

TATA Steel

Morfa Landfill Site, Margam Ecological Management Plan

Part A: Baseline Conditions

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Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

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1. Introduction

- 1.1 Pryce Consultant Ecologists were commissioned by Geotechnology Ltd in June 2014 to carry out a series of ecological surveys at the Morfa Landfill site at Margam, the site currently being under the ownership of Tata Steel and managed Darlow Lloyd & Sons (DLS). The purpose of the survey was to provide detailed baseline conditions of the site's ecological attributes together with monitoring methods to assist with satisfying the revised planning conditions, specifically Condition 26, parts a, b, d, e & f. This report describes studies and survey data gathered during 2014-2016, subsequently updated in response to ongoing on-site ecological monitoring carried out at the site.
- 1.2 The site is bordered by Margam Moors Site of Special Scientific Interest (SSSI) to the east and Kenfig Special Area of Conservation (SAC) to the south. The dunes within the study site area have undergone dramatic changes since planning permission was first granted for sand and gravel extraction and landfill operations in 1973. A large proportion of the original dune system at the landfill site has been affected by sand extraction and land in-fill, most waste materials being derived from the steelmaking process.
- 1.3 Currently the site extends to 93ha and can be divided up into three broad categories of land use influencing ecological attributes:
- 1) operational areas (31ha), including buildings, yards, tracks and uncapped tipping areas,
 - 2) the capped tip (38ha), on which new dune habitats have been created, and
 - 3) remnant areas of natural dune vegetation (24ha), parts of which are overplanted with pines.
- 1.4 For many years tipping took place without a lining system, but with the implementation of the Landfill Regulations the site was decommissioned and a replacement site constructed to modern standards. As part of the transition process the local planning authority undertook a major review of the Planning Consent and an Environmental Permit was initiated with a set of conditions. This document was prepared to assist with ecological aspects of the conditions, namely Condition 26 (reproduced below) together with aspects of conditions 37 and 41. To embrace to the dynamics that dunes typically experience, this is a fluid document that will continue to be revised periodically.

Condition 26 Ecological

Within 3 months of the date that these conditons come into effect an Ecological Management and Monitoring Scheme shall be submitted to the Local Planning Authoirty for its approval. The scheme shall include, inter alia,

- a. the provisions for the enhancement of biodiversity within the site boundary along with a programme and timescale for implementation.*
- b. the formation control and management of a buffer zone in accordance with the areas of set aside land identified on Figure 1.3 Revision 1 between the Margam Moors SSSI, the Morfa Beach and the Kenfig SAC.*
- d. the design and formation of dune slacks and dune pools as it applies to the restoration and aftercare of the site.*

- e. *the integration of the ecological management and monitoring scheme with the Ecological Restoration and Aftercare Report (report number 403.3/0/0906) the Working Plan for Ecological Restoration at the Morfa Closed Landfill site by LAB Coastal dated June 2006, and restoration and aftercare details as submitted under other conditions of this consent.*
- f. *the monitoring of the stability of the restored dune system and any operations and modifications required for their construction.*
- g. *details on the creation and operation of an Ecological, Restoration and Aftercare Steering Group that must include as a minimum the operator, their nominated consultants, representatives from Natural Resources Wales and the Local Planning Authority. The scheme shall be implemented as approved.*

* Note that a typographical error has meant that there is no item C.

- 1.5 It has been accepted the impacts on the groundwater regime from the closed landfill site have been negligible (ENDS, 2016) with no risk to the water quality of the River Kenfig or the SAC. However, recharge of the ditches of the SSSI has been contaminated by groundwater flowing through the open landfill, altering water chemistry and it has been necessary to completely cap the waste mass. This has reduced groundwater levels in the SSSI but has been addressed by the establishment of a recharge trench system and by restricting sand extraction to above the water table. All current sand extraction is used solely to recreate sand dunes as part of a restoration strategy to replace habitats lost to the landfill operations.

2 Vegetation Survey Baseline Conditions

2.1 Survey history

- 2.2 The only detailed documented vegetation survey of the of the study area traced was that carried out by the Nature Conservancy Council (NCC, now NRW) as part of an NVC survey of sand dunes throughout Wales during the 1970's and 1980's (Jones, 1990). Additional records from the site are published in the *Flora of Glamorgan* (Wade *et al*, 1994), which provides valuable historical reference and data for several key species. Existing data held by the Vice County Recorder for Vascular Plants and Bryophytes was made available and is summaraized below in table 1 below. Regular biological recording carried at the landfill site shortly after it was capped, provides a sufficiently detailed data set for describing the development of the communities. Whist the focus of recording has been on the vegetaton, incidental and *ad hoc* observations of fungi and various faunal groups has also helped to establish a basic level of detail of the fungi/faunal assemblage, as detailed in table 1. Unquestionably, the site is highly likely to support a notable invertebrate assemblage and targeted surveys are recommended.

Table 1: Survey dates and the number of field records for the study site.

Recording period	Number of biological records
Pre-2015	2462
2015	58
2016	123
2017	15
2018	101
2019	150
2020	196
2021	92
2022	133

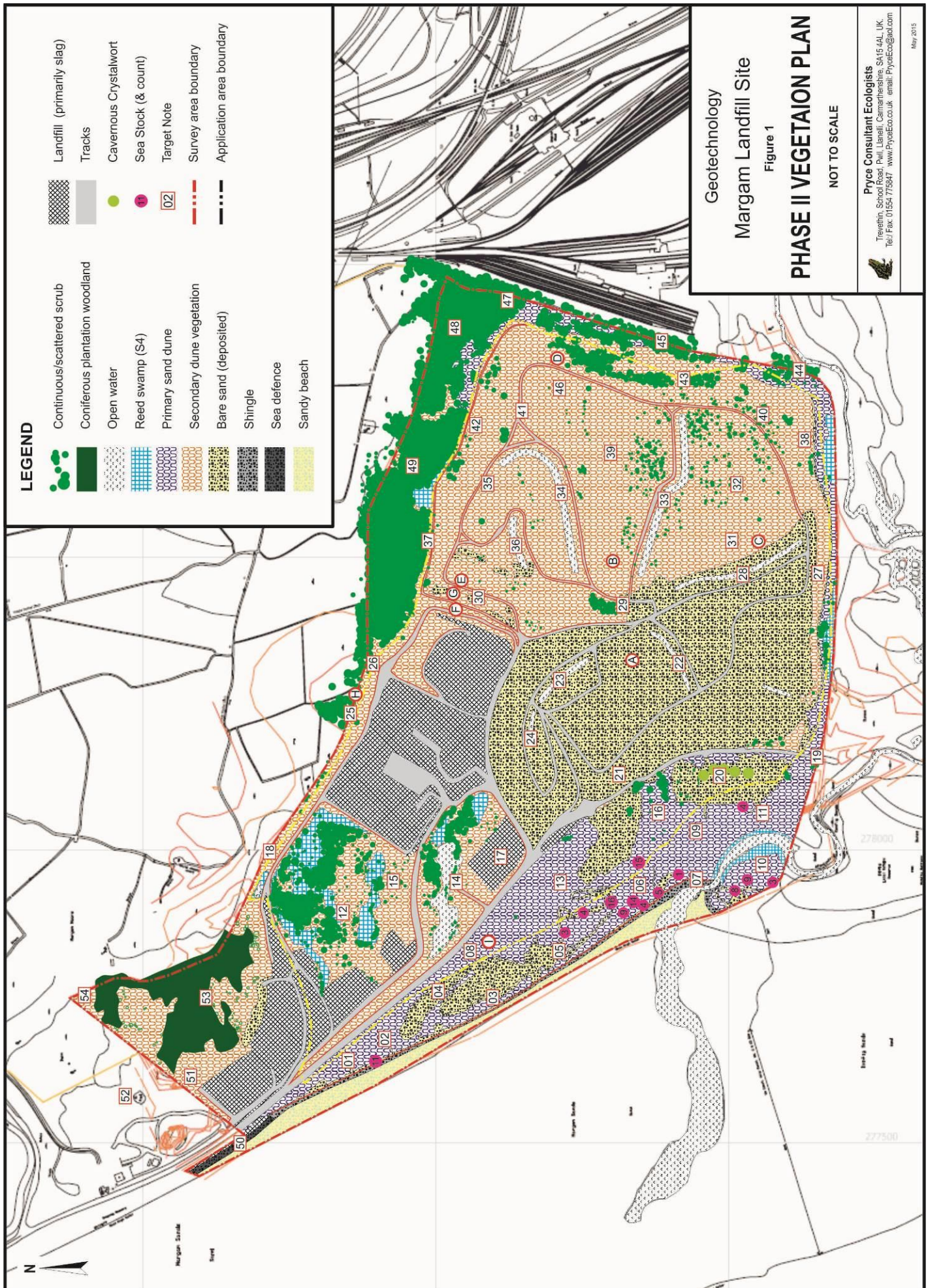
Table 2: Numbers of species recorded within Margam Landfill Site.

Species Totals for the Margam Landfill Site				
Taxonomic Groups	Capped Landfill	Additional species within Working Landfill Area	Additional species within marginal areas of Semi-natural Vegetation	Totals
Birds	65	3	12	80
Bryophytes	64	4	3	71
Fungi	21		1	22
Invertebrates	75	4	19	98
Lichens	17	4	1	22
Mammals	3		2	5
Reptiles	1		4	5
Vascular Plants	254	20	63	337
All species	500	35	105	640

2.3 Methods

The study area comprises the landfill site and adjacent remnant dune vegetation at Margam Burrows, i.e. the bulk of the land between the Margam Moors SSSI and the upper beach as shown on figure 1. The site lies within the unitary authority of Neath Port Talbot (NPT) and has a central Ordnance Survey grid reference of SS783837. The only detailed vegetation survey of the of the study area undertaken prior to the establishment of tip, was a National Vegetation Classification (NVC) survey of sand dunes carried out by the Nature Conservancy Council throughout Wales (Jones, 1990), which has been redrawn in context with the study site at figure 6.

During 2014 the entire study site (excluding active working areas devoid of vegetation) was surveyed. Species lists were compiled for all habitats by means of target notes (TN) which are reproduced at Appendix 1. In areas where community types were not clearly differentiated or where there were gradual transitions, selective quadrat sampling was used to help determine the closest community fit. Communities were identified using keys in the Rodwell (1991-2000), Cooper (1997) and in difficult cases the programme Match was used. Since the 2014 vegetation survey was undertaken an additional 868 records have been made at the site, additional to plot monitoring records.

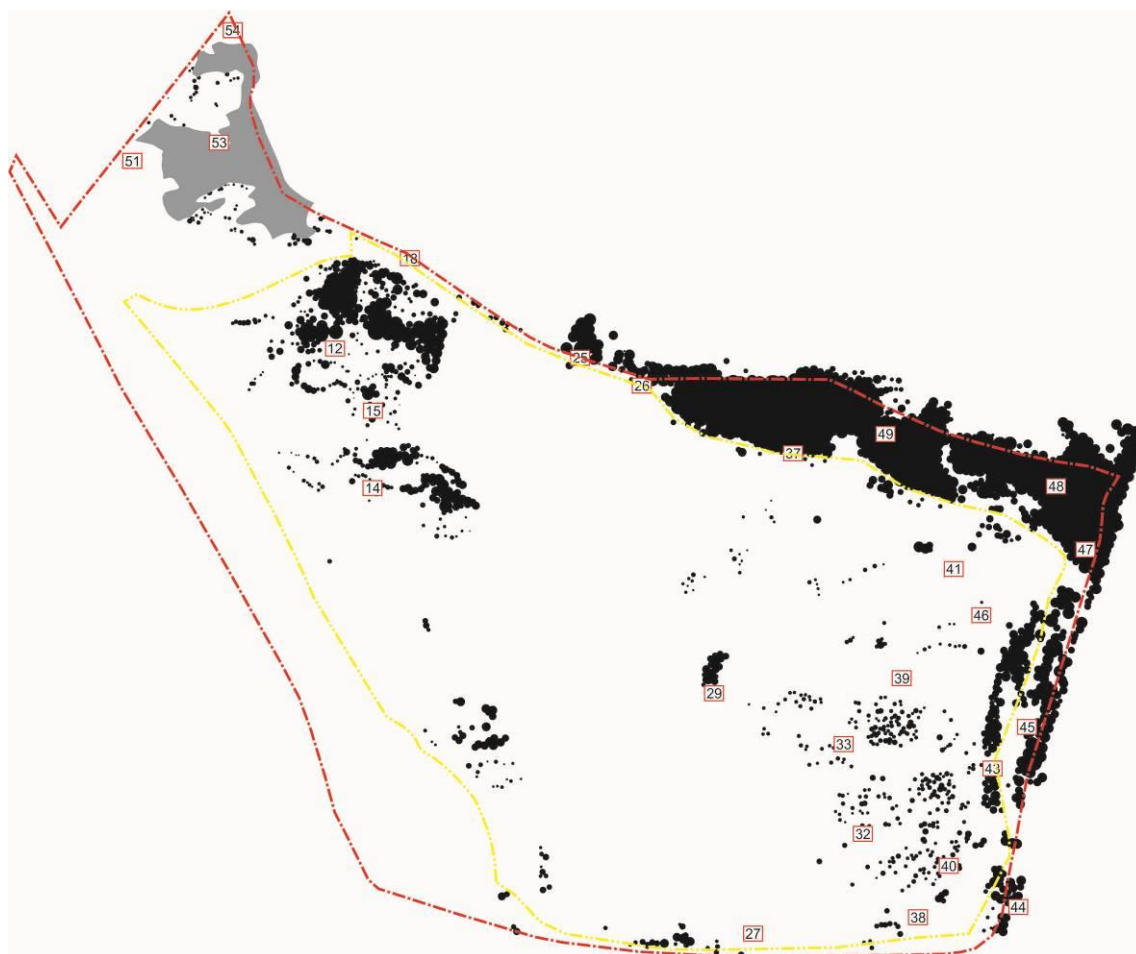


2.4 Results

Each habitat along with its representative NVC communities (where appropriate) is described below along with the main characteristics that help define each ecological unit within the study site.

2.5 Coniferous plantation woodland

Figure 2 Coniferous plantation (grey), Deciduous scrub & wet woodland (black).



An area of coniferous plantation woodland is located in the northernmost part of the study site as shown by the grey shading on figure 2. The dominant canopy species is Corsican Pine *Pinus nigra* ssp. *laricio*, but significant parts of the plantation have either failed and or been adversely affected by burning and salt spray during onshore gales. These impacts have created a broken canopy that has allowed the development of a diverse ground flora. The varied sand hill topography along with rabbit-grazing, which maintains open areas of short vegetation and patches of broken ground, provide a diverse range of conditions for plants and a total of 162 species has been recorded, as shown by Target Note (TN) 53 detailed at appendix 1. Other than Sycamore *Acer pseudoplatanus*, which was locally frequent, other tall woody species recorded within the plantation areas were generally noted as being only occasional or rare and included; Blackthorn *Prunus spinosa*, Hawthorn *Crataegus monogyna*, Maritime Pine *P. pinaster*, Pedunculate Oak *Quercus robur*, Rusty Willow *Salix cinerea* ssp. *oleifolia*, Wayfaring-tree *Viburnum lanthanum*, Wild Privet *Ligustrum ovalifolium* and Yew *Taxus baccatus*.

The most prominent species making up the field layer under and around the conifer block were Dewberry *Rubus caesius*, Buck's-horn Plantain *Plantago coronopus*, Bulbous Buttercup *Ranunculus bulbosus*, Cock's-foot *Dactylis glomerata*, Creeping Willow *Salix repens* var. *argentea*, Greater Bird's-foot-trefoil *Lotus pedunculatus*, Hart's-tongue *Asplenium scolopendrium*, Marram *Ammophila arenaria*, Red Fescue *Festuca rubra*, Ribwort Plantain *Plantago lanceolata*, Sand Sedge *Carex arenaria* and Sweet Vernal-grass *Anthoxanthum odoratum*. A wide range sand dune species were recorded with a representative sample of these including Agrimony *Agrimonia eupatoria*, Biting Stonecrop *Sedum acre*, Broad-leaved Helleborine *Epipactis helleborine*, Brookweed *Samolus valerandi*, Burnet Rose *Rosa spinosissima*, Carline Thistle *Carlina vulgaris*, Common Bird's-foot-trefoil *Lotus corniculatus*, Common Centaury *Centaureum erythraea*, Common Restharrow *Ononis repens*, Common Stork's-bill *Erodium cicutarium*, Heath Dog-violet *Viola canina*, Intermediate Polypody *Polypodium interjectum*, Kidney Vetch *Anthyllis vulneraria*, Little Mouse-ear *Cerastium semidecandrum*, Lady's Bedstraw *Galium verum*, Marram *Ammophila arenaria*, Parsley-piert *Aphanes arvensis*, Portland Spurge *Euphorbia portlandica*, Prickly Saltwort *Salsola kali* subsp. *kali*, Pyramidal Orchid *Anacamptis pyramidalis*, Sea Spurge *Euphorbia paralias*, Sea-holly *Eryngium maritimum*, Small-flowered Evening-primrose *Oenothera cambrica*, Stinking Iris *Iris foetidissima*, Thyme-leaved Sandwort *Arenaria serpyllifolia*, Viper's-bugloss *Echium vulgare*, Wallflower Cabbage *Coincya monensis* subsp. *cheiranthos* and Yellow-rattle *Rhinanthus minor*.

2.6 Continuous/scattered scrub

In addition to the conifer plantation, there is a wide variety of woody growth across the site including established wet willow scrub, alder carr and mixed scrub along with a few planted stands of broad-leaved species on the southern boundary of the tip. Figure 2 above shows that scattered scrub was recorded as widespread across much of the restored landfill area with locally frequent areas of scrub recorded at locations TN15, TN25, TN26, TN40, TN41, TN42 and TN45. The species recorded in these areas included locally frequent Alder *Alnus glutinosa*, Butterfly-bush *Buddleja davidii*, Creeping Willow *Salix repens*, Downy Birch *Betula pubescens*, Gorse *Ulex europaeus* Rusty Willow *Salix cinerea* subsp. *oleifolia*, and Sea-buckthorn *Hippophae rhamnoides*, with occasional to rare Dog-rose *Rosa canina* agg., Goat Willow *Salix caprea*, Hawthorn *Crataegus monogyna*, Pedunculate Oak *Quercus robur*, Corsican Pine *Pinus nigra* subsp. *laricio*, Elder *Sambucus nigra*, Sycamore *Acer pseudoplatanus*, Turkey Oak *Quercus cerris* and Yew *Taxus baccata*.

