Lake Turkana Wind Power Project - Kenya

Ornithological and Bat Surveys

Interim Report
July 2011




Revision Schedule

D132282
July 2011

Rev	Date	Details	Prepared by	Reviewed by	Approved by
01	6th May 2011	DRAFT	**Kevin Du Rose** Ornithologist **Mike Padfield** Senior Ecologist	**David Broughton** Senior Ecologist	**Russell Foxwell** Associate Director
02	21st July 2011	DRAFTv2	**Kevin Du Rose** Ornithologist **Mike Padfield** Senior Ecologist	**David Broughton** Senior Ecologist	**Russell Foxwell** Associate Director
03	28th July 2011	FINAL	**Kevin Du Rose** Ornithologist **Mike Padfield** Senior Ecologist	**David Broughton** Senior Ecologist	**Russell Foxwell** Associate Director

URS Scott Wilson Ltd
Meridian House
1 Meridian Way
Norwich
Norfolk
NR7 0TA

Tel. 01603 706 420
Fax. 01603 706 421

www.urs-scottwilson.com

Table of Contents

1 Introduction

1.1 Background

1.1.1 The proposed Lake Turkana Wind Power Project (LTWP) is situated in the Marsabit district of northwest Kenya (see Figure 1). The project aims to provide 300MW of wind energy for the national grid, via a series of 365 wind turbines. In addition to the turbines associated infrastructure will include turbine connection cables, improved access roads and workers village.

1.1.2 The wind farm will be positioned within an overall project site of 40,000 acres (162km^2), with the turbines located at a distance of around 7km to the east of Lake Turkana itself.

1.1.3 An Environmental and Social Impact Assessment for the wind farm development has been undertaken by others, formally approved and an EIA license was issued in July 2009. It was recommended that a one-year programme of ornithological surveys be carried out to validate the conclusions of the ESIA prepared for the Project.

1.1.4 LTWP commissioned URS Scott Wilson to carry out a review (the 'Review[1]') of the Project and the relevant project submissions, against the environmental and social requirements of the IFC Performance Standards. URS Scott Wilson was also commissioned to design and manage the ornithological surveys.

1.1.5 The ornithological survey method is based on best practice methods and was prepared following a reconnaissance survey and discussions with the Royal Society for the Protection of Birds (RSPB) and the National Museums of Kenya (NMK).

1.1.6 The surveys commenced in October 2010 using a team of ornithologists from the NMK. The surveys are conducted on a monthly basis over a twelve month period, including additional survey effort in the two migration periods of Autumn and Spring, which coincide with the months of October/November 2010 and March/April 2011.

1.1.7 An initial Progress Report was issued in December 2010, presenting a summary of the initial results arising from the first two months of survey, October and November 2010.

1.1.8 This Interim Report presents a summary of the combined initial results arising from the first seven month's survey (October 2010 to April 2011) including both the autumn and spring migration periods and an additional raptor flight line survey at one Vantage Point (VP8). The surveys in May and June 2011 have been undertaken, but have not yet been analysed. The full analysis of potential for bird strike from wind turbines will be modelled on the basis of a more complete data set (one year). The purpose of this report is to present the findings of the surveys to-date, including initial recommendations and conclusions, which might affect the project process. This includes draft operational monitoring recommendations.

1.1.9 Whilst not a specific requirement for approval of the EIA for the wind farm, it was recommended in the Review that further investigation of the bats using the site be carried out to determine potential impacts to bats from the project. The survey involved a week of surveys undertaken in March 2011 using bat specialists from the NMK and URS Scott Wilson.

[1] Scott Wilson (May 2011) Lake Turkana Wind Power Project, Kenya, IFC Performance Standards on Social & Environmental Sustainability: Project Review

Site Description

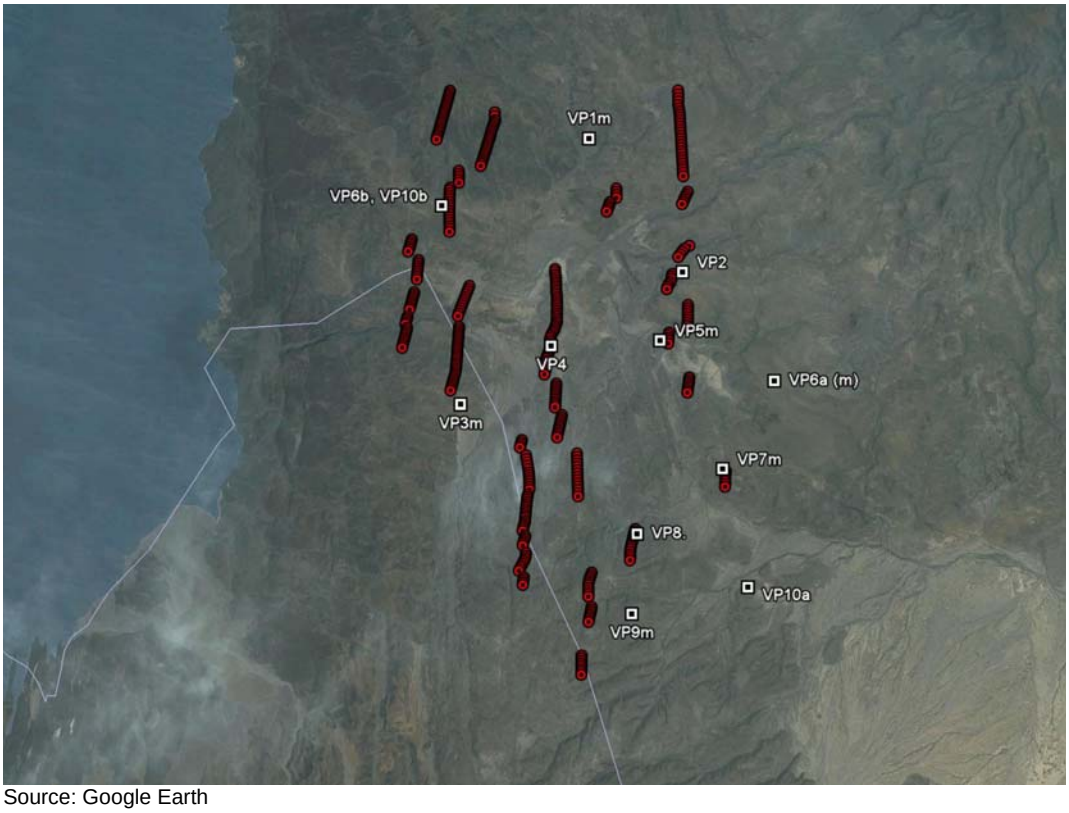
1.1.10 The wind farm site is approximately 162km^2 in size and comprises 'masai xeric[2]' grassland and scrubland with areas of bare alluvial deposits. There are very few trees across the site and no permanent water bodies. There are a number of bare ridges across the site, where the turbines will be positioned. The site is difficult to traverse due to the rocky terrain, however tracks have been cleared to facilitate construction of eight data masts which are situated on representative ridges located across the area to be occupied by the turbines.

1.1.11 Some acacias are found growing along occasional low lying "lagas[3]" which pass through the site. The lagas may be periodically flooded for a few days/weeks (possibly happening only between twice a year and one-in-ten years). The southern end of the site generally has a greater frequency of acacia-commiphora scrub, although this is sparse compared to habitats further south. Further north the habitats are dominated by a rocky desert habitat with very sparse vegetation. The main habitation is Sirima village located in the middle of the site. It comprises thatched grass huts, a dry reservoir and a brick school building; in April it was observed that there were less than 50 people from the nomadic Turkana tribe present. There are a few other disused huts around the site, which may be used from time to time.

1.1.12 Around 7km to the west of the site boundary is the shoreline of Lake Turkana, which is dominated by bare lava rocks. From the southern site boundary the habitats gradually change to scrub and tall acacia woodland as the main settlement of South Horr is approached at c.24km to the south of the site. South Horr is located within a canyon between Mount Nyiru and Mount Ol Donyo Mara. To the east of the site the land rises up to Mount Kulal (2335m) where the village of Gatab is located. This is a cooler habitat with moist broadleaf forests and steep sided valleys.

Figure 1 – Wind Turbine and Vantage Point Locations

[2] Includes a mix of desert, savanna woodland, wetland, and bushland.
[3] An intermittent stream or water course which dries up in the dry season.



Source: Google Earth

15km (approx.)

2 Ornithological Surveys

2.1 Methods

2.1.1 The survey methods involved vantage point (VP) watches and transect surveys. The methods were developed from a reconnaissance survey undertaken in 2010[4], best practise methods[5] and consultation with the RSPB and NMK. Experienced ornithologists from NMK were used for the majority of the surveys with quality checking and some additional site work by a URS Scott Wilson ornithologist. The methods are described below.

2.1.2 To assess the likelihood of collision with wind turbines VP watches were carried out overlooking the proposed site to assess the level of usage of the site by overflying birds. When the complete dataset has been collected, the data will then be analysed to estimate the probability of collision for potentially susceptible species and in turn the potential impact on such species can be assessed.

2.1.3 To estimate the population size of all of the species believed to have the potential to be excluded from the proposed wind farm it was necessary to estimate the population sizes of the bird species that were found within the area of the proposed wind farm. To do this a bird recording transect was used (transect survey). This allows for the baseline population of all of the potentially affected species to be established so that potential impacts can be established.

