ENVIRONMENTAL STATEMENT
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A9.1 TERRESTRIAL ECOLOGY AND NATURE CONSERVATION – DETAILED ASSESSMENT

9.1 INTRODUCTION

St Helena is noted for its unique range of landscapes and habitats and for its endemic flora and fauna (i.e. those species that are found nowhere else in the world). The loss of a number of unusual and endemic species to past woodland clearance and the effects of introduced domestic and wild species has been well documented and repeats a typical account of such impacts on many small oceanic islands.

Ecological issues are therefore of particular importance to the island and in relation to future development. This section of the report considers the implications of the proposed construction of the airport, the means of access for the building materials and the possible effects of the airport operation on the ecological and nature conservation resources of the island. The approach to restricting the extent of any adverse effects and for incorporating appropriate mitigation measures is included in this Appendix.

Some aspects of the ecology of St Helena and its Eastern Arid Area, (defined as Prosperous Bay Plain (PBP), Horse Point, Holdfast Tom and the area around the Government Garage at Bradley's) where it is proposed to locate the airport, and its haul/access road route, have been the subject of preliminary and in many cases relatively detailed study (see Key Reference Box below). This chapter summarises the results this work and the additional dedicated work for this Environmental Impact Assessment (EIA). Where relevant, detailed technical reports have been appended (see Appendices 9.2 to 9.5, Volume 4).

The potential effects of the proposed wharf in Rupert's Bay are assessed in Chapter 14 of Volume 2 of this ES.

9.2 APPROACH TO THE STUDY

Dedicated work for the ecological aspects for the EIA commenced in October 2005. The preliminary phases of work, informed by existing documentation as listed below, identified the scope of more detailed studies, some of which are continuing to date. Further information on the methodology adopted for some of the more detailed specific studies is given in the appropriate appended reports (Appendices 9.2 to 9.5).

9.2.1 Background Information

Key references and background information is provided below. The complete list is given in the –References and Bibliography at the end of the main text in Volume 2 of this ES.

- Ashmole, P & M (2000). St Helena and Ascension Island: a natural history. Antony Nelson, Oswestry UK
- Ashmole, P & M (2004) The Invertebrates of Prosperous Bay Plain – St Helena (Report)
- Atkins (January 2005) St Helena Access Feasibility Study (Report)
- Caesar L.G. (2001). An ecological impact assessment of the site proposed for the construction of the St Helena Island airport. BSc Thesis, University of Wolverhampton.
- Cairns-Wicks R. & Caesar L.G. (2004). Preliminary (Scoping) survey of the vegetation along the proposed haul road access routes of Prosperous Bay beach to Prosperous Bay Plain & Rupert's Bay to Deadwood to Bottom Woods. (Report).
- Cronk, Q C B (2000) The Endemic Flora of St Helena. Antony Nelson, Oswestry UK
- Government of St Helena (1993). Report on Sustainable Environment and Development Strategy and Action Plan for St Helena. Volume 2 Environmental Profile.
- McCulloch, N. (1992) The status and ecology of the St Helena Wirebird. BTO Research Report no. 97.
- McCulloch, N. (2004) A guide to the birds of St Helena and Ascension Island. RSPB
- McCulloch, N. (2006) A review of the status and habitat of the St Helena Wirebird Charadrius sanctaehelenae including an assessment of the potential impact of construction of the proposed St Helena Airport. RSPB (see Appendix 9.4)
- Edwards, A. (1990) Fish and fisheries of St Helena Island. Centre for Tropical Coastal Management Studies, Newcastle upon Tyne, UK
- Tremayne, J. (1998) Marine and Coastal Resources Management Plan. Directorate of Fisheries, Agriculture and Natural Resources Department, Government of St Helena.

The above reports reinforce the ecological importance of St Helena as a centre of endemism, though a number of species have been lost over the recent centuries and there have been countless introductions, many with invasive or competitive effects, on native vegetation in particular

The recent work by Ashmole & Ashmole (2000, 2004) shows the importance and uniqueness of the Eastern Arid Area and PBP, not only for its populations of endemic plants and semi-desert habitats but especially for the endemic invertebrates for which the island as a whole supports over 200 species. Some insect species possibly new to science have been found during recent survey work on PBP (Ashmole & Ashmole 2004).

PBP also provides the main natural desert habitat for the endemic plover, the Wirebird, though this species is also found on relatively level areas of sparse arid scrub and short pasture grassland elsewhere on St Helena. This species is the only remaining endemic bird on St Helena and with a recently recorded population decline is considered highly vulnerable to extinction. Formerly classified as "Endangered" under the International Union for Conservation of Nature and Natural Resources (IUCN) criteria by Birdlife International (Collare *et al.* 1994), it is now, as of May 2007, considered Critically Endangered (the highest category of concern).

The coastal waters hold 10 species of endemic fish and 2 species of endemic marine algae. A number of marine invertebrates are also endemic to St Helena or only known from St Helena and Ascension Islands. Further information relating to the marine ecology of St Helena is provided in Chapter 14, Volume 2 and Appendix 14, Volume 4.

With many areas of taxonomic research at a relatively preliminary stage, discoveries of new endemic species remain a strong possibility.

9.2.2 Survey Methodology

9.2.2.1 Habitats and Vegetation

Surveys were undertaken according to the Guidelines for Baseline Ecological Assessment, (1995) published by the Institute of Environmental Assessment, now the Institute of Environmental Management and Assessment (IEMA) using the principles outlined by the UK Joint Nature Conservation Committee in A Handbook for Phase 1 Habitat Survey, (1990). Surveys were undertaken by appropriate specialists quartering the ground on foot and recording the details of habitats and plant species present. All terrestrial habitats under actual or potential impact from the airport and its supporting infrastructure (e.g. the access road, quarry site, water pipeline route, navigation aids, ROL locations and proposed wharf area at Rupert's Bay) were visited, some on repeated occasions.

9.2.2.2 Wirebird Studies

A population census for the Wirebird and an assessment of its breeding status was undertaken over the months of November and December 2005 for the whole island by Dr N McCulloch. Full details of the methodology and results of this study are appended (McCulloch 2006). Further counts of breeding Wirebirds were undertaken by staff from the Royal Society for the Protection of Birds (RSPB) in April and May 2006. The survey concentrated on the key areas of St Helena to come under impact from the airport proposals, PBP, Bottom Woods and Deadwood Plain. Wirebird distribution continues to be monitored under this RSPB/ Overseas Territories Environment Programme (OTEP) project managed by the St Helena National Trust.

9.2.2.3 Marine Ecology

Coastal waters and the shore environment at the proposed site for the wharf, for the landing of construction materials at Rupert's Bay, were surveyed.

Technical Appendix to the Marine Environment 14.2 and 14.3, Volume 4 presents the results of the additional marine survey undertaken to assess the ecological implications of the proposed wharf at Rupert's Bay.

9.2.2.4 Additional Studies

Arising from the preliminary survey and assessment work, a number of other, more detailed, studies were undertaken in order to inform the EIA and the evolving design of the airport and its supporting infrastructure. The key studies are considered below:

Lichen Survey

The botanical surveys showed that lichens formed a prominent component of the flora both in terms of diversity and cover with species often growing in profusion on rock surfaces or consolidating desert sands by crust formations. In view of this and with the record of endemism in St Helena's flora and fauna, it was necessary to conduct a specialised survey for this group. Full details of this study and its methodology is given in the report enclosed in Appendix 9.3, Volume 4 (Aptroot 2006)

Wind Modelling Study

The proposed runway design involves removing land identified for the main runway alignment from an area that currently provides shelter to a natural bowl called the Central Basin from the strong prevailing south-easterly trade winds. Landforming would require the lowering of a 320-325 metre (m) high ridge termed the Eastern Plateau on the upwind side of the Basin, to a level of around 300 m above sea level to achieve the correct grade and the fill required for the runway and its Runway End Safety Areas (RESA) extension into the deep valley of Dry Gut. At present the Eastern Plateau acts as a windbreak for habitats that have developed upon fine sand and dust deposits within the Central Basin (see Figures 9.1 & 9.3, Volume 3 of this ES).

Accordingly, a modelling study was undertaken to compare the conditions on the PBP as they are currently against what they are likely to be with the proposed runway design, using wind modelling software applied to a 3D computational model of the existing terrain in the area of the PBP (see Appendix 9.5, Volume 4).

Mitigation by Avoidance; Other Engineering Options Considered

In view of the potential ecological impacts arising from the removal of the wind-shielding landform from the Eastern Plateau of PBP on the habitats of the Central Basin, a review of engineering options for the runway was undertaken by Atkins. Three main options were examined with a view to retaining, at least in part, the Eastern Plateau and the shelter so provided to the Central Basin. Preliminary costs, constraints and environmental and engineering risks were attached to these. The three options explored were:

- bridging the Dry Gut valley with a constructed deck, thereby avoiding the need for additional fill,
- lowering the Central Basin to retain sheltered conditions, and
- obtaining fill from quarrying elsewhere and retain the 325 m high eastern ridge, building up the land where needed to achieve the airstrip grade.

The preliminary review indicated that none of these options could be sustained on the grounds of excessive cost, safety implications for the bridge decking and, for the second option, a high environmental risk. Accordingly, these studies were progressed no further.

Marine Ecology Survey, Rupert's Bay

A detailed assessment was undertaken of the conditions at Rupert's Bay by means of a bathymetric survey. An ecology study formed part of this assessment and was undertaken in November and December 2006 by staff of the Fisheries Directorate of the St Helena Government's Agriculture and Natural Resources Department. Surveys were undertaken using measured transects across the bay with habitats and species recorded using SCUBA and sea-bed photography (see the Marine Environment – Detailed Assessment in Appendix 14, Volume 4).

9.2.3 Assessment and Evaluation of Nature Conservation and Potential Impact

For an environmental assessment to be carried out it is necessary to have some concept of the value of the site as a whole and the ecological value or conservation importance of the ecological receptors that it comprises. Receptors are those habitats and species that will come under some influence, either adverse or sometimes beneficial, from a

development. The value of ecological receptors can be identified using recognised criteria which, for United Kingdom (UK) environmental assessments, are based primarily on sites and species considered in national and European legislation and directives as being rare, vulnerable or under threat.

For species without complete statutory protection, or in some cases, no statutory protection, listings developed by academic research and conservation agencies, e.g. Red Data Book species, Biodiversity Action Plan habitats or species, can provide guidance on nature conservation value. In the international context, listings by agencies such as the IUCN and Birdlife International are relevant.

The assessment methodology follows that contained within the Guidelines for Ecological Impact Assessment 2006, published by the Institute of Ecology and Environmental Management (IEEM). However, reference has also been made to the UK Highways Agency's Design Manual for Roads and Bridges (DMRB) Volume 11 Environmental Assessment – Section 3, Part 4 Ecology and Nature Conservation, June 1993 and the UK Department of Transport's guidance, New Approach to Appraisal 1998.

This was subsequently updated to allow multimodal appraisals of different transport options including seaports and airports in the Guidance on the Methodology for Multi-Modal Studies, 2000, (GOMMMS). The appraisal approach is now published as Transport Analysis Guidance (TAG) available on www.webtag.org.uk and TAG Unit 3.3.10 deals specifically with 'The Biodiversity Sub-Objective'.

Evaluation of ecological receptors in a UK/European framework places some reliance on a hierarchy of protected and designated sites, rather than an emphasis on rare species. However, the site-based approach encompasses the partial requirements of certain of the most vulnerable and rare species for which key sites can be notified under the European Council (EC) Habitats Directive (92/43/EEC).

A species-based approach is particularly pertinent to St Helena in respect of the Wirebird, the only remaining endemic bird which, over much of its range on the island outside PBP, inhabits sites that are otherwise of very little ecological interest. The evaluation of ecological importance as described in the TAG provides a useful tool for application to the airport development in St Helena and is based on the criteria in Table 9.1 below.

Table 9.1 Nature Conservation Value of Features

Criteria	Value	Examples
High importance and rarity on an international scale with limited potential for substitution	Very high	Internationally designated sites
High importance and rarity on a national or regional scale with limited potential for substitution.	High	Nationally designated sites. Regionally important sites with limited potential for substitution
High or medium importance and rarity at a local or regional scale with limited potential for substitution.	Medium	Regionally important sites with potential for substitution. Locally designated sites
Low or medium importance and rarity on a local scale	Low	Undesignated sites of some local biodiversity and earth-heritage interest

Criteria	Value	Examples
Very low importance and rarity on a local scale	Negligible	Other sites with little or no local biodiversity and earth heritage interest

In practice, as noted above, the evaluation of nature conservation importance of an area also takes into account the presence of animal and plant species listed either for statutory protection, for conservation action in Biodiversity Action Plans, or listed by conservation agencies as being rare or vulnerable.

In St Helena the legislative framework regarding site and species protection is in its formative stages and in determining the value of ecological receptors found in the areas where development is proposed, note has been made of the international importance of the habitat or ecological receptors in that habitat, the rarity of the habitat or ecological receptor and conservation of genetic diversity inherent in the presence of endemic and indigenous species.

Under TAG, the magnitude of potential impacts upon the ecological receptors is considered under the following criteria (Table 9.2).

Table 9.2 Criteria for Determining the Magnitude of Impact

Criteria	Magnitude
The proposal (on its own or with other proposals) may adversely affect the integrity of the site, in terms of the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and / or the population levels of species of interest.	Major negative
The sites integrity will not be adversely affected but the effect on the site is likely to be significant in terms of its ecological objectives. (If in the light of full information, it cannot be clearly demonstrated that the proposal will not have an adverse effect on integrity, then the impact would be assessed as major negative)	Intermediate negative
Neither of the above apply but some minor negative impact is evident	Minor negative
No observable impact in either direction	Neutral
Impacts which provide a net gain for wildlife overall	Positive

Based on the criteria in Tables 9.1 & 9.2 above, the significance of the impacts is then derived as tabulated as in Table 9.3 below.

Table 9.3 Estimating the Overall Appraisal Category

Impact Magnitude	Nature Conservation Value of Features				
	Very High	High	Medium	Lower	Negligible
Major negative	Very large adverse	Very large adverse	Moderate adverse	Minor adverse	Neutral
Intermediate negative	Large adverse	Large adverse	Moderate adverse	Minor adverse	Neutral
Minor negative	Minor adverse	Minor adverse	Minor adverse	Minor adverse	Neutral
Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Positive	Large beneficial	Large beneficial	Moderate beneficial	Minor beneficial	Neutral

The scale at which the appraisal is applied depends on the distribution of the habitat or species in question. With habitat conditions at PBP and particularly the Central Basin being considered unique in St Helena this is taken as the assessment unit on habitat criteria (though this naturally comprises key species, e.g. Wirebird, or groups, e.g. desert invertebrates). This is also pertinent in view of the proposals for designation of PBP as a National Protected Area (proposed NPA) (see below). The haul roads necessarily require an island-wide assessment for determination of impact as the habitats affected are generally more widely distributed across St Helena.