A wide belt of continuous scrub is established on winter-flooded land between the landfill site and Margam Moors SSSI as represented by TN26, TN47, TN48 and TN49 on figure 2 above. These flood plain woodlands are characterised by a dominance of Rusty Willow and Common Reed *Phragmites australis*, with only occasional Purple Loosestrife *Lythrum salicaria* and Greater Tussock-sedge *Carex paniculata* fitting the National Vegetation Classification (NVC) description for **W2** *Salix cinerea*-*Betula pubescens*-*Phragmites australis* woodland. Occasionally Downy Birch also becomes a prominent feature of the canopy and the main woodland field layer components noted in these areas were Atlantic Ivy *Hedera hibernica*, Bluebell *Hyacinthoides non-scripta*, Bramble *Rubus fruticosus* agg., Common Nettle *Urtica dioica*, Common Tamarisk-moss *Thuidium tamariscinum*, Dog's Mercury *Mercurialis perennis*, Field Horsetail *Equisetum arvense*, Giant Fescue *Schedonorus giganteus*, Great Willowherb *Epilobium hirsutum*, Greater Pond-sedge *Carex riparia*, Ground-ivy *Glechoma hederacea*, Hemlock Water-dropwort *Oenanthe crocata*, Herb-Robert *Geranium robertianum*, Male-fern *Dryopteris filix-mas*, Marsh Bedstraw *Galium palustre*, Red Campion *Silene dioica*, Rough Meadow-grass *Poa trivialis*, Skullcap

Scutellaria galericulata and Wood Dock *Rumex sanguineus*.

Alder is more abundant in the woodland mosaic that runs alongside the River Kenfig and the frequency of Common Nettle, Marsh Bedstraw, Rough Meadow-grass and Bramble provide a good fit for the NVC community **W6** *Alnus glutinosa-Urtica dioica* woodland. Whilst there are some rather extensive areas of this woodland type in the local area, it only just creeps into the south-east corner of the study site at TN44.

2.7 Open water

The River Kenfig passes through the south-western part of the study site, but being tidal there are few instream vascular plants or bryophytes present in this lower section. The river banks were densely vegetated, being dominated by Common Reed, and are described in the Reed swamp section below. Other recorded open water features all fell within the landfill area and can be divided into two main types; i) shallow pools formed by former excavations exposing the water table on those parts of the landfill that are still uncapped, and ii) drainage channels created as part of the finished profile of the capped landfill site.

The fluctuating water table pools located on the uncapped areas of the tip are largely vegetated by young reedswamp as described below, but there were a few small remnants of seasonally open water bodies, the largest shown by TN14 on figure 3. This highly calcified slack has pH levels that are extremely high and aquatic vegetation in open was limited to robust, base-tolerant marginal species such as Common Reed, Common Sedge *Carex nigra*, Creeping Bent, Creeping Willow, Gypsywort *Lycopus europaeus*, Hard Rush *Juncus inflexus*, Marsh-marigold *Caltha-palustris*, Sharp Rush *Juncus acutus*, and Yellow Iris. This vegetation roughly equates to a highly modified **SD15** *Salix repens-Calliergon cuspidatum* dune-slack community.

The drainage channels on the capped landfill hold rainwater that has drained only off the capped landfill area. With locally derived sand being the only surface material on the landfill site, the water is extremely clear and nutrient poor. Natural colonisation has taken place over a relatively short period of time, several years in the case of more established drainage channels shown by TN33, TN34 and TN36, but less than two years in the case of the recently created channels at TN22, TN23, TN24 and TN28 and a diversity of early successional stages are well represented. The range of submergent and floating macrophytes recorded was limited but those species that have managed to colonise were flourishing. Species noted included Broad-leaved Pondweed *Potamogeton natans*, Common Stonewort *Chara vulgaris* (including var. *papillata*), Common Water-crowfoot *Ranunculus aquatilis*, Delicate Stonewort *C. virgata*, Opposite stonewort *C. contraria* (including var. *hispidula*), Small Pondweed *Potamogeton berchtoldii* and Thread-leaved Water-crowfoot *Ranunculus trichophyllus*. Aquatic emergent vegetation was similarly limited in diversity with Common Reed being widespread and dominant in some sections. Less abundant but equally widespread were Bulrush *Typha latifolia*, Common Spike-rush *Eleocharis palustris*, Fool's-water-cress *Apium nodiflorum*, Great Willowherb *Epilobium hirsutum*, Grey Club-rush *Schoenoplectus tabernaemontani*, Pink Water-speedwell *Veronica catenata*, Sea Club-rush *Bolboschoenus maritimus*, Water Mint *Mentha aquatic*, Water-plantain *Alisma plantago-aquatica* and Yellow Iris. Placement within the NVC is difficult due to the very heterogenous nature of vegetation, but there are elements of several communities including **A9a** *Potamogeton natans* community: Species-poor sub-community, **S4** *Phragmites australis* swamp, **S12** *Typha latifolia* reedbed, **S19** *Eleocharis palustris* swamp and **S20** *Scirpus lacustris* ssp. *tabernaemontani* swamp.

Figure 3 Open water.

The range of marginal species was found to be significantly greater than the true aquatics and even the exposed liner provided a suitable substrate for bryophytes where there was limited wave action. Margins were typically colonised by dune-slack communities, represented as narrow strips along the margins of the established channels. The best slack-type vegetation was found along the margins of channels shown by TN33 and TN34, with species noted including Broad-leaved Helleborine *Epipactis helleborine*, Common Fleabane *Pulicaria dysenterica*, Creeping Willow, Endive *Pellia endiviifolia*, Greasewort *Aneura pinguis*, Jointed Rush *Juncus articulatus*, Marsh Bryum *Bryum pseudotriquetrum*, Marsh Helleborine *Epipactis palustris*, Olive Beard-moss *Didymodon tophaceus*, Pointed Spear-moss *Calliergonella cuspidata*, Round-leaved Wintergreen *Pyrola rotundifolia* subsp. *maritima*, Southern Marsh-orchid *Dactylorhiza praetermissa*, Variegated Horsetail *Equisetum variegatum* and Yellow Starry Feather-moss *Campylium stellatum*. These linear mosaic communities fit the NVC descriptions for **SD14c** *Salix repens*-*Campylium stellatum* dune-slack community: *Bryum pseudotriquetrum*-*Aneura pinguis* sub-community and **SD15** *Salix repens*-*Calliergon cuspidatum* dune-slack community. Elements of upper saltmarsh vegetation were also noted in association with the dune slack vegetation with the appearance of species such as Long-bracted Sedge *Carex extensa*, Parsley Water-dropwort *Oenanthe lachenalii* and Sea-milkwort *Glaux maritima*.

The more recently created channels at TN22, TN23, TN24 and TN28 were largely open water channels with bare sandy margins supporting sparse pioneer vegetation characterised by species such as Bicoloured Bryum *Bryum dichotomum*, Bulrush *Typha latifolia*, Celery-leaved Buttercup *Ranunculus sceleratus*, Common Reed, Creeping Bent, Field Horsetail *Equisetum arvense*, Frog Rush *Juncus ranarius*, Jointed Rush *Juncus articulatus*, Knotted Pearlwort *Sagina nodosa*, Sand Sedge *Carex arenaria* and Toad Rush *Juncus bufonius*. This artificial pioneer vegetation does not fit well into any of the NVC communities.

2.8 Reed swamp

Figure 4 Reed swamp.



2.9 Primary sand dune

Remnant primary sand dunes are best represented on land between the active landfill site and the beach as shown on figure 5. There is also a narrow band of remnant dune vegetation present along the eastern and north-eastern margin of the tip, although this is modified to various degrees. The NVC survey undertaken by the Countryside Council for Wales in the late 1980s, redrawn at figure 6, shows that whilst there has been further loss on primary dunes to the landfill area, namely the central patch eastern fragments along with the excavation of SD7a+e dune ridges, now dune hollows at TN20 and the hollow between TN13 and TN16 on figure 5, much of the coastal strip has been retained. It is suspected that whilst the communities in these remnant areas have not changed appreciably in terms of NVC types, there are likely to have been significant structural changes; in respect of

dune-slack vegetation, it is suspected these have becoming ranker and have developed greater scrub cover; conversely the yellow dunes have been subjected to regular motorcycle activities, which has inadvertently maintained a degree dune mobility.

Figure 5 Primary sand dune vegetation.



The communities mapped at figure 6 can be broken down into the following categories:

Mobile Dunes

SD4 *Elymus farctus* ssp. *boreali-atlanticus* foredune community

SD6 *Ammophila arenaria* mobile dune community

SD6a *Elymus farctus* sub-community

SD6d *Ammophila arenaria* sub-community

SD6e *Festuca rubra* sub-community

SD6g *Carex arenaria* sub-community

Semi-fixed Dunes

SD7 *Ammophila arenaria* - *Festuca rubra* semi-fixed dune community

SD7a Typical sub-community

SD7b *Hypnum cupressiforme* sub-community

SD7c *Ononis repens* sub-community

SD7d *Elytrigia atherica* sub-community

SD7e *Elymus pycnanthus* sub-community

SD10 *Carex arenaria* dune community

Dune grasslandSD8 *Festuca rubra*-*Galium verum* fixed dune community

SD8a Typical sub-community

SD9 *Ammophila arenaria*-*Arrhenatherum elatius* dune grasslandDune SlacksSD14 *Salix repens*-*Campylum stellatum* dune-slackSD14b *Rubus caesius*-*Galium palustre* subcommunitySD15 *Salix repens*-*Calliergon cuspidatum* dune-slackSD15a *Carex nigra* subcommunitySD16b *Rubus caesius* sub-communityMobile Dunes

Erosion along the dune front has limited the extent of the **SD4** foredune community to the area around the Kenfig rivermouth, shown by TN10, where in addition to Sand Couch *Elymus farctus* ssp. *boreali-atlanticus*, a modest range of other foredune species were recorded including *Atriplex x gustafssoniana*, Dune Pansy *Viola tricolor* subsp. *curtisii*, Sea Radish *Raphanus raphanistrum* subsp. *maritimus*, Sea Rocket *Cakile maritime*, Sea Spurge *Euphorbia paralias*, Sea Stock *Matthiola sinuata*, Sea-holly *Eryngium maritimum* and Spear-leaved Orache *Atriplex prostrata*. **SD6** mobile dune communities are more extensive along the dune front and species diversity is recorded by TN02, TN03, TN05 & TN07. In these areas Marram is overwhelmingly constant and dominant with frequent Sand Sedge. The community on the whole was relatively species poor, but with important species represented, such as Common Broomrape *Orobanche minor*, Dune Pansy, Sandhill Screw-moss *Syntrichia ruralis* var. *ruraliformis*, Sea Stock, Sea-holly. *Hutchinsia Hornungia petraea* was also recorded as recently as 2012 and is it feasible it is still present in small quantity.

Semi-fixed Dunes

More stabilised dune vegetation lie on the landward side of the mobile dunes and are predominantly colonised by **SD7** *Ammophila arenaria*-*Festuca rubra* semi-fixed dune community and its various subcommunities. Species lists representative of these communities are provided at appendix 1, their locations shown by TN01, TN02 TN09, TN13, TN16 and TN19 on figure 5. The constant species in these areas were Marram, Red Fescue, Cat's-ear and Spreading Meadow-grass, with frequent associates characterising the various subcommunities including Biting Stonecrop *Sedum acre*, Carline Thistle *Carlina vulgaris*, Common Bird's-foot-trefoil *Lotus corniculatus*, Common Cornsalad *Valerianella locusta*, Common Restharrow *Ononis repens*, Dewberry *Rubus caesius*, Great Plait-moss *Hypnum cupressiforme* var. *lacunosum*, Hawkweed Oxtongue *Picris hieracioides*, Heath Dog-violet *Viola canina*, Intermediate Polypody *Polypodium interjectum*, Kidney Vetch *Anthyllis vulneraria*, Lady's Bedstraw *Galium verum*, Hybrid Evening-primrose *Oenothera x fallax*, Sea Bindweed *Calystegia soldanella*, Viper's-bugloss *Echium vulgare*, Wild Thyme *Thymus polytrichus* and Yellow Feather-moss *Homalothecium lutescens*.

Figure 6 Primary sand dune vegetation, redrawn from Jones (1990), showing NVC codes with areas lost since 1980's survey shown lighter within dark grey dotted line.



Stabilised dune grassland communities allocated to **SD8** and **SD9** are located along the inner parts of the coastal dune corridor and around the base of the landfill site along the south-eastern margins. In these areas Red Fescue and/or False Oat-grass *Arrhenatherum elatius* generally assume greater dominance over Marram along with forbes such as Bird's-foot Trefoil, Lady's Bedstraw, Ribwort Plantain *Plantago lanceolata*, White Clover and Yarrow *Achillea millefolium*. Species lists representing these communities are shown by TN04, TN19, TN38, TN45 and TN47 on figure 5. The most frequent associates recorded that characterise these communities included Carrot *Daucus carota*, Cat's-ear, Common Restharrow, Common Stork's-bill *Erodium cicutarium*, Dewberry, Dove's-foot Crane's-bill *Geranium molle*, Great Plait-moss *Hypnum cupressiforme* var. *lacunosum*, Hare's-foot Clover *Trifolium arvense*, Hawkweed Oxtongue *Picris hieracioides*, Intermediate Polypody, Kidney Vetch *Anthyllis vulneraria*, Thyme-leaved Sandwort *Arenaria serpyllifolia*, Viper's-bugloss *Echium vulgare*, Wallflower Cabbage *Coincya monensis* subsp. *cheiranthos*, Wild Thyme *Thymus polytrichus* and Yellow Feather-moss

Small remnants of dune-slack vegetation are distributed around the landfill site, as

indicated by **SD14** and **SD15** areas on figure 6. Target notes describing the floristics in these areas are TN06, TN08, TN45 & TN47, but Creeping Willow is typically dominant and unmanaged reducing opportunities for some of the rarer species associated with this habitat. Other constants that define these communities are Creeping Bent, Glaucous Sedge, Marsh Helleborine, Variegated Horsetail, Marsh Pennywort, Water Mint, Pointed Spear-moss and Yellow Starry Feather-moss. The slacks in the study site still support a few rarer species such as Sharp Rush and Round-leaved Wintergreen, but Fen Orchid is likely to have been lost in the 1980s when the landfill extended over the dunes.

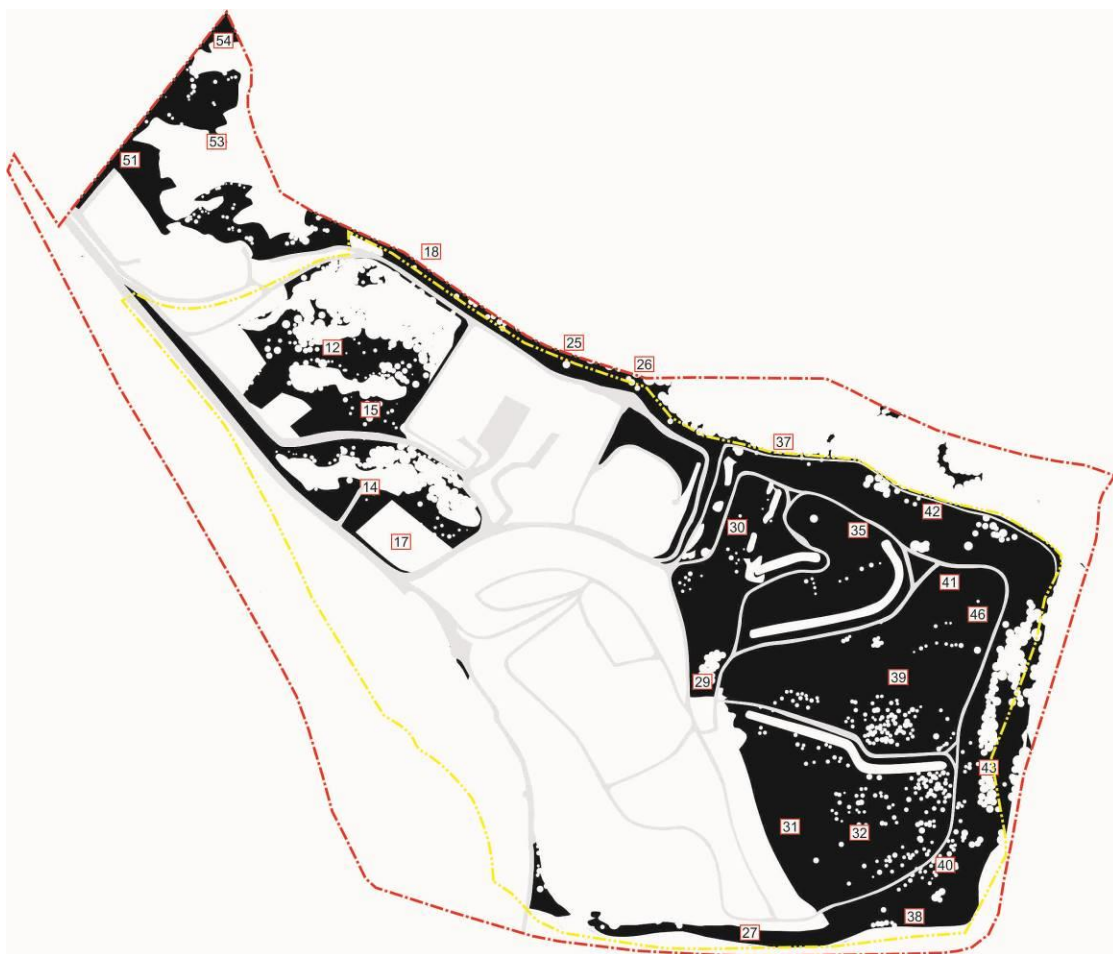
2.10 Secondary sand dune vegetation

Secondary dune vegetation is made up of two broad types; i) worked areas of dunes that remain uncapped, and ii) the capped and profiled landfill plateau that has been covered with locally sourced sand. In both cases colonisation has been allowed to take place naturally and these areas all support a complex mosaic of secondary dune communities, most of which are poorly defined in NVC terms.

The north-western half of the study site supports a patchwork of secondary dune types as shown by TN12, TN14, TN18, TN25, TN26, TN37, TN51, TN53 and TN54 on figure 7. In these areas a high level of topographical complexity and sand-based soil types provides a wide range of niches for a ruderal and dune species and the areas are highly diverse supporting 223 species of vascular plants and bryophytes. Species which appear as locally frequent or abundant include Burnet Rose *Rosa spinosissima*, Common Bird's-foot-trefoil, Common Fleabane, Common Restharrow, Common Stork's-bill *Erodium cicutarium*, Kidney Vetch, Lady's Bedstraw, Marram, *Oenothera x fallax*, Red Fescue, Wood Small-reed *Calamagrostis epigejos* and Yellow-rattle *Rhinanthus minor*. The NVC communities represented as mentioned are poorly defined but include elements of the following:

- SD6 *Ammophila arenaria* mobile dune community
- SD7 *Ammophila arenaria* -*Festuca rubra* semi-fixed dune community
- SD8 *Festuca rubra*-*Galium verum* fixed dune community
- SD9 *Ammophila arenaria*-*Arrhenatherum elatius* dune grassland
- SD10 *Carex arenaria* dune community
- SD15 *Salix repens*-*Calliargon cuspidatum* dune-slack
- OV25 *Urtica dioica*-*Cirsium arvense* community

Figure 7 Secondary sand dune vegetation.



