	0.6
	2006	Operation	CI	29/09/06	258	196.8	0	0.6
October	2001	Pre-Constr.	A	13/10/01	0	0.9	0	2.4
	2001	Pre-Constr.	B	25/10/01	0	1.8	0	3.8
	2002	Pre-Constr.	R	15/10/02	0	0.5	0	1.5
	2002	Pre-Constr.	S	24/10/02	0	0.5	8	7.0
	2003	Pre-Constr.	AK	12/10/03	0	0.5	0	1.5
	2003	Pre-Constr.	AL	26/10/03	0	0.5	0	1.5
	2004	Construction	BB	15/10/04	0	0.2	0	0.6
	2004	Construction	BC	27/10/04	0	0.4	0	0.9
	2005	Operation	BS	03/10/05	0	0.2	0	0.6
	2005	Operation	BT	14/10/05	0	0.2	0	0.6
	2006	Operation	CJ	09/10/06	0	0.2	0	0.6
November	2001	Pre-Constr.	C	18/11/01	0	0.6	10	8.4

					Common Tern		Guillemot	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2001	Pre-Constr.	D	30/11/01	0	1.6	0	3.8
	2002	Pre-Constr.	T	04/11/02	0	0.5	6	5.7
	2002	Pre-Constr.	U	15/11/02	0	0.5	0	1.5
	2003	Pre-Constr.	AM	06/11/03	0	0.5	0	1.5
	2003	Pre-Constr.	AN	27/11/03	0	0.5	0	1.5
	2004	Construction	BD	14/11/04	0	0.2	6	4.0
	2004	Construction	BE	26/11/04	0	0.2	7	4.2
	2005	Operation	BU	12/11/05	0	0.2	0	0.6
	2005	Operation	BV	17/11/05	0	0.2	3	2.5
	2006	Operation	CK	04/11/06	0	0.2	14	6.2
	2006	Operation	CL	01/12/06	0	0.2	17	7.1
December	2001	Pre-Constr.	E	19/12/01	0	3.0	0	5.8
	2002	Pre-Constr.	V	14/12/02	0	0.5	32	15.5
	2003	Pre-Constr.	AO	08/12/03	0	0.5	0	1.5
	2003	Pre-Constr.	AP	18/12/03	0	0.5	13	9.1
	2004	Construction	BF	11/12/04	0	0.2	36	11.0
	2005	Operation	BW	07/12/05	0	0.2	0	0.6

4.1.2 Control Site

The tables below (Tables 9 to 12) present the estimated number of each species in the control site over the 5 year period surveyed. Data was recorded in this area on 31 surveys, up to and including 9 October 2006.

4.1.2.1 Divers and Cormorants

Table 9 Population Estimates for Divers and Cormorants

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
January	2005	Construction	BG	19/01/05	38	24.1	0	1.4	3	3.3
	2006	Operation	BX	13/01/06	3	3.0	0	1.4	0	1.4
February	2003	Pre-Constr.	X	10/02/03	98	68.4	0	3.3	0	3.1
	2004	Pre-Constr.	AR	06/02/04	13	9.5	0	1.4	3	3.0
March	2002	Pre-Constr.	G	19/03/02	0	2.6	0	3.2	0	3.1
	2003	Pre-Constr.	AA	23/03/03	12	10.8	0	3.3	0	3.1
	2005	Construction	BI	08/03/05	3	2.6	0	1.4	0	1.4
	2006	Operation	BZ	02/03/06	0	1.2	0	1.4	6	5.6
April	2003	Pre-Constr.	AB	07/04/03	0	1.2	0	1.4	0	1.4
May	2002	Pre-Constr.	K	30/05/02	0	2.7	0	3.3	0	3.1
	2003	Pre-Constr.	AD	06/05/03	0	2.7	0	3.3	0	3.1
	2005	Construction	BM	29/05/05	0	1.2	0	1.4	0	1.4
	2006	Operation	CD	23/05/06	0	1.2	0	1.4	0	1.4
June	2004	Pre-Constr.	AW	08/06/04	0	1.2	0	1.4	0	1.4
July	2002	Pre-Constr.	M	22/07/02	0	2.7	0	3.3	0	3.1
	2003	Pre-Constr.	AG	22/07/03	0	2.7	12	14.8	0	3.1
	2005	Construction	BO	08/07/05	0	1.2	37	37.2	0	1.4
	2006	Operation	CF	21/07/06	0	1.2	14	15.2	0	1.4
August	2004	Construction	AY	26/08/04	0	1.2	3	3.3	0	1.4
	2006	Operation	CG	07/08/06	0	1.2	0	1.4	0	1.4
September	2002	Pre-Constr.	P	11/09/02	0	2.7	0	3.3	0	3.1

					Red-throated diver		Gannet		Cormorant	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
	2003	Pre-Constr.	AJ	22/09/03	0	2.7	0	3.3	0	3.1
	2005	Operation	BQ	06/09/05	0	1.2	0	1.4	0	1.4
October	2002	Pre-Constr.	S	24/10/02	0	2.7	0	3.3	0	3.1
	2006	Operation	CJ	09/10/06	0	1.2	3	3.3	0	1.4
November	2003	Pre-Constr.	AM	06/11/03	0	2.7	0	3.3	0	3.1
	2004	Construction	BE	26/11/04	7	5.9	0	1.4	0	1.4
	2005	Operation	BU	12/11/05	0	1.2	0	1.4	0	1.4
December	2001	Pre-Constr.	E	19/12/01	0	2.9	0	3.6	0	3.4
	2002	Pre-Constr.	V	14/12/02	25	20.5	0	3.3	0	3.1
	2003	Pre-Constr.	AP	18/12/03	13	12.2	0	3.3	0	3.1

4.1.2.2 Gulls

Population estimates and standard errors for larger gulls seen within the control site are shown below:

Table 10 Population Estimates for larger Gulls

					Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	**Year**	**Timing**	**Visit**	**Date**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**	**Population estimate**	**Standard Error**
January	2005	Construction	BG	19/01/05	0	1.5	0	1.3	0	1.2
	2006	Operation	BX	13/01/06	0	1.5	0	1.3	3	2.7
February	2003	Pre-Constr.	X	10/02/03	0	3.4	8	8.0	6	6.2
	2004	Pre-Constr.	AR	06/02/04	0	1.5	10	7.2	0	1.2
March	2002	Pre-Constr.	G	19/03/02	0	3.4	0	3.1	6	6.1
	2003	Pre-Constr.	AA	23/03/03	6	6.7	16	13.6	12	11.2
	2005	Construction	BI	08/03/05	0	1.5	0	1.3	3	2.7
	2006	Operation	BZ	02/03/06	0	1.5	3	2.7	12	9.1
April	2003	Pre-Constr.	AB	07/04/03	0	1.5	0	1.3	0	1.2
May	2002	Pre-Constr.	K	30/05/02	7	7.6	0	3.1	6	6.2
	2003	Pre-Constr.	AD	06/05/03	0	3.4	0	3.1	25	21.2
	2005	Construction	BM	29/05/05	0	1.5	8	5.9	33	21.6
	2006	Operation	CD	23/05/06	0	1.5	0	1.3	6	4.9
June	2004	Pre-Constr.	AW	08/06/04	0	1.5	0	1.3	52	31.9
July	2002	Pre-Constr.	M	22/07/02	0	3.4	0	3.1	41	32.7
	2003	Pre-Constr.	AG	22/07/03	0	3.4	0	3.1	6	6.2
	2005	Construction	BO	08/07/05	0	1.5	0	1.3	3	2.7
	2006	Operation	CF	21/07/06	0	1.5	6	4.9	3	2.7

					Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	Year	Timing	Visit	Date	Population estimate	Standard Error	Population estimate	Standard Error	Population estimate	Standard Error
August	2004	Construction	AY	26/08/04	0	1.5	0	1.3	0	1.2
	2006	Operation	CG	07/08/06	0	1.5	0	1.3	6	4.9
September	2002	Pre-Constr.	P	11/09/02	0	3.4	0	3.1	0	2.8
	2003	Pre-Constr.	AJ	22/09/03	6	6.7	39	26.2	0	2.8
	2005	Operation	BQ	06/09/05	0	1.5	0	1.3	0	1.2
October	2002	Pre-Constr.	S	24/10/02	0	3.4	7	7.2	0	2.8
	2006	Operation	CJ	09/10/06	7	5.4	9	6.5	0	1.2
November	2003	Pre-Constr.	AM	06/11/03	0	3.4	15	12.9	0	2.8
	2004	Construction	BE	26/11/04	3	2.9	21	12.1	13	9.6
	2005	Operation	BU	12/11/05	3	2.9	3	2.7	0	1.2
December	2001	Pre-Constr.	E	19/12/01	0	3.8	0	3.4	0	3.1
	2002	Pre-Constr.	V	14/12/02	0	3.4	40	26.8	134	90.6
	2003	Pre-Constr.	AP	18/12/03	0	3.4	8	8.0	111	76.9

Population estimates and standard errors for smaller gulls seen within the control site are shown below:

Table 11 Population Estimates for smaller Gulls

					Common Gull		Kittiwake	
Month	Year	Timing	Visit	Date	Population estimate	Standard Error	Population estimate	Standard Error
January	2005	Construction	BG	19/01/05	3	2.6	0	1.2
	2006	Operation	BX	13/01/06	26	15.7	9	7.8
February	2003	Pre-Constr.	X	10/02/03	0	2.8	20	20.1
	2004	Pre-Constr.	AR	06/02/04	0	1.2	0	1.2
March	2002	Pre-Constr.	G	19/03/02	0	2.8	0	2.7
	2003	Pre-Constr.	AA	23/03/03	14	12.2	0	2.7
	2005	Construction	BI	08/03/05	17	11.1	0	1.2
	2006	Operation	BZ	02/03/06	14	9.6	0	1.2
April	2003	Pre-Constr.	AB	07/04/03	6	4.5	0	1.2
May	2002	Pre-Constr.	K	30/05/02	0	2.8	0	2.7
	2003	Pre-Constr.	AD	06/05/03	0	2.8	0	2.7
	2005	Construction	BM	29/05/05	0	1.2	0	1.2
	2006	Operation	CD	23/05/06	0	1.2	0	1.2
June	2004	Pre-Constr.	AW	08/06/04	0	1.2	0	1.2
July	2002	Pre-Constr.	M	22/07/02	0	2.8	0	2.7
	2003	Pre-Constr.	AG	22/07/03	0	2.8	0	2.7
	2005	Construction	BO	08/07/05	0	1.2	0	1.2
	2006	Operation	CF	21/07/06	0	1.2	0	1.2
August	2004	Construction	AY	26/08/04	0	1.2	0	1.2
	2006	Operation	CG	07/08/06	0	1.2	0	1.2
September	2002	Pre-Constr.	P	11/09/02	0	2.8	0	2.7
	2003	Pre-Constr.	AJ	22/09/03	0	2.8	0	2.7
	2005	Operation	BQ	06/09/05	0	1.2	0	1.2
October	2002	Pre-Constr.	S	24/10/02	6	6.0	0	2.7
	2006	Operation	CJ	09/10/06	0	1.2	0	1.2

					Common Gull		Kittiwake	
Month	Year	Timing	Visit	Date	Population estimate	Standard Error	Population estimate	Standard Error
November	2003	Pre-Constr.	AM	06/11/03	6	6.0	0	2.7
	2004	Construction	BE	26/11/04	3	2.6	15	13.5
	2005	Operation	BU	12/11/05	0	1.2	0	1.2
December	2001	Pre-Constr.	E	19/12/01	0	3.1	0	3.0
	2002	Pre-Constr.	V	14/12/02	0	2.8	25	24.5
	2003	Pre-Constr.	AP	18/12/03	0	2.8	0	2.7

4.1.2.3 Terns and Guillemot

Table 12 Population Estimates for Common Tern and Guillemot

					Common Tern		Guillemot	
Month	Year	Timing	Visit	Date	Population estimate	Standard Error	Population estimate	Standard Error
January	2005	Construction	BG	19/01/05	0	1.2	0	1.5
	2006	Operation	BX	13/01/06	0	1.2	3	2.9
February	2003	Pre-Constr.	X	10/02/03	0	2.9	0	3.5
	2004	Pre-Constr.	AR	06/02/04	0	1.2	0	1.5
March	2002	Pre-Constr.	G	19/03/02	0	2.8	0	3.5
	2003	Pre-Constr.	AA	23/03/03	0	2.9	0	3.5
	2005	Construction	BI	08/03/05	0	1.2	0	1.5
	2006	Operation	BZ	02/03/06	0	1.2	0	1.5
April	2003	Pre-Constr.	AB	07/04/03	0	1.2	0	1.5
May	2002	Pre-Constr.	K	30/05/02	0	2.9	0	3.5
	2003	Pre-Constr.	AD	06/05/03	0	2.9	0	3.5
	2005	Construction	BM	29/05/05	0	1.2	0	1.5
	2006	Operation	CD	23/05/06	0	1.2	0	1.5
June	2004	Pre-Constr.	AW	08/06/04	0	1.2	0	1.5
July	2002	Pre-Constr.	M	22/07/02	6	7.1	0	3.5
	2003	Pre-Constr.	AG	22/07/03	0	2.9	0	3.5
	2005	Construction	BO	08/07/05	0	1.2	0	1.5
	2006	Operation	CF	21/07/06	6	6.2	0	1.5
August	2004	Construction	AY	26/08/04	0	1.2	0	1.5
	2006	Operation	CG	07/08/06	0	1.2	0	1.5
September	2002	Pre-Constr.	P	11/09/02	0	2.9	0	3.5
	2003	Pre-Constr.	AJ	22/09/03	0	2.9	0	3.5
	2005	Operation	BQ	06/09/05	0	1.2	0	1.5
October	2002	Pre-Constr.	S	24/10/02	0	2.9	0	3.5
	2006	Operation	CJ	09/10/06	0	1.2	0	1.5
November	2003	Pre-Constr.	AM	06/11/03	0	2.9	7	6.7
	2004	Construction	BE	26/11/04	0	1.2	0	1.5
	2005	Operation	BU	12/11/05	0	1.2	0	1.5
December	2001	Pre-Constr.	E	19/12/01	0	3.1	6	6.6
	2002	Pre-Constr.	V	14/12/02	0	2.9	41	18.9
	2003	Pre-Constr.	AP	18/12/03	0	2.9	0	3.5

4.1.3 Monthly Mean Population Estimates

Monthly population estimates have been calculated for the Wind Farm Site (including buffer) and Control Site based on the data collected over the 90 surveys conducted to date over the five years of monitoring at the Kentish Flats site. These monthly means are presented in Tables 13 to 20 to below.

4.1.3.1 Divers and Cormorant

Monthly means for divers have changed slightly from previous reports with the inclusion of data from Year 4. These are shown in below.

Table 13 Population Estimates for Red-throated Diver, Gannet and Cormorant – Wind Farm Site

		Red-throated Diver		Gannet		Cormorant	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error	Population Estimate	Standard Error
January	4	389	96.5	0	0.2	14	6.4
February	6	224	54.2	0	0.3	4	1.6
March	6	22	8.0	0	0.2	5	3.2
April	9	7	2.5	0	0.2	4	1.7
May	10	0	0.1	8	4.4	7	2.3
June	5	0	0.2	2	1.3	20	6.7
July	5	0	0.2	1	0.5	40	13.0
August	6	0	0.2	3	1.9	32	10.8
September	10	1	0.6	3	1.4	34	8.8
October	11	5	2.5	4	2.3	12	3.6
November	11	26	9.5	0	0.2	17	4.7
December	7	421	83.2	0	0.6	23	7.4

Table 14 Population Estimates for Red-throated Diver, Gannet and Cormorant – Control Site

		Red-throated Diver		Gannet		Cormorant	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error	Population Estimate	Standard Error
January	2	21	12.1	0	1.0	2	1.8
February	2	55	34.5	0	1.8	1	2.2
March	4	4	2.9	0	1.3	1	1.8
April	1	0	1.2	0	1.4	0	1.4
May	4	0	1.0	0	1.3	0	1.2
June	1	0	1.2	0	1.4	0	1.4
July	4	0	1.0	16	10.7	0	1.2
August	2	0	0.8	1	1.8	0	1.0
September	3	0	1.3	0	1.6	0	1.5
October	2	0	1.5	1	2.3	0	1.7
November	3	2	2.2	0	1.3	0	1.2
December	3	13	8.0	0	1.9	0	1.9

4.1.3.2 Gulls

Table 15 Population Estimates for larger Gulls – Wind Farm Site

		Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error	Population Estimate	Standard Error
January	4	3	2.0	27	9.0	22	9.2
February	6	1	0.7	10	3.5	18	5.3
March	6	13	5.9	6	2.3	46	11.8
April	9	2	0.9	11	3.0	30	8.7
May	10	1	0.6	4	1.4	30	6.8
June	5	2	1.1	4	1.7	58	14.9
July	5	6	2.9	16	5.9	61	16.2
August	6	3	1.3	8	2.7	7	3.8
September	10	3	1.1	41	7.1	12	2.8
October	11	12	4.2	62	12.4	7	2.1
November	11	16	4.8	63	9.7	26	6.8
December	7	1	1.0	27	7.8	19	6.1

Table 16 Population Estimates for larger Gulls – Control Site

		Great Black-Backed Gull		Lesser Black-Backed Gull		Herring Gull	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error	Population Estimate	Standard Error
January	2	0	1.1	0	1.0	1	1.5
February	2	0	1.9	9	5.4	3	3.2
March	4	1	1.9	5	3.6	8	4.0
April	1	0	1.5	0	1.3	0	1.2
May	4	2	2.2	2	1.9	17	7.8
June	1	0	1.5	0	1.3	52	31.9
July	4	0	1.3	2	1.7	13	8.4
August	2	0	1.1	0	1.0	3	2.5
September	3	2	2.5	13	8.8	0	1.4
October	2	3	3.2	8	4.8	0	1.5
November	3	2	1.8	13	6.0	4	3.3
December	3	0	2.0	16	9.4	82	39.6

Table 17 Population Estimates for smaller Gulls – Wind Farm Site

		Common Gull		Kittiwake	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error
January	4	13	4.3	15	7.7
February	6	17	5.2	99	49.1
March	6	26	7.3	0	0.2
April	9	4	1.4	0	0.1
May	10	0	0.2	0	0.1
June	5	0	0.2	0	0.2
July	5	9	3.8	0	0.2
August	6	0	0.2	0	0.2
September	10	0	0.2	0	0.1
October	11	2	1.0	2	1.3
November	11	15	4.1	5	1.9
December	7	6	2.5	5	1.8

Table 18 Population Estimates for smaller Gulls – Control Site

		Common Gull		Kittiwake	
Month	No. of Visits	Population Estimate	Standard Error	Population Estimate	Standard Error
January	2	15	8.0	4	3.9
February	2	0	1.5	10	10.1
March	4	11	4.8	0	1.1
April	1	6	4.5	0	1.2
May	4	0	1.1	0	1.1
June	1	0	1.2	0	1.2
July	4	0	1.1	0	1.1
August	2	0	0.9	0	0.8
September	3	0	1.4	0	1.3
October	2	3	3.0	0	1.5
November	3	3	2.2	5	4.6
December	3	0	1.7	8	8.3

4.1.3.3 Terns and Guillemot

Table 19 Population Estimates for Common Tern and Guillemot – Wind Farm Site

		Common Tern		Guillemot	
Month	**No. of Visits**	**Population Estimate**	**Standard Error**	**Population Estimate**	**Standard Error**
January	4	0	0.2	13	4.2
February	6	0	0.2	1	0.8
March	6	0	0.2	2	1.2
April	9	1	1.1	0	0.4
May	10	4	1.9	2	1.0
June	5	11	4.7	2	1.4
July	5	22	13.8	0	0.5
August	6	28	12.9	0	0.5
September	10	88	44.7	0	0.3
October	11	0	0.2	1	0.8
November	11	0	0.2	4	1.3
December	7	0	0.5	14	3.3

Table 20 Population Estimates for Common Tern and Guillemot – Control Site

		Common Tern		Guillemot	
Month	**No. of Visits**	**Population Estimate**	**Standard Error**	**Population Estimate**	**Standard Error**
January	2	0	0.9	2	1.6
February	2	0	1.6	0	1.9
March	4	0	1.1	0	1.3
April	1	0	1.2	0	1.5
May	4	0	1.1	0	1.3
June	1	0	1.2	0	1.5
July	4	3	2.5	0	1.3
August	2	0	0.9	0	1.1
September	3	0	1.4	0	1.7
October	2	0	1.6	0	1.9
November	3	0	1.1	2	2.3
December	3	0	1.7	16	6.8

4.1.4 Effects of Weather

On all dates in Year 5 weather conditions were ideal for surveying seabirds from the boat, and surveys were generally conducted in sea states of 3 or less, which should have permitted adequate sampling of marine mammals.

