Environment SYSTEMS
evidence and insight

Monitoring Sustaining the Gwent Levels for the Sustainable Management Scheme Project

Prepared by:
Samuel Pike, FRGS AFRSPSoc CGeog (GIS)
Dr Katie Medcalf CEnv

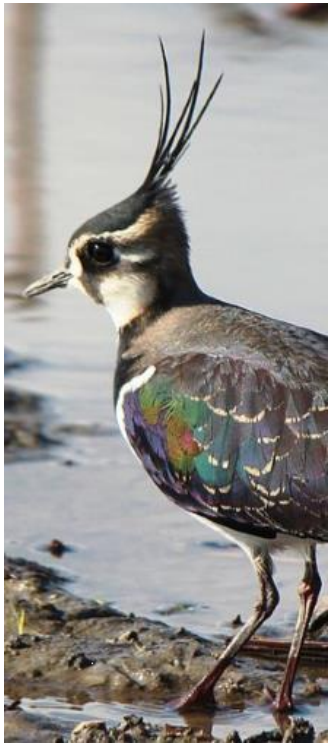
Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
European Agricultural Fund for Rural Development: Europe Investing in Rural Areas
Llywodraeth Cymru Welsh Government
Lefelau Byw Living Levels
CRONFA DREFTADAETH HERITAGE FUND
rspb yn rhoi cartref i fyd natur giving nature a home

Background

The Sustaining the Gwent Levels Project is a Welsh Government-funded Sustainable Management Scheme on the Gwent Levels.

A key objective of this project is to facilitate farmer/land manager engagement with new and developing policies, processes and mechanisms that have the potential to support sustainable land management.

It aims to create a positive environment in which the established project partnership of organisations, farmers and landowners, can work together to develop knowledge, skills, and trust, so that challenges are met collaboratively and adaptively both during and beyond the lifetime of this initiative.



Introduction

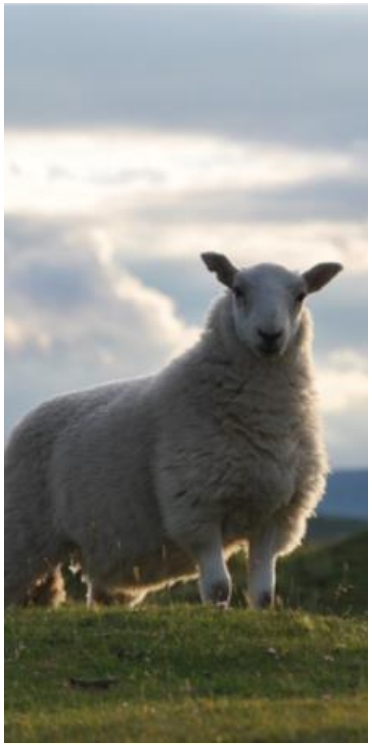
This document comprises the mapped outputs of the project. It is accompanied by a methodology document which describes the data and methods used.

Seven key contributing themes were identified for spatial analysis:

- Wader habitats (Lapwing)
- Pollinator habitats (Shrill Carder Bee)
- Landscape connectivity (bat species)
- Aquatic habitat
- Landscape structure
- Water quality, and
- Carbon storage

For each theme, four models were produced examining:

- Theme quality
- Theme connectivity or risk
- Theme opportunity for expansion, and
- Scenario modelling



Project Approach

The project employs the SENCE (Spatial Evidence for Natural Capital Evaluation) approach to modelling, developed by Environment Systems. SENCE uses spatial data to grade the importance of any area of land into a simple categorisation of suitability/quality, based on expert knowledge and scientific rule-bases. This system was developed further for the Wales Environment Information Portal and these tailored scientific rules have been used for this project.

The rule-base assessments are based on the combined interaction of key factors that determine the ecosystem service:

- Land-cover / habitat
- Soil and geology
- Elevation and slope
- Hydrology and water features
- Land management

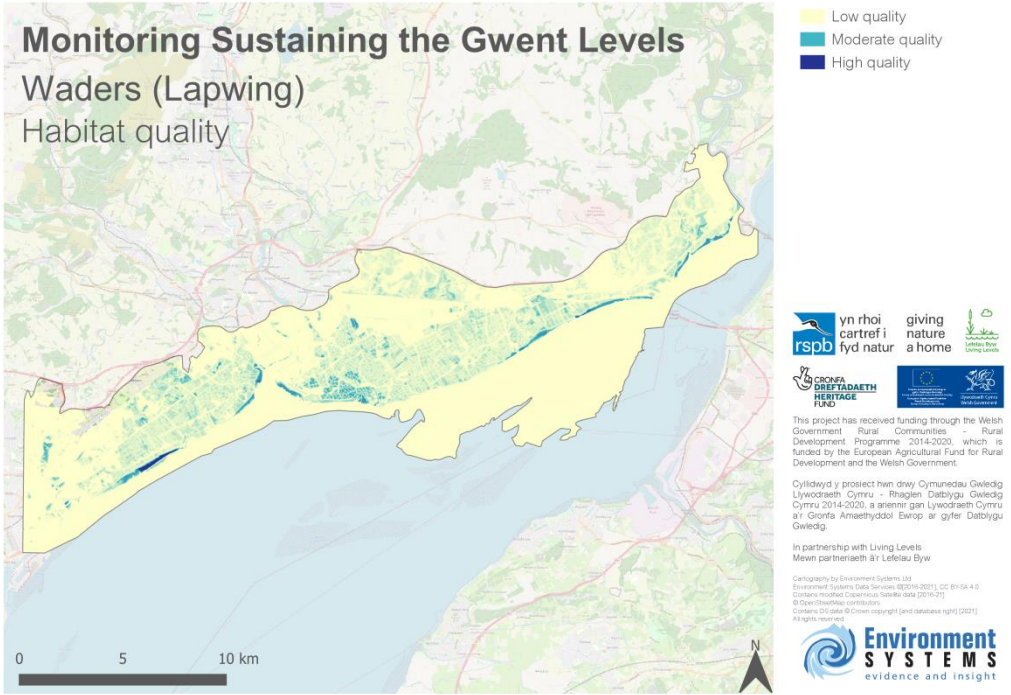
By understanding these interactions, it is possible to infer the type and quality of function that each parcel of land provides.

Wader Habitats (Lapwing)
Theme quality

Lapwings are an indicator of HNV farmland and a significant target species on the Gwent Levels.

One of the most extensive areas of reclaimed wet pasture in Great Britain is found within the Gwent Levels.

It is important to note that this map does not account for predator abundance, and is therefore a measure of the suitability of habitats that lapwings might select. These areas could be ecological traps.

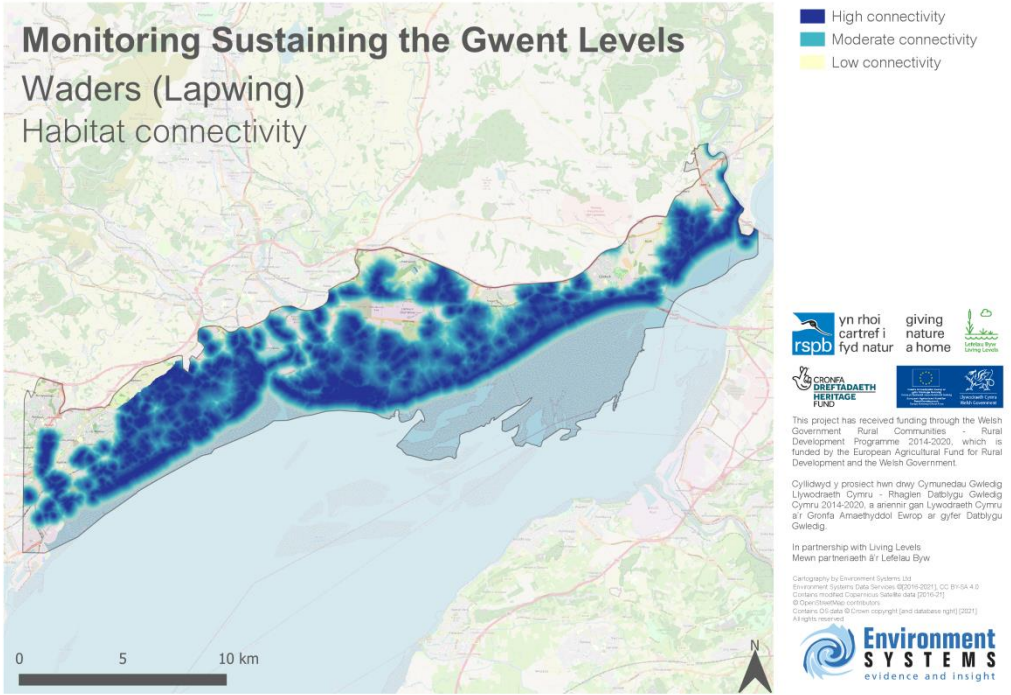


Wader Habitats (Lapwing)
Theme connectivity

Existing wader nest-foraging network within which species can move.

The network comprises the best quality nesting areas, and the surrounding suitable foraging land, from which the Lapwing can travel through relatively easily.

Areas of connected nesting and foraging habitats, at the landscape-scale, are more resilient to changing climate or management for waders. Inside these networks, habitats generally provide a higher level of other ecosystem services, such as the ability to clean or regulate water flow, as the habitats function as a complete system (sometimes called steady state system).

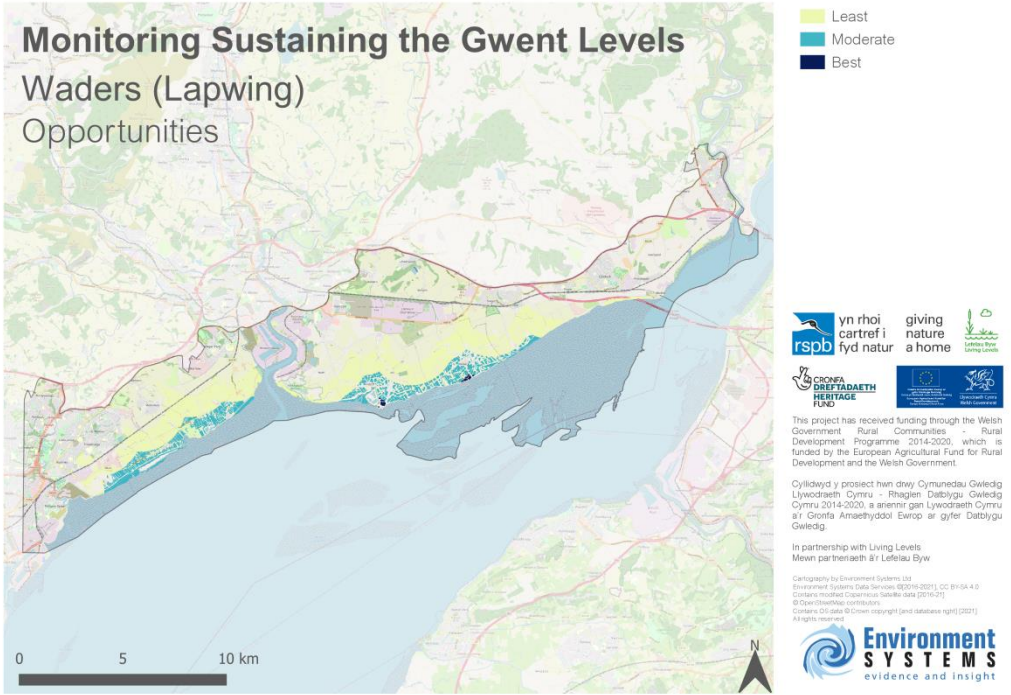


Wader Habitats (Lapwing)
Theme opportunity

The Gwent Levels is already very well suited for wader species, such as Lapwing.

For this theme, opportunity mapping was carried out using a constraints-based approach, i.e. where it is least preferable, based on:

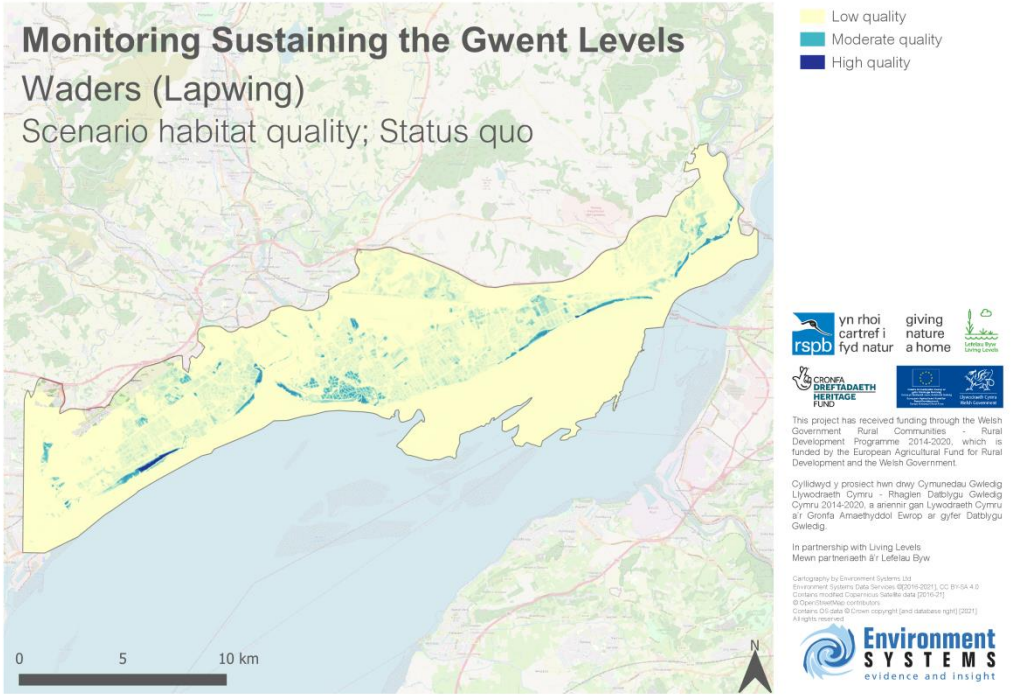
- The quality of the land, and existing suitable habitats
- Areas unsuitable for conversion
- Areas with unsuitable topography
- Within sight of potential perching spots for birds of prey
- Distances from hedgerows and woodlands to account for foxes



Wader Habitats (Lapwing)
Scenario model – status quo

The loss of grassland/arable sites to urban development reduces the available habitats for nesting and foraging.

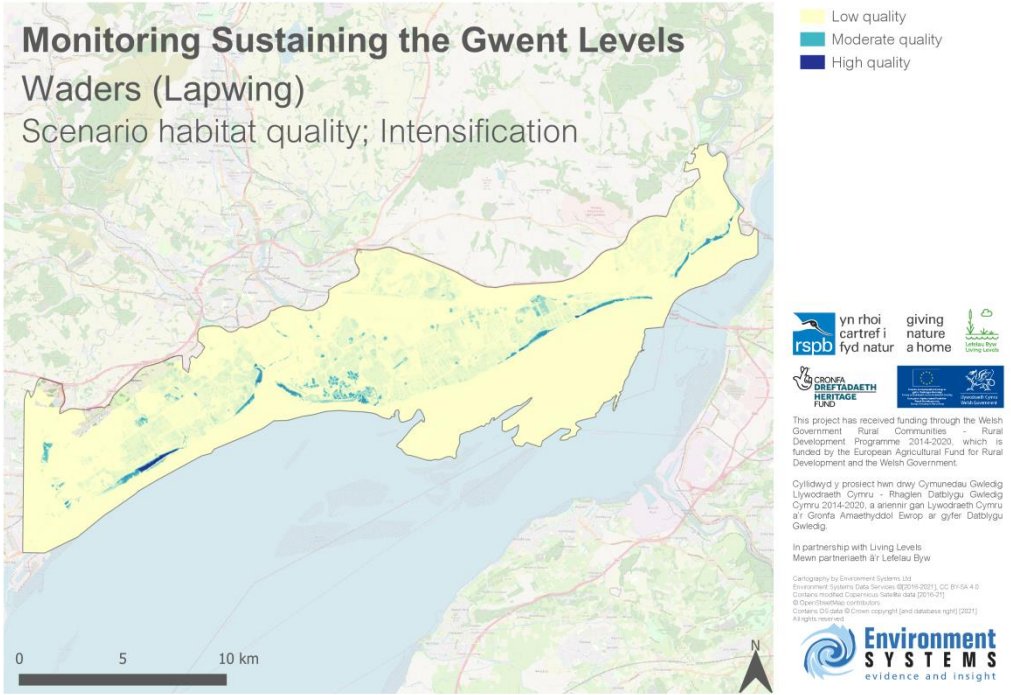
Ditches are neglected and hedges form, reducing areas suitable for nesting



Wader Habitats (Lapwing)
Scenario model – intensification

Increased stocking rates increase the potential for trampled nests.

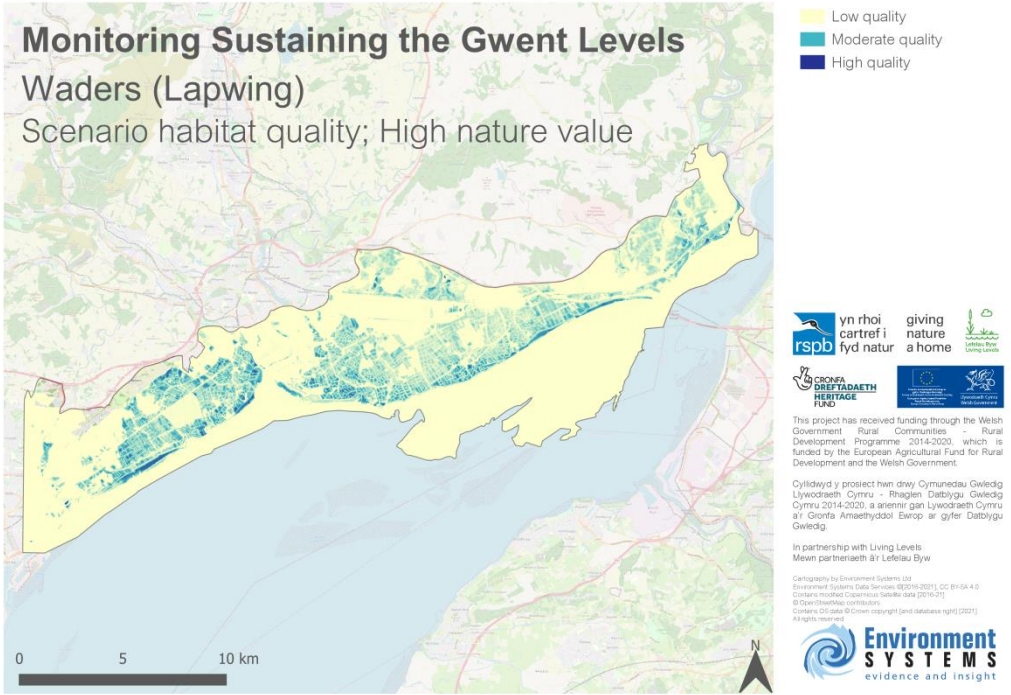
Previously short, tussocky swards are now heavily improved, and wet grasslands are converted to arable fields.