Species noted of particular significance in these areas included Broad-leaved Helleborine, Carline Thistle, Drooping Thread-moss *Bryum algovicum*, Portland Spurge *Euphorbia portlandica*, Prickly Saltwort, Pyramidal Orchid *Anacamptis pyramidalis*, Sea Rocket, Sea Spurge, Sea-holly, Sharp Rush, Viper's-bugloss and Wayfaring-tree *Viburnum lantana*.

Secondary dune vegetation in the south-eastern half of the study area, as shown by TN27, TN29, TN31, TN32, TN35, TN38, TN39, TN40, TN41, TN42, TN43 and TN46, is all situated on the capped landfill area. The most diverse and better quality vegetation occurs on those areas of the capped landfill area where sandy soils are thinnest. In areas where deeper deposits have been made, coarse grasses and tall ruderal herbs are prominent and often dominate sizeable areas. As with the uncapped areas of secondary dune the NVC communities represented include elements of SD6, SD7, SD8, SD9, SD10 and OV25, these communities supporting a very high level of diversity with 283 species of vascular plants and bryophytes recorded in total. Excluding scrub, which is described above, the most frequent/abundant species recorded in these areas included Common Couch *Elytrigia repens*, Creeping Bent, False Oat-Grass, French Bartsia *Odontites jaubertianus*, Hoary Mustard, Kidney Vetch, Lady's Bedstraw, Lesser Bird's-claw Beard-moss, Oxeye Daisy *Leucanthemum vulgare*, Red Fescue, Sand Sedge, Tall Melilot *Melilotus altissimus*, White Melilot *Melilotus albus*, Wild Carrot *Daucus carota*, Wild Parsnip *Pastinaca sativa*, Wood Small-reed *Calamagrostis epigejos*, Yellow-rattle and Yorkshire-fog

Species noted of particular significance in these areas included Autumn Lady's-tresses *Spiranthes spiralis*, Bee Orchid *Ophrys apifera*, Broad-leaved Helleborine, Bugseed

Corispermum intermedium, Carline Thistle, Common Spotted-orchid *Dactylorhiza fuchsia*, Common Twayblade *Neottia ovata*, Compact Brome *Anisantha madritensis*, Drooping Thread-moss, Hutchinsia *Hornungia petraea*, Knotted Pearlwort *Sagina nodosa*, Lesser Centaury *Centaureum pulchellum*, Neglected Couch *Elytrigia campestris* subsp. *maritima*, Pale Flax *Linum bienne*, Portland Spurge, Prickly Saltwort, Pyramidal Orchid, Sand Cat's-tail *Phleum arenarium*, Sea Bindweed *Calystegia soldanella*, Sea Fern-grass *Catapodium maritimum*, Sea-holly, Sea Rocket, Sea Spurge, Sharp Rush, Small-fruited Yellow-sedge *Carex oederi*, Southern Marsh-orchid *Dactylorhiza praetermissa* and Viper's-bugloss.

2.11 Bare sand

Figure 8 Bare sand.



The most extensive areas of bare sand within the study area were the recently capped areas of landfill. Most of these areas generally supported <5% plant cover, though diversity was surprising high with 66 species recorded at TN22 alone. Other areas of sparse vegetation on bare sand were recorded at locations shown by TN21, TN23, TN24 and TN29 in part. Only a limited number of species attained any degree of frequency in these areas, these being Curled Dock *Rumex crispus* var. *littoreus*, Dewberry, hybrid Evening-primrose, Kidney Vetch, Marram, Sand Sedge, Sea Mayweed *Tripleurospermum maritimum*, Viper's-bugloss and Wallflower Cabbage *Coincya monensis* subsp. *cheiranthos*. A few significant species were recorded including Bugseed, Frog Rush *Juncus ranarius*, Hawkweed Oxtongue, Neglected Couch, Prickly Saltwort, Sea-holly and Sea Rocket.

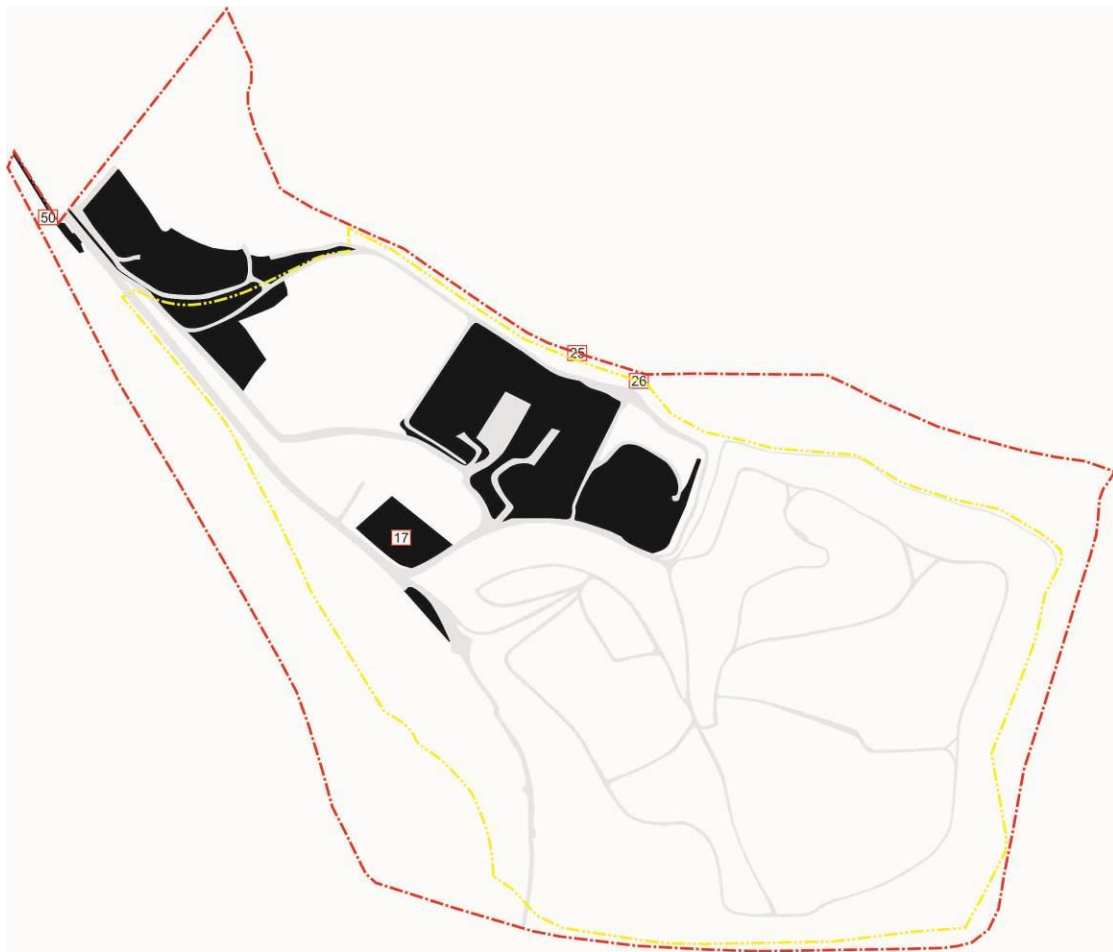
Sand extraction from the primary dunes has taken place in recent years in the areas shown by TN20 and the area between TN13 and TN16 on figure 8. The latter area is largely devoid of vegetation, but excavations at TN20 have gone slightly below the winter water table and a distinctive suite of pioneer dune-slack species have colonised including a number of significant species such as Bugseed, Cavernous Crystalwort *Riccia cavernosa*, Frog Rush, Knotted Pearlwort, Red Goosefoot *Chenopodium rubrum*, Sea-holly, Variegated Horsetail and Viper's-bugloss.

Bare sand in other parts of the site have largely arisen as a result of disturbance from vehicles along track edges and offroad motorcycling which occurs extensively through the beachside dune corridor, which is discussed under the heading primary sand dune vegetation.

2.12 **Uncapped landfill**

Areas of uncapped landfill materials are shown on figure 9. Some locations where landfill had been left undisturbed for several years, such as at TN17, supported a distinctive sparse lichen-bryophyte flora, with locally frequent Biting Stonecrop *Sedum acre*, Buck's-horn Plantain *Plantago coronopus*, *Cladonia* lichens, Great Plait-moss, Lesser Bird's-claw Beard-moss, Sand-hill Screw-moss and Whitish Feather-moss *Brachythecium albicans*.

Track embankments and verges frequently supported similar vegetation, but deposits of wind-blown sand also provided conditions for a wide range of grassland and sand-dune species typified by Bilbao's Fleabane *Conyza floribunda*, Cock's-foot, Colt's-foot *Tussilago farfara*, Common Ragwort, Common Restharrow, Common Vetch *Vicia sativa subsp. segetalis*, Creeping Bent, False Oat-Grass, Hare's-foot Clover, Oxford Ragwort *Senecio squalidus*, Red Fescue, Redshank *Ceratodon purpureus*, Wallflower Cabbage, White Clover, Wild Carrot and Yarrow.

Figure 9 Uncapped landfill.

2.13 Beach frontage

Figure 10 shows the narrow strip of shingle at the top of the open beach. This was largely sparsely vegetated except at the southern end at TN07 by the Kenfig rivermouth where several significant species were recorded including Japanese Rose, Sea Radish, Sea Rocket, Sea Spurge, Sea Stock, Sea-holly and Spear-leaved Orache.

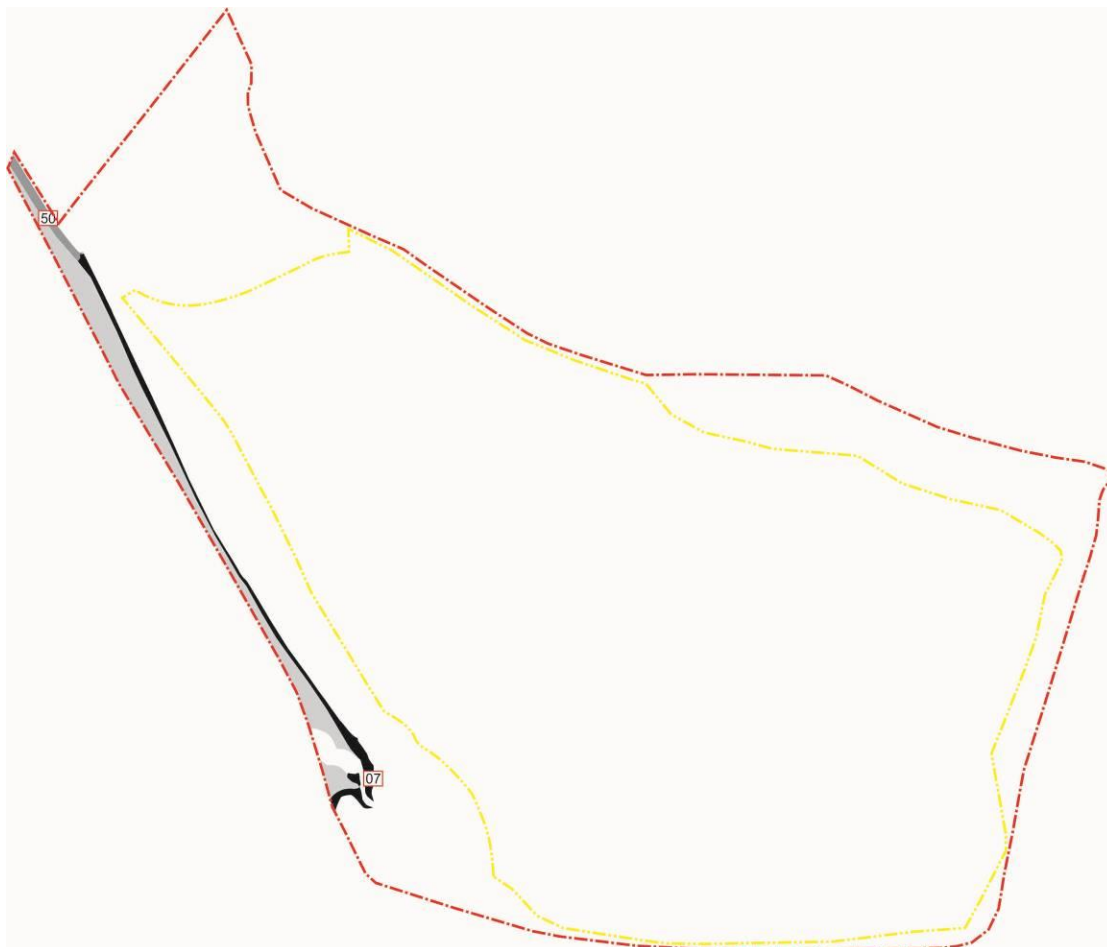
2.14 Sea defence

Sea defences at the northern end of the coastal strip as shown by TN50 on figure 10 were made up of blockstone and rubble with deposits of wind-blown sand. The most prominent species characterising the vegetation on this artificial substrate were Danish Scurvygrass *Cochlearia danica*, Common Bird's-foot-trefoil, Kidney Vetch, Portland Spurge, Rock Samphire *Crithmum maritimum* and Sea Mayweed. A few species of note were recorded including Dune Pansy, Knotted Clover *Trifolium striatum*, Sea Bindweed, Sea Spurge, Sea Stock, Sea-holly and Yellow Horned-poppy *Glaucium flavum*.

2.15 Open beach

No vascular plants were recorded on the open sandy beach below the MHW line.

Figure 10 Shingle (black), sea defence (dark grey) & open beach (light grey).



3. Ecological Significance of Features

- 3.1. Each feature has been classified according to its nature conservation value using the examples provided in Table 3.1.

Table 3.1. Ecological Significance

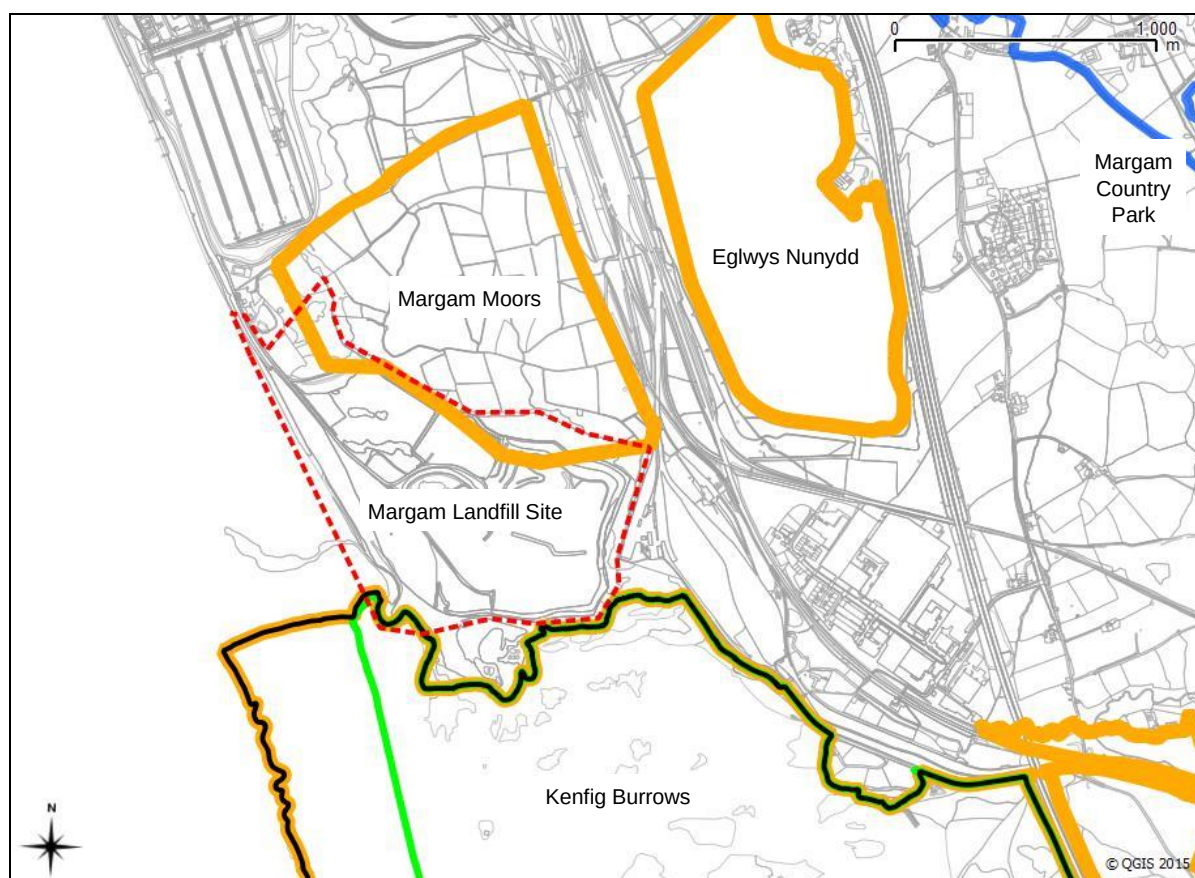
Value	Examples
International	Internationally designated or proposed sites such as Ramsar Sites, Special Protection Areas, Biosphere Reserves and Special Areas of Conservation, or otherwise meeting criteria for international designation. Sites supporting populations of internationally important species.
National	Nationally designated sites such as Sites of Special Scientific Interest (SSSIs), or non-designated sites meeting SSSI selection criteria, National Nature Reserves (NNRs), Nature Conservancy Review (NCR) Grade 1 sites, viable areas of key habitats within the UK Biodiversity Action Plan. Sites supporting viable breeding populations of Red Data Book (RDB) species (excluding scarce species), or supplying critical elements of their habitat requirements.
Regional	Sites containing viable areas of threatened habitats listed in a regional Biodiversity Action Plan, comfortably exceeding Site of Importance for Nature Conservation (SINC) criteria, but not meeting SSSI selection criteria. Sites supporting viable populations of Nationally Scarce species or those included in the Regional Biodiversity Action Plan on account of their rarity, or supplying critical elements of their habitat requirements.
County	Sites meeting the criteria for a county or metropolitan area designation (such as SINC), which may include amenity and educational criteria in urban areas. Ancient semi-natural woodland. Designated Local Nature Reserves. Sites containing viable areas of any key habitat type identified in the Local Biodiversity Action Plan (LBAP). Sites supporting viable breeding populations of species known to be county/metropolitan rarities e.g. featuring in county 'red data book' or LBAP, or supplying critical elements of their habitat requirements.
District	Undesignated sites, or features considered appreciably to enrich the habitat resource within the context of the Borough or District, or included in the Borough or District LBAP. Amenity and educational functions will be recognised in urban areas. Sites with viable breeding populations of species listed as rare in the District or Borough LBAP or supplying critical elements of their habitat requirements.
Local	Undesignated sites, or features considered appreciably enriching the habitat resource within the context of the Parish or neighbourhood (e.g. a species-rich hedgerow).
Unimportant	Low-grade and widespread habitats

3.2 Statutory Sites Adjacent to the Study Site

Figure 11. Context of site in relation to protected sites

Key to boundaries:

Red dots	Study site
Black	Special Area of Conservation (SAC) / Local Nature Reserve (LNR)
Gold	Site of Special Scientific Interest (SSSI)
Green	Natioanl Nature Reserve (NNR)
Blue	Country Park



3.3 Protected Sites of International Significance

Kenfig Special Area of Conservation (SAC)

The primary SAC features provided by JNCC (2015 url) are as follows:

Annex I habitats that are a primary reason for selection of this site

2130 "Fixed coastal dunes with herbaceous vegetation ("grey dunes")" * Priority feature

*Kenfig is a largely intact dune system in south Wales with extensive areas of fixed dune vegetation with red fescue *Festuca rubra* and lady's bedstraw *Galium verum* and semi-fixed dune grassland with marram *Ammophila arenaria* and red fescue. There is also a relatively large area of more acidic vegetation dominated by sand sedge *Carex arenaria*, sheep's-fescue *Festuca ovina* and common bent *Agrostis capillaris*.*

2170 Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)

Kenfig contains one of the largest series of dune slacks in Wales. The dune slacks are species-rich and there are extensive areas of dunes with *Salix repens* ssp. *argentea*, which represent a mature phase in dune slack development. This site is in the central part of the range of this community on the west coast and is a highly representative example of this habitat type.