4.1.5 Effects of Construction and Operation as Revealed by Boat Surveys

Section 3.5 describes the methodology for assessing changes to the populations of birds in and around the Kentish Flats relative to the control site that may be attributable to the effects of construction (FEPA monitoring objective 1).

The results of the quantitative density comparisons between the pre-construction, construction and operational phases suggested that:

- red-throated diver numbers were lower during the operational phase than during pre-construction.
- gannet numbers show no evidence of changes.
- cormorant numbers were lower between December and April since the wind farm became operational, but not at other times of year.
- lesser black-backed gull numbers in February were lower in the construction and operational phases. There were suggestions of differences in other months for this species and possible reductions for greater black-backed and herring gulls, but no consistent patterns were detected.
- common tern numbers show no evidence of changes.
- guillemot numbers appear to be low since the wind farm became operational.

These results must be treated cautiously for several reasons. The total number of birds in British waters can vary enormously between different years as can their distribution around the coasts. Further, the tests carried out for each month are not independent of each other.

The more satisfactory analysis which compares the wind farm site with the control area eliminated most of the variation in numbers between different years, although the control site was visited on only 31 of the 90 surveys and is smaller.

This second analytic approach used only those visits and for the four species which were recorded at both sites on more than two visits. For all four species red-throated diver, lesser black-backed gull, herring gull and common gull, the F tests comparing the three phases of the development were not statistically significant at the 5% level. Thus there is no evidence of a direct effect on the numbers of birds using the wind farm site when comparing the pre and post construction data. This suggests that the differences found in the first analyses were due to changes in the overall numbers visiting the general area, rather than birds being displaced from the wind farm site. However, the rather low power of the second analyses, because of the data limitations noted above, imply that a more direct effect can not be discounted.

4.2 NUMBERS AND DISTRIBUTION OF BIRDS FROM AERIAL SURVEYS

Aerial data provided by WWT from survey area TH1 has been analysed statistically to produce numbers of birds per transect. As described in Section 3.4.2, population estimates (as mean numbers per transect) for the wind farm, boat survey buffer zone and boat survey control site produced from the aerial survey data available would have produced very low figures, and it would not have been possible to calculate standard errors for them so there could be no indication of their precision. It is therefore not possible to obtain satisfactory population estimates directly for the wind farm, buffer or control areas because they are so small in relation to the scale and transect spacing of the aerial surveys.

In order to assess possible construction effects, numbers of birds seen within the TH1 aerial transects over the wind farm and buffer zone (termed the "Wind Farm" area) may be compared to those passing immediately to the west (termed the "West" area), and with those passing through the control site, immediately to the east (termed the "East" area). Section 3.4.2 includes a detailed methodology. It is important to appreciate that these areas do not correspond with the much larger 'Central', 'West' and 'East' regions analysed and mapped (see Figures 51-58) in the Second Monitoring Report (Gill, Sales & Beasley 2005). All aerial data have been reanalysed within the Wind Farm, West and East areas and are presented for comparison. As was the case in the First, Second and Third Monitoring Reports (Gill *et al* 2004, Gill *et al* 2005 & 2006), the first visit conducted by the JNCC has been omitted from the analyses, since the transects used on that occasion cannot be readily compared with the WWT transect data.

The TH1 aerial results are mapped in Figures 51-58, 79-88 and 110-116 (note there are no Figures 108 or 109).

Table 21 below presents the results for the 'Wind farm and buffer zone area"; Table 22 presents the results for the 'Western Area'; and Table 23 presents the results for the 'Eastern Area'. Units presented are all birds per transect recorded within bands A and B with the corresponding standard errors.

Although the dates of surveys do not correspond between years (see Table 2), the highest estimated numbers of divers per transect were seen on 18th January 2003 (Mean 27.3; S.E. 5.2 and see Table 21 and Figure 28), on 5th December 2004 (Mean 28.3; S.E. 5.3), on 15th January 2005 (Mean 33.6; S.E. 6.2) and on 11th December 2005 (Mean 27.1; S.E. 4.8).

The aerial data suggests that the peak month for divers for the 'Wind Farm' area (including buffer) appears to be mid-January to mid-December, though high number relatively may also be detected in February.

In Year 5 the mean number of birds per wind farm and buffer aerial transect remained between 27.1 (S.E. 4.8) and 22.1 (S.E. 4.4) between December and February, while the numbers at the East reference area increased from 23.8 (S.E. 5.7) to 33.0 (S.E. 8.31).

In Year 4, the December 2004 Mean (28.3; S.E. 5.3) increased to a January 2005 Mean of 33.6 (S.E. 6.2) in the wind farm/buffer zone area, while in the East area the December 2004 Mean of 13.8 (S.E. 6.3), increased to a January 2005 Mean of 24.2 (S.E. 7.3), and had reached a Mean of 80.6 (S.E. 26.4) by 6th March 2005. On this date the numbers within the wind farm/buffer zone area (Mean 2.4 (S.E. 22.3) were much lower, rising slightly by 13th March 2005 (Mean 7.1; S.E. 5.7).

In Year 3, February 2004 numbers of divers in the wind farm/buffer zone area (Mean 10.0; S.E. 7.2) had declined from December 2003 numbers (Mean 14.6; S.E. 3.6), but much higher numbers per transect were recorded in that month in the East reference area (over the same period Mean 31.6; S.E. 8.5 up from Mean 20.2; S.E. 4.2).

In Year 5 no divers were seen within the wind farm or boat survey buffer zone. Divers were more evenly dispersed throughout the survey area during the following three months. Numbers built up from the very few seen on 13th November, and more were seen in the buffer zone on 11th December than on 14th January or 18th February 2006 (see Figures 86, 110-114).

On 6th March 2005 in Year 4 most divers were seen at least 5km north and northwest of the wind farm and control sites. On 13th March 2005 most of the divers observed were not seen within the wind farm site or buffer, but rather to the south closer to the coast (see Figure 83). On this later date, the East area had higher numbers (Mean 17.0; S.E. 6.8), especially over 10km northwest of the wind farm, as did the West area on the north side of the Inner Thames which has generally appeared to hold fewer divers. Both these patterns and the changes between the 6th and 13th March 2005 indicate that there may be substantial changes in distributions of divers over relatively short periods at this time of year, and perhaps an influx of divers into parts of the outer Thames in some years. However, such large numbers have not been counted within the Kentish Flats Wind Farm site and buffer zone (or the areas directly north and south).

Gulls and waders were more numerous in the West region than other sections in February 2004. These peaks were exceeded in December 2004, November and December 2005. Wader numbers recorded per Western reference transect increased through the winter of Year 4, peaking at 853.3 (S.E. 400.3).

In January and December, auks appeared to be more numerous to the East region than in the Central (wind farm/buffer zone) region in Years 3 and 4 (see Figures 52 and 58).

Table 21 Area Means and Standard Errors for Wind Farm and buffer zone area derived from Aerial Survey data

Date	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
11/01/2002	Means	7.7	0.0	0.7	0.0	0.0	0.0	0.0	0.0	8.3
	S.E.	2.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	5.2
21/08/2002	Means	0.0	0.3	0.0	0.0	0.0	0.7	10.0	0.0	11.0
	S.E.	0.0	2.5	0.0	0.0	0.0	0.4	5.4	0.0	5.5
18/01/2003	Means	27.3	0.0	0.0	0.0	0.0	47.7	0.0	**15.0**	102.7
	S.E.	5.2	0.3	0.0	0.0	0.0	12.6	0.0	**6.2**	16.8
30/08/2003	Means	0.0	0.4	0.0	0.0	0.0	0.6	2.0	0.0	3.6
	S.E.	0.0	0.5	0.0	0.0	0.0	0.4	1.1	0.0	1.4
27/11/2003	Means	6.3	0.8	2.3	0.3	0.0	11.7	0.0	0.2	21.7
	S.E.	1.8	0.5	1.0	0.2	0.0	5.4	0.0	0.5	5.6
17/12/2003	Means	14.6	1.3	0.0	0.0	0.0	24.4	0.0	**4.0**	44.4
	S.E.	3.6	0.6	0.0	1.5	0.0	18.4	0.0	**1.7**	19.5
15/02/2004	Means	10.0	13.3	7.0	**147.1**	0.9	**271.7**	0.0	0.0	453.7
	S.E.	7.2	6.4	3.2	**133.6**	9.2	**81.9**	0.0	0.0	211.5
30/10/2004	Means	1.1	2.6	2.1	0.0	3.6	22.7	0.0	0.1	38.7
	S.E.	0.4	1.1	1.2	0.3	2.4	5.0	0.0	0.2	6.5
05/12/2004	Means	28.3	8.7	65.1	39.6	37.4	164.6	0.0	**4.1**	353.7
	S.E.	5.3	2.5	31.7	72.5	19.7	61.6	0.0	**1.3**	143.0
15/01/2005	Means	33.6	3.0	94.4	3.6	0.0	46.9	0.0	2.7	189.3
	S.E.	6.2	5.6	61.2	97.7	0.3	9.8	0.0	0.7	108.8
06/03/2005	Means	2.4	0.3	7.7	11.1	0.0	67.3	0.0	0.0	92.3
	S.E.	22.3	1.5	4.3	128.0	3.8	22.9	0.0	0.0	142.0
13/03/2005	Means	7.1	0.6	0.0	112.1	4.3	30.1	0.0	0.0	154.6
	S.E.	5.7	0.2	0.0	125.5	2.8	18.0	0.0	0.0	132.3
31/07/2005	Means	0.0	3.7	0.0	0.0	0.0	13.3	4.1	0.3	22.3
	S.E.	0.0	1.4	0.0	101.2	0.0	18.9	1.3	0.1	110.1
13/11/2005	Means	1.1	2.3	0.0	35.9	0.0	38.6	0.0	0.1	78.6
	S.E.	0.4	0.6	0.0	109.4	11.2	84.8	0.4	0.1	192.6
11/12/2005	Means	27.1	3.6	7.4	25.1	6.0	**407.9**	0.0	0.0	485.0
	S.E.	4.8	1.3	4.6	178.9	8.9	**191.3**	0.0	0.0	365.2
14/01/2006	Means	22.1	1.7	3.6	0.0	0.0	58.0	0.0	0.0	87.6
	S.E.	4.4	0.7	23.5	138.4	1.3	18.7	0.0	0.0	137.6
18/02/2006	Means	24.6	54.1	3.1	60.0	0.0	125.3	0.0	0.0	267.9
	S.E.	7.0	31.6	3.1	302.6	19.6	35.9	0.0	0.0	357.9

Table 22 Area Means and Standard Errors for the Western Area derived from Aerial Survey data

Date	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
11/01/2002	Means	4.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	18.0
	S.E.	2.4	0.0	5.8	0.0	0.0	0.0	0.0	0.0	6.3
21/08/2002	Means	0.0	7.5	0.0	0.0	0.0	1.0	0.0	0.0	8.5
	S.E.	0.0	3.1	0.0	0.0	0.0	0.5	6.6	0.0	6.8
18/01/2003	Means	35.0	0.0	0.0	0.0	0.0	42.0	0.0	1.5	98.0
	S.E.	6.9	0.3	0.0	0.0	0.0	16.7	0.0	8.2	22.2
30/08/2003	Means	0.0	0.5	0.0	0.0	0.0	2.0	5.0	0.0	7.5
	S.E.	0.0	0.9	0.0	0.0	0.0	0.7	1.8	0.0	2.2
27/11/2003	Means	1.0	0.3	0.0	0.3	0.0	30.0	0.0	0.0	32.3
	S.E.	2.5	0.6	1.4	0.3	0.0	7.6	0.0	0.6	7.9
17/12/2003	Means	5.5	0.5	0.0	0.0	0.0	20.0	0.0	0.5	30.0
	S.E.	6.7	1.2	0.0	2.8	0.0	34.5	0.0	3.2	36.4
15/02/2004	Means	2.0	5.3	0.5	**368.3**	24.5	**273.8**	0.0	0.0	675.0
	S.E.	9.5	8.5	4.2	**176.7**	12.2	**108.4**	0.0	0.0	279.7
30/10/2004	Means	0.5	0.5	0.0	0.5	0.8	15.0	0.0	0.0	18.3
	S.E.	0.5	1.5	1.6	0.4	3.1	6.6	0.0	0.3	8.6
05/12/2004	Means	4.3	0.8	0.3	215.0	17.3	327.3	0.0	0.0	565.3
	S.E.	7.1	3.3	41.9	96.0	26.1	81.5	0.0	1.8	189.2
15/01/2005	Means	11.8	1.0	6.3	361.8	0.0	30.3	0.0	1.0	413.3
	S.E.	8.2	7.4	81.0	129.3	0.4	12.9	0.0	0.9	143.9
06/03/2005	Means	0.3	0.0	6.5	**437.8**	10.0	146.8	0.0	0.0	602.0
	S.E.	29.5	2.0	5.6	**169.3**	5.0	30.3	0.0	0.0	187.9
13/03/2005	Means	15.8	0.0	0.0	292.8	0.3	105.8	0.0	0.0	414.5
	S.E.	7.6	0.3	0.0	166.1	3.7	23.7	0.0	0.0	175.1
31/07/2005	Means	0.0	0.0	0.0	267.8	0.0	75.0	1.3	0.0	344.3
	S.E.	0.0	1.8	0.0	133.9	0.0	25.0	1.7	0.2	145.7
13/11/2005	Means	0.3	1.3	0.0	**372.3**	32.3	**474.5**	0.0	0.0	880.8
	S.E.	0.6	0.8	0.0	**144.7**	14.8	**112.2**	0.5	0.2	254.8
11/12/2005	Means	8.5	0.8	7.3	**512.8**	22.0	**654.3**	0.0	0.0	1207.3
	S.E.	6.4	1.8	6.0	**236.7**	11.8	**253.0**	0.0	0.0	483.1
14/01/2006	Means	14.0	0.5	8.8	**428.3**	3.5	34.5	0.0	0.0	490.0
	S.E.	5.8	1.0	31.0	**183.1**	1.8	24.7	0.0	0.0	182.1
18/02/2006	Means	7.8	57.8	0.0	**853.3**	56.5	224.0	0.0	0.0	1201.5
	S.E.	9.2	41.9	4.1	**400.3**	25.9	47.5	0.0	0.0	473.5

Table 23 Area Means and Standard Errors for the Eastern Area derived from Aerial Survey data

Date	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
11/01/2002	Means	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4
	S.E.	1.5	0.0	3.7	0.0	0.0	0.0	0.0	0.0	4.0
21/08/2002	Means	0.0	0.2	0.0	0.0	0.0	0.4	1.4	0.0	2.2
	S.E.	0.0	1.9	0.0	0.0	0.0	0.3	4.2	0.0	4.3
18/01/2003	Means	11.6	0.6	0.0	0.0	0.0	23.0	0.0	**33.5**	67.4
	S.E.	5.6	0.3	0.0	0.0	0.0	13.6	0.0	**6.7**	18.1
30/08/2003	Means	0.0	1.0	0.0	0.0	0.0	1.0	1.8	0.0	4.8
	S.E.	0.0	0.6	0.0	0.0	0.0	0.5	1.3	0.0	1.6
27/11/2003	Means	4.0	0.5	0.8	0.0	0.0	3.3	0.0	1.2	9.8
	S.E.	1.8	0.5	1.0	0.2	0.0	5.4	0.0	0.5	5.6
17/12/2003	Means	20.2	1.0	0.0	3.0	0.0	65.4	0.0	**7.2**	107.4
	S.E.	4.2	0.7	0.0	1.8	0.0	21.8	0.0	**2.1**	23.0
15/02/2004	Means	31.6	0.2	0.0	0.0	0.0	59.0	0.0	0.0	96.2
	S.E.	8.5	7.6	3.8	158.1	10.9	97.0	0.0	0.0	250.2
30/10/2004	Means	0.6	0.4	0.0	0.6	0.0	25.0	0.0	0.6	31.2
	S.E.	0.4	1.3	1.5	0.4	2.8	5.9	0.0	0.3	7.7
05/12/2004	Means	13.8	0.6	0.0	0.0	0.0	35.2	0.0	**5.2**	56.2
	S.E.	6.3	3.0	37.5	85.8	23.3	72.9	0.0	**1.6**	169.3
15/01/2005	Means	24.2	13.8	1.2	0.0	0.6	29.4	0.0	0.4	70.6
	S.E.	7.3	6.6	72.4	115.6	0.3	11.6	0.0	0.8	128.7
06/03/2005	Means	80.6	3.2	0.0	0.0	0.0	18.8	0.0	0.0	106.0
	S.E.	26.4	1.8	5.0	151.4	4.5	27.1	0.0	0.0	168.0
13/03/2005	Means	17.0	0.0	0.0	0.0	0.0	11.8	0.0	0.0	29.6
	S.E.	6.8	0.3	0.0	148.5	3.3	21.2	0.0	0.0	156.6
31/07/2005	Means	0.0	0.0	0.0	0.0	0.0	20.2	5.8	0.0	27.2
	S.E.	0.0	1.6	0.0	119.7	0.0	22.4	1.6	0.2	130.3
13/11/2005	Means	0.8	0.6	0.0	0.0	0.0	21.8	0.8	0.2	35.0
	S.E.	0.5	0.7	0.0	129.4	13.3	100.4	0.4	0.2	227.9
11/12/2005	Means	23.8	2.6	0.0	0.0	0.0	127.4	0.0	0.0	160.6
	S.E.	5.7	1.6	5.4	211.7	10.5	226.3	0.0	0.0	432.1
14/01/2006	Means	31.6	0.0	51.8	0.0	0.0	33.2	0.0	0.0	131.2
	S.E.	5.2	0.9	27.8	163.7	1.6	22.1	0.0	0.0	162.8
18/02/2006	Means	33.0	0.0	6.0	0.0	0.0	65.4	0.0	0.0	106.0
	S.E.	8.3	37.4	3.7	358.0	23.2	42.4	0.0	0.0	423.5

These numbers of birds seen per aerial transect include many waders and others seen at northern and southern ends on the transects, far from Kentish Flats Wind Farm (see section 4.2.1 below).

