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Biodiversity Management Plan

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Document Control Sheet

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1 Introduction

A Masterplan has been prepared to guide the future development of the Grange Castle Business Park at Grange Castle West. A key element of the Masterplan design has been the incorporation of the Biodiversity Management Plan (BMP) prepared for Grange Castle West following the land use objective zoning of this area in 2018 as an area of Enterprise and Employment (EE).

The lands that are included within the BMP boundary, as shown on Figure 1.1, were originally zoned as Rural and Agricultural (RU) lands in the South Dublin County Council (SDCC) 2016 – 2022 County Development Plan (CDP). In April 2018 Variation No. 1 to the 2016 – 2022 CDP was adopted and these lands were rezoned from Rural and Agricultural (RU) to Enterprise and Employment (EE). The purpose of this rezoning was to facilitate the extension of the Grange Castle Business Park within the boundary of the BMP lands.

As part of the adopted Variation No. 1 a requirement was set out for the preparation and adoption of a Biodiversity Management Plan for the lands outlined in Figure 1.1 below. This requirement was outlined in the Variation No. 1 as follows:

“A Biodiversity Management Plan (BMP) shall be prepared for lands at Grangecastle West (subject of ET3 SLO1) by a qualified ecologist and be guided by relevant best practice guidelines and established techniques for habitats present on the lands.

The BMP shall incorporate the following measures:

- *The preservation of existing hedgerows, treelines, woodland, scrub and other semi-natural habitats where possible;*
- *High value historical boundary hedgerows shall be retained and management details included;*
- *Where hedgerows, treelines, woodland and other semi-natural habitats are to be retained within the lands, details of their management and protection should be provided in a Habitat Management Plan (HMP); and*
- *Opportunities to enhance the biodiversity value of SUDS measures where relevant should be included in habitat management plans.*

The recently adopted SDCC 2022 – 2026 CDP has maintained the EE land use zoning objectives for the Grange Castle West lands that are the subject of this BMP. Grange Castle West is identified as a key strategic employment area in the current CDP and the EE land use zonings aims to underpin the County Development Plan’s objective (EDE1 Objectives 5) to promote high tech, manufacturing and research and development at the Grange Castle Business Park.

Chapter 4 Green Infrastructure of the current CDP has identified the Grand Canal as a “Core Area” and has further identified “stepping stones”, which are identified as small areas of green space that are connected to the core areas via green corridors. Grange Castle Business Park has been identified as a stepping stone.

The aim of the BMP is to provide for the incorporation of stepping stones and linear corridors within the masterplan area that will support green infrastructure and natural heritage objectives set out in the current CDP.

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This BMP describes how the retention and enhancement of existing semi-natural hedgerow habitat and the creation of new habitat has been integrated with the Grange Castle Business Park masterplan. This Plan provides key principles for the future management of biodiversity and green infrastructure within the masterplan area.

The remainder of this BMP is structured as follows:

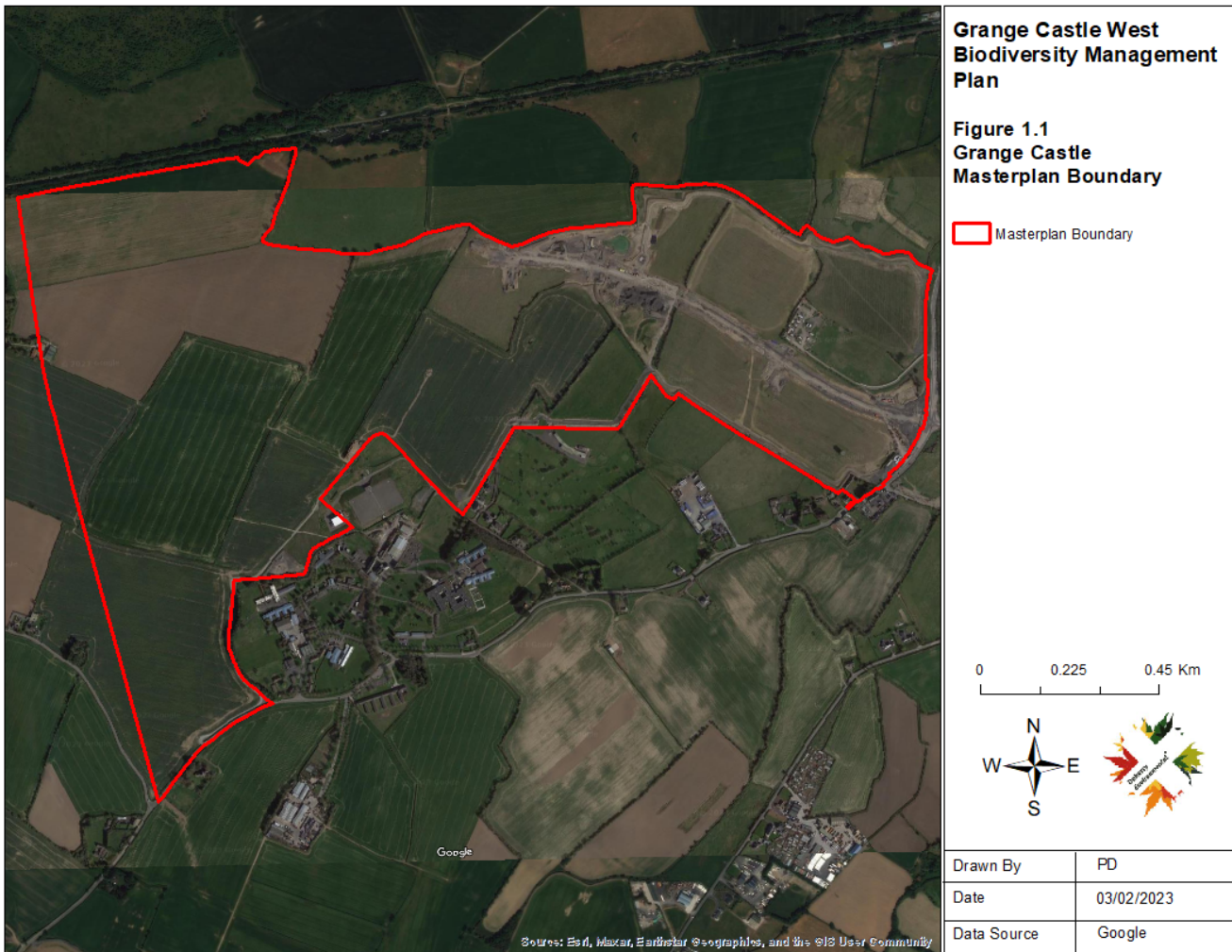
Section 2: Biodiversity Baseline

Section 3: Biodiversity Management Plan Zone and Associated Key Components

Section 4: Design and Management of Key Habitat Components

Section 5: Design and Management of Key Fauna Components

Section 6: Implementation and Monitoring



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2 Biodiversity Baseline

The land cover within the Grange Castle West Lands is dominated by intensively managed cultivated lands (arable land habitat). The principal crops within the lands include cereals and edibles. The land cover is also characterised by a large-size field pattern and much of the field boundaries comprise intensively-managed box-cut hedgerows. Figure 2.1 provides a current habitat map (as of February 2023) of the masterplan lands illustrating the location and extent of habitats occurring within the site.

The habitats that are representative of semi-natural habitats occurring within the lands are hedgerows and the section of the Tobermaclugg Stream (also known as the Coldblow/Lucan Stream) that flows north through the lands. The hedgerows are dominated by *Crataegus monogyna* and *Prunus spinosa*. Mature trees occur along hedgerows and these are dominated by *Fraxinus excelsior*, with *Acer pseudoplatanus*, *Quercus petraea* and *Fagus sylvatica* also occurring. A line of *Populus* sp. also occurs towards the eastern end of the lands. All hedgerows occurring within the lands are historic in origin and are depicted on the 6-inch historic maps from the early 1800's. Three lines of historic townland boundary hedgerows also occur within the lands. The location of townland boundary hedgerows and other remaining historic hedgerows are shown on Figure 2.2.

The Tobermaclugg Stream flowing north through the lands is representative of a minor lowland depositing stream. This section of the watercourse is predominantly enveloped by field boundary hedgerows. Where the channel is open it is choked with abundant macrophytes, dominated by *Apium nodiflorum*. This watercourse flows into the River Liffey approximately 4km to the north of the proposed access road. The section of this watercourse to the south of the Grand Canal has very little fishery potential and is currently not considered to be important in terms of supporting aquatic fauna.

Cut drainage ditches occur along hedgerow field boundaries. However these are ephemeral/transient freshwater features and are only likely to convey surface water during times of flood.

The principal feature of biodiversity in the surrounding area is the Grand Canal, which runs adjacent to the northern boundary of the site. The Grand Canal is a proposed Natural Heritage Area and the section adjacent to the lands has been identified as an Ecological Sensitive Area (ESA) (ROD, 2016). ROD (2016) provided the following summation of the ESA occurring along the section of the canal occurring to the north of the lands:

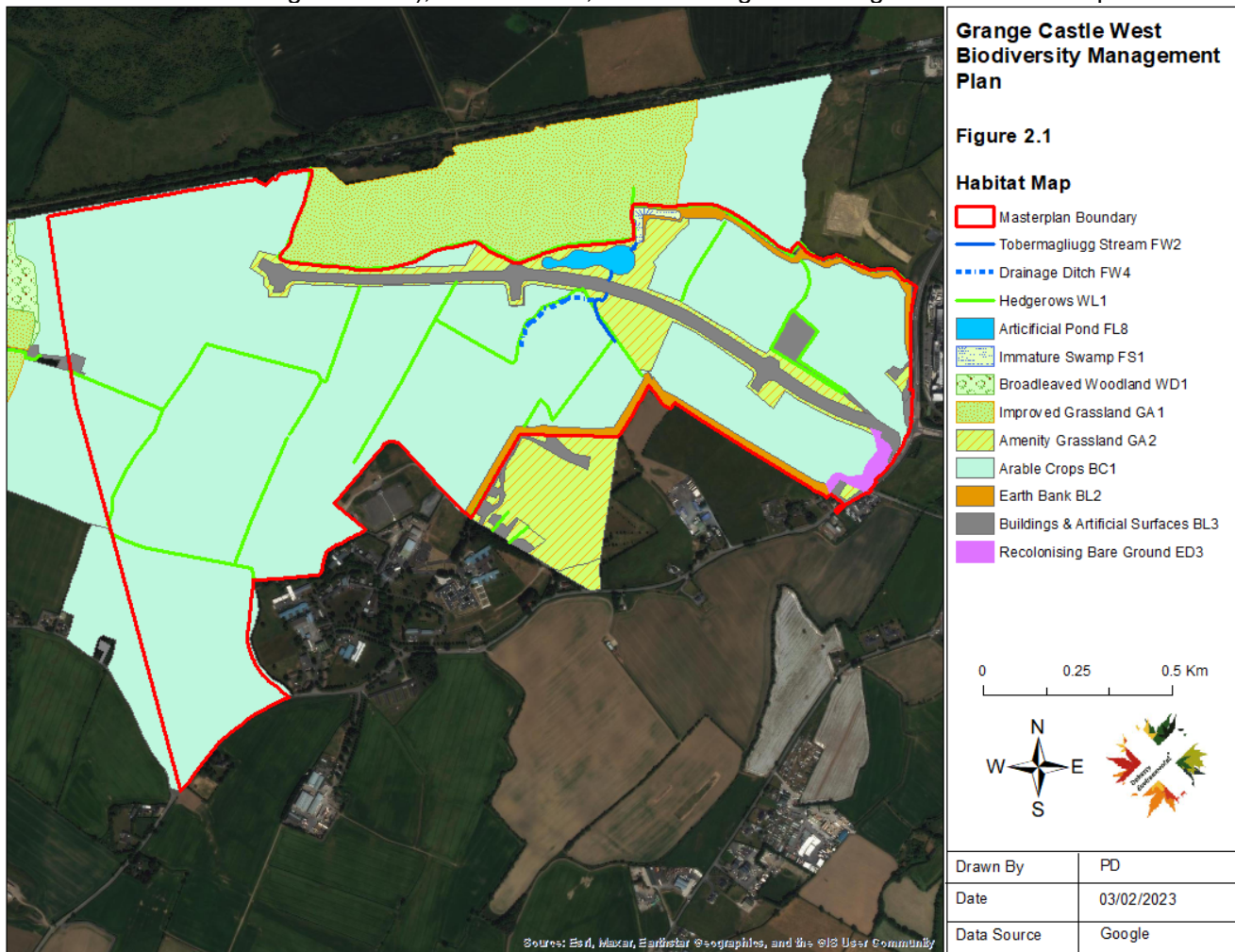
This ESA is identified for the diverse vegetation within the open channel and the rich diversity and zonation on the canal verge. The aquatic diversity includes Sagittaria sagittifolia swamp amongst well-developed fringe Nuphar-Potamogeton communities. The Phragmites swamp is also well developed along the canal margins between Aylmers and Golierstown Bridges.

The south canal verge is also diverse with Common Spotted Orchid (Dactylorhiza fuchsii) and many constant species of neutral and dry calcareous grassland abundant. Beyond the south canal boundary there is a mature species-rich hedgerow/woodland including Oak, Ash, Spindle, Sycamore, Willow and Beech. The scrub and woodland mosaic along the north boundary of the canal between Hazelhatch and Aylmer Bridges is also diverse.

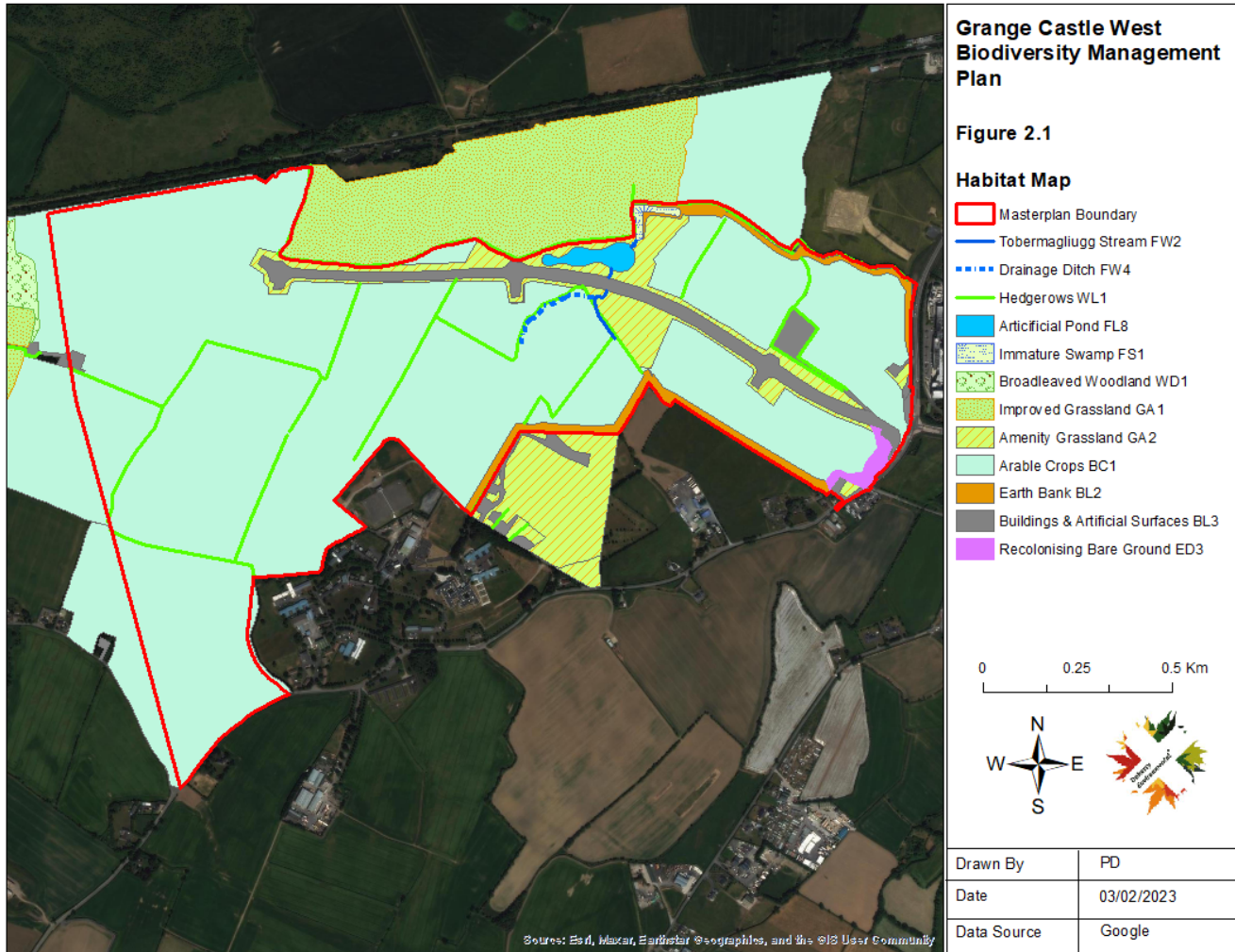
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Species listed and protected under Annex 2 of the EU Habitats Directive that rely on the Grand Canal include otters and white-clawed crayfish. The Grand Canal adjacent to the lands supports populations of crayfish that are of conservation concern. This section of the canal also functions as a home range for a population of otters and this species is very active along the canal, particularly in the vicinity of Gollierstown Quarry. There are historic records for the presence of *Vertigo moulinsiana* and suitable habitat for this species may occur along the canal and in adjacent wetland habitats. Targeted *Vertigo* surveys completed along the canal in 2018 identified *Vertigo moulinsiana* as occurring along the fringes of a pond occurring to the north of the canal, approximately 50m to the west of Gollierstown Bridge.

Other protected species known to occur along the Grand Canal include badgers, bats (up to eight species have been recorded along the canal), smooth newt, common frog and a range of bird and fish species.



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3 BMP Zones & Associated Key Components

An overall plan for the key habitat components that will be implemented as part of this BMP is presented as Figure 3.1 below. For the purpose of describing and identifying the location of management components for this BMP the lands have been sub-divided into five management zones. These management zones are shown on Figure 3.2 below. The management zones have been selected based on the following criteria:

- The alignment of existing hedgerow field boundaries that are recommended for retention within the lands;
- The boundary of the proposed biodiversity enhancement area within the lands; and