2190 Humid dune slacks

Kenfig in south Wales contains the most important example of Humid dune slacks in the UK, owing to the extent of the habitat type and the conservation of its structure and function. These calcareous dune slacks are also amongst the most species-rich in the UK, supporting communities dominated by a variety of mosses and a number of rare plants, notably 1903 Fen orchid *Liparis loeselii*, for which the site is also selected. Some of the dune slacks on the site are still in the early successional stage of development.

3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.

Kenfig Pool is a shallow lake system within the extensive sand dune system of Kenfig, alongside Swansea Bay in south Wales. The water chemistry is indicative of a coastal, alkaline lake with a moderate nutrient status. High alkalinity, conductivity, sodium and chloride values reflect this marine influence. Elevated calcium values are probably derived from marine shell remains in the sandy substrate. Large stands of common reed *Phragmites australis* are found on the pool's seaward side. Grey club-rush *Scirpus lacustris* ssp. *tabernaemontani*, sea club-rush *Scirpus maritimus*, branched bur-reed *Sparganium erectum* and yellow iris *Iris pseudacorus* are also present. A sheltered bay supports a plant association dominated by shining pondweed *Potamogeton lucens* and curled pondweed *P. crispus*. Hairlike pondweed *P. trichoides* is locally dominant in the north end and the south end has abundant rigid hornwort *Ceratophyllum demersum*, Canadian waterweed *Elodea canadensis*, fan-leaved water-crowfoot *Ranunculus circinatus*, spiked water-milfoil *Myriophyllum spicatum* and the charophytes *Chara aspera* var. *aspera* and *Nitella flexilis* var. *flexilis*. Shoreweed *Littorella uniflora* can be found growing in association with *C. aspera* and the aquatic moss *Fontinalis antipyretica* along the sandy shore section. *C. aspera* also dominates the substrate off the grazed landward shoreline, to a depth of approximately 1.5 m.

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site

1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

Annex II species that are a primary reason for selection of this site

1395 Petalwort *Petalophyllum ralfsii*

Kenfig is one of two sites selected for petalwort *Petalophyllum ralfsii* in south Wales and supports a large population of the species, numbering thousands of thalli. The calcareous dune system has many dune slacks that include the early successional, open slack vegetation this species requires.

1903 Fen orchid *Liparis loeselii*

Kenfig on the south Wales coast holds the largest populations of fen orchid *Liparis loeselii* in the UK, comprising about 50% of the UK resource. Management of the site is directed towards the maintenance and enhancement of the populations of fen orchid. The variety that occurs here, as at Whiteford Burrows, is var. *ovata*, which is currently known to occur only in Wales and on the coast of Brittany, as well as in the past at Braunton Burrows, Devon, England.

3.4 Protected Sites of National Significance

Kenfig SSSI

Cynffig/Kenfig SSSI is part of Kenfig/Cynffig candidate Special Area of Conservation, being host to the Annex I habitats and Annex II species of the EC Habitats Directive: (Directive 92/43/EEC on the Conservation of Natural habitats and of Wild Flora and Fauna) listed above.

Additionally the site is host to the following plant species protected under Schedule 8 of the Wildlife and Countryside Act as substituted by Schedule 9 to the Countryside and Rights of Way Act 2002:

Fen Orchid *Liparis loeselii*
Petalwort *Petalophyllum ralfsii*

This site is host to the following animal species protected under Schedule 5 of the Wildlife and Countryside Act as substituted by Schedule 9 to the Countryside and Rights of Way Act 2000 :

Medicinal Leech *Hirudo medicinalis*

The SSSI citation provides details of the main ecological attributes as follows:

“Kenfig is of special interest for its extensive sand dune habitats and standing waters together with a mixture of associated coastal habitats including saltmarsh, intertidal areas, swamp, woodland and scrub. In addition, the site is of special interest for the assemblages of plants, fungi and invertebrates that are associated with the sand dunes and standing waters. The following individual species are also of special interest: petalwort Petalophyllum ralfsii, the medicinal leech Hirudo medicinalis, the fen orchid Liparis loeselii, the shrill carder bee Bombus sylvarum, the hairy dragonfly Brachytron pratense and a weevil Pachytychius quinquepunctatus.

This extensive sand dune system is located on the south-eastern edge of Swansea Bay between Margam and Porthcawl. It is bounded by the Afon Cynffig to the north, with agricultural land and the village of Kenfig to the south and east.

The beach and dunes are composed of periglacial material most of which is derived from the Pennant Sandstone of the Upper Coal Measures. A large tidal range, predominantly onshore winds and low-lying coastal hinterland have permitted the development at Kenfig of a hindshore type dune system which extends inland for over 3 km at its widest point. There is a discontinuous distribution of clay and silt beneath the dune sand, with gravel and peat also occurring in the stratigraphy locally .

The exceptional wetness of the Kenfig dune system is of national significance, and the shallow, gently-domed groundwater table is thought to be mainly rain-fed, but it is possible that groundwater inflow from underlying/neighbouring carbonate aquifers also plays a role. Many of the Kenfig slacks flood to a depth of 0.5 metres or more during a typical winter, their peaty soils remaining wet during all but the driest summers.

Intertidal habitat at Kenfig is characterised by a large sandy beach with rocks to the south. The beach, which forms the coastal fringe of the site, is believed to be eroding at the present time, and the foredune frontage has experienced significant sediment loss in recent years. There is a typical foreshore community of prickly saltwort Salsola kali, long-stalked orache Atriplex

longipes, sea sandwort Honckenya peploides, and sea rocket Cakile maritima. Embryonic shifting dunes dominated by sand couch Elytrigia juncea occupy a very small area behind the foreshore but their continued development is restricted by inadequate supplies of new sand from the intertidal zone. Further inland, species such as marram Ammophila arenaria and sea-holly Eryngium maritimum form a typical foredune community. The nationally rare sea stock Matthiola sinuata occasionally occurs in grasslands on the landward slopes of foredunes. The succession from these fore-dunes to tall, white dunes of marram grass is evident along the foreshore. Grassland species colonise these white dunes inland, forming a marram grass/red fescue Festuca rubra semi-fixed dune grassland community.

The dune system includes extensive areas of semi-fixed and fixed species-rich dune grassland types. Dune grassland with red fescue Festuca rubra and lady's bedstraw Galium verum is especially common, but there are also areas of more rank neutral dune grassland with yorkshire-fog Holcus lanatus, false oat-grass Arrhenatherum elatius, dewberry Rubus caesius and burnet rose Rosa pimpinellifolia. Leaching of normally calcareous dunes has led to the occurrence of some short-sward acid grassland, particularly near the landward margin of the site. This grassland is characterised by sweet vernal-grass Anthoxanthum odoratum, common bent Agrostis capillaris, sheep's fescue Festuca ovina and sheep's sorrel Rumex acetosella. Discrete patches of dune heath with heather Calluna vulgaris occur within this grassland.

Kenfig has some of the most important and species-rich dune slack vegetation in the UK, with species composition and stand structure varying with hydrology and age. Creeping willow Salix repens is ubiquitous and often abundant on the slack floors, along with other typical slack species such as variegated horsetail Equisetum variegatum, marsh pennywort Hydrocotyle vulgaris, marsh helleborine Epipactis palustris, southern marsh-orchid Dactylorhiza praetermissa and early marsh-orchid D. incarnata. The rare petalwort Petalophyllum ralfsii occurs in the patches of damp, bare sand between the creeping willow, and the fen orchid Liparis loeselii, occurs in certain younger dune slack communities.

Areas of scrub are scattered throughout the site, including stands of hawthorn Crataegus monogyna and blackthorn Prunus spinosa. There are also stands of poplar Populus x candicans and P. tremula on dry dunes and of birch Betula spp. and willow Salix spp. in wetter slacks and areas of flushed dune grassland. Mature stands of sea-buckthorn Hippophae rhamnoides and birch support a dune woodland flora and provide cover for nesting birds. The overall cover of scrub has increased steadily in the post-war era largely as a result of lack of grazing.

To the northwest of the site, there is a small area of saltmarsh on the floodplain of the Afon Cynffig. This area is dominated by sea rush Juncus maritimus, saltmarsh rush Juncus gerardii, red fescue and sea club-rush Bolboschoenus maritimus. Sand couch Elytrigia juncea dominates the transition zone between saltmarsh and dune.

The water chemistry of Kenfig Pool is indicative of a coastal, alkaline lake with a moderate nutrient status. The sandy substrates which characterize the shoreline support significant stands of common reed Phragmites australis dominated swamp on the pool's seaward side, while the inland shoreline is cattle grazed and devoid of emergent vegetation. Other common components of the swamp vegetation include grey club-rush Schoenoplectus lacustris ssp. tabernaemontani, sea club-rush Bolboschoenus maritimus, and branched bur-reed Sparganium erectum. Sheltered bays and small clearings within the larger stands contain significant floating leaved stands of amphibious bistort Persicaria amphibia. Shining pondweed Potamogeton lucens and curled pondweed P. crispus are occasional aquatic species here. Common spike-rush Eleocharis palustris, marsh pennywort Hydrocotyle vulgaris, and marsh marigold Caltha palustris occupy the margins. The open water provides a habitat for many aquatic species which together cover the entire pool bed. The scarce hairlike pondweed Potamogeton trichoides is locally dominant, particularly in the north of the lake, while the south end includes abundant rigid hornwort Ceratophyllum demersum, fan-leaved water-crowfoot

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A: Baseline Conditions**

Ranunculus circinatus, *spiked water-milfoil* *Myriophyllum spicatum* and the *charophytes* rough stonewort *Chara aspera* var. *aspera* (nationally scarce) and smooth stonewort *Nitella flexilis* var. *flexilis*. The shallow open water habitat at the south end of Kenfig Pool supports swards of shoreweed *Littorella uniflora* often growing in association with rough stonewort and the aquatic moss *Fontinalis antipyretica*. Rough stonewort also dominates the substrate off the grazed landward shoreline, to a depth of approximately 1.5 m.

There is an abundant and diverse assemblage of aquatic invertebrates in Kenfig Pool. *Caenid* mayflies *Caenis luctuosa* can be found in large numbers in silty areas; damselfly larvae have also been recorded. Other aquatic invertebrates present include the bristleworms (*Oligochaetes*), pea mussels *Pisidium* spp., snails *Lymnaea peregra*, leeches, beetles, water bugs and predatory triclads.

Kenfig supports populations of petalwort *Petalophyllum ralfsii* and the largest UK population of the fen orchid *Liparis loeselii*. The site is also important for its assemblage of nationally scarce and nationally rare vascular plants such as sea stock *Matthiola sinuata*, variegated horsetail *Equisetum variegatum*, Portland spurge *Euphorbia portlandica*, *hutchinsia* *Hornungia petraea*, rock sea-lavender *Limonium procerum*, round-leaved wintergreen *Pyrola rotundifolia*, and dune fescue *Vulpia fasciculata*.

The sand dunes of Kenfig support an assemblage of rare macrofungi. Important species include a nail fungus *Poronia punctata*, an ink-cap fungus *Coprinus ammophilae*, a stalked puffball *Tulostoma brumale* and a milk-cap fungus *Lactarius controversus*.

Kenfig is important for its invertebrate fauna. The sand dunes represent a stronghold for rare invertebrates, such as the weevil *Pachytychius quinquepunctatus* and the shrill carder bee *Bombus sylvarum*. The pool is home to the medicinal leech *Hirudo medicinalis* and the hairy dragonfly *Brachytron pratense*. The site is also important for its assemblage of Red Data Book insects including a solitary wasp *Minumesa littoralis*, a snail-killing fly *Pteromicra pectorosa* a robber fly *Pamponerus germanicus* and the vernal colletes *Colletes cunicularius*.

Margam Moors SSSI

The SSSI citation provides details of the main ecological attributes as follows:

*"The last remaining example of the once extensive coastal levels in West Glamorgan. Bounded to the seaward by dunes and to landward by high ground, the meadows provide an agriculturally-managed freshwater habitat which hosts many species of plant on the edge of their geographical range, and nationally important invertebrates. Mesotrophic marsh, fen meadow and ditch communities support Flowering-rush *Butomus umbellatus*, Frogbit *Hydrocharis morsus-ranae*, Arrowhead *Sagittaria sagittifolia*, Cyperus Sedge *Carex pseudocyperus* and Brown Sedge *C. disticha* on the edge of their range, with others such as Lesser Water-plantain *Baldellia ranunculoides*, Tubular Water-dropwort *Oenanthe fistulosa* and Marsh Helleborine *Epipactis palustris* of local interest. The nationally rare beetle *Haliplus mucronatus*, the dragonfly *Sympetrum sanguineum* the regionally rare beetle *Anacaena bipustulata*, and the water-bug *Corixa panzeri* have all been found in the ditches."*

Eglwys Nunydd SSSI

The SSSI citation provides details of the main ecological attributes as follows:

"The largest sheet of fresh water in the county. On the site of Margam Moors which, before being reclaimed for the Abbey Steel Works, were a notable site for wildfowl. The reservoir attracts large numbers of wintering waterfowl and passage migrants. Notable species including Great Crested and Little Grebes, Mallard, Gadwall and Coot now breed."

3.5 Habitats and vegetation within the study site

3.6 Habitats of European Significance

Annex 1 habitats as defined in the EC Habitats Directive.

Three of the four habitats listed as primary features of the Kenfig SAC are represented as remnant fragments within the study area, their distributions being shown by the NVC codes on figure 6, these being:

"Fixed coastal dunes with herbaceous vegetation ("grey dunes")"

SD7 *Ammophila arenaria* -*Festuca rubra* semi-fixed dune community

SD7a Typical sub-community

SD7b *Hypnum cupressiforme* sub-community

SD7c *Ononis repens* sub-community

SD7d *Elytrigia atherica* sub-community

SD7e *Elymus pycnanthus* sub-community

SD8 *Festuca rubra*-*Galium verum* fixed dune community

SD8a Typical sub-community

SD9 *Ammophila arenaria*-*Arrhenatherum elatius* dune grassland

Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)

SD14 *Salix repens*-*Campylium stellatum* dune-slack

SD14b *Rubus caesius*-*Galium palustre* subcommunity

SD15 *Salix repens*-*Calliargon cuspidatum* dune-slack

SD15a *Carex nigra* subcommunity

SD16b *Rubus caesius* sub-community

Humid dune slacks

SD14 *Salix repens*-*Campylium stellatum* dune-slack

SD14b *Rubus caesius*-*Galium palustre* subcommunity

SD15 *Salix repens*-*Calliargon cuspidatum* dune-slack

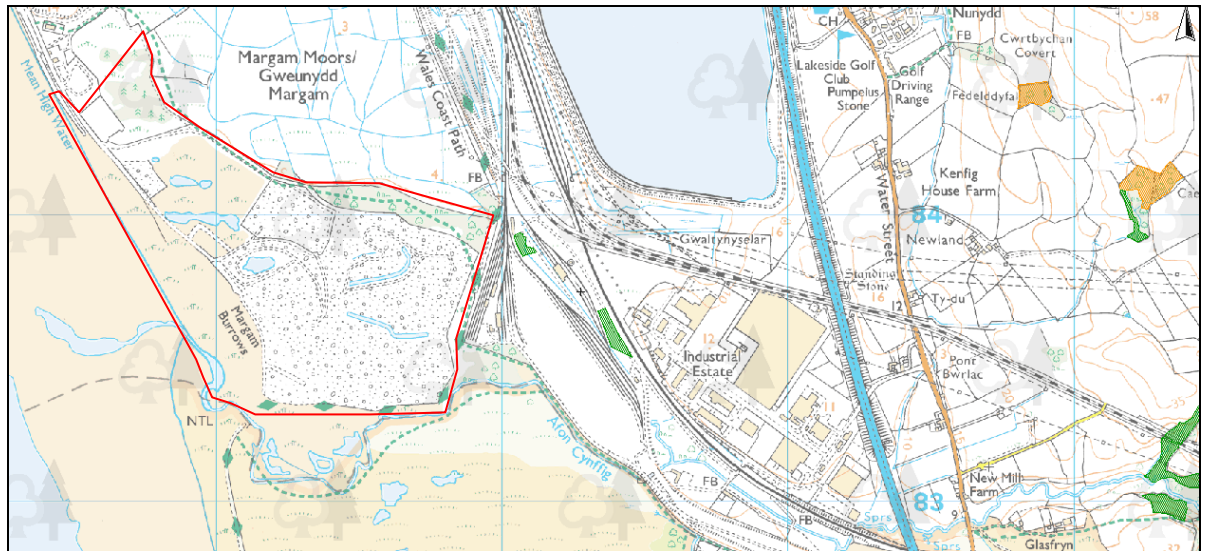
SD15a *Carex nigra* subcommunity

SD16b *Rubus caesius* sub-community

3.7 Ancient Woodland Inventory 2011

The Forestry Commission provides spatial data that show boundaries of Ancient Woodland sites in Wales. Each site is categorised as Ancient Semi Natural Woodland (ASNW), Restored Ancient Woodland Site (RAWS), Plantation on Ancient Woodland Site (PAWS) or Ancient Woodland Site of Unknown Category (AWSU). The study site supports no ancient woodland but lies within 100m of two small units of ASNW, as shown on figure 12 below.