4.2.1 Aerial Survey Data - Monthly Analysis

This approach is of limited value in detecting changes, which is better served by examining the ratios of relative abundance measures between the wind farm and buffer and the two other areas (see Section 4.2.1). Pooling over several years reduces the influence of unusually good or bad years for a particular species. In the present context, it does not overcome the influence of years because the control site is too small and visited less frequently than the wind farm site.

Table 24 Average number of birds per transect by region for the Wind farm and buffer zone area

Month	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
January	Means	**22.7**	1.2	**24.7**	0.9	0.0	38.1	0.0	4.4	97.0
	S.E.	**2.4**	1.4	**16.4**	42.4	0.3	6.1	0.0	1.6	44.1
February	Means	17.3	33.7	5.1	**103.6**	0.4	198.5	0.0	0.0	360.8
	S.E.	5.0	16.1	2.2	**165.4**	10.8	44.7	0.0	0.0	207.9
March	Means	4.8	0.4	3.9	61.6	2.1	48.7	0.0	0.0	123.4
	S.E.	11.5	0.8	2.1	89.6	2.4	14.6	0.0	0.0	97.1
July	Means	0.0	3.7	0.0	0.0	0.0	13.3	**4.1**	0.3	22.3
	S.E.	0.0	1.4	0.0	101.2	0.0	18.9	**1.3**	0.1	110.1
August	Means	0.0	0.4	0.0	0.0	0.0	0.6	**6.0**	0.0	7.3
	S.E.	0.0	1.3	0.0	0.0	0.0	0.3	**2.8**	0.0	2.8
October	Means	1.1	2.6	2.1	0.0	3.6	22.7	0.0	0.1	38.7
	S.E.	0.4	1.1	1.2	0.3	2.4	5.0	0.0	0.2	6.5
November	Means	3.7	1.6	1.2	18.1	0.0	25.1	0.0	0.2	50.1
	S.E.	0.9	0.4	0.5	54.7	5.6	42.5	0.2	0.2	96.4
December	Means	**23.3**	4.5	**24.2**	21.6	**14.5**	**199.0**	0.0	2.7	294.4
	S.E.	**2.7**	1.0	**10.7**	64.4	**7.2**	**67.3**	0.0	0.7	130.9

Table 25 Average number of birds per transect by region for the Western Area

Month	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
January	Means	**16.2**	0.4	7.0	197.5	0.9	26.7	0.0	0.6	254.8
	S.E.	**3.1**	1.9	21.7	56.0	0.4	8.1	0.0	2.1	58.3
February	Means	4.9	31.5	0.3	**610.8**	**40.5**	248.9	0.0	0.0	938.3
	S.E.	6.6	21.4	2.9	**218.8**	**14.3**	59.2	0.0	0.0	275.0
March	Means	8.0	0.0	3.3	365.3	5.1	126.3	0.0	0.0	508.3
	S.E.	15.2	1.0	2.8	118.6	3.1	19.3	0.0	0.0	128.4
July	Means	0.0	0.0	0.0	267.8	0.0	75.0	1.3	0.0	344.3
	S.E.	0.0	1.8	0.0	133.9	0.0	25.0	1.7	0.2	145.7
August	Means	0.0	4.0	0.0	0.0	0.0	1.5	2.5	0.0	8.0
	S.E.	0.0	1.6	0.0	0.0	0.0	0.4	3.4	0.0	3.6
October	Means	0.5	0.5	0.0	0.5	0.8	15.0	0.0	0.0	18.3
	S.E.	0.5	1.5	1.6	0.4	3.1	6.6	0.0	0.3	8.6
November	Means	0.6	0.8	0.0	186.3	**16.1**	252.3	0.0	0.0	456.5
	S.E.	1.3	0.5	0.7	72.4	**7.4**	56.2	0.3	0.3	127.5
December	Means	6.1	0.7	2.5	242.6	**13.1**	**333.8**	0.0	0.2	600.8
	S.E.	3.9	1.3	14.1	85.1	**9.5**	**89.3**	0.0	1.2	173.4

Table 26 Average number of birds per transect by region for the Eastern Area

Month	Transect	diver	cormorant	seaduck	wader	other wildfowl	gull	tern	auk	Total
January	Means	18.7	3.6	13.3	0.0	0.2	21.4	0.0	8.5	69.2
	S.E.	2.7	1.7	19.4	50.1	0.4	7.1	0.0	1.7	52.1
February	Means	**32.3**	0.1	3.0	0.0	0.0	62.2	0.0	0.0	101.1
	S.E.	**5.9**	19.1	2.6	195.7	12.8	52.9	0.0	0.0	245.9
March	Means	**48.8**	1.6	0.0	0.0	0.0	15.3	0.0	0.0	67.8
	S.E.	**13.6**	0.9	2.5	106.1	2.8	17.2	0.0	0.0	114.8
July	Means	0.0	0.0	0.0	0.0	0.0	20.2	5.8	0.0	27.2
	S.E.	0.0	1.6	0.0	119.7	0.0	22.4	1.6	0.2	130.3
August	Means	0.0	0.6	0.0	0.0	0.0	0.7	1.6	0.0	3.5
	S.E.	0.0	1.0	0.0	0.0	0.0	0.3	2.2	0.0	2.3
October	Means	0.6	0.4	0.0	0.6	0.0	25.0	0.0	0.6	31.2
	S.E.	0.4	1.3	1.5	0.4	2.8	5.9	0.0	0.3	7.7
November	Means	2.4	0.6	0.4	0.0	0.0	12.6	0.4	0.7	22.4
	S.E.	0.9	0.4	0.5	64.7	6.6	50.3	0.2	0.2	114.0
December	Means	19.3	1.4	0.0	1.0	0.0	76.0	0.0	4.1	108.1
	S.E.	3.2	1.1	12.6	76.1	8.5	79.6	0.0	0.9	154.9

Divers numbers peaked in the transects traversing the Kentish Flats Wind farm and buffer in December and January (the month in which peak numbers were seen in the western aerial reference area). Within the eastern reference area, including the boat survey control site, numbers per transect were highest in February and March.

Waders peaked in February, except in the east where numbers were highest in March. Seaduck numbers were highest in the wind farm/buffer transects in January and December, when they were higher than elsewhere in any month. Other wildfowl numbers peaked in the west in February, remaining low in all other areas except December in the wind farm/buffer transects.

Gull numbers were highest is all aerial study areas in December. Tern numbers detected by the aerial surveys peaked in July and August.

4.2.2 Effects of Construction and Operation as Revealed by Aerial Surveys

Seven of the aerial surveys were carried out during the pre-construction part of the study, six during the construction period (22 August 2004 – 22 August 2005), and four since the Kentish Flats offshore wind farm has been operational. Much smaller numbers have been counted from the air within the Kentish Flats Wind Farm site and buffer zone in Year 5. The visual comparisons between years of the maps showing bird locations revealed no other changes in the use of the wind farm site by seaduck, the other group for which aerial surveys were specifically undertaken (see Figures 25-31, 51-58, 79-88 and 110-116).

As described in Section 3.4.3 the ratio of the mean number of birds per aerial transect for the Wind Farm area to the two other east (including boat survey control site) and west reference areas was calculated. An additional three groups: seaduck, other wildfowl and terns, have been added to the statistical analyses due to the larger and longer dataset now available. Thus eight species groups: diver, cormorant, seaduck, other wildfowl, wader, gulls, terns, auks, and all birds, were recorded in both the group of transects that included part of the wind farm or passed near to it, and in transects away from the wind farm site. The estimated densities for the first group of transects were compared with those from the other two groups for all these groups except "other wildfowl" and terns, for which insufficient data exist. The logarithm of the ratio was analysed using the analysis of variance (ANOVA).

None of the F tests was found to be significant at the 5% level. Thus this analysis provided no evidence of displacement of birds that might be the result of the Kentish Flats construction activity and operation from the region that included the wind farm.

Because birds were seen along sections of the transects selected for analysis far from the wind farm, it may be helpful in future FEPA monitoring reports to restrict analysis to shorter stretches of transect closer to the wind farm. However, as discussed in section 7.2, the lower sample size will inevitable limit meaningful conclusions to the most frequently sampled species.

4.3 NUMBERS OF BIRDS SEEN IN FLIGHT IN DIFFERENT HEIGHT BANDS

Collision risk assessment and flight height analysis have not been undertaken for this or any previous monitoring report. Flight heights of birds flying above 20m are summarised by species in Table 27 below. These results show that very few species of conservation concern were at potential risk of collision when recorded. This issue may be considered in greater detail as part of the next Kentish Flats ornithological monitoring report in relation to potential collision risk related to objective 4 of the FEPA license. However, modelling the collision risk arising from a single red-throated diver, or from two common terns may be of limited value.

Table 27 Number of birds seen in flight and different height bands.

Species	Total	In flight	<1 metre	1-20 metres	>20 metres
Auk sp.	2	1	1		
Black Headed Gull	94	72	1	61	10
Black Tern	3	3		3	
Black-throated Diver	15	9	2	7	
Chaffinch	13	13	10	3	
Common Gull	219	203	1	151	51
Common Scoter	138	50	45	5	
Common Tern	195	182	4	176	2
Cormorant	187	35	20	13	2
Curlew	2	2	1	1	
Dark-bellied Brent Goose	21	21	13	8	
Fieldfare	3	3	3		
Gannet	30	29	6	19	4
Great Black-backed Gull	48	26	2	23	1
Great-crested Grebe	3	2	1	1	
Grey Plover	1	1	1		
Greylag Goose	2	2		2	
Guillemot	15	4	2	2	
Gull sp.	29	11		10	1
Herring Gull	509	447	41	320	80
House Martin	8	8	3	5	
Kittiwake	41	40		38	1
Lesser Black Backed Gull	297	218	13	172	33
Linnet	2	2		2	
Meadow Pipit	8	8		8	
Merlin	1	1			1
Peregrine	1				
Razorbill	3				
Red-throated Diver	176	135	26	108	1
Sandwich Tern	22	22	5	17	
Starling	201	201	168	33	
Swallow	46	46	6	38	2
Swift	3	3		3	
Woodpigeon	43	43			43
Unidentified finch	5	5		5	
Unidentified passerine	4	4	1	2	1
Unidentified pigeon	1	1		1	

5 DISCUSSION OF SURVEY BOAT SURVEY DATA

5.1 BIRD GROUPS

This Section describes the observations of birds of conservation importance including the qualifying Kent SPA species recorded during the boat surveys in Year 5. Surveyors' reports including their descriptions of birds seen in Year 5 can be viewed in full in Appendix A3. The following sections describe the population estimates of the various species recorded during the Kentish Flats boat surveys and draw in detailed observations from the surveyors' reports. For comparison, descriptions of bird populations recorded during the previous years of monitoring, and reproduced from the previous monitoring reports, are included in order to develop a longer term view of bird populations and behaviour across the area. Measures of abundance are included for species with sufficient sample sizes and for which realistic standard errors could be calculated. These observations and descriptions are discussed below, particularly in relation to FEPA objectives 1 to 4 (see also Section 7.3 FEPA Monitoring Objectives). Conclusions on the boat survey data are made in section 7.1

It is important to note that the numbers of birds referred to in the Surveyors Reports are sometimes incorrect because they are anecdotal and therefore implicitly less accurate than the data sheets. Results and figures presented in this report have been plotted from data imported into ESS's in-house database after checking and in some cases correcting raw data sheets, rather than from surveyors' reports.

5.1.1 Divers

On 7th December 2005 there were 11 red-throated and three black-throated divers. Five red-throats were also seen in between the northern ends of transects 2 and 3. In Year 4 on 11th December 2004 a total of 450 recorded.

On 13th January 2006 there was the highest diver count in Year 5, of 157 red-throated diver and 5 black-throats. In addition a group of around 40 divers was seen just to the north of the northwestern corner of the buffer zone. A number of fish marks, thought to be shoals of sprats was noted on the sounder towards the northern ends of transects 1 and 2. No divers were seen within the operational wind farm but a number were seen in flight or on the water very close to the outside edge of the wind farm, (some sitting less than 100m from a turbine). It appeared to the surveyors that the lines of turbines may act as a barrier to divers entering or passing through the turbine array, as opposed to them being troubled by individual rotating turbines. The population estimate for red-throats on this date was 99 (± 43.4). On 19th January 2005, 245 divers were recorded, of which 226 were identified as red-throated diver, which is below the total count, suggesting that the divers were aggregating, as has occurred during some previous surveys.

On 17th February 2006 only four red-throated divers were recorded (plus two seen between transects). The population estimate on this date was 17 (± 9.4) whose 95% probable range was above the total count. This is probably a record low count for divers in the recognized diver season and very surprising for February considering the quantity seen in this month in the past. On 7th February 2005, 683 divers were recorded (see Figure 61)

As in February there was an exceptionally low diver-count on 2nd March 2006 with only four red-throated and four black-throated divers recorded. On 8th March 2005 17 red-throated divers had been seen.

On 4th November 2006 the first diver of the season was recorded: a black-throat flying quite high at 20m, to the south-west in transect 7 and not on course for the turbines. There were still only a few divers on the site on 01/12/06 with three red-throated diver and two black-throats recorded, all flushed by the survey vessel.

More black-throated divers (11 shown on Figure 105) were detected in Year 5 than Year 4 (when six were seen) but fewer than in some previous years. The highest numbers of black-throats (25 in Year 3) is striking, with only two seen in Year 1 and none in Year 2.

On 8th March 2005 one black-throated diver was seen (see Figure 62) in the control site; three black-throated divers were recorded on 3rd April 2005 (see Figure 63), on 12th November 2005 a black-throat was seen on the control site (see figure 74), and on 17th November a black-throat was seen at the south of transect 1 in the southwest corner of the buffer (see Figure 75).

In Year 3 on 7th April 2004 eight black-throated divers were seen, some of which were in summer plumage. Incidentally while travelling to the survey site, approximately four kilometres north of Hampton pier, around 30 divers, at least six of which were identified as black-throated diver, were seen in a feeding frenzy. On 15th October 2004 two black-throated divers were seen flying over the wind farm site, plus one just to the south of the site. The previous year on 12th October 2003 the first divers of the autumn were thought likely to be black-throated divers (although identification was not certain) supporting the view that black-throats are generally seen in this part of the Thames Estuary earlier in the year than red-throats. On 26th November 2004, the highest number, 15 black-throated divers were observed (it was noted that it is very unusual to see so many of this rarer species).

Much lower population estimates and numbers were recorded during the Year 5 monitoring, compared to records for Year 4 and other previous years. On survey dates in November and December the population estimates were 3 (± 2.3) and in March and April were zero. During the Year 5 surveys no divers were seen either in the air or on the water within the Kentish Flats wind farm area.

In Year 5 observations of divers totalled 194, of which 51 were in transect. A detailed breakdown of all species including divers seen in and out of transect or snapshot during each Year 5 survey is also presented in Appendix A1.

By comparison, in Year 4 observations of divers totalled 1,404, of which 704 were in transect: this total was comprised of 1,392 red-throated (699 in transect or snapshot), 6 black-throated (4 in transect or snapshot) and 37 unidentified divers (1 in transect or snapshot) (see Appendix A1). In Year 3 of the monitoring program (2003/2004), a total of 17 unidentified divers, together with 942 red-throated divers and 25 black-throats (total 984) were detected within the combined wind farm site and buffer zone during the boat surveys. Of these 6, 333, and 14 respectively (total 353) were seen in transect or snapshot. A further 21 red-throats were recorded within the control site, of which 13 were seen in transect or snapshot.

These totals for Years 3 and 4 compare with the Year 2 total of 1,672 divers (293 were in transect or snapshot), of which 19 were unidentified divers, 1,653 were red-throated divers, and no black-throats or great northern divers were recorded within the wind farm site and buffer zone. A further 139 red-throats were recorded within the control site (of which 18 red-throats were seen in transect or snapshot).

In Year 1, only 48 unidentified divers, together with five red-throated divers, two black-throats and one great northern diver (total 56) were detected within the wind farm site and buffer zone during the boat surveys (of which 19, 4, 3 and 1 respectively were in transect or snapshot). A further 6 unidentified divers and 2 red-throats were recorded within the control site (of which one unidentified diver was seen in transect or snapshot).

5.1.2 Cormorants

Regular numbers of cormorants were seen within the turbine array area pre construction, whereas there have been very few during construction and operation. The statistical analyses showed that cormorant numbers were lower between December and April since the wind farm became operational, but not at other times of year.

This species might be expected to benefit from the erection of the turbines and the perching opportunities they offer since such structures at sea may be a key factor in determining how far out to sea cormorants will go to feed. It is possible that cormorants may habituate to the turbines.

5.1.3 Grebes

In Year 5 three great crested grebes were recorded out-of-transect or snapshot. One was on the sea on 17th February 2006 at the southern end of transect 2 in the buffer zone, and two were flying in the control site on 2nd March 2006. The two flying were on the second and fourth transects flying east at a height of 2m and west at a height of 1m respectively. For most of January and February 2006 there were 250+ great crested grebes wintering off the Kent coast south of the windfarm off Reculver, Minnis Bay, and especially Greham Bay.

No great crested or any other grebes had been seen in Year 4. In each previous year only small numbers had been seen; this very coastal species would not be expected as far from the coast as the wind farm. However, on 3rd January 2004 eight great crested grebes were recorded (see Figure 33), the highest number recorded yet for surveys on this site.

5.1.4 Geese

As in previous years the most frequently seen wildfowl, except scoter seaducks, were dark-bellied Brent geese. Fewer geese were seen during Year 5 (21 dark-bellied Brent and two greylags) compared to the 99 recorded in Year 4.

In Year 5 on 13th April 2006 two greylag geese flew low northwest past the boat on transect 6 at 10:13 (see Figure 106). The line they were taking took them straight through the turbine array so they were watched very carefully by the surveyors. As the geese approached to within about 200m of the array they hesitated, almost stalling in the air. They then flew a few tens of metres east, then west, then gained height, hesitated some more then headed northwest again equidistant between two rows of turbines, flying at about 60m asl each time they passed between pairs of turbines, and at about 20m asl in between pairs. They appeared not to take notice of the turbine array until they were almost upon it. This contrasts with the behaviour of a flock of 43 wood pigeon that were seen on the same day, which flew west ahead of the boat on transect 7 at 09:35. Their line of flight would have had them fly west just inside the southern edge of the turbine array. About 1000m before they reached the array the pigeons changed course and headed northwest parallel to the eastern side of the array.

On 9th October 2006 five Brent geese were recorded in the control area flying low to the west and looked as if they would fly to the south of the turbines rather than through the wind farm but were lost from view before the surveyors were able to confirm this. A further group of eight Brent geese were seen on the 'non-transect' side of the vessel in transect 8 (see Figure 106). These birds were seen to fly through the wind farm below the turbines behaving as if they were uneasy, starting at a height of 1m asl then up to 20m before flying at varying heights of between 1m and 15m asl, fragmenting as a group and reforming a number of times. They appeared to fly through the full east to west width of the wind farm, though remained below rotor height.