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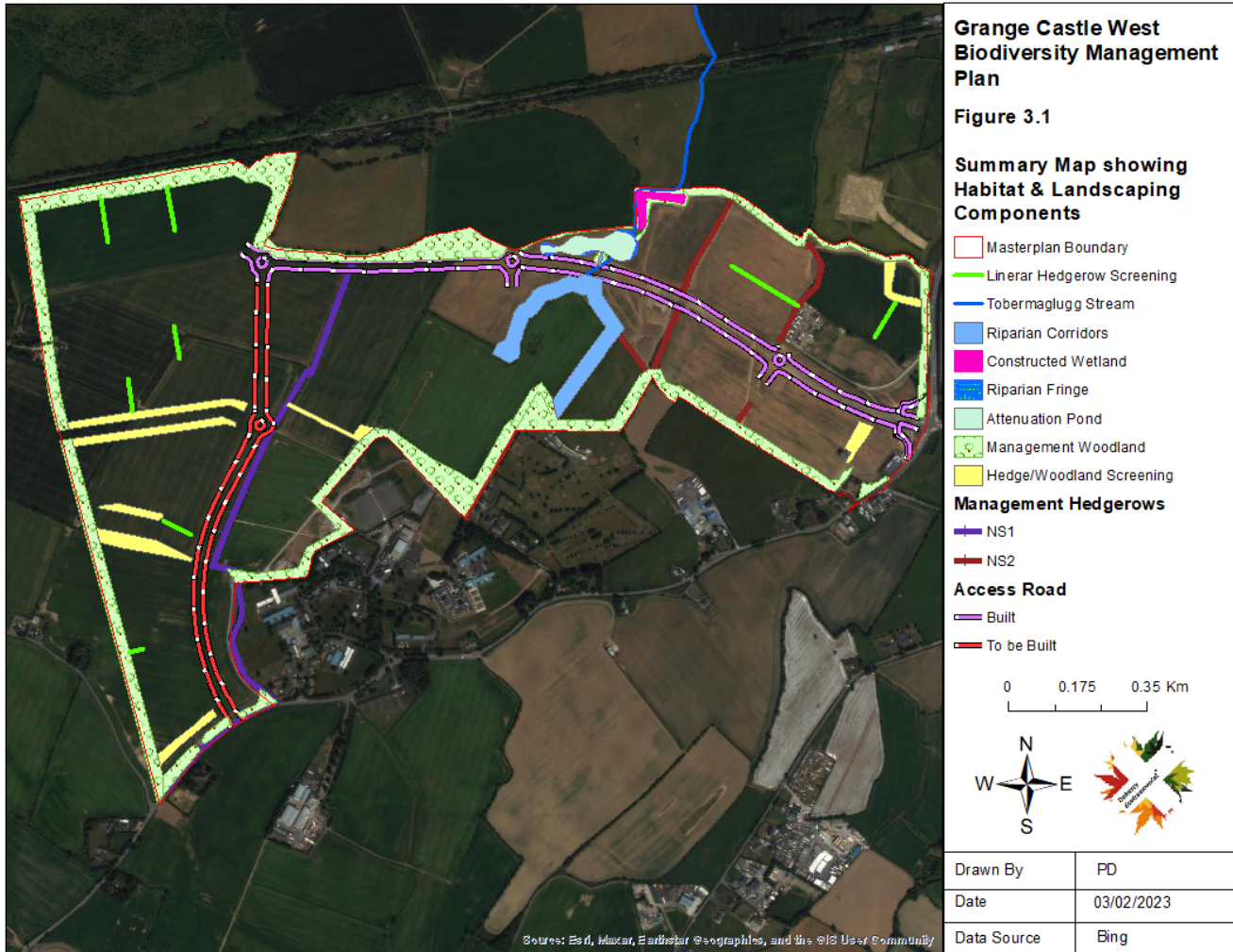
- The alignment of the proposed Grange Castle West access road, which will serve as the main transport artery facilitating access to the future business and commercial park.

A summary of the key components for biodiversity management to be implemented within each of the five management zones is provided in the following sub-sections and further details on the measures required for the successful implementation of these key components are then outlined.

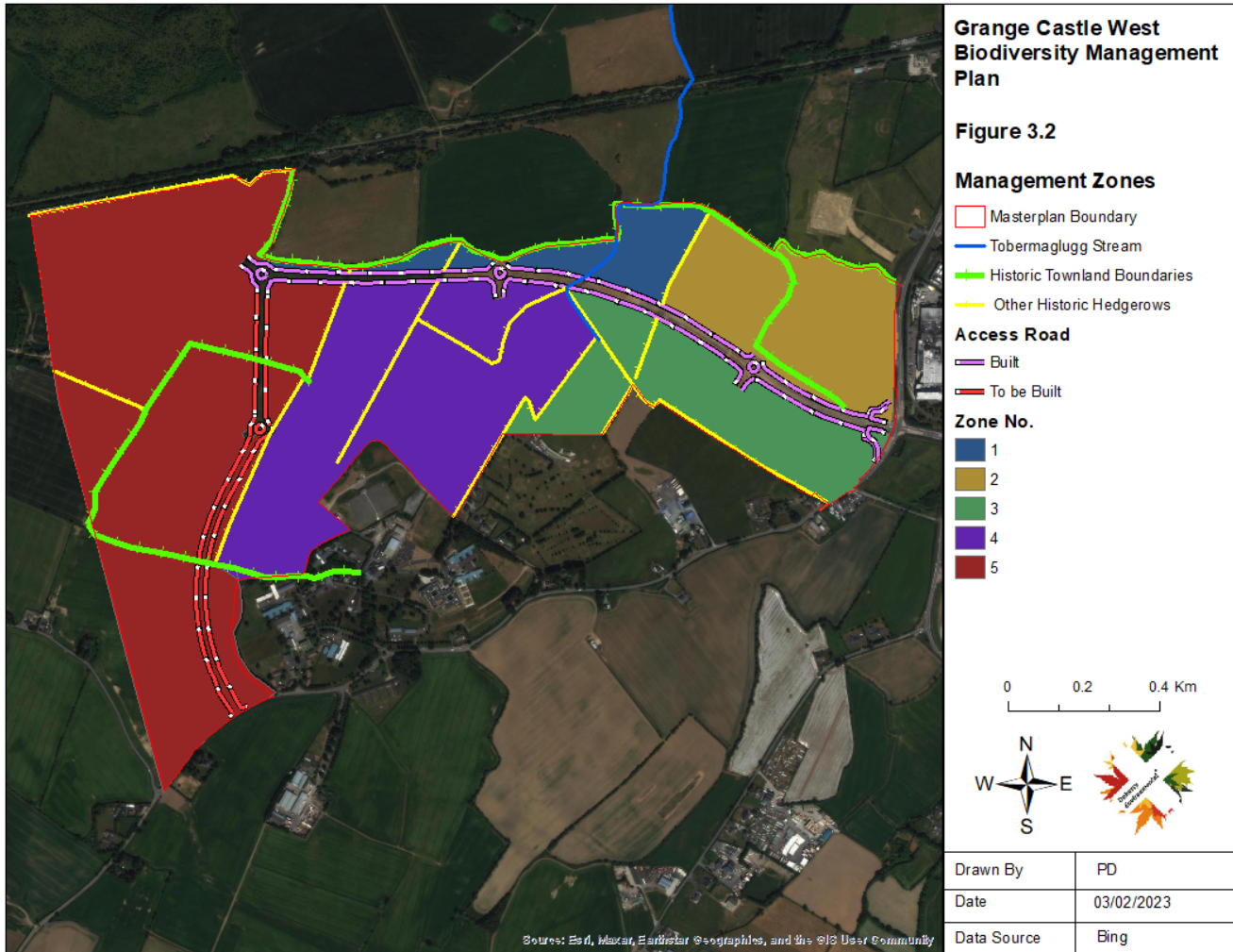
A summary of the key components set out in this BMP are as follows:

- The provision of approximately 21 Ha of woodland habitat
- The provision of approximately 700m of riparian corridor
- The provision of an artificial pond in the form of an attenuation pond, approximately 1 Ha in size.
- The provision of a constructed wetland area of approximately 0.4 Ha in size
- The retention and enhancement of existing hedgerows within the masterplan area, amounting to an approximate length of 2.5km.
- The provision of wildflower meadows, hedgerow and woodland screening and nature-based SUDS in the form of swales, raingardens and permeable paving etc.

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3.1 Zone 1

Figure 3.3 illustrates the biodiversity components that will be supported by Zone 1. These components are listed below:

- Terrestrial Woodland: terrestrial woodland will be provided in this area to the west of the attenuation pond, along the northern boundary of the masterplan area; and on the east/south sides of the integrated constructed wetland. The area of woodland that will be provided to the west of the attenuation pond and north of the existing access road is approximately 2.1 Ha in size. It will be connected by boundary woodland habitat that will be created along the existing northern hedgerow boundaries of the masterplan area to the Grand Canal to the north. The other areas of woodland in this Zone occurring along the boundary of the masterplan area and to the south/east

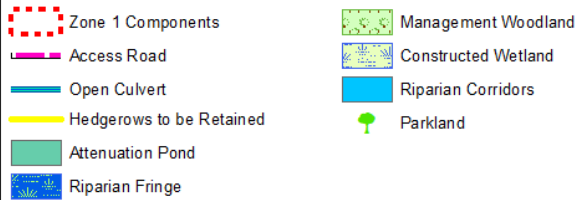
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of the integrated constructed wetland will amount to a further (approximate) area of 1 Ha of woodland habitat. Further details for this component of the Biodiversity Area are provided in Sections 4.1 below.

- The existing hedgerow occurring along the northern boundary of Zone 1 will be retained and woodland will be established along this linear feature as specified above. The retention of the hedgerow and the establishment of woodland along this boundary will provide an east-west linear corridor along the northern boundary of the BMP lands. Further details on this northern boundary woodland are provided in Section 4.1 below.
- SuDS Attenuation Pond: a SuDS attenuation pond, approximately 1 Ha in extent has been provided in this area. Further details for this component of the Biodiversity Area are provided in Sections 4.3 below.
- Watercourse and riparian scrub: The Tobermaclugg Stream has been realigned and culverted under the proposed access road. The realigned section of the watercourse, which will discharge into the attenuation pond, has been designed sensitively so that a natural watercourse has been re-created along its channel. Riparian woodland will be provided either side of the realigned stream. Further details for this component of the Biodiversity Area are provided in Sections 4.4 below.
- Integrated Constructed Wetland Area: Water discharges from the attenuation pond into a constructed wetland reedbed. As this wetland matures it will provide for the wetland habitat within this zone of the masterplan area.
- Fringing tall-herb swamp: fringing tall herb and wet woodland vegetation will be has been provided at sections fringing the attenuation pond. Further details on the creation of fringing habitat are provided in Section 4.3 below.
- Semi-natural Calcareous Meadow: Area of semi-natural calcareous meadow will be provided within the parkland setting surrounding the attenuation pond. Further details on the creation of this habitat are provided in Section 4.2 below.
- Parkland and Scattered Trees: Parkland scattered trees that will include native and non-native specimen trees will be provided in green/open space areas within the Biodiversity Area.



Figure 3.3: Biodiversity Area Components



Drawn By	PD
Date	03/02/2023
Data Source	Bing

3.2 Zone 2 – Northeast Lands

The key components for biodiversity management that will be implemented in Zone 2 are:

- The retention of east to west orientated hedgerows along the northern boundary of the masterplan area.
- The provision of linear woodland habitat along the berms adjacent to the northern and eastern boundaries of the masterplan area. The top of the berm is planted with a high canopy woodland whilst the berm slopes have been treated with scrub planting. The woodland within this zone will amount to approximately 1.5 Ha.