Figure 12: Ancient Woodland Register, with ASNW shown in green, RAWs shown in orange and the study area outlined red.



3.8 Section 7 and UK BAP Habitats

Stands of vegetation included under the Section 7 list of the habitats of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales (Environment (Wales) Act, 2016) which are present within the study area include:

- Wet Woodland Areas shown in figure 2 in section 2.5
- Reedbeds Areas shown in figure 4 in section 2.8
- Ponds Areas shown in figure 3 in section 2.7
- Coastal sand dunes Areas shown in figures 5, 7 & 8 in section 2.9, 2.10 & 2.11
- Coastal vegetated shingle Area shown in figure 10 in section 2.13

3.9 Local BAP Habitats and Species

No additional habitats or species of concern which have been adopted by Neatyh Port Talbot County Borough Council in order to facilitate their conservation at a local level and which are included in the county borough's Local Biodiversity Action Plan will be affected by the scheme.

3.10 Significant plant species

3.11 Plants of European Significance

No plant species of European significance were recorded within the study site.

3.12 Section 7 and UK BAP Species

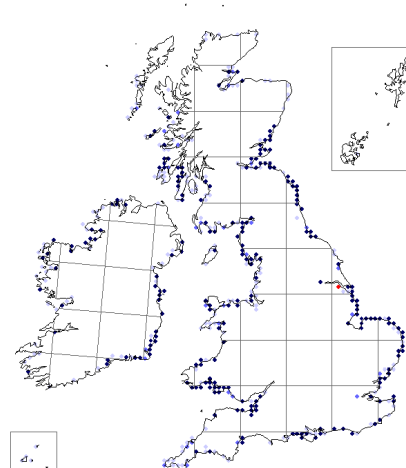
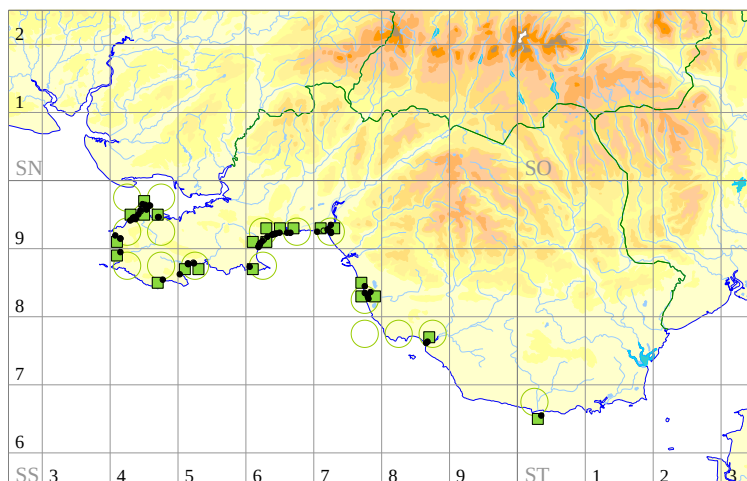
The following taxa have been recored on site that are on the Section 7 list of the living organisms of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales (Environment (Wales) Act, 2016). Therefore, these species need to be taken into consideration by a public body when performing any of its functions with a view to conserving biodiversity:

3.13 Prickly Saltwort *Salsola kali* subsp. *kali*

Prickly Saltwort has declined since the 1962 *Atlas*. Many populations, especially in S. England, have been lost due to excessive recreational pressures, and in some areas there has been a drastic decline (e.g. Cornwall and Hampshire). The species is included under the following designations:

- Species “of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales” (Environment (Wales) Act, 2016) and therefore need to be taken into consideration by a public body when performing any of its functions with a view to conserving biodiversity.
- The UK List of Priority Species and Habitats contains 1150 species and 65 habitats that have been listed as priorities for conservation action under the UK Biodiversity Action Plan (UK BAP).
- Listed as ‘Vulnerable’ on the IUCN (2001) Red List Vulnerable
- Listed as ‘Near Threatened’ on the Botanical Society of Britain & Ireland Red Data List (BSBI, 2010)

The species is found at Margam landfill site appearing as occasional plants on areas of open sand as indicated by 22 & 53 on figure 1. Its occurrence is likely to be short-term whilst there are open and mobile dunes, but it will disappear as the vegetation stabilises.



3.14 Sea Stock *Matthiola sinuata*

A biennial or short-lived perennial of young, mobile dunes which has historically declined and is now very restricted, but the overall distribution is currently stable. The population fluctuates considerably to the extent where it was thought to have become extinct in Glamorgan in 1848 and remained unrecorded until it was rediscovered there in 1964. In more recent times the species has fared better and since 2000, it has been recorded in twenty 1km squares as shown on the distribution map below. The species is included under the following designations:

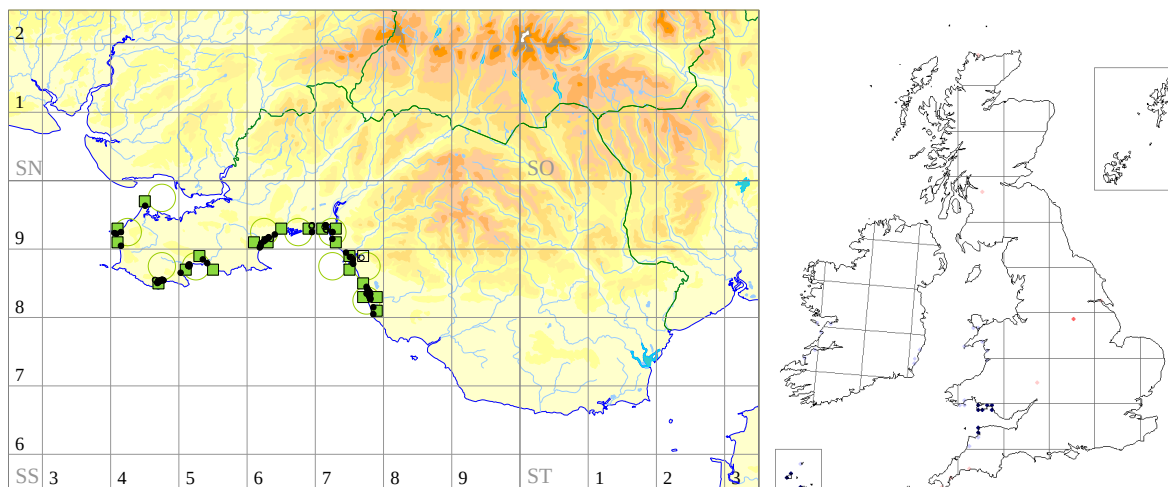
- Species “of principal importance for the purpose of maintaining and enhancing biodiversity in relation to Wales” (Environment (Wales) Act, 2016) and therefore need to be taken into consideration by a public body when performing any of its functions with a view to conserving biodiversity.
- The UK List of Priority Species and Habitats contains 1150 species and 65 habitats that have been listed as priorities for conservation action under the UK Biodiversity Action Plan (UK BAP).
- Nationally rare (Occurring in 15 or fewer hectads in Great Britain.)
- Listed as ‘Vulnerable’ on the IUCN (2001) Red List Vulnerable
- Listed as ‘Vulnerable’ on the Botanical Society of Britain & Ireland Red Data List (BSBI, 2010)

Figure 13. Distribution of Sea Stock within the study area:



The species is not found within the active Margam landfill site, but occurs within the study area buffer zone along the entire length of foredune at TN01, TN03, TN05, TN06, TN07,

TN10, TN11, TN13 & TN50. Counts at all locations where the species was recorded in 2014 are shown on figure 13, but it should be noted that numbers fluctuate annually and that populations viability requires a level of foredune mobility.



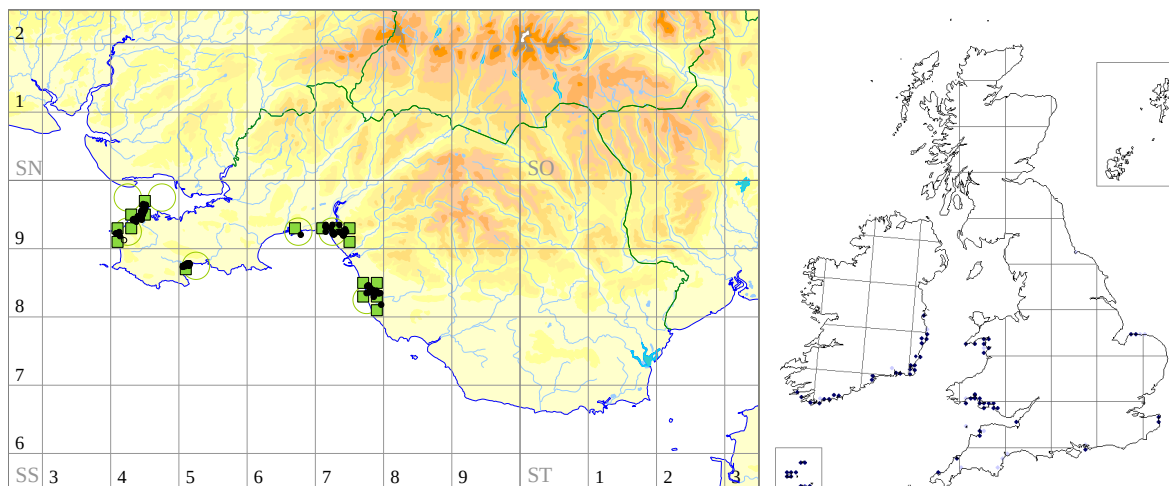
3.15 Nationally Scarce Plants

BSBI Red List

Autumn Lady's-tresses	<i>Spiranthes spiralis</i>	31, 32 & 46
Dune Pansy	<i>Viola tricolor subsp. curtisii</i>	6, 8, 10, 11 & 50
eyebright	<i>Euphrasia tetraquetra</i>	51
Green-winged Orchid	<i>Anacamptis morio</i>	44
Heath Dog-violet	<i>Viola canina</i>	19, 27, 38, 50 & 53
Prickly Saltwort	<i>Salsola kali subsp. kali</i>	22 & 53
Sea Stock	<i>Matthiola sinuata</i>	1, 3, 5, 6, 7, 10, 11, 13 & 50

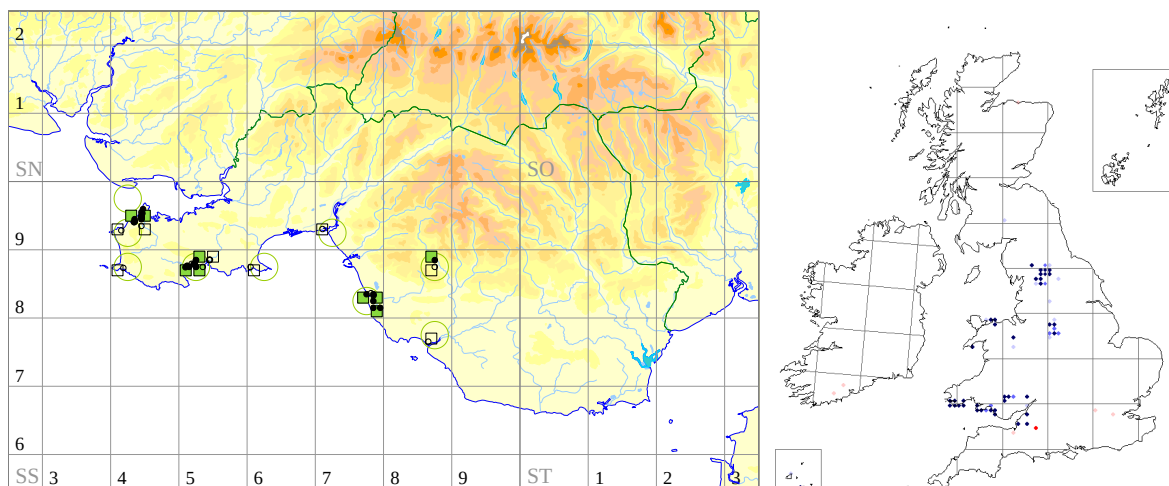
3.16 Sharp Rush *Juncus acutus*

'Nationally Scarce' but listed as 'Least Concern' on the BSBI Red Data List (2010). Kay (2015 url) states the tufts of this large and handsome species, which reaches its northern limit in the British Isles, are extremely long-lived and persistent, only slowly increasing in diameter. The plants produce long-lived seed capsules which can remain viable for a year or more although establishment from seed appears to be rare. The species occurs patchily throughout the study area and was recorded at the following Target Note locations: TN14, TN16, TN18, TN27, TN30, TN32, TN38, TN39, TN44, TN47 & TN52



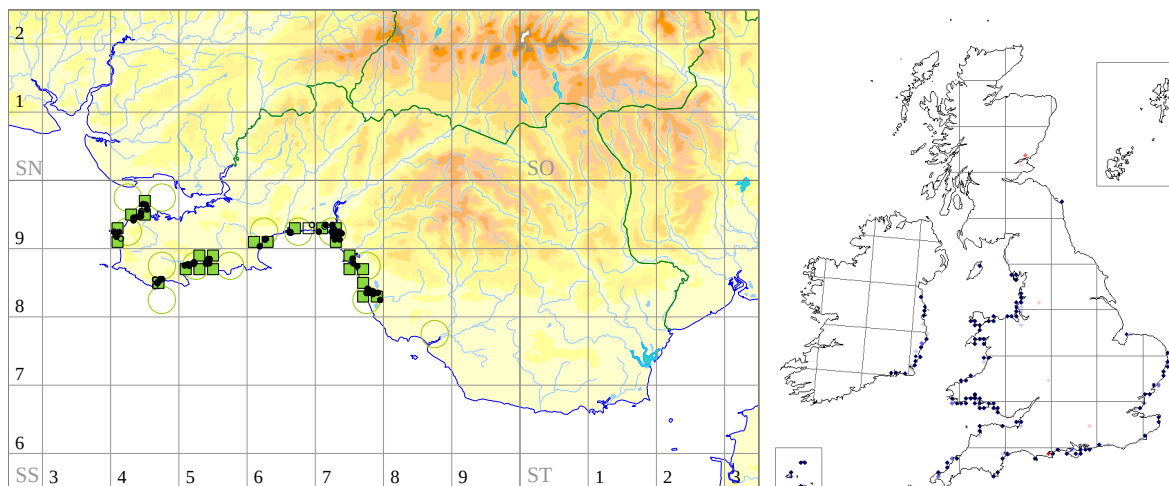
3.17 Hutchinsia *Hornungia petraea*

Listed as 'Scarce' in the *Scarce Atlas Account* and 'Least Concern' on the BSBI Red Data List (2010). Ratcliffe (2015 url) states that *Hutchinsia* is a winter annual restricted to open vegetation with bare soil which is dry in summer and moist in winter. A certain amount of disturbance can be beneficial by preventing development of a closed turf, and the species does well in the year following a dry summer when more bare soil is exposed by the death of perennial grasses. The species is scarce within the study area being recorded only at Target Note locations TN21 & TN27



3.18 Dune Fescue *Vulpia fasciculata*

Listed as 'Scarce' in the *Scarce Atlas Account* and 'Least Concern' on the BSBI Red Data List (2010). A.R. Watkinson (2015 url) states this is a winter annual grass of coastal dunes and sandy shingle, growing on infertile, free-draining calcareous soils. Mobile and fixed dunes are favoured and the species is frequently associated with other winter annuals such as *Aira praecox*, *Cerastium diffusum* and *Phleum arenarium*. Populations may persist in a given locality for many years where the vegetation is open and there is some movement of sand. The species is locally frequent within the study area and was recorded at Target Note locations TN01, TN08, TN09, TN27 & TN29.



3.19 Neath Port Talbot Priority & Contributory Species

The *Guidelines For The Selection of Local Sites in Wales* (2008) sets out a common set of detailed guidelines for the selection of biodiversity Local Sites in Wales based on an amalgamation of the detailed criteria of the three spatially separate systems developed by the North Wales Wildlife Trust, the Powys Wildlife Trusts, and the Gwent and Wildlife Trust for South and West Wales. The guidelines provide a framework within which individual Local Biodiversity Action Plan Partnerships [LBAPs]/ Local Planning Authorities which have refined their own detailed criteria for the selection and designation of Local Sites within their administrative boundaries. The following species were recorded within the study area (along with a list target notes locations from figure 1) that are listed as either NPT 'Priority Species', 'Contributory species' or in the case of charophytes (stoneworts) any site, which supports a species, which is 'Rare in Vice County' i.e. recorded from 3 or fewer sites within a Watsonian Vice County (where the distribution is well known):

Priority Species:

Dune Pansy	<i>Viola tricolor subsp. curtisii</i>	6, 8, 10, 11 & 50
Early Marsh-orchid	<i>dactylorhiza incarnata</i>	22
Green-winged Orchid	<i>Anacamptis morio</i>	32
Heath Dog-violet	<i>Viola canina</i>	19, 27, 38, 50 & 53
Prickly Saltwort	<i>Salsola kali subsp. kali</i>	22 & 53
Sea Stock	<i>Matthiola sinuata</i>	1, 3, 5, 6, 7, 10, 11, 13 & 50
Slender Spike-rush	<i>Eleocharis uniglumis</i>	32
Sticky Stork's-bill	<i>Erodium lebelii</i>	1 & 30

Contributory Species:

Bee Orchid	<i>Ophrys apifera</i>	39
Brookweed	<i>Samolus valerandi</i>	52 & 53
Brown Sedge	<i>Carex disticha</i>	14 & 53

