



Port of Milford Haven

Pembroke Port, Pembroke Dock

Bat Survey Report

856531

JULY 2018



RSK GENERAL NOTES

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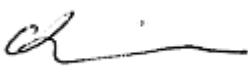
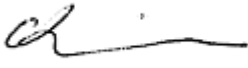
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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK.

EXECUTIVE SUMMARY

1. This report presents the findings of bat surveys for the proposed redevelopment of Pembroke Port, Pembrokeshire. Surveys include dusk emergence and dawn re-entry surveys (on buildings), tree roost inspections and activity surveys (by static detectors and walked transects).
2. As part of the redevelopment (described in the master plan REV G), vegetation removal will be required and the lighting regime will change.
3. RSK undertook a preliminary roost assessment on all buildings, structures and trees located on the site in July 2017. This identified several buildings, structures and trees offering suitable roosting habitat that may be affected by the proposed re-development. This report presents the findings of the additional surveys of these buildings and structures to determine the presence or likely absence of roosting bats.
4. Activity and static bat detector surveys were also undertaken to gather data on the assemblage and movement of bats throughout the site.
5. Buildings RSK B10, RSK B17 and RSK B38 were discovered to support roosting bats. However, only building RSK B38, which was found to support a non-maternity roost for Common Pipistrelle, is predicted to be directly affected by the proposals. Any works to this building will need to be conducted under a European Protected Species (EPS) licence and the destruction of the roost in the building will need to be compensated for by the creation of alternate roosting places for Common Pipistrelles. Mitigation proposals for the loss of this roost have been provided. No other bat roosts in the other buildings (RSK B10 and RSK B17) which will be affected by the proposed re-development.
6. Detailed tree roost inspections of potential roost features in trees were completed and their suitability for roosts confirmed. There is the potential for many of the trees to be retained in the proposed ecological corridor on the southern boundary of the site. Pre-works checks and avoidance measures are described for trees which may be affected.
7. Activity surveys for the site have identified that the southern boundary of the site to be frequently used by foraging and commuting bats. The majority of the bats using this southern wooded area are Common and Soprano Pipistrelle. Of particular importance is occasional use of this area by Greater Horseshoe bats. Only Common Pipistrelles (and a single Soprano Pipistrelle pass) were recorded elsewhere on the site, activity was mainly concentrated around the trees along Admiralty Way, adjacent to the sewage treatment works and near the known roost at building RSK B38.
8. An assessment of impacts based on the Outline Master Plan (REV G) has been made and mitigation and compensation measures in respect to habitat loss, habitat fragmentation and impacts from lighting are discussed.

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1 INTRODUCTION

1.1 Purpose of this Report

This report contains details of bat surveys undertaken between May 2017 and May 2018 in connection with the proposed redevelopment at Pembroke Port in Pembroke Dock, Pembrokeshire (centred at Ordnance Survey Grid Reference SM 959 037). *Figure 1* shows the site location and boundary.

Surveys were commissioned to understand the use of the site by bats (e.g. roosting, foraging and commuting) to inform the planning process for the proposed redevelopment on the site. The results of these surveys will be used to determine the importance of the site with regards to the movement of bats through the site, the levels of bat activity on the site and where bats are roosting on the site. By assessing these features the report will attempt to identify if bats could be affected by development proposals and, if necessary, inform a mitigation strategy to reduce impacts to acceptable levels.

1.2 Ecological Context

Pembroke Port is an active industrial port and dockyard with frequent movements of machinery, heavy goods vehicles and ferries. It is dominated by hard-standing, bare ground and industrial, commercial and office buildings associated with the port operations. A sand-storage depot is present in the east of the site. Vegetated areas are principally located in the southern part of the site and include a small area of immature secondary broad-leaved woodland, scattered trees, ruderal open grassland, a small area of unimproved grassland and scrub. Elsewhere, vegetation is scattered across the site and includes ephemeral species, amenity grassland and introduced shrubs.

The waters of Milford Haven form the northern site boundary of the site and the town of Milford Haven and a sewage treatment plant is adjacent to the port wall which forms the western site boundary. To the south the site is bounded by residential properties, the South Pembrokeshire Hospital, a golf course and farmland. The town of Pembroke lies east of the site and is dominated by residential and commercial buildings and transport infrastructure.

Summary of Previous Reports

In March 2017 a Preliminary Ecological Appraisal was produced for the site which included an assessment of habitats for protected species and a background data search (RSK, 2017^a). The report identified habitats to be of *moderate suitability* (Collin 2016) habitat for foraging and commuting. Habitats of particular interest to foraging and commuting bats on the site are:

- immature secondary broadleaved woodland;

- tree lines and scattered trees;
- scrub;
- open ruderal grassland; and
- port wall.

Potential roosting habitat was identified in the site in the form of buildings, structures (*i.e.* the port wall) and trees.

In July and November 2017 respectively a Preliminary Roost Assessment (PRA) report (RSK, 2017^b) and an Interim Bat Report (RSK, 2017^c) were issued by RSK. The PRA surveyed buildings and trees to identify suitability for roosting bats in order to determine the scope of additional surveys to confirm the presence or absence of bat roosts.

The Interim Bat Report described the initial findings of emergence and re-entry surveys for building and tree roosting inspection surveys completed in August and September 2017; with further surveys required in spring 2018.

Preliminary Roost Assessment

A total of 50 buildings, 47 within and 3 adjacent to, but outside, the site boundary were surveyed in June 2017. Summary of results for the PRA are detailed in *Table 1* below and are shown in *Figure 2*. Those buildings found to be of negligible suitability for roosting bats or not thought to be affected by the proposed development were scoped out for further consideration due to the absence of impacts¹.

In addition, trees and a stone gateway were included in the survey. A total of 28 trees where identified to contain a range of suitable features for roosting bats are described in *Table 2*.

Table 1: Summary of building assessment for roosting bats following PRA

RSK Building Reference	PoMH Building Reference	Bat Roost Suitability
Building B2	P820 Annex A	Moderate
Building B6	P864	Moderate
Building B8 (The Master Shipwright's House)	Na	Moderate, however, the building was subsequently scoped out of further surveys as no longer affected by redevelopment works.
Building B10 (Coach House to The Master Shipwright's House)	Na	Confirmed Greater Horseshoe bat roost via DNA analysis of droppings found in the building.
Building B17 (The Old Commodore Hotel)	Na	Known Greater Horseshoe bat roost.

¹ These buildings have been omitted from Table 1 for ease of interpretation but full details are provide in the PRA report for the site.

RSK Building Reference	PoMH Building Reference	Bat Roost Suitability
Building B18	M681 (B40)	Low
Building B20 (Mill Forge)	M800	Low
Building B21 (Mill Forge)	M800	Low
Building B26	M675 (B26)	Low
Building B28	M673 (B24)	Low
Building B30	Na	High
Building B31	Na	Moderate
Building B32	Na	Low
Building B34	Na	Moderate
Building B36	Na	Low
Building B38	M676 (B28)	Common Pipistrelle bat roost confirmed via DNA analysis of droppings found during the survey
Building B39	Na	Moderate plus requires hibernation surveys
Building B41	Unit 19	Moderate
Building B42	M677 (B28 A)	Low
Building B44	M678 (B29)	Low
Building B45	M679 (B35 A)	Low
Building B46	M679 (B35A)	Low
Building B48	M689 (B44A)	High
Building B50	M683 (B47)	Brown Long-eared bat roost confirmed by DNA analysis of bat dropping found during the survey.
Building B52	Tower	High
Stone gateway	Na	Moderate

Table 2: Summary of initial tree assessment for roosting bats

Tree Tag Reference	Bat Roost Suitability (ground level only)
1965	Low
1964	Low
1963	Moderate
1962	Moderate
1961	Low
1960	Moderate
1959	Negligable
1958	High
1957	Moderate
1956	Low
1955	Low
1954	Moderate

Tree Tag Reference	Bat Roost Suitability (ground level only)
1953	Negligible
1952	Low
1951	Negligible
1950	Moderate
1949	Negligible
1948	Negligible
1947	Negligible
1946	Negligible
1945	High
1944	Negligible
1943	Low
1942	High
1941	Negligible
1940	Negligible
1939	Negligible
Target Note 1	Moderate

2 METHODS

2.1 Introduction

The Bat Conservation Trust provides guidance in Bat Surveys: Good Practice Guidelines (Collins 2016). The survey methodologies presented within this document were followed.

2.2 Background Data Search

A search was made in March 2017 for reference materials relating to the ecology of the site, and a list of sources is given in *Table 1*.

Table 3: Data sources

Information Obtained	Available From
Protected and Noteworthy species-records	West Wales Biodiversity Information Centre
Designated site locations and citations	Natural Resources for Wales
Designated site locations and citations	West Wales Biodiversity Information Centre
Ancient Woodland Inventory	Forestry Commission Website
Designations and legal protection of noteworthy species	Joint Nature Conservation Committee (JNCC) website
Details of species and habitats listed on the Pembrokeshire LBAP	Local BAP website http://www.pembrokeshire.gov.uk/content.asp?id=19158&nav=1626,109,135&parent_directory_id=646

A search was made for information on statutory designated sites (often internationally and nationally important sites for ecology) and non-statutory designated sites (often important in a local context) within 2 km of the site boundary. A search was also made for records of noteworthy species within the same 2 km area. Species included in the search parameters are:

- European protected species (listed on *Schedules 2 and 5 of The Conservation of Habitats and Species (Amendment) Regulations 2012*);
- nationally protected species under *Schedules 1, 5 and 8 of The Wildlife & Countryside Act 1981* and *The Protection of Badgers Act 1992*;
- species listed as Critically Endangered, Endangered or Vulnerable on the *IUCN Red List*
- all species listed on the RSPB *Birds of Conservation Concern 2002-2007* as Red or Amber, as updated in *The Population Status of Birds in Wales 2*;
- Nationally Rare or Nationally Scarce species;
- Notable invertebrates; and

- species of Principal Importance under *The Natural Environment and Rural Communities (NERC) Act (2006)* or are Priority Species under the Local Biodiversity Action Plan.

2.3 Roost surveys

2.3.1 Dusk Emergence and Dawn Re-Entry Building Surveys

Following the dusk/dawn surveys conducted in 2017 (for low, moderate and high suitability buildings in August and September, 2017 (as described in section 1.2) the remaining dusk/dawn surveys were carried out in May 2018 for moderate and high suitability buildings to determine the presence or absence of roosting bats according to their category of suitability (as described in *Table 1*).