Wader Habitats (Lapwing)
Scenario model – high nature value

Improvement levels reduce, allowing for more species-diverse, and tussocky swards.

Small wet areas in field corners remain wet throughout summer. Some grasslands are converted into damp meadows and pastures.

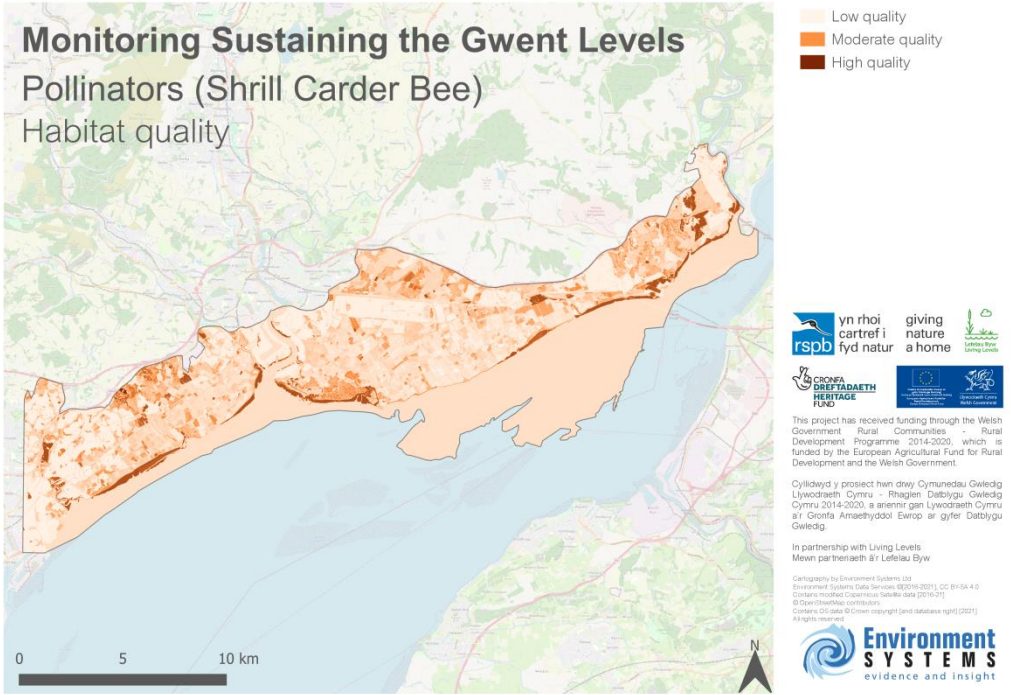


Pollinator Habitats (Shrill Carder Bee)
Theme quality

The shrill carder bee is a nationally rare bee and the Gwent Levels are one of its few known strongholds in the UK. It is a priority species in Wales.

The shrill carder bee is a late emerging species and they therefore benefit from late cut meadows.

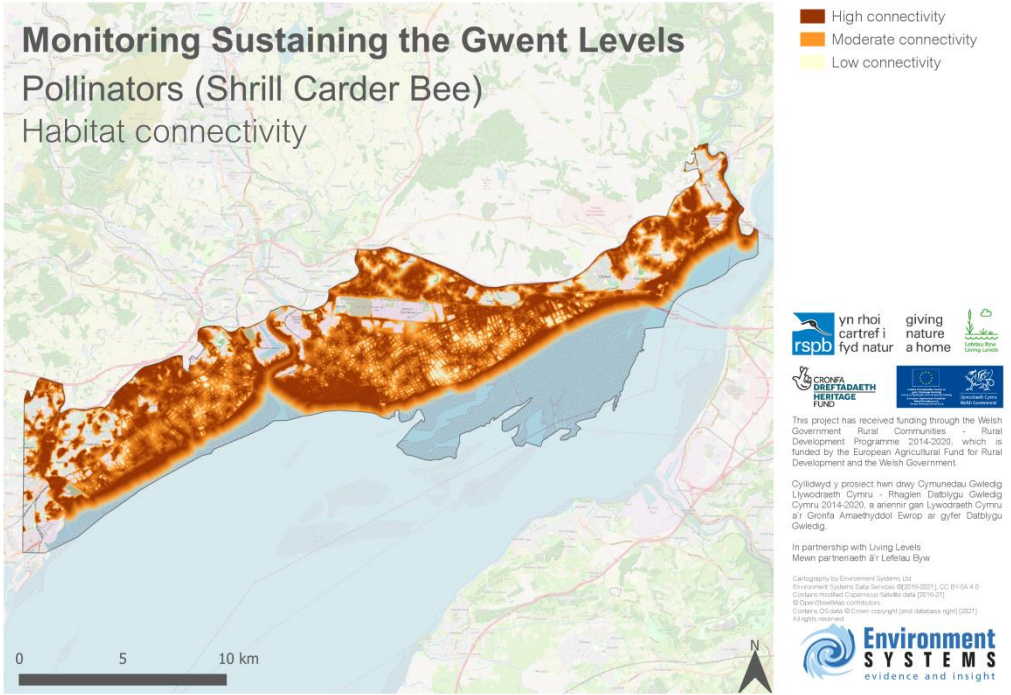
Semi-improved grassland and other flower-rich habitats such as hedges, ditches (reens) and banks provide habitat for the shrill carder bee and other pollinators.



Pollinator Habitats (Shrill Carder Bee)
Theme connectivity

Shrill carder bee rely on connected and high-quality forage resources from May – October. These need to be in close proximity to suitable nesting sites containing undisturbed tussocky and scrubby marginal grasslands.

Connecting, restoring and enhancing semi-natural habitats of importance for shrill carder bee should be a priority.



Pollinator Habitats (Shrill Carder Bee)
Theme opportunity

The shrill carder bee is a late emerging species and they therefore benefit from late cut meadows.

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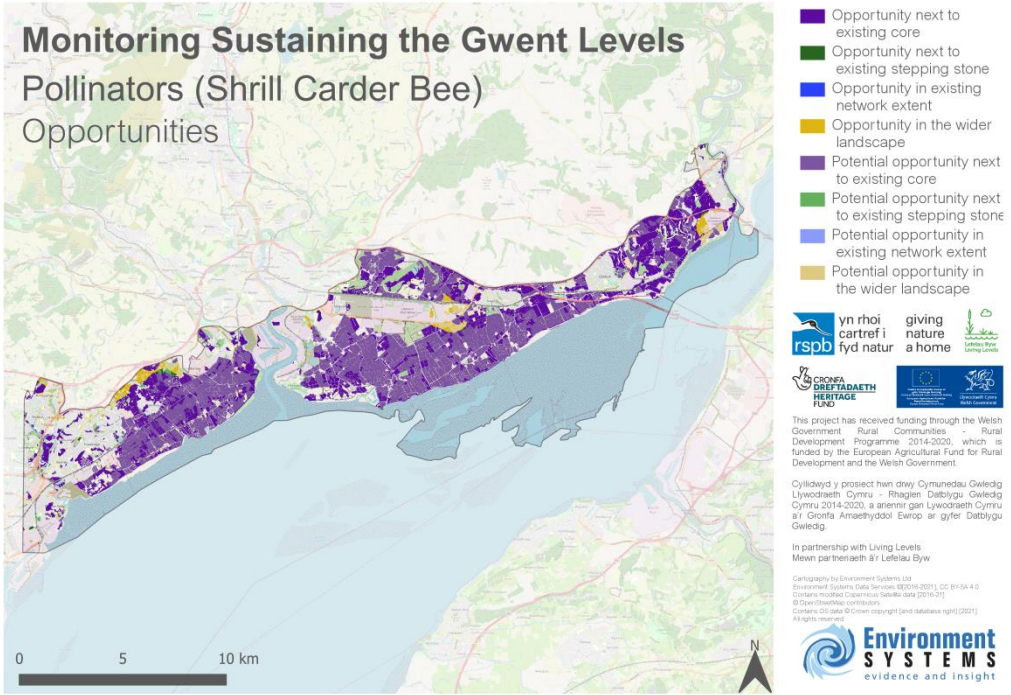
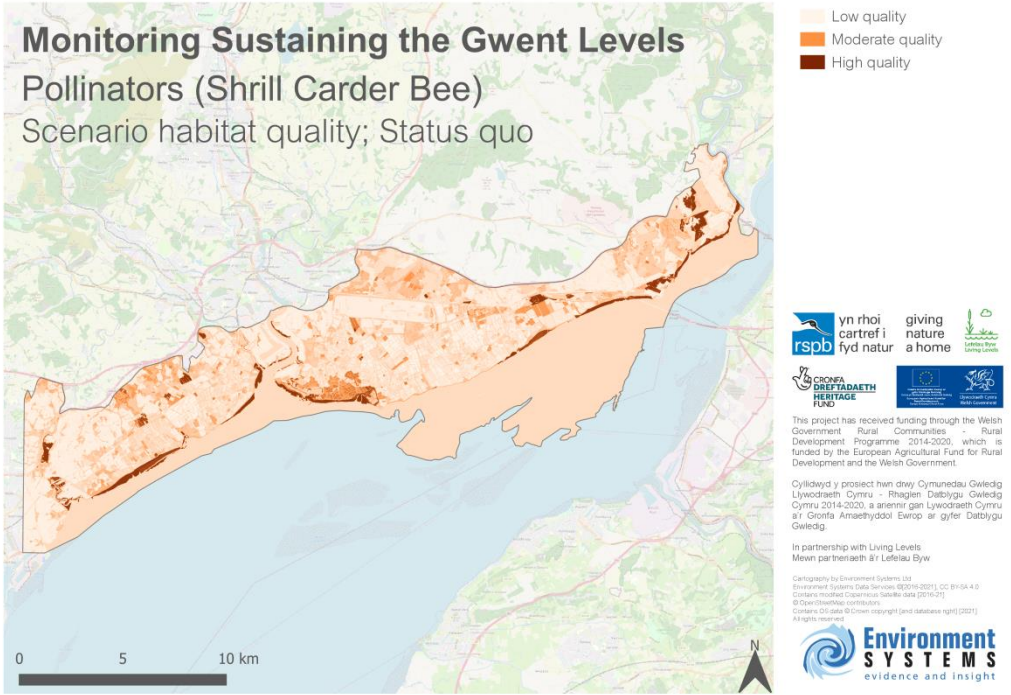


Pollinator Habitats (Shrill Carder Bee)

Scenario model – status quo

Outside of the SSSI, urban expansion reduces the areas of available grassland, whilst inside the SSSI, those grasslands are reduced in floristic diversity and available food for pollinators.

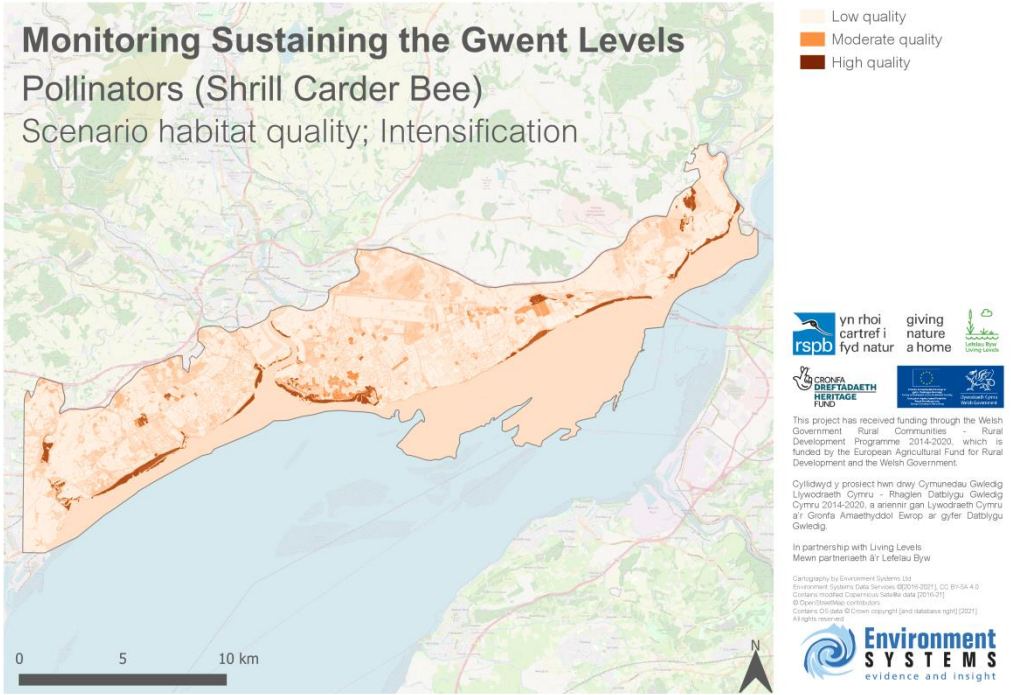
However, hedges formed over ditches do allow for potentially more nesting in the rougher grassland that grows underneath



Pollinator Habitats (Shrill Carder Bee)
Scenario model – intensification

Intensive agriculture takes over, leading to further losses in pastural diversity and with it, insect life.

Some areas of ditches and hedgerows are also lost, and replaced with high intensity, monoculture areas of arable and/or grazing.

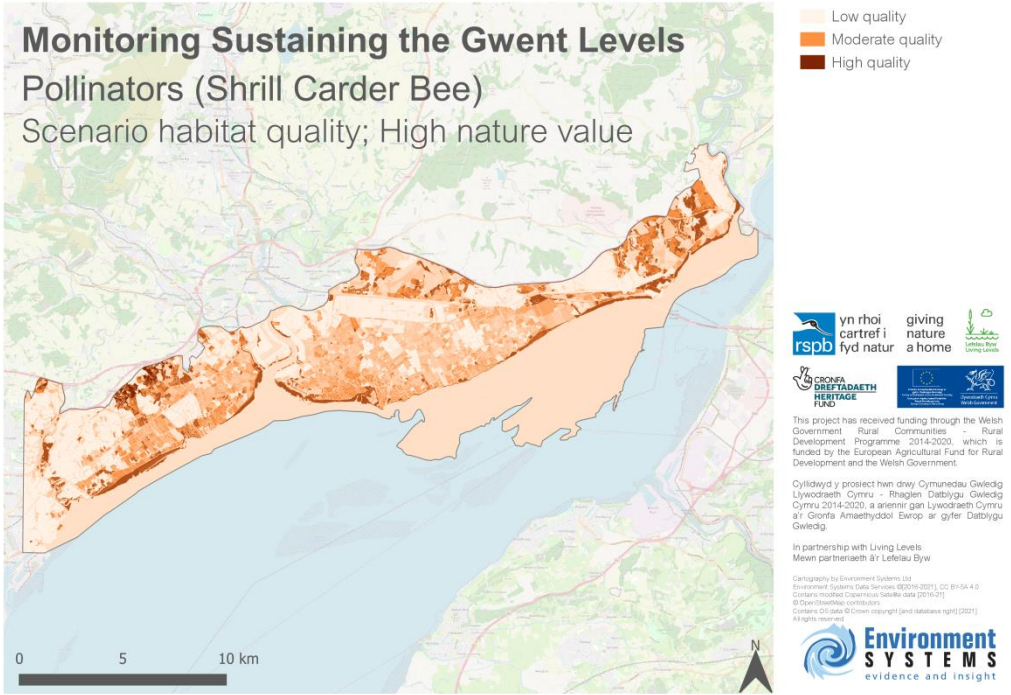


Pollinator Habitats (Shrill Carder Bee)

Scenario model – high nature value

Buffer zones maintained alongside field margins increase the availability of rougher grasslands for nesting.

Grassland pasture is less intensely grazed with fewer, and more targeted fertiliser applications, allowing for more flower-rich foraging sites.



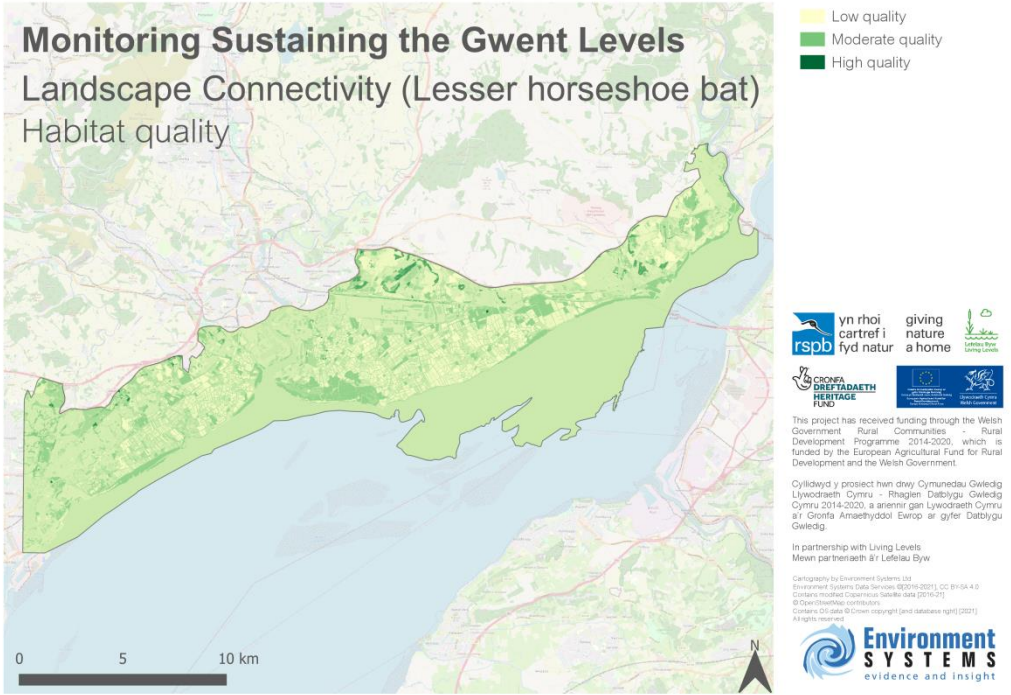
Landscape Connectivity (Lesser Horseshoe Bat)

Theme quality

Many UK bat species are closely associated with linear features such as hedgerows, tree-lines as well as reens and ditches.