2.1.4 Limitations of the bird surveys include

- Location: The site is a 2 day drive from Nairobi by vehicle and up to one day from Marsabit. It takes approximately 2 hours to get on to the site by vehicle from the base camp at South Horr.
- Disturbance: It is not possible to survey at or close to Sirima village, because the presence of 'outsiders' attracts the attention of large numbers of local children.
- Security: Surveys will either be undertaken at the guarded mast sites or from a vehicle.
- Climate: e.g. orientation to the sun, dehydration risk, wind.
- Access and terrain: Surveys were undertaken by 4x4 vehicle from tracks.

2.1.5 The methodology used for the VP watches and transects surveys are as follows:

Vantage point watches

2.1.6 Recording focussed on larger, less manoeuvrable species which are known to be at potential risk of collision with wind turbines (target species), these are as follows:

- All large water birds (plover sized and above), e.g. flamingos, pelicans, storks and cranes;
- Birds of prey, including owls and raptors such as vultures, eagles, buzzards; and
- Bustards.

[4] Scott Wilson (2010) Lake Turkana Wind Power Project: Methodology for Ornithological Survey.
[5] SNH (2005) Bird survey methods for use in assessing the impacts of onshore wind farms on bird communities

2.1.7 The International Union for Conservation of Nature (IUCN) Red List status of target species recorded on site are listed in Appendix 4.

2.1.8 The VP watches entailed recording bird flights over a set area of the proposed windfarm at a representative number of locations- ten (see Figure 2). The orientation of each VP covered a 180° field of view. Initially six of these VPs were located at meteorological mast sites (VP*m) and four adjacent to a track (VP*). These ten locations were chosen as a sample to give good spatial coverage across the site, approximately 50% of the area, (based on an average 2km field of view), to cover regular bird-flight lines and potential migratory movement. The locations included views of ridgelines and valleys, and the full range of habitats on the site (i.e. from desert to scrub). From February 2011 VP6a(m) and VP10a were moved to new locations to account for minor layout changes, becoming VP6b and VP10b (see Figure 2 for locations). The total survey area remained the same.

2.1.9 Bird flight heights were recorded within three flight height bands which correspond to the current turbine specifications (i.e. Vestas V52 turbines with a 44m hub height). These height bands were as follows:

- Band A below rotor sweep height (<18m a.g.l[6])
- Band B within rotor sweep height (18 to 70m a.g.l)
- Band C above rotor sweep height (>70m a.g.l)

2.1.10 Further detail on the location of the VPs and method is shown in Appendix 1. To ensure accurate identification binoculars and a tripod-mounted telescope with a suitable magnification (25-40x) were used during all watches. The number of seconds for each bird flight was entered onto standard recording proforma (see Appendix 1).

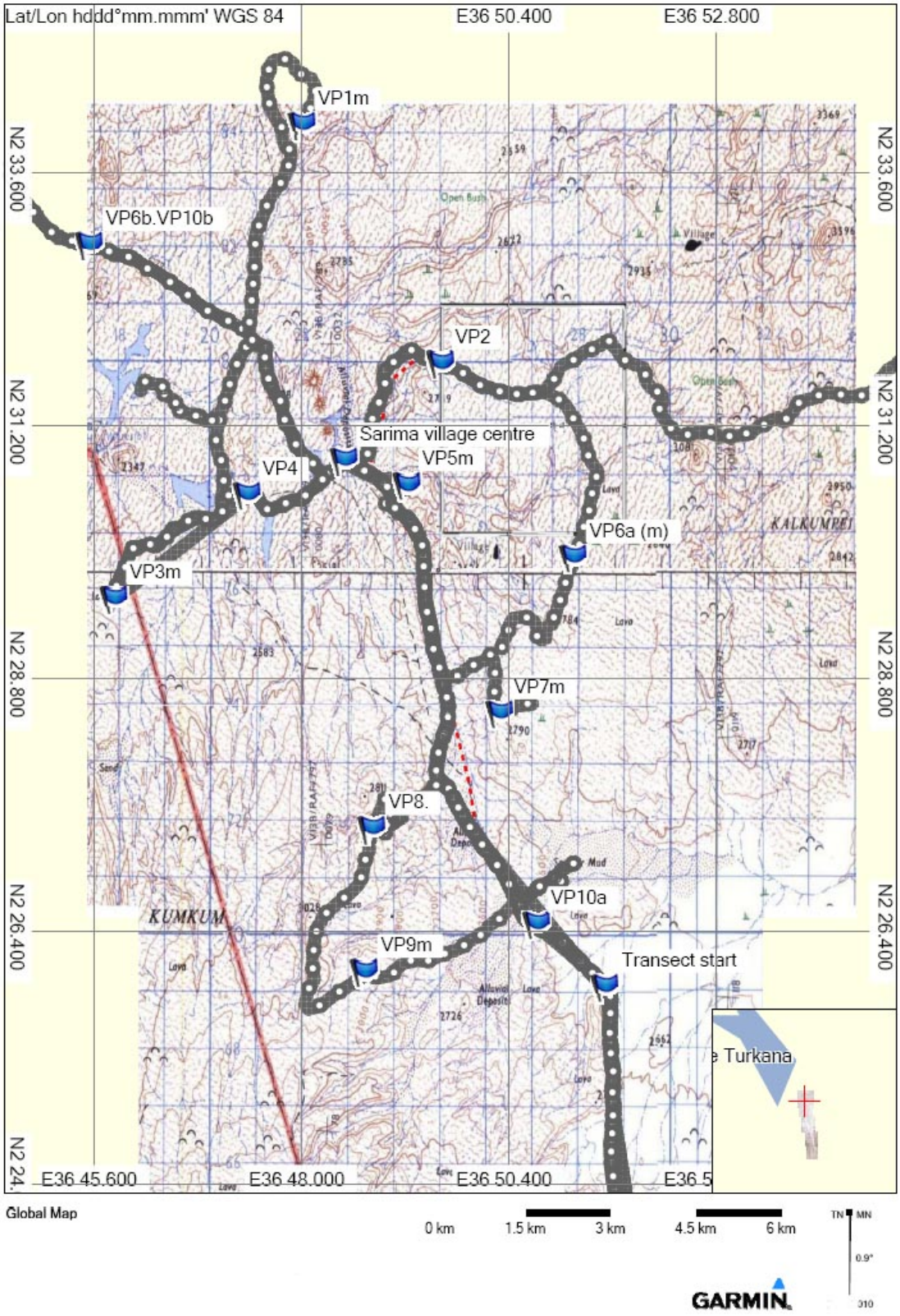
2.1.11 Each VP will be visited twice per month for one year (from October 2010 to September 2011) with each watch lasting 3 hours, resulting in a total of 72 hours of observations at each VP. In addition during the autumn and spring migration, additional survey effort was undertaken to ensure this important bird migration time is not missed. Therefore in October, November 2010, March 2011 and April 2011 each VP was visited a total of four times per month (4 x 3 hours). The timing of the surveys at each VP is varied to include all daylight hours and a proportion of early morning and dusk visits, which are included to capture periods of bird activity in which birds may be moving to or from roosting and feeding areas.

2.1.12 During the October 2010 surveys a high concentration of migrating raptors were recorded around VP8. Therefore during November an additional raptor flight line survey was undertaken to gather more data on the movements of raptors around VP8.

2.1.13 Data collected to date has been input to the 'band model' which is used to estimate the likely number of collisions for each species per year. At this stage, with seven months of data, it is not possible to model this with complete confidence that conclusions are likely to be accurate. However, the survey data has provided valuable data for discussion in the meantime.

[6] a.g.l above ground level

Figure 2 – Vantage point locations and access tracks



Bird recording transects

2.1.14 A number of different methods for the transect survey were investigated during the reconnaissance survey. The following method was undertaken based on the low number of birds recorded, lack of suitable habitat in most areas and the limitations stated in section 2.1.4 (e.g. practicalities of surveying the site due access and climate, etc).

2.1.15 Access tracks through the site and up to the meteorological masts provide a good sample of the habitats across the site (e.g. desert to scattered scrub). Transects along access tracks were surveyed by vehicle. This started from c.500 metres south of the site boundary on the main track and continued within the site boundary en route to the first VP watch location on each day (see Figure 2). Stops were made when target bird species (same as for VPs) were encountered both flying and on the ground, and details were recorded on the standard pro-forma. (see Appendix 1)

2.2 Results

Vantage point observations October 2010 to April 2011

2.2.1 Target species flights recorded at each VP from October 2010 to April 2011 are shown in Appendix 1, with target species flights recorded during observations from all ten vantage points shown in Table 1.

2.2.2 Very few water-birds or bustards were recorded from any of the VP watches during the period (840 hrs in total). The only records were one Heuglin's bustard recorded in January, four white storks and an unidentified stork recorded in February. The only other occurrences of a bird which was not a bird of prey, but is a target species, were 3 Somali coursers recorded during February.

2.2.3 October was the month with the most bird activity on the site. The total number of raptor flights recorded in October during the 120 hrs of observations across all the VPs was 272 flights, or just over 2 flights per hour. The most common species involved was steppe buzzard with 198 flights, followed by lesser-spotted eagle with 14 flights and greater kestrel with 10 flights. The remainder consisted of 13 further species making less than 10 flights during all of the watches (see Table 1).