Buildings or structures identified as having low, moderate or high suitability (or confirmed roost) and are predicted to be affected by the proposed re-development were subjected to one, two or three surveys respectively in line with published guidelines (Collins, 2016). In 2018 the following surveys remained to be conducted;

- A single survey of buildings judged to have high suitability for roosting bats; and
- A single survey of buildings judged to have moderate suitability for roosting bats.

No emergence/re-entry surveys were undertaken for buildings, structures or trees identified as negligible suitability for roosting bats.

Dusk emergence surveys commenced 15 minutes before sunset and continued for up to two hours (conditions allowing) after sunset. Dawn re-entry surveys were carried out at a time when bats are known to return to roost and commenced 1.5 hours prior to sunrise and continued until 15 minutes after sunrise. During each survey, surveyors stood in locations offering a good view of all likely roost access points and recorded any bats swarming, flying, exiting or entering their roosts. Petterson D240x, Batbox Duet and Batbox Baton XD detectors were used during surveys. Detectors were connected to Edirol recorders to record bat activity during the emergence and re-entry surveys. The recordings were analysed using BatSound Standard Sound Analysis v.4. Species identification was made on the basis of the characteristic of the call including peak frequency, minimum and maximum frequency, call duration and inter pulse interval.

Surveys were lead by Sam Davis (976173:OTH:CSAB2017), John Daw (70177:OTH:CSAB:2016) and Paul Parker (consultant ecologist) with assistance from suitably experienced ecologists Chloe Stephenson, Nick Mason, Evelyn Gruchala, Francesca Lemon, Aaron Leaf and Immanuel Amiral, Gary Lindsay, Ellen Quinton, Nick Weaver, Josh Mitchell, Nick Weaver, Cecilia Montauban, Hannah Strudwick and Sian Williams.

Surveys were carried out in weather conditions suitable for bats to emerge i.e. no rain, no strong wind and air temperature 10°C or above. *Tables 4-6* show the survey weather conditions during the surveys completed by RSK on buildings and structures predicted to be impacted by the development which have suitability for roosting bats or could not be fully inspected during the preliminary roost assessment.

Table 4: Survey weather conditions for dusk/ dawn surveys August 2017

Building/ Structure	Date	Survey Type	Start/End Temp (°C)	Start/End Wind (Beaufort)	Rain	Start/End Cloud Cover (Okta)
B26	29/08/2017	Dusk emergence	14-13	F1	None	7 - 8
B20 and B21	25/08/2017	Dusk emergence	13	F0	None	0
B42	24/08/2017	Dusk emergence	15-15	F2	None	2
B30,31 and 32	24/08/2017	Dawn re- entry	15-16	1-2	None	3-8
B17	23/08/2017	Dusk emergence	16-15	F1	None	2
B36, B44, B45 and B46	23/08/2017	Dawn re- entry	15	F4	None	0-2
B10 and B18	22/08/17	Dusk emergence	19	F3 –F2	None	8
B28	18/08/2017	Dawn re- entry	13	F4 –F5	None	6
B50	17/08/2017	Dusk emergence	16	F3	None	2 - 4

B38	16/08/2017	Dawn re-entry	15 – 15	F2	None	6-8
B52 and B48	15/08/2017	Dusk emergence	16	F3-F4	None	2 - 8

Table 5: Survey weather conditions for dusk/ dawn surveys September 2017

Building/ Structure	Date	Survey Type	Start/End Temp (°C)	Start/End Wind (Beaufort)	Rain	Start/End Cloud Cover (Okta)
B52	26/09/2017	Dusk emergence	18	F0	None	7-8
B6	26/09/2017	Dawn re-emergence	10	F0 – F1	None	2 with fog
B34	25/09/2017	Dusk emergence	19	F0	None	0
B39 and B2	20/09/2017	Dusk emergence	16 – 14	F2 – F3	Rain in the last hour	8
B41	20/09/2017	Dawn re-entry	14	F0 – F2	None	7
B10 and B50	19/09/2017	Dusk emergence	15 – 14	F1	None	2 - 8
B17 and stone gateway	19/09/2017	Dawn re-entry	11	F0	None	6-7
B30, 31 and 38	18/09/2017	Dusk emergence	16-15	F1	None	4 - 2

Table 6: Survey weather conditions for dusk/ dawn surveys May 2018

Building/ Structure	Date	Survey Type	Start/End Temp (°C)	Start/End Wind (Beaufort)	Rain	Start/End Cloud Cover (Okta)
B2, B10, B50 and stone gateway	18/05/2018	Dawn re- entry	11.5 – 10.7	F0	None	4 - 6
B6 and B34	17/05/2018	Dusk emergence	13 – 10	F0 – F1	None	1
B41	17/05/2018	Dawn re- entry	10.6 - 9	F0	None	1
B39	16/05/2018	Dusk emergence	13.3 – 10.6	F0 –F1	None	0-5
B17	16/05/2018	Dawn re- entry	11.3 - 10	F0 – F1	Light rain for first 20 mins	8
B30 and B38	15/05/2018	Dusk emergence	15 – 13.3	F3 – F4	None	6 - 8
B48	11/05/2018	Dawn re- entry	10-10.2	F1-F4	None	8
B52	10/05/2018	Dusk emergence	11-9	F0-F1	None	1

2.3.2 Tree Roost Inspection Surveys

Impacts to trees identified to contain suitability roosting features (listed in *Table 2*) during the PRA were assessed for the need for further survey work. Trees identified not to be affected by the proposed development or are of low suitability for roosting bats were not included with the scope of the tree roost inspection surveys.

Trees likely to be affected by the proposed development and identified as moderate or high suitability were subject to inspection surveys to determine the presence or likely absence of

roosting bats. Following the initial inspection, a potential roost feature's suitability for roosting bats can be upgraded or downgraded depending on the feature's internal dimensions and conditions. Trees with suitable potential roost features were categorised in line with Collins 2016.

Tree roost inspection surveys were led by a licensed bat ecologists trained in tree climbing or accessed with the use of a ladder. All trees and potential roost features were safe to climb and could be reached by surveyors. Potential roost features were fully inspected with the use of Rigid CA300 digital endoscopes and torches to record the dimensions, internal conditions and the presence of bats or any field signs of occupation (i.e. droppings, staining or feeding remains). Inspection surveys were carried out on 17 August 2017, 21 September 2017 and May 2018 by Sam Davis (976173:OTH:CSAB2017) and John Daw (70177:OTH:CSAB:2016) with assistance from Josh Mitchell and Aaron Leaf. Sam and John are a licensed bat workers and experienced in the assessment of potential roost features in trees.

Repeated tree roost inspections were undertaken as a replacement for dusk/dawn surveys as all trees are in good structural condition and safe to climb, and all potential roosting features could be fully inspected by the surveyor with the digital endoscope and/or torches. Repeat inspections were undertaken in line with Collins 2016 given the habitual roost switching exhibited by tree dwelling species and the likely occurrence of rapid degradation of droppings due to invertebrate activity.

Trees scoped in for repeat tree roost inspections are listed below. Trees with negligible and low suitability or not thought to be affected by proposals were not included within the scope of the survey.

Table 7. List of trees subject to repeated tree roost inspections

Tree Tag Reference	Date of First Detailed Survey	Date of Second Detailed Survey	Date of Third Detailed Survey
1963	17.08.2017	21.09.2017	NA
1962	17.09.2017	NA	NA
1961	21.09.2017	NA	NA
1960	17.08.2017	21.09.2017	16.05.2018
1958	17.08.2017	21.09.2017	16.05.2018
1957	18.08.2017	21.09.2017	16.05.2018
1954	17.08.2017	NA	NA
1950	18.08.2017	21.09.2017	NA
1945	18.08.2017	21.09.2017	16.05.2018
1942	18.08.2017	21.09.2017	16.05.2018
Target Note 1	17.08.2017	NA	NA

2.4 Activity surveys

2.4.1 Activity Survey Design

If habitats used by bats are affected by development offences may occur under the following pieces of legislation; the *Natural Environment and Rural Communities Act 2006*, the *Wildlife and Countryside Act 1981* (as amended), and the *Conservation of Habitats and Species Regulations 2010*. Offences relating to changes in habitats include

- significant impacts to the local distribution or abundance of a species;
- the impairment of an animal's ability to breed, reproduce, migrate, hibernate or the look after young; and
- adverse effects on biodiversity

See Appendix 1 for further details.

The ODPM Circular 06/2005 states the following: "it is essential that the presence or otherwise of protected species, and the extent that they may be affected by the proposed development, is established before the planning permission is granted".

The surveys described in this report will detail whether development proposals are likely to commit an offence in relation to the disturbance of bats and the data collected will help guide mitigation proposals to ensure no offences occur.

2.4.2 Activity Surveys

Bat activity surveys were led by Paul Parker (consultant ecologist) assisted by Dean Lefeuvre (consultant ecologist), Chloe Stephenson (consultant ecologist), Nick Mason (consultant ecologist), Gary Lindsay (assistant ecologist) and Shona Redman (assistant

ecologist) of RSK. Additional survey assistance was supplied by Josh Mitchell, Ellen Quinton and Hannah Strudwick of ADAS together with Sian Williams of Kite Ecology. All of the personnel used on these surveys were competent at carrying out these surveys.

Given the habitats present, the site falls under the category of '*moderately suitable habitat for bats*' as defined by Collins (2016). Current guidance for sites of this type is for at least one transect per month between April and October (totalling seven survey visits) and the use of automated static bat detectors located on at least two points of the transects for five nights per month over the same period.

2.4.3 Transect Surveys

A dusk survey was undertaken in each month from May to October 2017 and a dusk and pre-dawn survey was completed on a single night in April 2018.

Transect surveys covered all suitable habitats for foraging and/or commuting bats identified in the Preliminary Ecological Appraisal (RSK, 2017^a) Habitats of particular interest to foraging and commuting bats on the site are:

- immature secondary broadleaved woodland;
- tree lines and scattered trees;
- scrub;
- open ruderal grassland; and
- port wall.

Determining the presence of rare bats such as Greater Horseshoe and Lesser Horseshoe (*Rhinolophus hipposideros*) bats is particularly important to the status of the site. Dusk surveys commenced at sunset and lasted until 2 to 3 hours after sunset until the transect was completed, whilst pre-dawn surveys started 2 to 3 hours before sunrise and ended at sunrise. Each transect involved two surveyors walking a pre-defined transect (continuously recording any signs of bat activity) and stopping for five minutes at 10 predetermined 'spot count' locations before continuing along the transect route. The 'spot count' locations were chosen to sample areas with high quality habitat where bats were likely to be encountered if present on the site, but also to sample all habitat types present. Transect maps can be seen in *Figures 5- 10*. On each visit, the transect route was walked in weather conducive for bat activity (above 10°C at sunset with little or no rain and no strong winds) using an Elekon Batlogger M bat detector. Targeted and continuous recordings of bat calls were made during the survey in full spectrum format and the Batlogger assigns coordinates to each recording, which are later uploaded to transect maps so that statistics on the number of passes and bats could later be calculated. The start and end point of transects and / or the direction they were walked were alternated between each visit to take into account changes in bat activity across the site throughout the evening and the season.