Insect prey abundance is greater adjacent to linear features than in adjoining open habitat, and these features may also provide a commuting route between foraging patches that is sheltered from predators and the elements.

Short-ranged species, such as Lesser horse bats, also make use of pasture and arable land.



Landscape Connectivity (Lesser Horseshoe Bat)

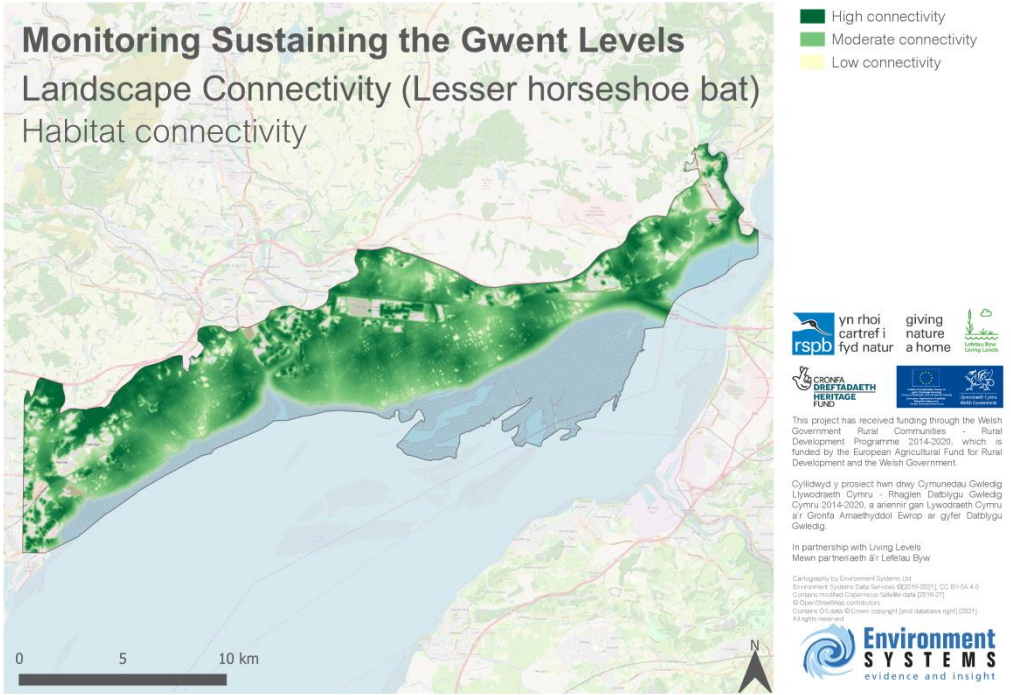
Theme connectivity

Hedgerows enhance structural heterogeneity, landscape connectivity and botanical diversity, and provide breeding habitat and food resources not just for bats but for many species of birds, small mammals and invertebrates.

Reens and ditches provide a natural passageway for bats when they move between roosting and foraging sites.

Furthermore, waterways are important foraging grounds in their own rights as they are habitat to bat's insect prey.

For short-ranged species, such as Lesser horse bats, the pasture and arable land also plays a large part in the quality of the connectivity network.



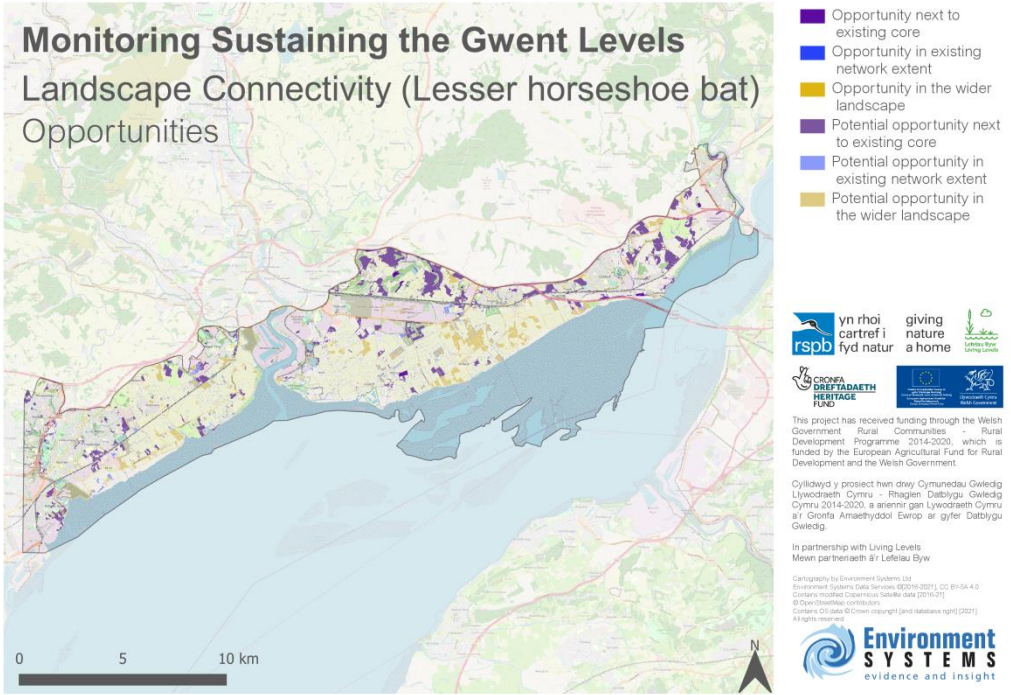
Landscape Connectivity (Lesser Horseshoe Bat)

Theme opportunity

To establish opportunities for bats, all existing habitats were scored with regards to whether it is possible, potentially possible, or not possible and desirable to convert the habitat to a core/home habitat for bat species.

The resulting opportunities were classed based on their spatial relationship to the existing pollinator ecological network.

As bat species do not require large patches of habitat for roosting, the best opportunities are those that enhance the landscape permeability by adding foraging sites.



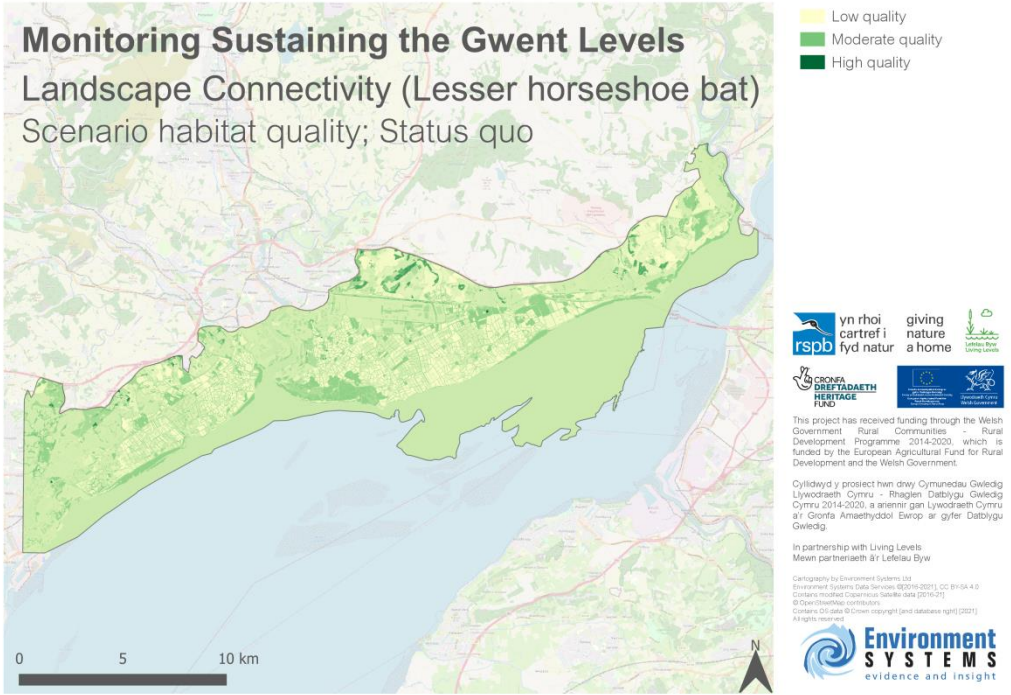
Landscape Connectivity (Lesser Horseshoe Bat)

Scenario model – status quo

Some grassland and farmland areas are lost to urban and industrial expansion.

This not only reduces the area of foraging habitats, but also increases the amount of light pollution and noise disturbances at night.

However, more hedgerows growing in ditches do provide some improved feeding grounds.

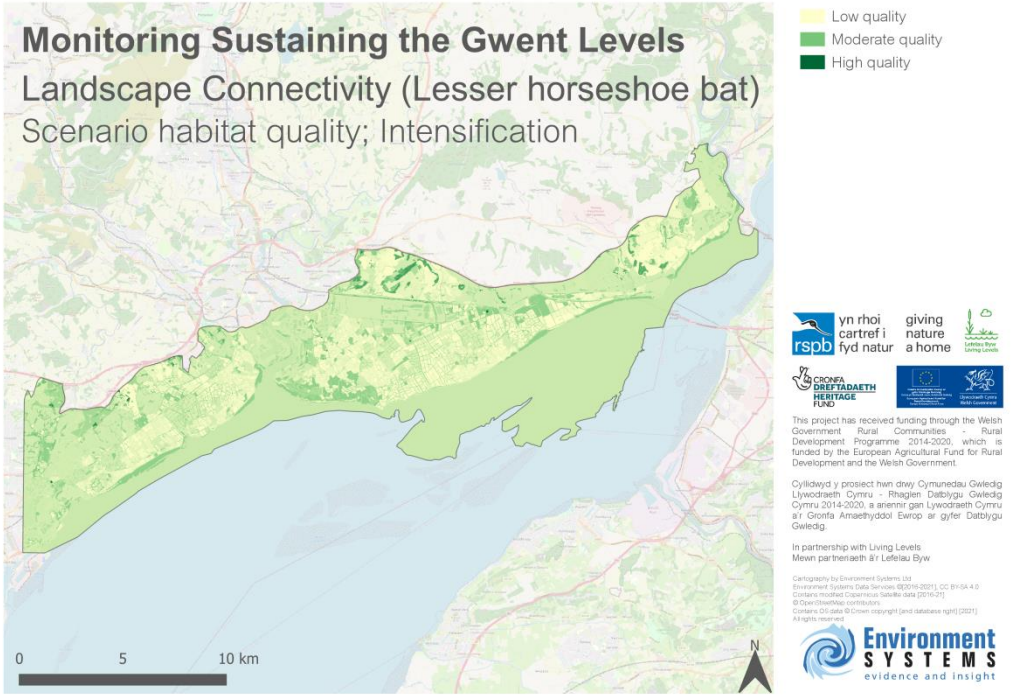


Landscape Connectivity (Lesser Horseshoe Bat)

Scenario model – intensification

Intensive agriculture takes over, leading to further losses in floristic diversity and with it, insect life and available prey.

Some areas of ditches and hedgerows are also lost, replaced with high intensity, monoculture areas of arable or grazing.

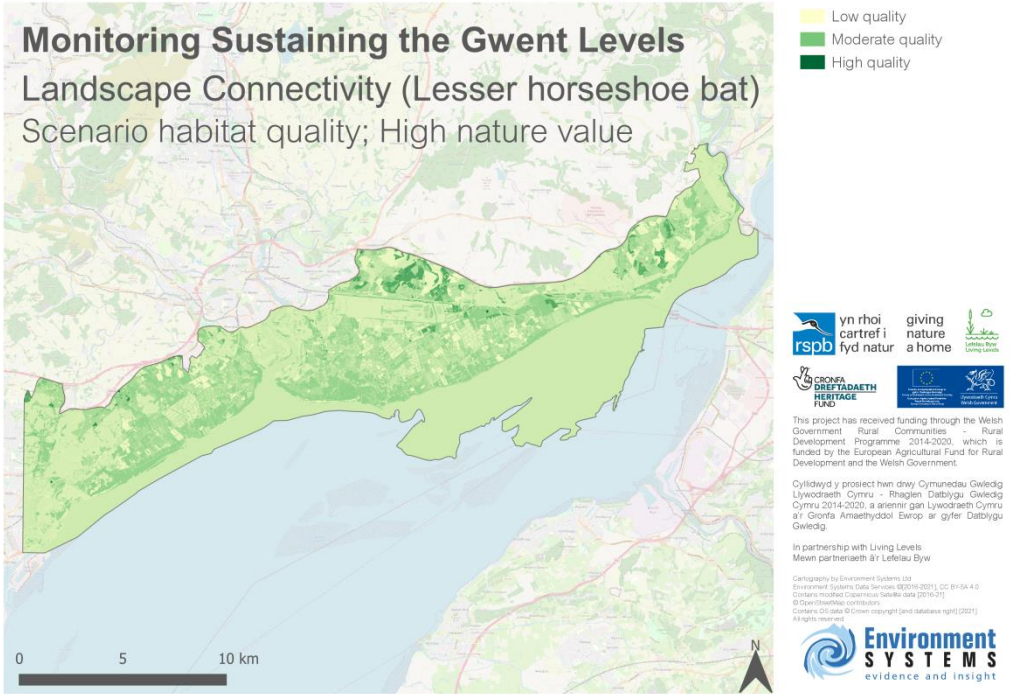


Landscape Connectivity (Lesser horseshoe bat)

Scenario model – high nature value

Buffer zones maintained alongside field margins increase the availability of pollinators and available food throughout the year.

Small increases in the woodland network also increases the edges of woodland available, and the travel corridors to/from roost sites.



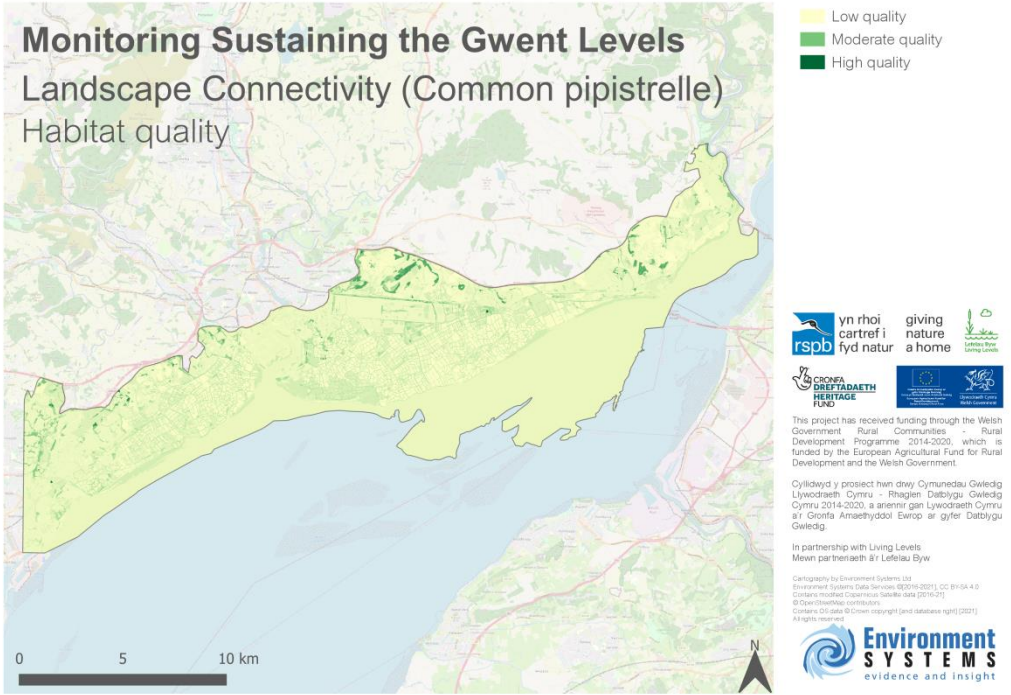
Landscape Connectivity (Common pipistrelle)

Theme quality

Many UK bat species are closely associated with linear features such as hedgerows, tree-lines as well as reens and ditches.

Insect prey abundance is greater adjacent to linear features than in adjoining open habitat.

These features may also provide a commuting route between foraging patches that is sheltered from predators and the elements.



Landscape Connectivity (Common pipistrelle)

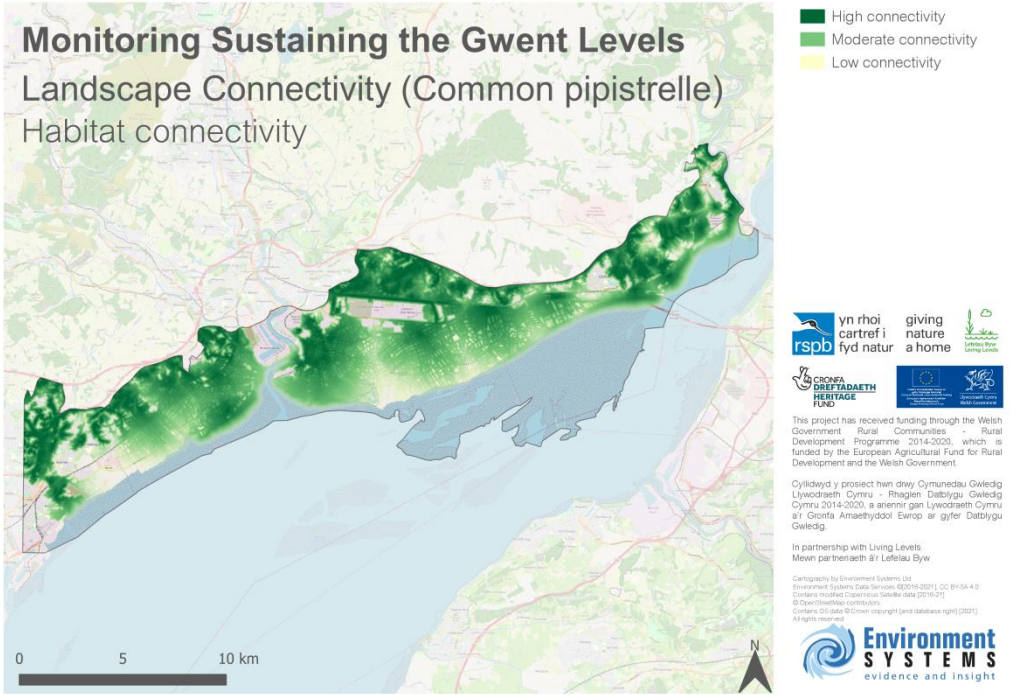
Theme connectivity

Hedgerows enhance structural heterogeneity, landscape connectivity and botanical diversity, and provide breeding habitat and food resources not just for bats but for many species of birds, small mammals and invertebrates.