2.2.4 The number of bird flights in November was noticeably lower than was recorded in October with only 92 raptor flights recorded during the 120 hours of VP watches (Table 1). Species abundance recorded in November was slightly different to that recorded in October, with steppe eagle being the most common species with 24 flights, followed by steppe buzzard with only 21 flights, followed by lesser kestrel and Eurasian hobby with 11 and 10 flights respectively.

2.2.5 The lower numbers of observed raptor flights in November compared to October appears to indicate that the raptor migration season may have begun to slow down during November (Table 1). Overall this trend was largely due to the fact that steppe buzzard flights dropped from 198 flights in October to 21 flights in November (see Appendix 1).

2.2.6 From December onwards the number of bird flights decreased from what was recorded in October and November. This trend continued with to the end of the survey period, including the recent May and June data which has not yet been analysed in detail. It is particularly noteworthy that during the spring migration period of March and April the frequency of bird flights hardly increased over what was recorded during the mid-winter months of December, January and February. Note that although the actual number increased this is largely due to the fact the

number of hours survey effort in the March and April spring migration period was double the amount of hours surveyed during the mid-winter months.

2.2.7 Vantage Point 8 which is situated close to the top of a ridge that runs roughly north to south through the site produced a higher number of flights of migrating birds of prey during October and November, notably steppe buzzard, lesser spotted and steppe eagle. VP's 2, 3 and 4 also produced moderate numbers of raptor flights although not quite in the numbers recorded at VP 8. No concentration of migrating raptors was noted at VP 8 during the spring migration period (March to April).

2.2.8 During the 24 hours of VP watches conducted in October and November from VP8 a total of 67 steppe buzzards, 12 lesser-spotted eagles, 11 steppe eagles were recorded. All other species were recorded in numbers of less than five individuals during the October to November from VP8. Low altitude movements (turbine height and below) were mainly restricted to the first and last couple of hours of each watch. During the middle part of the day migrating raptors were generally flying at a great height at least 1km a.g.l and therefore well above turbine height and as a consequence they were mostly undetectable.

2.2.9 In response to the concentration of raptor flights at VP8 recorded in October additional study was carried out to look at raptor movements from this VP during November. This study has indicated that southward migrating raptors (in October/November) most probably use this ridge and high ground to the west of VP8 as a part of their migration route towards the mountains which lie between Lake Turkana and South Horr. This study confirmed that the number of low altitude flights peak during early morning and then again later on in the day when their flight is much lower than during the middle part of the day. It was noted that many of the raptors migrating past VP8 tended to fly just below the top of the ridge.

Table 1 – The number of target species flights recorded during observations from all ten vantage points during the period October 2010 to April 2011.

Species	Month						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Black-shouldered kite	-	-	-	1	-	1	1
African swallow-tailed kite	-	-	1	-	-	1	-
Osprey	1	-	-	-	-	-	-
Gabar gosshawk	-	-	-	-	-	-	1
Eastern pale chanting gosshawk	-	-	1	2	-	-	-
Steppe buzzard	198	21	1	2	-	10	2
Long-legged buzzard	-	-	-	-	-	1	-
Tawny eagle	7	1	2	3	1	8	2
Steppe eagle	6	24	-	2	2	3	1
Lesser-spotted eagle	15	4	-	-	-	-	-
Greater-spotted eagle	4	-	-	-	-	-	-
Martial eagle	2	2	-	-	-	-	-
Verreaux's eagle	-	-	-	-	-	-	3
Bateleur	4	-	-	-	1	2	1
Black-chested snake eagle	-	2	-	1	-	-	1
Egyptian Vulture	5	8	-	-	1	-	1
African white-backed vulture	-	-	4	1	5	1	-
Lappet-faced vulture	-	-	2	-	-	-	-
Rüppell's griffon vulture	2	-	-	-	-	-	-
Pallid harrier	4	1	-	-	-	3	-

Species	Month						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Saker falcon	4	-	1	-	-	-	-
Lanner falcon	-	3	-	-	-	-	-
Peregrine falcon	-	-	-	-	-	-	1
Barbary falcon	-	-	1	-	-	-	-
Greater kestrel	10	-	-	-	-	1	-
Eurasian hobby	-	11	-	-	-	2	-
Fox kestrel	-	-	-	-	3	-	8
Common kestrel	2	5	4	3	5	-	12
Lesser kestrel	7	10	1	-	2	19	-
Black-shouldered kite	1	-	-	-	-	-	-
Unidentified raptor	-	-	-	-	2	-	-
Unidentified kestrel	-	-	-	-	-	1	-
White stork	-	-	-	-	1	-	-
Unidentified stork	-	-	-	-	1	-	-
Heuglin's bustard	-	-	-	1	-	-	-
Somali courser	-	-	-	-	3	-	-
Monthly totals	**272**	**92**	**18**	**16**	**27**	**53**	**34**
Number of hours of watches per month at each vantage point	***12***	***12***	***6***	***6***	***6***	***12***	***12***

Transect survey observations October 2010 to April 2011

2.2.10 Once all transects counts are completed it will be possible to estimate a density for all of the target species recorded on site. However, at this stage due to the fact that nine months of data has been collected, of which seven has been analysed in detail, it is not possible to make any firm estimates, although the data does indicate the majority of species are at relatively low densities. This is evidenced by the fact that no target species birds at all were recorded on a large numbers of transects which average approximately 6km in length. The total length for all transects combined is 522km from which 153 individuals of all target species were recorded.

2.2.11 The transect data showed a similar pattern to the VP data in that there were many more bird registrations in October than the other months (Table 2). Other than steppe buzzard which was the most common species the remainder of species were recorded in only small numbers. The majority of target species records were of birds of prey; non bird of prey target species recorded during the transects were: one Kori bustard, seven Heuglin's bustard, one buff-crested bustard, eight white stork, one Abdim's Stork and one Somali courser.

Table 2 – Total number of bird registrations for all target species recorded during 10 transect counts conducted during the period October 2010 to April 2011

Species	Month						
	Oct	Nov	Dec	Jan	Feb	March	Apr
Black-shouldered kite	-	1	-	-	-	-	-
European Honey buzzard	-	-	1	-	-	-	-
Steppe buzzard	65	1	1	-	-	-	-
Steppe eagle	7	2	-	1	-	-	1
Lesser-spotted eagle	5	-	-	-	-	-	-
Martial eagle	1	-	-	-	-	-	-
African hawk-eagle	2	-	-	-	-	-	-
Black-chested snake eagle	-	-	-	-	1	-	-
Long-legged buzzard	1	-	-	-	-	-	-
Greater-spotted eagle	2	-	-	-	-	-	-
Lappet-faced vulture	2	-	-	-	-	-	-
Lesser spotted eagle	-	-	1	-	-	-	-
White-backed vulture	-	1	-	-	-	-	-
Egyptian Vulture	1	5	1	-	-	-	-
Pallid harrier	3	-	-	-	-	-	-
Fox kestrel	-	-	-	-	-	-	5
Eurasian hobby	-	1	-	-	-	-	-
Common kestrel	-	-	-	2	-	-	-
Lesser kestrel	2	-	-	1	-	-	-
Greater kestrel	3	-	-	-	-	-	-
Eastern pale chanting gosshawk	2	-	-	1	1	1	-
Gabar gosshawk	1	-	-	-	3	2	1
Kori bustard	-	-	1	1	-	-	-
Heuglin's bustard	1	1	-	-	5	-	-
Buff-crested bustard	-	-	-	1	-	-	-
White stork	-	-	-	-	8	-	-
Abdim's stork	-	1	-	-	-	-	-
Somali courser	-	-	-	-	2	-	-
Total number of transects per month	10	10	7	10	10	20	20

2.3 Discussion

2.3.1 The survey data presented and discussed in this report represent seven months of data (October 2010 to April 2011 inclusive). This period includes both the autumn and spring migration period for migrating raptors and other target species.

2.3.2 There are two main potential impacts on avifauna brought about by wind farms, these are i), the risk of collision, potentially from the less manoeuvrable species colliding with the wind turbines and ii) general bird avoidance of wind turbines meaning birds are excluded from otherwise suitable habitat within the vicinity of the windfarm. Direct habitat loss from windfarm infrastructure may also be an impact on breeding habitat. These impacts are discussed further below in relation to the survey findings.

2.3.3 Whilst the data is preliminary, it is possible to make inferences regarding the occurrence of target species observed on the site, which have the potential for collision risk. Firstly, of the species recorded, there were very few records of a water bird during a transect survey and VP watches (see Tables 1 and 2). Following consultation the potential impact upon water birds at Lake Turkana was the primary concern arising from the project and the main basis for recommending the surveys. The low number of records of water-bird species seems likely to be due to the fact that there is little or no water on site and that Lake Turkana lies a considerable distance from the Site (c.7km). Furthermore, the site does not lie directly between Lake Turkana and any other of the Rift Valley lakes and as a consequence does not lie on any regular water bird flyway.

2.3.4 At this stage in the surveys, potentially the main bird issue appears to be associated with raptors. Raptors can be categorised into three groups,

- Western Palaearctic migrants (migrating October/November and again March/April e.g. steppe buzzard, steppe eagle)
- Resident species (present all year round e.g. martial eagle, vultures.)
- Wintering species (October to April, possibly small numbers of species such as steppe buzzard may remain on site throughout the winter months).

2.3.5 The first two months of survey (October and November 2010) coincided with the autumn migration of Western Palaearctic birds from Europe to Africa. As a consequence it was predicted that the first two months of survey would be likely to record higher numbers of birds than the rest of the year except for March and April, when migration is reversed with birds migrating from Africa to Europe and Asia for the summer months. This was shown clearly by the data which recorded much higher numbers of birds during the October period than the mid-winter non-migration period (see Table 1).