Table 8 details the dates and survey times for each activity survey completed. Weather conditions recorded at the beginning and end of each survey were also recorded. These are provided in Table 9.

Table 8: Survey dates and timings for each transect survey

Date	Survey Type	Sunset/ Sunrise Time	Start Time	End Time
10/05/2017	Dusk	20:58	20:58	23:35
13/06/2017	Dusk	21:38	21:38	00:10
17/07/2017	Dusk	21:29	21:29	23:39
24/08/2017	Dusk	20:25	20:25	22:51
14/09/2017	Dusk	19:36	19:36	22:05
18/10/2017	Dusk	18:19	18:19	20:36
11/04/2018	Dusk	20:09	20:09	22:53
12/04/2018	Pre-dawn	06:30	03:54	06:27

Table 9: Weather conditions recorded at the beginning and end of each transect survey

Date	Air Temperature (°C)	Cloud Cover (%)	Wind Speed (Beaufort)	Precipitation
10/05/2017	15 – 15	80 – 100	1 – 2	None
13/06/2017	14 – 14	10 – 10	0 – 1	None
17/07/2017	19 – 16	10 - 10	1 – 1	None
24/08/2017	15 - 14	60 – 50	0 – 1	None
14/09/2017	14 - 13	50 – 25	1 – 2	None
18/10/2017	15 – 15	80 – 100	1 – 2	None
11/04/2018	11 – 8	100 – 100	1 – 1	None
12/04/2018	9 – 8	100 – 100	1 – 1	None

A Batlogger M detector was used for all transect surveys. The detector was set to trigger automatically when bats calls were detected. The detector recorded data 0.5 seconds before the first trigger event and stopped recording when there was no ultrasonic noise for more than 1 second. A separate pass was therefore defined when there is no ultrasonic noise detected for 1 second. Species were identified using the BatExplorer® software program. GPS fixes were taken with each recording.

2.4.4 Static Detector Surveys

Wildlife Acoustics Song Meter 2 Bat+ (SM2) bat detectors were used to monitor two different monitoring points (MP) on the site (see *Figure 4*), as follows:

- MP1 (The Woodland); located on a secondary woodland edge to the west of the Commodore Hotel, adjacent to the southern site boundary.
- MP2 (The Avenue); located in an avenue of trees to the east of the Commodore Hotel in the southern part of the site.

The locations were selected as they were in suitable habitat for commuting and foraging bats, which is concentrated in the southern part of the site. Furthermore, they were positioned to maximise the likelihood of recording passes of Greater Horseshoe bats, a rare species previously identified as roosting in the Commodore Hotel (Biodiversity Solutions, 2014), and nearby building RSK B10 (P808) to provide useful information about how this important species uses the area.

Static bat surveys followed Collins (2016) and the SM2 provided data collected over five consecutive nights to augment the data collected during the transect surveys. They were deployed each month from May 2017 to October 2017 and April 2018 as shown in *Table 10*. Survey dates were selected when the predicted weather forecast indicated suitable conditions for foraging and commuting bats (*i.e.* air temperature above 10°C, the absence of strong winds and minimal precipitation). The units were set up to continuously record from 30 minutes before sunset until 30 minutes after sunrise. The surveys were designed to provide information on the level of bat activity and the bat species using the site, the relative importance of features and locations and how patterns of bat activity may change throughout the year. The data collected by the SM2s was used to complement the information collected during the manual bat transect surveys, as the SM2s collected information over a longer period of time.

Table 10: Survey dates for static detector deployment

SM2 MP	Spring	Summer			Autumn		Spring
	May 2017	June 2017	July 2017	Aug 2017**	Sept 2017**	Oct 2017	April 2018
MP1 Woodland	23 to 27 May	13 to 17 June	17 to 21 July	17 to 21 Aug	**14 to 15 Sept & 18 to 19 Oct	13 to 17 October 2017	11 to 15 April 2018
MP2 Avenue	23 to 27 May	13 to 17 June	*22 – 26 Aug	17 to 21 Aug	14 to 18 Sept	25 to 29 October	***11 to 13 Apr & 02 to 03 May

* SM2 detector failed during July. Additional 5 nights of data collected in August 2017 from same location to compensate

**SM2 detector recorded only 2 nights, to compensate 2 nights of additional monitoring data was undertaken in October 2017

***SM2 detector recorded only 3 nights, to compensate 2 nights of additional data were collected in May 2018

The microphones were mounted at least 3 m off the ground. All recordings were stored onto memory cards and analysed using the Kaleidoscope Pro® software program. All automated identifications, noise and no ID files from the software were double checked by an experienced ecologist for quality assurance purposes. Echolocation calls were identified down to species or genus level depending on the type of bat encountered (i.e. it is not possible to reliably identify species belonging to the genus *Myotis* and *Plecotus* and *Nyctalus* species) and the quality of the recording. A numbers of calls had parameters between Common and Nathusius Pipistrelle bats these were queried with a national expert (Jonathan Russ *pers.com.*) and it was judge to most likely that they were Common Pipistrelle calls. Calls which had characteristics shared by two species were labelled as the most likely species if there were other calls of this species present on the night. If the species were not present, calls were labelled to group i.e. large bat (encompassing *Nyctalus sp* and *Serotine*) or *Myotis sp*.

The level of bat activity was quantified by the number of files (e.g. passes) recorded for each species for each monitoring period. The Kaleidoscope analysis software produced a single file for each pass made by an echolocating bat separated by 1 second of silence.

2.5 Survey Constraints

During transect surveys, bats and their direction of flight were easiest to observe during the period just after sunset when light levels were still high. As the light faded, visual observation often became impossible and 'heard not seen' records were made. When this occurred only the location of the bat pass could be recorded and not the direction of flight.

A number of technical failures were experienced both during static surveys. Static detectors failed three times over the seven month recording period. In July 2017 MP 2 (The Avenue) failed to record. MP2 also recorded only two days instead of the recommended five in April 2018. Finally, MP1 (The Woodland) recorded only two days of data in September 2017. In all cases these constraints were mitigated by additional data collected in the month following the affected period during the same season (spring, summer or autumn). As a result the failure of the recorders is not considered to be a significant constraint.

3 RESULTS

3.1 Background Data Search

The background data search contained records of at least seven different bat species within 2 km of the site, including records of Greater Horseshoe Bat and Lesser Horseshoe Bat (*Annex 2* listed species under the *Conservation of Habitats and Species Regulation 2010*). Additionally, a small colony of Greater Horseshoe bats (peak count of three bats) has previously been reported from the Commodore Hotel building (Biodiversity Solutions, 2014). The increased level of protection afforded to both species of Horseshoe bats make them a particular focus of the surveys and proposed mitigation of this site.

The Milford Haven Water Way Site of Special Scientific Interest (SSSI) which borders the site to the northwest has internationally important populations of Greater Horseshoe bat, as well as nationally important numbers of Lesser Horseshoe bat.

3.2 Roost surveys

3.2.1 Dusk Emergence and Dawn Re – Entry Building Surveys

Buildings and structures that offer suitable roosting habitat which could not be fully inspected during the PRA survey and are predicted to be affected by the proposed re-development were subject to dusk emergence and dawn re – entry surveys (as shown in *Table 11*). As described in section 1.2, four buildings were identified as roosts during the preliminary roost assessment these are buildings RSK B10 (P808), RSK B17 (Commodore Hotel), RSK B38 (M673 (B28)) and RSK B50 (M683 (B47)). Of these buildings bats were recorded emerging or returning to roost in buildings RSK B10, RSK B17 and RSK B38 were confirmed roosts. No bats were observed emerging from or re-entering building RSK B50. Results are summarised below.

Table 11. Summary of dusk emergence and dawn re-entry surveys for buildings.

RSK Building Ref	Building Suitability	Survey Date	Survey Type	Results of Nocturnal Surveys
RSK B2	Moderate	20.09.17	Dusk	No bats were seen emerging from the building
		18.05.18	Dawn	No bats were seen entering the building
RSK B6	Moderate	26.09.17	Dawn	No bats were seen entering the building
		17.05.18	Dusk	No bats were seen emerging from the building
RSK B10	Confirmed	22.08.17	Dusk	One Brown Long-eared Bat emerged from the attached building on the western elevation. Non emergent/re-entering species recorded foraging or commuting during the survey; Common Pipistrelle, Soprano Pipistrelle, Greater Horseshoe Bat.
		19.09.17	Dusk	One Common Pipistrelle observed emerging from beneath the corrugated roof of the southern elevation of the Coach House. A Greater Horseshoe Bat was observed to twice enter and leave the open parking area on the ground floor of the attached building on the western elevation but did not roost. Non emergent/re-entering species recorded foraging or commuting during the survey; Common and Soprano Pipistrelle, Greater Horseshoe Bat and Noctule.
		18.05.18	Dawn	A single Brown Long-eared bat re-entered the building via an open door on the ground floor on the western elevation of the building. A single Lesser Horseshoe bat exited the building via an open door on the southern elevation. Soprano Pipistrelles were foraging around the building.

RSK Building Ref	Building Suitability	Survey Date	Survey Type	Results of Nocturnal Surveys
RSK B17	Confirmed	23.08.17	Dusk	One unidentified bat (silent) observed emerging from the north-western elevation. This was most likely a Pipistrelle bat. One unidentified Pipistrelle (social call only) observed emerging from the south-eastern elevation of the four-storey part of the building. High probability that a Common Pipistrelle and an unidentified (silent) bat emerged from beneath roof ridge tiles towards the northern end of the ridge tile and a Common Pipistrelle from the south-eastern elevation of the four-storey part of the building. The location of these potential roosting locations at height is responsible for the degree of uncertainty. Non emergent/re-entering species recorded foraging or commuting during the survey; Common and Soprano Pipistrelle and Brown Long-eared Bat.
		19.09.17	Dawn	Two Common Pipistrelles entered the three-storey part of the hotel; the first at the south-western corner where the roof and wall meet. The second near the chimney. An unidentified (silent) bat entered a window on the western elevation of the four storey part of the hotel. Possibly a Horseshoe bat based on ground hugging flight behaviour. High probability that a Soprano Pipistrelle entered the building on the southern elevation of the four-storey part of the hotel. The location of this potential roosting location at height is responsible for the degree of uncertainty. Non emergent/re-entering species recorded foraging or commuting during the survey; Common and Soprano Pipistrelle and Greater Horseshoe Bat.
		16.05.18	Dawn	There was a possible entry of a Common Pipistrelle on the western elevation of the building. A Common Pipistrelle entered the building via an open door in the main four storey section of the building. The open door was on the eastern elevation of the building. A Common Pipistrelle entered the building via an ivy obscured window in the two storey section of the building, on the eastern elevation of the building.