Reens and ditches provide a natural passageway for bats when they move between roosting and foraging sites.

Furthermore, waterways are important foraging grounds in their own rights as they are habitat to bat's insect prey.

For medium-ranged species, such as Common pipistrelle, both open space areas and edge-habitats play a large part in the quality of the connectivity network.

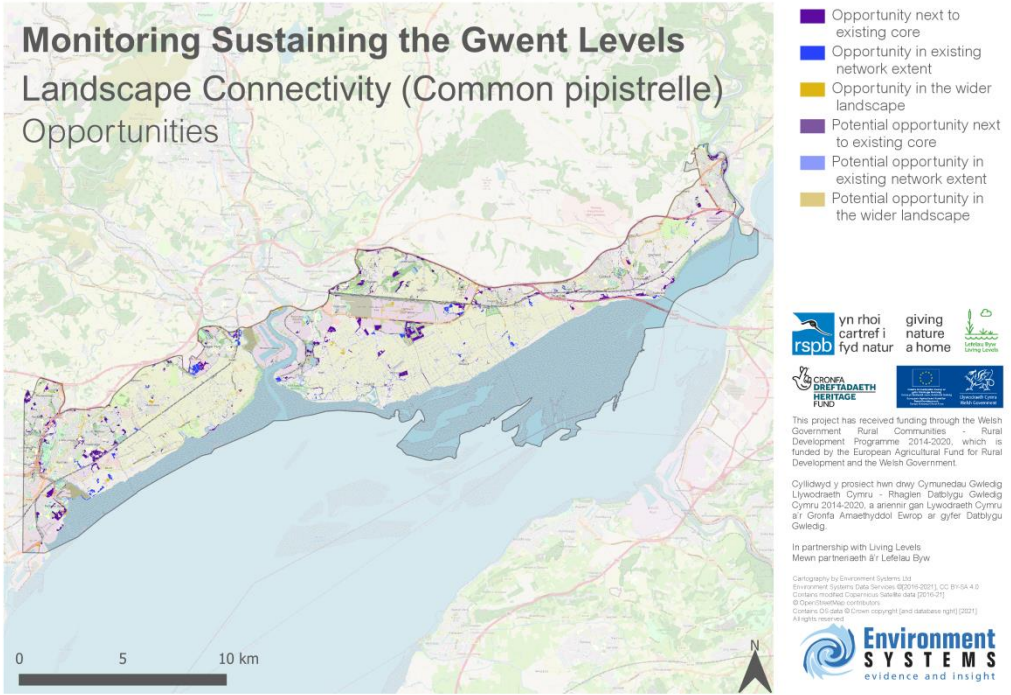


Landscape Connectivity (Common pipistrelle)

Theme opportunity

As bat species do not require large patches of habitat for roosting, the best opportunities are those that enhance the landscape permeability by adding foraging sites.

As well as providing better connectivity for foraging sites, areas of native woodland and hedgerows, joined together at the landscape-scale, are more resilient to changing climate and management practises.



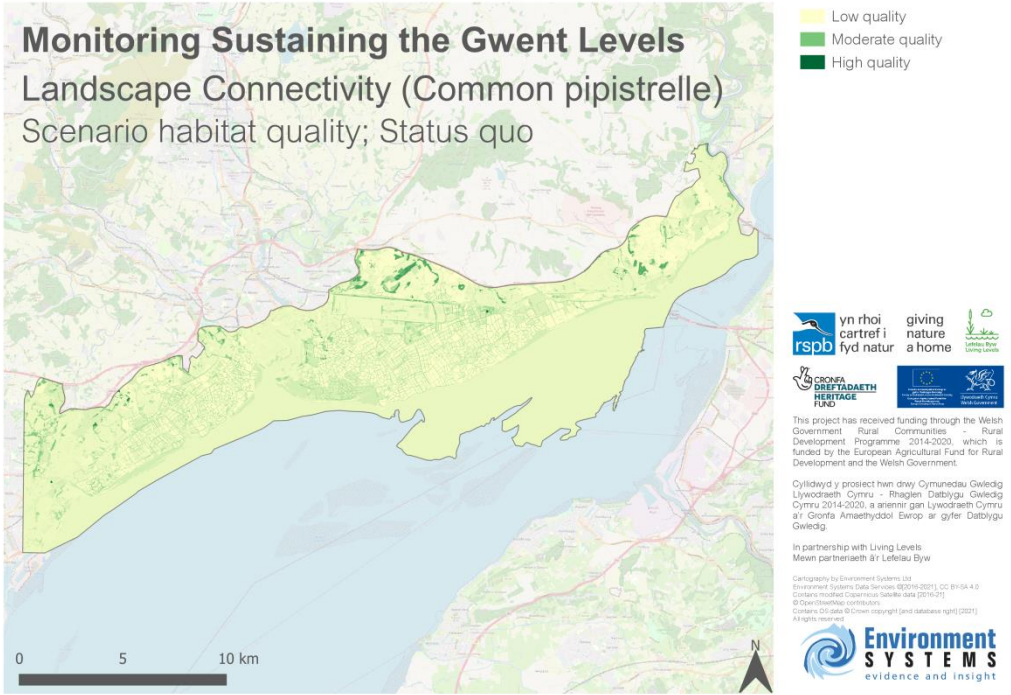
Landscape Connectivity (Common pipistrelle)

Scenario model – status quo

Urban expansion may not be a problem for the common pipistrelle, providing possible extra roosting sites.

The degraded ditches may also provide extra foraging opportunities as well.

However, reducing floristic diversity within the grassland and arable sites may reduce food availability across the Levels as a whole.

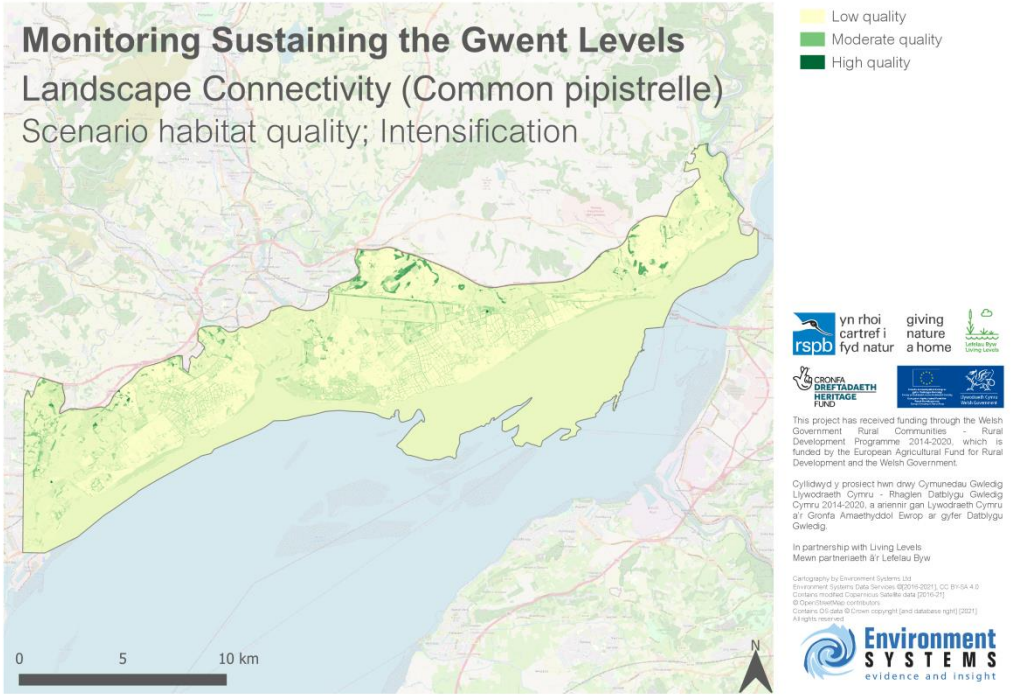


Landscape Connectivity (Common pipistrelle)

Scenario model – intensification

A reduction of the hedgerow network, replaced with intense monoculture, severely impacts how pipistrelles use the landscape for navigation. Suitable foraging sites may no longer be accessible.

Watercourses, overwhelmed with nutrients as farms struggle to manage run-off, are no longer abundant with insect prey.

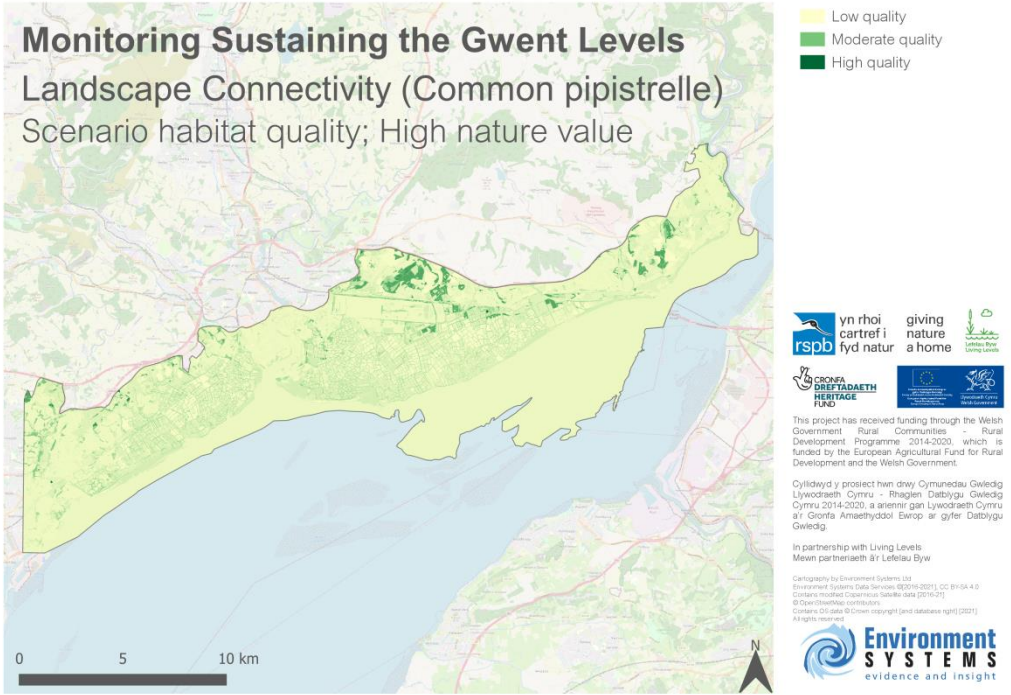


Landscape Connectivity (Common pipistrelle)

Scenario model – high nature value

Cleaner water and air through reduced agricultural pollution results in better aquatic environments, and prime hunting ground.

Woodland creation project that connects previously disjointed areas, strengthen the habitat corridors and allows for easier to foraging sites from the roost.

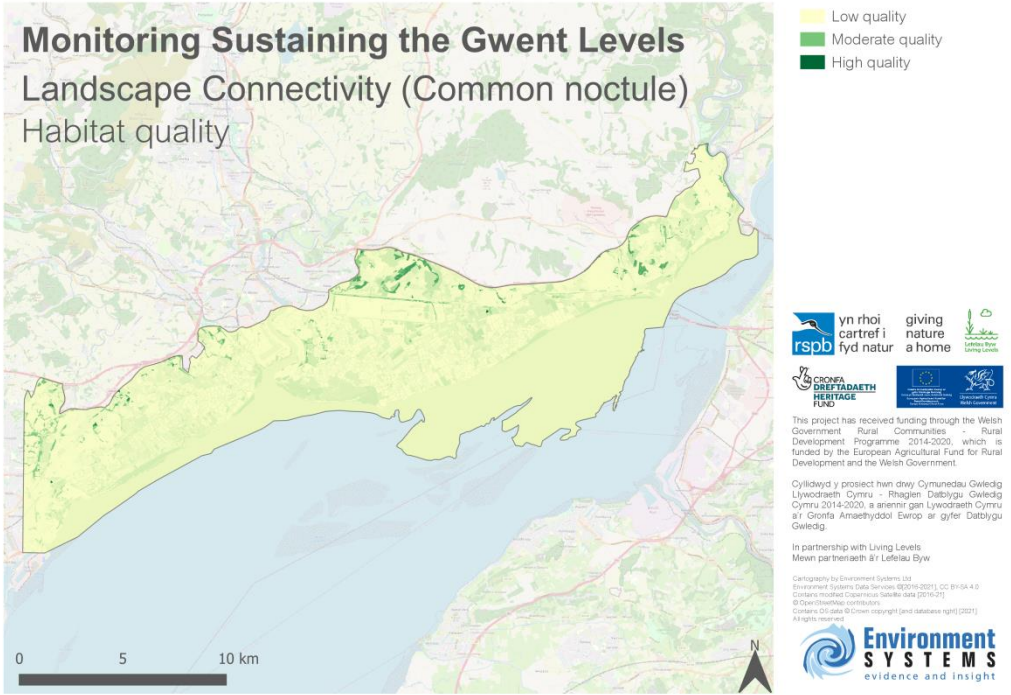


Landscape Connectivity (Common noctule)

Theme quality

Many UK bat species are closely associated with linear features such as hedgerows, tree-lines as well as reens and ditches.

Insect prey abundance is greater adjacent to linear features than in adjoining open habitat, and these features may also provide a commuting route between foraging patches that is sheltered from predators and the elements.



Landscape Connectivity (Common noctule)

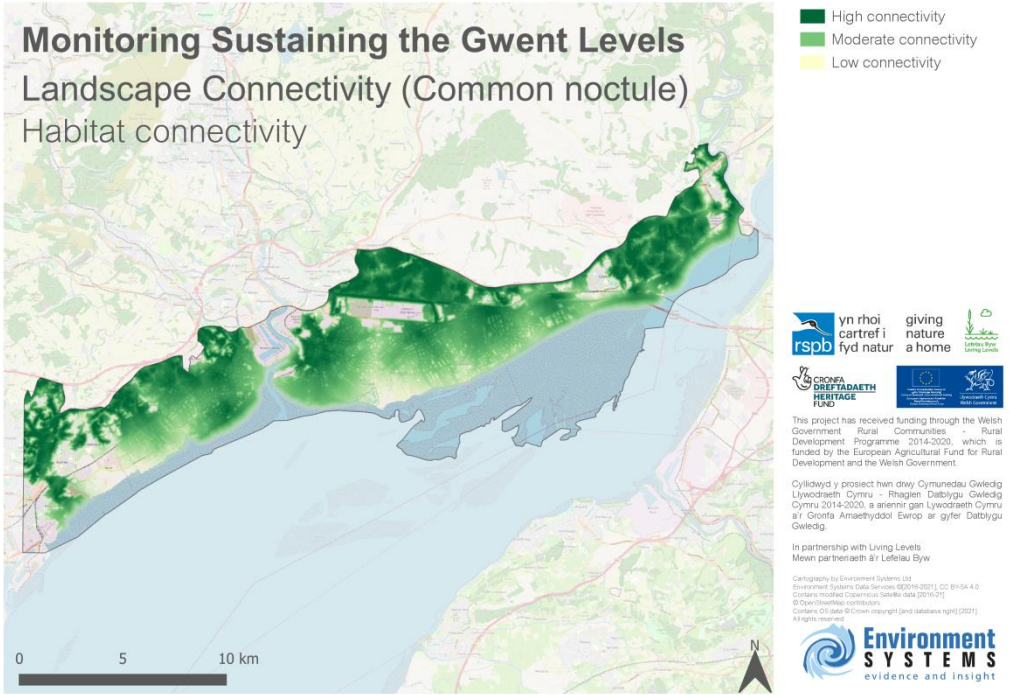
Theme connectivity

Hedgerows enhance structural heterogeneity, landscape connectivity and botanical diversity, and provide breeding habitat and food resources not just for bats but for many species of birds, small mammals and invertebrates.

Reens and ditches provide a natural passageway for bats when they move between roosting and foraging sites.

Furthermore, waterways are important foraging grounds in their own rights as they are habitat to bat's insect prey.

For long-ranged species, such as Common noctule bats, woodlands and hedgerows are the largest contributors to the the quality of the connectivity network.



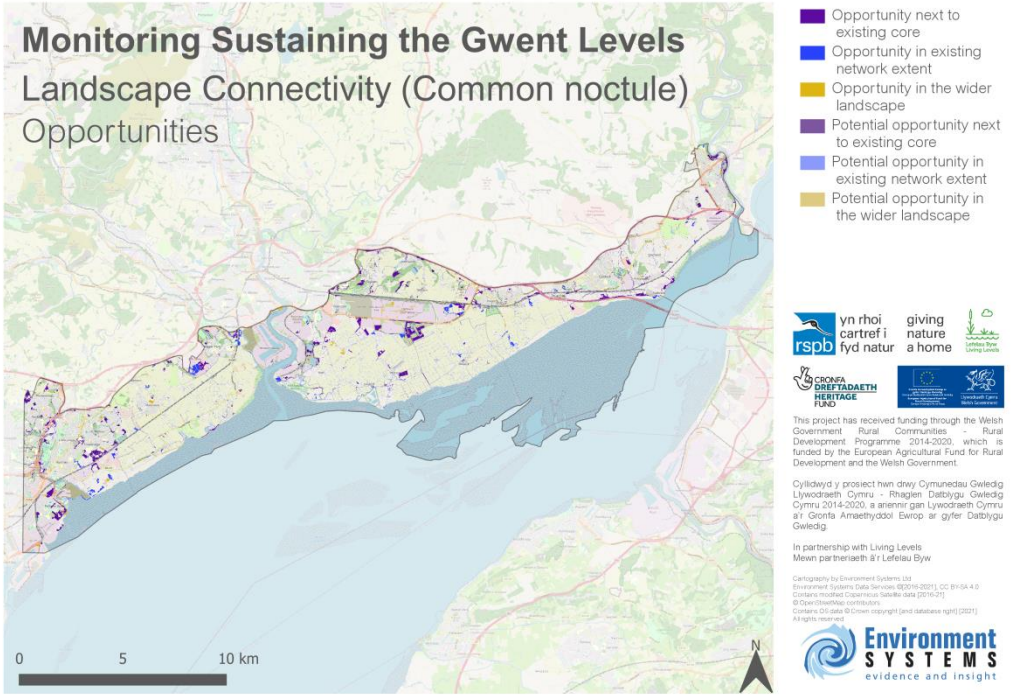
Landscape Connectivity (Common noctule)

Theme opportunity

As bat species do not require large patches of habitat for roosting, the best opportunities are those that enhance the landscape permeability by adding foraging sites.