9.3 EXISTING CONDITIONS

9.3.1 Legislation and Protected Areas

Figure 9.1 in Volume 3 shows the locations of the protected areas.

At an international level a number of conventions have been ratified by the UK Government which applies to the Overseas Territories. With respect to nature conservation issues these include:

- The Convention concerning the Protection of the World Cultural and Natural Heritage (World Heritage) 1972;
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973;
- The Convention on the Prevention of Marine Pollution by dumping of Wastes and Other Matter 1975;
- Ramsar Convention on Wetlands, extended to St Helena (Jan 1976); and
- The Convention on Biological Diversity 1992.

At the National level, a number of early ordinances and regulations concerned with the protection of the wildlife of St Helena were the Plants Protection Ordinance 1950, Forestry Ordinance 1954 (as amended) with Forestry (Indigenous Trees and Plants Preservation) Rules 1959 (as amended), the Wild Life (Protection) Ordinance 1984 Game and Wild Birds (Protection) Ordinance 1950 (as amended) and the Fisheries Protection Regulations. A number of these have subsequently been revised and the latest key revisions are now as follows.

- 2.12.03. No 14 2003 National Parks Ordinance “to provide powers to permit the establishment of parks, nature reserves, sanctuaries and areas of historical interest and generally for the conservation of the natural environment and ecology of St Helena”.
- Under this ordinance any area in St Helena, including any part of the territorial waters can be declared by the Governor in Council to be:
- A national park; or a nature reserve; or a sanctuary, or an area of historical interest. Since its enactment in 2003 no areas have been declared, although the Land Development Control Plan (LDCP) (2006) identifies a number of areas to be established as Protected Areas.
- 6.6.03. No 3 of 2003 Endangered Species Protection Ordinance “to provide protection of endangered, endemic and indigenous species of animals and plants and to regulate the trade in endangered species”.
- 3.12.01. No 6 of 2002 The St Helena National Trust Ordinance “to establish and make provision for the St Helena National Trust.

Where no appropriate national legislation is considered to apply St Helena can, under the English Law (Application) Ordinance, 2005, adopt English laws, with such modifications as local circumstances render necessary.

In 2001 the St Helena Environment Charter was signed which set out 10 guiding principals for the governments of St Helena and the UK with 11 more specific

commitments that the parties will do to honour the Charter. St Helena Government commitments 3, 4 and 5 are particularly relevant, whilst 2, 6 and 7 have some relevance, particularly to the development of mitigation strategies. UK Government commitments 1, 2, and 5 are relevant.

The Airport Development Ordinance (2006) makes provision for the Governor in Council to designate any land in St Helena to be an Airport Development Area. Furthermore it makes provision to avoid the necessity to amend other legislation. Nothing done in an Airport Development Area with the consent of the Governor in Council shall be held to be in contravention of a number of other comparative legislation, including The Forestry Ordinance, Cap 92, and the Land Planning and Development Control Ordinance.

The Land Acquisition Bill (2005) makes provision for the Governor in Council to declare and acquire land for public purpose.

The LDCP (2006) proposes a number of areas as Protected Areas. PBP has been identified as a proposed National Protected Area (refer to Figure 9.1, Volume 3). The Area extends from the stream bed of Dry Gut to the northern RESA and from the edge of the level ground on the Eastern Plateau before it falls steeply to the sea between Dry Gut Bay and Porches Gate and to the point where the terminal access road divides from the main route into PBP in the west. Gill Point, including Shore and George Islands are also a proposed National Protected Area.

The land immediately to the north, south and east of PBP National Protected Area, which includes Dry Gut and Prosperous Bay, is classified as Coastal Zone. Under the LDCP, 2007 development is restricted to preserve the natural scenic beauty of the area.

In addition to this land Parcel 5, which extends east from the Bradleys Garage to Saddle Point, from Bradleys south to Dry Gut and then east to Porches Gate, is a National Forest, under the Forestry Ordinance (1954 with amendments). The St Helena LDCP includes PBP in the list of potential sites to be scheduled under the National Parks Ordinance; in the meantime the Forestry Ordinance currently provides the legislative framework for its preservation. The proposed NPAs remain unscheduled under the National Parks Ordinance. Areas of overlap between the National Forest need to be excised to coincide with scheduling.

Fisher's Valley has been considered as a possible candidate Ramsar Site (Pienkowski, 2005). This is the first stage towards eventual designation though it does not oblige St Helena to designate. Fisher's Valley is virtually one of the only stream valleys on St Helena to retain wet conditions and green vegetation throughout its length and it probably provides an important drinking and bathing area for the Wirebird and habitat for the indigenous Moorhen.

9.3.2 Rupert's Bay and Rupert's Valley

The bay and the adjacent areas of Rupert's Valley are dominated by the built environment. Further details of the ecological conditions at the sites for the wharf, bulk fuel installation (BFI), site compounds and quarry are given in the appended reports. The lichen survey has noted one location in the upper valley (site 11 on map 2 of the specialist report, see Appendix 9.3) as the richest lichen site in the valley. Currently, quarrying is

proposed in the mid-valley where the vegetation is characterised by prickly pear, black olive, wild mango and samphire.

9.3.4 Rupert's Valley to PBP: Haul and Access Route

With much of the route alignment affecting habitats dominated by non-native vegetation of little ecological interest, the following sections refer to some key areas only.

9.3.4.1 Rupert's Valley – Deadwood Plain

While indigenous species such as samphire and purslane can be found in some areas along this section of the alignment, the introduced exotic species have generally gained dominance to the exclusion of the endemic and indigenous species.

Of note, however, is an area approximately 100 metres (m) north of the existing trig. point on the summit of Rupert's Hill where a small colony of some 30 individual scrubwood remains intact. This location was examined more closely by Ashmole & Ashmole in January 2006 who noted a number of endemic insects associated.

The endemic lichen species *Xanthoparmelia beccae* and the rare but non-endemic *X. wildae* are present along the Pipe Path, Rupert's Hill.

9.3.4.2 Deadwood Plain – Mulberry Gut

Deadwood Plain is predominantly pasture land used for the grazing of cattle. The Plain has in the past supported more than 120 Wirebirds comprising 17% of the total breeding population of St Helena. However, the numbers of birds in the pasture grasslands are highly reliant on sympathetic management of grazing to produce a short, sparse turf in which the birds can feed and breed. McCulloch (2006) recorded a sharp decline at this site (see Table 9.6), apparently related to changes in the nature of the pastures. Derelict fencing, locally undergrazed, tall and rank vegetation with an increased cover of "weed" species (e.g. the unpalatable bull grass, various shrub species) indicated that the rotational grazing needed to maintain short grassland throughout Deadwood had largely ceased. Surveys are ongoing under the RSPB/OTEP project in order to clarify current Wirebird distribution and to identify the management needed to promote species recovery.

9.3.4.3 Mulberry Gut – North west of Bradley's Government Garage

Mulberry Gut and Billberry Field Gut are two northerly orientated valleys separating Deadwood from Longwood Farm pastures, and Longwood Farm from Bottom Woods respectively. The formerly grazed pastures of Longwood Farm have largely fallen into disuse and the former Wirebird population has become concomitantly much depleted. The recent 2005/2006 count recorded only two individuals at this site.

To the east of Mulberry Field Gut is Bottom Woods. This area was formerly arable land and subsequently used as pasture. Formerly an important Wirebird refuge, holding the highest density of Wirebirds in 1988/9, the cessation of grazing has led to invasion by prickly pear, wild coffee and wild currant with few grass species covering less of the ground. As a result, Wirebird numbers declined (see Table 9.6 below). However, the

lower end of the Bottom Woods area has recently been cleared of prickly pear and wild coffee in order to aid in the conservation of the Wirebird. Some success may be indicated by the latest counts for Bottom Woods rising from around 5 to 19 birds (Table 9.6).

9.3.4.4 North west of Bradley's Government Garage – Cook's Bridge

At Cook's Bridge the road alignment crosses Fisher's Valley, one of the few open watercourses in St Helena. Around the bridge the valley is dominated by wild mango scrub and dense stands of thatching grass. Formerly a more open site frequented by Wirebirds and moorhens, the need for clearance to more open habitats has been recognised.

9.3.5 Terrestrial Habitats at the Airport Site

PBP as noted above represents one of St Helena's remaining natural areas which while in part colonised by some alien plant species, remains dominated by indigenous and endemic plant and animal communities. It is therefore treated in some detail in this account.

9.3.5.1 Habitats and Vegetation

Habitats on PBP have been classified (Cronk (1984) as Saline Semi-desert, and Semi-desert, with some lateral areas of prickly pear scrub which is particularly common in the west of PBP and localised patches of Creeper Waste (see Appendix 9.2 report on Baseline Ecology/Vegetation Survey)

PBP comprises a Central Basin surrounded on 3 sides by a raised plateau whilst the remaining side on the north-western edge descends into the deep gulley of Fisher's Valley. The location of the Central Basin is shown on Figure 9.1 in Volume 3 of this ES. The ecological communities found in this area are influenced by wind, temperature and moisture levels but perhaps more significantly by the substrate found in the area. The substrate contains little or no organic material to retain moisture or nutrients and is also highly variable in terms of particle size, consolidation and chemical composition.

Caesar (2001) demonstrated that sodium levels within the PBP area are spatially highly variable with levels of between 300 parts per million (ppm) and 3286 ppm being found in relatively close proximity. Fossil guano deposits from former land-based seabird colonies locally give rise to high phosphate levels in the substrates. Bone remains from birds, including species now extinct, can be found in sedimentary deposits.

The flora found in the area of PBP is dominated by a few species of varying dominance levels and includes a characteristic community of endemic species together with indigenous (i.e. naturally occurring natives but not endemic) and introduced species. Many species are annuals and so are inconspicuous in dry periods. Figures 9.2 and 9.3 identify the various vegetation categories present in the study area.

Eastern Plateau: This, (see Figure 9.2, Volume 3), the site for the proposed runway strip, is a mosaic of gravel and sandy materials of similar appearance to several areas found in the Central Basin, interspersed with disturbed and rocky ground. The disturbed ground appears to be as a result of human activities, mainly ad hoc stone collecting for

construction. This has resulted in extensive disturbance from both the stone collection and the need for vehicles to transport the material from the site. Other areas suffer from the dumping of waste, e.g. metal drums. There are few areas of the Eastern Plateau which have not been adversely affected by human intervention.

Flora on the upper plateau is sparse with bare ground being most prevalent in most areas. Vegetation where present includes the introduced creeper on some of the more rocky areas with native and endemic species such as samphire, babies' toes, saltbush and ice plant also all present to differing degrees with some areas of low-growing prostrate grasses.

Seaward Edge/sea cliffs: The rocky habitats of the seaward edge are notable for the occasional colonies of the endemic plants scrubwood and tea plant, both categorised by the IUCN as vulnerable. Lichens, particularly the foliose species, are often abundant and luxuriant.

Central Basin: This section of PBP is a unique habitat which has developed through a particular set of geological and climatological factors and such conditions are found nowhere else on St Helena (Ashmole & Ashmole, 2004). The Central Basin is fairly level. There are several minor almost indiscernible drainage gullies throughout the Basin and only 2 main ephemeral water channels. These are Bone Gully "draining" into the south-west of the Central Basin and the gullying to the north of the Basin which is a small side gully to Fisher's Valley. The normally dry gullies tend to have an increased amount of vegetation present with the main Basin species of samphire, saltbush and creeper all present in various levels.

The substrate of the Central Basin is a complex mosaic similar to the surrounding raised plateau in that it is highly variable with particle sizes ranging from dust, fine sands and gravel through to fist sized rock and boulders. However, the Basin has a much higher percentage of fine dust than the surrounding areas. Caesar (2001) noted that in the western section of the more than 90% (and in some cases almost 100%) of the substrate sampled passed through a 2 millimetre (mm) soil sieve. It should be noted that there are only a limited number of large boulders present on the surface of the Basin.

The vegetation is sparse over much of the Basin with open and bare substrate and only selected areas having a significant proportion of vegetation. The main vegetation types found in the Central Basin include an extensive area of creeper in the north-west section which may be gaining in coverage, samphire, saltbush and areas where low-growing prostrate grasses (principally the 'probably' indigenous *Eragrostis cilianensis*) are dominant. Samphire in particular acts as an accretion agent with small raised dunes forming around the plant while old stems of samphire support a species of yellow lichen.

Lateral areas of the Central Basin include the area termed the Southern Plateau which comprises a diverse range of desert and semi-desert habitat types. These include a saddle shaped area to the west of the site of the proposed airport terminal with a higher cover of plants comprising an attractive mosaic of samphire, ice plant, babies' toes and *Eragrostis*. Adjacent areas of stabilized bare sand and soil crusts are often covered by lichens. Creeper is often also present. A similar area is present on a plateau to the north of the Central Basin between Fisher's Valley and the northern end of the proposed runway. The endemic plover, the Wirebird, often favours these areas with a better cover

of vegetation which probably support a greater density of invertebrate prey. Small rocky outcrops add to the habitat diversity in these lateral areas and these are usually covered with a diverse community of lichens with 6 or 7 species present in very small areas (e.g. within a 20 centimetre (cm) square). The western extent of the Southern Plateau forms the catchment for Bone Gully.

Dry Gut: This gorge is deeply cut with a central section very enclosed with vertical sides. Anecdotal evidence suggests that the river only flows infrequently and only after prolonged wet weather. During the October/November field work the channel was dry. The valley walls are sparsely vegetated with extensive areas of friable material and base rock. The rocks and cliffs have extensive lichen communities which differ in species composition according to aspect. Flora found in Dry Gut includes the endemic bone seed, samphire, saltbush, pagoda plant, wild tobacco and occasional wild coffee. The shaded sheltered rocks at the base of the gut provide damp conditions for cyanobacteria growth.

The semi-desert habitats of PBP provide the main area of lichen interest in St Helena. Lichens are present in most places; they are often abundant or form the dominant plants within vegetation communities. Many lichen species are endemic to St Helena. Within the PBP area three main lichen vegetation types can be distinguished:

- soil crusts
- boulder fields
- vertical cliffs

The vegetation of the vertical cliffs is the richest in abundance, but not necessary in diversity. The boulder fields are the richest in diversity, as there are soft sandy patches between with soil crusts. The soil crusts occur also alone, on some of the sandy desert areas, often with a low diversity.

Additional habitats with a few extra or characteristic species are:

- overhanging cliffs
- ledges with run-off along gullies
- shrubs

The key endemic species present on PBP are considered below. Full details are available in the specialist report Lichens on St Helena, Aptroot 2007 (see Appendix 9.3).

Dermatiscum pusillum Aptroot sp. nov. ined. is only the third species in this genus, which is only known from Africa. It occurs on boulders and rock outcrops on PBP, but also elsewhere on St Helena (e.g. the Barn, Gregory's Battery).