2.3.6 Unexpectedly, during the spring migration period of March and April 2011 bird numbers remained relatively low with no large increase in numbers of birds of prey or other migrating target species. At this stage it is not possible to fully explain the lower numbers of birds of prey migrating through the site in spring, however two of the most likely explanations for this are: Firstly birds could have passed through the site on days when survey was not being conducted. This seems fairly unlikely due to the fact that surveys were conducted for 50% of the days within March and April. Secondly, and a more likely explanation is that, Migrating birds of prey may take a different migration route across the general area in spring compared to their autumn migration. This could be caused by the prevailing wind conditions on the site which are invariably

from a south-easterly direction. This could have the effect of deflecting birds towards or away from the site depending on the season.

Notes on western Palaearctic migrants

2.3.7 Western Palaearctic migrant species were recorded in higher numbers than resident species, for example the most numerous species was steppe buzzard with 219 flights recorded from the autumn migration period with 12 in the spring migration period of this approximately 50% of flights recorded at a height where collision would be possible. However when taking into account avoidance (at 95%[7]) and the fact most flights were below the ridgelines actual collisions are predicted to be minimal, if, as proposed, the turbines are located on top of the ridges.

2.3.8 Data collected during both the autumn and spring migration periods suggests that bird numbers were lower than might have been expected for a location within or close to a main migration route thought to be taken by Western Palaearctic migrants.

Resident Species

2.3.9 Resident bird of prey species appear to be present in small numbers resulting in only a small number of flights being recorded during the VP watches. Only one bustard flight was recorded from any of the VP watches, despite Kori, Heuglin's and Buff-crested bustards being seen fairly frequently between South Horr and the north of the site. Therefore on the basis of the initial data, the potential for collision risk from turbines appears to be low for the bustard species.

2.3.10 There is likely to be displacement from the footprint of the windfarm infrastructure itself. However, due to the low numbers of target species recorded on site and the presence of large areas of alternative suitable habitat the impacts from exclusion is likely to be low.

2.3.11 Nightjars were seen at night along the main access road often close to lagas. Whilst vehicles travelling at night are a potential threat to nightjars, and other nocturnal species, it is understood that the vast majority of construction vehicle movement will be restricted to daylight hours.

2.3.12 Vultures (which are also a migrant species) were recorded in low numbers and were seen on occasions around settlements, e.g. Sirima village. Precautions may be needed to ensure that the presence of the proposed wind farm workers settlement does not attract large numbers of vultures to the site.

Wintering Species

2.3.13 Numbers of birds were relatively low compared to the Autumn migration period with only small numbers of Western Palearctic migrants being recorded during the winter period. For example only three steppe buzzard flights and four steppe eagle flights were seen from all VP watches during December, January and February.

[7] There has been much debate on the extent to which birds might avoid wind turbines as opposed to flying blindly into them. At present the vast majority of studies suggest for the majority of target species as defined in this report avoidance rates are between 99.9 and 95%. As a precaution SNH guidelines suggest a default value of 95% avoidance is factored into any predictions unless higher values are provided by them for individual species derived from multiple studies.

Notes on the higher concentration of birds of prey occurring during the autumn migration at VP8

2.3.14 During autumn migration there was a distinct concentration of raptors moving along the ridge which is overlooked by VP8. Low level movements (turbine height and below) of raptors along the above mentioned ridge normally occur early and late in the day. During the middle part of the day what raptors that were recorded were usually at great height and barely detectable.

2.3.15 Based on the studies to date, it is believed that some raptors migrating south in autumn use the ridge and high ground to the west of VP8 as a part of their migration route towards the mountains which lie between Lake Turkana and South Horr. Observations in this area suggest that most raptors fly along the edge of the ridges, thus avoiding the proposed turbines.

Notes on overhead power cables

2.3.16 As part of the scheme there will be an overhead network of 33kV power lines linking collections of turbines to the onsite sub-station. These pose two potential dangers to birds: direct collision with the cables (birds of prey and bustards) and electrocution (birds of prey only)[8]. Providing that the insulators are of the suspended type and long enough to prevent perching birds of prey from electrocuting themselves (which appears to be the case) this can be ruled out as an impact.[9] Similar to the wind turbines overhead cables can pose a collision risk to birds. The risks to bustards and birds of prey have been well documented in other countries and are, in particular, at potential risk.

2.4 Initial Conclusions and Recommendations

2.4.1 The data collected to date indicates that a low resident population of target bird species is present on site and that during the autumn migration period there is a significant increase in birds of prey passing through the site.

2.4.2 Based on the location of the proposed turbines, observed flight routes undertaken by migrating birds of prey alongside ridges and avoidance rates, it is unlikely that there will be a significant impact to migrating birds through collision with the turbines. When the full dataset has been collected in September 2011 collision risk modelling will be undertaken for target species to predict the number of collisions per year.

2.4.3 There is also a possible risk from collision with overhead power lines, although the flight heights of migrating birds of prey and the low density of target species on site reduces the likelihood of this.

2.4.4 There are other associated risks such as a potential increase in traffic collisions that have been mitigated for by limiting the speed of vehicles on site and avoiding use of site vehicles at night. To avoid attracting vultures any waste food produced by the windfarm workers village should be stored in secure containers or composters on site prior to removal.

[8] Raab, R., Spakovszky, P., Julius, E., Schutz, C. & Schulze, C.H. (2010) Effects of power lines on flight behaviour of the West-Pannonian Great Bustard *Otis tarda* population. Birdlife International.
[9] Ferrer,M., de la Riva, M., Castrovie, J. (1991) Electrocution of Raptors on Power Lines in southwestern Spain. Journal of Field Ornithology, Vol.62, No.2 (Spring 1991), pp.181-190.

2.4.5 A programme of monitoring is recommended to validate the conclusions made during this assessment and to quickly identify any impacts to birds from the operational windfarm. A draft monitoring plan is given in Appendix 6. This will be reviewed based on the final report.

3 Bat Surveys

3.1 Introduction

3.1.1 Based on the reconnaissance survey of the site undertaken in July 2010 the site appeared to have low potential for bats. However, it was recommended in the Review that bats should be considered, via a one-off survey, in order to close out the possibility of a significant threat to bats from the wind turbines. The aim of this study was to appraise the use of the project site by bats as no background data was available and determine any potential impacts to bats from the proposed wind turbines.

3.2 Methods

3.2.1 A range of techniques were used to determine the use of the site and surroundings by bats.

3.2.2 The method is based on using a variety of techniques to record both fruit bats (Megachiroptera) and insect bats (Microchiroptera). It should be noted that this is a baseline appraisal for bats and does not constitute a comprehensive study of bats using the site. The survey comprised a week of surveys on and around the site from the 12th to 18th March 2011. Methods involved daylight roost surveys, bat activity surveys, mist and hand netting, transect surveys using hand-held bat detectors, and use of static bat detectors.

3.2.3 The daylight roost surveys comprised searching disused shelters, mature trees, suitable rocky outcrops and caves within and up to 10km from site. This included off-site habitats at Mount Kulal, Mount Nyiru, and the eastern shore of Lake Turkana.

3.2.4 Bat activity surveys were undertaken in five different sample points (SP) on the site (see Figure 3), that encompassed the full range of habitats present including wooded areas, lagas, scrub habitat, grassland habitat, and exposed rocky ridges. Bats from these SP may forage over the whole wind farm site and across the surrounding landscape.

3.2.5 The mist netting was undertaken under guidance of the NMK bat ecologist to ensure minimal distress or harm to the bats. Mist nets were located in suitable habitats to catch and identify flying bats. Bats were be identified in the hand where possible, and/or photographed for future identification.

3.2.6 Transects were walked at the SP (where the terrain allowed for this) at a steady speed using hand held heterodyne/frequency division bat detectors (Bat box duets) connected to a recording device (Edirol R-09). The surveys commenced up to 0.5 hours before sunset and were completed within 3 hours after sunset. This aimed to sample the peak of dusk and post dusk bat activity. Environmental parameters and bat activity were recorded on standard proforma.

3.2.7 The static bat detectors (Anabat SD1 and SD2) were used during the surveys and left overnight at SPs to provide additional data.