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A: Baseline Conditions**

Common Broomrape	<i>Orobanche minor</i>	5, 9, 27, 30, 32, 38, 39 & 46
Dune Fescue	<i>Vulpia fasciculata</i>	1, 8, 9, 27 & 29
Dune Pansy	<i>Viola tricolor subsp. curtisii</i>	6, 8, 10, 11 & 50
Fragrant Agrimony	<i>Agrimonia procera</i>	27 & 38
Grey Club-rush	<i>Schoenoplectus tabernaem.</i>	33, 34, 52 & 53
Hawkweed Oxtongue	<i>Picris hieracioides</i>	4, 11, 19, 22, 25, 27, 29, 30, 31, 32, 38, 39, 44, 46, 47 & 51
Hutchinsia	<i>Hornungia petraea</i>	21 & 27
Knotted Pearlwort	<i>Sagina nodosa</i>	28, 30, 31, 32, 39 & 46
Lesser Sea-spurrey	<i>Spergularia marina</i>	44
Long-bracted Sedge	<i>Carex extensa</i>	32 & 33
Marsh Helleborine	<i>Epipactis palustris</i>	16, 32, 33 & 39
Meadow Crane's-bill	<i>Geranium pratense</i>	26 & 54
Pale Flax	<i>Linum bienne</i>	29
Parsley Water-dropwort	<i>Oenanthe lachenalii</i>	33
Pink Water-speedwell	<i>Veronica catenata</i>	5 & 33
Pyramidal Orchid	<i>Anacamptis pyramidalis</i>	16
Rough Clover	<i>Trifolium scabrum</i>	29
Sand Cat's-tail	<i>Phleum arenarium</i>	1, 6, 8, 9, 30 & 32
Sand Couch	<i>Elytrigia juncea</i>	1, 2, 3, 5, 6, 27, 38 & 53
Sea Bindweed	<i>Calystegia soldanella</i>	1, 5, 16, 19, 22, 27, 29, 31, 38 & 50
Sea Rocket	<i>Cakile maritima</i>	5, 6, 7, 22, 35 & 53
Sea Spurge	<i>Euphorbia paralias</i>	2, 5, 7, 27, 50 & 53
Sea-holly	<i>Eryngium maritimum</i>	1, 2, 3, 5, 6, 7, 8, 16, 19, 20, 22, 27, 29, 30, 31, 32 & 38
Sharp Rush	<i>Juncus acutus</i>	14, 16, 18, 27, 30, 32, 38, 39, 44, 47 & 52
Viper's-bugloss	<i>Echium vulgare</i>	4, 9, 19, 20, 22, 25, 26, 30, 31, 32, 35, 38, 44, 46, 47, 51 & 53
Water Dock	<i>Rumex hydrolapathum</i>	7, 27 & 38

Rare in Vice County:

Bugseed	<i>Corispermum intermedium</i>	20, 22, 27, 29, 35 & 38
Cavernous Crystalwort	<i>Riccia cavernosa</i>	20
Opposite Stonewort	<i>Chara contraria</i> var. <i>hispidula</i>	36
Common Stonewort	<i>Chara vulgaris</i> var. <i>papillata</i>	28

3.20 Sand Dune Species

Due to the importance of sand dune vegetation both at local and national levels an inventory of all key components of sand dune flora recorded within the study site is provided below together with all target note locations each was recorded at, as shown on figure 1:

Annual Wall-rocket	<i>Diploaxis muralis</i>	30
Bloody Crane's-bill	<i>Geranium sanguineum</i>	44
Brookweed	<i>Samolus valerandi</i>	53
Bugseed	<i>Corispermum intermedium</i>	20, 22, 27, 29, 35 & 38
Burnet Rose	<i>Rosa spinosissima</i>	27, 38, 44, 51, 53 & 54
Cavernous Crystalwort	<i>Riccia cavernosa</i>	20
Common Cornsalad	<i>Valerianella locusta</i>	19 & 50
Common Restharrow	<i>Ononis repens</i>	1, 4, 5, 6, 8, 19, 20, 22, 26, 29, 30, 31, 32, 38, 39, 44, 46, 47, 51 & 53
Creeping Willow	<i>Salix repens</i>	1, 3, 4, 14, 16, 20, 26, 27, 29, 30, 31, 33, 34, 35, 39, 42, 44, 47, 48, 51, 52 & 53
Dewberry	<i>Rubus caesius</i>	1, 3, 4, 6, 8, 13, 14, 16, 19, 20, 22, 26, 29,

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A: Baseline Conditions**

		30, 31, 32, 38, 39, 42, 44, 46, 47, 51 & 53
Drooping Thread-moss	<i>Bryum algovicum</i>	25, 29 & 30
Dune Fescue	<i>Vulpia fasciculata</i>	8, 9, 27 & 29
Dune Pansy	<i>Viola tricolor subsp. curtisii</i>	10, 11 & 50
Early Marsh-orchid	<i>dactylorhiza incarnata</i>	22
Frog Rush	<i>Juncus ranarius</i>	5, 20, 22, 32 & 39
Greasewort	<i>Aneura pinguis</i>	33 & 34
Great Plait-moss	<i>Hypnum acunosum</i>	8, 13, 16, 17, 19, 27, 29, 30, 38, 39, 44 & 46
Green-winged Orchid	<i>Anacamptis morio</i>	32
Hare's-foot Clover	<i>Trifolium arvense</i>	4, 19, 25, 27, 26, 30, 33, 38, 46 & 47
Hawkweed Oxtongue	<i>Picris hieracioides</i>	11, 19, 22, 25, 27, 29, 30, 31, 32, 38, 39, 44, 46, 47 & 51
Heath Dog-violet	<i>Viola canina</i>	27 & 38
Hutchinsia	<i>Hornungia petraea</i>	21 & 27
Hybrid Evening-primrose	<i>Oenothera x fallax</i>	8, 11, 19, 20, 22, 29, 30, 31, 32, 37, 38, 39, 44, 45, 47, 51 & 53
Intermediate Polypody	<i>Polypodium interjectum</i>	1, 9, 19, 22, 25, 27, 30, 38, 51 & 53
Kidney Vetch	<i>Anthyllis vulneraria</i>	1, 6, 8, 11, 19, 22, 25, 27, 29, 30, 31, 32, 38, 39, 46 & 50
Knotted Pearlwort	<i>Sagina nodosa</i>	28, 30, 31, 32, 39 & 46
Lesser Centaury	<i>Centaureum pulchellum</i>	39
Little Mouse-ear	<i>Cerastium semidecandrum</i>	53
Marram	<i>Ammophila arenaria</i>	1, 2, 3, 4, 5, 6, 8, 11, 14, 16, 18, 19, 22, 25, 27, 29, 30, 31, 32, 38, 39, 44, 47, 51 & 53
Marsh Helleborine	<i>Epipactis palustris</i>	33 & 39
Megapolitan Feather-moss	<i>Rhynchostegium megapol.</i>	29 & 46
Neglected Couch	<i>Elytrigia campestris ssp. mar.</i>	22, 31 & 32
Pale Flax	<i>Linum bienne</i>	29
Prickly Saltwort	<i>Salsola kali subsp. kali</i>	22 & 53
Pyramidal Orchid	<i>Anacamptis pyramidalis</i>	27, 31, 32, 44, 51 & 53
Round-leaved Wintergreen	<i>Pyrola rotundifolia ssp. mar.</i>	16, 34 & 39
Sand Couch	<i>Elytrigia juncea</i>	2, 3, 5, 6, 27 & 38
Sand Feather-moss	<i>Brachythecium mildeanum</i>	25, 29 & 30
Sand Sedge	<i>Carex arenaria</i>	1, 3, 6, 8, 11, 14, 16, 19, 20, 22, 26, 28, 29, 30, 31, 32, 38, 44, 46, 50, 51 & 53
Sand-hill Screw-moss	<i>Syntrichia r. var. ruraliformis</i>	1, 6, 7, 8, 9, 11, 13, 16, 17, 19, 25, 27, 30, 38, 44, 46 & 47
Sea Bindweed	<i>Calystegia soldanella</i>	1, 5, 16, 19, 22, 27, 29, 31, 38 & 50
Sea Spurge	<i>Euphorbia paralias</i>	2, 5, 7, 27, 50 & 53
Sea Stock	<i>Matthiola sinuata</i>	3, 5, 6, 7, 10, 11, 13 & 50
Sea-holly	<i>Eryngium maritimum</i>	1, 2, 3, 5, 6, 7, 8, 16, 19, 20, 22, 27, 29, 30, 31, 32, 38, & 50
Sharp Rush	<i>Juncus acutus</i>	16, 18, 30, 32, 39, 44, 47, 52 & 53
Sticky Stork's-bill	<i>Erodium lebelii</i>	30
Stinking Iris	<i>Iris foetidissima</i>	1, 3, 11, 14, 19, 22, 32, 51 & 53
Thyme-leaved Sandwort	<i>Arenaria serpyllifolia</i>	1, 8, 11, 16, 19, 22, 25, 29, 30, 32, 38, 44, 46, 47, 51 & 53
Variegated Horsetail	<i>Equisetum variegatum</i>	20, 31, 32, 33 & 34
Wild Thyme	<i>Thymus polytrichus</i>	19, 27 & 38
Yellow Crisp-moss	<i>Tortella flavovirens</i>	30
Yellow Feather-moss	<i>Homalothecium lutescens</i>	1, 8, 11, 13, 16, 19, 29, 30, 38, 44, 46 & 47
Yellow-wort	<i>Blackstonia perfoliata</i>	8, 27, 30, 32, 39, 46, 51 & 53

3.21 Additional species of local interest

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

The 37 species listed below are not confined to sand dunes but are considered to be of local importance, as they are either important components of other valuable habitats, support scarce invertebrates or are locally scarce:

Broad-leaved Helleborine	<i>Epipactis helleborine</i>	16, 32, 34 & 53
Buckthorn	<i>Rhamnus cathartica</i>	53
Burnet-saxifrage	<i>Pimpinella saxifraga</i>	53
Common Milkwort	<i>Polygala vulgaris</i>	30
Common Spotted-orchid	<i>Dactylorhiza fuchsii</i>	32
Common Stonewort	<i>Chara vulgaris</i>	22, 23, 24, 28, 33, 34, & 36
Common Twayblade	<i>Neottia ovata</i>	27, 38 & 44
Compact Brome	<i>Anisantha madritensis</i>	27 & 38
Delicate Stonewort	<i>Chara virgata</i>	33
Devil's-bit Scabious	<i>Succisa pratensis</i>	48
Downy Oat-grass	<i>Avenula pubescens</i>	27 & 38
English Scurvygrass	<i>Cochlearia anglica</i>	44
French Bartsia	<i>Odontites jaubertianus s</i>	9, 30, 31, 32, 33, 35 & 39
Great Brome	<i>Anisantha diandra</i>	27 & 38
Greater Tussock-sedge	<i>Carex paniculata</i>	27 & 38
Guernsey Fleabane	<i>Conyza sumatrensis</i>	30
Hybrid Orache	<i>Atriplex x gustafssoniana</i>	7
Kneiff's Hook-moss	<i>Drepanocladus aduncus</i>	12
Knotted Clover	<i>Trifolium striatum</i>	50
Large-flowered Evening-primrose	<i>Oenothera glazioviana</i>	27, 38 & 39
Lesser Centaury	<i>Centaureum pulchellum</i>	39
Marsh-marigold	<i>Caltha palustris</i>	14, 27, 38 & 44
Opposite Stonewort	<i>Chara contraria</i>	24, 28, 33, 34, & 36
P. gramineus x perfoliatus	<i>Potamogeton x nitens</i>	23
Pearly Everlasting	<i>Anaphalis margaritacea</i>	48
Perennial Wall-rocket	<i>Diploaxis tenuifolia</i>	27, 38, 50 & 53
Portland Spurge	<i>Euphorbia portlandica</i>	50, 51 & 52
Red Goosefoot	<i>Chenopodium rubrum</i>	20
Rock Samphire	<i>Crithmum maritimum</i>	5, 19, 50 & 53
Salad Burnet	<i>Poterium sanguisorba</i>	27 & 38
Sea Beet	<i>Beta vulgaris subsp. maritima</i>	5, 27 & 38
Skullcap	<i>Scutellaria galericulata</i>	27 & 38
Small Pondweed	<i>Potamogeton berchtoldii</i>	28
Small Toadflax	<i>Chaenorhinum minus</i>	47
Small-fruited Yellow-sedge	<i>Carex oederi</i>	36
Sticky Groundsel	<i>Senecio viscosus</i>	22
Tall-clustered Thread-moss	<i>Bryum pallescens</i>	46
Wayfaring-tree	<i>Viburnum lantana</i>	53
Yellow Horned-poppy	<i>Glaucium flavum</i>	50

3.22 Invasive species

Japanese Knotweed *Fallopia japonica*, was recorded at Target Notes TN29, TN34, TN35 & TN39. It is a non-native invasive species listed under Schedule 9 of the Wildlife and Countryside Act (WCA) 1981 (as amended) which makes it an offence to plant it in the wild, knowingly allow it to spread, or otherwise cause it to grow. The Environmental Protection Act 1990 also lists Japanese Knotweed as 'controlled waste' which should be disposed of properly. These provisions mean that if this species occurs on a site proposed for development or other ground disturbance works then control of this species is likely to be required. In the first instance it is recommended that the precise locations of these species are accurately mapped (using a GPS or topographical survey). This information can then be used to produce a method statement for removing the contaminated area and avoiding the accidental spread of this species during works. Successful treatment of affected areas can take a number of years, and it is recommended that control measures are implemented as soon as possible to avoid future delays.

Other invasive non-native species were recorded within the study site that are likely to have a significant adverse impact on native flora and should be eradicated at the earliest stage possible, these being;

American Skunk-cabbage	<i>Lysichiton americanus</i>	27, 38 & 44
Butterfly-bush	<i>Buddleja davidii</i>	30, 32, 34 & 40
Japanese Rose	<i>Rosa rugosa</i>	7, 11, 19, 27 & 38
Sea-buckthorn	<i>Hippophae rhamnoides</i>	4, 6, 8, 14, 15, 16, 19, 25, 27, 29, 30, 31, 32, 35, 38, 39, 40, 41 & 44
Wall Cotoneaster	<i>Cotoneaster horizontalis</i>	27 & 38

4 **CONDITION 26, a**

4.1 **Provisions for the enhancement of biodiversity within the site boundary along with a programme and timescale for implementation**

- 4.2 The primary biodiversity enhancement at the landfill site is the progressive reinstatement of sand dune vegetation on top of the capped tip. The implementation of this management plan aims to ensure that maximum benefits are delivered and adverse impacts minimised, during the full lifetime of the scheme. The management plan will be responsive to changes brought about by successional processes, climate change and other external pressures.

5 **CONDITION 26, b**

5.1 **The formation control and management of a buffer zone in accordance with the areas of set aside land identified on Figure 1.3 Revision 1 between the Margam Moors SSSI, the Morfa Beach and the Kenfig SAC**

- 5.2 The buffer zone supports a range of vegetation types, with sand dunes in particular being of high conservation value, these being the largest remnants of the once extensive Margam Burrows system. Safeguarding this feature and ensuring it is favourably managed will ensure a level of connectivity is maintained between the Kenfig dune system and other primary dunes lying to the north-west at Baglan, Crymlyn and beyond. The role that secondary dune vegetation plays in maintaining the viability of dune flora

and fauna is also likely to be extremely important within industrialised and urban sections of the coast and reducing impacts on dune vegetation and maximising opportunities for dune habitats are the main objectives within the boundaries of Margam Landfill buffer zone.

- 5.3 Figure 14 shows the extent of sand dune vegetation within the buffer zone. Opportunities for extending the area of dune vegetation is limited as the wet woodlands which dominate the eastern part of the buffer zone are a significant feature in their own respect and the land on which they are established is unlikely to be suitable for a dune creation/restoration project. The main area of potential gain is the area planted with conifers in the north of the buffer zone, as depicted by the grey cross-hatching on figure 14. Clearance and removal of these conifers (predominantly pines) would open up a significant area sand dunes.
- 5.4 Management of the dune resource within the buffer zone should aim to achieve two primary objectives, i) the maintenance of an active foredune system, ii) control of invasive non-native species.

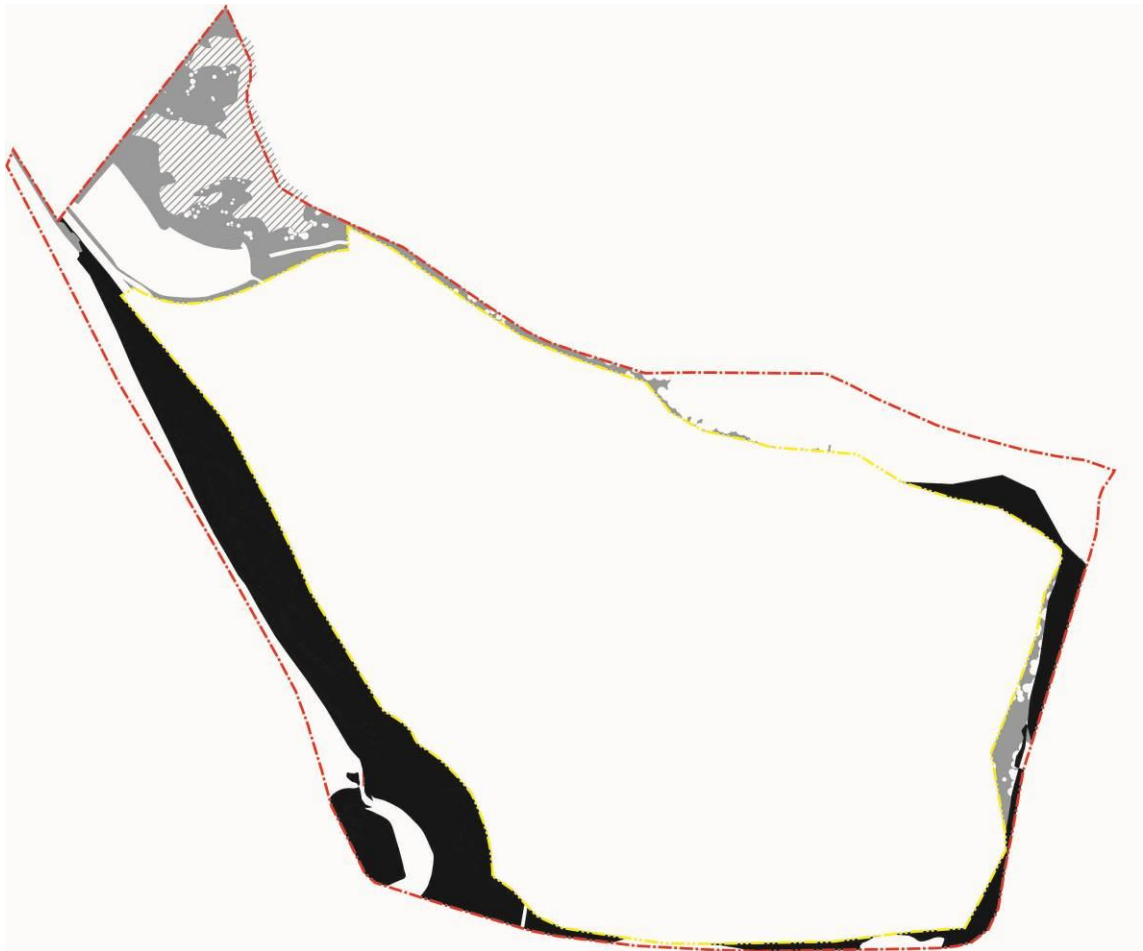
5.5 **Maintenance of an active dune system**

The strandline and foredune zone is very narrow for almost the entire Margam and Kenfig section of coast. Erosion and deposition processes within this narrow band occur over an annual cycle and there appears to have been minimal movement of the MHWL over the last few decades. This apparent stability is desirable in an industrial setting and opportunities to undertake significant beach nourishment activities is probably inappropriate. However, limited beach enrichment, to encourage the settlement wind-blown sand and develop more extensive foredunes, would be beneficial for improve sea defences as well as providing greater niche availability for wildlife. Consideration should be given to low key experimental use of locally sourced materials, such as timber and brash from clearance works within the conifer plantation, in order to encourage foredune development on the north side of the Kenfig rivermouth. Partially buried tree trunks, back-filled with brash, will provide a semi-stabilised foundation onto which wind-blown sand can accumulate. The development of embryo dunes, will provide niches for species such as Sea Rocket, Prickly Saltwort and the nationally scarce strandline beetle *Eurynebria complanata* amongst others. Once in place, a largely non-intervention management regime with regard to clearance of strandline debris is preferred.