On 4th November 2006 eight Brent geese were seen, one group of three skirting the southern edge of the wind farm, and a group of five skirting the northern edge (see Figure 106). It is not known if these geese altered their flight path to avoid the wind farm as they were not seen until already alongside the turbines.

During the previous Year 4 on 3rd October 2005 two groups of ten and two Brent geese had been recorded (see Figures 72 and 77) while groups of five and seven were seen on 14th October 2005 (see Figures 73 and 77). Approximately 75 Brent geese to the west of the wind farm on 7th February 2005 (see Figures 61 and 77). In Year 3 on 14th November 2004, 21 Brent geese had been seen flying in an approximately westerly direction, up the estuary (see Figures 46 and 49). No other Brent geese were seen in Year 3. In Year 2, on 12th October 2003, three groups of Brent geese (see Figure 18) comprising 43 birds were seen flying southwest, (except four geese heading north). All would have passed through the turbine area, though only the skein of 23 were flying near rotor height (flight height estimated at 20m asl) and therefore would have been at potential risk of collision if such a flight were repeated during the operational phase. In Year 1 six Brent geese were seen within the buffer zone and eight flew within the wind farm site on 13th October 2001. On 4th November 2002 32 Brent geese were seen.

Sixteen pink-footed geese had been seen in the buffer zone on 13th October 2001. None were seen later in Year 1, nor were any seen in Years 2-5.

5.1.5 Dabbling ducks

None were seen in Year 5. During the surveys conducted in previous years, a number of dabbling duck species had been seen including shelduck, wigeon, gadwall, teal and merganser. The ten shelducks seen in Year 4 on 3rd October 2005 were flying northwest at 45m asl. It is possible but unlikely that these ducks may have flown through the wind farm site *en route* to one of the coastal SPA sites surrounding the Thames Estuary, but it is not possible to be certain of this based on the available observation (see Figures 72 and 77) since they were not seen to fly near the turbines.

During the previous reporting period in Year 4, ten wigeon were seen on 14th October 2005 flying at a height of 60m were recorded heading in a northerly direction through transect 7 (see Figures 73 and 77) and would probably have flown at rotor height through the wind farm, but were not observed to do so.

On 5th March 2004 in Transect 5, four gadwalls were seen sitting on the water. A shelduck was seen sitting on the sea on 6th November 2003 in the control site, and on 18th December 2003 another was recorded flying over transect 3. On 12th May 2004 a pair of shelduck was seen flying towards the Swale in transect 7.

In Year 3, on 3rd September 2004, eleven teal were seen, probably migrating, and in Year 2 a pair of teal were also recorded on 8th September 2003, probably also in migration. In Year 2 a group of approximately 80 teal were recorded heading west on 14th December 2002 at the south of transect 6 and were probably flying in from the continent. They may have spent the early part of the winter in the Low Countries and were heading into the UK as temperatures on the continent dropped.

5.1.6 Seaducks

Appendix A1 shows 138 common scoters were seen in Year 5, 48 of which were in transect on the sea out of a total of 88 seen on the water; 50 were recorded in flight).

The first scoters seen in Year 5 were a flock of five common scoters was seen on 13th January 2006, flying to the west in the control area (see Figure 106). On 2nd June 2006 around 40 common scoters were seen on the water north of the wind farm in transect 4, probably summering in the area. They were observed to take off and land nearby a number of times. On 9th October 2006 a tight group of 45 common scoters was seen flying low to the southeast in transect 6 to the north of the turbines. A flock of 40 common scoters were seen on the sea between transects 4 and 5 on the 2nd of June 2006. On 1st December 2006 a group of eight common scoters was flushed about 400m ahead of the survey vessel in transect 1 through the western part of the buffer zone.

In Year 5 138 common scoters were seen. This total and that of 200 recorded during Year 4 is substantially greater than the 36 common scoters, 26 velvet scoters and six eiders recorded in Year 3, and the 17 common scoters recorded in Year 2.

The party of eight common scoter seen heading east through transect 5 on 10th May 2005 might have been migrants, but could have been birds intending to summer in the area. The group of 45 common scoter seen on 29th May 2005 were heading southeast on transect 8. This late in the year it would seem likely they were summering birds.

The largest flocks seen in Year 4 comprised around 50 and 55 birds on 8th July 2005. Both flocks of common scoter were seen in Transect 8 to the east of the buffer zone, with two smaller flocks adding up to 19 in the control site (see Figures 68 and 77). On 1st August 2005, eight common scoter were seen on the 'non-transect' side of the boat flying in a southeasterly direction. On 6th September, six common scoters were seen between transects to the south of the site flying to the west so were not included in the analyses or mapped. Three common scoter were flushed ahead of the survey vessel on 3rd October near the northern end of transect 5 in the buffer zone.

In Year 3, on 8th December 2003, a flock of four female eiders were seen flying across transect 2, and on 26th November 2004 a pair of eider was recorded. None were seen in other years. On 5th March 2004 in transect 5, a flock of 26 velvet scoter were recorded in flight. On 14th November 2004 and on 15th November 2002 single mergansers were recorded. Neither species were recorded in Year 4.

In Year 2 on 27th November 2003, two small flocks of common scoter, comprising 18 birds were seen near the southern border of the wind farm site during the outbound journey. On 8th December 2003 two pairs of female common scoter were seen at different times, so were possibly the same birds. On 3rd September 2004 over a low tide, six common scoter were recorded in the buffer zone, one solitary bird at the south of transect 7, and one flock of five seen between transects 2 and 3. On 27th October 2004 a party of eight common scoters was seen flying in a southerly direction in transect 5.

5.1.7 Waders

A curlew was recorded flying at a height of 3m to the northwest in transect 7 (see Figure 106) on 2nd March 2006 and would have flown through the wind farm site so the wind farm has not presented a barrier to this species.

A grey plover (BTO code GV on Figure 106) was seen in transect 6 flying at a height of 1m on the 18th of September 2006. No other wader species were seen in the study area within Year 5.

Three oystercatchers had been recorded in Year 4 on 8th July 2005 heading to the north across the estuary (see Figures 68 and 77) with a further one seen incidentally doing the same on the other side of the survey vessel. Twelve bar-tailed godwits were seen to the south of the wind farm on 6th September 2005, flying at 20m height and in a westerly direction (see Figures 70 and 77), probably migrating into the estuary for the winter. They would not have flown through the turbine area, and were therefore not at potential risk of collision.

In Year 3, on 12th May 2004, three common sandpipers were recorded flying in a northerly direction in Transect 6, in migration through the area on their way to breeding grounds in the north. On 26th August 2004 a small flock of four unidentified medium-sized waders was recorded in the control site, plus a solitary knot, all flying in a southwesterly direction. On 3rd September 2004 a mixed flock of waders, identified as 30 dunlins and one knot, was recorded in the buffer zone on Transect 7 flying in a southwesterly direction, probably in migration. On 29th September 2004 two knot and eight dunlin were recorded incidentally just after the end of the survey, heading in an approximately westerly direction. On 27th October 2004 a flock of seven dunlins was recorded flying in a southwesterly direction.

In Year 2 waders seen included common sandpiper, dunlin, turnstone, knot and unidentified medium-sized waders. Dunlin were recorded flying east at 5 m height in Transect 4 on 6th March 2003, and a turnstone nearly landed on the bow of the boat in Transect 5 near the centre of the wind farm site on 27th November 2003.

In Year 1 five dunlins flew through the wind farm site on 30th November 2001. Thirteen lapwings were seen in Year 2 and one was recorded in Year 1. Two single curlews had been seen in Year 1. The single redshank recorded in migration in Year 2 was the only record of this species over the four year study so far.

5.1.8 Terns

The first terns seen in Year 5 were two Sandwich terns flying west at 0910 on 2nd May 2006, just before the start of the survey. On 23rd May 2006 11 common terns and seven Sandwich terns were recorded. The great majority were seen to the south of the wind farm, flying in a westerly direction. Some were seen feeding, or trying to, but none were observed carrying fish. Surprisingly few terns, (only four common tern), were seen on 2nd June 2006 either on the study site or during the outward and returning journeys to and from Whitstable harbour. Five of the eight common terns recorded on 21st July 2006 appeared to actively avoid the wind farm by veering north or south from a westward flight. Five Sandwich terns were also recorded, one of which was seen flying through the wind farm. On 7th August 2006 36 common terns, (plus a group of 21 on the 'non-transect' side of the vessel), two Sandwich terns, and two black terns were recorded. Black terns have been recorded in the past on this site in the late summer but these were the first in Year 5. They will probably have been in migration from the Baltic to the West African coast. Twenty two of the common terns recorded, the two black terns, and three gannets were seen feeding together at the now regularly observed summer feeding area near the southern end of Transect 8. Four common terns, (plus a group of seven feeding to the north of transect 2), and five Sandwich terns were recorded on 18th September 2006.

On 29th September 2006 there was a high count of common terns with a tight group of 82 birds seen dip-feeding near the Spaniard buoy at the southern end of transect 1. A further 25 common terns were seen flying in generally eastern or western directions through the site including five that were seen flying through the wind farm (see Figures 101 and 107). The Medway breeding terns are thought to have migrated south and these birds are likely to be from further north, on their way south, opportunistically feeding on the way. Three Sandwich terns and one black tern were also recorded. Just one common tern was recorded on 09th October 2006, very different to the survey eleven days before when over 100 were recorded.

In Year 4 on 6th September 2005 a large group of terns (by far the largest seen so far) was recorded within the study area. The population estimate was 522 ± 402 (see Table 5 in Gill *et al* 2006). Approximately 180 common terns and 10 Sandwich terns were seen moving near the southern end of transect 1 in bands A-D (see Figure 70). Some were feeding but not in a 'feeding frenzy' (as had been seen during the previous three surveys) that can be seen when a tight shoal of small fish such as sandeel are forced near the surface. They appeared to be 'milling about', back and forth across the transect line, sometimes sitting on the water. Three arctic skuas were also seen almost continually harassing the terns which kept the terns on the move. It is known that on their southern migration terns regularly cross the land from this north facing Kent coast to the English Channel, effectively cutting the corner by flying over the 'thumb' of Kent. It had been postulated by the surveyors that these terns were collecting here, possibly over several days before migrating over the land as a large group. This is possibly supported by the 29/09/06 observations.

In Year 5 there was less repetition of 'feeding frenzies', which occurred in Year 4 near transect 8 from 8th July 2005 to 1st August 2005 and on 6th September 2005. However, on 29th September 2006 82 common terns were seen dip-feeding in a tight group near the Spaniard buoy at the southern end of transect 1.

Fewer Sandwich and common terns appear to be flying through the turbine array prior to the operational phase of the Kentish Flats Wind farm.

5.1.9 Passerine migrants

In Year 5 a total of 237 passerines were recorded, of which 21 were in snapshot counts. On 2nd March 2006 dove sp were seen flying northwest. Of a total of 124 birds of eight species recorded on 13th April 2006, 49 were passerines (including three meadow pipits, two linnets and a house martin, all of which will have been migrants). On 2nd May 2006 three swifts flew west, and six swallows flew west on transect 6. The 19 swifts, 60 swallows, two house martins and two meadow pipits seen in the previous year on the survey of 10th May 2005, compared with only three swifts, six swallows and no martins or pipits on this survey may have been attributable to the northerly wind direction on the earlier date, which is ideal for migrants. On 23rd May 2006 one swallow was seen flying through the site, probably a late returning migrant. Two swallows were recorded flying on 2nd June 2006. On 18th September 2006, a number of passerines were seen migrating through the site, all in a generally western direction: 28 swallows in groups of two to eight throughout the day (including some flying through the wind farm); and one group of four house martins; five meadow pipits; and five unidentified finch species. On 29th September 2006 flocks of seven and eight starlings were recorded flying low and to the west through the site. Two unidentified small passerines were seen flying to the southwest, just north of the buffer zone between transects. On 09th October 2006 48 starlings were seen migrating through the site in a westerly or southwesterly direction. On 4th November 2006 13 chaffinches, 138 starlings, two fieldfares and one unidentified small passerine were recorded, all flying in a generally western direction. All were flying alone or in small groups apart from one tight flock of around 110 starlings.

In Year 4 on 3rd April 2005 16 meadow pipits, and six sand martins were the first passerines seen. One swallow was recorded flying through the site on 22nd April 2005, migrating into the UK to breed. On 10th May 2005 there was a relatively large number of land birds (19 swifts, 60 swallows, two house martins; and two meadow pipits) migrating through the survey area, all flying strongly north. The only passerines seen on 29th May 2005 were 5 swallows, all heading north, they will have been late migrants. On 15th June, 19 swifts were seen, all flying in a southwesterly direction, probably in response to a weather system. On 8th July five starlings were recorded, probably early migrants into the UK. On 6th September four swallows were recorded flying across the estuary to the south, probably in migration to Africa. A number of small passerines were recorded on 3rd October, presumably in migration. Seven wagtails that could not be identified to species flying to the north-west, (three of these were seen on the 'non-transect side' of the vessel); two meadow pipits flying to the north-west; one starling flying west; and three unidentified small passerines heading to the north-west. Two small flocks of small passerines were seen on 14th October 2005.

5.1.10 Raptors

On 2nd June 2006 a peregrine falcon was seen actively looking around on the top of the nacelle of turbine F3, (as the wind was so light the rotor was not revolving). The peregrine was probably sitting on this vantage point to spot potential prey. On 4th November 2006 a merlin was observed on the 'non-transect' side of the vessel, seen stooping on a group of starlings.

In Year 4 no raptors were seen. In Year 3 on 26th August 2004 a female marsh harrier was seen near the northwest corner of the turbine area, and on 18th April 2002 a marsh harrier was seen within the buffer zone. On 15th October 2004, a peregrine falcon was recorded flying in a northerly direction. It had been speculated that once the wind farm was operational, it might benefit falcons preying on tired birds towards the end of migration across the sea to the coast, but any such pattern has yet to be detected. In Year 2 a merlin was seen with a dead bird in its talons, feeding on it while it flew.

5.1.11 Rarer Gulls and notable gull observations

On 13th January 2006 there was a sighting of a possible 1st winter bird Mediterranean gull but this had to be recorded as 'unidentified gull sp' as there was no absolute species identification. In Year 2 on 14th December 2002 a Mediterranean gull was recorded. None were seen in Years 4, 3 or 1.

A number of gulls were seen within the operational wind farm and surveyors noted this occurrence (see Figure 89-91 & 93).

On 2nd March 2006 a feeding frenzy' of approximately 100 gulls was observed just to the south of the south-east corner of the main study-site. A 'feeding frenzy' was also witnessed on 21/07/06 during the outward journey near the southern end of transect 8, (as it was several times last summer).

On 22nd April 2005 17 little gull were seen in two groups on the western side of the site migrating through the area, probably on their way to breeding grounds in the Baltic. During the 3rd January 2004 survey (AO), 14 little gulls were recorded moving through the study-site in two groups. Incidentally, another group of six little gulls was seen whilst returning from the survey area to port. These gulls were probably in migration from the North Sea to winter in the Atlantic. On 15th October 2004 a total of 84 gulls were recorded and little gull made up a surprisingly high percentage at 32%. On 27th October 2004 two little gull (together with four great skuas) were recorded in one flock in Transect 5. On 26th November 2004 one little gull was recorded

5.1.12 Skuas

An arctic skua was seen outside the survey area on 9th October 2006.

Five arctic skuas were recorded in Year 4, slightly more than in Year 3. The largest numbers were seen on 6th September 2005 when three arctic skuas were almost continually harassing a feeding frenzy of terns. On 14th October 2005 an arctic skua was seen between the northern ends of transects 1 and 2, whilst three arctic skuas were seen amongst the terns on 6th September 2005 just inside the study area. The previous year on 3rd September 2004 three arctic skuas were also recorded, including one juvenile and one seen harassing terns. An arctic skua was seen flying towards the feeding frenzy on Transect 8, attracted by the abundant terns within it. Another arctic skua was recorded in Transect 1. On 29th September 2004 one great skua was recorded, heading in an approximately westerly direction. On 27th October 2004 four great skuas (with two little gulls) were recorded in one flock in Transect 5.

5.2 MARINE MAMMALS

On 13th January 2006 a common seal was seen in transect 8 on the eastern edge of the buffer zone. One common seal was seen 7th December 2005 between the northern ends of transects 3 and 4, again in the buffer. On 17th February 2006 a seal was recorded in transect 8 along the edge of the Pan Sands, too distant and fleeting a view to identify to species. On 2nd March 2006 and an unidentified seal was recorded in transect 1. On 23rd May 2006 one common seal was seen in transect and two others were noted on the 'non-transect' side of the boat. On 7th August 2006 a common seal was seen within the wind farm.

Two common seals were recorded on 9th October 2006. A common seal was recorded on 1st December 2006 just to the south of the wind farm in transect 5.

On 11th December 2004 two common seals were recorded at the northern ends of transects 1 and 3 (see Figure 59). On 7th February 2005, a single common seal was recorded in transect 7. On 3rd April 2005 a lone common seal was seen and on 6th September 2005 two common seals were recorded within the study area between the buffer and control site (see Figure 70). One common seal was recorded just to the east of the buffer zone (see Figure 71) on 27th September 2005. On 12th May 2004 a single common seal was seen in transect 5 just to the south of the turbine area.

During the previous year, on 5th March 2004, a single unidentified seal was recorded within the south-eastern margin of the buffer near the control on transect 8. Five seals were also seen incidentally on the outward trip from the port to the survey area. On 7th April 2004 two seals were recorded on transect 8 at the east of the buffer, one being identified as a common seal. On 8th June 2004 two seals were seen in transect 8 close to the Pan Sands to the east of the buffer but were too distant to be able to identify to species.

The first of the Year 5 cetacean observations was a harbour porpoise seen very briefly in the control area on 2nd March 2006. On 23rd May 2006 a harbour porpoise was seen between the southern ends of transects 3 and 4. On 7th August 2006 three harbour porpoises were recorded to the north of the wind farm in transect 4 and a further porpoise was recorded in transect 8. One harbour porpoise and two common seals were recorded on 9th October 2006.

In Year 4, on 19th January 2005 a harbour porpoise that appeared to be actively chasing fish was recorded in transect 3, and another was recorded in transect 2. In Year 2, on 27th November 2003, one or possibly two harbour porpoises were seen swimming in a southeasterly direction between the northern ends of transects 3 and 4. On 7th April 2004, while travelling to the survey site and approximately four kilometres north of Hampton pier, two harbour porpoises were seen. In Year 1 no harbour porpoises were detected during the boat surveys.

On 13th and 19th April and 2nd May 2006 no cetaceans or seals were seen. Although conditions were perfect on 2nd June and 21st July 2006 no marine mammals were recorded. No marine mammals were recorded on 18th or 29th September or on 4th November 2006.

The majority of these observations have been recorded outside the wind farm site, with some at the edge of the buffer near the shallows to the east and southeast.