Inside the native woodland/hedgerow network, habitats generally provide a higher level of other ecosystem services, such as the ability to clean or regulate water flow, reduce erosion, and store carbon.

Habitat restoration of woodland will be far more effective within the existing woodland network, as propagules, pollinators and other important species will be available for colonisation.

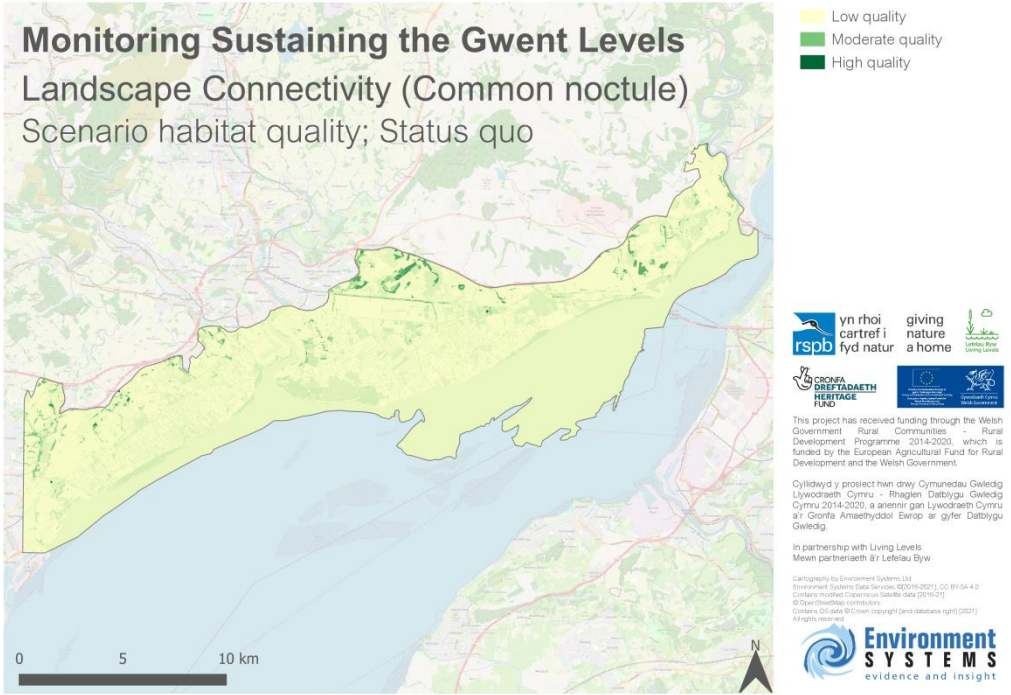


Landscape Connectivity (Common noctule)

Scenario model – status quo

The extra hedgerows from neglected ditches may work in the common noctule's favour, though will be negatively effected by urban expansion and the decrease in available dark corridors.

With increasing grassland improvement levels and decreasing floristic diversity, the overall availability of prey may decrease, even if suitable woodlands and hedgerows remain intact.

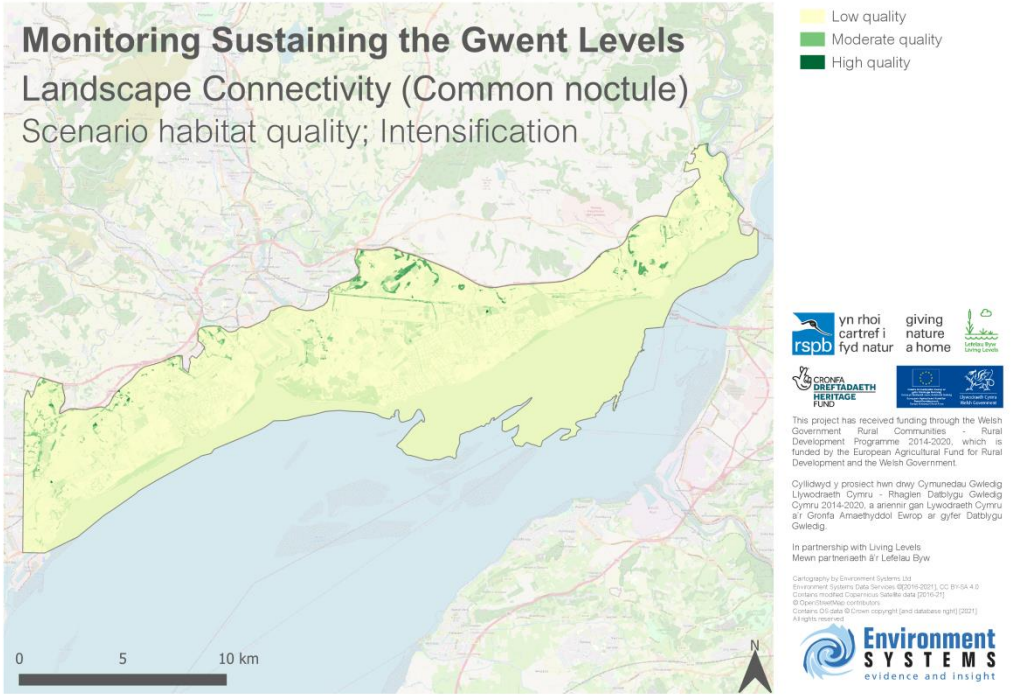


Landscape Connectivity (Common noctule)

Scenario model – intensification

The loss of previously well-connected hedgerows, in favour of more arable and grazing production, reduces the capability of the noctule finding suitable foraging sites across the Levels.

Hedgerows that are overgrown from neglect may supply more prey than before, but the lower floristic diversity of the remaining grassland could reduce the once varied diet.

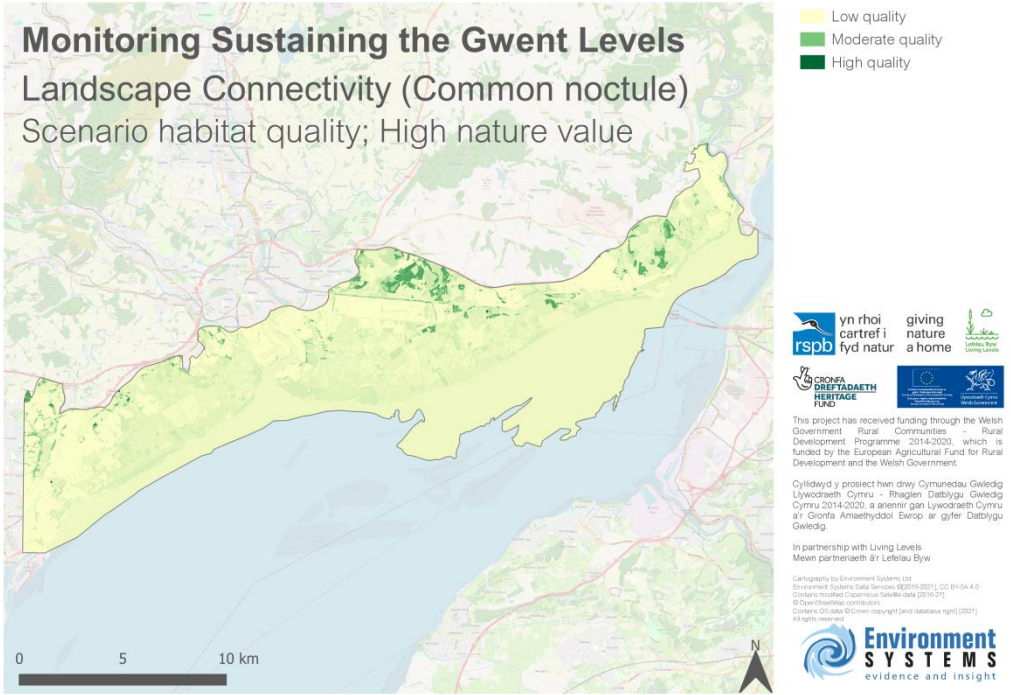


Landscape Connectivity (Common noctule)

Scenario model – high nature value

Woodland creation project that connects previously disjointed areas, strengthen the habitat corridors and allows for easier to foraging sites from the roost.

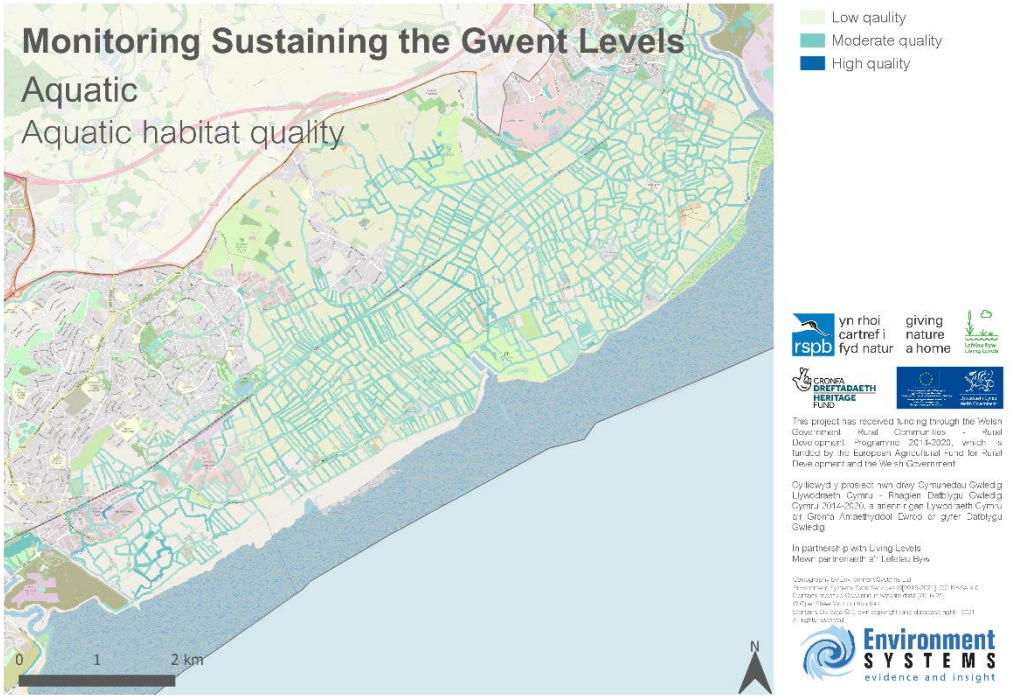
Buffer zones maintained alongside field margins, together with less improved grassland management, increases the availability of moths, beetles, and other insects, available throughout the year.



Aquatic Habitats
Theme quality (west)

The Levels contain a unique network of over 800 miles of highly interconnected waterways that form field boundaries managed by NRW and private landowners.

Many nationally rare and scarce invertebrate species are present, e.g., water beetles and they form ideal habitats for amphibians and reptiles.



Aquatic Habitats
Theme quality (east)

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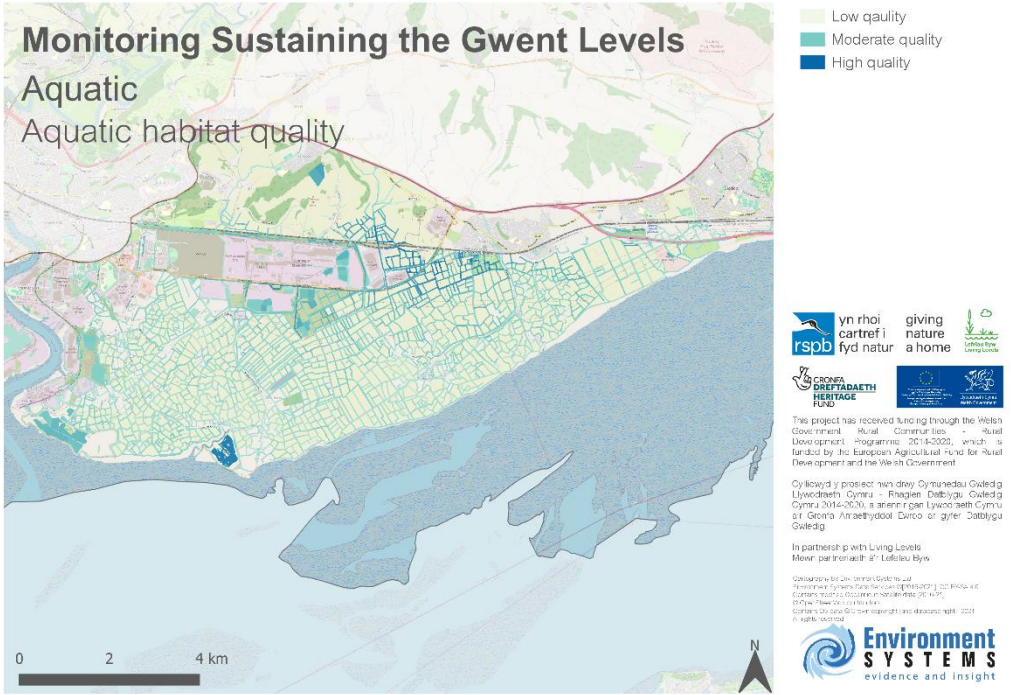
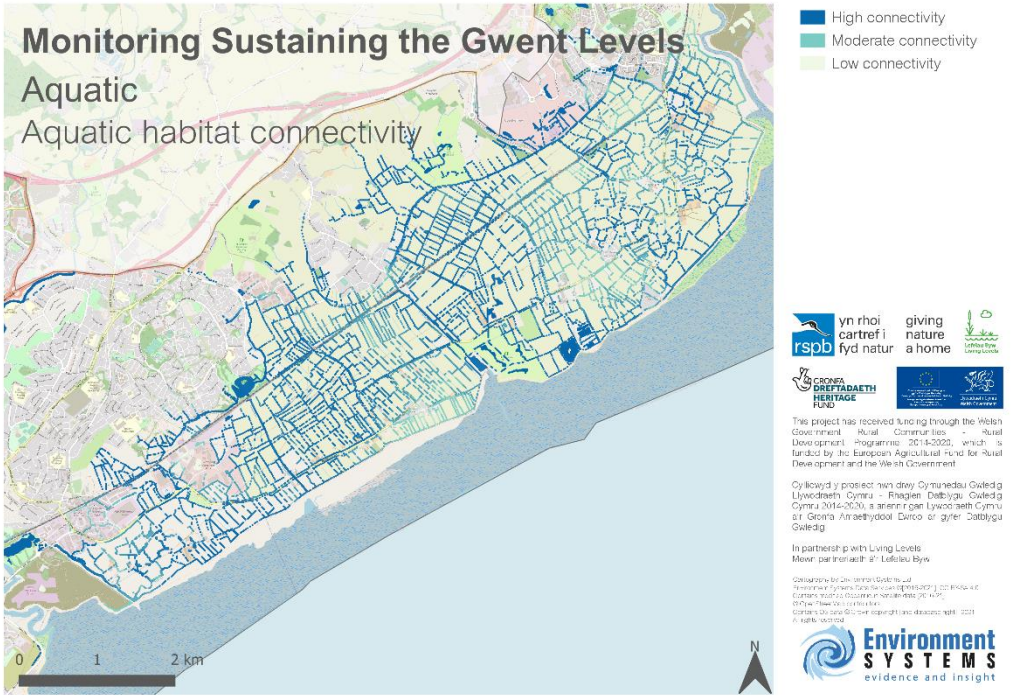


Aquatic Habitats
Theme connectivity (west)

Existing aquatic network within which associated species can permeate through.

The network comprises the best quality aquatic habitats, and the surrounding suitable reens/ditches/ponds. It assesses how well connected the high quality areas are to one another.

Areas of connected high quality aquatic habitats, at the landscape-scale, are more resilient to changing climate or management for waders.



Aquatic Habitats
Theme connectivity (east)

Existing aquatic network within which associated species can permeate through.

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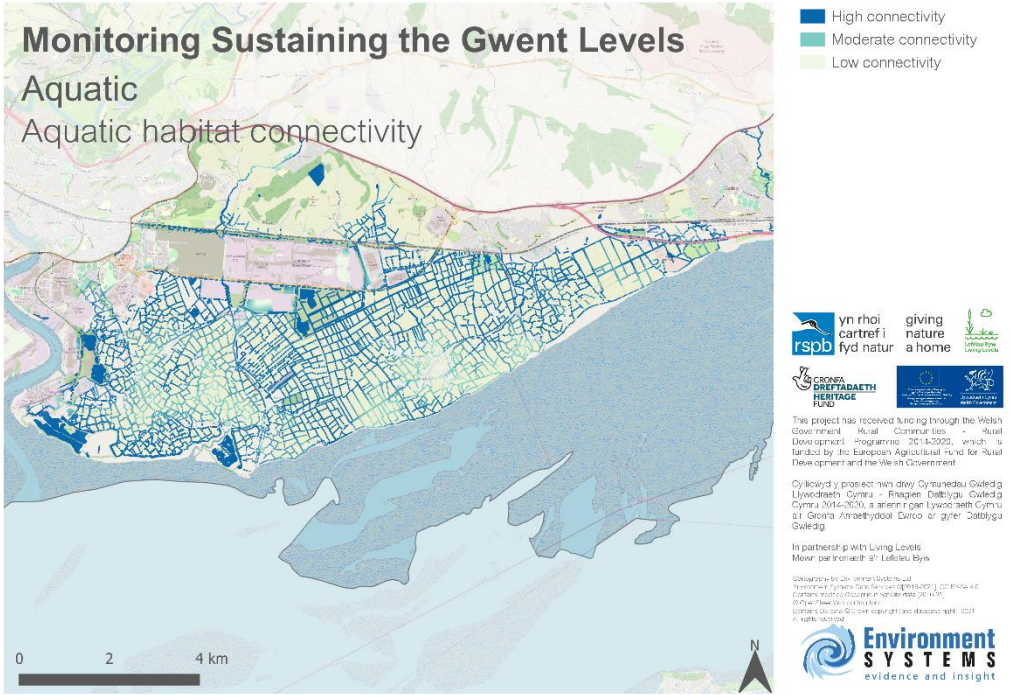


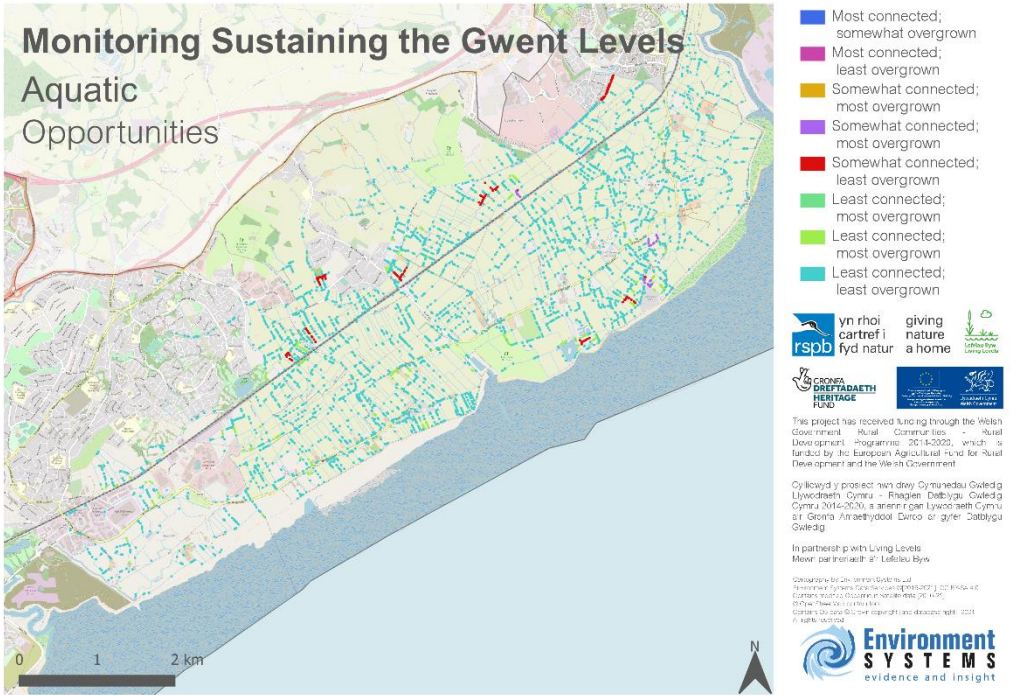
Aquatic Habitats
Theme opportunity (west)

Traditional management of the watercourses (reens and ditches) includes tree and hedgerow removal to maintain an open landscape and water system. Where tree and hedgerow features run along both sides of reens and ditches, they can negatively affect habitat quality for invertebrates.