RSK Building Ref	Building Suitability	Survey Date	Survey Type	Results of Nocturnal Surveys
				Common Pipistrelle, Soprano Pipistrelles and possible Brown Long-eared bats were recorded foraging around the building.
RSK B18	Low	22.08.17	Dusk	No bats were seen emerging from the building
RSK B20	Low	25.08.17	Dusk	No bats were seen emerging from the building
RSK B21	Low	25.08.17	Dusk	No bats were seen emerging from the building
RSK B26	Low	29.08.17	Dusk	No bats were seen emerging from the building
RSK B28	Low	18.08.17	Dawn	No bats were seen entering the building
RSK B30	High	24.08.17	Dawn	No bats were seen entering the building
		18.09.17	Dusk	No bats were seen emerging from the building
		15.05.17	Dusk	No bats were seen emerging from the building
RSK B31	Moderate	24.08.17	Dawn	No bats were seen entering the building
		18.09.17	Dusk	No bats were seen emerging from the building
RSK B32	Low	24.08.17	Dawn	No bats were seen entering the building
RSK B34	Moderate	25.09.17	Dusk	No bats were seen emerging from the building
		17.05.17	Dusk	No bats were seen emerging from the building
RSK B36	Low	23.08.17	Dawn	No bats were seen entering the building
RSK B38	Confirmed	15.08.17	Dawn	One Common Pipistrelle observed entering a gap beneath the barge board at the apex of the southern gable. One Common Pipistrelle bat observed entering behind the barge board on the northern gable end. One Common Pipistrelle was then observed emerging from the same spot from under the barge board on the northern gable later in the survey. Non emergent/re-entering species recorded foraging or commuting during the survey; Common Pipistrelle and Soprano Pipistrelle.

RSK Building Ref	Building Suitability	Survey Date	Survey Type	Results of Nocturnal Surveys
		18.09.17	Dusk	Two Common Pipistrelles emerged from beneath the barge board on the northern gable end. One Common Pipistrelle later re-entered the building at the same location. Non emergent/re-entering species recorded foraging or commuting during the survey; Common Pipistrelle and Soprano Pipistrelle .
		15.05.18	Dusk	A single Common Pipistrelle emerged from behind the barge board on the northern gable of the building and flew eastward across the site. There was only one other recording of a Common Pipistrelle foraging around the building.
RSK B39	Moderate	20.09.17	Dusk	No bats were seen emerging from the building
		16.05.18	Dusk	No bats were seen emerging from the building
RSK B41	Moderate	20.09.17	Dawn	No bats were seen entering the building
		17.05.18	Dawn	No bats were seen entering the building
RSK B42	Low	24.08.17	Dusk	No bats were seen emerging from the building
RSK B44	Low	23.08.17	Dawn	No bats were seen entering the building
RSK B45	Low	23.08.17	Dawn	No bats were seen entering the building
RSK B46	Low	23.08.17	Dawn	No bats were seen entering the building
RSK B48	Low	15.08.17	Dusk	No bats were seen emerging from the building
RSK B50	Confirmed	17.08.17	Dusk	No bats were seen emerging from the building Non emergent/re-entering species recorded foraging or commuting during the survey; Common Pipistrelle and Soprano Pipistrelle.
		19.09.17	Dusk	No bats were seen emerging from the building Non emergent/re-entering species recorded foraging or commuting during the survey; Common Pipistrelle and Soprano Pipistrelle.
		18.05.18	Dawn	No bats were seen entering the building Non emergent/re-entering species recorded foraging or commuting during the survey



RSK Building Ref	Building Suitability	Survey Date	Survey Type	Results of Nocturnal Surveys
				included Common Pipistelle.
RSK B52	High	15.08.17	Dusk	No bats were seen emerging from the building
		26.09.17	Dusk	No bat were seen emerging from the building
		10.05.18	Dusk	No bats were seen emerging from the building
Stone Gateway	Moderate	19.09.17	Dawn	No bats were seen entering the building
		18.05.18	Dusk	No bat were seen emerging from the building



3.2.2 Tree Roost Inspection Surveys

The results of the tree roost inspection surveys are provided in *Table 12* below. No trees were found to contain roosting bats or evidence of roosting bats during detailed tree surveys.

Table 12. List of Trees Subject to Repeated Tree Roost Surveys Carried Out on Features Previously Identified During the Preliminary Roost Assessment Report.

Ref	Bat Roost Suitability as Classified During the PRA	Re-classification of Bat Features During Tree Roost Inspections	Presence/absence of Roosting Bats	Descriptions of Potential Roost Features in Trees
1963	Moderate	Moderate	No bats were found during tree climbing surveys.	Two tear-out wounds on north-east stem at 4 and 5 m above ground level. Crack along horizontal beam also noted but found to not offer refuge for bats Cavity in tear out extends 70 cm upwards however interior was found to be densely covered in cobwebs and significant levels of moisture and decaying material making the cavity of limited suitability.
1962	Moderate	Low	No bats were found during tree climbing surveys.	5 x 5 cm hole on the northern side of the tree. On inspection the feature was found to be superficial and does not offer refuge for bats. Hole at 1 m above ground on the northern side of the tree. PRF surveyed by torch and found to be rough inside and of limited potential.
1960	Moderate	High	No bats were found during tree climbing surveys.	15 x 15 cm hole in base of trunk facing in north-easterly direction. Extends upwards for more than 30 cm. The cavity is relatively large on inspection and extends into multiple spires. PRF surveyed with endoscope to its full extent; no bats were found Several other PRFs noted including knot holes and a tear out hole however these were found to be superficial and did not require further inspection.

1958	High	High	No bats were found during tree climbing surveys.	A tear out with external dimensions of 40 x 6 cm and the hole extends upwards into the limb. On inspection the cavity was found to have smooth and dry areas above the entrance but held no evidence of bats. An occluded tear out wound with an 8 x 3 cm entrance hole, decreasing to c. 3 x 3 cm and potentially extending into the occlusion. Inspections found the feature to be narrow and damp holding a number of invertebrates. No bats were found during the inspections.
1957	Moderate	High	No bats were found during tree climbing surveys.	A basal cavity on the northern side of the trunk was surveyed with an endoscope. Internally there is a 1 x 3 cm hole which appeared striated, dry and smoothed and an 8 x 8 cm hole which led into a 25 x 25 cm cavity which appeared dry, striated and un-smoothed. No bats or evidence of bats was found.
1954	Moderate	Low	No bats were found during tree climbing surveys.	An occluded, snapped off branch with a hole on either side of dead wood in the centre of the feature. The larger hole is located on the eastern side of the feature and is 5 x 5 cm in size. An upward facing 3 x 3cm knot hole at 10 m in height appears which is unlikely to extend. Inspections resulted in the tree being downgraded from moderate to low suitability.
1950	Moderate	Moderate	No bats were found during tree climbing surveys.	An occluded tear out situated at a height of 6 m and with external dimensions of 40 x 10 cm. It appears likely that holes extend into the limb at either side of the tear out. During inspections the feature was found to narrow towards its end and the entrance was covered by light cobwebs. No evidence of roosting bats was found. A tear out situated at a height of 8 m and with external dimensions of 50 x 10 cm. It appears likely that holes extend into the limb at either end of the tear out. This feature was found to have low suitability during inspections due to the presence of an old birds nest at the base and the fact that entrance was heavily cobweb.
1945	High	High	No bats were found	A 20 x 15 cm hole resulting from a large tear out on the north-

			during tree climbing surveys.	western side of the trunk extends upwards into a stem with a diameter of 70 cm. Appears to enlarge internally into a hole with a diameter of 30 cm and which has a smooth, flat, unpolished surface with minor striations. The feature splits into two internal cavities at the apex, no evidence of bats was found during inspections. A 3 x 3 cm hole in a broken limb at 4 m in height potentially extends towards the main stem. During tree climbing inspections these features were found to be superficial and mostly occlude and were downgraded to low suitability. No evidence of roosting bats was found during inspections.
1942	High	High	No bats were found during tree climbing surveys.	A 3 x 4 cm, upward facing, partially occluded tear out was recorded at 5 m in height on the north-western limb. The feature was found to extend vertically into the trunk and was wet and sludgy at the entrance. No evidence of roosting bats was found during surveys. Two 4 x 4 cm pruning wounds were recorded at 14 m in height on the south-western and northern limbs respectively. These had the potential to extend downwards into the limb. Both of these features were found to be superficial on inspection.
(Target Note 1)	Moderate	Low	No bats were found during tree climbing surveys.	3 pruning wounds between 4 - 5 m above ground level on the easterly limb which are 10, 8 and 4 cm in diameter entrances respectively. One 2 cm in diameter pruning wound on the east limb which may extend to a limited depth. After close inspection all features were found to be of limited depth and are of low suitability for roosting bats. Subsequently the tree was re-classified as having low suitability for roosting bats.

3.3 Activity surveys

3.3.1 Transect Surveys

Transect surveys were undertaken each month from May 2017 to October 2017 and April 2018. Table 13 details the total number of bat passes recorded for each transect. At least four different species of bat were recorded during the surveys. Over the course of the seven surveys, Common Pipistrelle (*Pipistrellus pipistrellus*) attributed for 90 % of all activity recorded (foraging and commuting) on the site. This was followed by Soprano Pipistrelle (*Pipistrellus pygmaeus*) roughly 10%. Other species accounted for a negligible percentage of recordings.

Table 13. Total numbers of bat passes recorded for each transect.

Species	May-17 Dusk	Jun-17 Dusk	July-17 Dusk	Aug-17 Dusk	Sep-17 Dusk	Oct-17 Dusk	April-18 Dusk	April-18 Pre-Dawn	TOTAL
<i>Common Pipistrelle</i>	104	920	57	145	97	54	22	0	1399
<i>Soprano Pipistrelle</i>	15	5	0	37	30	28	60	1	176
<i>Noctule</i>	1	0	0	0	0	1	0	0	2
<i>Myotis sp.</i>	0	0	0	2	0	0	0	0	2
<i>Pipistrelle sp.</i>	0	0	1	0	0	0	0	0	1
TOTAL	120	925	58	185	127	83	82	1	

The dusk activity survey in June had the highest level of bat activity recorded (total of 925 passes), followed by the August dusk activity survey (185 passes); which coincides with increased bat activity in summer during the maternity period.