3.2.8 Within each habitat type a Bat Activity Index (BAI) was calculated as follows:

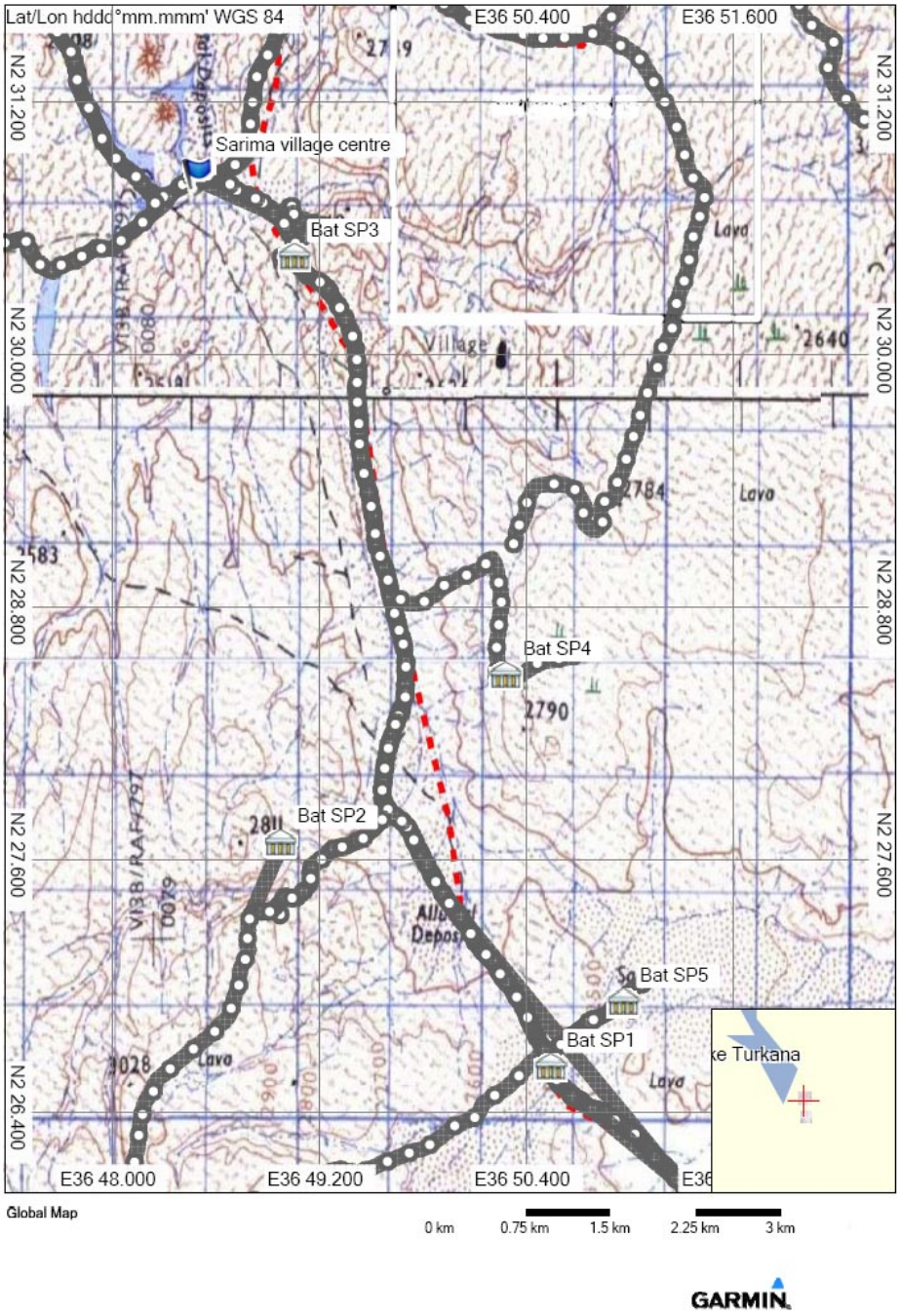
Bat Activity Index = Number of passes / time[10]

[10] Time calculated as from sunset to sunrise.

3.2.9 The objectives were to find not only an estimate of the population size and the species present, but also to identify those parts of the site that are most important for bats.

3.2.10 The bat recordings made during the survey were analysed in Batsound and Analook. Where data existed on echolocation calls of Kenyan species of bats the calls were assigned to genus, species or unknown.

Figure 3 – Bat Sample Point (SP) Locations



3.3 Results

Daylight roost surveys

3.3.1 On the site there are estimated to be approximately 50 mature trees, particularly along the lagas with potential for roosting bats. The only suitable building on site at Sirima village did not contain any signs of bats. There are some rocky outcrops with suitable roosting habitat.

3.3.2 Off site, towards the summit of Mount Kulal (c. 15km from site) are numerous caves in mostly inaccessible locations and mature woodland with potential for bats. On Mount Nyiru (c.20km from site) a *Hipposideros* sp (a leaf nosed bat) roost was found in a rocky outcrop by a waterfall. There were also feeding signs of *Epomophorus* sp (an epauletted fruit bat) in the wooded areas. There were no signs of roosts along the 3km surveyed section of the eastern shore of Lake Turkana.

Bat Activity Surveys on site

3.3.3 Five SP were surveyed (see Figure 3) comprising sparsely wooded lagas (SP1,2,3 and 5), an exposed ridge at a mast site (SP4) and open semi-desert/scrub (also at SP5). The results are shown in Appendix 5.

3.3.4 At least 15 different bat species were recorded during the activity surveys on site with six identified to species; *Lavia frons* (yellow-winged bat), *Pipistrellus nanulus* (tiny pipistrelle), *Chaerophon bivittata* (a wrinkle lipped bat), *Scotoecus hirundo* (an evening bat), *Hipposideros commersoni* (Commerson's leaf nosed bat), *Scotophilus nigrita* (Schreber's yellow bat); seven to Genus *Chaerophon* sp., two *Rhinolophus* species (horseshoe bats), *Neuromicia* sp., *Tadarida* sp. (a guano bat), two *Nycteris* species (slit-faced bats); and at least two unknown bats.

3.3.5 Bats recorded at, or soon after the expected emergence times, indicate the presence of roosts on site. For example at SP5, five *Pipistrellus nanulus* were caught in nets within 1 minute of each other at 19:15.

3.3.6 BAIs were calculated (see 3.2.8), based on transect and Anabat data for each habitat type sampled during the survey. This gave a comparison between the usage of different habitats (and wind conditions) on the site by bats.

3.3.7 Surveys undertaken in the lagas, ranging from still to windy conditions had a mean BAI of 0.13, with surveys during an absence of wind with at BAI of 0.21, and in windy conditions a BAI of 0.06. An exposed windy ridge had a BAI of 0.03. An open desert with scattered scrub had a BAI of 0.03 (no wind).

Other mammal records

3.3.8 Populations of large mammals in the area are understood to be low. The endangered Grévy's zebra were seen on three occasions at close range a few kilometres south east of the site well away from any habitation. Numbers ranged from between two and 11 animals. Two Grévy's zebra were filmed using night vision cameras 2km to the south of the site crossing the road along a Laga. Gerenuk were recorded between South Horr and the site and occasionally on the site. Günther's and Kirk's dik-dik were also seen occasionally along the roadside, mainly to the south of the site.

3.3.9 A female cheetah with two well grown cubs were recorded crossing the access track at one of the less rocky areas towards the south of the site on 1st August 2010. Footprints were also seen in the same area on 15th March 2011. Other species recorded occasionally, all south of the site included common jackal, black-backed jackal, striped hyena, spotted hyena, greater kudu, grey striped bush squirrel, Somali galago and cape hare.

3.4 Discussion

3.4.1 Bats were found using all of the habitats on site, with at least 15 species recorded during the all the surveys. The highest level of bat activity was recorded in and around the sparcely wooded lagas when there was little or no wind. The presence of bats recorded soon after expected emergence times indicate bat roosts on site, most likely in mature trees or rocky outcrops close to the lagas.

3.4.2 The presence of bats flying in windy condition over the exposed sparsely vegetated ridges, albeit in lower numbers, was largely unexpected, indicating that there is an availability of food in these habitats and that certain bat species can tolerate the exposed, windy conditions experienced on site.

3.4.3 Consideration will need to be given to the potential impact to bats flying across the ridges interacting with the rotating turbine blades. The risk of death or injury as a result of collision or decompression barotrauma arising from the operation of the wind turbines is a function of the characteristics and behaviour of the individual bat species involved. The risk of an impact occurring is also a function of the position (proximity) of the turbine in relation to features used by bats.

3.4.4 Although bat activity is low on the ridges where the turbines are located, some of the bat species recorded here are likely to be at moderate to high risk of collision or decompression barotrauma[11]. Monitoring of the behaviour of bats and any collisions is therefore recommended particularly in these areas on site.

3.5 Conclusions and Recommendations

3.5.1 With regards to bat roosts, it is understand that trees will not be lost as part of the proposed wind farm. If any mature trees are required to be de-limbed, e.g. for cabling or road widening at laga crossings, the following method should be followed.

3.5.2 Prior to any tree felling work, the contractor should undertake a visual inspection of the tree to check for bats. As far as possible, fissures and cavities should be inspected e.g. with the use of small hand-torch. Special attention should be given to splits that are held open by the weight of a branch, and which will close once the branch is removed.

3.5.3 If more complex cavities are present within the trees, the section should be carefully lowered to the ground and left with the entrance upward facing for at least 2 nights before limbing or removal. Unless the section is to remain intact onsite, after 2 nights the cavity should be cut into sections and inspected to ensure that bats are absent.

[11] Natural England (2009) Bats and onshore wind turbines: Interim guidance, first edition. Natural England Technical Information Note TIN051

3.5.4 Trees with active maternity roosts should not be removed until the juvenile bats can safely fly (usually 8 weeks after being born). For health and safety reasons, it is important to ensure that bats are not handled under any circumstances without the use of gloves.

3.5.5 Due to the potential for bats interacting with the turbines monitoring a programme of monitoring is recommended to determine any changes to bat activity as a result of the operational wind farm (see Appendix 6).

4 Overall Initial Conclusions

4.1.1 The seven months of data, including capturing both Autumn and Spring migrations, indicates that a low resident population of target bird species is present on site and that during the autumn migration period there is a significant increase in birds of prey passing through the site.

4.1.2 Based on the turbine layout, observed flight routes undertaken by migrating birds of prey and avoidance rates it is unlikely that there will be a significant impact to migrating birds through collision with the turbines.