Dimelaena triseptata Aptroot sp. nov. ined. occurs on dusty plains and boulder fields on PBP and on the track of the proposed airport access road, but also elsewhere on St Helena (e.g. the Barn, Little and Great Stone Top).

Xanthoparmelia beccae Aptroot sp. nov. ined. is new to science, a very unusual coralloid species that grows in dusty areas, where it can be the only species present. It also occurs in boulder fields areas intermixed with a rich lichen flora.

Ramalina species were found to be rather common on lava in the semi-desert and elsewhere on St Helena. Following detailed study it appears that four undescribed endemic species are present. The following taxa have been recognised:

- *Ramalina geniculatella Aptroot sp. nov. ined*. on boulders and cliffs in the PBP and almost everywhere elsewhere on the island
- *Ramalina ketner-oostrae Aptroot sp. nov. ined*. occurring only on cliffs in the PBP and elsewhere on the island.
- *Ramalina rigidella Aptroot sp. nov. ined*. occurring on boulders and cliffs and:
- *Ramalina sanctae-helenae Aptroot sp. nov. ined*, found from all over the semi-desert area and cliffs.

Lichen communities on PBP comprise the above endemic species plus a range of non-endemics such as *Lecanora personata, Lecanora sanctae-helenae, Lecidea approximans* and *Lecidea lactescens*. Generally, these species and communities are well distributed and often abundant and none are limited to the areas under proposed construction.

Full details of the lichen survey and its findings are given in Appendix 9.3.

9.3.5.2 Invertebrates

Extensive surveys for the presence of invertebrates have been carried out on PBP and immediate environs by a Belgian expedition during the 1960s and more recently by Ashmole & Ashmole (2000, 2004, 2006) who found *"an extraordinary concentration of endemic invertebrates on PBP, ... this area is the main evolutionary centre on St Helena for animals adapted to arid habitats"*. Of the 51 endemic invertebrates present in the Eastern Arid Area (EAA) (PBP and immediately adjacent areas), 35-40 occur in PBP and of these, at least 20 are considered to be endemic to the Plain itself. Ashmole & Ashmole (2004) consider that the results of their survey of 22 sample points in the EAA between September and December 2003 may have resulted in the finding of 10 species new to science (see Figure 9.4 in Appendix 3 of this ES).

PBP contains a surprising diversity of habitats influenced by substrate, wind, temperature, moisture level, and flora. Invertebrates may be directly associated with certain plant species, e.g. samphire, or rely on fine substrates for burrowing, e.g. some wolf spiders, certain beetles and sand wasps. The nature of the surface deposits, presumably particle size, appears to determine which of the burrowing species are dominant in different parts of the Basin.

Spiders are one of the most significant animal groups occurring on PBP, wolf spiders in particular which are mainly nocturnal burrow-dwellers largely restricted in their distribution to dusty or gritty substrates found in the Central Basin. The habitat within the Central Basin, comprising generally very fine grit, sand and dust substrates, is replicated nowhere else on St Helena.

Sample points from the fine dust substrates from the Central Basin have recorded the following endemic invertebrates.

Table 9.4 Endemic Invertebrates of fine sand and dust substances

Species	**Group**	**Habitat Notes**
Hogna nefasta	Wolf spider	Nocturnal burrowing species
Trochosippa (?) sp.	Wolf spider	Nocturnal burrowing species

Species	**Group**	**Habitat Notes**
Brevilabus (?) sp. (2 species)	Wolf spider	Nocturnal burrowing species
Lycorma (?) sp.	Wolf spider	Nocturnal burrowing species
Pellenes inexcultus	Jumping spider	Under rock refuges during the day, hunts at night
Sphallowithius excelsus	Pseudo-scorpion	Appears limited to fine dust substrates
Nysius sanctaehelenae	Bug	Feeds on desert plants
Psilopa sp	Fly	Associated with babies toes
Anthicodes fragilis	Flower beetle	Flightless, refuge under small stones

Seven sample sites were located within the area to be directly affected by the proposed construction of the airport and essential support facilities (2 (& 20 this was not a full site and species records included with site 2), 3, 4, 6, 7, 17 & 21), an additional three sites are in areas immediately adjacent and likely to be affected (12 and 22, site 5 will be affected by the proposed contractor's camp and temporary runway). The remaining sites within the Central Basin (1, 8, 15 & 14) are likely to be indirectly affected by the lowering of the Eastern Plateau. Table 9.5 shows the endemic species recorded from these sites (see Figure 9.4, Volume 3) for the locations of the sampling sites).

Table 9.5 Endemic invertebrates of conservation concern at sites to be lost and impacted by the construction (Ashmole & Ashmole 2004)

Species **** endemic genus** **@ confined to EAA**	**Group**	**Survey site (2003)**	**Habitat Notes**
Nesopupa turtoni	Snails (whorl snails)	13	Previously known only from fossils. Found in sheltered steep barren ravine below signal station, potential habitat of similar nature may be impacted by construction activities on seaward cliff edges
*@**Sphallowithius excelsus*	Pseudoscorpions	8 & 22	Only known from PBP in the deep fine dust and gritty, samphire dominated areas of the central basin.
*@**Hemisolinus helenae*	Pseudoscorpions	None	Only known from PBP but not found in 2003, highly restricted distribution or seasonal unavailability
*@**Benoitodes caheni*	Spiders (Gnaphosidae)	None	Previously recorded but not found in 2003, either extinct or much reduced in numbers on PBP
?@Brevilabus(?) elysae Brevilabus ringens	Wolf Spiders (Lycosidae)	4, 8, 11, 24	Dust and gritty areas, under pieces of debris
@Hogna nefasta (prowling wolf spider)	Wolf Spiders (Lycosidae)	4, 22, 24, 8, 5, 11 & 10	Only known from EAA, dominant invertebrate predator of Central Basin requiring unvegetated dust and gritty habitats
@Lycorma sp (St Helena mole spider)	Wolf Spider (Lycosidae)	4, 22, Bencoolen View (2006) & Government Garage ROL[1]	Dust and fine gritty areas largely restricted to the Central Basin & Southern Plateau.

[1] Appendix 9.2 Ecology baseline and vegetation survey

Species **** endemic genus** **@ confined to EAA**	**Group**	**Survey site (2003)**	**Habitat Notes**
@Trochosippa (?) sp. (Lurking wolf spider)	Wolf Spider (Lycosidae	8, 20, 22, 24	Only found in central basin within fine dust and gritty substrates with some of strongest colonies close to the eastern end of Central Basin
*@**Bonapruncinia sanctaehelenae*	Spider (Thomisidae)	None	Previously found in the south of PBP at c. 260m, rocky gravel slopes of Dry Gut, possibly near Gill Waterfall.
@Labidura herculaeana	Earwig	None	Previously recorded from HPP by Belgians, remains of dead specimen found in 1995 near site 4.
***Anthicodes fragilis*	Beetle	1,2,5,8,11,15,17, 22,23,24	Open stony areas, under small stones, threatened by spread of alien plants, particularly creeper
*@**Homoeodera scolytoides*	Beetle	17	Single specimen found in 2003. Stony areas
***Aplothorax burchelli*	Beetle (Carabidae)	None	Last stronghold on HPP but not found in recent years and may already be extinct
*****Mellissius adumbratus***	Beetle	5, 8, 10, 17, 22, 34	May be restricted to HPP and PBP, with localised distribution in PBP, abundant at site 22 in gritty friable substrate good for burrowing. May be subject to intensive predation by mice and in decline
*@**Mellissius oryctoides*	Beetle	10, Bencoolen View (2006)	Rocky bluffs and gritty areas. May be restricted to HPP and PBP, may be subject to intensive predation by mice and in decline
*@**Helenomelas basilewski*	Beetle	None in 2003 or 2006	Precise location unknown – very local occurrence, seasonal unavailability or species may be facing or have become extinct due to environmental change by predation and competition of introduced species
?@ Psilopa sp.	Fly (Ephydridae)	4, 5, 20	Associated with Babies' toes
*@**Atlantomyia nitida*	Fly (Tachinidae)	12	Not collected in 2003, two specimens found March, 2004, may well have wider distribution but of considerable conservation importance

The overall results of the invertebrate survey of PBP and the Prosperous Bay area, together with a nature conservation evaluation, and suggestions for mitigation are given in Ashmole & Ashmole 2004 and their update report of 2006.

9.3.5.3 Birds

PBP is notable for its breeding population of endemic Wirebird, here nesting in its presumed ancestral habitat. Breeding success appears to be best in the relatively level areas of low, mixed and sparse, semi-desert vegetation and the species tends to avoid dense carpets of creeper and areas of prickly-pear scrub. Population counts on PBP have varied between 25-43 individuals (McCulloch 2001). The Plain, on average, supports around 10% of the Island's total population which, for the 2001 census, was estimated to

be around 350 birds. However, the next census (McCulloch 2006) showed a steep decline in numbers (see Table 9.6)

Figure 9.6, Volume 3 identifies the 9 Wirebird territories identified on PBP during the 2005/2006 survey undertaken by McCulloch. Somewhat later in the same breeding season, work by Prater and Ellick under an OTEP funded project, recording an additional 9 breeding territories in PBP including the area around the proposed airport (see Figure 9.6, Volume 3). These results indicate that the position of territories within areas of suitable habitat is both flexible and numbers will vary with time over the breeding season.

Elsewhere on the island, the Wirebird inhabits pasture grasslands in a number of key areas, e.g. Deadwood, where, as long as the grassland is maintained as a short turf, breeding densities are normally higher than in the arid conditions of PBP, reflecting a higher population of invertebrate prey. However, since the 2001 survey, the condition of the pastures in these areas has declined with the invasion of coarse rushes and scrub species thus reducing the overall area of habitat available to breeding Wirebirds. Counts for Wirebird in the key areas under impact from the airport and for the whole island are given in Table 9.6.

Table 9.6 Wirebird Counts

Site	1988/9	2000/01	2005/06	2006	2006/7
Deadwood Plain	124	92	35	35	44
Bottom Woods	44	12	5	5	19
Prosperous Bay North	14	9	2	7	4
Upper Prosperous Bay	20	39	22	19	32
PBP	19	19	15	31	18
Island Totals	425	362	208	Key sites only	322

At Gill Point to the south-east of the proposed airport, there is occasional nesting by fairy terns, black noddies and Madeiran storm petrels. However, these species can fall prey to feral cats which may be a factor in the decline of the sooty tern colony at the Point. Fairy terns, nesting typically on relatively inaccessible ledges are more successful and over 100 pairs breed in the area, particularly on the precipitous walls of Prosperous Bay Valley.

Two offshore stacks offer protection to breeding birds from land-based predators. Shore Island lies around 100 m to the south of Gill Point and at around 70 m is the higher of the two stacks. George Island lies a further 600 m to the south-east and is around 35 m at its highest. Counts of breeding seabirds are undertaken annually by the ANRD. A summary of recent data is shown in the Table 9.7.

Table 9.7 Peak Numbers (breeding pairs) of seabirds on Shore and George Island

	Shore Island				George Island		
Species	**2004**	**2005**	**2006**	**2007**	**2004**	**2005**	**2006**
Masked Booby	25	42	33	22	0	13	6
Brown Booby	4	4	3	2	0	1	1

	Shore Island				George Island		
Black Noddy	258	300	279	355	20	89	36
Brown Noddy	69	126	115	187	38	70	22
Sooty tern	1	8	16	1	10	5	8
Red-billed tropicbird	1	0	1	1	0	0	0
Fairy term	0	1	0	1	0	0	0
Madeiran storm petrel	0	1*	0	0	0	0	0

9.3.6 Water Supply

9.3.6.1 Water pipeline route

Observations were made of vegetation and habitat during a walk-over reconnaissance survey of the raw water pipeline. Three possible routes (A, B & C) across Dry Gut were identified on the field visit. An area approximately 50 m each side of the proposed pipeline was surveyed along the whole length for all three possible routes.

The proposed routes traverse a variety of substrate and habitat types. The ascent from Sharks Valley is across lichen rich weathered basalt outcrops and boulders. Aloe, saltbush and Acacia mearnsii are present in the area below the crest of the hill (break tank) spreading down from former terraced plantings for erosion control towards the more heavily eroded badlands. Creeper and soil crust lichens, including *Xanthoparmelia beccae* and *X. subramigera*, are dominant across the sparsely vegetated eroded open spur of weathered basalt and residual clay soils which descends into Dry Gut. Samphire and babies toes are dominant and frequent in the fine clayey alluvium and flood plain terraces of the ephemeral watercourse. Creeper increasingly dominates the steep scarp slope, of highly weathered basalt at base to slightly weathered rocky outcrops with gravely soil, as it ascends from Dry Gut to the southern plateau of PBP (see Appendix 9.2, Volume 4 for further detail).

9.3.6.2 Water Abstraction (Sources)

A preliminary survey of the vegetation and habitats was made of Sharks Valley from below Hancock's Hole to the sea.

Sharks Valley is a steep sided deeply incised valley with interlocking spurs. The valley sides are made up of several larva layers with spectacular columnar jointing. The stream snakes along the valley bottom along a narrow (not wider than 1 m in most places) water course. The watercourse and flood plain terraces provide moisture for a variety of plants which creates a green 'oasis' along the length of the valley, surrounded by dry rocky sparingly vegetated margins which rise steeply away from the base of the river bed. There are several small waterfalls along the length.

The vegetation of the valley is dominated by the introduced wild mango which is spreading across dry areas and has formed dense thickets in many of the islands gullies and valley bottoms. It is invasive and if left unchecked is very likely to continue to spread

through the valley, pushing out other species. Most of the vegetation in the valley comprises introduced species. Also present are the possibly indigenous *Scirpus prolifer, Polypogon monspeliensis*, and pagoda plant. Wild celery is an early introduction which has reverted and grows wild. It is probably more abundant in Sharks Valley than any other. The Valley is a popular walking destination.

Mitigation has been developed through the design and incorporated into the technical specification which the Contractor would follow. Mitigation measures have also been developed for the construction and operation of the proposed scheme and these are set out in the EMP in Volume 5 of this ES.

9.3.7 Ancillary Components

A preliminary examination has been made of some of the proposed locations for the aircraft navigational aids and the remote obstacle lights (ROLs). It is not thought that the locations proposed at present for the ROLs, which are small structures, would pose any particular ecological impacts though further survey of these areas, together with an assessment of likely access routes for construction and maintenance will be undertaken during the detailed design phase. The lichen study noted that Great Stone Top (site for ROL) is the only location in St Helena for several non-endemic species which also occur on the top and nearby sea cliffs.