Higher levels of activity recorded during the surveys were associated with the southern border of the site which includes Admiralty Way and the areas of secondary broadleaved woodland surrounding buildings RSK B16 (P845) and RSK B20/B21 (M800). Raised levels of bat activity were also recorded on the sites south-western border, along the wall separating the site from the sewage works.

Visual sightings of bats during the survey illustrated by Figure 11 show that the small number of bats seen to the north of the site were largely commuting suggesting that these sightings may comprise exploratory or very occasional use of the habitat. To the south east, in the woodland surrounding buildings RSK B16 (P845) and RSK B20/B21 (M800) a far larger number of bats were seen to be foraging. In this area of the site the commuting bats largely appeared to be travelling towards the vegetated areas associated with the residential properties and the hospital to the south of Pembroke Dock.

Transect survey results for each section are illustrated in *Figures 5-10*.

3.3.2 Static Surveys

Seven different species (or groups) of bat were recorded; Common Pipistrelle, Soprano Pipistrelle, Pipistrelle sp., Long-eared, Noctule, Myotis species and Greater Horseshoe (*Tables 14 – 16*). Temporal changes for individual species at each monitoring point are shown below.

Table 14: Summary of results for Monitoring Point 1 (MP1, The Woodland) and Monitoring Point 2 (MP2 The Avenue).

	<i>Common Pipistrelle</i>	<i>Noctule</i>	<i>Pipistrelle Sp</i>	<i>Soprano Pipistrelle</i>	<i>Myotis sp.</i>	<i>Long-eared</i>	<i>Greater Horseshoe</i>
MP1	2079	65	8	1387	10	1	19
MP2	4932	5	1	2196	13	3	9
All data	7011	70	9	3584	23	4	28

Table 15: Summary of the species recorded per month for Monitoring Point 1 (MP1, The Woodland)

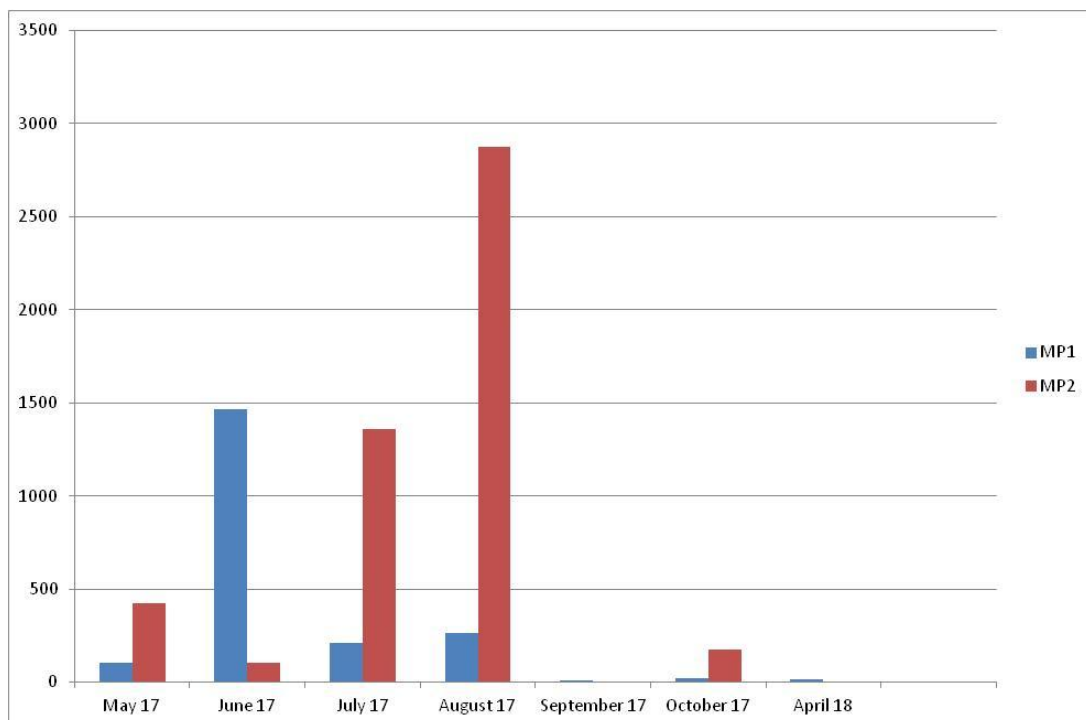
<i>Species</i>	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Apr-18	Total
<i>Myotis sp.</i>	3	1	4	0	2	0	0	10
<i>Noctule</i>	1	0	1	63	0	0	0	65
<i>Common Pipistrelle</i>	103	1466	209	263	3	21	14	2079
<i>Soprano Pipistrelle</i>	169	946	102	143	2	4	21	1387
<i>Greater Horseshoe</i>	7	1	0	11	0	0	0	19
<i>Pipistrelle sp.</i>	0	7	1	0	0	0	0	8
<i>Long Eared Bat</i>	0	0	0	1	0	0	0	1

Table 16: Summary of the species recorded per month for Monitoring Point 2 (MP2, The Avenue)

<i>Species</i>	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Apr-18	Total
<i>Myotis sp.</i>	0	0	6	4	0	3	0	13
<i>Noctule</i>	1	2	2	0	0	0	0	5
<i>Common Pipistrelle</i>	422	103	1360	2873	0	174	0	4932
<i>Soprano Pipistrelle</i>	31	92	592	1470	0	11	0	2196
<i>Greater Horseshoe</i>	0	7	1	1	0	0	0	9
<i>Pipistrelle sp.</i>	0	1	0	0	0	0	0	1
<i>Long Eared Bat</i>	0	0	3	0	0	0	0	3

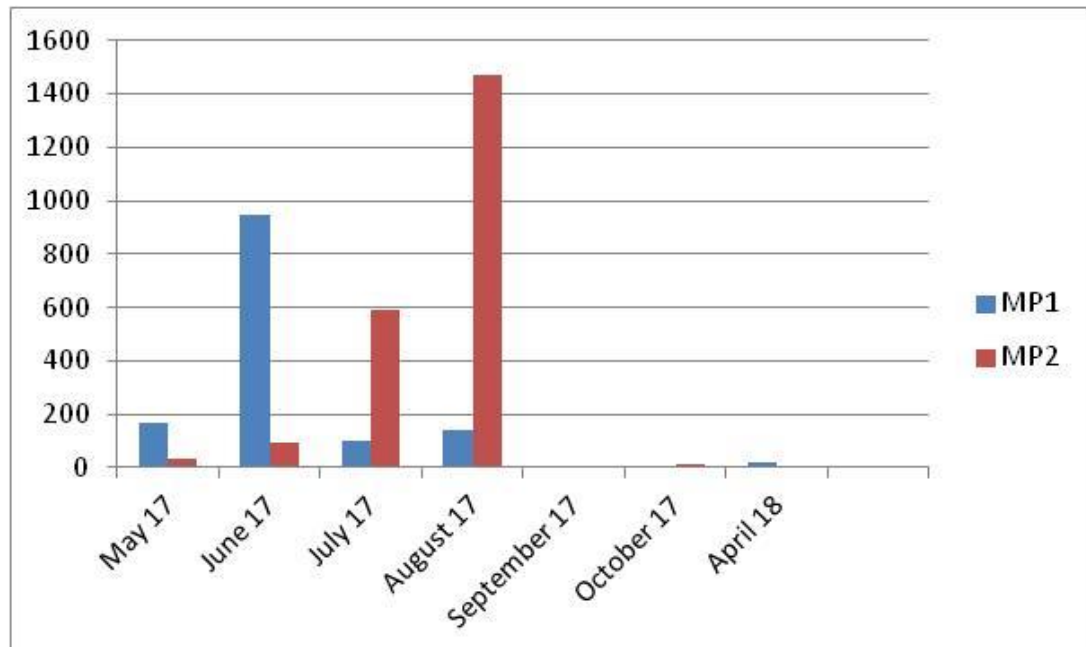
Graph 1 shows the number of Common Pipistrelles recorded by static detectors over the months they were deployed. In general a larger number of bats were recorded by MP2 which was placed in the Avenue see figure 4. The number of bats appeared to increase in the summer months.

Graph 1: Recorded passes of Common Pipistrelle per month.



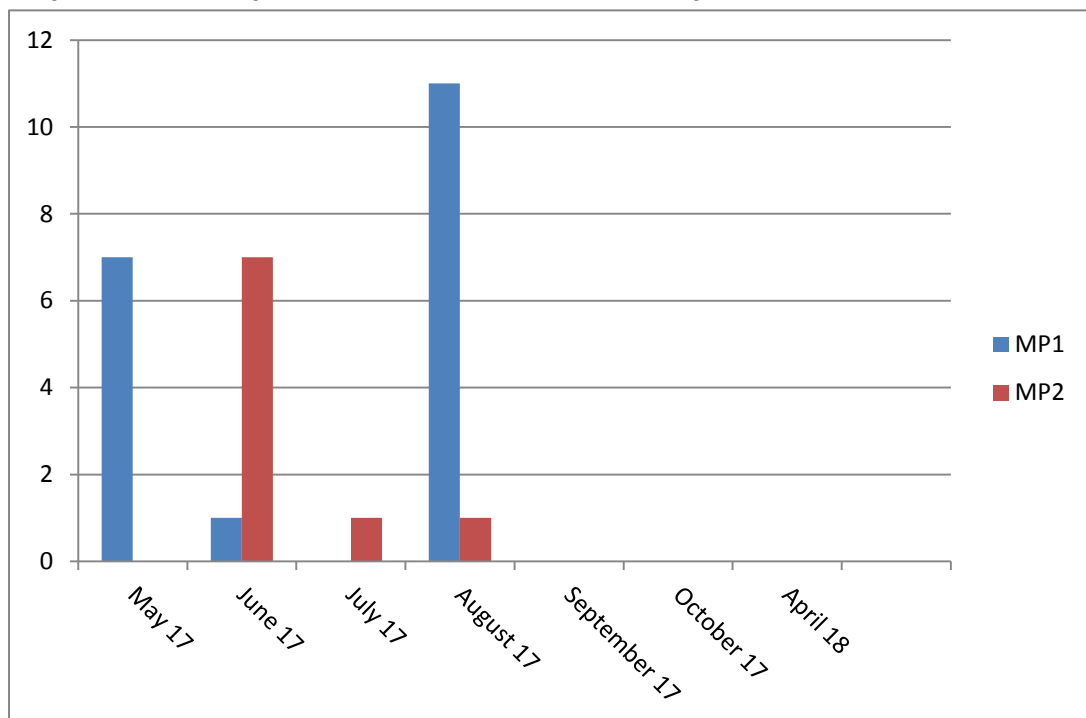
Graph 2 shows the number of Soprano Pipistrelles recorded by static detectors over the months they were deployed. In general a larger number of bats were recorded by MP2 which was placed in the Avenue see figure 4. The number of bats appeared to increase in the summer months.