6 DISCUSSION OF THE AERIAL SURVEY DATA

The following sections describe the distribution and characteristic behaviour of birds across the TH1 Strategic Survey area of the Inner Thames estuary in relation to the Kentish Flats wind farm areas based on the observations from the aerial surveys. The descriptions focus on the data gathered during year 5 of the monitoring program, but also refer to the findings of the surveys conducted in years 1 to 4 in order to provide the appropriate context to this data.

6.1 DIVERS

No divers were seen within the Kentish Flats Wind Farm site in Year 5 (see Figures 108-116). There also appear to be slightly fewer divers seen with the boat survey buffer zone than in previous years.

As noted in the previous monitoring report, the changes in aerial counts of divers between the 6th and 13th March 2005 (see Figures 81 and 83) indicated that there may be substantial changes in distributions of divers within survey area TH1 of the Thames Estuary in over a single week at this time of year. Much smaller numbers have been counted from the air and boat within the Kentish Flats Wind Farm site and buffer zone in Year 5.

Differences in survey dates between each year's aerial surveys (by approximately one month) make drawing firm conclusions from the data more difficult. The closest survey corresponding dates between years were on 11th January 2002, 18th/19th January 2003, 15th January 2005, and 14th January 2006, followed by 26th February 2004, 6th March 2005 and 18th February 2006. The difficulty in comparing data is compounded by the likely natural, inter-annual variations in the monthly patterns of diver distribution across the survey area and indeed across the whole Thames Estuary. These difficulties have been explored by the British Trust for Ornithology (BTO) in their COWRIE review (Maclean, Skov, Rehfisch & Piper 2006) of the statistical power of the WWT aerial survey programme to detect changes around Kentish Flats Wind Farm, North Hoyle and other small offshore wind farms (see section 7.2).

No divers were seen within the Kentish Flats Wind Farm during Year 5 and large numbers have not been counted within the buffer zone. On 11th December 2005 divers were seen to the west and south of the buffer zone (see Figure 110) whereas on 14th January 2006 divers were recorded more to the southwest, north and northeast (see Figure 112). On 18th February the main distribution within the area plotted had shifted to the east (see Figure 114). The aggregated diver distribution shown in Figure 116 reveals the absence of divers from the wind farm and fewer seen within the buffer zone than elsewhere.

In Year 4 diver distribution both within the buffer zone, and elsewhere within the TH1 survey area was at its most dispersed on 15th January 2005 (see Figure 79), when numbers within the buffer zone were greatest, though again none were seen within the turbine area (as was the case for all of the five aerial surveys conducted in Year 4). Diver numbers and distribution recorded within the TH1 area have fluctuated between the aerial surveys conducted during Year 4. On 6th March, single divers only were seen to the south of the wind farm site, whilst greater numbers were recorded over 5km to the northeast, including a group of 534 over 20km away (see Figure 81). By contrast one week later more divers were detected between the wind farm and the coast (only one in the buffer zone), to the west, and to the northeast (see Figure 83). Very few divers were seen in the TH1 survey area during the survey conducted on 13th November 2005 (only 16 divers are shown on Figure 86).

Year 3 locations mapped in Figure 30 indicate that on 27th November 2003 there were very few divers within the boat study area (two were identified within the wind farm site and three (one red-throat) within the buffer), with larger numbers to the north and east. Just to the west of the buffer zone (by a few hundred metres) a group of divers (some identified as red-throated diver) were recorded feeding on the edge of the deeper water. On 26th February 2004 (see Figure 53) no divers were recorded within the wind farm site and only six were noted within the buffer, though much higher numbers were again seen to the east and northeast. The survey flown on 30th October 2004 (see Figure 55) revealed a marked absence of divers from the boat survey area and only 12 divers to the north of the wind farm, buffer and

control. Numbers of divers built up through the winter so that at the start of Year 4 there were substantial numbers of divers seen around (though none within) the wind farm on 5th December 2004 (see Figure 57).

Comparison between the 27th November 2003 (see Figure 30) and 17th December 2003 (see Figure 51) aerial survey data indicates that in December 2003 much higher numbers of divers were seen from the air within the boat survey buffer, and several were within the wind farm site. Considerable numbers of divers were seen on 5th December 2004 immediately to the north of the wind farm site (and some were detected to the west, south and east), but none were seen within the wind farm site and only six were within the buffer area. In the previous year, on 27th November 2003, a broadly similar pattern of diver numbers building up was seen, though by 17th December 2003 divers were utilising much of the area surveyed including the wind farm site and buffer (compare Figures 30 and 51). This demonstrates the build up of diver numbers in December, and emphasises the importance of avoiding such peak diver periods for monopiling operations, as was achieved in Year 3 and in compliance with the conditions set out by the FEPA licence as Objective 5.

In Year 2 large numbers of diver were recorded during the aerial surveys conducted on 18th and 19th January 2003. Of the 21 divers recorded within the wind-farm area, six were identified as red-throated diver. Within the buffer zone 20 out of 45 divers recorded were identified as red-throated diver. Three unidentified divers were recorded within the control area. Two high-density areas were recorded within the wind-farm/buffer zone, at densities as comparably high as anywhere within the aerial survey area examined at that time. There may of course be higher densities elsewhere within the outer Thames Estuary. Large numbers of unidentified divers (all those identified specifically were red-throated diver) were recorded throughout the area surveyed.

In Year 1 small numbers of divers were recorded on 11th January 2002 within the wind-farm site, buffer zone and the control area. All were either red-throated diver (two in the wind farm site and three in the buffer zone) or unidentified diver species (one in the wind-farm site and one in the control area). Elsewhere in the area surveyed, larger numbers of divers were recorded and at greater densities. All were recorded as red-throated diver or unidentified diver species, except one great northern diver identified in the outer Swale Estuary, off the north coast of Kent.

There were differences between the methods and transects of January surveys in Years 1 and 3 which confounded any differences between years. These were discussed in the First Monitoring Report (Gill, Sales & Pullinger 2004).

The Year 2 to 5 January survey methods and transects flown were identical so the comparisons are more valid than those in relation to Years 1 and 2. Indeed the aerial transects have largely remained the same since 30th October 2004 (see 55-58, 79-88, 110-116). There were no statistically significant changes revealed by the analyses.

6.2 GREBES

No grebes were recorded within 5km of the Kentish Flats wind farm site during the aerial surveys in Year 5. On 5th December 2004 one great-crested grebe was seen to the north of the buffer zone (see Figure 58). Since this species tends to feed close in to shore this is an unusual record. On 17th December 2003 one unidentified grebe was seen within the wind farm site (see Figure 52).

6.3 SEADUCK

Common scoter were seen on 18th February 2006 in five small flocks (numbering 6, 9, 1, 5, 1, and totalling 22) over 2.5km from the nearest turbine to the north and west of the boat survey buffer zone, along with one eider (see Figure 115).

The Year 4 and 5 aerial survey data continues to show the low importance of the wind farm and surrounding area for seaduck. In Year 4 the aerial surveys detected large numbers (for the Thames) of common scoter over 10km to the north of the wind farm.

In Year 4 on 5th December 2004 four groups of common scoter, in groups of 27 to 60 were seen over 10km to the north of the wind farm, and a single bird over 10km to the north-east. Seven eider ducks were seen to the south of the buffer zone near the coast on 5th December 2004 (see Figure 58). On 15th January 2005 two flocks of common scoter were seen, also over 10km to the north (650) and north-east (25). The group of 650 were seen in band B and should therefore have been fairly accurately counted. No behaviour was noted. Ten red-breasted mergansers were seen to the south off the Kent coast (see Figure 80). On 6th March 2005 fewer numbers of seaducks were recorded; nine common scoter were within 10km of the wind farm to the north-east, and three around 4km to the south, with six eiders seen to the southeast (see Figure 82). A week later no scoter were recorded, and five eiders were noted in the same location as the six seen previously. No seaduck were seen on 13th March or 13th November 2005.

In Years 1-3 the aerial surveys recorded small numbers of seaduck near the boat study area. On 27th November 2003 two common scoter were recorded within the buffer zone, whilst a small loose group of 13 common scoter was recorded just off the north Kent coast near Thanet, the closest of these being 3 km to south of the buffer zone. None were seen in December 2003, whilst 64 common scoters and two eiders were to the south of the buffer zone in February 2004 and 24 common scoters were seen to the southwest of the buffer zone on 30th October 2004.

In Year 2, during the 18th and 19th January 2002 surveys, large numbers of seaduck were recorded in the Swale Estuary (480 common eider, an extraordinarily high count for Eider in the Swale, and 120+ common scoter) and off Foulness (small numbers of common scoter and common eider, plus 10 velvet scoter). In Year 3, no comparably large aggregations of scoter or common eider were seen nearby, though 58 common scoters were seen off the Essex coast. Scoter and common eider feed on shellfish and being restricted to shallow feeding areas may be more likely to be recorded feeding over the shellfish beds close inshore off the Essex and Kent coasts.

In Year 1, the first JNCC aerial survey on 11th January 2002 revealed three small flocks totalling 42 individuals of common scoter off the Essex coast over 10km to the north of the wind farm, and another flock of 25 common scoters was recorded approximately 6km west of the Kentish Flats buffer zone. No seaducks were recorded near the wind farm by the WWT on 21st August 2002 (also in Year 1) though this is not surprising during the summer period. In Year 2, on 30th August 2003, a group of three common scoters were seen to the north of the mouth of the Swale, northwest of Whitstable, and over 10 km to the southwest of the wind farm site. It is possible that these ducks were moulting, though this was not indicated by the aerial data.

6.4 OTHER KENT SPA SPECIES

No waders were recorded near the Kentish Flats Wind Farm in Year 5 during the aerial surveys. In Year 4 very few Kent SPA species had been recorded from the air anywhere near the boat study area. The only notable observation in Year 4 was of 30 waders off the Isle of Sheppey on 13th March 2005 (see Figure 84). On 6th March 2005 40 Brent geese were seen from the air off the Essex coast 15km from the nearest turbine (Figure 82), and three geese were even further away on 15th January (Figure 80) and on 13th March 2005 (Figure 84).

In Year 3, Kent SPA species recorded during the aerial surveys included 60 waders along the Kent coast on 17th December 2003, and one dark-bellied Brent goose to the northeast of the wind farm on 15th February 2004. There were 35 dark-bellied Brent geese to the north of the wind farm and 3 lapwings seen within the control site on 30th October 2004, when there were 25 teal and one dark-bellied Brent goose off the Kent coast. On 5th December 2004 almost 300 dabbling ducks (including flocks of 200, 6 and 35 wigeon) were recorded off the Kent coast. On the first Year 2 survey in January 2003, 175 wigeon were recorded on the edge of the Swale Estuary.

It is not possible to draw any conclusions with regard to SPA bird movements from a visual review of aerial data, since flight direction is only rarely recorded during aerial surveys. However, the Year 4 and 5 data continue to suggest the very minor importance of the Kentish Flats wind farm site and buffer zone for these SPA species.

6.5 TERNS

No terns were recorded in Years 4 or 5 as surveys were restricted to the winter months.

6.6 MARINE MAMMALS

In Year 5, on 13th November, a seal was seen in the northeast corner of the buffer zone. On 14th January seals were seen in the southern part of the buffer, and to the north (see Figures 111, 113 & 115).

In Year 4 no marine mammals were seen within the boat survey area. A substantial number of unidentified seals, and occasional harbour porpoises were seen during aerial surveys in area TH1. All seals were more than 3km (and all but two were 10km or more) from the Kentish Flats wind farm site.

On 13th March 2005 a porpoise was seen around 3km north of the wind farm site (see Figure 84). On 27th November 2003 a single harbour porpoise was recorded just outside the control area.

7 CONCLUSIONS

7.1 BOAT SURVEY DATA

Between 7th December 2005 and 1st December 2006, a total of sixteen boat surveys of birds and marine mammals have been carried out. Over 43% of these covered the wind farm site, the buffer and the control area, whilst the remainder covered the wind farm site and the buffer only. The control site has therefore been surveyed in a higher proportion of visits in Year 5 than previously, but no more frequently during the peak diver period in comparison to previous years. Thus the power of the data to detect changes in diver populations has not been substantially improved.

Population estimates for the wind farm, buffer and control site calculated for the 90 surveys since October 2001 permit comparisons of changes in abundance, as required by Objective 1 of the FEPA license. However, this remains difficult even after five years of boat survey data, in part because survey dates do not match between years but also due to natural and in some cases extensive seasonal variation between years. The more reliable of the two statistical comparisons of the boat survey data between the pre-construction, construction and operational periods has not revealed any statistically significant changes. However, the density analyses suggest that the numbers of red-throated divers were lower during the operational phase than during pre-construction. Cormorant numbers were lower between December and April since the wind farm became operational, but not at other times of year. Lesser black-backed gull numbers in February were lower in the construction and operational phases. There were suggestions of differences in other months for this species and possible reductions for greater black-backed and herring gulls, but no consistent patterns were detected. Gannet and common tern numbers show no evidence of changes.

The mapped data in Figures 105 (boat) and 116 (aerial) shows the complete absence of divers from within the wind farm in Year 5 and highlights the locations of those seen in the west of the buffer zone and in the control site, and the larger numbers recorded outside the buffer zone. Because the boat surveys last much longer than aerial surveys, the finding that no divers were seen from the boat within the wind farm in Year 5 at all is very notable. Fewer divers (194, of which 51 were in transect or snapshot) were seen within the buffer zone and control site than in previous years. Over the whole of Year 4, divers were regularly seen within the wind farm site (see Figure 76). A total of 1,435 divers were seen during the boat surveys, with 704 recorded in transect/snapshot. A higher proportion were seen in transect or snapshot in Year 4 than in any previous year, suggesting that population estimates may have been too high, because some were behaving unusually in aggregating within an area 300m wide, as suggested by the December 2004 and February 2005 data. The proportion seen out of transect has varied in Years 1, 2, 3 & 4, with the greatest numbers observed in Year 2. Nevertheless this finding may indicate some displacement of divers from the Kentish Flats wind turbine array. While no divers were seen within the operational wind farm a number were seen in flight or on the water very close to the outside edge of the wind farm, (some sitting less than 100m from a turbine).

There have continued to be some movements of wildfowl and a few waders seen possibly flying to and from the Thames coastal SPAs. No dabbling duck species were seen in Year 5. One hundred and thirty eight common scoters were seen in the study area during Year 5 (see Figure 106), more than in any previous year except Year 4 when 200 scoter were seen (see Figure 77).

Numbers of waders seen in Year 5 were fewer than in Year 4, though the numbers seen are far too low to comment upon whether such a change is statistically significant. With such low numbers seen even in previous years, no conclusions can currently be drawn as to whether any barrier effect has arisen or if waders have been discouraged from flying to or from one of the coastal SPAs (Objective 3). Indeed on 2nd March 2006 one curlew was recorded flying to the northwest at a height of 3m in transect 7 (see Figure 106) and would have flown through the wind farm site so the wind farm has not presented a barrier to this species. On 9th October 2006 another curlew was recorded flying low to the southwest in transect 2, possibly migrating into the Swale for the winter.

Two greylag geese seen on 13th April 2006 flew between two rows of turbines and varied in height between 60m and 20m asl (see 7.3.2 and 7.3.4 below). On 9th October 2006 eight Brent geese appeared to fly through the wind farm below rotor height and a further five were thought to have flown from the control area to the south of the turbines. On 4th November 2006 eight Brent geese were seen in two groups skirting the southern and northern edges of the wind farm.

The pattern of common tern flights passing regularly through the southern part of the turbine area carrying fish back to their breeding colonies in the Medway, detected by boat surveys in previous years, was less pronounced in 2005 (see Figures 66, 68 and 70) and in 2006 (see Figure 107), but terns were seen flying through the turbine array in slightly smaller numbers. However, the difference in numbers between those recorded in Years 4 and 5 and previous years is not statistically significant. As suggested in the third Monitoring Report (Gill *et al* 2006) the flight line for terns identified in previous years appears to have diverged north and south of the turbines with birds flying slightly further. This should be termed flight line divergence rather than flight line disruption. The tern 'feeding frenzies' witnessed in Year 4 was again in evidence in Year 5 on 29th September 2006 when common terns were seen dip-feeding in a tight group of 82 birds near the Spaniard buoy at the southern end of transect 1.

Passerine migrant species were recorded during boat surveys conducted during Year 5, but as in previous years there is no evidence of a regular flight line through the wind farm any more than the part of the Thames Estuary away from the coast. However there is considerable broad front movement of passerines through the windfarm, heading north in spring and south west and southwest in autumn.

The surveyors' reports suggest that gulls in general seem not to be have been influenced by the Kentish Flats wind farm and continue to use the wind farm site after construction. This is supported by the population estimates for the four gull species most frequently seen in snapshot or transect. There appear to be no statistically significant changes in gull abundance at the wind farm and buffer, though there is an indication that lesser black-backed gull may have declined in the construction and operational phases. Herring gull and great black-backed may have declined but results were inconclusive.

Fewer guillemots have been recorded since the construction phase, but the differences are not statistically significant.

Patterns of use and passage revealed by the mapped distributions of birds seen indicate some changes between years but in the majority of examples it is not possible to attribute these to any effects that might have arisen from the construction of the Kentish Flats wind farm. However, it is noted that divers appear to have avoided the wind farm site, based on the first year of data collected during the operational phase.

7.2 AERIAL SURVEY DATA

Only four aerial surveys were carried out in Year 5 covering the TH1 area and extending beyond the wind farm site, as part of the wider Thames strategic offshore wind farm aerial bird survey programme.

As in previous years the aerial surveys revealed only small numbers of seaduck within the boat study area (see Figures 111, 113 & 115). In Year 4 seven eiders were seen to the south of the buffer zone on 5th December 2004 (see Figure 58). No eider or scoter were seen within the boat study area. On 15th January 2005 ten red-breasted mergansers were seen south and east of the study area close to the shore. Approximately 650 scoters were seen to the north in the middle of the estuary, and a further 25 off the Essex coast, both groups around 15km from the wind farm site (see Figure 80). On 6th March 2005 there were six eiders over 5km southeast of the wind farm site as shown in Figure 82 (also there on 13th March – see Figure 84), a party of nine common scoter were seen around 9 km to the northwest, 45 over 10km to the north, and three common scoter were within 5km of the south of the wind farm (see Figure 82). Very few SPA bird species were seen on 13 November 2005, except waders off the Essex coast and four tern species seen 4-8km to the east and north of the wind farm. On 31st July 2005 waders were only seen off the Essex coast and 30 waders were recorded off the Isle of Sheppey on 13th March 2005 (see Figure 84).

In Year 3, SPA species seen from the air included 60 waders along the coast on 17th December 2003, one Brent goose to the northeast of the wind farm on 15 February 2004, 35 dark-bellied Brent geese to the north of the wind farm and 3 lapwing seen within the control site on 30 October 2004, as were 25 teal and one Brent goose off the Kent coast. Common scoter and two eiders had been seen to the south of the buffer zone in February 2004 (when cormorants were the commonest species around but not within the wind-farm/buffer zone). A total of 24 common scoters were seen to the southwest of the buffer zone on 30 October 2004. These aerial data cannot be conclusive but could suggest that the larger aggregations of scoter (120+ in Year 2) or common eider (480 in Year 2) had avoided the wind farm area in Year 3 but the boat data (see 7.1) suggests that any such avoidance did not occur in Years 4 or 5.