To establish opportunities for aquatic habitats, reens were identified that are currently overgrown with hedges.

The hedges that are only somewhat overgrown form good opportunities to create functioning aquatic habitats.

The most overgrown reens, on the other hand, will be more challenging to convert.



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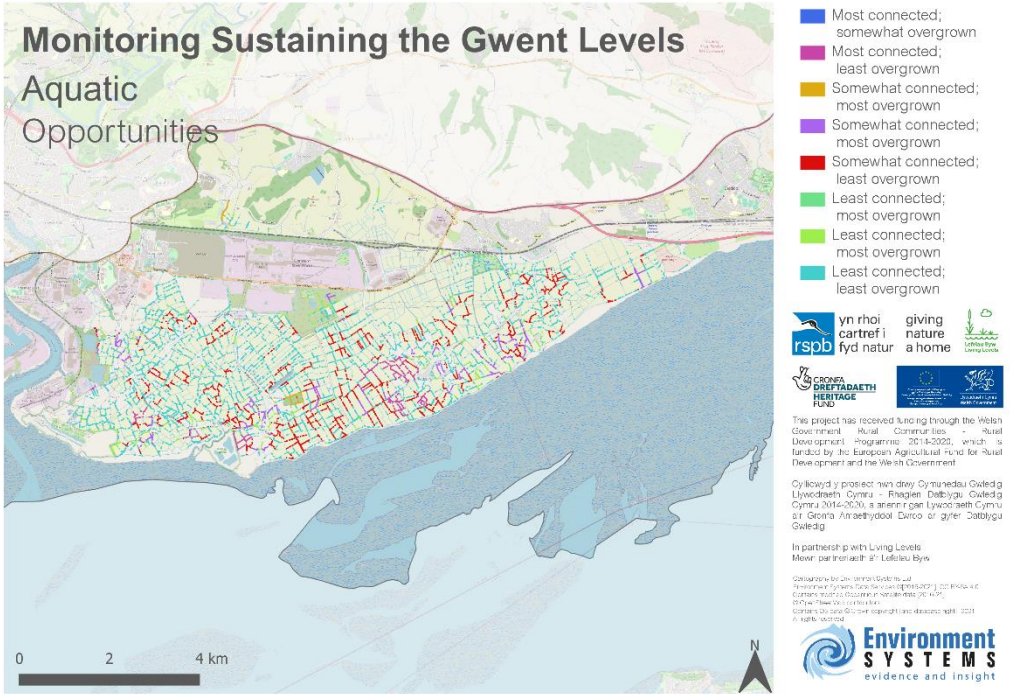


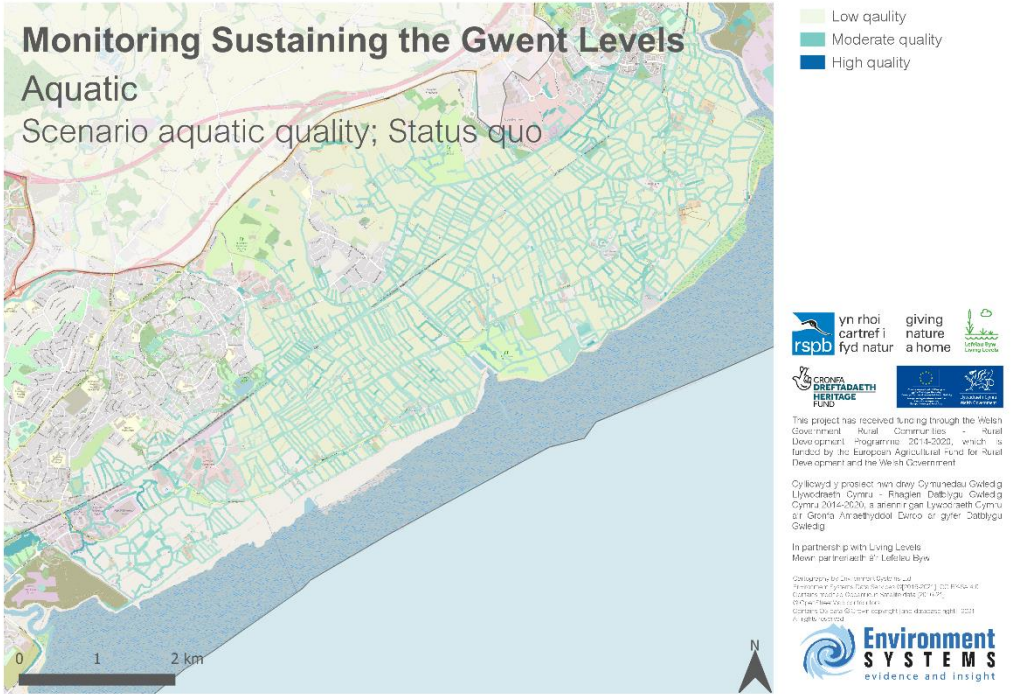
Aquatic Habitats

Scenario model – status quo (west)

The traditionally gripped fields are lost to modern farming methods. Wet field ditches, too costly to maintain, are neglected.

Over time, hedges form on both sides of reens and ditches.

Those hedges that were maintained, are now overgrown, negatively effecting habitat quality for invertebrates.



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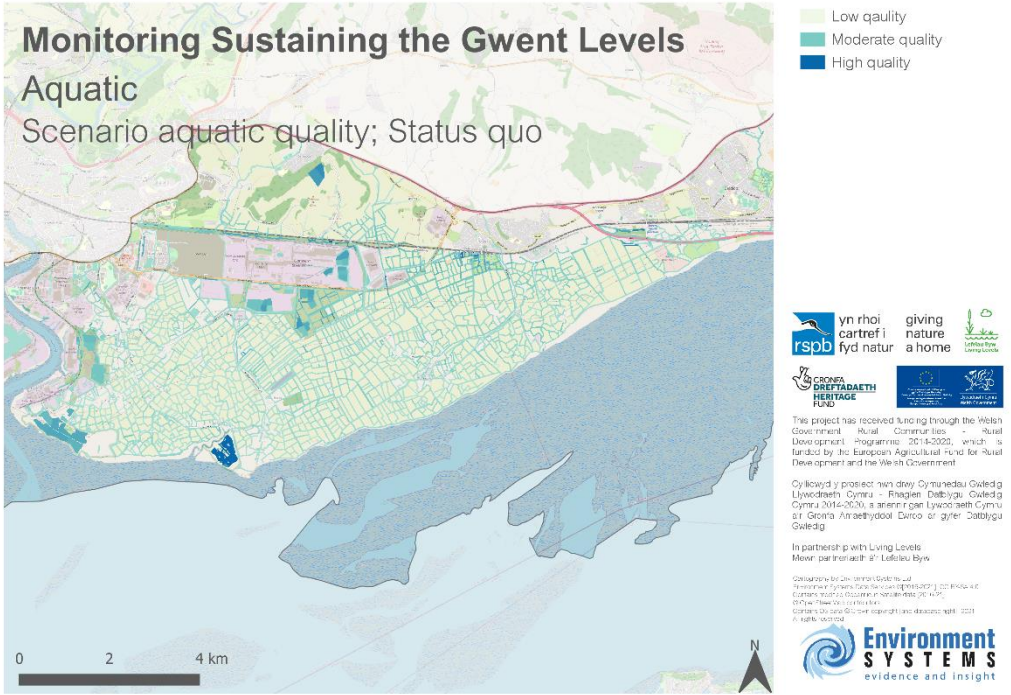
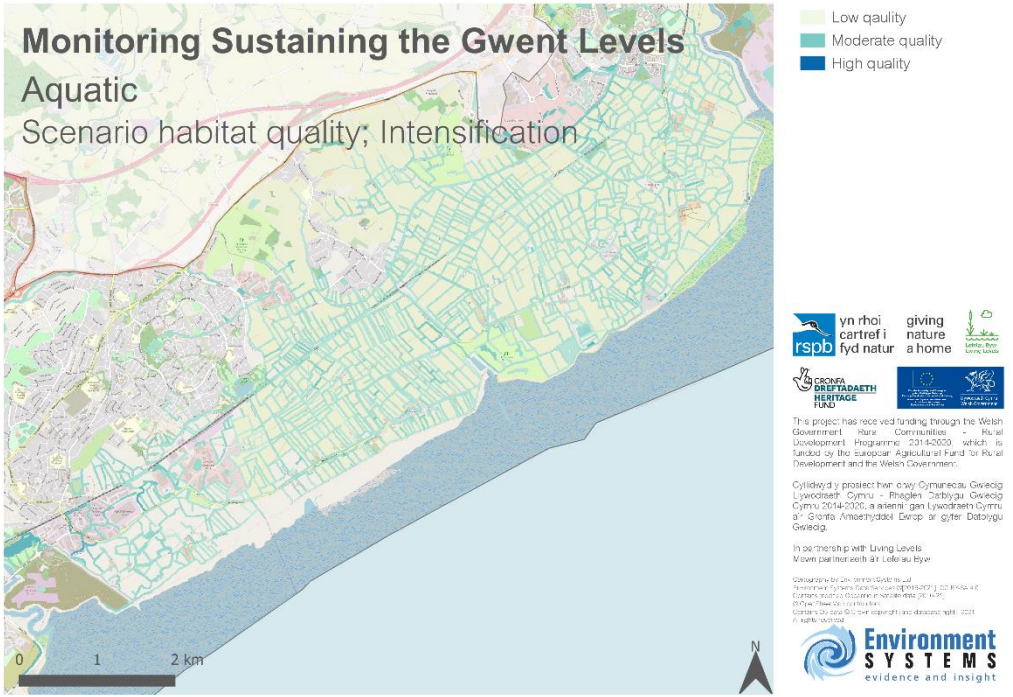


Aquatic Habitats

Scenario model – intensification (west)

Watercourses are overwhelmed with nutrients as farms struggle to manage run-off. With increased diffuse pollution from adjacent land, reens are subject to eutrophication and algae problems.

Some ditches/reens are removed altogether to make room for more grass and arable land. This drastically reduces the connectivity of the aquatic environment, and increasing its vulnerability to climate and land management forces.



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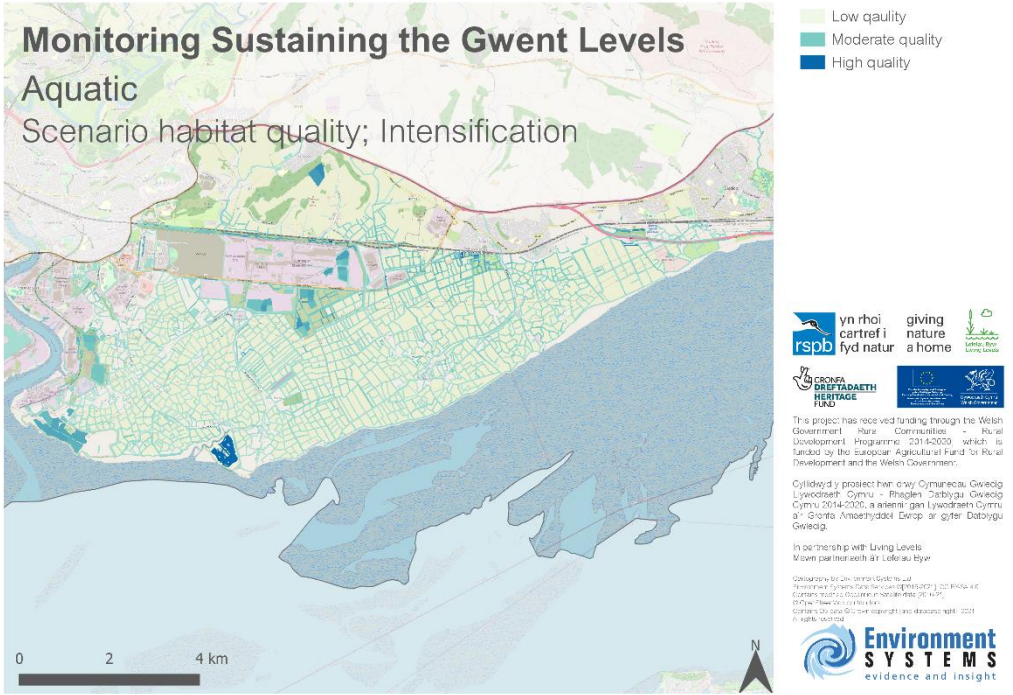
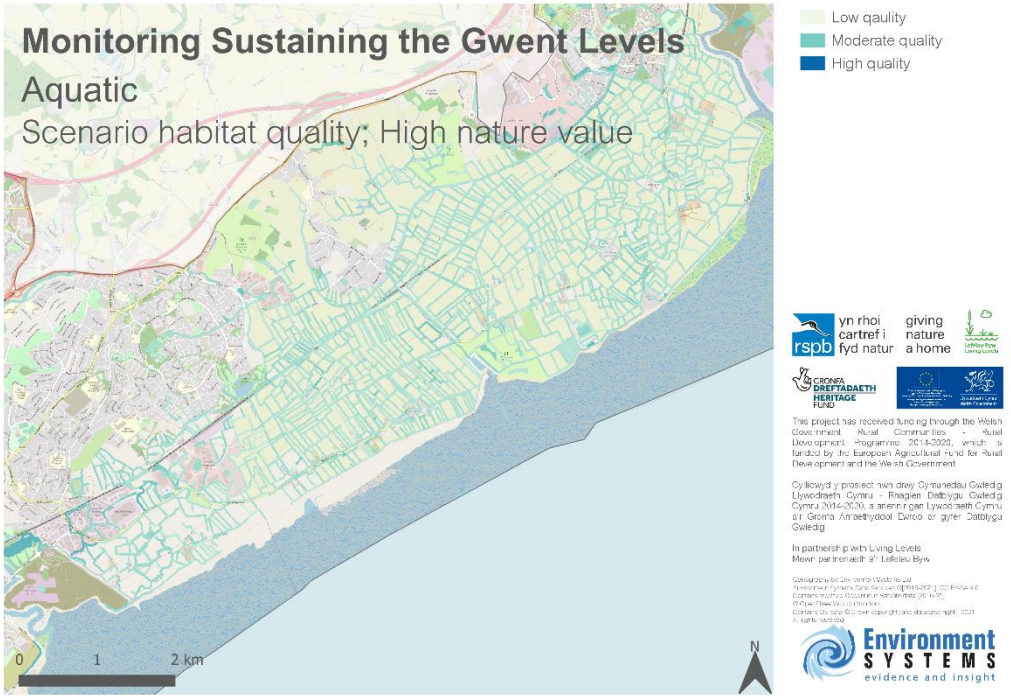


Aquatic Habitats

Scenario model – high nature value (west)

Increased surface roughness from more semi natural habitats, and increased infiltration through greater heterogeneity of vegetation, slows the flow of surface water into the aquatic environment and reduces the concentration of sediment influx.

This not only contributes to the Levels natural flood management, but also increases the water quality potential. In turn, increasing diversity and abundance of invertebrates, reduces foraging competition for those that feed on them.