Graph 2: Recorded passes of Soprano Pipistrelle per month.



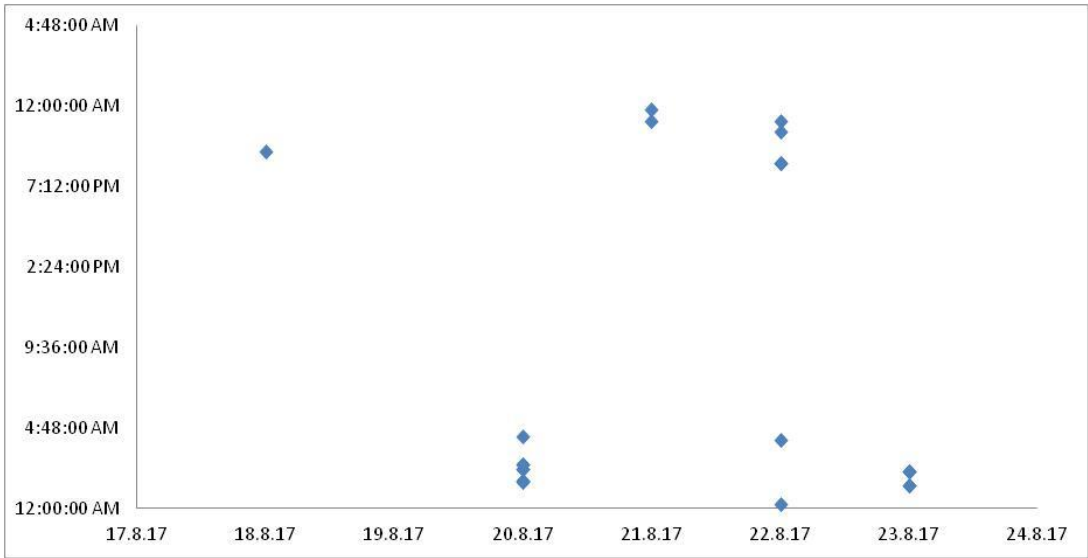
Graph 3 shows the number of Greater Horseshoe bats recorded by static detectors. In general a larger number of bats were recorded by MP1 which was placed in the woodland see figure 4. The number of bats appeared to increase in the summer months.

Graph 3: Recorded passes of Greater Horseshoe bats per month.



Graph 4 shows the number of Greater Horseshoe bats recorded by Mp1 (The Woodland) plotted against the time at which the passes were recorded. The calls appear to be recorded throughout the night with no clusterings around dusk or dawn to suggest that the static had been placed in close proximity to a roost.

Graph 4: Greater Horseshoe passes recorded in August at MP1 (The Woodland), plotted against time.



5 DISCUSSION

5.1 Roosts

5.1.1 Roosting Bats in Buildings

Previous work by Biodiversity Solutions (2014) confirmed building RSK B17 (The Commodore Hotel) to support a small colony of Greater Horseshoe bats (peak number of three bats). Despite the absence of Greater Horseshoe bats recorded during the current suite of dusk/dawn surveys the building is still considered to be used by Great Horseshoe but as an infrequently used non-maternity roost. In addition, other species of bat were recorded roosting in this building during the dusk/dawn surveys. This includes the possible presence of a small maternity roost for Common Pipistrelle (highest count of five individual bats during 23 August 2017) as well as use for the building by individual Soprano Pipistrelle and Lesser Horseshoe bats as an infrequently used, summer non-maternity roost.

During the preliminary roost assessment and dusk/dawn surveys, building RSK B10 (P808) was confirmed to be used as a bat roost. This includes the use of the building as non-maternity summer roost for Greater Horseshoe (via analysis of droppings), Brown Long-eared and Common Pipistrelle, as well as a night roost for an individual Lesser Horseshoe record on a single occasion exiting the building during a dawn survey.

During the initial assessment of building RSK B38 (M676 B26) a single bat dropping was found on the building's exterior. DNA analysis confirmed this to have originated from Common Pipistrelle. In building RSK B38 individual Common Pipistrelle bats were seen emerging and re-entering the building at opposite gables (northern and southern end). No more than one bat was seen emerging from the building on any one occasion during the surveys. Therefore, it is considered that building RSK B38 (M676 B26) supports a summer, non-maternity roost for Common Pipistrelles.

Three dusk/dawn surveys and a second thorough inspection at building RSK B50 found no evidence of roosting bats. Therefore it is considered that the single dropping found previously during an internal inspection was from a Brown Long-eared bat exploring the roof void momentarily. Therefore, building RSK B50 is not considered to be used by roosting bats.

The dusk/dawn surveys completed elsewhere on the site indicate that no other buildings predicted to be affected by the development contain bat roosts.

5.1.2 Roosting Bats in Trees

No roosts were identified during tree inspection surveys. No further surveys are required, however pre-construction checks are recommended as described in section 6 below.

Many of the trees surveyed and classified during the detailed surveys have the potential to be retained in the proposed ecological corridor on the southern boundary of the site.

5.2 Activity surveys

5.2.1 Bat species identified on site

A total of seven species of bat were recorded using the site from the three types of surveys undertaken. The following species were recorded during transect surveys Common Pipistrelle, Noctule, Soprano Pipistrelle, and Myotis sp. In addition Long-eared bat and Greater Horseshoe were recorded during static surveys. Finally, during the dusk/dawn surveys the presence of Lesser Horseshoe bats was also confirmed. With reference to the background data search included in the Preliminary Ecological Appraisal (RSK, 2017c) and the National Bat Monitoring Programme Annual Report (2017) this is an expected assemblage for the site.

By far the largest proportion of the calls recorded during static and activity transects were from Common Pipistrelle followed by Soprano Pipistrelle which had 7011 and 3584 calls in total detected by static recorders. In comparison, no other species had more than 70 calls recorded by static detectors during the full suite of surveys. Long-eared bat species are hard to record as they can echolocate quietly. Although this species can be hard to detect if they were dependent on the site higher levels of activity would still be expected. Based on their habitat preferences it is assumed that they will only use the southern end of the site.

Building RSK B10 (P808), RSK B17 (The Commodore Hotel) and RSK B38 (M676 B26) were found to contain roosts for Common and Soprano Pipistrelle, Brown Long-eared, Lesser Horseshoe and Greater Horseshoe. The distribution of Noctule, Pipistrelle sp., and Myotis sp. recorded during both static and activity transects which were not found to be roosting on the site matches those species that were found to be roosting on the site. As a result any site wide mitigation proposed will provide for species found to be commuting and foraging on the site but not breeding and therefore they are not discussed further.

5.2.2 Spatial use of the site and wider context

The foraging opportunities on the site are limited to vegetation principally found in the southern part of the site (scattered trees, broadleaved woodland and scrub).

In the wider landscape the site is connected to other areas of foraging habitat to the south including residential properties, the South Pembrokeshire Hospital, a golf course and farmland. The town of Pembroke Dock east of the site is dominated by residential and commercial buildings and transport infrastructure. The variety and number of buildings surrounding the site make it likely that bat roosts are present outside the sites boundaries.

The distribution of bats as recorded by the transects showed a preference by all bat species for more vegetated habitats on the southern border of the site, in particular the secondary broadleaved woodland surrounding buildings RSK B16 (P845), RSK B17 (The Commodore Hotel), RSK B9 (P808), RSK B10 and RSK B20/B21 (M800) as shown in *Figures 11 and 12*.

There are also concentrations of Common Pipistrelle activity along Admiralty Way, a road heading north away from the southern boundary of the site. Observed behaviour suggested that pipistrelles were foraging and commuting in this area. The higher level of Common Pipistrelle recordings along Admiralty Way may be explained by the presence of a roost close by or by the preference of Common Pipistrelle for micro-habitat features, *i.e.* tree lines less than 20 m in length (Racey, 1985). Neither the buildings nor the tree line along Admiralty Way are predicted to be impacted by the current draft master plan. As a result it is considered unlikely that any roost in this area is located off site and will not be affected by the development and no further mitigation is required. Elsewhere on the site there were occasional recordings of Pipistrelle sp. but these were less common. Areas of note included in the recordings of Common Pipistrelle are in the vicinity of buildings RSK B30, RSK B31 and RSK B32. This trend was supported by the static surveys which were both placed in locations in the south eastern corner of the site.

A relatively small number of Soprano Pipistrelle passes were recorded at the western end of the site by a high wall bordering the sewage treatment works. These recordings are from bats foraging around the sewage works on the western side of the wall (outside of the site). There was also bats visually seen commuting along the eastern side of this wall, sheltered from the wind. The number of passes in this area is very small (c.15 over all of the surveys). As the large wall is predicted to remain post-development it is considered that works in this area will not trigger a disturbance offence and as such no mitigation is necessary.

5.2.3 Temporal Activity Levels

Common and Soprano Pipistrelle

Increasing levels of Common Pipistrelle activity were recorded both during transect and static surveys between May and August and there was a marked change of preference from MP1 (The Woodland) to MP2 (The Avenue) between June and August. To a lesser extent this trend was mirrored by Soprano Pipistrelle.

The increase in bat activity through the season is likely due to increased numbers of bats because of flying juveniles, the increased feeding needs of lactating females and in part due to the increased length of nights in mid-summer

Female Common Pipistrelles exhibit reduced flying time during late pregnancy (May/June) and lactation (July/August) but undertake more foraging bouts, mean c.2.5 per night. In late June male Pipistrelles establish territories and are joined by females during late July, August and September (Russ, 2003 from Gerrell-Lunberg & Gerrell, 1994). The increase in activity in The Avenue may be due to a new male territory being established.

In contrast, the bat passes on Admiralty Way were largely detected during activity transects around 30 – 40 minutes after sunset. In general, Common Pipistrelle emerge around 20

minutes after sunset, earlier on warmer nights. These timings of the recording suggest that the bats are travelling to this location and may be roosting nearby.

Greater Horseshoes

Greater Horseshoe bats emerge later from the roost at night (around 30 minutes after sunset) and return to the roost close to sunrise (University of Bristol School of Bioscience, 2005). *Graph 4* shows that Greater Horseshoes were not recorded around sunrise (6:00 am to 6:30 am) or sunset (20:30 to 20:15). It suggests that the site was not close to a roost, with the exception of building RSK B17 (The Commodore Hotel), and that the majority of the bats were using the area to commute or forage.