The British Trust for Ornithology (BTO) review of aerial survey and analytic methods as part of the COWRIE programme concluded that detection of changes in common scoter and red-throated diver populations near small offshore wind farms was unlikely to be achievable from aerial survey data collected under the current DTI-subsidised programme, providing only "restrained means of detecting changes in regions in which these species are particularly abundant" (Maclean, Skov, Rehfisch & Piper 2006). The authors surprisingly concluded that the size of the reference area has little predictable effect on the likelihood of detecting changes in numbers.

In this study, data collected from the aerial transects which pass through the wind farm and buffer were compared with reference areas to the east and west. The data subjected to statistical analysis includes large sections far to the north of the boat survey area so is not ideal. The ratio of the mean number of birds per aerial transect for the wind farm and buffer area together with the east and west reference areas were calculated and the log (ratio) was analysed using ANOVA to look for any changes in bird numbers that might be attributable to the effect of construction and operation. No statistically significant differences were found for any of the six species groups considered. The analysis therefore provided no evidence of displacement of birds from the aerial survey region that included the wind farm and buffer zone.

7.3 FEPA MONITORING OBJECTIVES

7.3.1 Objective 1

FEPA Objective 1 is to determine whether there has been any change in bird species, abundance and behaviour using and/or passing through the wind farm site.

The most apparent change, based on qualitative observations, is the absence of divers from the Kentish Flats Wind Farm site, though this may be partly attributable to the lower overall numbers of divers detected in Year 5. No statistically significant change was detected during the analysis of the Year 5 monitoring data.

It is apparent that the numbers of divers recorded within the turbine area have fluctuated both seasonally and between years, but have now declined to zero detected. For example, a comparison of Figures 22, 48, 76 and 105 reveals that diver numbers within the turbine area were greatest in Year 3 before construction (Figures 51 and 53 which show large numbers of divers to the northeast and northwest of the wind farm site) and lowest in Year 5. Nonetheless, it remains the case that the Kentish Flats and the surrounding area are of relatively low importance for red throated diver in comparison to other parts of the Thames estuary.

There appears to have been little other change in bird use and passage through the Kentish Flats Wind Farm, as measured by comparing species, abundance and behaviour between the pre-construction, construction and operational periods.

There were no statistically significant changes revealed by the analyses of aerial data for the six groups examined.

7.3.2 Objective 2

FEPA Objective 2 is to determine whether there is disruption to bird flight lines. The curlew recorded flying on a route through the wind farm site on 2nd March 2006 does not suggest a barrier to passage by this species. Several goose flights were recorded during the boat survey, more than in previous years. While there is no evidence of a specific goose flight line though the wind farm, as in Year 4 data there is some evidence of a general flight line westwards up the estuary so there may be some minor displacement of goose flights around the turbines *en route* to and from the North Kent SPAs. There is also some evidence that some geese (greylag and Brent geese observed) do not alter their flight line and fly their way right through the wind farm."

The pattern of common tern flights regularly passing through the southern part of the turbine area carrying fish back to their breeding colonies in the Medway, recorded in previous years, was also apparent in 2005 and 2006, but less pronounced than previously and terns appeared to fly to the north or south of the turbines. This is the only example of a regularly used flight line detected by boat surveys prior to construction. It is possible that this flight line may have been split during 2005 since in some cases a higher proportion of common tern flights passed to the north or south of the turbine area, than was the case during the equivalent surveys during 2003 or 2004. This result suggests some slight disruption to the tern flight lines noted during pre-construction monitoring surveys.

Only for common terns is there a suggestion of any change in use (for passage rather than feeding) within the wind farm site. Terns were recorded during the operational phase in Year 5 for the first time. They were seen both within (in smaller numbers than previously), and to the south and north of the turbines. There is little indication from the data available that Objective 2 is relevant for any other species.

Passerine migrants were recorded during nine boat surveys, but there is no evidence of a regular or specific flight line through the wind farm any more than the rest of the Thames Estuary.

7.3.3 Objective 3

Both boat and aerial survey data have been used to address Objective 3, which is to determine the distribution and any movements of wildfowl and divers in the boat survey area, and movements to and from the coastal SPA sites surrounding the Thames Estuary. These data continue to suggest minor importance of the wind farm site and buffer zone for wintering divers, which will qualify the Thames SPA, and for Kent SPA wildfowl species.

It may be relevant from the point of view of Cumulative Effects Assessment (CEA) of other Thames wind farms that no divers were seen within the Kentish Flats Wind Farm on any of the boat or aerial surveys in Year 5 (see Figures 105 & 116).

Diver numbers and distribution recorded within the TH1 aerial survey area fluctuated between surveys in Year 5 as in previous years. The changes in aerial counts of divers in Year 4 between 6th and 13th March 2005 had illustrated the scale of some changes in distributions of divers in the Thames at this time of year, and perhaps indicated an influx of divers into parts of the outer Thames in some years. Changes were not as dramatic in Year 5. At the start of the winter (in Year 4) very few divers were seen in TH1 on 13th November 2005, with just nine seen between the wind farm and buffer and the North Kent coast (see Figure 86, and Figure 108 which plots the same data but does not show the divers seen far to the north of the Kentish Flats Wind Farm). By 11th December 2005 many more were seen, particularly to the west and south of the buffer zone (see Figure 110) whereas on 14th January 2006 divers were recorded more to the southwest, north and northeast (see Figure 112). On 18th February the main distribution within the area plotted had shifted to the east (see Figure 114).

The aggregated diver distribution is shown in Figure 116, which reveals the complete absence of divers from the wind farm itself and fewer seen within the buffer zone than elsewhere. No divers were seen within the Kentish Flats Wind Farm during Year 5 and large numbers have not been counted within the buffer zone. Divers appeared to the surveyors to be reluctant to go within the wind farm area once the 30 monopiles were in place. For example, on 19th January and 7th February 2005 no divers were seen on the water within this area and only a very few were seen to fly through it.

A comparison of Figures 22, 48, 76 and 105 reveals that diver numbers and their distribution within the turbine area were greatest in Year 3 (see also Figure 51 which shows large numbers of divers to the northeast and northwest of the wind farm site), lower in Year 4 (see Figure 76, when turbine foundations had been installed but before the turbines had been erected), and fewest in Year 5 (zero seen).

The shortage of control data from boat surveys during the peak diver period from December to February limits the power of the statistical tests (the control site was only surveyed once in January in Years 4 and 5, in addition to once during March in each year). No significant changes have yet been proven. The ratio of the estimated number of red-throated divers on the wind farm and buffer to those on the control site was calculated for all occasions on which red-throats were recorded on both sites, but the logarithm of the ratios compared using a t-test revealed no statistically significant changes. It is because there were only a few observations for divers that the power of these statistical tests is very low. The results of the density comparisons between the construction phase with the pre-construction phase and the operational phase with the pre-construction phase suggest that the numbers of red-throated divers had gone down within the study area during the operational period.

The recorded movements of wildfowl in Year 5 included four groups of Brent geese totalling 21, two greylag geese and waders (see Figure 106). Twelve of the Brent geese were flying in a south westerly direction and the two greylag geese were flying northwest. The remaining nine Brent geese were flying west. All could possibly have been flying towards the coastal SPA sites surrounding the Thames estuary. There were more flights by geese (five groups, all Brent, totalling 99) within the boat survey area in Year 4 than in any previous year.

No dabbling duck were seen in Year 5. The main dabbling duck species seen in Year 4 were wigeon and shelduck. There was a flock of ten wigeon flying north on 14th October 2004 at 60m in a northerly direction through Transect 7, and possibly passing through the turbine array, and a single shelduck flying southwest on 29th May. These could have been cross-estuary movements.

In Year 5, 138 common scoter were recorded seen in the boat survey. Larger numbers of common scoter were seen in the boat survey area during Year 4 than in any previous year. A total of 200 common scoters were seen, though only eight were within the wind farm site (see Figure 77). None were seen during the aerial surveys. These were seen most frequently on 8th July 2005 (124), though also on 11th December 2004 (five), 10th May (8), 29th May (45) and 1st August 2005 (8). The party of 45 common scoter seen on 29th May heading southeast on Transect 8 were probably summering birds. The largest flocks comprised c50 and c55 birds seen on 8th July 2005. Both flocks of common scoter were seen in Transect 8, with two smaller flocks totalling 19 in the control area.

The total of 138 common scoter seen during boat surveys in Year 5 (and 200 common scoter in Year 4) makes scoter the most frequently seen wildfowl species. These numbers are substantially greater than the 36 common scoter, 26 velvet scoter and six eider recorded in Year 3 and the 17 common scoter recorded in Year 2. This suggests that any earlier displacement has not been sustained, although annual fluctuations may be a greater factor than any response to the wind farm. For at least the last 10 years, there have been 50-200 common scoter wintering along the North Kent coast between Whitstable and Margate. Typically they are to be seen on or over the sea between a half and four or so miles offshore. Many of the sightings of common scoter on the windfarm over the 5 years of study may therefore probably represent these same birds ranging just a little further out to sea than normal.

In Year 5 no seaduck were seen within the boat study area, though six scoter were seen just to the north of the buffer zone on 18th February 2006 (see Figure 115). In Year 4 the aerial surveys had revealed small numbers of seaduck within the boat study area. No eider or scoter were seen within the boat survey area, though on 15th January 2005 ten mergansers and a grebe were seen to the south and east of the wind farm site. On 5th December 2004 seven eiders were seen to the south of the buffer zone. On 6th March 2005 three common scoter and six eider were observed to the south and west, a further nine common scoter to the northwest. On 13th March 2005 five eiders were seen to the southeast.

Numbers of waders seen from the air around the wind farm in Year 5 were higher than in previous years, but too few waders are seen during aerial or boat surveys to draw any conclusions about changes from year to year. Figures 113 and 115 show several hundred oystercatchers and unidentified waders seen on 14th January and 18th February 2006 in flight (direction unspecified on the aerial data obtained from the WWT) over 5km to the west of the buffer zone. They could have flown closer to the wind farm, but it is not possible to determine this from the available data. Four oystercatchers were recorded from the boat on 8th July 2005 heading to the north across the estuary. This is unusual behaviour for the few waders seen within the boat study area, as the surveyors note that most appear to fly in an easterly or westerly direction. Twelve bar-tailed godwits were seen to the south of the wind farm on 6th September 2005, flying at 20m height to the west, probably migrating into the estuary for the winter. They would not have flown through the turbine area, and were therefore not at potential risk of collision. It is not possible to conclude whether waders have been discouraged from flying to or from the coastal SPAs by disruption to bird flight lines, but the available evidence suggests that this is not the case.

Previous aerial observations relevant to Objective 3 are that on 5th December 2004 one great-crested grebe was seen to the north of the buffer zone, and almost 300 dabbling ducks (mostly wigeon) were recorded off the north Kent coast. On 6th March 2005 three common scoter and six eider were observed to the south and west, a further nine common scoter to the northwest (see Figure 82) and on 13th March five eider were seen to the southeast (see Figure 84). On 15th January 2005 ten mergansers and a grebe were seen to the south and east of the wind farm site (see Figure 80). On 31st July 2005 there were no aerial survey records of wildfowl and waders near the wind farm. The latest aerial data reinforces the suggestion that the wind farm site and buffer zone are of very minor importance of the for these SPA species.

In conclusion, although there have been some movements of wildfowl (dark-bellied Brent geese and common scoter) and waders (grey plover and curlew) to and from the coastal SPA sites surrounding the Thames Estuary recorded during Year 5, and these appear to be more frequent after construction commenced for common scoter and for geese when compared to pre-construction patterns but at lower levels for dabbling ducks.

The aerial data continues to demonstrate that the importance of the Kentish Flats Wind Farm for wintering divers is low in relation to the buffer zone, and even lower in relation to other parts of the TH1 aerial survey area (see Figures 76, 88 and 116).

7.3.4 Objective 4

FEPA Objective 4 seeks to determine the rate of bird collision but does not specify how this should be achieved. No formal assessment of collision risk has been made in this report. However, examination of the number of birds of each species seen at rotor height (see Table 27) suggests a very low collision risk for species of conservation concern. The vast majority of species seen above 20m asl were gulls, and herring gull was the most frequently observed species recorded at rotor height.

However, the height of flight at the time of initial recording does not tell the whole story. On 13th April 2006 two greylag geese flew low northwest past the boat in the buffer zone on transect 6 at 10:13 (see Figure 106). They were observed by the surveyors to approach to within 200m of the turbine array, hesitate almost stalling in the air, and then gaining height, fly northwest through the wind farm equidistant between two rows of turbines. They were estimated to be flying at about 60m asl each time they passed between pairs of turbines, and at about 20m asl in between pairs. Alarmingly they appeared not to take notice of the turbine array until they were almost upon it. In Year 4 on 7th February 2005 a group of 75 Brent geese would have flown directly through the wind farm, and may have been at rotor height further away from the wind farm (though were seen at 10m asl). Previous potential 'risky' goose flights were seen on 12th October 2003, when three flocks of Brent geese comprising 43 birds in total were in seen migration.

In Year 4, ten wigeon were seen on 14th October 2005 flying at a height of 60m were recorded heading in a northerly direction through transect 7 (see Figures 73 and 77) and would probably have flown at rotor height through the wind farm, but were not observed to do so. In Year 4 ten shelduck were seen on 3rd October 2005 to the south of the wind farm heading west at 45m asl. No dabbling ducks were seen during the Year 5 boat surveys.

The number of Kent SPA species, potential Thames SPA-qualifying species and other bird species of conservation concern which might be potential collision victims remains very low.

7.3.5 Objective 5

FEPA Objective 5 concerns the effectiveness of mitigation measures during the construction period only, and were considered in the previous monitoring report (Gill, Sales & Beasley 2006). The suggested mitigation measures to reduce disturbance to divers during construction appear to have been fully effective by avoiding the peak diver season as recommended prior to consent and in line with the FEPA consent condition. There is no evidence that monopile-driving and increased boat traffic which inevitably increased disturbance levels during construction had any significant long term effects on bird populations.

No other mitigation was employed in relation to potential effects on bird species at the Kentish Flats site during the construction period.

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9 APPENDICES

A1.SUMMARY OF SPECIES OBSERVED IN AND OUT OF TRANSECT, BOAT SURVEYS BW – CL

Number of birds recorded in and out of transect on surveys BW (7 Dec 05) to CL (1 Dec 06)

Common Name	*Species*	*Total Number Sighted*				*Total Number In Transect*			
		Total	Flying*	On Sea*	Feeding	**Total**	Flying*	On Sea*	Feeding
Divers & Grebes									
Red-throated Diver	*Gavia stellata*	**176**	135	41	0	**45**	13	32	0
Black-throated Diver	*Gavia arctica*	**15**	9	5	0	**6**	1	4	0
Great-crested Grebe	*Podiceps cristatus*	**3**	2	1	0	**0**	0	0	0
		194	**146**	**47**	**0**	**51**	**14**	**36**	**0**
Gannets									
Gannet	*Morus bassanus*	**30**	29	4	6	**11**	10	4	3
		30	**29**	**4**	**6**	**11**	**10**	**4**	**3**
Cormorants									
Cormorant	*Phalacrocorax carbo*	**187**	35	152	0	**110**	8	102	0
		187	**35**	**152**	**0**	**110**	**8**	**102**	**0**
Geese									
Greylag Goose	*Anseranser*	**2**	2	0	0	**0**	0	0	0
Dark-bellied Brent Goose	*Branta bernicla*	**21**	21	0	0	**4**	4	0	0
		23	**23**	**0**	**0**	**4**	**4**	**0**	**0**
Diving Ducks									
Common Scoter	*Melanitta nigra*	**138**	50	88	0	**48**	0	48	0
		138	**50**	**88**	**0**	**48**	**0**	**48**	**0**
Raptors									
Merlin	*Falco columbarius*	**1**	1	0	1	**0**	0	0	0
Peregrine	*Falco peregrinus*	**1**	0	1	0	**1**	0	1	0
		2	**1**	**1**	**1**	**1**	**0**	**1**	**0**
Waders									
Grey Plover	*Pluvialis squatarola*	**1**	1	0	0	**0**	0	0	0
Curlew	*Numenius arquata*	**2**	2	0	0	**0**	0	0	0
		3	**3**	**0**	**0**	**0**	**0**	**0**	**0**
Gulls									
Black Headed Gull	*Larus ridibundus*	**94**	72	22	0	**12**	12	0	0
Common Gull	*Larus canus*	**219**	203	19	12	**64**	48	19	12
Lesser Black Backed Gull	*Larus fuscus*	**297**	218	78	7	**113**	61	52	6
Herring Gull	*Larus argentatus*	**509**	447	60	30	**135**	89	45	19
Great Black-backed Gull	*Larus marinus*	**48**	26	22	0	**23**	2	21	0
Kittiwake	*Rissa tridactyla*	**41**	40	1	0	**13**	12	1	0
Gull sp.		**29**	11	18	0	**0**	0	0	0
		1237	**1017**	**220**	**49**	**360**	**224**	**138**	**37**
Terns									

* Occasionally in this summary the same bird may be shown both in the flight and on sea columns. These birds took off or landed. Such records will be partitioned prior to analysis.

Common Name	*Species*	*Total Number Sighted*				*Total Number In Transect*			
		Total	Flying*	On Sea*	Feeding	**Total**	Flying*	On Sea*	Feeding
Sandwich Tern	*Sterna sandvicensis*	**22**	22	0	2	**2**	2	0	0
Common Tern	*Sterna hirundo*	**195**	182	35	107	**120**	109	35	107
Black Tern	*Chlidonias niger*	**3**	3	2	2	**2**	2	2	2
		220	**207**	**37**	**111**	**124**	**113**	**37**	**109**
Auks									
Guillemot	*Uria aalge*	**15**	4	11	0	**11**	0	11	0
Razorbill	*Alca torda*	**3**	0	3	0	**3**	0	3	0
Auk sp.		**2**	1	1	0	**1**	0	1	0
		20	**5**	**15**	**0**	**15**	**0**	**15**	**0**
Pigeons etc.									
Woodpigeon	*Columba palumbus*	**43**	43	0	0	**0**	0	0	0
		43	**43**	**0**	**0**	**0**	**0**	**0**	**0**
Swifts									
Swift	*Apus apus*	**3**	3	0	0	**0**	0	0	0
		3	**3**	**0**	**0**	**0**	**0**	**0**	**0**
Hirundines									
Swallow	*Hirundo rustica*	**46**	46	0	0	**0**	0	0	0
House Martin	*Delichon urbica*	**8**	8	0	0	**0**	0	0	0
		54	**54**	**0**	**0**	**0**	**0**	**0**	**0**
Passerines									
unidentified pigeon		**1**	1	0	0	**0**	0	0	0
Meadow Pipit	*Anthus pratensis*	**8**	8	0	0	**0**	0	0	0
Fieldfare	*Turdus pilaris*	**3**	3	0	0	**0**	0	0	0
Starling	*Sturnus vulgaris*	**201**	201	0	0	**21**	21	0	0
Chaffinch	*Fringilla coelebs*	**13**	13	0	0	**0**	0	0	0
Linnet	*Carduelis cannabina*	**2**	2	0	0	**0**	0	0	0
Unidentified finch		**5**	5	0	0	**0**	0	0	0
Unidentified passerine		**4**	4	0	0	**0**	0	0	0
		237	**237**	**0**	**0**	**21**	**21**	**0**	**0**
Total for all birds		**2391**	**1853**	**564**	**167**	**745**	**394**	**381**	**149**

* Occasionally in this summary the same bird may be shown both in the flight and on sea columns. These birds took off or landed. Such records will be partitioned prior to analysis.