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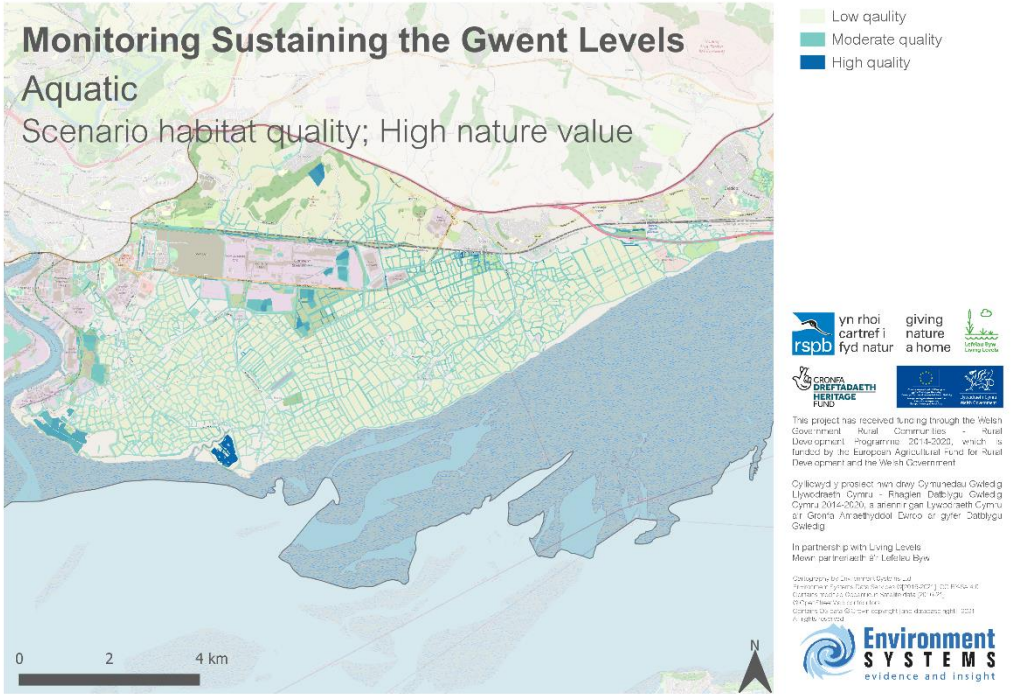
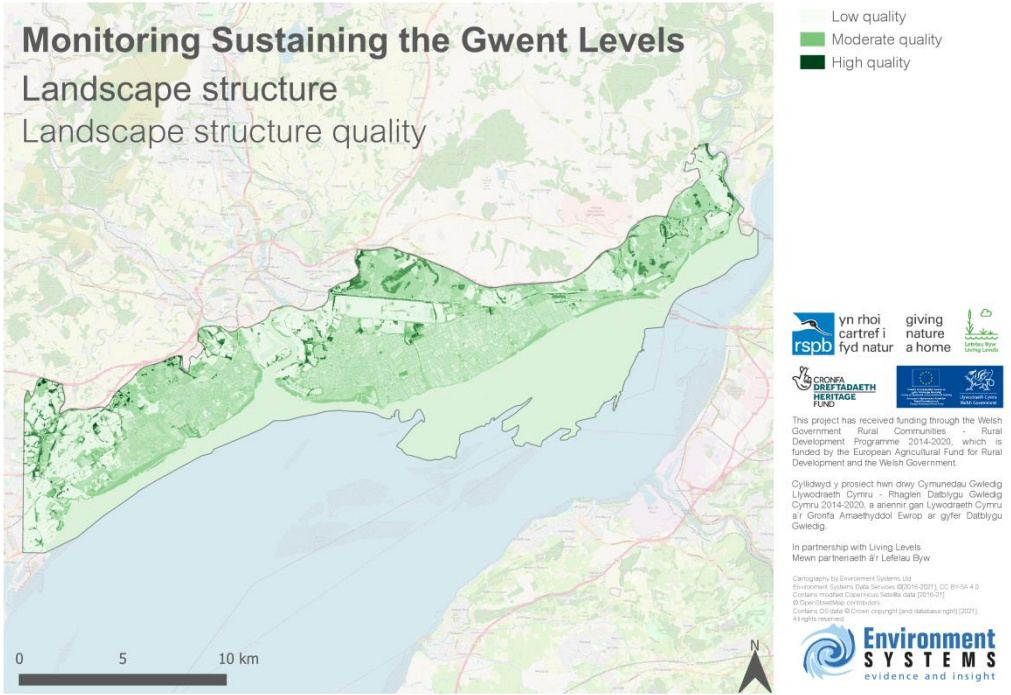


Landscape Structure
Theme quality

The absence of woodland is significant to the open landscape character of the Gwent levels.

Wooded features - orchards, pollarded willow, parkland veteran trees, and hedgerows - are nevertheless significant components of the landscape.

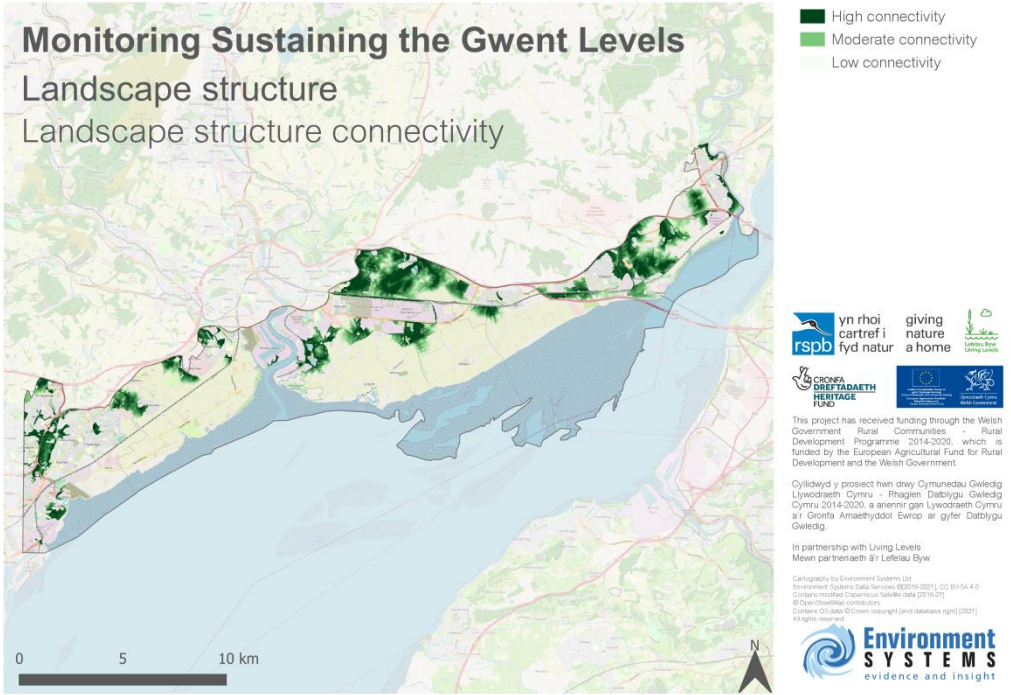


Landscape Structure
Theme connectivity

Areas of native habitat joined together at the landscape-scale are more resilient to changing climate or management practises.

Inside these networks, habitats generally provide a higher level of other ecosystem services, such as the ability to clean or regulate water flow, as the habitats function as a complete system.

Habitat patches creating or strengthening links within the ecological woodland network are of particular importance of biodiversity and ecosystem service generation.

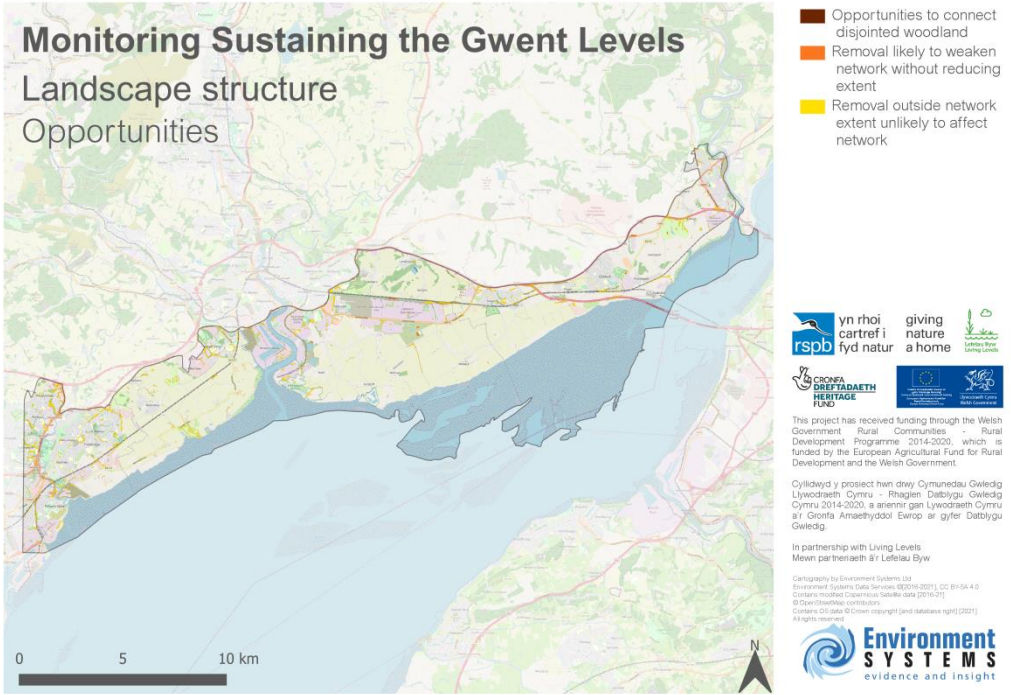


Landscape Structure
Theme opportunity

Traditional management of the watercourses (reens and ditches) includes tree and hedgerow removal to maintain an open landscape and water system.

A significant increase in wood and scrub cover would signal a detrimental change to the landscape character across the levels.

Where tree and hedgerow features run alongside reens and ditches they can negatively affect habitat quality for invertebrates.



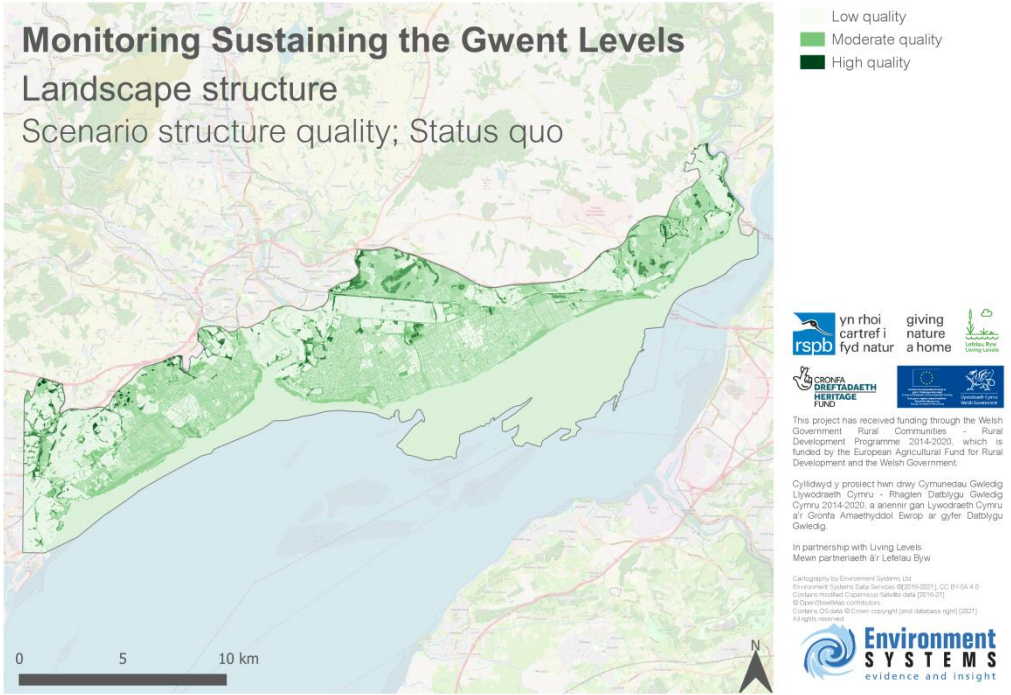
Landscape Structure

Scenario model – status quo

The hedgerow network is inadvertently enhanced through neglect, as ditches and reens become over grown.

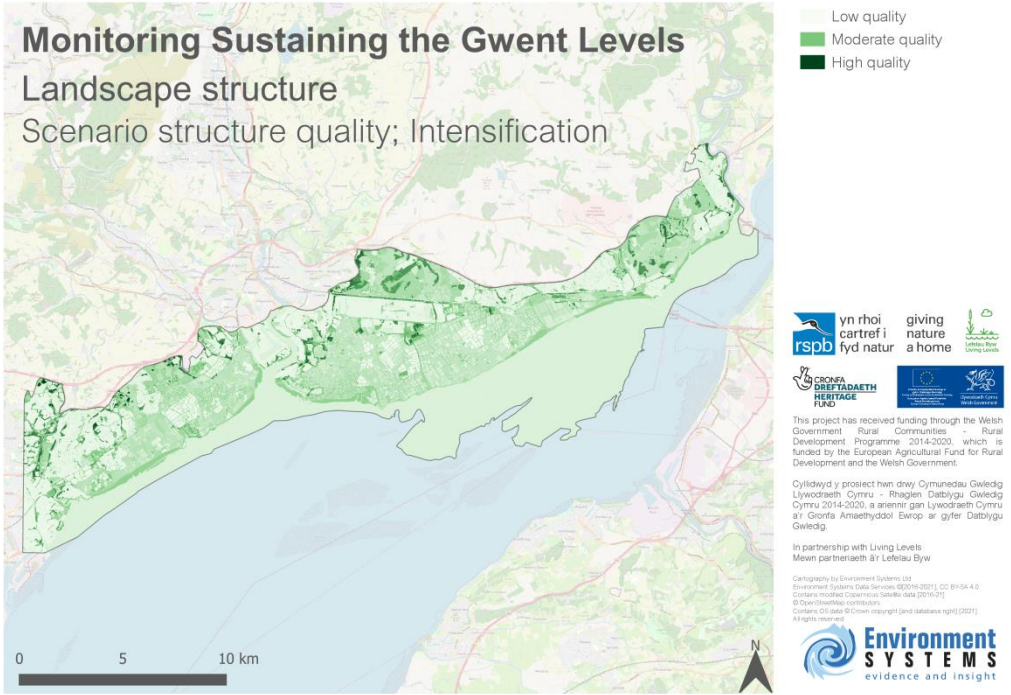
This change benefits bats species, allowing them to better navigate across the landscape.

However, where trees and hedgerow features run alongside reens and ditches, they can negatively affect aquatic habitat quality for invertebrates.



Landscape Structure
Scenario model – intensification

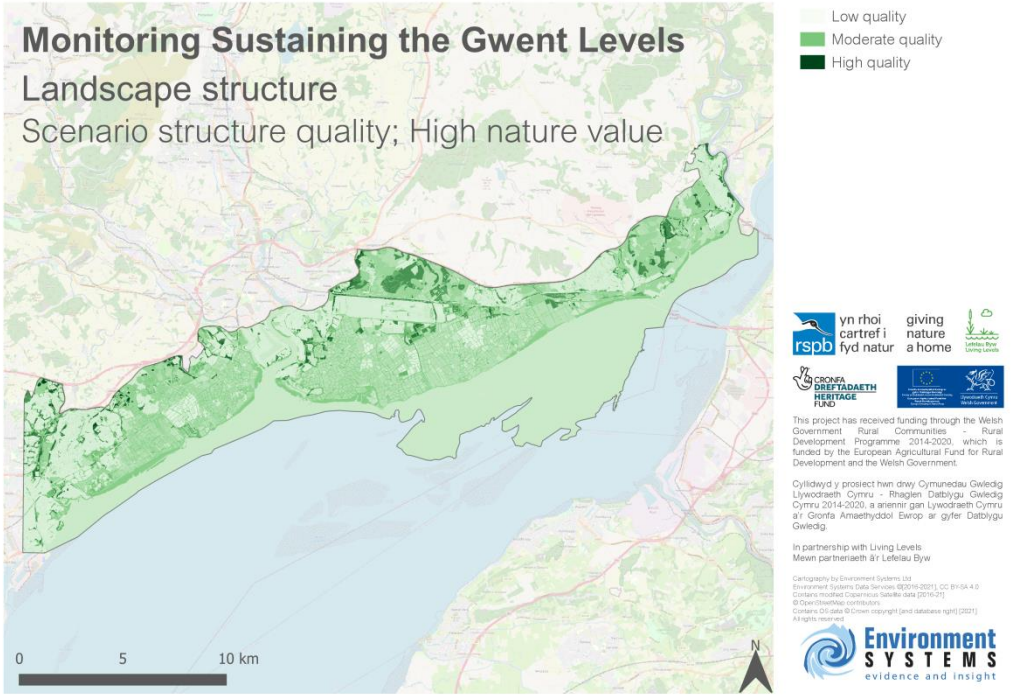
Landscape features, including orchards and hedgerows, are completely removed to make way for improved grassland and increased productivity.



Landscape Structure
Scenario model – high nature value

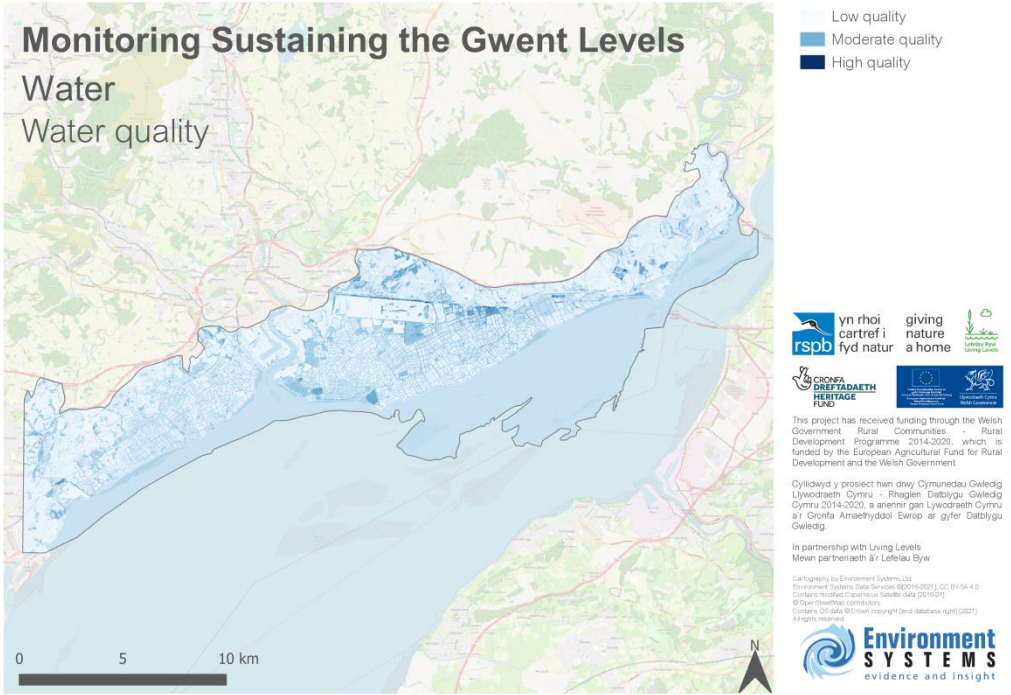
Green corridors are strengthened, but only where necessary. The most effective sites would be those opportunities within the existing woodland network, but that connect disjointed, separate patches.