Yellow and grey dunes are by and large self-sustaining but diversity is substantially enhanced by grazing, with wild Rabbits being the main grazing unit at Margam. The condition of the dunes can, however, be significantly improved by implementing an eradication plan that targets invasive non-native shrubs. Sea-buckthorn is the main threat to native dune flora at the site and whilst it has already encroached into many areas, it is not yet established at a level beyond economic affordability. Sea-buckthorn removal, will mirror control efforts which are ongoing at Kenfig NNR and a coordinated approach aimed at eradicating the species from the Margam and Kenfig dune units would be desirable.

Restoration of the few dune slack remnants, through removal of scrub and accumulated topsoil (i.e. phased scraping to just below the winter water table) would help restore habitats suitability for key dune slack flora.

Figure 14. Extent of sand dune vegetation within the buffer zone, with primary and secondary types differentiated; primary shown as black and secondary grey. The grey cross-hatch shows sand dune planted with conifers.



6 **CONDITION 26, d**

6.1 **Design and formation of dune slacks and dune pools as it applies to the restoration and aftercare of the site**

Detailed by Geotechnology.

7 **CONDITION 26, e**

7.1 **Integration of the ecological management and monitoring scheme with the Ecological Restoration and Aftercare Report (report number 403.3/0/0906) the Working Plan for Ecological Restoration at the Morfa Closed Landfill site by LAB Coastal dated June 2006, and restoration and aftercare details as submitted under other conditions of this consent**

Compliance of the points above will continue be monitored by the regular committee meetings.

8 **CONDITION 26, f**

8.1 **Monitoring of the stability of the restored dune system and any operations and modifications required for their construction**

8.2 **Vegetation Monitoring Method**

During 2014, locations for eight nested plots, using NRW methodology were selected during a site visit for long-term vegetation monitoring. Vegetation types were selected that represent the main dune communities on the restored landfill. These plots provide a semi-quantitative method informing site management.

Locations of each plot were recorded using GPS instruments and plot locations selected are shown on Figure 1. Their National Grid co-ordinates as measured are listed below.

Plot A	SS7832783662
Plot B	SS7849683709
Plot C	SS7852183449
Plot D	SS7884283795
Plot E	SS7845983962
Plot F	SS7841183978
Plot G	SS7843383972
Plot H	SS7826684136

At each selected location sampling was undertaken using the following NRW method (D. Guest in prep.):

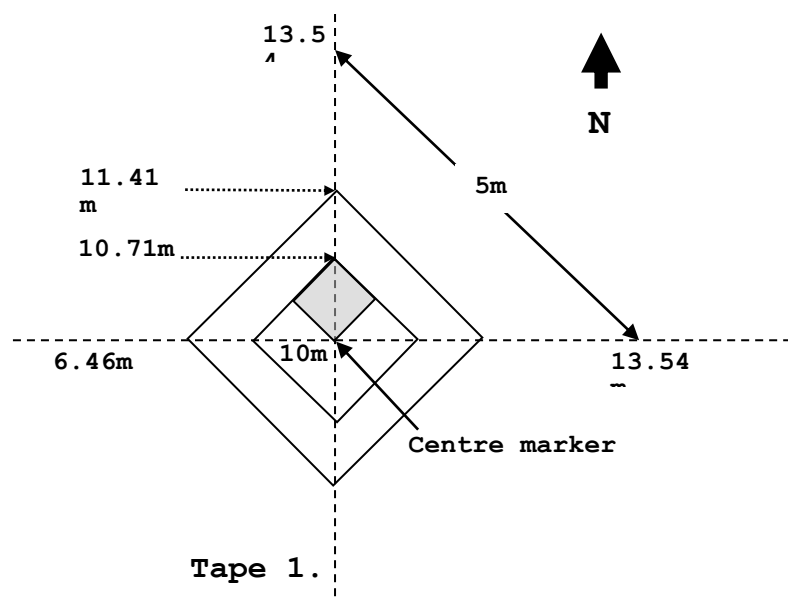
Sample plots: Recording instructions

The formal sampling within the scrapes follows a nested plot design centred around a 50 cm by 50cm quadrat, with further recording in the surrounding 1m x 1m, 2m x 2m and 5m x 5m area.

Establishing plot

- 1. Locate the central point of the plot (using existing marker if available) and mark with cane.*
- 2. Run measuring tape along the North-South diagonal passing through the centre of the plot (it is simplest to have the centre point at the 10m mark on the measuring tape).*
- 3. Run a second measuring tape at right angles to the first, again passing through the centre of the plot with the centre at the 10m mark on the two tapes. (The accuracy of the right angle can be checked by measuring the edge of the outer plot which should stretch 5m from the 13.54m marks on the two measuring tapes)*

4. Place the first 50cm x 50cm sample with its long diagonal running from the centre of the plot to the 10.71m mark on tape 1 (see diagram below and note that this is the only sample not centred on the mid. point in the plot)
5. Record all of the species rooted within the sample assigning each an estimated % cover.
6. Mark out the 1m x 1m sample using canes set at points 71cm distant from the mid point in the plot and record any additional species not found in the 50 cm sample this time just recording if they are present)
7. Repeat process to set up first the 2m x 2m and then the 5m x 5m sample, again recording all additional species.
8. Search the whole scrape recording any additional species (where multiple small scrapes have been established with a single named slack these should all be included in a single combined list.
9. Estimate the frequency/abundance of all species within the scrape using the DAFOR scale.



Rules for plot recording:

1. Record only species rooted within the plot
2. Record only living plants or still rooted annuals (displaced/non-rooted annuals and long dead perennials should be ignored)
3. Estimate the % cover of all species and pseudo-species (i.e. groups of species, or other cover forming elements such as bare ground within the central 50 x 50 cm plot.

This cover should be estimated as seen from vertically above the sample, without disturbing the vegetation surface (hence it should total to 100% as layering is ignored). Although it is worth taking some time over this, for example by considering that a 10 x 10 cm square (roughly the size of the palm of an adults hand) represents 4% of the whole sample, don't worry too much about it as it is only a relatively quick and dirty estimate and experience has taught us that with the best will in the world it is likely to vary considerably between observers.

4. *Sward height should be estimate as a range ignoring inflorescences*

The DAFOR scale:

Although well established and widely used the DAFOR scale is not precisely defined. For the purposes of this work we have adopted the following definition.

D = Dominant: over 50% cover across the bulk (more than 50%) of the sward

A = Abundant: between 10% and 50% cover across the bulk of the sward

F = Frequent: Would be present in at least 50% of 1m square samples but does not make more than 10% cover across the bulk of the sward.

O = Occasional: present in between 20% and 50% of 1m square samples.

R = Rare: present in less than 20% of 1m square samples.

Where a species occurs a very different frequencies or covers in different parts of the scrape two DAFOR ratings can be presented the first giving the overall averaged value the second representing the local frequency/abundance and being prefixed by the letter L. Hence R: LA would denote a plant that was rare but locally abundant.

8.3 Results

Survey data for the baseline year, 2014 and 2018 are presented below. An analysis of community changes will be carried out once data for 2022 have been collected.

Date:

18/08/14

26/07/18

Species

0.25 m2
1 m2
2 m2
5 m2
Area

0.25 m2
1 m2
2 m2
5 m2
Area

Vascular Plants
Aira praecox
Ammophila arenaria
Anthyllis vulneraria
Arenaria serpyllifolia subsp. serpyllifolia
Arrhenatherum elatius
Bellis perennis
Betula pubescens
Blackstonia perfoliata
Bromus hordeaceus
Calystegia soldanella
Carex arenaria
Catapodium marinum
Catapodium rigidum
Centaurium erythraea
Cerastium diffusum
Chamerion angustifolium
Cirsium arvense
Coincya monensis subsp. cheiranthos
Conyza floribunda
Corispermum intermedium
Crepis capillaris
Echium vulgare
Eryngium maritimum
Eupatorium cannabinum
Festuca ovina
Hippophae rhamnoides
Holcus lanatus
Hypochaeris radicata
Lotus corniculatus
Oenothera sp.
Oenothera x fallax
Ononis repens
Orobanche minor
Pastinaca sativa subsp. sylvestris
Phleum arenarium
Plantago coronopus
Rubus caesius
Rumex crispus subsp. littoreus
Sagina filicaulis
Salix cinerea subsp. oleifolia
Salix repens
Salsola kali subsp. kali
Senecio jacobaea

				lf
1				o
				r
	r			r
				r
				r
1				o
				r
				o
2				o
			r	r
				r
				r
				o
				r
				r
				r
	o			lf
			r	r
				r
1				o
				o
				r
				r

2				o
	r			o
	r			r
2				o
	r			r
			r	r
2				o
1				r
			r	r
2				o
1				o
				r
				r
				o
			o	o
3				o
				r
1				
				r
3				o
			r	o
20				o
		r		o
1				r
			lf	lf
			r	o
			o	o
			r	r
		o		o

Sonchus arvensis				r					
Ulex europaeus				r	r	2			o
Vicia cracca									r
Vulpia fasciculata						6			o
Lower Plants									
Barbula convoluta var. convoluta						2			o
Bryum algovicum						2			o
Bryum dichotomum	1					1			o
Combined bryophyte									
Veg. Height (cm)	5				1	5			10
Bare Sand	95				o	15			la

COLUMN COUNT (vp & lower taxa) =	5	2	0	3		16	3	2	8	
TOTAL COUNT vp & lower taxa (5m quadrat) =				10					29	
TOTAL COUNT vp & lower taxa (plot) =					26					34

26/07/18

Species	0.25 m2	1 m2	2 m2	5 m2	Area
	0.25 m2	1 m2	2 m2	5 m2	Area

Vascular Plants									
Agrostis stolonifera	83					a		o	
Ammophila arenaria						o			
Anacamptis pyramidalis									o
Anthyllis vulneraria			lf			lf			
Arenaria serpyllifolia subsp. serpyllifolia						o			
Betula pubescens						r			
Carex arenaria	1					f	2		o
Carex flacca									o
Catapodium marinum						o			
Catapodium rigidum						r			
Centaureum erythraea						r			
Cirsium arvense									r
Conyza canadensis						o			
Conyza floribunda	2					lf			
Crepis capillaris						r			
Dactylis glomerata				f	f		2		o
Dactylorhiza praetermissa				o	o				
Daucus carota subsp. carota					o				
Deschampsia cespitosa					o			r	r
Elytrigia repens					ld		60		a
Equisetum arvense	1				o				
Erigeron acris					o				
Eupatorium cannabinum					o			r	r
Festuca rubra				ld	ld		20		f
Fraxinus excelsor					r				

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Hippophae rhamnoides					o					o
Holcus lanatus	3				lf	20				f
Hypericum perforatum					r					
Hypochaeris radicata					lf					
Leontodon saxatilis					o					
Linum bienne					r					
Lotus corniculatus		o			lf	3				o
Medicago lupulina				o	o					
Melilotus officinalis					o					
Mentha aquatica					o					
Molinia caerulea				o	o					r
Oenothera cambrica				o	o					
Oenothera x fallax	2				lf					
Ononis repens		o			lf					
Orobancha minor									o	o
Pastinaca sativa subsp. sylvestris					o				r	r
Phragmites australis				o	o					
Picris hieracioides	1				o					
Plantago coronopus					o					
Plantago lanceolatus	1				lf					
Poa humilis				o	o					
Ranunculus repens	1				lf					
Rhinanthus minor	1				lf	4				lf
Rosa rugosa									r	r
Rubus caesius					f					
Rubus fruticosus agg.					o					
Salix caprea					o					
Salix cinerea subsp. oleifolia				o	o				o	o
Salix repens				o	o			lf		lf
Senecio jacobaea			o		o					
Sonchus arvensis	1				o					
Trifolium dubium	1				o					
Trifolium repens		o			lf					
Trifolium scabrum					r					
Tussilago farfara					r					
Ulex europaeus					r					
Vicia sativa							r			r
Vulpia fasciculata					o					
Lower Plants										
Barbula convoluta var. convoluta					lf					
Barbula unguiculata					r					
Brachythecium albicans					r					
Brachythecium mildeanum	2				o					
Brachythecium rutabulum							o			o
Bryum algovicum					o					
Dicranella varia					r					
Homalothecium lutescens				lf	lf					
Hypnum cupressiforme var. lacunosum					lf					
Pseudocrossidium hornschurchianum					o					
Pseudoscleropodium purum										
Rhynchostegium megapolitanum			o		o	3				o
Combined bryophyte	2				lf					

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Veg. Height (cm)
Bare Sand

5				30
				o

30				40
				r

COLUMN COUNT (vp & lower taxa) =
TOTAL COUNT vp & lower taxa (quadrat) =
TOTAL COUNT vp & lower taxa (plot) =

13	3	4	10	
			30	
				67

8	3	1	6	
			18	
				23

Plot C

Grid Ref:

Date:

Margam Landfill C

SS7852183449

22/08/14

Margam Landfill C

SS7852183449

26/07/18

Species

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

Vascular Plants
Achillea millefolium
Agrostis stolonifera
Ammophila arenaria
Anacamptis pyramidalis
Anthyllis vulneraria
Arrhenatherum elatius
Betula pubescens
Blackstonia perfoliata
Bromus hordeaceus
Calystegia soldanella
Carex arenaria
Centaureum erythraea
Chamerion angustifolium
Cirsium vulgare
Coincya monensis subsp. cheiranthos
Conyza floribunda
Crepis capillaris
Crepis vesicaria
Dactylis glomerata
Dactylorhiza praetermissa
Echium vulgare
Elytrigia campestris subsp. maritima
Epipactis palustris
Equisetum arvense
Equisetum variegatum
Erigeron acris
Eryngium maritimum
Eupatorium cannabinum
Euphrasia sp.
Festuca rubra
Hieracium sp.
Hippophae rhamnoides
Hirschfeldia incana
Holcus lanatus
Hypochaeris radicata
Inula conyza

				o
	la			la
	la			la
				r
				o
				lf
				o
2				f
				o
				r
				o
				lf
				lf
				lf
				o
16				la
				o
			o	o
1				ld
		o		o
				o
				o
				o
	o			o

2				o
			r	o
				r
			o	o
			r	r
		r		o
1				r
				r
2				o
		o		o
			r	o
	r			r
	r			r
				r
		r		lf
				o
50				la
2				o
				o
				o
	lf			lf
2				lf
		o		o
3				o
			r	r



Juncus articulatus				o					
Leontodon saxatilis		o		o					
Lotus corniculatus	8			lf		2			lf
Medicago lupulina				r					
Odontites jaubertianus subsp. jaubertianus									o
Odontites vernus				o					
Oenothera x fallax			lf	lf					
Ononis repens	4			la		3			f
Picris hieracioides	2			lf		1			o
Pilosella officinarum			o	o		2			o
Plantago coronopus				o					
Plantago lanceolatus	1			o		2			o
Plantago major				r					
Poa annua				o					
Poa humilis			o	o		o			o
Pulicaria dysenterica			o	o					
Rhinanthus minor						o			o
Rubus caesius	2			f				r	o
Rubus fruticosus agg.									o
Rumex acetosa							r		r
Rumex crispus subsp. littoreus			o	o					
Sagina filicaulis				o					
Sagina nodosa				o					
Salix cinerea subsp. oleifolia			o	o				o	lf
Salix repens			o	o			o		o
Senecio jacobaea				o					
Sonchus arvensis			o	o					
Spiranthes spiralis				r					
Taraxacum agg.		o		o					
Tripleurospermum maritimum				lf					
Tussilago farfara				r					
Lower Plants									
Barbula convoluta var. convoluta				o		o			o
Barbula unguiculata				r					
Bryum algovicum						4			o
Bryum dichotomum				o		o			o
Combined bryophyte									
Veg. Height (cm)				10		5			8
Bare Sand						3			lf

COLUMN COUNT (vp & lower taxa) =	8	5	2	9	
TOTAL COUNT vp & lower taxa (quadrat) =				24	
TOTAL COUNT vp & lower taxa (plot) =					56

15	7	6	7	
			35	
				42

Grid Ref:
Date:

Margam Landfill D
SS7884283795
22/08/14

Margam Landfill D
SS7884283795
26/07/18

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Species	0.25 m2	1 m2	2 m2	5 m2	Area	0.25 m2	1 m2	2 m2	5 m2	Area
Vascular Plants										
<i>Aira caryophyllea</i>	1				o					
<i>Anacamptis pyramidalis</i>										r
<i>Anthyllis vulneraria</i>							o			o
<i>Arenaria serpyllifolia</i> subsp. <i>serpyllifolia</i>	1				o			o		o
<i>Arrhenatherum elatius</i>						4				
<i>Blackstonia perfoliata</i>										r
<i>Bromus hordeaceus</i>	2				o	3				
<i>Calamagrostis epigejos</i>										lf
<i>Catapodium marinum</i>	2				o					
<i>Catapodium rigidum</i>						1				
<i>Dactylorhiza praetermissa</i>										r
<i>Daucus carota</i> subsp. <i>carota</i>				r	r	1				
<i>Echium vulgare</i>	2				o	1				
<i>Elytrigia atherica</i>	1				la					
<i>Elytrigia repens</i>						10				
<i>Equisetum arvense</i>					o					
<i>Erodium cicutarium</i>	2				o					
<i>Eupatorium cannabinum</i>			lf		o					
<i>Festuca rubra</i>						50				
<i>Geranium molle</i>	1				o					
<i>Hypochaeris radicata</i>				o	o					
<i>Juncus acutus</i>										r
<i>Leontodon saxatilis</i>		o								
<i>Linum catharticum</i>								lf		o
<i>Oenothera x fallax</i>				o	o					
<i>Ononis repens</i>					lf				o	o
<i>Orobancha minor</i>				o	o					
<i>Pastinaca sativa</i> subsp. <i>sylvestris</i>				r	r					
<i>Phleum arenarium</i>						2				
<i>Picris hieracioides</i>				o	o	1				
<i>Pilosella officinarum</i>							o			o
<i>Plantago coronopus</i>	3				o					
<i>Plantago lanceolatus</i>			o		o			o		o
<i>Poa humilis</i>						2				
<i>Rubus caesius</i>					o					o
<i>Rubus fruticosus</i> agg.										o
<i>Scorzoneroide autumnalis</i>									r	r
<i>Sedum acre</i>	1				o			r		r
<i>Sonchus oleraceus</i>				r	r					
<i>Trifolium arvense</i>			lf		lf	2				
<i>Vicia sativa</i>									r	r
<i>Vulpia myuros</i>	1				o	3				
Lower Plants										
<i>Barbula convoluta</i> var. <i>convoluta</i>	20				f	2				
<i>Brachythecium albicans</i>	1				o					
<i>Bryum algovicum</i>						2				
<i>Bryum dichotomum</i>						1				
<i>Didymodon fallax</i>		o			o					