9.3.8 Other Ecological Issues: Introduced Animals

St Helena has no indigenous terrestrial mammals but many introductions and feral animals have colonised most habitats throughout the island. Feral dogs, once frequent on St Helena, are now considered to be less frequent and previous unchecked grazing by domestic animals such as goats and donkeys is also now rare. House mice continue to be ubiquitous, having adverse ecological effects by grazing on endemic plants and invertebrates. Rabbits occur almost everywhere on the island. Grazing notably occurs on babies toes, purslane and is suspected of seriously affecting the regeneration of endemic species, including salad plant (Ashmole & Ashmole 2000).

9.4 NATURE CONSERVATION EVALUATION

9.4.1 Rupert's Bay to Prosperous Bay Plain – Haul/Access Road Route

Given the vulnerability of the endemic Wirebird population, habitats supporting this species on St Helena would rank as of high to very high importance, depending on the number of breeding pairs supported, even though the floristic composition of these sites is usually dominated by introduced species. Deadwood Plain is one of these key sites though now has a much reduced population (McCulloch, 2006). Nevertheless, given present numbers and the potential of the site for habitat restoration and conservation measures for the Wirebird, it would therefore be considered as an internationally important area for the Wirebird. Bottom Woods represents another key site for Wirebird where the commencement of restoration of former pastures has resulted in increasing numbers of breeding Wirebird.

Habitats elsewhere along the haul/access road route are dominated by non-native and introduced species and are of low importance in the St Helena context. One small colony

of the endemic scrubwood was found on Rupert's Hill, however, and while the surrounding habitat is no longer representative of the vegetation type that this species once dominated, the colony would be accorded a high conservation importance given the current scarcity of the species on the island and that despite their small size, isolated populations, including this colony, are known to provide habitat for endemic invertebrates. Its discovery emphasises the importance of detailed surveys and appropriate mitigation where needed for the haul/access routes.

9.4.2 Prosperous Bay Plain

Based on the approach to ecological assessment outlined in TAG, the importance of the habitats supporting endemic species would be considered as very high as these are of international significance for biodiversity. On this evaluation, PBP would be considered as of international importance for its endemic species, the higher plants, lichens, insects and the Wirebird population. The Plain contains semi-desert habitats, in particular the desert deposits of the Central Basin comprising dusts, fine sands and grit, which are not replicated elsewhere in St Helena and which provide the key habitats required by some of the endemic burrowing invertebrates.

PBP probably represents the habitat that forged the evolutionary traits of the Wirebird on St Helena to make it the distinct species seen today. Ashmole & Ashmole (2004) consider the area to be a rare example of a mature semi-desert on an isolated oceanic island which probably represents the most intact of the habitats on St Helena.

Its importance is reflected in the proposal for designation of the PBP National Protected Area (NPA) in the LDCP. The Plan takes account of the potential requirement for the construction of the airport within the proposed NPA. From the work undertaken for this EIA, it is evident that the proposed PBP NPA represents a minimum area to encompass the biodiversity present (see below).

PBP terminates to the north and east at the seaward rocky cliff edge. These habitats are also of very high to high conservation importance for their populations of endemic scrubwood and tea plant, species which have a much localised distribution, often with small populations, on St Helena on the less accessible coastal cliffs of the east and south coast. The lichen flora of both the rocky seaward habitats and the other habitats of PBP is of note for its diversity and endemism, and, in the sandy semi-desert habitats, for their ecological function in stabilising surface deposits. The invertebrate fauna may also be of significance with the potentially very rare snail, *Nesopupa turtoni*, being located in this habitat area along the seaward edge.

Fisher's Valley represents a unique wetland habitat on St Helena, described as *"an oasis like river valley through desert"* (Pienkowski, 2005) and thus should be considered as of high importance for this and for its use by Wirebirds which have bred in small numbers in the linear grazed grassland. Wirebirds and their young may also derive some benefit from the damp conditions and shallow pools that can form near Cooks Bridge. Moorhen is also present, a species thought to have naturally established being first recorded in 1670. The valley has been considered as a possible candidate Ramsar site, wetland of international importance, especially for bird populations.

Based on the nature conservation evaluation, a constraints map is provided (see Figure 9.1, Volume 3) to show areas that would be protected around the airport development, including the reserve area of the Central Basin of PBP described by Ashmole and Ashmole (2004) to be of key importance for endemic invertebrates. The proposed protected areas are based on the following criteria:

- Presence of endemic invertebrates and their characteristic substrate and habitat conditions.
- Presence of good populations of endemic and indigenous higher plants and lichens typical of desert and semi-desert communities of the Eastern Arid Area and PBP;
- Habitats of importance for breeding or foraging Wirebirds; and
- Landscape quality.

The protected area of the Central Basin as depicted in the Atkins feasibility study (Ecological Sites, Drawing No. 5035914/C/202) which is based on the area considered by Ashmole & Ashmole (2004) to be a key area for endemic invertebrates has been extended on the above criteria to include a longer extension up Bone Gully described by P & M Ashmole *as "a rich and unique site requiring protection as part of the Central Basin"*.

Also included for protection is the area of flat land to the north of the Basin, between the edge of the proposed runway and the sharp descent into the gorge of Fisher's Valley, and a saddle shaped area of land to the west of the proposed site for the airport building, (land now subject to the temporary runway option) between the Basin and Dry Gut. Adjustments may be made to the boundaries of these protected areas on the basis of continuing survey and assessment work concomitant with detailed design by the appointed Contractor.

9.5 CONSTRUCTION EFFECTS

The following section assesses the potential impacts that may arise from the construction of the proposed airport and supporting infrastructure. The principal impacts are categorised and considered as follows:

- Temporary land-take for the construction programme, e.g. Contractor's compounds and lay-down areas for the storage of materials and plant or any other temporary construction sites e.g. any temporary runway. This includes consideration of the following:
  - The need to carry out extensive excavations for runway construction with lowering of the landform of the Eastern Plateau potentially leading to changes in wind-based erosion and accretion patterns in the adjacent desert and semi-desert habitats of the Central Basin;
  - Levelling and grading of any temporary runway and construction compound on the Southern Plateau if this option is pursued, and,
  - The likelihood of successful restoration of former habitat conditions to these levelled and graded areas.
- Specific construction impacts arising from dust, noise, and visual disturbance by humans and machinery within and adjacent to works areas, including along haul and access routes, disturbance from operational aircraft and traffic.
- Loss of marine benthic (seabed) habitats to wharf construction*.

* Implications for the marine environment are considered in the Chapter 14, Volume 2 and Appendix 14, Volume 4.

Mitigation to reduce the potential impacts is described in section 9.7.

9.5.1 Rupert's Bay - Temporary and Permanent Wharf

This is addressed in the Marine Environment - Chapter 14 and Appendix 14 of this ES. To summarise, the ecological impacts of the temporary and permanent wharf works is not considered significant.

9.5.2 Rupert's Valley

9.5.2.1 Construction Compounds

Ecological impacts of the intended construction compounds are not considered significant although there are implications for landscape and human amenity which are considered elsewhere in the ES.

9.5.2.2 Bulk Fuel Installations

Impacts on this site are discussed in section 9.6.2.1 Operational/Permanent Effects.

9.5.2.3 The quarry

Impacts to the higher plant flora at the quarry sites in Rupert's Valley are not significant. The exact location of the quarry site was not known at the time of the lichen study. The locality investigated (locality 11 on map 2 of the Lichen Report enclosed in Appendix 9.3) in the upper valley stands out as the richest lichen site in the valley. One of the sites for the quarry is lower down in the valley (the mid-valley site) and the advised mitigation in the lichen report requiring removal and translocation of lichen covered rocks and boulders would therefore not be required at this location.

9.5.3 Rupert's Bay to Prosperous Bay Plain

9.5.3.1 The Haul/Access Road

The ecological impacts of construction are considered similar to the permanent impacts of the road such that there is little value in making a distinction between the two. However, attention would be paid to the need for mitigating the potential effects of fugitive dust emissions in the region of sensitive receptors such as stands of endemic plants and the Millennium Forest. The control of dust arisings is discussed in Air Quality and Dust in Chapter 7, Volume 2 and Appendix 7, Volume 4 of this ES.

9.5.4 PBP

9.5.4.1 Airfield

While many of the construction impacts are regarded as temporary in nature, there are in some cases, a risk of longer lasting effects. The timescales of impact is a function of the magnitude of temporary impact and the nature of the works undertaken. The main source of impact is dust and noise and mitigation is discussed in section 9.7 below.

9.5.5 Water Supply

9.5.5.1 Water Abstraction and Construction Use

Quantities of water demand for potable supplies and for construction, in particular, the requirement for compaction of the embankment across Dry Gut will be confirmed by the Contractor. With limited water supplies in the Eastern Arid Area, there is the potential for significant temporary impacts on springline supplies, e.g. at Sharks Valley. Proposals for water abstraction in the valley is for abstraction of a maximum of 40 cubic metres per day (m^3/day) at point A1/A2 for operational supply over which there is little environmental concern. Where abstraction is for construction, however, there is a risk of severely depleting the supply. It is therefore proposed that water is abstracted up to a level so as to leave a residual flow in the valley. There remains an option to further abstract from below the Sharks Valley waterfall, or to use sea water abstracted from Gill Point for compaction of fill.

The waterfall above the beach is the only location along Sharks Valley that is capable of meeting the demand of airport construction, according to the PWSD data which is described in more detail in Chapter 15: Surface Water, Volume 2 of this ES. At present it is not known what invertebrate communities depend on the water source but it is considered unlikely that any are dependent on the stream flow from the waterfall to the beach alone. Nevertheless, it remains possible that communities of rare or endemic invertebrates could be affected. Mitigation and surveys/monitoring is also discussed in Chapter 15, Volume 2 and in detail in Appendix 15.1, Volume 4 of this ES.

Options for the use of sea water for at least the core of the Dry Gut embankment are being considered. This will give rise to the potential for the leaching over time of saline waters which could affect downstream conditions in Dry Gut. This is not considered at present to have significant ecological implications. However, any lateral and upward migration of salts to the surface layers of Dry Gut could severely compromise attempts to re-establish semi-desert conditions on the terraced slopes of the Dry Gut embankment for desert invertebrates and plants of the arid zone. Use of salt (marine) water could be envisaged for the deeper, core layers of the RESA embankment in Dry Gut but at depths to preclude any upward or lateral migration of salts onto re-instated desert surfaces. Clear criteria for the Contractor to follow in the event that it is proposed to use sea water in the core of the embankment are provided in the EMP in Volume 5 of this ES and in Surface Water - Appendix 15.1, Volume 4 of this ES.

9.5.5.2 Water Use for Earthworks Compaction and Dust Control

Salt water or other agents for earthworks compaction or dust control will not be used in areas to be re-instated so as to support natural ecological communities as their use is likely to render conditions unsuitable for plant and animal re-colonisation. If necessary these areas will be treated using fresh water only.

9.5.5.3 Water Pipeline

From the preliminary survey the installation of a water pipeline is expected to have potential impacts at certain localities only, e.g. at some sensitive bryophyte and lichen sites and where trenching across Dry Gut will be necessary. Here desert communities of

endemic plants growing on the stream terraces will be affected. It is also a potentially interesting site for invertebrates because of its fine dust and sandy substrates. Mitigation will adopt avoidance where possible; translocations of lichens if needed and at Dry Gut, the pipeline will need to be laid at a depth below the level of erosion with restoration of the desert soils and endemic plants after the works. The route from the slope above Dry Gut to Creeper Hill passes through sensitive areas of the southern plateau which provides habitat for Wirebirds, invertebrates and endemic plants. The raw water tanks on Creeper Hill will be highly visible and adds to the built structures in PBP which could provide shelter for predators.

9.5.5.4 Temporary Reservoir

Proposals to dam Dry Gut temporarily to provide a reservoir for construction could affect communities of endemic plants and potentially invertebrates on the upstream terraces. Rehabilitation of landform using the original natural substrate post use may be required depending upon the detailed design. The original overlying material will be used which would be stripped, stored and reapplied to the re-graded surfaces where appropriate. Affected plants may need to be removed to appropriate receptor sites or seed collected and restored to the terraces following construction.

9.5.6 Noise Impacts on Wildlife

Noise disturbance to wildlife and birds in particular has been the subject of increasing research (see reviews by Larkin 1996, Radle, 1998, Brown & Raghu 1998) and there are many studies describing behavioural responses, e.g. fright and flight, which can lead to significant weight loss (Ward 2001) and physiological reactions (i.e. stress, Berglund & Lindvall 1990) to noise disturbance, although the significance of these reactions is often not clear. However, difficulties are commonly experienced in drawing general conclusions from field studies given the complexity of, and variation in, noise emission characteristics, the considerable variation in species-specific responses, and with separating the observed effects of noise and related visual stimuli. There is, in addition to species-specific variation, seasonal and contextual variation in responses to disturbing stimuli, e.g. differing responses may be apparent during the breeding season, or equivalent noise stimuli may be more alarming to wildlife from ground sources than from airborne sources (Delany *et al.*, 1999). Finally, while some evidence is beginning to emerge for deleterious effects on reproductive fitness and therefore recruitment to the affected population (Fleming et al., 2001, Hunsaker 2001), this key factor can be difficult to demonstrate even where there are clear behavioural and physiological reactions to noise disturbance (Delany *et al.*, 2000). Such adverse results of noise pollution have been inferred from studies that have demonstrated reductions in species diversity or population densities of bird populations adjacent to motorways (Foppen & Reijnen 1994, Reijnen *et al.*, 1995a, 1995b, 1995c, 1996, 1997, Forman & Deblinger 2000), or by anthropogenic urban and industrial noise sources in general (Fenandez-Juricic 2001, Stone 2002).

In the open habitats of PBP noise disturbance may often be accompanied by visual stimuli arising from the movement and operation of construction machinery and traffic. The Wirebird is the most relevant and potentially sensitive receptor of such disturbance. Noise emissions will be of varying intensities and durations, and probably unpredictable in pattern (although the effect of the predictability of noise events on the reactions of birds is unclear). An established reaction to noise stimuli in humans and animals is habituation

(i.e. get used to the noise), but it is not possible to predict if the bird populations will, or to what degree and at what rate they might habituate to noise stimuli. Consequently, the worst case is that birds may fail to habituate or will habituate to a lesser degree more slowly, to such variable stimuli. Any recourse to blasting for rock removal may result in high levels of noise which will probably significantly add to the degree and range of, disturbance.

From the research findings available, and given the current distribution of breeding territories, it would be cautiously prudent to adopt the precautionary principle and conclude that where construction noise levels exceed the existing ambient noise levels the breeding population of PBP may suffer significant disturbance during the construction phase. This may reduce recruitment to the population leading to a proportional decline in the overall numbers in St Helena, an effect which may extend beyond the construction period, until such a time as successful breeding can recommence at PBP leading to net recruitment.

With the auditory response characteristics of the avian ear broadly similar to that of humans, a noise assessment based on the dB(A) weighting is an appropriate measure of intensity for birds and hence the normal approach to minimising noise exposure to humans can also mitigate for noise effects on birds. This provides a robust worst-case approach, as noise limits are typically based on emotional response of humans, i.e. annoyance, rather than actual physiological injury.