6 MITIGATION AND ENHANCEMENT

6.1 Roosts

6.1.1 Roosting Bats in Buildings

Of the three buildings confirmed to support bat roosts only building RSK B38 (M676 B26) will be directly affected by the development as it is scheduled for demolition to make way for an 'external multi-use laydown and final assembly area'. As such, construction works to this building must take into account the legal protection of all roosts including transitional roosts (see *Appendix A* for legislation). A European Protected Species (EPS) licence will need to be in place before works commence. Detailed mitigation measures to ensure the persistence of bat roosting opportunities will be set out in the EPS licence.

Based on the draft master plan current mitigation proposals are to install three bat Schwegler 1FF and three 2F boxes (ratio of 1:3) to provide alternative opportunities for Common Pipistrelles. Two of these boxes should be located on the exterior of the nearby Fabrication Building and the remaining on trees along the proposed ecology corridor in the south of the site. Boxes should be placed as high as possible (minimum of 4 m above the ground) in sheltered sunny places. It should be noted that once bats have inhabited a roost site they may only be disturbed by licensed bat workers². Proposed locations of bat boxes are shown in *Figure 13*.

Impacts to building RSK B17 (Commodore Hotel) and RSK B10 (P808) may occur through unsympathetic removal of habitats on the southern boundary and a poorly designed lighting scheme. As such the creation of an ecology corridor along the southern boundary can avoid possible impacts and retain the site's use by foraging and commuting bats occupying these two buildings.

6.1.2 Roosting Bats in Trees

As no roosts were found in trees no EPS licences are anticipated for works to trees. Comprehensive surveys were carried out but surveys of trees cannot prove definitive absence of roosting bats and remain proportionate. Saproxylic (tree roosting bats) bats switch roosts on a regular basis, therefore where trees with features are being removed it is advised that these features are carefully sectioned and strapped to nearby trees where possible or bat boxes can be provided to compensate for the features loss. This will ensure that the local roost resource is maintained.

Following best practice guidance pre-works checks for roosting bats are required immediately prior to the felling and pruning of trees designated as low suitability for bats by an arboculturalist or other suitably knowledgeable site personnel.

² Bat Conservation Trust. (2018). Bat Boxes. [Online]
http://www.bats.org.uk/pages/bat_boxes.html#Putting%20up%20your%20box

Despite the absence of roosting bats found by the surveys, trees designated as moderate and high suitability which are predicted to be affected by the development must be subject to a pre-work check to confirm their continued absence in line with industry best practices. The checks should be undertaken by a qualified ecologist to confirm the continued absence of bats in these trees.

6.2 Bat activity

6.2.1 Summary

Bats use the southern border of the site to commute and forage. It is unlikely that the levels of activity in this area of the site are due the presence of nearby roosts. It is more likely that the level of activity here is caused by bats commuting between good habitat in the wider landscape and bats foraging.

6.2.2 Habitat Loss and Fragmentation

The current draft master plan (Rev G) will require the demolition of some of the existing buildings and construction of new buildings. Several transport corridors 15 m to 30 m wide and oriented east-west and north-south across the site will be created and the Graving and Dry Dock will be in-filled.

The draft master plan proposes to remove open mosaic vegetation in the south of the site to allow for the construction of a staff car park, a proposed batching plant and a light assembly and maintenance building. This has the potential to cause an offence under the Conservation of Habitats and Species Regulations 1994 (as amended) by causing fragmentation of the bats habitat which may impair their ability to survive, breed or reproduce and in the case of bats roosting in buildings RSK B17 (The Commodore Hotel) and RSK B10. In order to retain habitat which is regularly used by commuting and foraging bats an ecological corridor comprising of native trees and shrubs should be created along the sites southern boundary. The corridor should also include a 5m buffer zone from the nearest development footprint. This will maintain connectivity both on and off the site (as shown in *Figure 13*) for bats and avoid causing a disturbance offence.

The wall along the southern and western boundary should be kept to ensure that the area stays dark from adjacent street lighting and flight lines are retained. The ecology corridor (as compensation for the predicted removal of a large proportion of the southern boundaries vegetation) should be completed with a planting scheme tailored to suit Greater Horseshoe, Lesser Horseshoe, *Myotis* sp., Brown Long-eared and Pipistrelle bats. This should include the planting of native tree and shrub species to create a vegetated corridor and to replicate habitat similar to woodland edge. A hedgerow should be planted and managed to encourage the growth of a thick, tall and bushy hedgerow off set from the existing wall to ensure that a dark commuting corridor is retained for commuting bats.

The planting scheme should use native plant species which are of benefit to insects and in turn bats. The Bat Conservation Trust provides information on the creation of habitats to encourage bats and biodiversity which can be found on their website:

www.bats.org.uk/pages/landscapedesign.html.

Where footpaths and small breaks in the commuting habitat are unavoidable (*i.e.* created by paths or access roads) then habitat connectivity can still be maintained by the planting of trees and trailing plants both sides to allow bats to cross at canopy height.

Once detailed design plans and phasing of the development have been finalised an ecological statement should be produced highlighting the development's predicted impacts and mitigation measures (e.g. a detailed lighting plan and the soft landscaping specifications for the ecology corridor).

6.2.3 Lighting

All species of bat are nocturnal and artificial lighting of areas in which bats are active is likely to disturb their normal activities and cause offence due to disturbance, as described above. Illumination of foraging and commuting areas can prevent or reduce activity, causing bats to pass quickly through lit areas or to avoid them all together. It can cause loss of foraging and commuting areas for some bats species, particularly for Lesser Horseshoe and Greater Horseshoe bats, as well as Brown-Long eared and *Myotis* sp. (Rowse et al, 2015). The proposed changes to the site in the draft master plan have the potential to alter light conditions in the area which may negatively affect bats but if measures are taken to mitigate for these impacts the site has the potential to be enhanced for bats. For example measures could be taken to attenuate the bright lighting which is currently in use in some areas of the site.

A detailed lighting scheme should be designed to minimise disturbance to commuting bats along the southern border of the site. Indiscriminate lighting should be avoided along this corridor with lighting angled below the horizontal plan and focused on the intended area. The lighting scheme should aim to create a 'dark flyway' along the proposed green corridor on the sites southern border.

Where possible lux levels from lighting along the southern border should be no higher than 1 lux to avoid detrimental effects on foraging and commuting bats. Current light levels at least throughout the wider site and at the edge of the woodland in the south appear to be well in excess of 1 lux. Recordings of bats in these area are dominated by Common Pipistrelle which are relatively tolerant of artificial lighting. Therefore there is scope to significantly improve the lighting conditions along the commuting corridor along the southern border of the site and in the wider site to make them more suitable for light sensitive bats such as Horseshoe bats.

A number of different lighting methods and techniques can be used to reduce impacts to bats from lighting. These are discussed below.

Variable Lighting Regimes (VLR)

VLR involve switching off or dimming lights for certain periods of the night. Many county councils are adopting VLR using Central Monitoring Systems (CMS) controlled units,

switching off/dimming lights when human activity is low (e.g. Between 00.30 – 5.30). This technology could also be used to create a lighting regime that switches off lights during periods of high bat activity, such as during peak commuting periods. Lights can also be dimmed (e.g. to 30% power) for periods of the night to reduce illumination and spill. Lights can also be fitted with movement sensors which switch lights on as people walk by and switch them off when people pass (this is usually adopted for garden lighting). Such lights will reduce the overall lit time , potentially reducing the impact on bats.

If appropriate and practical, lights could be dimmed between 20:30 and 22:00 and turned off between 00:30 and 05:30 (when human activity is low) to avoid illumination during peak activity levels for bats.

Height

Reducing the height of lighting units will keep the light as close to the ground as possible, reducing the volume of illuminated space. This will also give bats a chance to fly over the light units in the dark area above the light (as long as the light does not spill above the horizontal plane). There are many low level lighting options for pedestrian lighting which minimise spill and reduce overall illumination including low level illuminated bollards; an example is provided in Plate 2.

Plate 1: Example of low level lighting provided by bollards



Reducing Intensity

Reducing light intensity will reduce the overall amount and spread of illumination.

Light intensity can be reduced by:

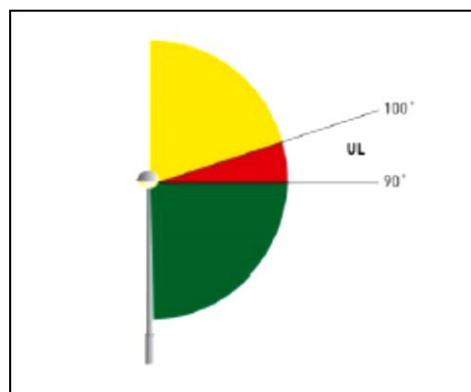
- Dimming: CMS technology can be used to reduce the power of lights on request (e.g. by 80%) and can be used as part of a VLR for periods of high bat activity
- Changing the light source: new technologies such as ceramic metal halide (e.g. Philips CosmoPolis, 45 watts) often have a lower wattage compared to old lamp types (e.g. HPS, 75 watts), and can be used to reduce light intensity, or;
- Creating light barriers: light intensity can be reduced at a particular part of the site by creating a light barrier which restricts the amount of light reaching the sensitive

area. Barriers can be in the form of newly planted vegetation, walls, fences or buildings.

Reducing Spill

Lighting should be directed only where it is needed to avoid trespass (spilling of light beyond the boundary of area being lit). Attention should be paid to avoid the upward spread of light near to and above the horizontal plane to minimise trespass and sky glow. It is important to avoid lighting above 90° and 100°, a diagram is provided in Plate 2. Commuting habitat on the site should be protected from light spill and lights should be directed away from these areas.

Plate 2: Critical luminaire angle for minimising sky glow, showing the upward light output zone.



Changing the Type of Light

In order to reduce potential negative effects on bats and wildlife in general the development should seek to:

- Avoid blue-white short wavelength lights: these have a significant negative impact on the insect prey of bats. Use alternatives such as warm-white (long wavelength) lights as this will reduce the impact on insects and therefore bats, and;
- Avoid lights with high UV content: (e.g. metal halide or mercury light sources), or reduce/completely remove the UV content of the light. Use UV filters or glass housings on lamps which filter out a lot of the UV content.