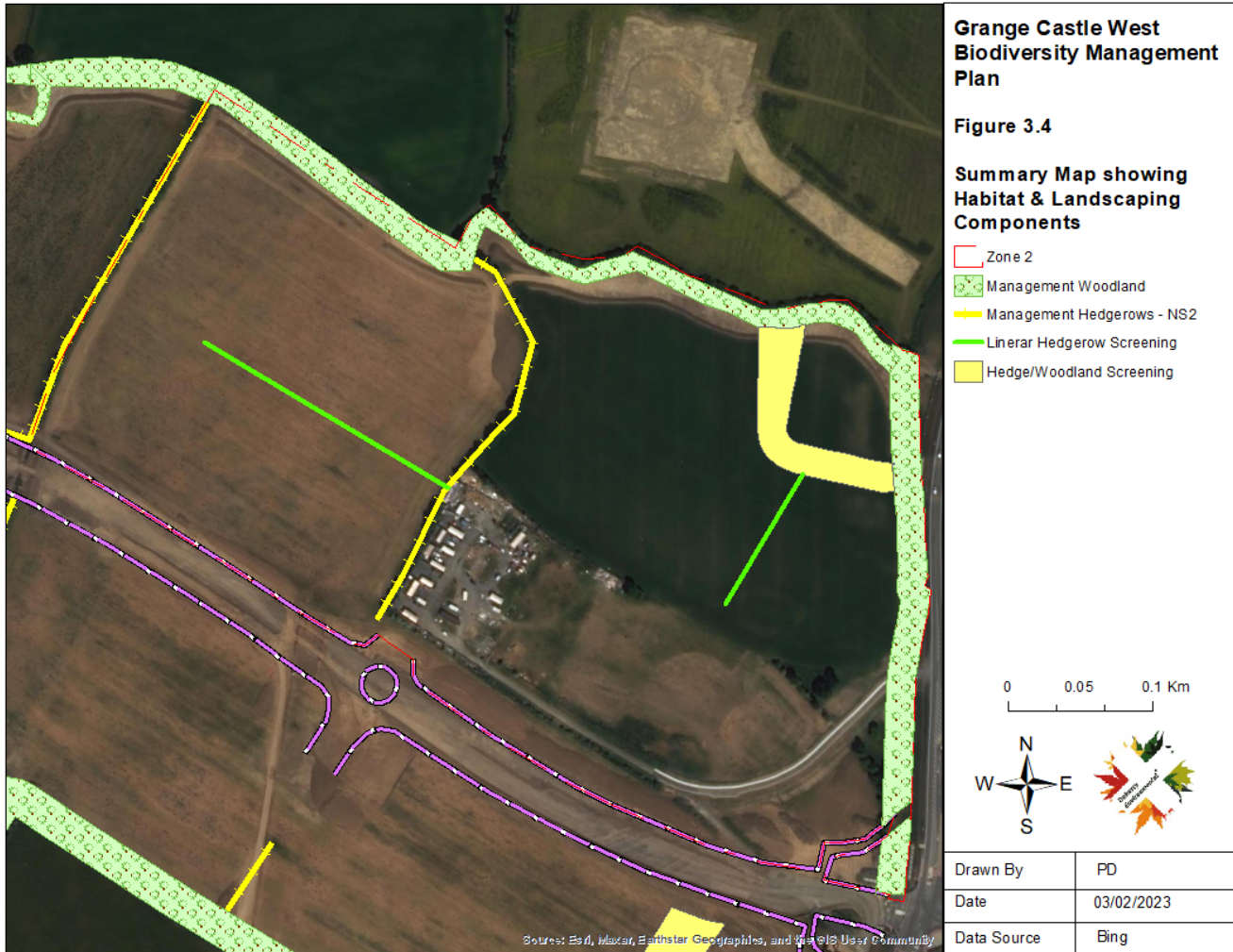
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- The retention of an existing hedgerow that will provide a linear corridor leading south from the northern boundary woodland. This hedgerow forms part of the overall north-south hedgerow corridors to be retained within the masterplan area and is denoted on Figure 3.4 as NS2.
- The provision of hedge/woodland screening at the northeastern corner of the masterplan area.

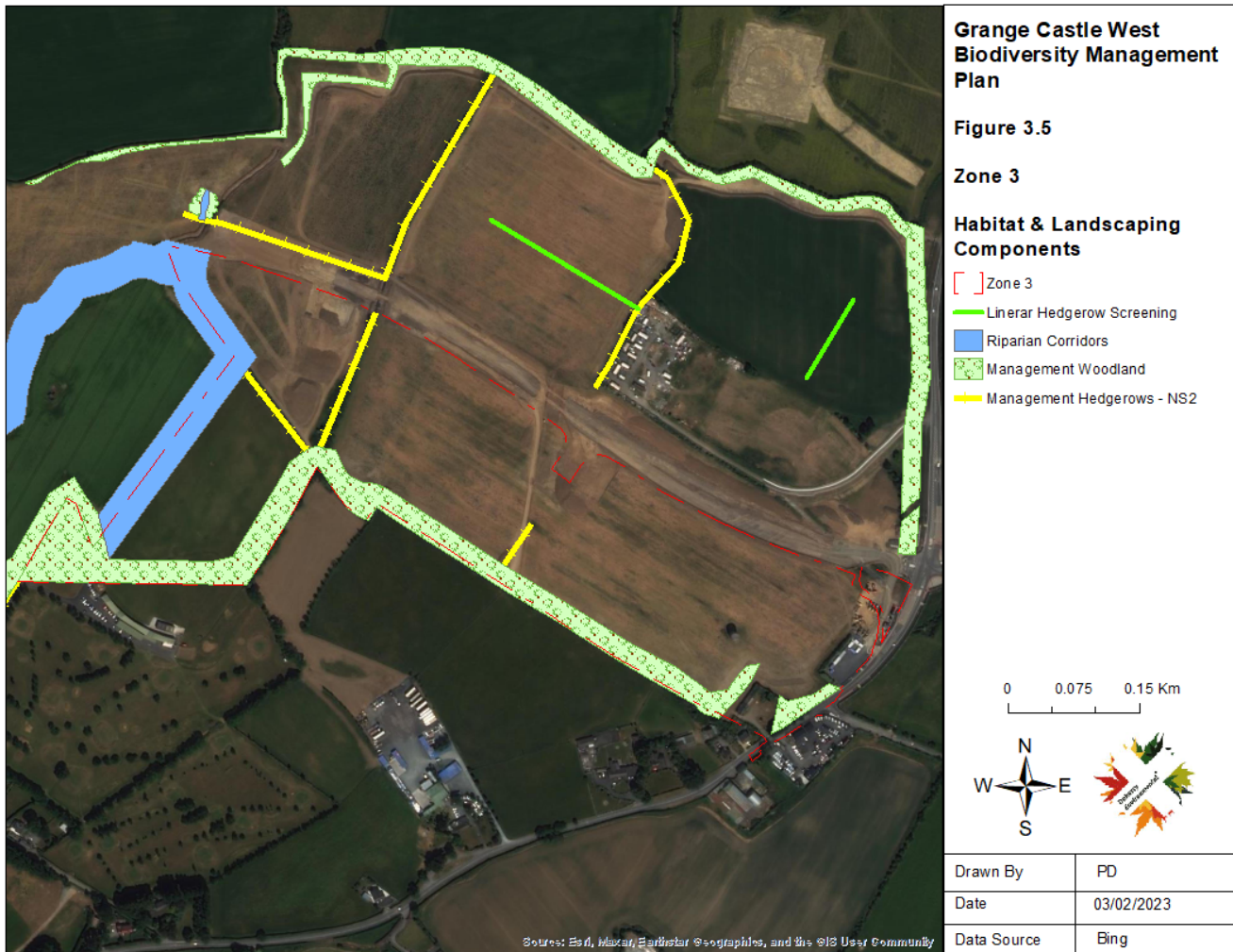
3.3 Zone 3 – Southeast Lands

The key components for biodiversity management that will be implemented in Zone 3 are highlighted in Figure 3.5 and are as follows:

- The provision of linear woodland habitat, approximately 3.5 Ha in size along the berm adjacent to the southern boundary of the masterplan area. The top of the berm is planted with a high canopy woodland whilst the berm slopes have been treated with scrub planting.
- The retention and enhancement of hedgerows along the western boundary of Zone 3 which will form part of the Hedgerow NS2. This hedgerow will provide a north south linear corridor through the BMP lands.



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- Provision of a riparian corridor along the alignment of the Tobermaclugg Stream to the west of this zone.
- The provision of hedge/woodland screening at the northeastern corner of the masterplan area.

3.4 Zone 4 – SouthCentral Lands

The key components for biodiversity management that will be implemented in Zone 4 are highlighted on Figure 3.6 and are as follows:

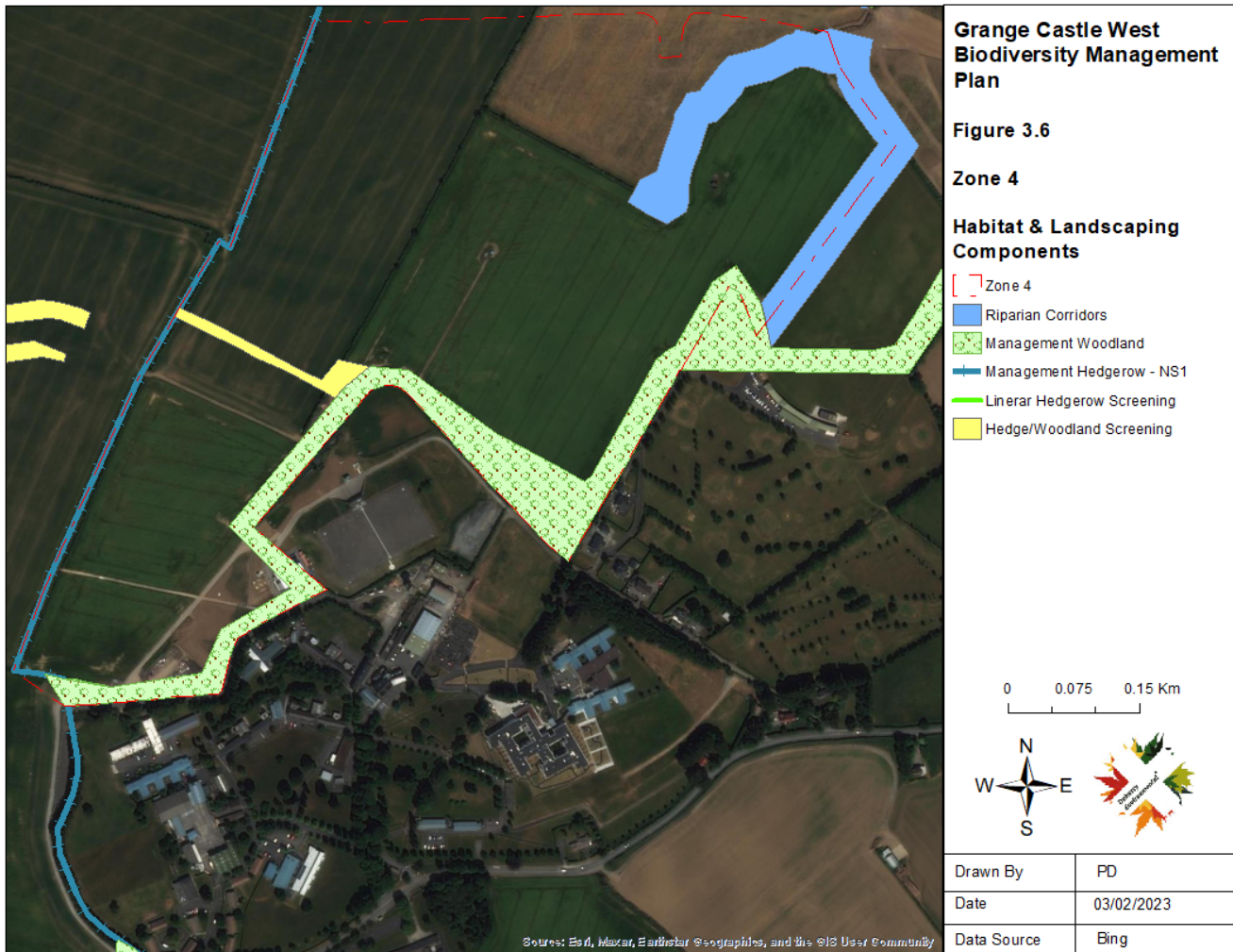
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- The retention and enhancement of hedgerows along the western boundary of Zone 4 which will form part of the Hedgerow NS1. This hedgerow will provide a north south linear corridor through the masterplan area. Further details on Hedgerow NS1 are provided in Section 4.1 below.
- Provision of a riparian corridor along a drainage ditch to the east of this zone.
- The provision of woodland habitat corridor along the southern boundary of the masterplan area in this zone. The area of woodland in this zone will amount to approximately 4 Ha of woodland habitat and will augment existing woodland habitat to the southeast bounding Peamount Hospital and Newcastle Golf Centre.
- The provision of hedge/woodland screening at the northeastern corner of the masterplan area.

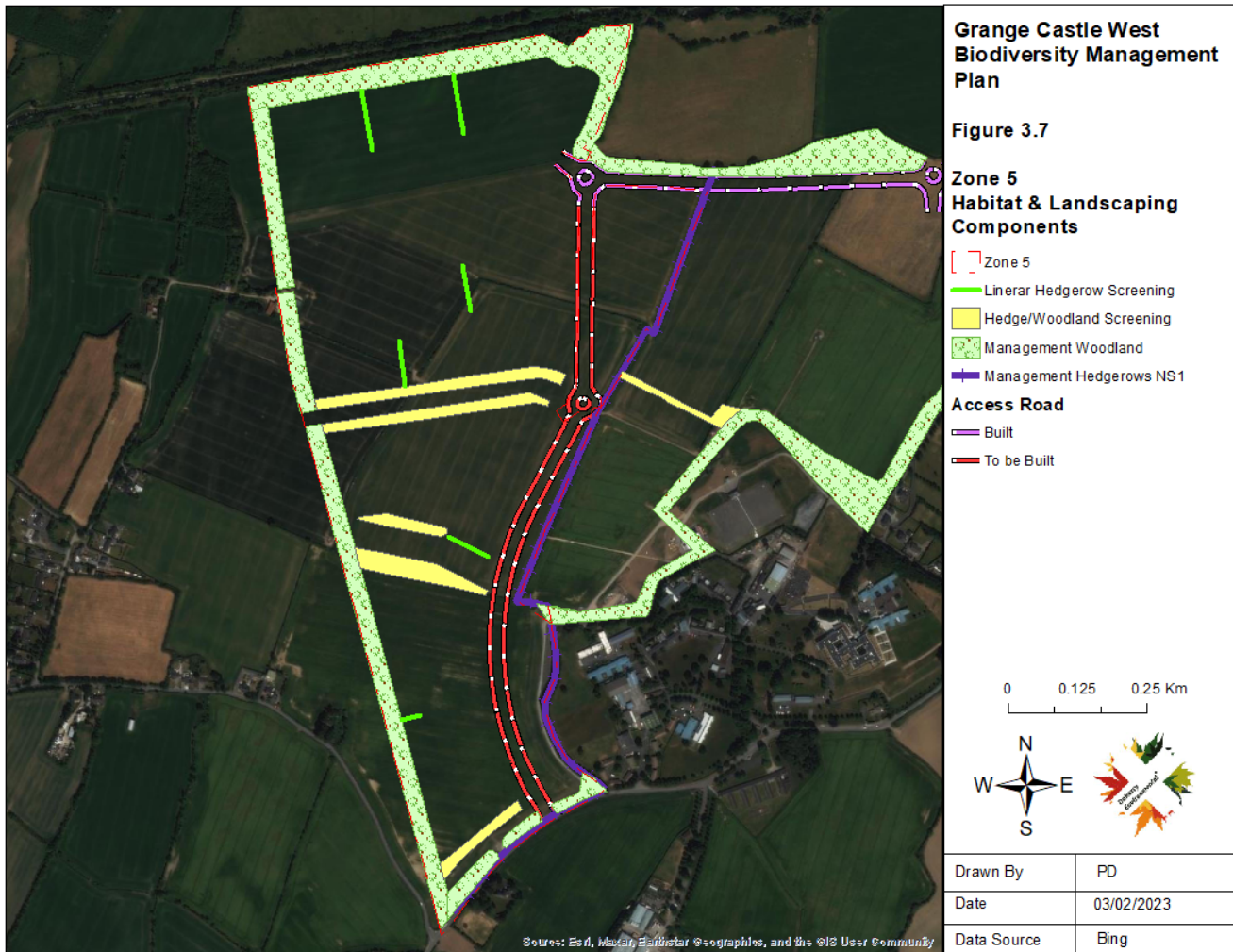
3.5 Zone 5 – Western Lands

The key components for biodiversity management that will be implemented in Zone 5 are highlighted on Figure 3.7 and are as follows:

- The retention and enhancement of hedgerows along the eastern boundary of Zone 5 which will form part of the Hedgerow NS1. This hedgerow will provide a north south linear corridor through the masterplan area.



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- Provision of linear woodland corridors along the southern, western and northern masterplan boundaries within Zone 5. This woodland will provide connectivity to existing woodland habitat to the southeast bounding Peamount Hospital and Newcastle Golf Centre. The woodland along the northern and southern boundaries of the masterplan area in this Zone will also connect into the management hedgerow NS1. The section of woodland habitat along the northern boundary of Zone 5, will augment existing linear woodland along the southern side of the Grand Canal and will increase the buffer area of woodland between areas of land to be used for enterprise and employment and the Grand Canal pNHA. The overall area of woodland habitat to be provided in Zone 5 will amount to approximately 9.1 Ha.

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- The provision of hedge/woodland screening at the northeastern corner of the masterplan area.

4 Design & Management of Key Habitat Components

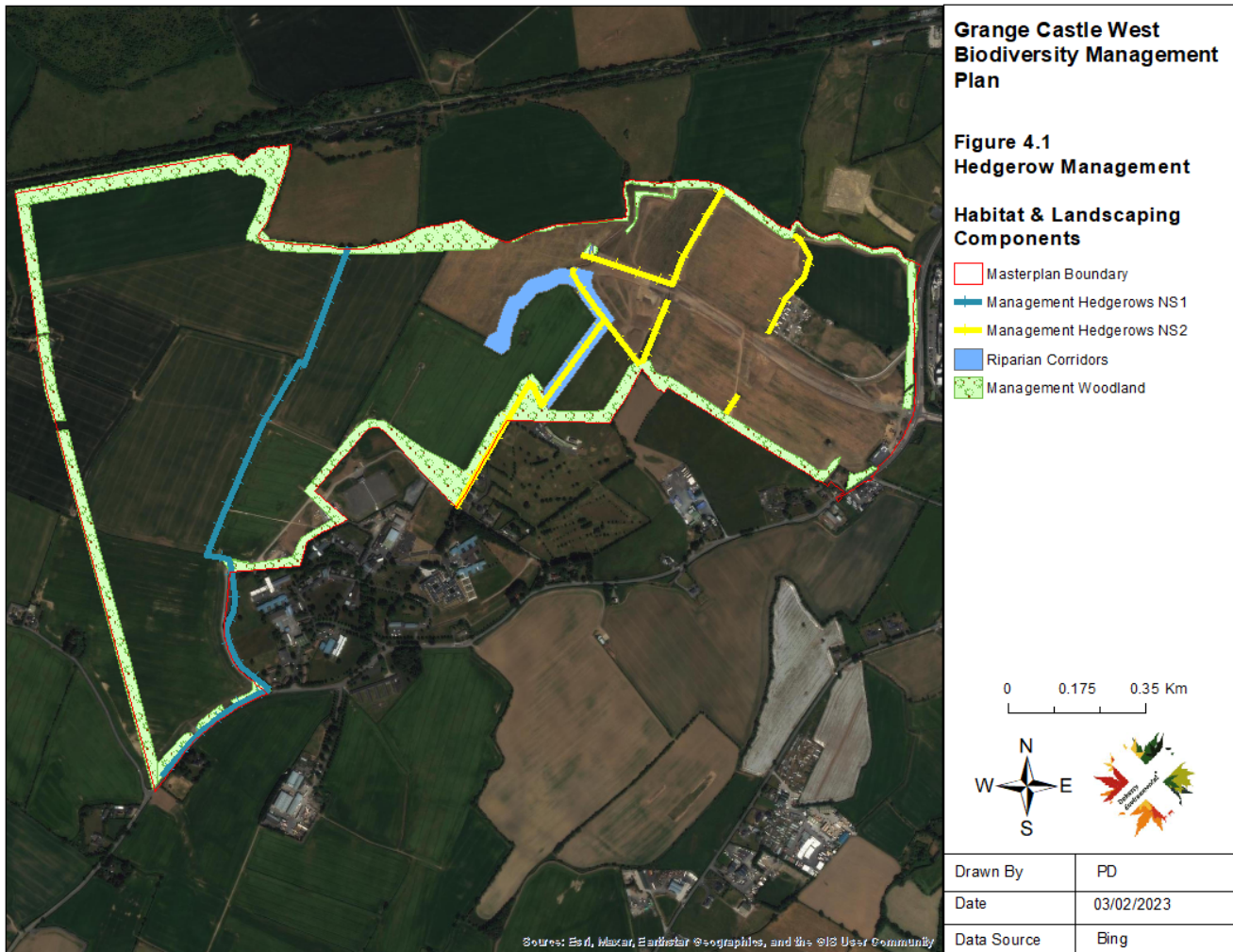
4.1 Design & Management of Woodland Habitats

An illustrated overview of the management measures for hedgerows and woodland within the lands are provided on Figure 4.1 and described below.