Mitigation measures are discussed in section 9.7 below.

9.6 PERMANENT AND OPERATIONAL EFFECTS

The following section assesses the potential impacts that may arise from the use of the proposed airport and supporting infrastructure. Although the majority of effects on ecology and nature conservation such as, land take from important and sensitive habitats, would occur during the construction works they are considered to be effects of a permanent nature and are therefore discussed in this section. The principal impacts are categorised and considered as follows:

- Permanent habitat loss to land-take for the airport construction site, the haul roads, water pipeline, navigational aids, remote obstacle lighting and their means of access (excluding land temporarily taken for construction).
- Loss of marine benthic (seabed) habitats to wharf construction*.
- Operational disturbance and pollution of designated areas or habitats with high ecological value, both in the marine* and terrestrial domains.

* Implications for the marine environment are considered in Chapter 14, Volume 2 and Appendix 14, Volume 4.

- Mitigation measures have been applied during the phase of preliminary design and have followed the recognised hierarchy of:
- Avoidance: – Through identifying potential impacts during the design process and through close co-operation with the design team, potential impacts may be designed out of the project. This can include changes to working practice, adoption of strict protocols and working practices, as well as changes to design and the routing of haul or access roads. Protected areas can be declared in which no construction or other damaging activity will be permitted and the locations of particular sensitive species can be located and protected on the ground (see Figure 9.1 for ecological constraints on PBP).
- Amelioration/Reduction: – The restoration of habitats to original condition through reinstatement of disturbed ground, restoration of soil profiles, reforming of landscape and micro-topographic features, removal of invasive or alien species and establishment of natives and endemics.
- Compensation: – The loss of habitat is compensated for by often off-site provision or reinstatement of a similar habitat type or habitats with a similar function. To compensate for potential risks of failure to create or manage appropriate habitats, compensation areas would exceed in area that which is being lost, or placed at risk of loss, to the development.

9.6.1 Rupert's Bay

9.6.1.1 Permanent Wharf

Chapter 14, Volume 2 reports the findings of the assessment of impacts on the marine environment. To summarise, ecological impacts of the permanent wharf are not considered significant.

9.6.2 Rupert's Valley

9.6.2.1 Bulk Fuel Installations

Impacts on the endemic flora and fauna are not considered to be significant and no further studies are deemed necessary at this time. Removal and translocation of notable lichen covered rocks and boulders and avoidance of rocky outcrops would be beneficial in supporting enhancements post construction.

The assessment of ecological impact for this section of Rupert's Valley is considered to be Neutral to Minor Beneficial in view of the opportunities for new habitat plantings. Proposals for enhancement with respect to new plantings are given in the Landscape chapter of the ES.

9.6.3 Rupert's Bay to Prosperous Bay Plain

9.6.3.1 The Haul/Access Road

From the preliminary ecological surveys undertaken so far, land take for construction of the haul/access road option originating from Rupert's Bay is not expected to have a significant adverse impact upon endemic or indigenous flora with two potential exceptions.

One finding of a population of the endemic scrubwood has been made in the vicinity of the Rupert's – Deadwood haul road and it is possible that other small populations of valued plant species may potentially be affected elsewhere. The endemic lichen species *Xanthoparmelia beccae* and the rare but non-endemic *X. wildeae* are present along the Pipe Path, Rupert's Hill and vulnerable to disturbance from the haul/access road.

Mitigation by route alignment will be adopted in these locations to avoid the main centres of botanical interest. Residual impacts on lichen communities may be mitigated by carefully transferring the affected substrate, complete with the lichen tissue, to an adjacent receptor site carefully chosen to replicate the appropriate microclimatic conditions.

Earlier proposals for the haul/access road from Rupert's Bay indicated a route traversing Deadwood which could have affected around 6 Wirebird territories. Accordingly, a re-designed alignment places the road along a westerly route following the edge of Deadwood Plain so avoiding severance of the Deadwood pastures and reducing the impact on Wirebird territories.

With similar implications for the Wirebird population at Bottom Woods as for Deadwood, the envisaged route passes to the south of the main block of pasture though some severance of habitat will occur. Overall, construction of the access route is likely to impinge upon 5-6 territories with the potential to disturb another 3-6.

Seasonal working would therefore be considered to avoid disturbance during the breeding season in the key areas such as at Deadwood Plain and Bottom Woods. Mitigation for the loss of Wirebird territories to the airport project is considered in more detail below.

The environmental implications of a future permanent fuel pipeline are likely to be similar to those of the haul roads. Construction would involve some disturbance but it is likely that in the more sensitive locations, the pipe, around 15 cm diameter, could be laid in a small trench along the edge of the access road. Disturbed ground from the earthworks will be appropriately reinstated.

Details of re-enforcement planting, including the establishment of endemic species along the access road corridor is given in the Landscape and Visual Impact - Chapter 10, Volume 2.

The assessment of ecological impact following successful mitigation particularly with respect to Wirebird conservation (see below) is considered to be Neutral and where endemic plant species can successfully be established and managed over the long term

in areas along the access routes that are currently dominated by alien species, the resulting gains may be Minor to Moderate Beneficial.

Operational impacts of the access road is not expected to be significant given the apparent capacity of the Wirebird to habituate to passing traffic and any minor local effects would be adequately compensated for by the proposed mitigation for this species (see below).

Operational use of the roads could have a minor disturbance effect on nesting Wirebird but as noted above, the species appears to tolerate passing traffic. After mitigation, operational use of the roads is not expected to be significant.

9.6.4 PBP

9.6.4.1 Airfield

Land-take for Construction

The direct habitat loss in PBP along the Eastern Plateau and within Dry Gut to land-take for the airport, its runway and the related areas of cut and fill is estimated to be around 170 hectares (ha) excluding the areas of the haul/access road (Atkins 2004). Of the key area of the Central Basin, defined in Ashmole & Ashmole (2004), some 15% of the area will be lost to construction. The areas of cut extend to the seaward cliff edges where populations of the endemic scrubwood and tea plant are present. Beyond the lateral safety strip to the east of the runway some prominent landforms may need to be truncated by the need to achieve the 1:7 slope of the safety “transitional surface”.

Land on the Southern Plateau, comprising an area of diverse semi-desert habitat types, would be adversely affected by levelling and grading for any possible temporary runway and Contractor’s compound (see Figure 2.1 in Volume 3 which shows the location of the possible temporary runway).. This could affect another 21 ha of land of high ecological value. The residential construction compound could introduce a considerable degree off disturbance from human intrusion to the associated impacts of lighting, water supply and waste disposal. Combined land-take for permanent use and for temporary construction purposes is of the order of 190.7ha, comprising 55% of the area of the proposed PBP NPA.

Based on the earlier 2001 counts, the main runway and airport works could displace between 4 and 6 breeding pairs of Wirebird, at that time being around 25% of the breeding population of PBP. The recent survey (2005/06, McCulloch, Prater & Ellick) has confirmed that under the current breeding distribution, 6 territories would be lost directly, with a further 6 suffering partial loss or probably significant disturbance from construction.

A further 6-7 breeding territories would be lost to any temporary runway and site compound situated on the Southern Plateau. These numbers are based on the distribution of recent counts and, as territories can vary in position from year to year, may not fully represent the carrying capacity of the affected sites. Adverse effects on a further 11-14 pairs to partial territory loss or disturbance from construction are likely. At the present population level, this could represent a 15% loss to the island’s breeding population, around 23-27 territories.

Land take for hard surfaces, i.e. runway, terminal, apron and dispersal areas, access roads represent a permanent impact. Of the area lost, however, the levelled safety areas along the lateral edges of the runway, a strip of around 130 m in width on each side, will have a natural surface, though the emergency runway, 30 m in width, required alongside and on the eastern edge of the main runway, may need occasional maintenance by grading and rolling.

All land taken for temporary use will be restored to the best conditions possible with the aims of achieving a replication of former conditions or enhanced conditions as appropriate. The safety strips and the areas of new landforms beyond the safety strips, together with any other areas under temporary use (e.g. any temporary airstrip if sited away from the main runway alignment) can be restored by natural regeneration with, if necessary, replanting with appropriate local species as required under the specification for the Contract. Nevertheless there remains a significant risk that the as yet untried methods of re-instatement of appropriate substrate and the introduction of desert plants may fail to replicate the habitats lost.

This is particularly pertinent in view of the exposed conditions lateral to the main runway on the lowered post-construction profile of the Eastern Plateau. Similarly, the Southern Plateau, the site of the possible temporary runway and Contractor's compound, would be levelled and graded thereby losing local wind-shielding from small-scale variations in landform and micro-topography, dwarf shrub vegetation and the consolidating effects of mature lichen crusts. Post construction, these areas would be exposed to the unattenuated prevailing winds. Restoration of a mature desert surface in these locations is unlikely to be achieved in anything less that the medium to long-term. Such levelled and worked surfaces under temporary use for the construction programme would probably be regarded, in realistic timescales, to be a permanent loss of current habitat conditions. Mitigation by avoidance would be considered for the temporary runway (i.e. is it possible for any temporary runway to be provided within the permanent footprint of the works rather than a location outside). If possible, the Contractors' compound would be sited outside PBP. However, when assessing the impacts of the proposed scheme a worst case has been assumed i.e. it has been assumed that the temporary runway would be required and that there would be a compound on PBP adjacent to the possible temporary runway.

The significant area of land-take for construction in PBP, an area of very high ecological value, is assessed as a Very Large Adverse impact.

This considers the nature of the permanent loss to the paved surfaces and new buildings of the airport, together with the potential for longer term changes to the desert substrates, and hence the invertebrate communities, of the Central Basin as a result of the loss of the wind-shielding landform of the Eastern Plateau.

Where it is possible to restore some measure of vegetation cover to areas subject to land-forming and grading during the construction phase, this could restore to some extent the invertebrate habitat lost and part of the nesting territory of the Wirebird. However, based on the 2005/2006 survey, all territories within the overall footprint of construction of the airport would still suffer some permanent habitat loss to the runway and terminal area, and the policy of the airport operators to birds nesting on the lateral safety strips in close proximity to the runway remains, for the present, uncertain. There will be a permanent

loss, therefore, of around 6 breeding territories, under current conditions at the proposed airport site (the carrying capacity of the Eastern Plateau could be higher had protection against adverse human disturbance been initiated).

The Eastern Plateau identified for the main runway alignment, will be lowered by up to 25 m to a level of around 300 m above sea level to achieve the correct grade and the fill required for the runway and RESA extension into Dry Gut. At present this landform acts as a partial windbreak for habitats within the Central Basin. Following earthworks and runway construction, this natural windbreak will be removed with the elevation of the runway being slightly lower than the lowest elevation in the Central Basin.

The results of the wind-speed modelling (see Technical Appendices 9.5, Volume 4 of this ES) suggest that the wind-speeds experienced over the Central Basin are likely to change significantly following construction and the lowering of the ridge. The sheltered area in the middle of the Central Basin which, when modelling using a reference wind speed at the approximate location of the runway centreline, experiences wind speeds of less than 3 metres per second (m/s) is reduced in size following the earthworks (see Figures 4,5,6 & 7 in the Wind Study report in Appendix 9.5, Volume 4 of this ES). At the same time, the area in the north east region of the protected zone, representing wind speeds greater than 7 m/s increases in size. A significant area in the east of the Central Basin will experience a doubling of average wind-speeds from around 4 to 8 m/s following construction of the runway.

The increase in wind speeds will lead to changes in the erosion/accretion balance. A decrease in deposition of dusts and fine sands is a likely result of the changes in wind exposure with possible erosion of the existing finer deposits. Part of the erosion source provided by the current landform will be lost to the consolidated surfaces of the runway and other areas of made ground. Subtle or more radical differences in the nature of the ecosystem could result from this which may adversely affect the habitat requirements of the endemic invertebrates, particularly the burrowing species of the finer sediments. . Thus, in addition to direct loss of such habitats to runway construction, further losses may be experienced over time to the endemic species such as the wolf spiders (*Brevilabus*, *Hogna, Lycoma, Trochosippa*) and beetle species (*Mellissius*), many with highly restricted distributions in the areas under actual and potential impact.

Lowering of the ridge and increasing wind speeds could also affect the condensation patches, observed on white gritty areas in the Central Basin, east of Ashmole site 22, and north of site 2, which could be contributing to the presence of invertebrates there even in totally unvegetated areas.

The wind modelling exercise undertaken to predict effects on substrates of the Central Basin is also pertinent to the scenario for restoration works in other areas subject to the relatively strong and constant prevailing winds, in particular the Southern Plateau if this area is to be used as a temporary airstrip. As noted above, it is considered unlikely that former conditions can be restored to these areas in realistic timescales.

In summation of the above possible permanent effects of construction, the overall impact at PBP may remain between Very Large Adverse to Large Adverse depending on the success of mitigation. Where, over the long term, it can be demonstrated that populations of endemic plants have been successfully established, that there have been no

extinctions of endemic invertebrates of the finer substrate fractions e.g. wolf spiders, and that sustainable populations remain in the western section of the Central Basin or other more sheltered areas of PBP the impact might then be re-assessed. Impacts upon the Wirebird population, given the permanent loss of breeding sites at PBP and the vulnerability of this species, would represent a moderate adverse impact. However the overall ecological impact upon the Wirebird population following successful mitigation and sustainable improvements to pasture and breeding success, is considered to be neutral.

Operation of the airport will result in additional noise and result in disturbance to wildlife with the key receptors being the Wirebird population on PBP and the seabird colonies along the coast. Operational noise emissions will be characteristically phased or discontinuous corresponding to the passage of aircraft or vehicles. Such phased emissions, in contrast to impulsive noise produced by blasting for example, have a gradual onset and decay though high intensities may be experienced during the central section of the sound phase, e.g. low-level jet aeroplanes. In the first few years at least, noise emissions from the airport will be very limited, corresponding to the numbers of flights and the passage of vehicles.

In view of the phased nature of the noise emissions and their infrequency, operational noise is less likely to pose a disturbance issue to Wirebirds in the Plain than construction noise and previous experience with this and related species suggests that the birds are likely to habituate to the routine passage of aircraft and vehicles (McCulloch pers com).

The seabird colonies on Shore and George Islands may be disturbed by the passage of aircraft. Research has suggested that some seabirds are highly sensitive to noise disturbance, though some of the results relate to helicopter movements. Non-habituated crested terns (Brown, 2001) showed behavioural responses to any level of aircraft noise above ambient environmental levels. Escape responses (flight) were recorded in some birds at all levels of the noise stimulus with the majority of birds flying at levels over 70 dB(A). In another study, Brunnich's guillemots responded to helicopters at a distance of 6 km and always by a distance of 2.5 km (Fjeld, et al., 1988) though no precise data on noise levels were available and no observable impact on reproductive success was evident during the one season of study. A number of studies including the three cited above have shown particular sensitivity by birds to helicopters, possibly because of the complex amplitude or pulse-modulated noise emitted.