4.1.3 There is a possible risk from collision with overhead power lines which will be around 7.5m in height. However the higher flights recorded by migrating birds of prey (generally on Band C >70m a.g.l) and the low density of target species on site reduces the likelihood of this.

4.1.4 Bat activity is low, especially on the ridges, where the turbines are located. However, bats recorded here may be at risk of collision or decompression barotraumas.

4.1.5 A programme of monitoring is recommended to validate the conclusions made during this assessment and to quickly identify any impacts to birds and bats from the operational wind farm. A draft monitoring plan as per best practise guidelines for windfarms is given in Appendix 6.[12]. This plan will be reviewed based on the final report to be issued in September 2011.

[12] Natural England (2010) Technical Information Note TIN069: Assessing the effects of onshore wind farms on birds. Scottish Natural Heritage, (2009) Guidance on Methods for Monitoring Bird Populations at Onshore Wind Farms.
Onshore Wind Farms

Appendices

Appendix 1 - Vantage Point Locations, Method and Recording Forms

VP1m Grid ref. N2 34.041 E36 48.011

VP Orientation: 180° centre line is NORTH EAST

VP2 Grid ref. N2 31.783 E36 49.602

VP Orientation: 180° centre line is NORTH

VP3m Grid ref. N2 29.546 E36 45.840

VP Orientation: 180° centre line is NORTH EAST out of the gate at mast site (Photo n/a)

VP4 Grid ref. N2 30.532 E36 47.375

VP Orientation: 180° centre line is NORTH WEST

VP5m Grid ref. N2 30.623 E36 49.223

VP Orientation: 180° centre line is SOUTH WEST just outside entrance of Mast Site

VP6a (m) (Oct 2010 to Jan 2011) Grid ref. N2 29.938 E36 51.159

VP Orientation: 180° centre line is NORTH

VP6b (from Feb 2011) Grid ref. N2 32.906 E36 45.560

VP Orientation: 180° centre line is NORTH

VP7 Grid ref. N2 28.459 E36 50.283

VP Orientation: 180° centre line is EAST

VP8 Grid ref. N2 27.359 E36 48.833

VP Orientation: 180° centre line is NORTH

VP9m Grid ref. N2 26.003 E36 48.744

VP Orientation: 180° centre line is WEST

VP10a (Oct 2010 to Jan 2011) Grid ref. N2 26.456 E36 50.711

VP Orientation: 180° centre line is NORTH

VP10b (from Feb 2011) Grid ref. N2 32.906 E36 45.560

VP Orientation: 180° centre line is SOUTH

Methods for Vantage Point (VP) watches

This is taken from the generic guidance for onshore wind farms by Scottish Natural Heritage (SNH). Full details can be found at http://www.snh.gov.uk/planning-and-development/renewable-energy/onshore-wind/

Watches are undertaken between dawn and dusk by a single observer under conditions of good ground visibility (>3km).

Each watch should last a maximum of three hours but can be suspended and then resumed to take account of changes in visibility (e.g. fluctuations in the cloud base). Experience from field trials suggest that the accuracy of most observers declines after three hours, and some may prefer to conduct shorter watches. A gap of at least one hour between watches is advisable.

During each watch the area in view is scanned until a target species is detected at which point it is followed until it ceases flying or is lost from view. The time the target bird was detected and the flight duration are recorded. The route followed is plotted in the field onto the field maps. The bird's flight height is estimated at the point of detection and then at 15 second intervals thereafter, using, for example, a count-down timer with an audible alarm. A 15 second interval is recommended as a practical compromise that aims to minimise dependency within data while maximising the sample of observations. Flight heights will be classified to height bands reflecting rotor swept area as appropriate (see main text). Training and checking of observer accuracy in relation to height estimation should be made and accounted for where this is possible. Use of a clinometer and range finder provides one means of determining flight heights accurately. Observations of target species take priority over completion of activity summaries.

At the end of each watch, the locations and activity indicative of breeding by target species should be recorded on the map.

Data should be recorded on the form and maps. Forms must be completed for each VP watch, regardless of whether target species were recorded or not. Use different forms for different watches (i.e. do not combine data from different watches onto one form or map). Forms used should encapsulate the observations listed below and, of course, record start and finish times, observer name, weather records and VP location (cross referenced to the map).

Forms:

- For each watch number each flying bout consecutively. Cross reference this number to the flight path recorded on the relevant map.
- Record the time the bird is first detected to the nearest minute e.g. 15:45.
- Record duration of flying bout to the nearest second.
- For each flying bout: starting at 0 (zero – point of first detection), number each 15 second interval consecutively, and tick appropriate flying height for each 15 second interval.
- Rule off under each flying bout to highlight end of recording.

Map(s):

- Mark the location of the VP used.
- Mark flight paths of target species and indicate direction of flight. Use different colours and symbols for each species. Provide key on back of form.
- Number each flying bout and cross reference with Form.
- Use additional map(s) if data records are cluttering initial map.

Vantage Point Recording Form (*Total seconds for each band to be completed by Surveyor)

VP recording sheet			**Project**	**LTWP**			
VP number:			Name:		start/end time /	wind speed/direction	precipitation
Date:					temp C *max* *min*	cloud cover %	Visibility

flight no.	time	species	number	total secs.	Height(15 sec intervals)	*Total secs for each band
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		
				A. <18m		
				B. 18 to 70m		
				C. >70m		

Transect Recording Form

	LTWP transect recording form		
Start Point	**Start of site**	**End Point, VP number**	**VP**
DATE	/ /	Temp C	
Observer		Cloud %	
start /end time	/	Wind mph	

Map ref.	Species	No. of birds	Waypoint	Distance from Waypoint	Bearing from Waypoint	GPS Co-ordinates

Appendix 2 - Target species flights recorded at each vantage point from October 2010 to April 2011

Table 1 – Target species flights recorded during the 12 hrs of observations at each vantage point during October 2010

Species	Location										total
	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP8	VP9	VP10	
Osprey	1	-	-	-	-	-	-	-	-	-	1
Steppe buzzard	3	22	31	24	5	6	3	66	7	31	198
Tawny eagle	-	-	-	-	1	2	1	-	2	1	7
Steppe eagle	-	-	-	-	-	1	-	2	-	3	6
Lesser-spotted eagle	1	-	-	2	-	1	1	9	-	1	15
Greater-spotted eagle	-	-	-	-	-	-	-	1	-	3	4
Martial eagle	-	-	-	-	-	-	-	-	2	-	2
Bateleur	-	1	-	-	-	-	-	2	-	1	4
Egyptian Vulture	-	-	-	2	3	-	-	-	-	-	5
Rüppell's griffon vulture	-	-	-	-	-	-	-	2	-	-	2
Pallid harrier	-	1	-	-	1	1	1	-	-	-	4
Saker falcon	-	-	-	-	-	-	2	2	-	-	4
Greater kestrel	-	1	1	-	-	-	-	2	5	1	10
Common kestrel	-	-	1	-	-	-	-	-	-	1	2
Lesser kestrel	-	-	-	-	-	-	-	1	-	6	7
Black-shouldered kite	-	-	-	-	-	-	-	-	1	-	1

Table 2 – Target species flights recorded during the 12 hrs of observations at each vantage point during November 2010

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP8	VP9	VP10	
Steppe buzzard	1	1	4	5	-	3	-	1	6	-	21
Tawny eagle	-	-	-	-	-	-	-	1	-	-	1
Steppe eagle	1	-	1	3	-	3	3	9	4	-	24
Lesser-spotted eagle	-	-	-	1	-	-	-	3	-	-	4
Martial eagle	1	-	-	-	-	-	-	1	-	-	2
Black-chested snake eagle	1	-	-	-	-	-	1	-	-	-	2
Egyptian Vulture	-	-	-	-	1	-	-	-	2	5	8
Pallid harrier	-	-	-	-	-	-	1	-	-	-	1
Lanner falcon	-	-	-	-	-	1	-	2	-	-	3
Eurasian hobby	-	1	-	1	-	7	-	2	-	-	11
Common kestrel	-	-	-	2	1	-	-	2	-	-	5
Lesser kestrel	-	-	-	-	-	7	-		3	-	10

Table 3 – Target species flights recorded during the 6 hrs of observations at each vantage point during December 2011

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP8	VP9	VP10	
African swallow-tailed kite	-	-	-	-	-	-	-	-	-	1	1
Steppe buzzard	-	1	-	-	-	-	-	-	-	-	1
Tawny eagle	-	-	1	-	-	-	-	-	1	-	2
African white-backed vulture	-	-	-	-	-	-	-	-	4	-	4
Lappet-faced vulture	-	-	-	-	-	-	-	-	2	-	2
Saker falcon	-	1	-	-	-	-	-	-	-	-	1
Barbary falcon	-	1	-	-	-	-	-	-	-	-	1
Common kestrel	-	-	-	-	-	-	-	1	1	2	4
Lesser kestrel	-	-	-	-	-	-	-	-	-	1	1
Eastern pale chanting gosshawk	-	-	-	-	-	-	-	-	-	1	1

Table 4 – Target species flights recorded during the 6 hrs of observations at each vantage point during January 2011