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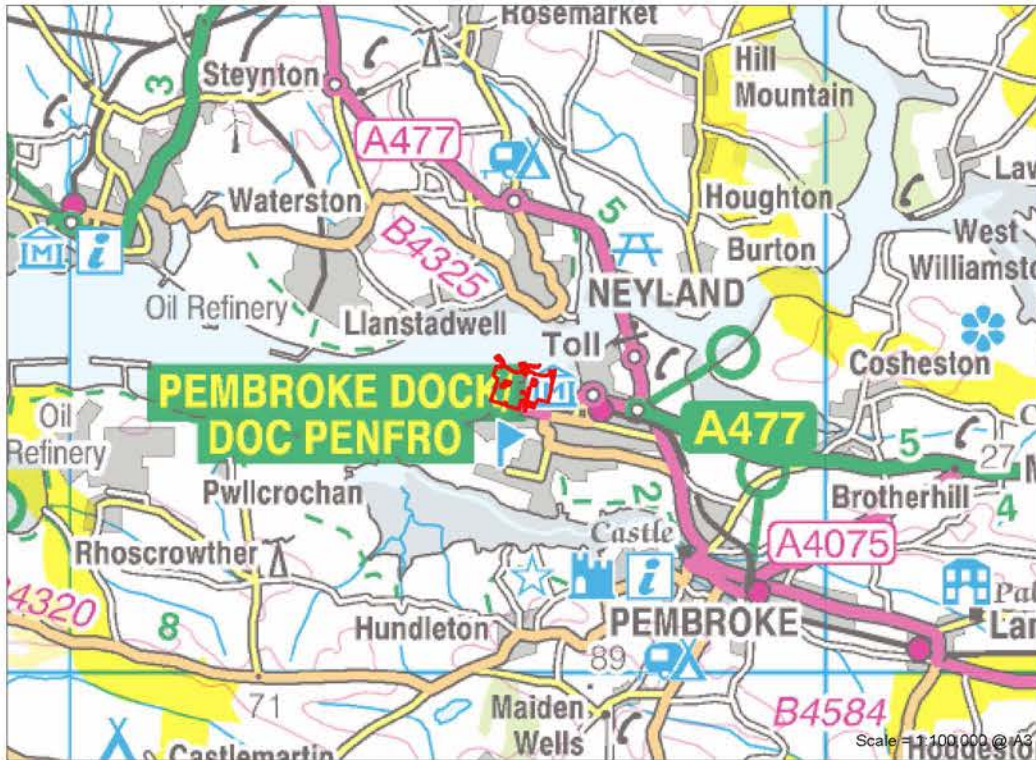
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Site boundary

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Pembroke Docks

Figure 1

Site Location Plan

0300metres

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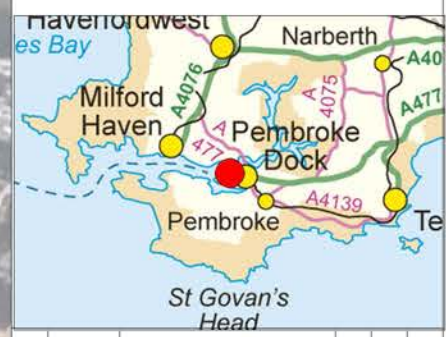
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REV 00



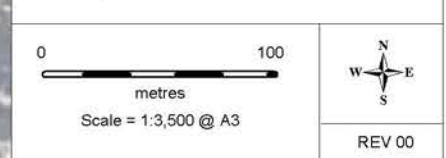
- Site boundary
- Preliminary Roost Inspection
 - High bat roost potential
 - Moderate bat roost potential
 - Low bat roost potential
 - Negligible potential - no further surveys required
 - Building not affected by development



00	15.06.18	856531	RG	SP	CS
Rev	Date	Description	Drn	Chk	App
Pembroke Docks					



Figure 2
Preliminary Building Bat Roost Inspection with Target Note





- Site boundary
- Tree Roost Inspection Survey
- Tree - High bat roost potential
 - Tree - Moderate bat roost potential
 - Tree - Low bat roost potential

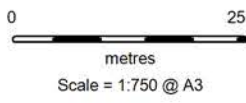


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Pembroke Docks



Figure 3
Tree Roost Inspection Survey Results





Site boundary

Bat transect route and stop points

Static detector location

00	11.07.18	856531	SP	RG	PP
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Pembroke Docks					
Figure 4					
Bat Transect and Static Detector Locations					
0 100 metres					
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- Site boundary
- Bat transect route and stop points
- Pipistrelle bat species



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Rev	Date	Description	Drn	Chk	App

Pembroke Docks



Figure 5
Bat Transect Survey Results
May 2017





Site boundary

Bat transect route and stop points

Pipistrelle bat species

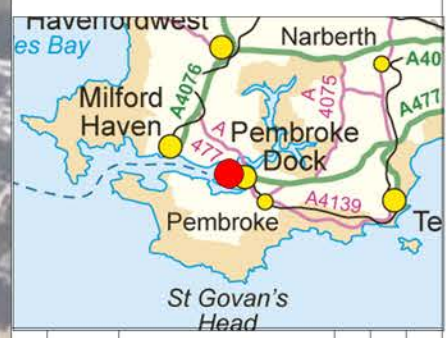
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Rev	Date	Description	Drn	Chk	App
Pembroke Docks					
Figure 6					
Bat Transect Survey Results					
June 2017					
0 100 metres					
Scale = 1:3,500 @ A3			REV 00		

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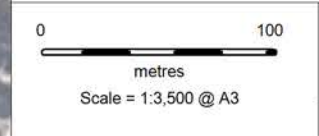
- Site boundary
- Bat transect route and stop points
- Pipistrelle bat species



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Rev	Date	Description	Drn	Chk	App
Pembroke Docks					



Figure 7
Bat Transect Survey Results
July 2017





Site boundary

Bat transect route and stop points

Pipistrelle bat species

00	11.07.18	856531	SP	RG	PP
Rev	Date	Description	Drn	Chk	App
Pembroke Docks					
Figure 8					
Bat Transect Survey Results					
August 2017					
0 100 metres					
Scale = 1:3,500 @ A3			REV 00		

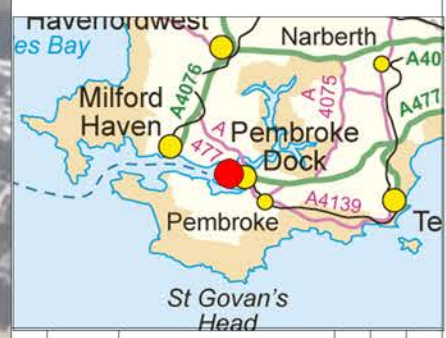
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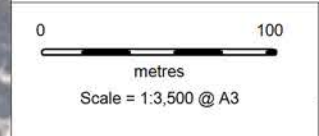
- Site boundary
- Bat transect route and stop points
- Pipistrelle bat species



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Rev	Date	Description	Drn	Chk	App
Pembroke Docks					



Figure 9
Bat Transect Survey Results
September 2017





Site boundary

Bat transect route and stop points

Pipistrelle bat species

Haverfordwest

Narberth

Milford Haven

Pembroke Dock

Pembroke

St Govan's Head

A4076

A4075

A4077

A4139

00	11.07.18	856531	SP	RG	PP
Rev	Date	Description	Drn	Chk	App

Pembroke Docks

RSK

Figure 10

Bat Transect Survey Results

October 2017

0100

metres

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REV 00

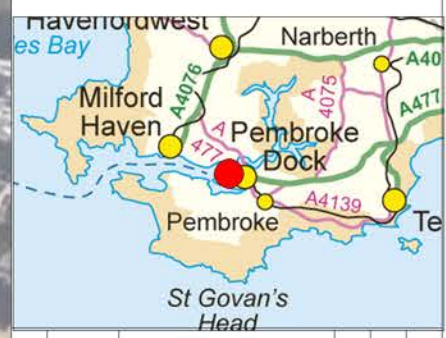
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File Name : U:\Ecology\856000s\856531 - Pembroke Docks 2017\07 - GIS



- Site boundary
- Bat transect route and stop points
- Pipistrelle bat species (Apr 2017)
- Pipistrelle bat species (May 2017)
- Pipistrelle bat species (July 2017)
- Pipistrelle bat species (Aug 2017)
- Pipistrelle bat species (Sept 2017)
- Pipistrelle bat species (Oct 2017)
- Pipistrelle bat species (Apr 2018)

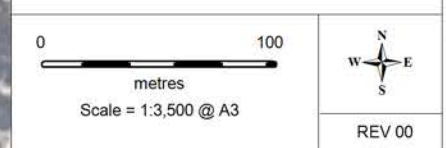


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Rev	Date	Description	Drn	Chk	App

Pembroke Docks



Figure 11
Bats Observed During Activity Surveys
May - Oct 2017





Site boundary



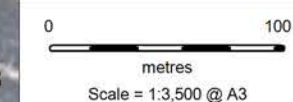
Rev	Date	Description	Drn	Chk	App
00	11.07.18	856531	SP	RG	PP

Pembroke Docks

RSK

Figure 12

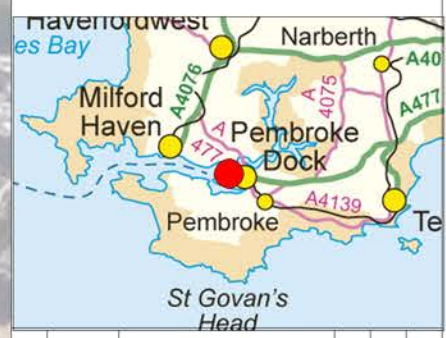
Heat Map Showing Bat Activity Hot Spots During Transect Surveys Between May 2017 - October 2017



REV 00



- Site boundary
- Bat roost
- Bat commuting and foraging habitat on site
- Bat commuting and foraging habitat adjacent to the site



00	11.07.18	856531	SP	RG	PP
Rev	Date	Description	Drn	Chk	App
Pembroke Docks					



Figure 13
Bat Commuting and Foraging Habitats

0100metresScale = 1:3,500 @ A3

NWSE

REV 00

Appendix A - Legislation

Bats

All species of British bat are protected by *The Wildlife and Countryside Act 1981* (as amended) extended by the *Countryside and Rights of Way Act 2000* (the CRow Act). This legislation makes it an offence to:

- intentionally kill, injure or take a bat;
- possess or control a bat;
- intentionally or recklessly damage, destroy or obstruct access to a bat roost; and
- intentionally or recklessly disturb a bat whilst it occupies a bat roost.

Bats are also European Protected Species listed on *The Conservation (Natural Habitats, & c.) Regulations 2010* (as amended). This legislation makes it an offence to:

- deliberately capture, injure or kill a bat;
- deliberately disturb a bat, including in particular any disturbance which is likely (a) to impair their ability - (i) to survive, to breed or reproduce, or to rear or nurture their young; or (ii) hibernate or migrate, where relevant; or (b) to affect significantly the local distribution or abundance of the species to which they belong.
- damage or destroy a breeding site or resting place of a bat; and
- possess, control, transport, sell, exchange a bat, or offer a bat for sale or exchange.

All bat roosting sites receive legal protection even when bats are not present.