At Gill Point, however, both islands are significantly lower than the adjacent mainland with the runway at around 300 m in altitude. In addition, the islands lie to the east of the flight path, unless after take-off a banking turn is made to the east which may carry aircraft closer to the islands. Eggs left unincubated by birds disturbed from the nest can suffer chill and fail to hatch. Eggs may suffer predation though here there are currently no significant predators (e.g. frigate birds) to take unguarded eggs from temporarily vacated nests.

In view of this, and the available research results, impacts upon the adjacent sea bird populations are difficult to predict but given the low frequency of aircraft passes, and the adoption of strict flight protocols, the impacts would be minor.

9.6.6 Ancillary Components

Installation of the ROLs and navigation aids will also affect habitats, notably invertebrates, in PBP and the wider EAA. While land-take for these structures will be minor there will be the need for a dedicated access for construction and subsequent maintenance.

Loss of and disturbance of surface sediments to airport construction, or from road construction, may result in the loss of deposits of bird bones, the study of which have revealed a number of details about the avifauna of St Helena before the island was discovered by the early mariners.

The construction and operation of the airport presents significant opportunities for the inadvertent introduction of alien species which could have devastating long term impact on the ecology and wider environment of the island, including the endemic and indigenous flora and fauna (terrestrial and marine), agriculture, forestry and built environment.

Installation of lighting for construction and operation of the airport could disrupt natural life cycles, in terms of feeding patterns and predation.

Impacts upon the marine environment at Rupert's Bay are not considered to be significant.

Abstraction of water for use during the operation of the airport will be much lower than during the construction period and will be limited to a maximum of 40 cubic metres per day at point A1/A2. Mitigation measures are described in the EMP in Volume 5 and Appendix 15, Volume 4 of this ES.

9.7 Mitigation and Monitoring

9.7.1 General Approach to Mitigation

With respect to mitigation, the proposals include direct reinstatement where possible of habitats lost to construction, species conservation programmes, site protection by access control or the eradication of invasive plants or predatory species, and through institutional support to ensure compliance with environmental regulation, contractual obligation and best construction and environmental practice.

The mitigation measures considered provide key objectives and the most likely means by which these can be achieved. In some areas, refinement will be possible in response to further work on ecological survey and its interaction with detailed design. In addition, pre-construction surveys together with any mitigation required will be completed prior to any onset of works so as to identify additional areas for protection or the need for additional mitigation e.g. the translocation of plant material.

Monitoring over the longer term is an essential component of mitigation programmes to determine if the outcome of the original works and ongoing management is producing the desired effect and to indicate any need for additional or alternative management in order to achieve the nature conservation objectives.

Mitigation has been developed through the design and incorporated into the technical specification which the Contractor would follow. Mitigation measures have also been developed for the construction and operation of the proposed scheme and these are set out in the EMP in Volume 5 of this ES. In addition, the LEMP in Appendix 10.2, Volume 5 of this ES set out measures for mitigating impacts during construction and operation.

9.7.2 Mitigating Construction Effects

Mitigation measures relating to construction are all discussed in more detail in section 9.7.3 below as they are equally applicable to mitigation of permanent/operational effects albeit that in most cases the activity which causes the effect will occur during the construction phase.

Dust Emissions

There is the potential for fugitive dust emissions arising from construction to affect plant and possibly animal communities downwind of the construction sites. Potentially much of the Central Basin and other areas on the western side of PBP could be affected. Works to level and grade any temporary runway and construction compound on the Southern Plateau would add another significant linear front of disturbance and the potential for fugitive dust emissions. Air quality issues are considered further in Chapter 7, Volume 2 and Appendix 7, Volume 4 on Air Quality. In addition to the mitigation measures described in section 7.4.2 of Chapter 7 to control dust arising from the works during construction, it may be appropriate to use a series of high barriers to trap dust. These barriers will be particularly effective at trapping the larger fractions of dust. Due to the large areas, and the scarcity of water available for dust suppression these barriers have the potential to be an effective form of mitigation, assuming they are appropriately positioned. Due to regulations regarding the height of obstacles around an airport, these barriers will need to be removed before the airport is operational. Temporary impacts on plants and animals may be assessed as at least Minor Adverse.

Noise and Visual Disturbance

Disturbance from noise, machinery and the increase in human activity at PBP and along the haul and access roads during the construction period may affect breeding success of the Wirebird beyond the areas of direct disturbance from construction to immediately adjacent territories, particularly given the changing pattern and routines of construction activity which may prevent birds habituating to the disturbing stimuli. Potential impacts of noise emissions are considered in Appendix 6 and, together with the effects of visual disturbance and habitat loss to construction would be considered as Large Adverse for the local Wirebird population during the construction period.

Where practicable, the noisiest activities (notably blasting operations during construction) near to breeding colonies may need to be restricted during the breeding season. For example, as far as practicable such activities will be scheduled to take place once the majority of young birds have fledged. Notwithstanding this, observations of the impact of construction noise i.e. blasting, on the exposed bird populations, and use this data to predict the scope and scale of the impacts on the breeding populations as a whole, so that an estimate of any likely reduction in recruitment rate can be made in order to better

understand how to manage any short-term significant adverse impacts in the medium to long term.

In some areas, further restrictions in addition to the operating hours detailed above, may need to be considered at the works phasing stage to protect sensitive wildlife seasons (e.g. Wirebird nesting season – most notably October - February).

With respect to the first two strategies in particular, further surveys will be undertaken where necessary to inform the detailed design and any residual mitigation necessary

9.7.3 Permanent and Operational Effects –Mitigation for Impacts PBP

9.7.3.1 Land Take

With the severe constraints placed by the landforms on the location and orientation of the runway there is very little scope for mitigation by avoidance of some areas of sensitive habitat on PBP. The total land-take for the airport is around 170 ha.

To compensate for this loss therefore, the aim would be to restore habitats beyond the airport elsewhere in PBP to at least the same extent with an additional margin to cover the risk that re-instatement and habitat creation may not replicate those habitats lost. Resources would be made available to restore around 240 ha of desert and semi desert in the area of PBP to a condition resembling pristine conditions with a predominance of vegetation dominated by endemic and indigenous species. This mitigation is in response to anticipated impacts on three key ecological receptors, plants, both higher plants and lichens, of the arid zone, endemic and indigenous invertebrates, and the Wirebird.

The possible temporary runway and Contractor's compound on the Southern Plateau significantly increases the temporary impacts of construction and, as explained above, may have long-lasting permanent effects with respect to the nature of the desert substrates and their suitability for re-colonisation by certain invertebrates in particular. The offsite compensation areas in PBP would therefore be proportionately increased to a total of around 280 ha that reflects a multiple of 1.5 x the area lost to all temporary construction works.

Compensation enhancements are to be achieved by the eradication and control of invasive plants in PBP. The following plant species would be subject to measures for eradication or reduction in their competitive effect on the indigenous and endemic flora, prickly pear wild currant, tobacco and creeper. For creeper in particular, gradual removal is preferred as this species does serve to consolidate desert soils and where present as a sparser mosaic provides feeding areas for Wirebird. The rate of removal would therefore equate to the capacity, in areas that might be subjected to wind-blow, for native plants to establish, either by natural regeneration, re-seeding or by planting. No herbicides would be used to eradicate pest species but physical removal only with the plant material taken off site for composting.

The location of the airport buildings has been designed to reduce land-take from the more ecologically sensitive areas. Provision has been made in the specifications to the Contractor to ensure that where possible during detailed design incursion into ecologically valuable areas such as the drier grit and fine-sand habitat types typical of the Central

Basin or, in relation to areas of proposed cut, the scrubwood and tea plant populations along the seaward cliffs has been minimised. Similarly, it may be possible to avoid the minor additional land-take for the drainage system by relocation of some elements of the system.

The accurate delineation of the minimum area required for the construction of the airport is essential in this area which is important for its high ecological interest for its endemic species. Emphasis would be given to the retention of wind-shielding landforms for the Central Basin where these do not impinge on air-safety requirements (the southern ridge to the north of the Terminal Building). Sequential construction operations would be employed to ensure that the land occupied by construction activity is limited as far as is possible to the footprint of the completed airport together with its re-graded landforms and the haul/operational access road. Site offices located outside PBP at Bradleys Government Garage would reduce temporary land-take.

Reference would be made to the constraints map provided (see Figure 9.1) which identifies areas of high ecological value. These areas would be protected from construction activities and other unauthorised access that may damage the ecological interest of this area e.g. recreational use by off-road vehicles.

9.7.3.2 Changes in Wind Exposure and Geomorphological Processes

With the current design proposals, no direct mitigation appears available for any changes to wind exposure and erosion in the Central Basin arising from the lowering of the upwind Eastern Plateau for the main runway alignment, though some compensatory mitigation may be possible on the sheltered embankment to be formed to support the RESA in Dry Gut (see below). The removal of this partial windbreak for habitats within the Central Basin requires an early protection and restoration programme for the Basin to prevent further damage from vehicle use and to re-establish appropriate plants, if needed, in the eroded areas. Fencing is currently being considered to prevent unauthorised access by recreational vehicles and the consequent damage to sensitive semi-desert surfaces of PBP. With the potential for losses by increased wind erosion in the Central Basin, greater reliance may have to be placed on trapping and stabilizing fine sediments at a micro-topographical scale by an enhanced cover of indigenous plants. Additional means such as the construction of artificial embankments are not favoured as these may:

- Impinge on air safety requirements;
- Increase habitat loss to the fine desert deposits of the Central Basin, and
- Produce a habitat or microhabitat that may favour non-endemic species, e.g. the brown widow spider inhabiting crevices in loose rocks.

The application of a wind attenuation/dust screen mesh to the permanent airport fence on the western perimeter may have some local benefit for the zone directly downwind of the fence. It may also make the fence more visible to flying Wirebirds (see also Section 5.8.1.2 below).

9.7.4 Mitigation for Impacts on Species and Species-groups

This section describes mitigation proposals for the endemic desert invertebrates typical of habitats in PBP and the Central Basin in particular, the endemic and indigenous desert

plants, and for the Wirebird in respect of impacts on PBP and along the route of the haul/access road.

9.7.4.1 Invertebrates

Invertebrates including many endemic species are likely to be the most adversely affected ecological receptors of PBP. Adverse effects will arise not only from the loss of plants that provide food and shelter but also the distinctive and varied substrate types required by certain species, particularly burrowing invertebrates (see Table 9.4 in section 9.3). The following mitigation is required to restore the original substrate conditions to all non-surfaced reworked areas of the airport to favour establishment by both plants and invertebrates characteristic of the PBP environment.

In principle, the rehabilitation of all non-surfaced areas and graded slopes would be undertaken using the original natural substrate according to the local conditions. The original overlying material would be stripped, stored and reapplied to the worked and re-graded surfaces where appropriate. Detailed design will aim for a mixture of substrate characteristics to replicate the original habitat lost and provide similar microhabitats, in particular the finer substrates for burrowing insects, (e.g. wolf spiders). There would be, therefore, special requirements to obtain and store, protected from wind, the various grades of substrate from fine gravels to dusty sands for subsequent re-application to newly graded and landscaped areas. Areas for the deposition of finer fractions would take account of the potential for wind erosion.

Alien plant control programmes, in particular for creeper, will help maintain the open dust and gritty areas preferred by some of the species of conservation concern restricted to the Central Basin and EAA. Minimisation of the area needed for construction of airport, ancillaries and haul/access route and establishing defined access routes to reduce compaction of substrates by vehicles are also important components of mitigation.

The new embankment supporting the RESA across Dry Gut presents a particular opportunity for habitat creation, in particular on the sheltered western embankment slope. Here, detailed design would seek to provide a rising stepped profile with a series of broad level terraces. The ecological objective of the level terraces is to provide a retentive surface for re-deposition of fine desert deposits, dusts and fine sands, retained from other worked areas, in order to support communities of endemic and indigenous plant and insects that are currently typical of the fine desert deposits of the Central Basin. It is not, however, possible to predict the likely response of endemic invertebrates to this artificial habitat.

The cut and fill balance between runway construction and embankment formation will impose a constraint on the profile of the structure. Detailed design of the terraces would seek to provide perhaps around 5 terraces of around 10 m, or more, in width, on the sheltered western edge. There are no overriding ecological requirements for the design of the exposed eastern edge of the RESA embankment though there will be an opportunity on the exposed seaward edge to introduce endemic plants typical of this habitat such as scrubwood and teaplant together with lichen species of the seaward edge

The western terraces would be constructed so as to receive and retain fine sandy and dusty sediments. For this purpose, close packing of fill shall be required to prevent voids

from remaining in the sub-soils into which the fine surface materials may infiltrate over time. A fine-grade Terram may be more effective for this requirement, retained at its outer edge by blockwork and with a sub-grade layer of coarser fill. Finer sediments, retained for the purpose, would overlay this to a depth of at least 300 mm, reflecting the average burrow depth of some desert spiders at around 20-25 cm. The surface profile of the terrace would be gently concave so as to avoid mobilisation of surface sediments during periodic rainfall events.

Within engineering constraints, the design of the new landforms lateral to the runway safety areas will seek for variation in topography and aspect and be shaped and graded into adjacent undisturbed landforms. The limited information available (Ashmole & Ashmole 2004) on the habitat/substrate types with which certain endemic invertebrates are associated will serve as an initial guide to some of the basic differing substrate types to be replicated on the new landforms. Additional information on the physical characteristics of the desert deposits and the habitat requirements of the endemic invertebrates will improve the chances of successful habitat re-creation.

9.7.4.2 Plants

Natural regeneration is the preferred process by which habitats can be re-instated. This, however, depends on sources of recruitment for seed or other propagules in relation to the areas of land for re-colonisation and the need to protect certain areas from erosion. Given the inevitable losses to some areas of desert and semi-desert habitats, a seed collection, germination and propagation programme will be initiated prior to any construction to provide a stock of endemic and indigenous plants for habitat restoration following construction.

Plant material is to be sourced from the Eastern Arid Area and PBP in particular. An advance programme of sowing and planting where needed in the degraded habitats in the Central Basin, as well as strict site protection against damaging incursions is required prior to the onset of earthworks for runway construction. This would involve a gradual removal of the non-native species (creeper, prickly pear, wild currant) starting in areas dominated by samphire and working outwards from these areas so as to encourage natural regeneration, with reinforcement planting only if needed in the disturbed sites. It would be remembered, however, that bare substrates are a natural and essential component of the cover of semi-desert ecosystems, and the aim would not be to establish a complete vegetation cover.

Physical translocation of established higher plants from the works area is unlikely to be successful where plants are rooted in rocky or consolidated substrates. However, where rock substrates or outcrops with a cover of lichens are present, it would be desirable to retain rocks with particular species or colonies for subsequent re-instatement in the land-formed areas. The appropriate method of off-site storage between removal and re-instatement would be carefully considered with respect to maintaining the correct microclimate required to sustain the lichens during the construction period.