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6b	VP7	VP8	VP9	VP10b	
Black-shouldered kite	-	-	-	-	1	-	-	-	-	-	1
Steppe buzzard	-	-	-	-	-	-	-	2	-	-	2
Tawny eagle	1	-	-	-	1	-	-	-	1	-	3
Steppe eagle	-	-	-	-	-	-	-	-	2	-	2
Black-chested snake eagle	-	-	1	-	-	-	-	-	-	-	1
African white-backed vulture	-	-	-	-	-	-	1	-	-	-	1
Common kestrel	-	2	1	-	-	-	-	-	-	-	3
Eastern pale chanting gosshawk	-	-	-	-	-	1	1	-	-	-	2
Heuglin's bustard	-	-	-	-	-	-	1	-	-	-	1

Table 5 – Target species flights recorded during the 6 hrs of observations at each vantage point during February 2011

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6b	VP7	VP8	VP9	VP10b	
Tawny eagle	-	-	-	-	-	-	1	-	-	-	1
Steppe eagle	1	-	-	1	-	-	-	-	-	-	2
Bateleur							1				
African white-backed vulture	3	-	-	-	-	-	2	-	-	-	5
Egyptian Vulture	-	-	-	-	-	-	-	1	-	-	1
Common kestrel	-	-	-	-	5	-	-	-	-	-	5
Lesser kestrel	-	-	-	-	-	-	2	-	-	-	2
Fox kestrel	-	-	-	-	-	1	-	-	-	2	3
Unidentified raptor	-	-	-	-	1	-	1	-	-	-	2
Unidentified stork	-	-	-	-	-	-	1	-	-	-	1
Somali courser	-	-	-	-	-	-	-	3	-	-	3
White stork	4	-	-	-	-	-	-	-	-	-	4

Table 6 – Target species flights recorded during the 12 hrs of observations at each vantage point during March 2011

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6b	VP7	VP8	VP9	VP10b	
African swallow-tailed kite	-	1	-	-	-	-	-	-	-	-	1
Black-shouldered kite	-	-	-	-	-	-	-	-	-	1	1
Steppe buzzard	-	-	2	-	2	1	1	1	-	3	10
Tawny eagle	2	-	-	-	1	-	1	-	1	3	8
Long legged buzzard	-	-	-	-	-	-	-	1	-	-	1
Steppe eagle	-	-	-	-	-	-	3	-	-	-	3
Bateleur	2	-	-	-	-	-	-	-	-	-	2
African white-backed vulture	-	-	-	-	-	-	-	-	1	-	1
Pallid harrier	-	1	1	-	-	-	1	-	-	-	3
Eurasian hobby	-	-	1	-	-	-	1	-	-	-	2
Greater kestrel	-	-	-	-	-	-	-	-	-	1	1
Lesser kestrel	-	5	9	-	2	1	-	-	-	2	19
Unidentified kestrel	-	-	-	-	1	-	-	-	-	-	1

Table 7 – Target species flights recorded during the 12 hrs of observations at each vantage point during April 2011

Species	Location										Total
	VP1	VP2	VP3	VP4	VP5	VP6	VP7	VP8	VP9	VP10	
Black-shouldered kite	-	-	-	-	-	-	-	-	1	-	1
Steppe buzzard	-	-	-	1	-	-	1	-	-	-	2
Tawny eagle	-	-	-	-	-	-	-	2	-	-	2
Steppe eagle	-	-	-	-	-	1	-	-	-	-	1
Black-chested snake eagle	-	-	-	-	-	1	-	-	-	-	1
Bateleur	-	-	-	-	-	-	-	-	1	-	1
Verreaux's eagle	-	-	-	-	-	3	-	-	-	-	3
Egyptian Vulture	-	-	-	-	-	-	-	-	1	-	1
Peregrine falcon	-	-	-	-	-	-	1	-	-	-	1
Common kestrel	-	-	1	6	-	3	-	2	-	-	12
Fox kestrel	-	1	-	-	-	-	-	5	2	-	8
Gabar gosshawk	-	-	-	-	-	1	-	-	-	-	1

Appendix 3 - Total number of bird registrations for all target species recorded during the transect counts conducted from October 2010 to April 2011

Table 1 – Total number of bird registrations for all target species recorded during 10 transect counts conducted during October 2010

Species	Date									
	18/10	19/10	20/10	21/10	22/10	23/10	24/10	26/10	27/10	28/10
Steppe buzzard	-	-	20	4	1	9	12	16	3	-
Steppe eagle	-	1	-	1	-	1	4	-	-	-
Lesser-spotted eagle	-	-	-	-	4	-	1	-	-	-
Martial eagle	-	-	-	-	-	-	1	-	-	-
African hawk-eagle	1	1	-	-	-	-	-	-	-	-
Long-legged buzzard	-	1	-	-	-	-	-	-	-	-
Greater-spotted eagle	-	-	-	-	-	-	1	1	-	-
Lappet-faced vulture	-	-	-	-	-	-	2	-	-	-
Egyptian Vulture	-	-	-	-	-	-	1	-	-	-
Pallid harrier	-	1	-	2	-	-	-	-	-	-
Lesser kestrel	-	-	-	-	2	-	-	-	-	-
Greater kestrel	-	-	-	-	1	2	-	-	-	-
Eastern-chanting goshawk	-	-	-	-	-	2	-	-	-	-
Gabar goshawk	-	-	-	-	-	-	1	-	-	-
Heuglin's bustard	-	-	1	-	-	-	-	-	-	-

Table 2 – Total number of bird registrations for all target species recorded during 10 transect counts conducted during November 2010

Species	Date									
	10/11	11/11	12/11	13/11	14/11	15/11	16/11	17/11	18/11	19/11
Steppe buzzard	-	1	-	-	-	1	-	-	-	-
Steppe eagle	1	-	1	-	-	-	-	-	-	-
White-backed vulture	-	-	-	-	-	1	-	-	-	-
Egyptian Vulture	2	-	-	-	-	-	1	-	-	2
Eurasian hobby	-	-	-	-	-	1	-	-	-	-
Heuglin's bustard	-	-	1	-	-	-	-	-	-	-
Black-shouldered kite	-	-	1	-	-	-	-	-	-	-
Abdim's stork	-	-	-	1	-	-	-	-	-	-

*Note two transects were conduction on each date.

Table 3 – Total number of bird registrations for all target species recorded during 7 transect counts* conducted during December 2010

Species	Date				
	13/12	14/12	15/12	16/12	17/12
Steppe buzzard	-	-	-	-	1
Honey buzzard	-	-	-	1	-
Lesser spotted eagle	-	-	-	-	1
Egyptian Vulture	-	-	-	-	1
Kori bustard	-	-	1	-	-

*Note one or two transects were conduction on each date.

Table 3 – Total number of bird registrations for all target species recorded during 10 transect counts* conducted during January 2011

Species	Date				
	10/01	11/01	12/01	13/01	14/01
Steppe eagle	1	-	-	-	-
Common kestrel	-	-	-	-	2
Lesser kestrel	1	-	-	-	-
Eastern pale chanting gosshawk	-	1	-	-	-
Kori bustard	-	-	1	-	-
Buff-crested bustard	-	-	-	-	1

*Note two transects were conduction on each date.

Table 4 – Total number of bird registrations for all target species recorded during 10 transect counts* conducted during February 2011

Species	Date				
	14/02	15/02	16/02	15/2	18/2
Black-chested snake-eagle	1	-	-	-	-
Eastern chanting gosshawk	-	-	1	-	-
Gabar gosshawk	3	-	-	-	-
Heuglin's bustard	2	1	-	1	1
White stork	1	-	-	-	-
Unidentified sand grouse	2	-	-	6	-
Somali courser	-	-	-	2	-

*Note two transects were conduction on each date.

Table 5 – Total number of bird registrations for all target species recorded during 20 transect counts* conducted during March 2011

Species	Date								
	21/03	22/03	23/03	24/03	25/03	27/03	28/03	29/03	30/03
Eastern pale chanting gosshawk	-	-	-	-	1	-	-	-	-
Gabar gosshawk	-	-	-	-	2	-	-	-	-

*Note one or two transects were conduction on each date.

Table 6 – Total number of bird registrations for all target species recorded during 20 transect counts* conducted during April 2011

Species	Date									
	02/04	03/04	04/04	05/04	06/04	07/04	08/04	09/04	10/04	11/04
Steppe eagle	-	-	1	-	-	-	-	-	-	-
Fox kestrel	3	-	-	1	-	-	-	1	-	-
Gabar gosshawk	-	-	-	-	-	-	1	-	-	-

*Note two transects were conduction on each date.

Appendix 4 – IUCN Red List status of target species recorded on site

IUCN Red List status of 'endangered'

Egyptian vulture is an endangered species which a population which is at risk of becoming extinct because it is either few in numbers, or threatened by changing environmental or predation parameters. **Grévy's zebra** is also listed as endangered.

IUCN Red List status of 'vulnerable'

White-headed vulture, **lappet faced vulture,** and **saker falcon** are listed. Vulnerable species are likely to become endangered unless the circumstances threatening its survival and reproduction improve. Vulnerability is mainly caused by habitat loss or destruction. **Cheetah** is also listed as 'vulnerable'.

IUCN Red List status of 'near threatened'

Populations of **African white-backed vulture, Rüppell's vulture** have declined and the IUCN predicts that populations of the species will continue to decline. **Bateleur**, **martial eagle** and **pallid harrier** are also listed as 'near threatened'. Of the mammals **gerenuk** listed as 'near threatened'.

All the other target species recorded including the bustards are of 'least concern'.