4.1.1 Hedgerows

A key component of the BMP is the retention and/or creation of linear hedgerow habitats within the footprint of the lands so that connectivity is maintained from north to south through the lands. The hedgerows identified for retention & enhancement and/or creation have also been selected to ensure that connectivity is provided between these linear habitats and the proposed biodiversity enhancement areas within the lands and the Grand Canal to the north of the lands. To ensure that these aims are achieved two north to south orientated linear hedgerow corridors will be provided within the lands that will connect boundary woodland along the southern and northern boundaries of the masterplan area. These hedgerows are:

1. A north – south corridor labelled NS1 on Figure 4.1. This corridor has been selected in order to maintain a connection north to south within the lands on the western section of the site.



2. A north – south corridor labelled NS2 on Figure 4.1. This corridor has been selected to provide a connection from the existing parkland habitats provided by the golf course and Peamount Hospital to the south of the masterplan area, north to the attenuation pond, constructed wetland, northern boundary woodland and on to the Grand Canal along the alignment of the Tobermaclugg Stream.

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4.1.1.1 Hedgerow Design Treatment

4.1.1.1.1 General Hedgerow Treatment Measures

All hedgerows will support a variety of native broadleaved tree species. A minimum of five species will be supported by these hedgerows. These species will include a mix of the following: ash, pedunculate oak, hazel, wych elm, crab apple, hawthorn, blackthorn, elder, spindle and eared willow.

Hedgerows will be maintained so that a diversity of hedgerow structure is provided. Tall and short ($\leq 3\text{m}$) sections will be provided. Thick and dense cover at the base of the hedgerow will be maintained and gaps along hedgerows will be minimised. Gaps to facilitate pedestrian access or visual permeability will be provided at selected locations along hedgerows.

The outer edges of the hedgerows will be maintained so that they undulate, or have a wavy plan profile. Hedgerows within the masterplan area will be bisected by roadways. For instance, the access road will bisect hedgerows NS1 and NS2 as they approach Management Zone 1. In order to minimise the severance effect created by the access road (and any other roads to be provided within the BMP lands) the hedgerows will be managed as follows in the vicinity of roadways:

The species mix of hedgerows as they approach bisecting roads will include a gradation towards taller trees approach the roadway.

This will provide a gradual increase in height of the corridor approach the roadway. Specimen trees with spreading crowns will be used at the terminus of the hedgerow adjacent to the roadway.

In the woodland to be created towards the west of the Management Zone 1 (see Figure 3.3) tall trees with spreading crowns such as native oak will be provided in the area opposite the terminus of NS1.

This approach to hedgerow planting will minimise the extent of aerial gaps caused by road severance between woodland habitats.

Hedgerows will be maintained on an ongoing basis as follows:

- Hedgerow trimming will be undertaken on three-year rotations.
- Hedgerow trimming will be alternated between sections of hedgerows so that at least one-third of the hedgerow length remains uncut.
- Hedgerow trimming will be undertaken between the months of January and February

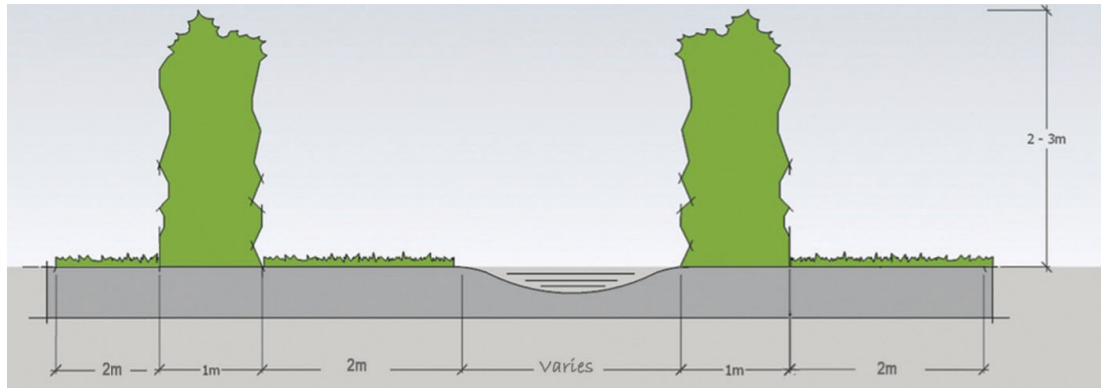
4.1.1.1.2 NS1 Hedgerow Treatment

The existing hedgerow along NS1 contains sections of intensively managed box cut hedgerows dominated by *Crataegus monogyna* and *Prunus spinosa*. Towards the north of the hedgerow mature *Fraxinus excelsior* trees occur. A drainage ditch, which is ephemeral in nature occurs along sections of this hedgerow.

The hedgerow will be double lined, with a central swale provided (see Figure 4.2). One hedgerow line will be set back from the swale and a grass verge will be provided. This grass verge inside the double line of hedgerow will facilitate access for ongoing landscape management of the hedgerow. Grass verges will also be provided along the outsides of the hedgerow as depicted in Figure 4.2. The species to be planted along this hedgerow will include those listed in Section 4.1.1.1.1 above.

The grass verges will be managed as meadow grassland. The requirements for meadow grassland treatment and management are outlined in Section 4.2 below will be implemented along the grassy verge

Figure 4.2: Illustration of the Proposed Treatment for NS1, showing double row hedgerow with central swale and grassy verges



habitat associated with hedgerow NS1.
4.1.1.1.3 NS2 Hedgerow - Riparian Corridor
Hedgerow NS2 supports an unmanaged hedgerow to the south

with uncut *Crataegus monogyna* and *Fraxinus excelsior* dominating the corridor. The initial section of the Tobermaclugg Stream occur along the northern section of NS2, aligned southeast to northwest. The management treatment for riparian corridor section of this hedgerow corridor is illustrated in Figure 4.3 below. This will involve the provision of a woodland riparian corridor either side of the Tobermaclugg Stream. The tree species to be planted along this hedgerow will include those listed in Section 4.1.1.1.1 above.

Figure 4.3: Treatment of NS2 Riparian Corridor



4.1.1.1.4 NS2 Hedgerow – Hedgerow Corridor

Elsewhere along the NS2 hedgerow corridor, existing north to south orientated hedgerows will be retained and enhanced to promote vegetation species richness, which will in turn augment the overall ecological function of these corridors.

The hedgerow corridor will be managed as a natural hedgerow habitat that supports taller canopy trees as well as an understorey of scrub. The hedgerows will be bound to one side with a rain garden feature that will support a range of hydrophilous species. An illustration of the design for this hedgerow corridor is shown in Figure 4.4 below.

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Figure 4.4: Treatment of NS2 Hedgerow Corridor



4.1.2 Terrestrial Woodland

New woodland planting aims to provide functional linear habitat for biodiversity. Planting of native tree species will be undertaken in the new woodland areas as shown on Figure 4.1 above.

The terrestrial woodland habitat will be provided along the boundary of the masterplan area. This woodland habitat will be a minimum of 30m in width and will provide a linear woodland corridor that will provide connectivity to the Grand Canal to the north and other areas of existing green infrastructure to the south of the masterplan area such as at Peamount Hospital and the Newcastle Golf Course. The woodland will be provided on a boundary berm that have and will continue to be deposited along boundaries of the masterplan area. Once the fill material for the berm is deposited along the boundary the berm will be seeded/planted with a mix of species listed in Section 4.1.1.1.1 above. Trees will be of local provenance.

The terrestrial woodland habitat will be provided along the northern boundary of Zone 5 of the masterplan area will be a minimum of 30m in width. This woodland will also be planted on a berm to be created parallel to the Grand Canal pNHA and will provide for a broader area of woodland habitat between lands to be used for enterprise and employment and the Grand Canal to the north.

4.2 Management of Meadow grassland and grassy verges

Meadow grassland and grassy verges will be managed to promote the establishment of a species-rich calcareous grassland habitat within the Biodiversity Area and alongside hedgerows.

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In order to achieve a meadow grassland habitat representative of semi-natural calcareous grassland active seeding and management of the sward will be required. In order to promote the establishment of such habitat in these locations active seeding will be undertaken with a grassland meadow species mix representative of semi-natural calcareous grassland. The seed mix will be typical of such habitat in the surrounding area and will include the following species:

Bellis perennis, Briza media, Cardamine pratensis, Carex acuta, Carex flacca, Carex hirta, Carex nigra, Carex remota, Centaurea nigra, Centaurium erythraea, Conopodium majus, Cynosurus cristatus, Dactylis glomerata, Dactylorhiza fuschii, Deschampsia cespitosa, Equisetum arvense, Euphrasia spp., Festuca rubra, Filipendula ulmaria, Galium verum, Geum urbanum, Hieracium pilosella, Holcus lanatus, Hypericum perforatum, Hypericum tetrapterum, Hypochaeris radicata, Knautia arvensis, Lathyrus pratensis, Leontodon hispidus, Leucanthemum vulgare, Lotus corniculatus, Odontites vernum, Phleum pratense, Potentilla sterilis, Primula veris, sanguisorba minor and Succisa pratensis,

The following management measures will apply for the management of the meadow grassland in the Biodiversity Area and the grassy verges along hedgerows:

The application of slurry, chemical fertiliser, lime, herbicides, pesticides, basic slag, sewage sludge, poultry litter or any other material will not be permitted.