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Didymodon insulanus
Homalothecium lutescens
Hypnum cupressiforme var. lacunosum
Peltigera rufescens
Pseudocrossidium hornschruchianum
Pseudoscleropodium purum
Rhynchostegium megapolitanum
Syntrichia ruralis var. ruraliformis
Combined bryophyte
Veg. Height (cm)
Bare Sand

	r			r
4				lf
50				lf
1				lf
2				o
	o			o
1				o
2				4
1				o

10				
4				
			o	o
				lf
2				
7				15
0				r

COLUMN COUNT (vp & lower taxa) =
TOTAL COUNT vp & lower taxa (quadrat) =
TOTAL COUNT vp & lower taxa (plot) =

20	4	3	7	
			34	
				36

20	2	4	4	
			30	
				20

Plot E

Grid Ref:

Date:

Species

Margam Landfill E

SS7845983962

15/09/14

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

Margam Landfill E

SS7845983962

26/07/18

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

Vascular Plants
Achillea millefolium
Ammophila arenaria
Anthyllis vulneraria
Arenaria serpyllifolia subsp. serpyllifolia
Arrhenatherum elatius
Betula pubescens
Blackstonia perfoliata
Carex arenaria
Centaurea debauxii
Centaurea erythraea
Cerastium diffusum
Coincya monensis subsp. cheiranthos
Coryza floribunda
Crepis capillaris
Daucus carota subsp. carota
Echium vulgare
Erigeron acris
Eupatorium cannabinum
Festuca ovina
Festuca rubra
Hippophae rhamnoides
Holcus lanatus
Hypochaeris radicata
Juncus acutus
Lotus corniculatus
Mentha aquatica

			o	o
25				1
2				lf
1				o
	o			o
2				o
				r
1				o
	o			o
			o	o
		o		o
1				o
			o	o
	o			o
	o			o
				o
			lf	lf
				o
			r	r
			o	o
				r
4				lf
				r

8				lf
			o	o
	o			o
				o
				r
			r	r
3				o
1				r
	r			r
2				r
			r	r
	r			r
	r			r
20				lf
		o		o
				r
		o		o
				r
3				o

[illegible]

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Agromonia sp.									r
Agrostis stolonifera		lf			lf				
Aira caryophyllea									o
Aira praecox							r		r
Anthyllis vulneraria	2				o		r		r
Arenaria serpyllifolia subsp. serpyllifolia	2				o	3			o
Betula pubescens					r				
Buddleja davidii					o				
Carex arenaria					o				
Catapodium marinum		o			o			r	r
Catapodium rigidum	2				o				
Centaurea erythraea							r		r
Cirsium vulgare	1				o			r	r
Coincya monensis subsp. cheiranthos					o				
Conyza floribunda		f			f	1			r
Conyza sumatrensis					r				
Dactylis glomerata					o			r	r
Diplotaxis muralis					r				
Echium vulgare				o	o			r	r
Erigeron acris				o	o				
Festuca ovina									o
Festuca rubra		lf			lf				r
Hieracium sp.	1				r				
Hippophae rhamnoides					r				
Hirschfeldia incana		lf			lf			r	la
Holcus lanatus		o			o				
Hypericum perforatum					r				
Hypochaeris radicata					o				
Leontodon saxatilis		o			o				
Lotus corniculatus	3				lf			o	o
Medicago lupulina		r			r				
Oenothera x fallax					o				r
Ononis repens					lf	2			o
Pastinaca sativa subsp. sylvestris				o					
Phleum arenarium							r		r
Picris hieracioides	2				o				
Pilosella officinarum		o			o				
Plantago lanceolatus					o				
Poa humilis									r
Rubus caesius			o		o			o	o
Rubus fruticosus agg.									r
Salix cinerea subsp. oleifolia					o				r
Sedum acre	2				lf	3			o
Senecio jacobaea					o				
Sonchus oleraceus	1				o				
Trifolium arvense		o			o				
Trifolium dubium	1				o				
Verbascum thapsus					r			r	r
Lower Plants									
Barbula convoluta var. convoluta	14				lf	3			o
Brachythecium albicans		o			o				
Bryum dichotomum						1			o
Ceratodon purpureum	5				f				

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Didymodon fallax
Homalothecium lutescens
Hypnum cupressiforme var. lacunosum
Orthotrichum anomalum
Peltigera rufescens
Pseudocrossidium hornschurchianum
Pseudoscleropodium purum
Syntrichia ruralis var. ruraliformis
Tortula muralis
Combined bryophyte
Veg. Height (cm)
Bare slag

				o
2				lf
40				lf
2				o
10				
20				f

	o			o
1				o
	o			o
			r	r
	o			o
2				o
				o
70				la
			r	o
5				
10				f

COLUMN COUNT (vp & lower taxa) =
TOTAL COUNT vp & lower taxa (quadrat) =
TOTAL COUNT vp & lower taxa (plot) =

16	11	1	3	
			31	
				46

10	7	2	8	
			27	
				35

Plot G

Grid Ref:

Date:

Species

Margam Landfill G

15/09/14

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

Margam Landfill G

SS7843383972

26/07/18

0.25 m2	1 m2	2 m2	5 m2	Area
---------	------	------	------	------

Vascular Plants
Agrostis stolonifera
Aira praecox
Ammophila arenaria
Anagallis arvensis
Anthyllis vulneraria
Arenaria serpyllifolia subsp. serpyllifolia
Arrhenatherum elatius
Blackstonia perfoliata
Buddleja davidii
Carex arenaria
Catapodium maritimum
Centaurea debauxii
Centaurea erythraea
Cerastium diffusum
Cerastium fontanum
Coincya monensis subsp. cheiranthos
Conyza canadensis
Conyza floribunda
Crepis capillaris
Daucus carota subsp. carota
Diplotaxis muralis
Echium vulgare
Elytrigia repens
Erigeron acris
Erodium cicutarium

				lf
				lf
				r
3				o
				r
			o	o
				o
		o		o
		lf		o
2				o
				o
1				o
		o		o
1				o
				r
			o	o
1				o
				o
	o			o
			o	o

2				o
		r		lf
			r	o
2				o
				r
				r
	o			o
1				r
		r		o
3				o
				r
				o



Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Erodium lebelii				r					
Eryngium maritimum				o					r
Festuca rubra		o		o					
Geranium molle				o					
Geranium pyrenaicum				o					
Hieracium sp.			r	r					
Hirschfeldia incana			o	o					
Holcus lanatus				o					r
Hypochaeris radicata	1			o					
Leontodon saxatilis			o	o					
Lotus corniculatus		o		o		2			o
Medicago lupulina				r					
Oenothera cambrica				o					
Oenothera sp.							r		r
Oenothera x fallax		lf		lf					
Ononis repens			lf	lf			o		lf
Phleum arenarium	2			o		1			o
Phragmites australis				r					
Picris hieracioides			o	o					
Pilosella officinarum	5			o		2			o
Plantago coronopus							r		r
Plantago lanceolatus	3			o					
Polygala vulgaris	1			o					
Polypodium interjectum				r					
Ranunculus bulbosus			r	r					
Rubus caesius	1			lf		1			o
Rumex crispus subsp. littoreus				r					
Sagina nodosa		r		r					
Salix cinerea subsp. oleifolia									r
Salix repens				o					r
Sedum acre	1			o		3			o
Senecio jacobaea			o	o					
Senecio squalidus				o					
Sonchus oleraceus				o					
Taraxacum agg.	1			o					
Trifolium arvense			o	o					
Tripleurospermum maritimum				o					
Lower Plants									
Brachythecium albicans						3			o
Brachythecium mildeanum		o							
Ceratodon purpureum							o		o
Didymodon fallax						1			r
Homalothecium lutescens				o		3			o
Hypnum cupressiforme var. lacunosum	2			o					
Pseudoscleropodium purum						2			o
Syntrichia ruralis var. ruraliformis	2			o		9			lf
Tortella flavovirens							o		o
Trichostomum crispulum	1			o			o		o
Combined bryophyte									
Veg. Height (cm)	6					5			
Bare sand	3			a		60			la

COLUMN COUNT (vp & lower taxa) =
TOTAL COUNT vp & lower taxa (quadrat) =
TOTAL COUNT vp & lower taxa (plot) =

17	3	6	11	
			37	
				58

15	6	3	1	
			25	
				32

Date:

15/09/14

26/07/18

Species	
---------	--

0.25 m2
1 m2
2 m2
5 m2
Area

0.25 m2
1 m2
2 m2
5 m2
Area

Vascular Plants
<i>Achillea ptarmica</i>
<i>Agrostis capillaris</i>
<i>Carex acutiformis</i>
<i>Cirsium arvense</i>
<i>Conyza floribunda</i>
<i>Epilobium ciliatum</i>
<i>Epilobium hirsutum</i>
<i>Eupatorium cannabinum</i>
<i>Galium aparine</i>
<i>Geranium robertianum</i>
<i>Glechoma hederacea</i>
<i>Hedera hibernica</i>
<i>Iris pseudacorus</i>
<i>Mentha aquatica</i>
<i>Phragmites australis</i>
<i>Pulicaria dysenterica</i>
<i>Rubus fruticosus</i> agg.
<i>Salix cinerea</i> subsp. <i>oleifolia</i>
<i>Scrophularia auriculata</i>
<i>Solanum dulcamera</i>
<i>Tussilago farfara</i>
<i>Urtica dioica</i>
Lower Plants
<i>Brachythecium rutabulum</i>
<i>Calliergonella cuspidata</i>
<i>Leptodictyum riparium</i>
<u>Epiphytes</u>
<i>Cryphaea heterophylla</i>
<i>Frullania dilatata</i>
<i>Homalothecium sericeum</i>
<i>Hypnum andoi</i>
<i>Hypnum cupressiforme</i> var. <i>cupressiforme</i>
<i>Metzgeria furcata</i>
<i>Metzgeria violacea</i>
<i>Microlejeunea ulicina</i>
<i>Orthotrichum affine</i>
<i>Ulota phyllantha</i>

[illegible][illegible]

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Combined bryophyte											
Veg. Height (cm)	2					2					
Bare calcified mud	98					99					
COLUMN COUNT (vp & lower taxa) =	1	0	0	10		1	1	0	20		
TOTAL COUNT vp & lower taxa (quadrat) =				11					22		
TOTAL COUNT vp & lower taxa (plot) =					11					32	

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APPENDIX 1: All Vegetation Survey Data

'Margam_Landfill_biological_data_2014-to-2022' saved as Excel spreadsheet, available on request.

APPENDIX 2: PHOTOGRAPHS

Photos 1 to 30: Representative management compartment habitats.

Photos 31 to 66: Sample of important wildflowers at Margam Landfill

Photo 1: **Area D1** humid dune slack vegetation (SD13) on top of capped tip 19-Jan-18



Photo 2: **Area D1** Small-bud Bryum *Bryum gemmiferum*, a localised species of humid dunes



Photo 3: **Area D2** species-poor coarse dune grassland on top of capped tip 20-Feb-19



Photo 4: **Area D2** coarse dune grassland after topping in winter 24-May-21



Photo 5: **Area D3** mosaic of mixed scrub and coarse grassland before clearance 20-Feb-19



Photo 6: **Area D3** Autumn Lady's-tresses *Spiranthes spiralis* in shorter dune grassland 21-Aug-20



Photo 7: **Area D4** with developing stands of Sea-buckthorn *Hippophae rhamnoides* 26-Jul-18



Photo 8: **Area D4** after winter scrub-bashing & topping 24-May-21



Photo 9: **Area D6** with pioneer stands of Marram *Ammophila arenaria* 25-Apr-16



Photo 10: **Area D7** with diverse humid slack vegetation 16-Aug-21



Photo 11: **Areas D8, D9 & D5** with pioneer stands of Marram *Ammophila arenaria* 25-Apr-16



Photo 12: **Area D9** with Sea Spurge *Euphorbia paralias* community at toe of slope 19-Jan-18



Photo 13: **Area D9** landfill face exposed to prevailing winds with trial anti-erosion 16-Aug-21



Photo 14: **Area D9** part of liner damaged by off-road motor cycles 11-Jan-22



Photo 15: **Areas D10 & D1** with pioneer and established dune (SD19) vegetation 24-May-21



Photo 16: **Area D11** scrub development on the older part of the capped landfill 26-Feb-19



Photo 17: **Area D18** disturbed humid slack vegetation supporting several scarce species 15-Jul-19



Photo 18: **Area D18** during high winter water levels, area with lots of bike disturbance 21-Dec-20



Photo 19: **P2** one year after flailing adjacent Sea-buckthorn 11-Jan-22



Photo 20: **P3** with scrub and reed dominant along margins 20-Feb-19



Photo 21: **P4** with exposed liner, well developed emergent vegetation and scrub 26-Jul-18



Photo 22: **P5** infilled with sand and has developed diverse dune slack vegetation 26-Feb-19



Photo 23: **P6** Newly created pool with little vegetation 25-Apr-16



Photo 24: **P6** with pioneer slack vegetation after three years 20-Feb-19



Photo 25: **P7** during drought retaining dune slack features 26-Jul-18



Photo 26: **P7** high winter levels 21-Dec-20



Photo 27: **P8** high winter levels extending species-rich slack vegetation onto **Area D7** 21-Dec-20



Photo 28: **P9** high winter levels and motorcycle tracks through species-rich vegetation 21-Dec-20



Photo 29: Lichen/bryophyte-rich vegetaion on slag in uncapped part of landfill site 19-Jan-18



Photo 30: supervised winter scrub clearance on uncapped section of landfill site 21-Dec-20





Early Marsh-orchid *Dactylorhiza incarnata* ssp. *coccinea*
Rare in NPT, first colonized in 2021



Broad-leaved Helleborine *Epipactis helleborine*
Scarce in NPT, several localised colonies



Marsh Helleborine *Epipactis palustris*
Scarce in NPT, good numbers in wet parts of capped landfill



Bee Orchid *Ophrys apifera*
Uncommon in NPT, small numbers across capped landfill



Pyramidal Orchid *Anacamptis pyramidalis*
Frequent on dunes in South Wales, including the landfill site



Southern Marsh-orchid *Dactylorhiza praetermissa*
Frequent in NPT, large population on capped landfill

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Autumn Lady's-tresses *Spiranthes spiralis*
Scarce in NPT, the site supports NPT's largest population



Hybrid Marsh-orchid *Dactylorhiza x grandis*
Localised in NPT, scattered clumps on landfill site



Brown-banded Carder Bee *Bombus humilis*
Nationally Scarce & Section 7 Priority Species in Wales



Shrill Carder Bee *Bombus sylvarum*
Nationally Rare & Section 7 Priority Species in Wales



Lesser Centaury *Centaureum pulchellum*
Localised in NPT, scattered patches across landfill site



Hutchinsia *Hornungia petraea*
Nationally Scarce, thinly scattered populations on site

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Sea Stock *Matthiola sinuata*
Nationally Rare, currently a small population at the site



Sea Stock *Matthiola sinuata* (foliage)
Nationally Rare, currently a small population at the site



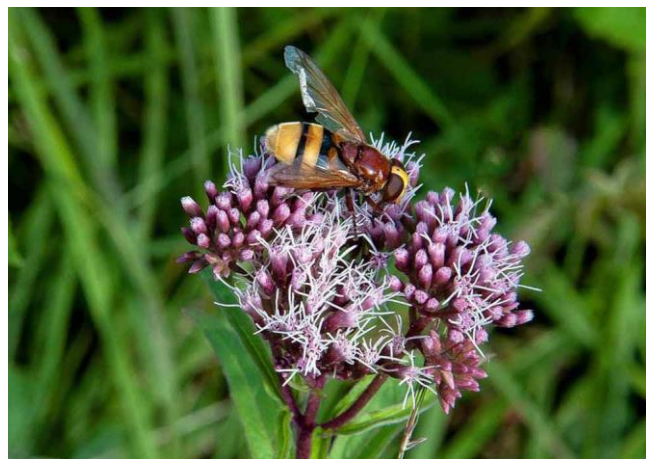
Kidney Vetch *Anthyllis vulneraria*
An important dune species for dune ecology



Sea-holly *Eryngium maritimum*
A local species of open sand dunes



Water Mint *Mentha aquatica*
A wetland species attractive to bees and other insects



Hemp-agrimony *Eupatorium cannabinum*
A tall herb of dune slacks of value for invertebrates



Carlina Thistle *Carlina vulgaris*
A local species with significant invertebrate interest



Field Bindweed *Convolvulus arvensis*
A common grassland component of drier sites



Pale Flax *Linum bienne*
A good indicator species of species-rich grasslands



Thread-leaved Water-crowfoot *Ranunculus trichophyllus*
A localised species thriving in the pools



Wild Carrot *Daucus carota* & Bee Beetle *Trichius fasciatus*
A common species excellent for invertebrates



Slack community with Variegated Horsetail *Equisetum variegatum* and Kneiff's Hookmoss *Drepanocladus aduncus*

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A**: Baseline Conditions

Bugseed *Corispermum intermedium*
Non-native species with a highly restricted British range



Eyebright *Euphrasia* agg.
Complex group of hemiparasitic plants of grasslands



French Bartsia *Odontites jaubertianus*
Non-native species with a highly restricted global range



Opposite Stonewort *Chara contraria*
A localised clean-water species abundant in the ponds



Sea Sandwort *Honckenya peploides*
An important pioneer dune-forming species



Common Fleabane *Pulicaria dysenterica*
Common in damp sand, important for invertebrates

Morfa Landfill Site, Maragam, Ecological Management Plan, **Part A:** Baseline Conditions

Prickly Saltwort *Salsola kali* ssp. *kali*
Section 7 Priority Species in Wales, pionner of bare sand



Yellow-wort *Blackstonia perfoliata*
A localized species of calcareous habitats



Round-leaved Wintergreen *Pyrola rotundifolia* ssp. *maritima*
Nationally Scarce, locally frequent on damp capped landfill



Viper's-bugloss *Echium vulgare*
A localised species important for pollinators



Cavernous Crystalwort *Riccia cavernosa*
Nationally Scarce, site holds Glamorgan's largest colony



Sea Bindweed *Calystegia soldanella*
A dune specialist frequent in the frontal dunes