Number of mammals recorded in and out of transect on surveys BW (7 Dec 05) to CL (1 Dec 06)

Common Name	*Species*	*Total Number Sighted*		*Total Number In Transect*	
		Total	Feeding	**Total**	Feeding
Pinnipeds					
Common seal	*Phoca vitulina*	**6**	0	**5**	0
Seal sp.		**3**	0	**3**	0
		9	**0**	**8**	**0**
Phocoenidae					
Harbour porpoise	*Phocoena phocoena*	**7**	0	**5**	0
		7	**0**	**5**	**0**
Total for all animals		**16**	**0**	**13**	**0**

A2.SPECIES AND ACTIVITY CODE LISTS

These list the three-letter mammal and unspecified bird codes and the standard two letter BTO code (Marchant 1983, Gilbert *et al* 1998), together with the standard international ESAS five letter bird codes (Komdeur *et al* 1992). The three-letter mammal and unspecified bird codes and the standard two letter BTO codes are used in plotting the data, while the 5 letter codes are used on the field forms and raw data.

Family	Common Name	Species Name	BTO Codes	5-Letter Species Code
Diver	**Red Throated Diver**	*Gavia stellata*	RH	GASTE
	Black Throated Diver	*Gavia arctica*	BV	GAARC
	Great Northern Diver	*Gavia immer*	ND	GAIMM
Grebe	**Little Grebe**	*Tachybaptus ruficollis*	LG	TARUF
	Great Crested Grebe	*Podiceps cristatus*	GG	POCRI
	Slavonian Grebe	*Podiceps auritis*	SZ	POAUR
Shearwater	**Northern Fulmar**	*Fulmarus glacialis*	F	FUGLA
	Great shearwater	*Puffinus gravis*	GQ	PUGRA
	Cory's shearwater	*Calonectris diomedea*	CQ	CADIO
	Sooty shearwater	*Puffinus griseus*	OT	PUGRI
	Manx shearwater	*Puffinus puffinus*	MX	PUPUF
	Balearic shearwater	*Puffinus mauretanicus*		PUMAU
Petrel	**European storm-petrel**	*Hydrobates pelagicus*	TM	HYPEL
	Leach's storm-petrel	*Oceanodroma leucorhoa*	TL	OCLEU
	Gannet	*Morus bassanus*	GX	MOBAS
	Cormorant	*Phalacrocorax carbo*	CA	PHCAR
	Shag	*Phalacrocorax arisotelis*	SA	PHARI
Swans	**Mute swan**	*Cygnus olor*	MS	CYOLO
	Bewick swan	*Cygnus colombianus*	BS	CYCOL
	Whooper swan	*Cygnus cygnus*	WS	CYCYG
Goose	**Pink-footed goose**	*Anser brachyrhynchus*	PG	ANBRA
	White-fronted goose	*Anser albifrons*	WG	ANALB
	Greylag goose	*Anser anser*	GJ	ANANS
	Barnacle goose	*Anser leucopsis*	BY	ANLEU
	Dark-bellied Brent goose	*Branta bernicla*	DB	BRBER
Ducks	**Shelduck**	*Tadorna tadorna*	SU	TATOD
	Wigeon	*Anas penelope*	WN	ANPEN
	Gadwall	*Anas strepera*	GA	ANSTR
	Teal	*Anas crecca*	T	ANCRE
	Mallard	*Anas platyrhynchos*	MA	ANPLA
	Pintail	*Anas acuta*	PT	ANACU
	Shoveller	*Anas clypeata*	SV	ANCLY
	Common pochard	*Aythya ferina*	PO	AYFER
	Tufted duck	*Athyra fuligula*	TU	AYFUL
	Scaup	*Aythya marila*	SP	AYMAR
	Eider	*Somateria mollissima*	E	SOMOL
	Long-tailed duck	*Clangula hyemalis*	LN	CLHYE
	Common Scoter	*Melanitta nigra*	CX	MENIG
	Velvet Scoter	*Melanitta fusca*	VS	MEFUS
	Goldeneye	*Bucephala clangula*	GN	BUCLA
	Red Breasted Merganser	*Mergus serrator*	RM	MESER
	Goosander	*Mergus merganser*	G	MEMER
	Merlin	*Falco columbarius*	ML	FACOL

Family	Common Name	Species Name	BTO Codes	5-Letter Species Code
Harriers	**Marsh Harrier**	*Circus aeruginosus*	MR	CIAER
	Hen Harrier	*Circus cyaneus*	HH	CICYA
Waders	**Oystercatcher**	*Haematopus ostralegus*	OC	HAOST
	Ringed Plover	*Charadrius hiaticula*	RP	CHHIA
	Golden Plover	*Pluvialis apricaria*	GP	PLAPR
	Grey Plover	*Pluvialis squatarola*	GV	PLSQU
	Lapwing	*Vanellus vanellus*	L	VAVAN
	Knot	*Calidris canutus*	KN	CACAN
	Black-tailed Godwit	*Limosa limosa*	BW	LILIM
	Bar-tailed Godwit	*Limosa lapponica*	BA	LILAP
	Redshank	*Tringa totanus*	RK	TRTOT
	Greenshank	*Tringa nebularia*	GK	TRNEB
	Curlew	*Numenius arquata*	CU	NUARQ
	Ruff	*Philomachus pugnax*	RU	PHPUG
	Dunlin	*Calidris alpina*	DN	CAALP
	Turnstone	*Arenaria interpres*	TT	ARINT
Skuas	**Pomarine Skua**	*Stercorarius pomarinus*	PK	STPOM
	Arctic Skua	*Stercorarius parasiticus*	AC	STPAR
	Long-tailed Skua	*Stercorarius longicaudus*	OG	STLON
	Great Skua	*Catharacta skua*	NX	CASKU
Gulls	**Mediterranean Gull**	*Larus melanocephalus*	MU	LAMEL
	Little Gull	*Larus minutus*	LU	LAMIN
	Sabine's Gull	*Larus sabini*	AB	LASAB
	Black Headed Gull	*Larus ridibundus*	BH	LARID
	Common Gull	*Larus canus*	CM	LACAN
	Lesser Black Backed Gull	*Larus fuscus*	LB	LAFUS
	Herring Gull	*Larus argentatus*	HG	LAARG
	Iceland Gull	*Larus glaucoides*	IG	LAGLA
	Glaucous Gull	*Larus hyperboreus*	GZ	LAHYP
	Great Black-backed Gull	*Larus marinus*	GB	LAMAR
	Kittiwake	*Rissa tridactyla*	KI	RITRI
Terns	**Sandwich Tern**	*Sterna sandvicensis*	TE	STSAN
	Roseate Tern	*Sterna dougallii*	RS	STDOU
	Common Tern	*Sterna hirundo*	CN	STHIR
	Arctic Tern	*Sterna paradisaea*	AE	ATPAR
	Little Tern	*Sterna albifrons*	AF	STALB
	Black Tern	*Chlidonias niger*	BJ	CHNIG
Auk	**Guillemot**	*Uria aalgae*	GU	URAAL
	Razorbill	*Alca torda*	RA	ALTOR
	Black Guillemot	*Cepphus grylle*	TY	CEGRY
	Little Auk	*Alle alle*	LK	ALALL
	Puffin	*Fractercula arctica*	PU	FRARC
Passerines	**Feral pigeon**	*Columba livia*	COLIV	FP
	Blackbird	*Turdus merula*	B	TUMER
	Skylark	*Alauda arvensis*	S	ALARV
	Swift	*Apus apus*	SI	APAPU
	Swallow	*Hirundo rustica*	SL	HIVUL
	Meadow Pipit	*Anthus pratensis*	MP	ANPRA
	Pied Wagtail	*Motacilla alba*	PW	MOALB
	House martin	*Delichon urbica*	HM	DEURB

Family	Common Name	Species Name	BTO Codes	5-Letter Species Code
	Fieldfare	*Turdus pilaris*	FF	TUPIL
	Starling	*Sturnus vulgaris*	SG	STVUL
	Chaffinch	*Fringilla coelebs*	CH	FRCOE

*Where species not determined, genera indicated as below

General Birds

Common Name	Species Name	3L Codes	BTO codes used by WWT	Name Code
Diver sp.	*Gavia sp.*	div	UL	Diver
Grebe sp.	*Podiceps sp.*	gre	UV	Grebe
Cormorant/shag	*Phalacrocorax sp.*	c/s	XU	Phala
Unidentified goose sp.		goo		Goose
Unidentified duck		duc	UM	Duck
Unidentified seaduck		sdu		Duck
Scoter sp.	*Melanitta sp.*	sco		Scoter
Godwit sp.	*Limosa sp.*	god		Godwit
Small wader sp.			U.	
Unidentified wader		wad		Wader
Skua sp.		sku	UQ	Skua
Gull sp.		gul	UU	Gull
Large gull sp. (Herring or black-backs)		lgu	VU	L. Gull
Herring or common gull			XP	
Small gull sp. (Little, black-headed, common, kittiwake)		sgu		S. Gull
Greater/Lesser black-backed gull		bbg	XD	B-B Gull
Tern sp.		ter	UT	Tern
Common/Arctic tern		com	UI	Commic
Auk sp.		auk	AU	Auk
Unidentified thrush		thr		Thrush
Unidentified passerine		pas		Passerine
Unidentified finch		fin		Finch
Unidentified		uni		Unidentified

Mammals

Common Name	Species Name	3L Codes	BTO codes used by WWT	Name Code
Grey seal	*Halichoerus grypus*	GSE		G.Seal
Common seal	*Phoca vitulina*	CSE		C.Seal
Seal sp.		SEA	S2	Seal
Harbour porpoise	*Phocoena phocoena*	POR	C1	Porpoise
Unidentified seal sp		sea		Seal

Field Codes

Category	Category Abbreviation	Explanation
Age	*Age*	A=Adult
		I=Immature
		1W=First Winter; 1S = First Summer
		U=Undetermined
Plumage	*Pl.*	D=Dark
		L=Light
		I=Intermediate
		M=Male
		F=Female
Numbers	*NOS.*	Number of individuals seen
Distance	*DIST.*	A=0-50 metres
		B=50-100 metres
		C=100-200 metres
		D=200-300 metres
		E= more than 300 metres
Direction	*Dim.*	F=Following = Associating
		H=Hovering / Variable
		spiral=Hovering=H
		N, NE, etc = North, Northeast, etc
Flying	*Fl.*	Y or ✔ =F for flying
Sea	*Se*	Y or ✔ =S for on the sea, even if only landing briefly
Feeding	*Fe*	Y or ✔ =Feeding
Radial	*Radial*	Distance from eye to bird in metres or VAR = variable
Height	*Height*	Estimate of bird's height in metres or VAR = variable
Graduation	*Grad*	Height in centimetres above horizon when ruler held at arms length
Transect?	*T*	Y or ✔ =For flying birds seen during snapshot and for birds on sea in transect

A3. SURVEYOR'S REPORTS

07 / 12 / 05

A steady force 2 to 3 north-westerly wind with 0.5m waves and good visibility resulted in good surveying conditions. It is unlikely that many birds at all were missed in the A to D bands. The survey had to be temporarily halted when we went aground on a sandbank in transect 1 but was resumed in 15 minutes when the rising tide floated the vessel free. A small deviation from the line was then also required to navigate shallow water. High tides occurred at 04.00 (4.9m), and at 16.55 (4.9m).

53 gulls were recorded on site. Herring gull were the most numerous with 23 recorded. Also recorded were 14 lesser black-backed gull, four great black-backed gull, eight common gull, three kittiwake and one unidentified gulls. There were no fishing vessels in the vicinity, which can have a huge influence on recorded gull numbers. As usual there did not really appear to be any pattern to the gull's movements. A number of gulls were seen within the operational wind farm but the majority were recorded in the eastern-most two transects and the western-most two, either side of the wind farm.

Apart from gulls the only other bird species seen today were one cormorant, 11 red-throated diver and 3 black-throated diver. Five red-throats were also seen in between the northern ends of transects 2 and 3. More divers were expected in December especially as there was some evidence of sprats being in the estuary – while on the trip over to Whitstable from Essex the skipper saw what he read as small sprat shoals in the Princes Channel just to the north of the site, also one of the kittiwake, known as 'sprat gulls' to local fishermen, was seen flying with a sprat in its bill.

One common seal was seen between the northern ends of transects 3 and 4.

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13 / 01 / 06

A cold overcast day with a steady force 3 southerly wind off the land gave a sea state 2 and with good visibility resulted in good surveying conditions. It is unlikely that many birds at all were missed in the A to D bands. Leaving from Ramsgate and finishing in Whitstable, the control area was also covered today. High tide occurred at 12.09 (4.9m).

138 gulls were recorded on site; about average for this time of year. What was unusual though was the high percentage of common gulls – over half of the gulls identified to species were common gulls. Similarly high numbers of common gulls were recorded on another site in the Thames estuary in the past few days. There was a 'probable' sighting of a Mediterranean gull but this had to be recorded as 'unidentified gull sp' as there was no absolute species identification. There were no fishing vessels in the vicinity, which can have a huge influence on recorded gull numbers. There did not really appear to be any pattern to the gull's movements, apart from a general southerly movement at the beginning of the survey in the control area. Wether this was a spatial or temporal phenomenon is unsure. Also, because the boat was moving to the north and the gulls were moving to the south, there tended to be a disproportionate number of birds flying 'in snapshot'. There were no large feeding groups of gulls. A number of gulls were seen within the operational wind farm.

At 162, there was the highest count of divers so far this year – 157 red-throated diver and 5 black-throats. In addition a group of c40 divers was seen just to the north of the north-western corner of the study site. A number of fish marks, thought to be shoals of sprats was noted on the sounder towards the northern ends of transects 1 and 2. No divers were seen within the operational wind farm but a number were seen in flight or on the water very close to the outside edge of the wind farm, (some sitting less than 100m from a turbine). It appears that the lines of turbines may act as a barrier to divers as opposed to them being troubled by individual rotating turbines.

Otherwise, few other birds were recorded today. One flock of six common scoter was seen flying to the west in the control area. Three auks and a cormorant were recorded and a common seal was seen in transect 8.

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17 / 02 / 06

A steady force 2 to 3 westerly wind gave a sea state 2 and a slight sea which with good visibility resulted in very good surveying conditions. It is unlikely that many birds at all were missed in the A to D bands. High tides occurred at 02.41 (5.1m) and 15.02 (5.1m).

A total of 190 gulls were recorded on site; 50 herring gull, six lesser black-backed gull, 2 great black-backed gull, 47 common gull, 82 black-headed gull, and three kittiwake. It is very unusual to record so many black-headed gull; most of these were flying in a general north-easterly direction. There were no large feeding groups of gulls. A number of gulls were seen within the operational wind farm.

Apart from gulls there were only two species of bird recorded on site - four cormorant, all of which were in full breeding plumage, and only four red-throated divers (plus two between transects). This is probably a record low count for divers in the recognized diver season and very surprising for February considering the quantity seen in this month in the past. A great-crested grebe was seen between transects 1 and 2.

A seal was recorded in transect 8 along the edge of the Pan Sands, too distant and fleeting a view to identify to species.

02/ 03 / 06

A steady force 3 north-westerly wind gave a sea state 2 and a slight sea which with good visibility resulted in very good surveying conditions although some glare was experienced in transects 3, 5 and 7. It is unlikely that many birds at all were missed in the A to D bands. High tides occurred at 01.57 (5.6m) and 14.37 (5.5m). These were particularly strong spring tides and a deviation from the line was required in transect 8 to navigate shallow water. The survey started at sunrise with the control area was also being covered today.

A total of 114 gulls were recorded on site; 37 herring gull, three lesser black-backed gull, 66 common gull, four black-headed gull, and four unidentified gull species. There appeared to be a general northerly and westerly movement of gulls. A 'feeding frenzy' of approximately 100 gulls was observed just to the south of the south-east corner of the main study-site. A number of gulls were seen within the operational wind farm.

Three cormorant were recorded and a group of approximately 150 were observed about 4km to the south of the middle of the site – possibly over the herring spawning ground situated in this general area. Herring may well be over the ground at this time of year.

As last month there was an exceptionally low diver-count with only four red-throated divers and four black-throated divers recorded. Two great-crested grebe was seen flying through the site. A curlew was recorded flying to the north-west in transect 7 and a pigeon, possibly a stock dove, was also seen flying to the north-west in transect 6.

A harbour porpoise was very briefly seen in the control area and a seal was recorded in transect 1, too distant and fleeting a view to identify to species.

Kentish Flats

13/4/6

General

The survey started 0902 (sunrise 0604) on Transect 8 on the E side of the site and finished at 1308 on Transect 1 on the W side of the site. It covered the main survey area (not the control). Surveying conditions were good, and though it was overcast throughout, visibility was excellent and there was no rain. Air temperature was 11C. Wind was W F3 to start then increased on Transect 2 to W F4 and on Transect 1 to W F5. HW was 1349 (5.0m).

Birds

A total of 124 birds of 8 species were recorded.

By "family" ...

```
    2 wildfowl
   73 gull
   49 passerine
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By species ...

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    2 Greylag Geese            -   1 records,   1.6% tot, 100.0% wildfowl
tot
   34 Lesser Black-Backed Gull -  13 records,  27.4% tot,  46.6% gull tot
   36 Herring Gull             -  22 records,  29.0% tot,  49.3% gull tot
    3 Great Black-backed Gull  -   3 records,   2.4% tot,   4.1% gull tot
    3 Meadow Pipit             -   1 records,   2.4% tot,   6.1% passerine
tot
   43 Wood Pigeon              -   1 records,  34.7% tot,  87.8% passerine
tot
    2 Linnet                   -   1 records,   1.6% tot,   4.1% passerine
tot
    1 House Martin             -   1 records,   0.8% tot,   2.0% passerine
tot
```

By transect ...

TRANSECT	1	2	3	4	5	6	7	8
Greylag Geese	-	-	-	-	-	2	-	-
Lesser Black-Backed Gull	-	10	2	2	3	5	1	11
Herring Gull	13	12	1	2	1	2	2	3
Great Black-backed Gull	-	-	-	-	1	-	-	2
Meadow Pipit	-	-	-	-	-	-	-	3
Wood Pigeon	-	-	-	-	-	-	43	-
Linnet	-	-	-	-	-	-	2	-
House Martin	-	-	-	-	-	-	1	-

An interesting day.

2 Greylag Geese flew low NW past the boat on Transect 6 at 1013. The line they were taking took them straight through the turbine array so they were watched very carefully. As they approached to within about 200m of the array they hesitated, almost stalling in the air. They then flew a few tens of metres E, then W, then gained height, hesitated some more then headed NW again equidistant between two rows of turbines, flying at about 60m each time they passed between pairs of turbines, and at about 20m in between pairs. Most puzzling thing was they appeared not to take notice of he turbine array until they were almost upon it (contrast with the behaviour of the flock of Wood Pigeon that were seen).