The application of slurry, chemical fertiliser, lime, herbicides, pesticides, basic slag, sewage sludge, poultry litter or any other material will not be permitted.

- The spread of scrub-tree will be controlled.
- Trees will not be planted on areas to be managed as species-rich calcareous grassland.

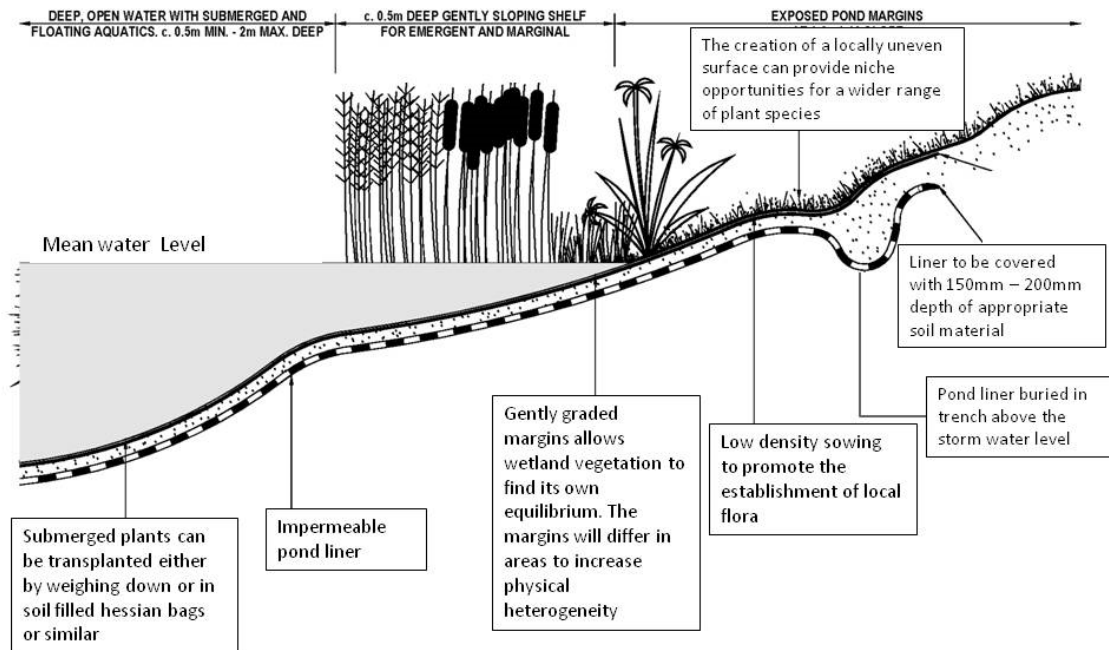
4.3 Key Components for SuDS

4.3.1 Integrated Constructed Wetland

The following key components will be implemented as part of the integrated constructed wetland (ICW) design, management and maintenance:

- Filtration of all surface water run-off from the site prior to final discharge into existing surface water networks must be incorporated into the design of the SUDS system by way of ICW.
- The location for ICW attenuation pond is shown in Figure 3.3.
- The detailed design of the ICW will comply with all relevant standards and will also be designed to maximise its potential to support biodiversity. A typical sketch of an ICW pond that aims to maximize its potential to support biodiversity is provided as Figure 4.5 below.

Figure 4.5: Section through margin of ICW Pond. Adapted from Vol. 4 UK DMRB



The following specifications will be incorporated into the attenuation pond to maximum their value for Biodiversity:

- o Bank slopes will be graded unevenly to promote greater physical heterogeneity. Sections of the banks should include gently sloping sides, no steeper than a slope of 3:1;
- o Sections of the sloping banks should be permanently saturated so that they are able to support aquatic and semi-aquatic vegetation. The following species will be planted permanently saturated bank slopes: Bulrush (*Typha latifolia*); Floating sweet-grass (*Glyceria fluitans*); Common club-rush (*Schoenoplectus lacustris*); Common reed (*Phragmites australis*); Yellow iris (*Iris pseudocarus*); Amphibious bistort; bottle sedge (*Carex rostrata*)
- o Wet woodland habitat will be provided at sections of the edge of attenuation pond in permanently saturated/inundated sections of bankside.
- o In the marginal zone the following herbaceous vegetation will be sown: water mint (*Mentha aquatica*), water plantain (*Alisma plantago-aquatica*), lesser spearwort (*Ranunculus flammula*), meadowsweet (*Filipendula ulmaria*), marsh woundwort (*Stachys palustris*), purple-loosestrife (*Lythrum salicaria*), horsetail species (*Equisetum* spp), marsh pennywort (*hydrocotyl vulgaris*),

sneezewort (*Achillea ptarmica*), wild angelica (*Angelica sylvestris*), marsh-marigold (*Caltha palustris*), cuckooflower (*Cardamine pratensis*), wavy bitter-cress (*C. flexuosa*), hairy bitter-cress (*C. hirsuta*), common mouse-ear (*Cerastium fontanum*), sedge species (*Carex* spp), creeping bent (*Agrostis stolonifera*), red fescue (*Festuca rubra*), smooth meadow grass (*Poa pratensis*), rough meadow grass (*Poa trivialis*), marsh foxtail (*Aleopecurus geniculatus*).

- The pond liner will be covered with appropriate soil material to support planted vegetation; and
- Variable depths will be installed and maintained in the pond.
- An island habitat to provide additional habitat and refuge for fauna, particularly wetland bird species will be instated within the pond;
- Fringing marginal vegetation such as *Phragmites australis*, will be managed to prevent gradual terrestrialisation within the pond. The design of the pond basin and water depths will contribute towards the management of the spread of marginal vegetation and confine such species to marginal areas around the pond edge.
- Prevent shading, particularly from the south surrounding attenuation ponds. Prevent poaching of pond edges.
- Suitable terrestrial habitat, hibernation sites and basking sites, such as piles of logs and large boulders will be provided around the edges of the attenuation pond.

4.3.2 Swales

Surface water conveyancing systems where possible should be via the existing ditch and hedgerow systems and/or along constructed swales. Surface swales and drainage ditch should be preferred to underground piped systems.

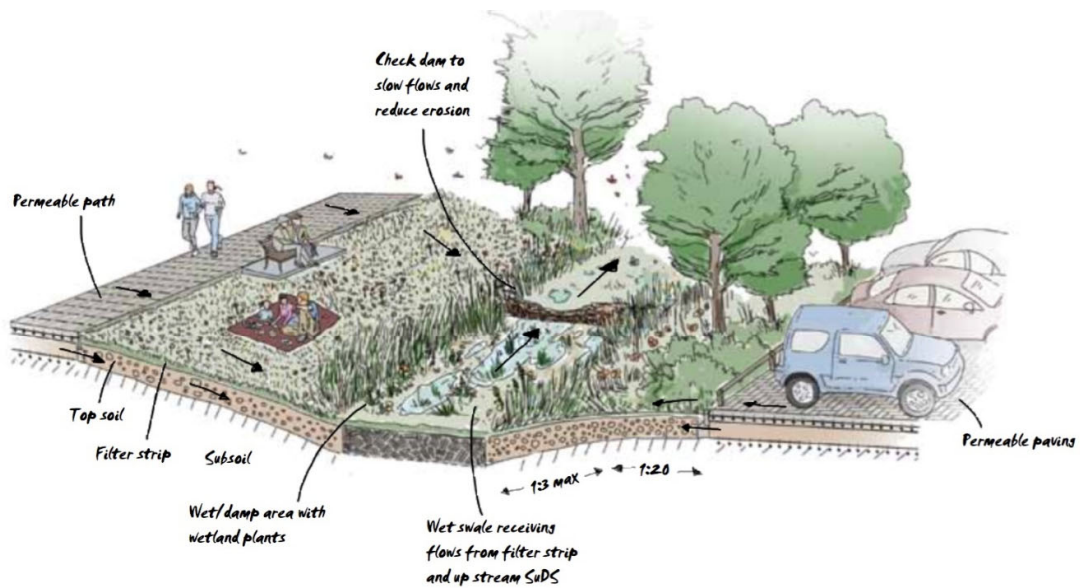
Design criteria for swales will include the following:

- Maximum side slopes will be 3:1. Slopes and depths should be minimised to the extent practical for aesthetic and safety reasons. The base width should be a minimum width of 2 feet.
- Check dams should be installed at regular intervals along the swales to promote ponding. Large rocks that are obvious and do not become concealed by vegetation should be used as check dams. Such rocks will create an attractive as well as effective check dam and will provide micro-habitat for species (e.g. basking sites for invertebrates etc.). Figure 4.6 provides examples of swales.
- All new swales will be bounded by filter strips a minimum of 2m in width. Broadleaved trees should be planted along the filter strips (see example diagram in Figure 4.6).
- Grassy verges along retained field boundaries and new green corridors will function as natural filter strips.

Figure 4.6: Example of Swale (source: Natural England 2009)



Figure 4.7: Example of Swale Design Features (source: Graham et al. 2012)



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4.3.3 Other SUDS Components

The engineering design approach to the management of surface water shall include nature-based solutions and these solutions shall be incorporated into the capacity calculations during the design of surface water drainage systems. Other features of SUDS components that will be incorporated into the design of surface water drainage systems, as appropriate, are described below.

4.3.3.1 Biodiversity Roofs

Biodiversity roofs: both intensive and extensive biodiversity roofs should be implemented wherever possible, as part of the design of buildings and nature-based SUDS solutions. Intensive roofs provide similar benefits as a small urban park. They have a deep layer of soil, which can support a range of plants, trees and shrubs. Native species (plants which would grow naturally in the local area) can provide a rich habitat for wildlife. Intensive biodiversity roofs are designed to include access for people. These Roofs may require regular maintenance. A typical design of an intensive biodiversity roof will comprise:

- 200mm Insulation and Waterproofing layer over roof slab
- 40mm egg crate drainage layer
- 75mm - 80mm substate – topsoil and no more than 20% organic matter.