Replanting of species appropriate to PBP would be undertaken in some re-formed habitats on the re-graded landforms in the airport site. Again, as noted above, bare substrates comprising a range of sediment types (gritty areas and dusty bowls) would be left as essential components of the semi-desert ecosystem. Plants would be established

in a rolling programme as soon as land-formed areas become available. There will be a need to take account of habitat requirements of the species proposed in the table below for replanting in relation to substrate types, chemical conditions such as salinity or phosphate concentrations and exposure conditions, e.g. arid zone species as in the Central Basin area or condensation zone species found on the seaward side of PBP.

Some of these species will also be suitable for planting in public amenity areas, along entrance paths, etc., in the airport grounds, as an introduction to the flora of St Helena and the more arid habitats of the island. Protection from damage by mice and rabbits is essential throughout the mitigation areas and control programmes for these species would also be initiated in advance of planting schemes.

Table 9.8 provides details of the species of plants proposed for use and their ecological characteristics. Further details on planting proposals are provided in the Landscape and Visual Impact - Appendix 10.1, Volume 4 and the Landscape and Ecological Mitigation Plan enclosed in Appendix 10.2, Volume 4 of this ES.

Table 9.8 Species of Plants Proposed for use and their Ecological Characteristics

Species	Common name	Plant form	Habitat Notes
Central Basin			
Suaeda fruticosa	Samphire	Low spreading shrub	Arid areas, host plant for endemic insects
Hydrodea cryptantha +	Babies toes	Succulent annual	Arid areas & intermittent rain water formed water channels, endemic insects associated
Chenopodium helenense +	St Helena goosefoot	Erect annual herb, woody at base	Arid areas
Airport and surrounding PBP area including all re-graded and landformed areas, Dry gut, PB gut			
Suaeda fruticosa	Samphire	Low spreading shrub	Arid areas, host plant for endemic insects
Hydrodea cryptantha +	Babies toes	Succulent annual	Arid areas & intermittent rain water formed water channels, endemic insects associated
Commidendrum rugosum +	Scrubwood	Perennial low growing shrub	Condensation zones, possibly the former dominant species in present creeper zones, host plant for endemic insects
Frankenia portulacifolia +	Tea plant	Perennial, erect wiry shrub	Condensation zones, host plant for endemic insects
Mellissa begoniifolia +	Boxwood	Perennial shrub	Condensation zones
Hypertelis acida +	Salad plant	Succulent annual or short-lived perennial	Seaward facing slopes, exposed to sea mist/condensation
Chenopodium helenense +	St Helena goosefoot	Erect annual herb, woody at base	Arid areas
Euphorbia heleniana +	French grass	Tiny prostrate annual herb	Arid Areas. Rare on site
Portulaca oleracea	Purslane	Prostrate annual herb	Arid areas

Species	Common name	Plant form	Habitat Notes
Osteospermum sanctae-helenae+	Boneseed	Prostrate annual herb	Arid areas
Pelargonium cotyledonis +	Old Father live-forever	Thick stemmed perennial, prostrate to sub-erect	Seaward facing slopes, exposed to sea mist/condensation Cliffs and rocky places – where cool sheltered (from sun exposure) environment is created.
Ophioglossum polyphyllum	Lily fern	Tiny erect annual fern	Annual. Locally abundant around Munden's Hill. Found in open dry and hot places.
Cook's Bridge – Bradleys Government Garage			
Commidendrum robustum +	Gumwood	Tree	Dry Gumwood Woodland – reinstate in suitable sites for enhancement planting/ebony gumwood thicket
Bulbostylis lichtensteiniana	St Helena Tuft sedge	Low tufted sedge	Confirmed identification for seed collection required. Grows under forestry trees and in soil pockets amongst rocks in dry parts of the island.
Trochetiopsis ebenus +	Ebony	Perennial shrub	Enhancement planting
Suaeda fruticosa	Samphire	Low spreading shrub	Arid areas, host plant for endemic insects
Bradleys Government Garage – Mulberry Gut			
Trochetiopsis ebenus +	Ebony	Shrub	Enhancement planting / ebony gumwood thicket
Commidendrum robustum +	Gumwood	Tree	Dry gumwood woodland
Mulberry Gut – Deadwood			
Trochetiopsis ebenus +	Ebony		Enhancement planting/ebony gumwood thicket 200-500m
Commidendrum robustum +	Gumwood	Tree	Dry gumwood woodland
Commidendrum rotundifolium +	Bastard Gumwood	Tree	Dry gumwood woodland (400 – 520). Rare seed may be limiting.
Deadwood – Rupert's Valley			
Commidendrum robustum +	Gumwood	Tree	Dry gumwood woodland (limit to upper areas adjacent to Deadwood)
Scirpus nodosus	Thatching rush	Large sedge	Found in semi-barren areas between 300-500m, formerly associated with dry gumwood woodland
Commidendrum rugosum +	Scrubwood	Shrub	From trig point, beside Pipe Path to the coast
Trochetiopsis ebenus +	Ebony	Shrub	Arid areas 200-500m

Species	Common name	Plant form	Habitat Notes
Commidendrum rotundifolium+	Bastard Gumwood	Tree	Dry gumwood woodland (400-520 (limit to upper areas adjacent to Deadwood))
Bulbostylis lichtensteiniana+	St Helena Tuft sedge	Low tufted sedge	Confirmed identification for seed collection required. Grows under forestry trees and in soil pockets amongst rocks in dry parts of the island, including around area of Pipe Path.
Euphorbia heleniana +	French grass	Tiny prostrate annual herb	Arid Areas. Rare on site
Osteospermum sanctae-helenae+	Boneseed	Prostrate annual herb	Arid areas
Suaeda fruticosa	Samphire	Perennial shrub	Arid areas
Eragrostis saxatilis +	Hair grass	Dense tufted grass	Abundant in the south west where it grows with tea plant, scrubwood and salad plant. Small population possibly exists at Banks' Ridge.
Pelargonium cotyledonis +	Old Father live-forever	Thick stemmed perennial, prostrate to sub-erect	Seaward facing slopes, exposed to sea mist/condensation Cliffs and rocky places – where cool sheltered (from sun exposure) environment is created.
Ophioglossum polyphyllum	Lily fern	Tiny erect annual fern	Annual. Locally abundant around Munden's Hill. Found in open dry and hot places.
Asplenium haughtonii+	Barn fern	Small annual cliff dwelling fern	Annual. Occurs between 200-500m in moist cliff crevices and rocks.
Rupert's Valley			
Commidendrum rugosum +	Scrubwood	Low growing perennial shrub	arid areas and condensation zones
Suaeda fruticosa	Samphire	Perennial shrub	Arid areas, host plant for endemic insects
Portulaca oleracea	Purslane	Prostrate annual herb	Arid areas
Trochetiopsis ebenus +	Ebony	Shrub	Arid areas 200-500m

It will be imperative to ensure that any plants, or seed, used in reinstatement do not introduce inappropriate animals or soils that will affect soil fertility and where any watering is required that it be entirely constrained to the plant.

Over the longer term, there may be the need for the control of invasive non-indigenous plant species from the areas of re-planting though control of these species in the larger area of PBP is desirable (see section 9.11 below).

Core areas of the invasive creeper appear to correspond to more mature soils (Caesar 2001) and may represent areas formerly dominated by scrubwood. Re-establishment of

scrubwood in addition to other species in Table 9.8 above, depending on ground conditions, could focus on the creeper dominated areas with the creeper being successively removed following establishment or dying out naturally under competition from the scrubwood.

9.7.4.3 The Wirebird

The graded areas within the airport grounds, given successful planting and colonisation by invertebrates, may restore some habitat for nesting Wirebird. However, this area cannot be regarded as mitigation for this species given the uncertainty over the interaction between Wirebirds and aircraft and the widely accepted view of airport operators in their assessment of potential hazard from birds. Given experience of the nesting behaviour of the related Kittlitz's sand plover and African airstrips (McCulloch 2006) it is concluded the risk of collision with aircraft is low. It is desirable that the airport security fencing be of such a mesh size (e.g. 50x50 mm square mesh) so as to be permeable to Wirebird chicks. Any wind attenuation mesh attached to the western perimeter fence would therefore be applied at a height of around 150 mm above ground level so as to allow Wirebird chicks to pass through the security mesh beneath.

A control programme for feral cats together with other pest species would reduce predation pressures on birds and the effects of grazing on endemic plants. The strategy may be of limited value if only undertaken at PBP the programme may need to be extended in time to an island-wide scope to have any significant effect. Mynah birds may also be having an adverse effect on Wirebird populations from direct predation of eggs and possibly chicks and by competing for invertebrate prey. Doctoral research to be initiated in November 2007 by Fiona Burns will aim to better quantify predation pressures on Wirebirds.

As with the proposals for advance ecological mitigation at PBP, reinstatement and enhancement of pastures to improve the carrying capacity for the Wirebird at Deadwood and Bottom Woods (and elsewhere on the island) well before the onset of construction of the haul road would be initiated. In early 2007 two paddocks on Deadwood Plain were cleared of invasive weeds in a demonstration project for pasture restoration and Wirebird conservation under OTEP funding. Similarly, scrub clearance at Bottom Woods has been undertaken and has resulted in an increase in the Wirebird population in 2006/7 to around 19 birds from previous counts of around 5 (see Table 9.6 above). These activities are part of the proposals being prepared for the Wirebird Species Action Plan. The Wirebird Species Action Plan is being prepared for all of St Helena with the assistance of the St Helena National Trust and the RSPB. The plan's long-term vision is to 'find a way to happily co-exist - allowing St Helena to develop and the Wirebird to thrive'. Within this framework the plan will work towards stabilising the population of the Wirebird and reducing its threatened status from Critically Endangered to Vulnerable (because of its small and isolated population) with a sustainable population by 2017.

This process would be continued in order to stimulate an increase in the Wirebird population in advance of any impacts that may subsequently depress breeding success in areas of habitat loss to the airport, its haul/access roads and from construction disturbance. Given the highly vulnerable status of the population, the target for territory gain by pasture restoration would be a multiple of 1.5 times the number of territories under threat of loss or disturbance.

Costed proposals have now been prepared under the RSPB/OTEP Wirebird project for a number of pastures at and around Deadwood Plain for scrub clearance and fencing as required in order to re-introduce the former grazing regime that proved beneficial both to stock farming and the Wirebird. Figure 9.6 shows the location of these priority areas and the Table 9.9 below indicates the expected number of breeding territories that could be gained.

Table 9.9 Wirebird Mitigation Areas

Priority Area	Area in ha.	No. of Existing Territories	No. of Territories Gained*
Woody Ridge	18.0	10 - 14	4 – 7
Bottom Woods	32.1	2 – 5	5 – 8
Middle Point	10.0	0	3 – 5
Deadwood Paddock 12	8.8	3	3
Deadwood P. 11	6.5	2	2
Deadwood P. 10	6.4	1	2 – 3
Netley Gut	27.9	2	4
Deadwood P. 9	9.2	1	2 – 3
Flagstaff	27.9	0	2 – 5

*Assumptions:

- Pastures are fully cleared and maintained over the long term under a sustainable grazing regime.
- Gains to be expected over 2 – 3 years with stabilization of conditions and an increase in the populations of invertebrate prey
- Other factors remaining constant.

The total numbers of potential territories that could be made available by pasture restoration is of the order of 27 – 40. If such gains can be realised, this would compensate for the loss of around 19 territories on PBP to airport construction work. Restoration of the pastures is seen as the most effective method of mitigation for construction disturbance and the long-term enhancement of the island's population. This is the subject of the Wirebird Species Action Plan.

Conservation of the wetland habitats in Fisher's Valley with removal of the dense wild mango scrub may also be important to the maintenance of the Wirebird population in addition to other species such as the moorhen.

Key sites on St Helena for the Wirebird would be declared as protected areas and subject to a management plan agreed with stakeholders. Financial incentives are likely to be necessary, based on the agri-environment schemes in the UK (Higher Level Stewardships of the Environmental Stewardship scheme provide a relevant model where farmers are grant-aided to undertake sustainable agricultural practices incorporating targeted biodiversity gains; see http://www.defra.gov.uk/erdp/schemes/es/default.htm), to permit the reclamation of derelict pastures, to undertake sustainable grazing regimes and maintain suitable conditions for the Wirebird.

Operational impacts arising from noise emissions are considered in more detail in the Noise and Vibration - Appendix 6, Volume 4. On ecological criteria these are not thought to be significant. Mitigation for the seabird colonies in this area by strict definition of approach/take off path employed in the airport's Aeronautical Information Publication, Local Traffic Regulations, to prevent direct passes over Gill Point and the offshore stacks, Shore and George islands. In addition, the slow increase in numbers of flights from 1 per week up to 10 per week over the first 35 years of operation will allow seabirds to habituate to the routine passage of aircraft and vehicles.

An eradication programme of feral cats in the area around the airport, and in particular along the coastline around Gill Point would reduce predation pressure on nesting seabirds on the mainland as well as nesting Wirebird on PBP, thereby assisting in the compensation for any minor effects of operational disturbance.

Access restrictions would be put into place to prevent disturbance to the Central Basin and other sensitive areas of PBP from incursions by recreational vehicles.

9.7.5 Monitoring

Ecological monitoring is essential during construction and is proposed for an initial 10 year period after construction with surveys conducted at appropriate intervals. All survey work in the PBP area would be undertaken from the access road only or otherwise on foot. The following surveys would be undertaken:

- Dust monitoring during construction and the implications for desert flora and fauna in the or at other habitats exposed to dust deposition (see also Chapter 7);
- Plants and lichens in habitat reinstatement areas – quarterly following planting (overview and fixed quadrats);
- Structural integrity of made terraces on the RESA embankment across Dry Gut;
- Substrate characteristics in areas of habitat re-instatement, visual assessment initially with small scale particle size analysis if deemed necessary – year 1 following re-instatement then every 2 years;
- Invertebrates in reinstatement areas – every 3 years for a 15 year period (fixed sample points);
- Plants of the reserve area – every 3 years (overview and fixed transects);
- Wirebird population of PBP, haul and access roads and habitat reinstatement areas– annually. Operational use of this road would be studied annually and also in relation to pasture management;
- Seabird behaviour in response to operational aircraft and breeding success on Gill Point and the offshore stacks - every 2 years (census methods to be determined); and
- Incidence of feral animals and the response to control programmes (ongoing).

Monitoring of the haul route and construction site including downwind spread sectors, using baseline of existing species in these areas.

Where there is concern that mitigation is not proceeding satisfactorily, additional checks may be needed and remedial action taken accordingly.