Appendix 5 – Bat Survey Results March 2011

Sample Point 1

SP1 – A wooded laga close to main access track	Date: 12/3/11	Sunset time: 18:45
Weather conditions: 30 to 25 C , 0% cloud, gusty wind up to 15 mph		

Transect at SP1

Time Start	**Time End**	**Species**	**Notes**
18:30			Survey start
19:10	19:10	Unknown bat	
19:18	19:20	*Pipistrellus nanulus*	Five passes
19:50	19:50	Large bat	Visual passing
20:00	20:00	Unknown bat	Foraging call
	21:00		Survey end

Two mist nets at SP1 - No bats caught

Anabat at SP1

8 calls recorded between 19:21 to 19:57

1. Six are of *Pipistrellus nanulus* (tiny pipistrelle) calling at c. 48khz
2. Two are indeterminable

Sample Point 2

SP2 – A wooded laga 1.5km to west of main access track	Date: 13/3/11	Sunset time: 18:45
Weather conditions: 30 to 25 C , 0% cloud, gusty wind up to 15 mph		

Transect at SP2

Time Start	**Time End**	**Species**	**Notes**
18:30			Survey start
18:50	18:51	*Pipistrellus* sp.	Two passes in laga
19:00	20:30	*Pipistrellus nanulus, Pipistrellus sp.* and unknown bat	Ten passes in laga, one outside laga
	21:00		Survey end

Three mist nets at SP2 - No bats caught.

Anabat at SP2
There are 5 recorded calls
1. Four are of *Pipistrellus nanulus* calling at c. 48 khz
2. One indeterminable

Sample Point 3

SP3 – A wooded laga just south of Sirima village	Date: 15/3/11	Sunset time: 18:44
Weather conditions: 30 to 25 C , 0% cloud, sheltered, light wind up to 5 mph		

Transect at SP3

Time Start	**Time End**	**Species**	**Notes**
18:30			Survey start
18:45	20:30	20 passes of *Pipistrellus nanulus/Pipistrellus sp.* One unknown bat.	Passing and feeding in laga
	21:00		Survey end

Three mist nets at SP3 – one *Pipistrellus nanulus,* one *Lavia frons* (yellow-winged bat) and one *Nycteris* sp. (a slit-faced bat) caught in nets.

Anabat at SP3 used during the survey only on 15th March

No. of recordings	**Description of call**	**Bat identified**
14	48khz	*Pipistrellus nanulus*
2	Calling between 30-35khz with very shallow long duration FM	?
2	Calling at about 38khz with long CF end	*Pipistrellus* sp

Anabat at SP3 left overnight on 16th March

154 calls between 19:04 and 07:15

No. of recordings	**Description of call**	**Bat identified**
4	Indeterminable calls/pulses	?
1	strange call, opposite hockey stick shape	?
11	*Lavia frons* CF between 30 & 25khz	*Lavia frons*
57	*Pipistrellus nanulus* at c. 46-57khz	*Pipistrellus nanulus*
1	*Pipistrellus* like pulses (hockey stick at 37-46khz	*Neuromicia* sp.
42	unidentified shallow between 30-35 khz	?
8	unidentified shallow FM just at or just above 35 khz	*Nycteris* sp 2(a slit-faced bat)
7	unidentified CF between 16-20 khz	*Tadarida* (a guano bat)
4	unidentified FM nearly CF just below 25 khz	*Chaerophon* (a wrinkle-lipped bat)
8	unidentified CF with tiny FM head at 70khz	*Hipposideros commersoni* (Commerson's leaf nosed bat)
6	unidentified arch-shaped shallow FM at 40khz	*Scotophilus nigrita* (Schreber's yellow bat)
2	unidentified tiny FM tail-long CF-tiny FM head at 45	*Rhinolophus* sp. (a horseshoe bat)
3	Steep sharp gradient FM at nearly 50 khz	*Nycteris* sp 1 (a slit-faced bat)

Sample Point 4

SP4 – On a windy exposed ridge with limited vegetation at a mast site	Date: 16/3/11	Sunset time: 18:44
Weather conditions: 25 to 20 C , 0% cloud, exposed, windy up to 20 mph		

Anabat left overnight at SP4 on 16th March

There are 19 calls recorded between 19:45 and 01:28

No. of recordings	**Description of call**	**Bat identified**
1	Call at about 48khz	*Pipistrellus nanulus*
1	Very broad band call 16-37FM bat	?
2	Shallow (narrow band) between 31-39khz	?
13	Calling at 25khz with low duty narrow band	*Chaerophon* sp (a wrinkle-lipped bat)
2	Narrow band call between 14-15khz	?

Sample Point 5

SP5 – A shelter wooded laga and open scrub/ desert located 1km west of the main access track	Date: 17/3/11	Sunset time: 18:44
Weather conditions: 30 to 25 C , 0% cloud, sheltered, no wind		

Transect at SP5

Time Start	**Time End**	**Species**	**Notes**
18:30			Survey start
18:45	20:30	*20 passes Pipistrellus sp*. 10 passes unknown bats	Passing and feeding in and around the laga.
	21:00		Survey end

Three mist nets at SP5 one in the laga and two in open scrub areas– five *Pipistrellus nanulus* caught at 19:15, one *Pipistrellus nanulus* caught at 20:50 all in the laga.

Two Anabats (one in the laga, one in the open area) at SP5 overnight on 17th March.

Laga – 143 calls from 18:56 to 06:27

No. of recordings	Description of call	Bat identified
28	Call at about 47khz	*Pipistrellus nanulus*
2	Calling at about 80khz high duty CF frequency with brief FM end	*Rhinolophus* sp 1(a horse shoe bat)
2	Calling at 69khz	*Rhinolophus* sp 2
46	A shallow, narrow band FM tending towards CF call at c. 33khz	*Chaerophon* sp (a wrinkle-lipped bat)
10	Calling with hockey stick type of steep FM pulse ending shallow at nearly 40khz	*Scotoecus hirundo* (an evening bat)
15	Bat call at about 18khz	*Mollosid* sp (free-tailed bat)
41	Unidentified bats, peaking at 26khz and 37khz at least 2 two species	Unidentified

Open area – 19 calls from 19:12 to 07:05

No. of recordings	Description of call	Bat identified
1	Just below 30khz	*Lavia frons*
9	Call at about 47khz	*Pipistrellus nanulus*
4	Sp1-calling at 30khz with shallow FM	?
4	Sp2-calling at just above 25khz with shallow FM	*Chaerophon bivittata* (a wrinkle lipped bat)
1	Sp2-calling at just below 35khz with shallow FM	?

Other bat observations

Daytime walkover surveys were undertaken at surrounding sites including a small section of the shore at Lake Turkana, Mount Kulal and Mount Nyiru.

No roosting potential was found adjacent to the lake as it was devoid of trees, structures and crevices, although there is excellent foraging potential over the lake itself. Caves were inspected for bat roosts on the way to Mount Kulal. No roost were confirmed, but there were many inaccessible caves and crevices suitable for bats.

On the east side of Mount Nyiru a *Hipposideros* sp. (a leaf-nosed bat) roost was found in a cave above a waterfall. Signs of *Epomophorus* sp. (epilauted fruit bats) were found in the form of feeding remains (figs sucked dry).

Appendix 6 – Draft Ornithology and Bat Monitoring Methodology

As per best practise guidelines for wind farms (Natural England, 2010 and Scottish Natural Heritage, 2009) it is recommended that the operational windfarm is monitored to identify bird movement patterns, flight characteristics and actual collisions. This is usually undertaken in years 1, 2, 3, 5, 10 and 15 of operation. At the end of year 3 there will be a review to determine whether to continue the monitoring.

The monitoring should include similar surveys to those being undertaken during the pre-construction monitoring. These would comprise vantage point and transect surveys to identify any displacement of birds from the windfarm, changes in flight lines and collision or avoidance of collision with turbines or power cables. In addition, corpse monitoring would be undertaken particularly at times of the year when more birds are present (e.g. Autumn migration) to assess true collision rates.

The full scope of the monitoring surveys will depend on the results of the on-going pre-construction surveys and further consultation with the RSPB/Birdlife International. A draft plan is presented below for Year 1 of operation based on the survey results to date.

The vantage points would be surveyed as per the current methods, with a reduced surveyor effort, during four periods per year. This would involve 1 day (6 hours) per vantage point per month during the autumn migration (October and November), 1 day per vantage point during the winter (January), 1 day per vantage point per month during the spring migration (March and April) and 1 day during the summer (June). Transect surveys should also be undertaken during this period as per current methods. In total this would be 60 man days of bird surveys providing 360 hours of data for analysis.

Bat surveys, comprising one week activity surveys per year should be undertaken during years 1, 2, 3, 5, 10 and 15 to assess any changes in the bat activity on the site. The surveys should follow the methods used during this study with particular focus on areas around the turbines. At the end of year 3 there would be a review to determine whether to continue the monitoring.

Corpse monitoring for birds and bats should be undertaken around a sample of the turbines, during a two week period around both autumn and spring migration and two other one week periods in winter and summer. Local staff will be trained by a consultant with large-scale wind farm monitoring experience to undertake this to the agreed methods. This training would assess scavenger rates and surveyor efficiency. Calculations of actual collisions would then be undertaken and reported on annually.

Outside of this time period a nominated person would undertake regular checks around the turbines to look for any dead/injured birds or bats. These will be reported on standard forms and sent to an experienced consultant for analysis.

Where any mitigation is required this would then be discussed and agreed with LTWP.