Extensive roofs are more lightweight with a shallow soil layer and are not normally designed to provide access for people. They need little maintenance and are typically planted with sedum species. A species mix for biodiversity roofs is provided under Appendix 1 of the Grange Castle Landscape Report.

4.3.3.2 Rain Gardens

rain-gardens and car-parking rain-gardens. The car parking rain-gardens will have a minimum size of 2.7m width to collect car park water. Figure 4.8 provides an example of a permeable car parking with rain-garden;

4.3.3.3 Tree Pits

Tree pits in the form of Stockholm Tree-Pits shall be provided as part of the nature-based design solutions in hard landscaped areas. The Stock tree-pit design allows for the provision of healthy large standard trees in hard landscaped area. The tree-pit is installed in a stone-based “structural soil” which can be compacted to provide a solid base for surfacing while allows large voids to remain for water movement, air diffusion and gaseous exchange and tree growth. Examples of the Stockholm Tree-Pit design is shown on Figure 4.9.

Figure 4.9: Example of Stockholm Tree-Pit Design

The Stockholm system (structural soil with biochar)

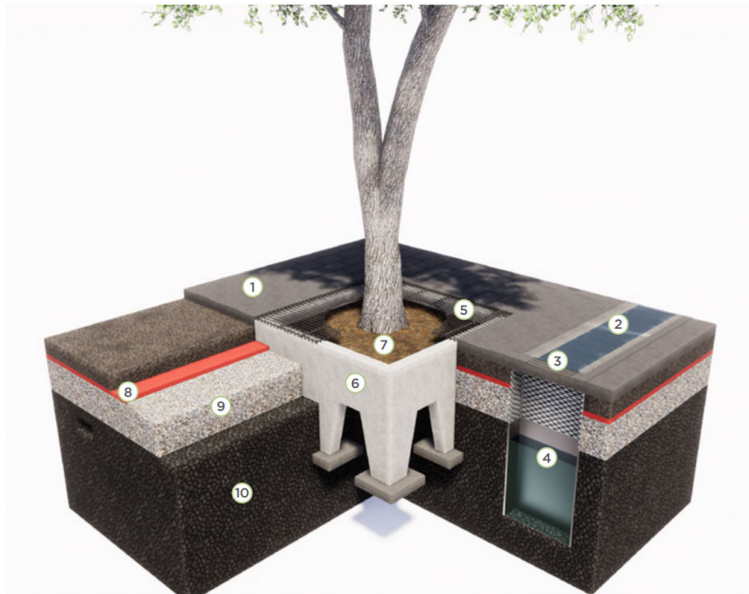


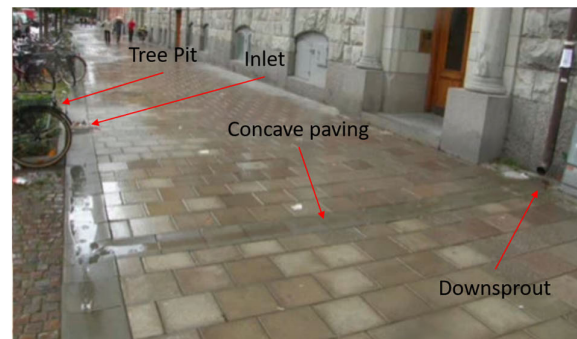
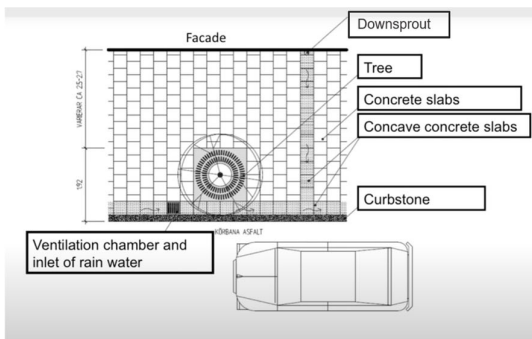
Diagram notes:

- 1 Standard paved surface with base course (this does not need to be permeable)
- 2 Channel to divert rainwater into the tree pit
- 3 Inlet/gully grate for water ingress and gaseous exchange
- 4 Aeration well with silt trap (available from www.stockholmtrleepits.co.uk)
- 5 Tree grille
- 6 Concrete frame (available from www.stockholmtrleepits.co.uk)
- 7 The concrete frame is filled with topsoil
- 8 Separation geotextile
- 9 Aeration layer, this is a 200mm layer of 20-40mm clean stone. Water from the inlet(s) is also distributed through this layer.
- 10 Structural soil is made up of 32-63mm clean stone combined with a 1:1 mix of enriched biochar and compost (15% volume)

4.3.3.4 Downsprout Disconnections

Downsprout disconnections to pervious surfaces that feed tree pits shall form part of the nature-based solutions design. This will provide for the direction of roof water to tree pits via concave paving in hard landscaped surface such as car parking and footpath areas adjacent to buildings. An example of the design of downsprout disconnections feeding tree pits is shown on Figure 4.10.

Figure 4.10: Example of Downsprout Design



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4.3.3.5 Living Walls/Vertical Gardens

The provision of living walls/vertical gardens as a key component of the approach to nature-based solutions and biodiversity enhancement provides an opportunity to integrate plant life and biodiversity into the fabric of the built environment. Given the large surface area that will be provided by building walls within the masterplan area, incorporating vertical gardens into these buildings will have the potential to significantly increase the extent of vegetation biomass with the area with associated ecological benefits.

A vertical garden planting mix has been provided in Appendix 1 of the Grange Castle Landscape Report and this mix should be used wherever vertical gardens are incorporated into the design of structures.

4.4 Key Components for the Tobermaclugg Stream realignment

The Tobermaclugg Stream rises a short distance to the southeast of the proposed attenuation pond location. The initial stretch of this watercourse is also located to the south of the recently constructed section of access road and the stream has been realigned to the south and north of the newly constructed section of road so as to minimise the distance of the watercourse under the new road way.

The realignment of the Tobermaclugg Stream has been completed using a box cut culvert that is of an adequate width to maintain flows within the stream and an adequate height to ensure sufficient head room for the provision of a mammal ledge within the box culvert. The section of realigned watercourse has been backfilled with appropriate stone and gravel material so that a natural stream bed is provided along the stretch of the stream upstream of the attenuation pond.

4.5 Key Principles for Lighting

The key principles for lighting to be implemented as part of this BMP will be the provision of “Dark Corridors” within the masterplan area and the provisions of a sensitive lighting scheme within the lands.

The southern, western and northern boundary woodland corridors will be treated as Dark Corridors.

The key principles for public lighting along these Dark Corridors that will aim to promote the ecological functioning of these corridors and their potential to support nocturnal fauna will be underpinned by a lighting design approach that will maintain these corridors outside the 1 lux lighting contour associated with any future lighting design.

In addition to the provision of the above dark corridors and associated lighting management the following measures will be implemented to form the basis of the civic lighting plan for the BMP lands:

- Where feasible a Central Monitoring System (CMS) for lighting should be used for all public lighting within the Masterplan Area. This will facilitate the implementation of a variable lighting regime (VLR) to suit both people and wildlife within the Masterplan Area.
- Maximise the spacing between lights to reduce light intensity.
- Reduce light spill by directing light only where it is needed. The upward spread of light above the horizontal plane should be avoided. This will be achieved by installing low beam angle lights, less than 70° above the horizontal plane.
- Blue-white short wavelength lights should be avoided.

- Lights with a high UV content should be avoided.
- Best practice recommendations for night time lighting for bats as outlined in *Bats and Artificial Lighting in the UK: Bats and the Built Environment Series* (available from <https://www.theilp.org.uk/documents/guidance-note-8-bats-and-artificial-lighting/>) should be observed when designing lighting.

5 Design & Management of Key Fauna Components

5.1 Otters

The existing masterplan area support no suitable habitat for otters and there is no records indicating the otters are active within these lands. The Tobermaclugg Stream represents the only freshwater habitat within the masterplan area and this stream is currently of sub-optimal habitat potential for otters.

The management of the attenuation pond as a fishery pond will provide a potential foraging resource for otters. The provision of the attenuation pond and the constructed wetland provides enhanced conditions for otters. Woodland habitat fringing these wetland habitats also provide cover for otters, enhancing the suitability of conditions along the Tobermaclugg and within the attenuation pond for otters.

5.2 Other Non-volant Mammal

The Biodiversity Management Plan for the masterplan area provides for the provision of a mammal passes under the proposed main access road to facilitate the movement of mammals through the lands into the future. A mammal ledge has been provided along the box culvert that conveys the Tobermaclugg Stream under the access road.

5.3 Bats

The woodland habitat and freshwater pond habitat to be provided within the masterplan area will be managed as natural and species rich woodland habitats and will provide potential foraging habitat for bat species. The lighting design requirements outlined in Section 4.5 above will aim to minimise the adverse effect of artificial night-time lighting on woodland and pond habitats.

Roosting opportunities will be provided within the masterplan area through the provision of bat boxes, including bat hibernation boxes.

A roost structure will be provided within the boundary berm along the northern boundary of Management Zone 5. The berm will be construction to slope to the north and south. The roost structure will be provided within the north facing side of the berm, facing the Grand Canal. A detailed design of the roost structure will be required in advance of the construction of the boundary berm. The details and final design of the roost structure are to be finalised in collaboration with the National Parks and Wildlife Service.

5.4 Birds

Bird nest boxes will be provided within woodland habitat throughout the BMP lands.

An island will be provided within the attenuation pond so that a secure nesting location for wetland bird species is provided onsite.

6 Implementation & Monitoring

The measures outlined in this BMP will be implemented by South Dublin Council and the management of the future business and commercial park within the BMP lands.

To ensure that the measures outlined in this Plan are implemented and achieving the required objectives regular monitoring is required. Upon appointment of site management, it will be a requirement of their management role to implement all measures outlined herein and to prepare a monitoring schedule that will monitor and report on the progress of this plans implementation. As part of the monitoring plan site management will be required to report to SDCC on the implementation and ongoing maintenance of all measures included in this Plan. The schedule of monitoring and reporting will be agreed with SDCC upon appointment of site management.

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