34 Lesser Black-Backed Gull, 36 Herring Gull and 3 Great Black-backed Gull were seen during the survey. Most were drifting N or NW as singles or in groups of 2 or 3. Only concentration was a group of 10 Lesser Black-Backed and 15 Herring following a fishing boat heading back to harbour.

3 Meadow Pipit flew low W close by the boat on Transect 8 at 0923. They will have been migrants.

43 Wood Pigeon flew W ahead of the boat on Transect 7 at 0935. Their line of flight would have had them fly W just inside the S edge of the turbine array. About 1000m before the array they changed course and headed NW parallel to the E side of the array. Which direction they went when they reached the NE corner of the array couldn't be seen.

2 Linnet flew SW past the boat on Transect 7 at 0953. They will have been migrants and the direction they were heading suggested they wanted to make landfall sooner rather than later, which in turn suggested they had likely overshot the E Kent coast as they crossed from the continent.

1 House Martin flew low W past the boat on Transect 7 at 0952. Perhaps only thing to be said about it was it was the only one seen during the whole survey. Many more Hirundines were expected.

Cetaceans and Seals

No cetaceans or seals were seen.

Ian Harding,
13/4/6.

19/ 04 / 06

A steady force 4 westerly breeze produced a sea state 2 to 3 which with good visibility resulted in good surveying conditions. It is unlikely that many seabirds were missed in the A to D bands although hirundines or other small migrating passerines flying below the horizon will have been hard to spot in the C and D bands. High tides occurred at 04.41 (4.9m) and 16.52 (4.7m).

Birds were very sparse today with total of only 56 recorded, 43 of which were gulls. Herring gull were the most numerous with 27 recorded, most being immature birds. Fourteen lesser black-backed gull, one greater black-backed gull and an unidentified gull were also recorded. While there did not seem to be any pattern to the gulls movements for most of the survey, there appeared to be a general southerly movement of gulls in transect 1, the last transect to be surveyed. It is thought that this was more a temporal than spatial phenomena. A number of gulls were seen within the operational wind farm.

One cormorant were recorded in transect 2 flying to the north-east. Nine swallows and three house martins were all recorded flying in a westerly direction through the site in ones and twos, all in the eastern-most transects. Again, thought to be related to time not place.

Kentish Flats

2/5/6

General

The survey started 0710 (sunrise 0526) on Transect 1 on the W side of the site and finished at 1123 on Transect 8 on the E side of the site. It covered the main survey area (not the control). Surveying conditions were excellent, spoiled only by sun glare on Transects 2 4 and 6. There was little cloud, no rain, a light S F2. Air temperature was 15C. HW was 0419 (5.2m) and 1633 (4.9m)

Birds

A total of 38 birds of 6 species were recorded.

By "family" ...

29 gull
6 passerine
3 other

By species ...

2 Black-headed Gull	-	1 records,	5.3% tot,	6.9% gull tot
1 Common Gull	-	1 records,	2.6% tot,	3.4% gull tot
3 Lesser Black-Backed Gull	-	3 records,	7.9% tot,	10.3% gull tot

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   23 Herring Gull             -  18 records,  60.5% tot,  79.3% gull tot
    6 Swallow                  -   2 records,  15.8% tot, 100.0% passerine
tot
    3 Swift                    -   2 records,   7.9% tot, 100.0% other tot
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By transect ...

TRANSECT	1	2	3	4	5	6	7	8
Black-headed Gull	-	-	2	-	-	-	-	-
Common Gull	-	1	-	-	-	-	-	-
Lesser Black-Backed Gull	1	-	2	-	-	-	-	-
Herring Gull	3	2	4	1	-	3	5	5
Swallow	-	-	-	-	-	6	-	-
Swift	2	-	1	-	-	-	-	-

An exceptionally quiet day. An interesting one nonetheless.

3 Swift flew W, 2 on Transect 1 at 0732 and 1 on Transect 3 at 0836.
6 Swallow flew W on Transect 6, 4 at 0955 and 2 at 1009.

Only other birds recorded were Gulls. 1 immature Common Gull headed SE on Transect 2 at 0802 and 2 Black-headed Gull headed W on Transect 3 at 0830. 23 Herring Gull and 3 Lesser Black-Backed Gull were seen. Mostly they were headed W or NW, most likely because they had caught sight of some distant fishing activity or similar.

On Transect 5 no birds at all were seen. Noteworthy though were 2 Sandwich Tern that flew W at 0910 just before the start of the transect.

Also, at no time during the survey, on transect or in between transects, were any birds seen on the sea. Only other time no birds have been seen on the sea was on the survey this time last year (10/5/5).

Further comparison between that survey and this survey is interesting.

On that survey, 126 birds of 11 species were seen, which suggests it was a very different survey. However, the species breakdown for that survey was 1 Fulmar, 1 flock of 8 Common Scoter, 6 Lesser Black-backed Gull, 18 Herring Gull, 6 Common Tern, 2 Little Tern, 1-2 Guillemot, 19 Swift, 60 Swallow, 2 House Martin and 2 Meadow Pipit.

If one sets aside for the moment the Fulmar, Scoter, Guillemots, Swifts, Swallows, Martins and Pipits that were seen then, and includes the Terns seen this survey between transects, then that survey looks rather similar to this one.

The Fulmar, Scoter and Guillemots seen on that survey were all in flight and there presence then and not this survey can probably be explained by the difference in wind strength. It was a F3-4 then, this survey it was a F2. Also, the numbers of each (1 Fulmar, 1 flock of 8 Common Scoter and 1-2 Guillemot) were low so not statistically highly significant.

The 19 Swift, 60 Swallow, 2 House Martin and 2 Meadow Pipit on the survey of 10/5/5 and only 3 Swift, 6 Swallow and no Martins and Pipits on this survey is explainable by looking at the wind direction. On that survey it was from the N (ideal for migrants) and on this survey it was from the S (not ideal).

Time of day of the two surveys possibly also played a part, though likely not
much (0539-0944 on 10/5/5 compared to 0710-1123 on this survey).

Cetaceans and Seals

No cetaceans or seals were seen.

Ian Harding
3/5/6

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23 / 05 / 06

A light westerly or south-westerly wind, apart from for the last 90 minutes of the survey when the wind suddenly rose to a force 5, produced a sea state 2 or 3 which with good visibility resulted in good surveying conditions. It is unlikely that many seabirds were missed in the A to D bands. The control area was also surveyed today. A small deviation from the line was required at the northern end of transect 8 to avoid shipping. High tides occurred at 10.13 (4.9m) and 22.17 (4.9m).

Birds were very sparse again today with total of only 58 recorded, 19 of which were recorded within the control area. Only two species of gull were recorded – 29 herring gull and six lesser black-backed gull. While there did not seem to be any pattern to the gulls movements for most of the survey, there appeared to be a general southerly movement of gulls in transect 1, the last transect to be surveyed.

11 common tern and seven Sandwich tern were recorded. The great majority seen to the south of the wind farm, flying in a westerly direction. Some were seen feeding – or trying to - but none observed carrying fish yet.

Two cormorant were recorded, one seen roosting on the derelict Girdler tripod, within the eastern part of the wind farm, the other on the met mast. Another was seen on the 'non-transect side' of the boat fishing in the western part of the wind farm. The Girdler tripod was a very popular roost for cormorant before the wind farm was built but only a few birds have been recorded on it since. Perhaps this will be the beginning of their return having become habituated to the turbines. Cormorant on other offshore wind farms seem to very soon get used to the turbines, roosting on the rails around the bases as the propeller rotates above them.

Two adult gannet were recorded flying low to the water in a south-westerly direction to the south of the wind farm. One swallow was seen flying through the site, probably a late returning migrant.

One common seal was seen in transect and two others on the 'non-transect' side of the boat. A harbour porpoise was seen between the southern ends of transects 3 and 4.

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02 / 06 / 06

A very light south-westerly wind, resulted in a flat calm sea state which with good visibility resulted in exceptionally good surveying conditions. It is unlikely that any seabirds were missed in the A to D bands although high-flying small passerines could have slipped by unnoticed. A small deviation from the line was required near the southern end of transect 3 due to the proximity of a dive boat and a diversion was also required in transect 8 to navigate shallow water. High tides occurred at 05.30 (4.7m) and 17.35 (4.7m).

73 gulls were recorded today. Herring gull were by far the most numerous with 67 recorded. Four lesser black-backed gull and two great black-backed gull were also recorded. While there did not seem to be any pattern to the gulls movements for most of the survey, a group of 16 herring gull appeared to be feeding on small fish near the southern end of transect 8.

Surprisingly few terns, (only four common tern), were seen either on the study site or during the outward and returning journeys to and from Whitstable harbour. The four gannets recorded appeared to be in transit through the site as opposed to actively seeking food. Several of the 11 cormorant recorded were seen within the wind farm, including one roosting on the Girdler Tripod. c40 common scoter were seen on the water north of the wind farm in transect 4. They were observed to take off and land nearby a number of times.

Two swallows were recorded flying through the study site. The most interesting observation of the day was a peregrine falcon roosting on the top of the nacelle of turbine F3, (as the wind was so light the rotor was not revolving). The peregrine was probably sat on this vantage point to spot potential prey – maybe passing terns?

Although conditions were perfect no marine mammals were recorded today.

21 / 07 / 06

A warm, sunny day with a very light south-easterly wind, resulted in a calm sea which with good visibility resulted in very good surveying conditions. Only a very few seabirds could have been missed in the A to D bands. The line had to be cut a little short at the northern end of Transect 8 because of shipping and a small deviation from the line was required near the southern end of Transect 1 to avoid static fishing gear fixed in shallow water on the line. High tides occurred at 10.05 (4.6m) and 22.30 (4.6m). The Control area was also surveyed today.

117 gulls were recorded. Herring gull were the most numerous with 67 recorded. Ten lesser black-backed gull, four great black-backed gull, and 19 common gull were also recorded plus 18 gulls that could not be identified to species. While there did not seem to be any pattern to the gulls' movements for most of the survey, there did appear to be a south-easterly movement of gulls through Transects 1 and 2 to the west of the wind farm. A 'feeding frenzy' was witnessed on the outward journey near the southern end of transect 8, (as it was several times last summer), but it had dissipated by the time the survey vessel was on that line. Also, many of the common gull recorded were seen pecking at the surface, presumably for planktonic food of some sort. A herring gull was seen roosting on the rail of a turbine base.

Five of the eight common tern recorded appeared to actively avoid the wind farm by veering north or south from a westward flight. Five Sandwich tern were also recorded, one of which was seen flying through the wind farm. The six gannets recorded appeared to be in transit through the site as opposed to actively seeking food. Several of the 25 cormorant recorded were seen within the wind farm, including ten roosting on the Girdler Tripod, two of which were clearly juvenile birds.

Despite perfect observing conditions, no marine mammals were recorded today.

07 / 08 / 06

A Force 1 to 2 northerly wind produced a sea state 1 to 2 which, with good visibility, resulted in good surveying conditions. Few seabirds will have been missed in the A to D bands. There was some light rain while surveying the western half of the main survey area. The Control area was also covered today. High tide occurred at 11.40 (4.8m).

With a total of only 21, very few gulls were recorded today. Herring gull were the most numerous with 10 recorded. Eight lesser black-backed gull, and four great black-backed gull were also recorded. There did not seem to be any pattern to the gulls' movements

Regarding terns, 36 common tern, (plus a group of 21 on the 'non-transect' side of the vessel), two Sandwich tern, and two black tern were recorded. Black tern have been recorded in the past on this site in the late summer but these were the first this year. They will probably have been in migration from the Baltic to the West African coast. 22 of the common tern recorded, the two black tern, and three gannet were seen feeding together at the now regularly observed summer feeding area near the southern end of Transect 8.

A total of seven gannet were recorded through the day. Most of the 18 cormorant recorded were seen roosting on the met mast, Girdler Tripod, or Spaniard buoy.

Regarding marine mammals, a common seal was seen within the wind farm, three harbour porpoises were recorded to the north of the wind farm in Transect 4 and a further porpoise was recorded in Transect 8.

18 / 09 / 06

A Force 3 westerly wind produced 0.5m waves which, with very good visibility, resulted in good surveying conditions. Few seabirds will have been missed in the A to D bands although some small migrating passerines may have flown by unseen in the C or D bands. High tides occurred at 10.39 (4.5m) and 23.32 (4.7m).

A total of 33 gulls were recorded today. Lesser black-backed gull were the most numerous with 15 recorded. 12 herring gull, four great black-backed gull, and two black-headed gull were also recorded. Most gulls were seen in transects 6 and 7 where there appeared to be a general northward movement.

Four common tern, (plus a group of seven feeding to the north of transect 2), and five Sandwich tern were recorded. Two juvenile gannet and one guillemot were seen flying through the site. 21 cormorant were recorded, most roosting on the Girdler Tripod, the met mast, or the Spaniard buoy. A grey plover was identified, flying to the west just south of the south-eastern corner of the wind farm.

Regarding passerines, a number were seen migrating through the site, all in a generally western direction: 28 swallows in groups of two to eight throughout the day, (including some flying through the wind farm); one group of four house martins; five meadow pipits; and five unidentified finch species.

No marine mammals were recorded today.

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29 / 09 / 06

A force 1 south-westerly wind producing a sea state 1 slowly increased through the morning to force 3 to 4 which produced a sea state 2 to 3. The visibility was reduced in the rain showers but always remained beyond three kilometres so surveying conditions were generally quite good. Few seabirds will have been missed in the A to D bands although some small migrating passerines may have flown by unseen in the C or D bands.
High tides occurred at 04.46 (4.8m) and 17.10 (4.8m).

A total of 40 gulls were recorded today. At 21 birds, herring gull were the most numerous and, interestingly, all were immature. Nine lesser black-backed gull, six great black-backed gull, and four unidentified gulls were also recorded. There did not appear to be any real pattern to the gull's movements.

There was a high count of common tern with a tight group of 82 birds dip-feeding near the Spaniard buoy at the southern end of Transect 1. A further 25 common tern were seen flying in generally eastern or western directions through the site including six that were seen flying through the wind farm. The 'resident' Medway terns are thought to have migrated so these birds are likely to be from further north, on their way south, opportunistically feeding on the way. Three Sandwich tern and one black tern were also recorded.

Four juvenile gannet were seen flying through the site. 13 cormorant were recorded, most roosting on the Girdler Tripod, the met mast, or the Spaniard buoy.

Regarding passerines, a flock of seven and a flock of eight starlings were recorded flying low and to the west through the site. Two unidentified small passerines were seen flying to the south-west, just north of the study site between transects.

No marine mammals were recorded today.

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09 / 10 / 06

The wind remained a steady force 2 south-westerly producing a sea state 1 / 2 throughout the survey which, with good visibility, resulted in very good surveying conditions. Very few seabirds will have been missed in the A to D bands although some small migrating passerines may have flown by unseen in the C or D bands.
High tides occurred at 02.44 (5.5m) and 14.47 (5.7m) – exceptionally high spring tides.

29 lesser black-backed gull, three great-black backed gull and three herring gull were recorded. Considering that the control area was covered today, the herring gull count may have been the lowest since these surveys began. There did not appear to be any real pattern to the gull's movements.

Just one common tern was recorded - very different to the survey eleven days ago with over 100 recorded. This could lend more weight to the 'staging post proposition'. Two first year gannet were seen flying through the site. 14 cormorant were observed on the usual roosting structures.

A curlew was recorded flying low to the south-west in transect 2, possibly migrating into the Swale for the winter. 48 starling were seen migrating through the site in a westerly or south-westerly direction.

Regarding wildfowl, five Brent geese were recorded in the control area flying low to the west and looked as if they would fly to the south of the wind farm but were lost from view before being able to confirm this. A further group of eight Brent geese were seen on the 'non-transect' side of the vessel in transect 8. These birds were seen to fly through the wind farm behaving as if they were uneasy – starting at a height of 1m then up to 20m before flying at varying heights of between 1m and 15m, fragmenting as a group and reforming a number of times. They appeared to fly through the full east to west width of the wind farm. A tight group of 45 common scoter were seen flying low to the south-east in transect 6.

One harbour porpoise and two common seals were recorded.

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04 / 11 / 06

A force 3 to 4 westerly to north-westerly wind produced a sea state 2 / 3 throughout the survey which, with good visibility, resulted in quite good surveying conditions although sun-glare was a minor problem in transects 5 and 7. The close proximity of all the auks recorded on the water suggests that a number may have been lost in the wave troughs in bands C and D. Some small migrating passerines flying below the horizon, and thus not offering a silhouette, may have also flown by unseen in the C or D bands. High tides occurred at 11.04 (5.3m) and 23.50 (5.3m).

A total of 178 gulls were recorded of 6 different species. Lesser black-backed gull were the most numerous with 122 recorded. Many of these were seen in a loose aggregation near the north end of transect 3. 12 great-black backed gull, 36 herring gull, five common gull, two kittiwake, and a black-headed gull were also recorded.

3 juvenile gannet were seen plunge diving in transects 6 and 7. 40 cormorant were observed, mostly on the familiar roosting structures of the met mast, Girdler Tripod and Spaniard buoy. Eight auks were recorded - four guillemot, three razor-bill, and one bird that was not identified to species.

The first diver of the season was recorded – a black-throat, flying quite high at 20m, to the south-west in transect 7. Eight Brent geese were seen, one group of three skirting the southern edge of the wind farm, and a group of five skirting the northern edge. It is not known if these geese altered their flight path to avoid the wind farm as they were not seen until already alongside the turbines.

Regarding passerines, 13 chaffinch, 138 starling, 2 fieldfare and one unidentified small passerine were recorded, all flying in a generally western direction. All were flying alone or in small groups apart from one tight flock of c110 starling. A merlin was observed on the 'non-transect' side of the vessel, seen stooping on a group of starlings.

No marine mammals were recorded today.

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01 / 12 / 06

A dull overcast day with some light rain and a force 4 to 5 south to south-westerly producing a sea state 3 resulted in reasonable surveying conditions. Some birds on the water may have been missed in the further bands but few flying sea birds will have been missed within the A to D bands. A small deviation from the line was required in transect 8 to navigate shallow water. High tides occurred at 08.31 (4.9m) and 21.31 (4.9m).

A total of 53 gulls were recorded of five different species. Herring gull were the most numerous with 27 recorded. 10 lesser black-backed gull, one great black-backed gull, one common gull, and 14 kittiwake were also recorded.

28 cormorant were observed, mostly on the familiar roosting structures of the met mast, Girdler Tripod and Spaniard buoy. Eight guillemot were recorded, mostly in band A which would indicate that a number were lost from view in the wave troughs. A group of eight common scoter was flushed about 400m ahead of the survey vessel in transect 1.

There are still only a few divers on the site with three red-throated diver and two black-throats recorded, all flushed by the survey vessel. The significance is unsure but no shoals of sprats were seen on the echo sounder today and fishermen are not targeting sprats in the area yet but very large shoals were noticed off the Suffolk coast two days previously.

A common seal was recorded just to the south of the wind farm in transect 5.

A4.CD WITH FIGURES – 1 TO 116: SHOWING SITE LOCATION, VESSEL AND AERIAL OBSERVATIONS FROM 2002 TO 2005, COVERING MONITORING REPORTS YEARS 1 TO 5.