9.7.6 Institutional Support

9.7.6.1 St Helena Government

The scale of the airport development and the ecological and environmental requirements represents a novel and challenging situation for the SHG and its environmental specialists. In view of this and to meet and the environmental obligations already

imposed by the LDCP (2006) together with future environmental requirements of an expanding economy, additional environmental staff will be required in a regulatory capacity in a government department with a role independent of the Planning.

The appointment of a suitably experienced ecologist to the ANRD or a new Environmental Agency division is therefore seen as a vital requirement in order to manage the environmental aspects of airport planning and construction issues. An early appointment would enable management of advance mitigation works. Such a role would be considered a permanent addition to St Helena Government (SHG) environmental staff with a future remit over Protected Areas island wide and related environmental conservation issues. The appointee could be assisted by a working committee of governmental and Non Governmental Organisation (NGO) representatives pending, or concurrent with, the expansion of a permanent environmental department.

9.7.6.2 Environmental Management of the Contract

The Contractor will be required to appoint an ecologist/environmentalist who will provide the required inputs into detailed design and be responsible for good environmental practice upon the work site. Designs will be approved and certified by the environmental monitor who will be part of the SHG/DFID Engineer's Team (see EMP Volume 5 of this ES). Final certification will be required to sign-off mitigation designs as is standard practice for Design and Build or similar contracts in the UK. The St Helena Government's environmental regulator would also oversee the final design process in liaison with the Engineer during the process of planning determination for detailed design.

9.7.7 Recommendations for Further Work

Further work would be of benefit in the areas outlined below in order to refine the mitigation proposals and inform the approach to construction so as to achieve the minimum adverse environmental effect in an area acknowledged as being of prime regional and international importance for biodiversity.

9.7.7.1 Techniques of Dust Control

High volumes of dust are anticipated from the processes of rock stripping and levelling of the substrate for the runway and its safety areas. Windborne dusts would be expected to re-deposit to the west and north west of the works area, affecting habitats in the Central Basin and the northern seaward crags. The populations of endemic plants in these areas may be adversely affected. Methods of dust control that do not result in pollution of the semi-desert soils may be needed where water supplies are inadequate. These need to be investigated, e.g. a series of physical temporary semi-permeable barriers of the type that are used to wind-shield young trees and shrubs. Further proposals for mitigation are discussed in Air Quality - Chapter 7, Volume 2 and Append 7, Volume 4.

9. 7.7.2 Propagation of Desert Plants

Methods for the propagation of desert plants would be investigated further to reduce the risk of the plants proposed for habitat creation and reinstatement of the semi-desert ecosystem failing to colonise and exposing the re-laid substrates to wind erosion. Data have been collected on the particle size and profile distribution of the different desert soils

in the Central Basin and wider PBP. This will be used to inform mitigation when trying to replicate the semi-desert substrates in mitigation areas.

9. 7.7.3 Land Management for the Wirebird

A consensus needs to be drawn on the best means of achieving the long-term conservation objectives for the Wirebird in habitats outside the eastern arid area of St Helena. Consideration needs to be given to the best approach to pasture management, by what animals and how grazing is to be managed optimally for both Wirebird conservation and sustainable agricultural returns. Observations of the species using fallow land in rotational arable farming (McCulloch, pers. com) would suggest that a sustainable approach to small-scale arable farming may not be inimical to this species.

9. 7.7.4 Additional Detailed Survey

Additional work will be needed with regard to the detailed design of the haul routes, ROLs and navigational aids, and the means of access for emplacement or construction. Detailed habitat surveys will be needed, primarily based on vegetation characteristics and the presence of valued endemic plants, but with a view to assessing habitat importance for e.g. the Wirebird or key endemic invertebrates such as wolf spiders, for all additional areas of airport-related construction prior to the finalisation of detailed design. Mitigation by avoidance of any valued ecological features found would be the first option in all cases.

Aquatic Invertebrates of Ephemeral Watercourses.

It is increasingly apparent that the requirement for construction water has implications for the flow regimes in watercourses affected by surface water or potentially ground water abstraction. Invertebrate communities of ephemeral watercourses have not been investigated. Such communities may comprise rare specialist fauna including the possibility of new endemic species. Surveys would be completed for this group in the affected watercourses with requirements for the maintenance of residual flows as needed.

Fossil Remains

With the considerable scientific interest inherent in the findings of recent bird and insect fossil remains on St Helena that have provided a window into the evolutionary process on the island before the advent of anthropogenic impacts, facilities would be made available for the excavation of any areas of sedimentary deposition or cave deposits at the airport site or along the routes of the haul roads for fossil remains.

Non-Native and Widespread Invertebrate Species

Ecology and impacts of non-native and widespread invertebrate species including the brown widow spider would be studied. Ashmole & Ashmole (2004) consider that the spread of these species is likely to have had important effects on the native species. Further research is needed in this area but it is important to note that construction and reinstatement works would avoid, as far as is possible, creating habitats for non-native species such as the brown widow that may compete with or predate upon native endemics. This re-enforces the need for habitat monitoring in areas of reinstatement.

9.8 SUMMARY AND RESIDUAL EFFECTS

A number of baseline and more detailed studies have been undertaken in anticipation of the proposed airport development in PBP on plants, insects and spiders and the endemic Wirebird. The results of these together with site work undertaken commencing in October and November 2005 for the purposes of an EIA have provided sufficient data to guide the reference design and enable the environmental assessment with predictions of potential impact and to prescribe the approach to mitigation based on the reference design presented in Chapter 2, Scheme for Assessment in Volume 2 of this ES.

Ecological conditions at PBP appear to be unique and are not replicated elsewhere on St Helena. The area represents a centre of endemism for a number of higher plants and lichens of the semi-desert ecosystem, insects, and the Wirebird.

While the habitat losses in PBP to airport construction is a measurable proportion of the area available for the specialist and endemic species of plants and animals, with all other factors being constant, and mitigation applied successfully, a greater proportion of habitat remains. However, there is considerable uncertainty at present over the future conditions in the Central Basin of PBP, the centre for endemic invertebrates of fine sandy deserts, following the potentially significant change to the upwind landforms to runway construction. Similarly, there are uncertainties as to the degree with which the graded areas for any temporary runway and the site compound on the Southern Plateau may be restored to former condition.

Following the assessment approach to determining the magnitude of impact considered above, the combination of the above discussed impacts upon the ecological resources at PBP potentially represents a major negative impact upon the semi-desert ecosystem. The uncertainty present over the success of mitigation for loss of habitat to temporary disturbance of a large area during construction requires the application of the precautionary principle to the determination of significance of impact. For the habitats of PBP this is considered to range from Very large Adverse to Large Adverse. The outcome will depend on:

- The degree of change in the substrates of the Central Basin over the longer term after construction,
- The success of mitigation in restoring the ecological conditions for endemic plant and invertebrate communities of the semi-desert such that there is no overall change in species diversity within PBP.

The considerable difficulty in predicting the outcome of mitigation in an area of very high ecological interest requires significant effort to be applied to mitigation strategies, in particular, the reclamation of native semi-desert by eradication and control of invasive species from the wider area of PBP and an enhancement of the population of endemic plants. Eradication of invasive plants from this area is expected to improve habitat conditions for endemic plants, insects and spiders and the Wirebird. Such mitigation would commence well in advance of construction works.

However, it is unlikely that mitigation alone at PBP will compensate for the loss of Wirebird breeding territories to the airport project and pasture re-instatement elsewhere on the Island is essential in order to enhance the Wirebird population on an island-wide basis. While impacts upon the Wirebird **populations at PBP** are assessed as **Moderate Adverse**, given the successful and sustainable pasture enhancements as part of a dedicated conservation programme for the Wirebird elsewhere on St Helena, on an

island-wide basis the overall impact of the airport and supporting infrastructure would be **Neutral**.

The formation of broad, level terraces on the sheltered western embankments of the RESA embankment across Dry Gut may be the only strategy to mitigate for potential losses of fine dusty deposits in the Central Basin following lowering of the upwind landform for runway construction.

The potential impacts of construction noise and vibration on the indigenous birdlife on the Island are difficult to predict. Studies indicate that animals and people are likely to habituate to new noise stimuli, but the degree and rate of habituation is not predictable. For birdlife, the most significant potential impact would be the disturbance of breeding patterns. As the response of indigenous birds to noise stimuli is not fully understood, the assessment of the potential for impacts during the construction phase would take a precautionary approach. Where practicable, the noisiest activities (notably blasting operations during construction) near to breeding colonies may need to be restricted during the breeding season. For example, as far as practicable such activities will be scheduled to take place once the majority of young birds have fledged. Notwithstanding this, at an early stage observations of bird reactions to noisy construction activities would be carried out to inform mitigation measures for later noisy works if significant adverse impacts are identified.

In addition, the potential impacts of operational noise on the indigenous birdlife on the Island are also difficult to predict. Given the low frequency of flights, and the very gradual increase in the number of movements over the first 35 years of operation, studies indicate that birds are likely to habituate to the routine passage of aircraft and vehicles. Adoption of a strict flight path, avoiding the islands at Gill Point, would further control the impacts to nesting birds.

A summary of the assessment and the current approach to mitigation is given in Table 9.10 below. The key elements of the ecological and landscape mitigation plan are given in the LEMP, Appendix 10.2 in Volume 4 of this ES.

Table 9.10 Summary of Assessment, Impact and Mitigation

Ecological Resource or Receptor: Evaluation	Assessment of Significance Without Mitigation	Proposed Mitigation Measures	Residual Impact
Desert Habitats of PBP including the Eastern Plateau, site for the main airport, and Central Basin, and varied semi-desert communities along the Southern Plateau, proposed site for a temporary runway and works compound. Key Sub-Receptors: endemic plants, invertebrates and the Wirebird. Ecological interest considered Very High Value and of International Importance.	Land-take for construction of the main airport and, potential impacts from any temporary runway and site compound construction resulting in: 1) Loss of valuable invertebrate habitat and related loss to species populations. 2) Loss of rare endemic and indigenous flora species. 3) Loss of 13-19 breeding territories of the Wirebird. 4) Increase in wind erosion to fine sand and dust substrates of the Central Basin from the lowering of the upwind landform. 5) Challenging mitigation in graded areas of the Southern Plateau following reclamation of land for any temporary runway and construction compound. 6) Dust emissions during construction could affect sensitive ecological habitats. Temporary effects are predicted, largely as a result of the ecological sensitivity of the area and the potential shortage of water for dust suppression, considering the size of the area affected and the dry and windy conditions.	Seed collection of endemic and indigenous plants, storage, propagation and planting in mitigation areas (see Figure 10.7 in Volume 3 of this ES). Remove substrate from identified areas of cut for later reuse in habitat creation on the level terraces on the western slope of the Dry Gut RESA embankment and on reformed landforms lateral to the runway. Restoration of native semi-desert communities to the wider area of PBP by eradication and control of invasive alien plant species. See Figure 10.7 in Volume 3 of this ES. Preparation of EMP and preparation of mitigation and monitoring protocols as part of contract requirements. Restrict working area to minimum required. Seek to further minimise land-take from valued habitat during detailed design (for haul/access roads, drainage, areas of peripheral cut and grading). Prevent all access to adjacent valuable habitats to be retained. Dust suppression techniques to be used in working areas as described in Table 7.2 of Chapter 7 of this ES.	Success of mitigation is uncertain and therefore risks of ecological losses remain. There may be no adequate compensatory mitigation available for increase in erosion of fine sand and dust substrates in the Central Basin or in other exposed graded and levelled areas. Lack of experience in restoration of desert habitats, plants, and in particular, substrate characteristics required by endemic invertebrates. Restoration of levelled and graded areas for any temporary runway and works compounds may be difficult and effectively constitute a permanent impact. Mitigation of impacts on Wirebird population relies on off-site habitat enhancements over a wider area of PBP and in appropriately managed agricultural land elsewhere on St Helena. Ecological impacts at PBP therefore likely to remain between **Very large Adverse to Large adverse** depending on scale of land-take for construction and success of mitigation

Ecological Resource or Receptor: Evaluation	Assessment of Significance Without Mitigation	Proposed Mitigation Measures	Residual Impact
	Potentially a very large adverse impact.	High wind breaks may be used in some areas to minimise dispersion of dust. Undertake removal of invasive alien plants from valued habitats and control pests to reduce grazing	
Endemic and Indigenous Birds of PBP Wirebird Habitats of ornithological importance adjacent to the airport site. Wirebird habitats of Very High Value and International Importance. Seabird colonies considered of High Value, of Regional Importance	Habitat loss and disturbance during construction for Wirebird considered Large Adverse Disturbance to birds from air and road traffic during airport operation. Given low frequency of air and road traffic anticipated during, at least, the first few yeas of operation, and the capacity of many bird species to habituate to routine stimuli, operational impacts for Wirebird and seabirds are anticipated to be minor adverse. No significant effects are predicted on Fisher's Valley possible candidate Ramsar site.	Restoration of native semi-desert communities as Wirebird habitat on the wider area of PBP by eradication and control of invasive alien plant species. Appropriate refinement of route of haul/access road to the airport during detailed design to avoid key Wirebird breeding territories. Prevent access to adjacent areas so as to avoid disturbance to breeding birds Undertake pest control to reduce predation Flight take-off and approach protocols to avoid flying over the islands off Gill Point	With the implementation of habitat restoration in PBP as **Wirebird** mitigation, impacts likely to be reduced to **moderate adverse** (see below for an Island-wide assessment). Operational impacts on **seabird colonies** may be **minor adverse**.
Other habitats for Wirebird between Rupert's Bay and airport site. Deadwood Plain would be considered of High to Very High Value for its breeding Wirebird population	Some habitat loss to Rupert's Bay access/haul road on Deadwood Plain, Wirebird habitat. Potential for loss to small remnants of endemic vegetation. Impacts may be minor adverse given the relatively small area of land-take and expected capacity for habituation by Wirebird to potential disturbance	Minimise land take and severance of Wirebird breeding habitat through detailed design. Habitat enhancements, weed clearance and improved grazing regime on Deadwood and pastures elsewhere to improve breeding areas for Wirebird Detailed survey and route design to avoid areas of endemic vegetation	Impacts considered to be **neutral** assuming successful mitigation and sustainable improvements to pasture and breeding success.
Other habitats for endemic plants at	Impacts likely to be mainly obviated by route	Translocations as a last resort. New planting of	Residual impacts **Minor beneficial to Moderate**

Ecological Resource or Receptor: Evaluation	Assessment of Significance Without Mitigation	Proposed Mitigation Measures	Residual Impact
Rupert's Bay and airport site. Deadwood Plain would be considered of High Value	refinement with translocation of plant material (e.g. lichens) if needed. Potential Minor adverse effect	endemics and indigenous species.	**beneficial** given success in planting schemes for endemic species.

Appended Reports

9.2. Baseline Ecology/Vegetation Surveys
9.3. Lichen Study
9.4. Wirebird Survey 2005 (McCulloch 2006).
9.5. Wind Modelling Study