The hedgerow network remains intact - supporting pollinators, bats, water quality and the natural flood management of the reens. This comes at the detriment to waders



Water Quality
Theme quality

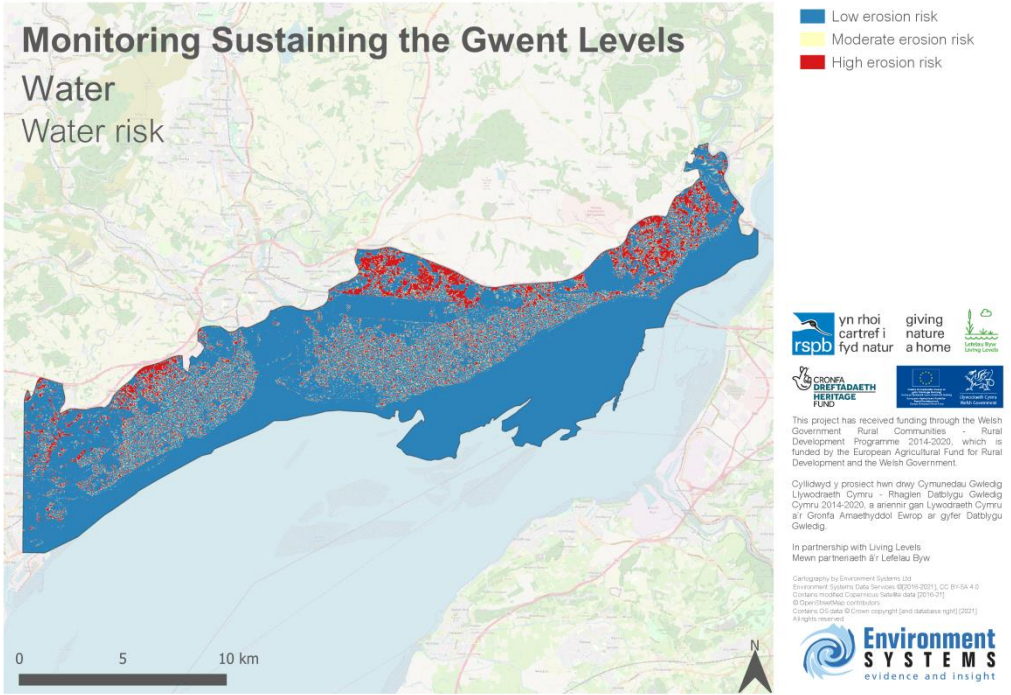
The quality of the water available is not only intrinsically important for the flora and fauna living directly within water ways, but also has a wider effect on the habitats drawing from these water sources.



Water Quality
Theme risk

Loss of soil from the land to the water system during rainfall and storm events has the potential to affect which types of habitats the soil can support, as well as the quality and condition of those habitats.

From external pressures, soil disturbances resulting from agricultural practices can lead to increased erosion and nutrient leaching from soils, which can lead to eutrophication within inland aquatic and coastal ecosystems.

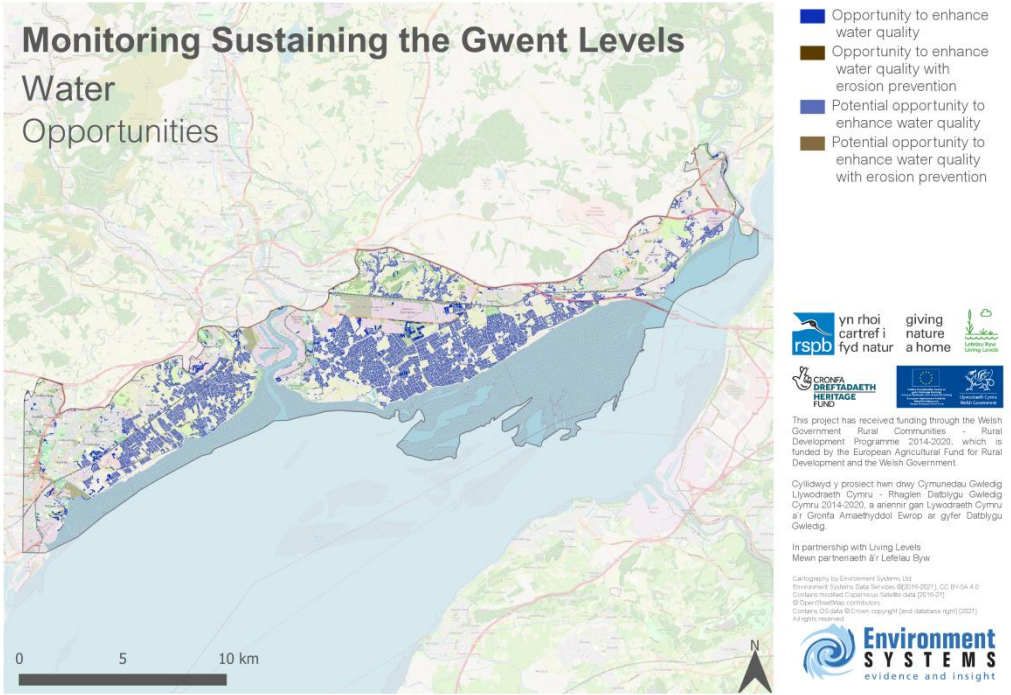


Water Quality
Theme opportunity

Nutrient management is desirable across the entire agricultural, grazing, and arable network, to improve quality of aquatic and buffer habitats, and the ecosystem services they provide.

There are opportunities for both habitat restoration and habitat creation, to both filter water and prevent erosion.

Those areas that are closer to nearby water sources, offer the greatest opportunity for impact.

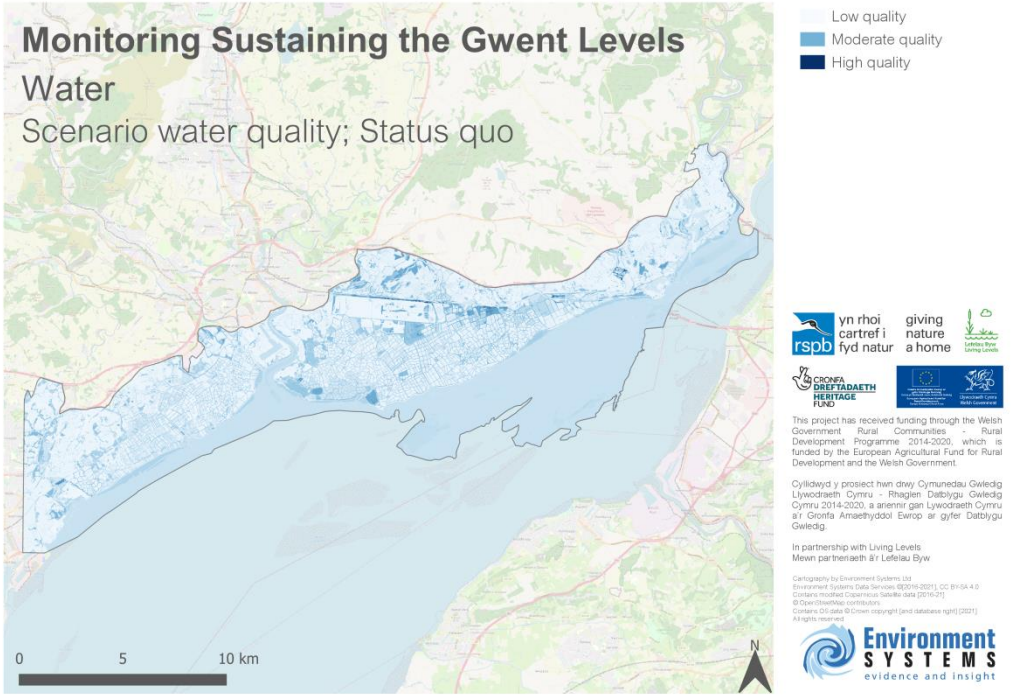


Water Quality
Scenario model – status quo

Struggling farm businesses may start to sell their land for development, drastically increasing the area of impermeable surfaces and urban run-off.

Fertiliser application and diffuse pollution increase, as does the compaction of the ground from grassland conversion to arable use.

This reduces the ability of the soil to filter water after rainfall events, increasing agricultural run-off into nearby aquatic environments.



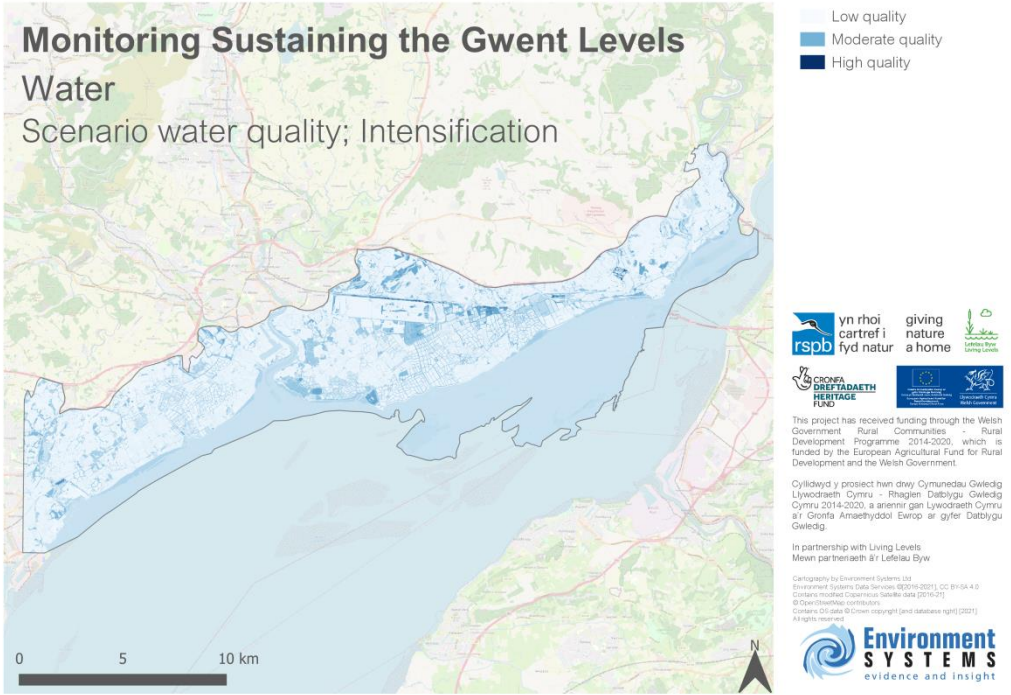
Water Quality
Scenario model – intensification

Intensive agriculture management takes over.

Grassland improvement levels increases, and with it, associated diffuse pollution. More areas are given to arable production, leading to increased agricultural soil disturbances and overland run-off.

Fewer hedgerows are available to help filter water, given over to more grazing opportunities.

The quality of water within the grips and reen network deteriorates. At low tide, the gouts release contaminated water into the surrounding designated sites, including the Rivers Usk and Severn.

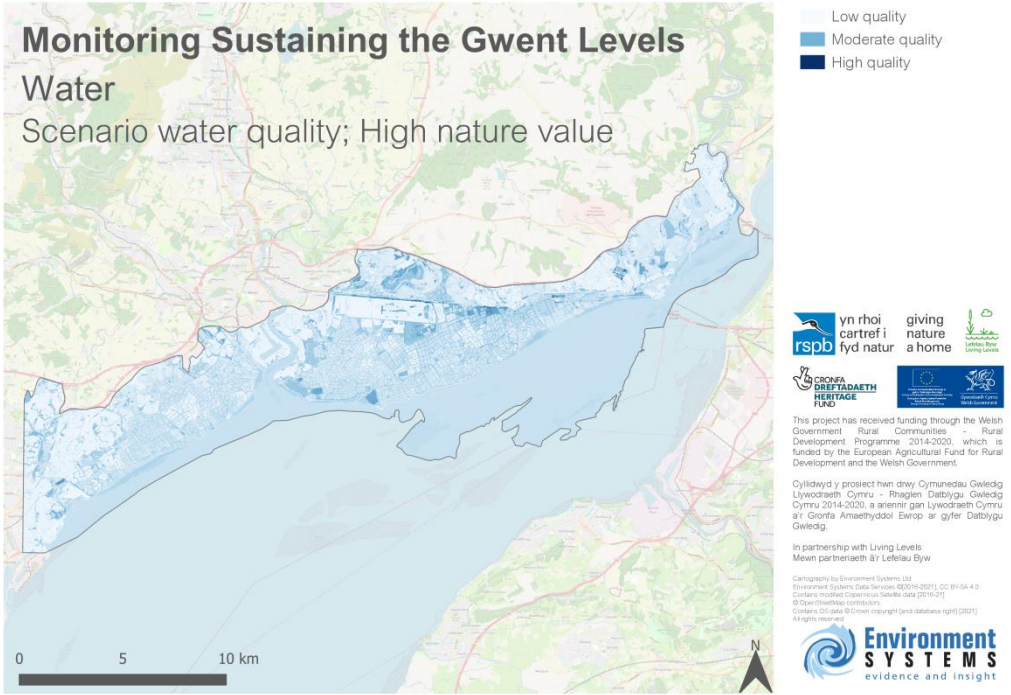


Water Quality
Scenario model – high nature value

Agricultural pollution is reduced from targeted measures and precision agriculture.

Grassland improvement levels are reduced and floristic diversity increased; improving the soil filtration rate and helping to purify the ground water.

Buffer zones maintained alongside water courses filter out the worst of the sediment and diffuse pollution, before it enters the water network.



Carbon Storage
Theme quality

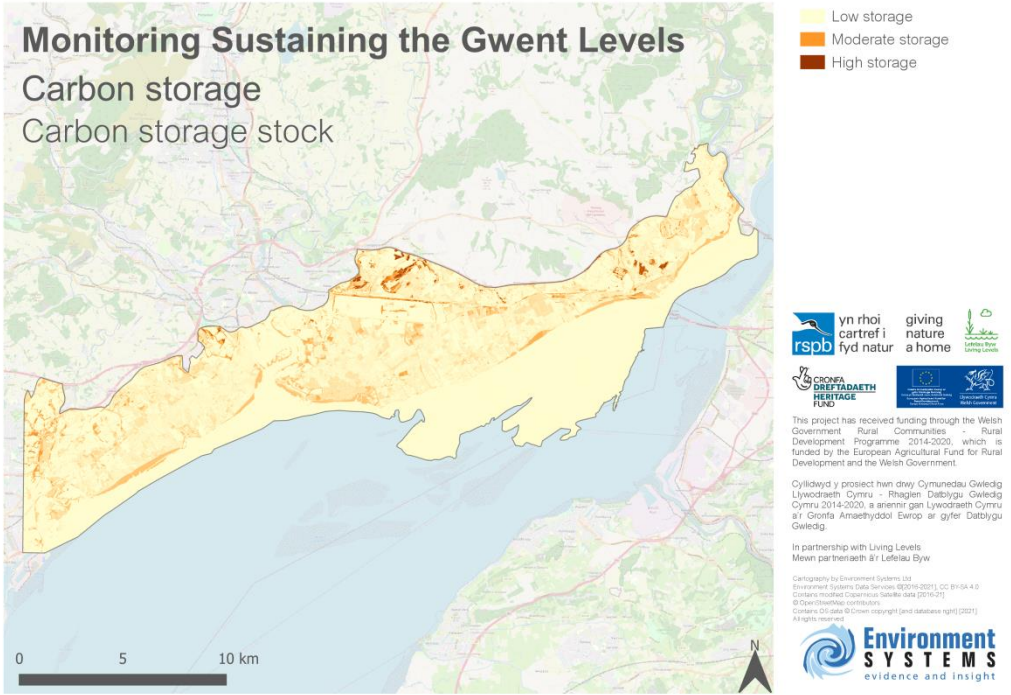
Soil carbon storage is a vital ecosystem service, resulting from interactions of ecological processes.

Anthropogenic activities affecting these processes can lead to carbon loss or improved storage.

Organic matter is a key component of soil that affects its physical, chemical, and biological properties.

Benefits of soil organic matter include improvement of soil quality through increased retention of water and nutrients, resulting in greater productivity of plants in natural environments and agricultural settings.

The storage values do not reflect values of carbon, but are an indication of relative carbon storage. A Levels-wide carbon storage layer, in tC/ha, was produced for *'Sustainable Farming Scheme: Nature & Carbon Benefits'.*



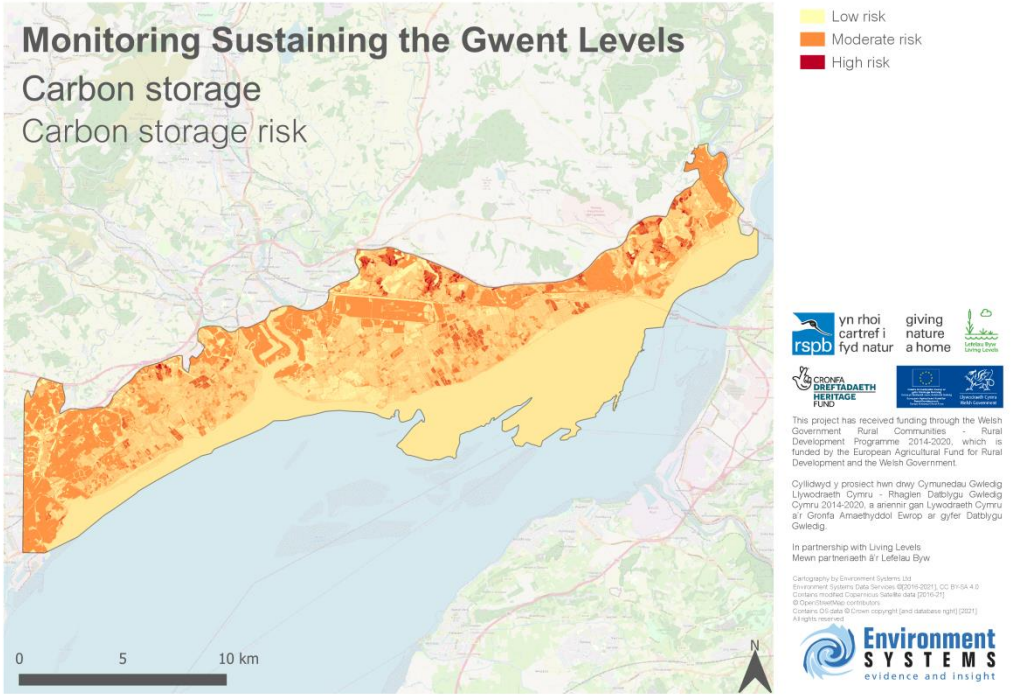
Carbon Storage
Theme risk

Land management is among the largest contributors to climate change.

Semi-natural habitats and woodlands provide the lowest risk to carbon, provided they are not cleared.

Soil provides the greatest variability in carbon storage, and is best left undisturbed.

Common agricultural practices, such as driving a tractor, tilling the soil, over-grazing, using fossil fuel based fertilizers, pesticides and herbicides, can all result in significant carbon dioxide release.



Carbon Storage
Theme opportunity

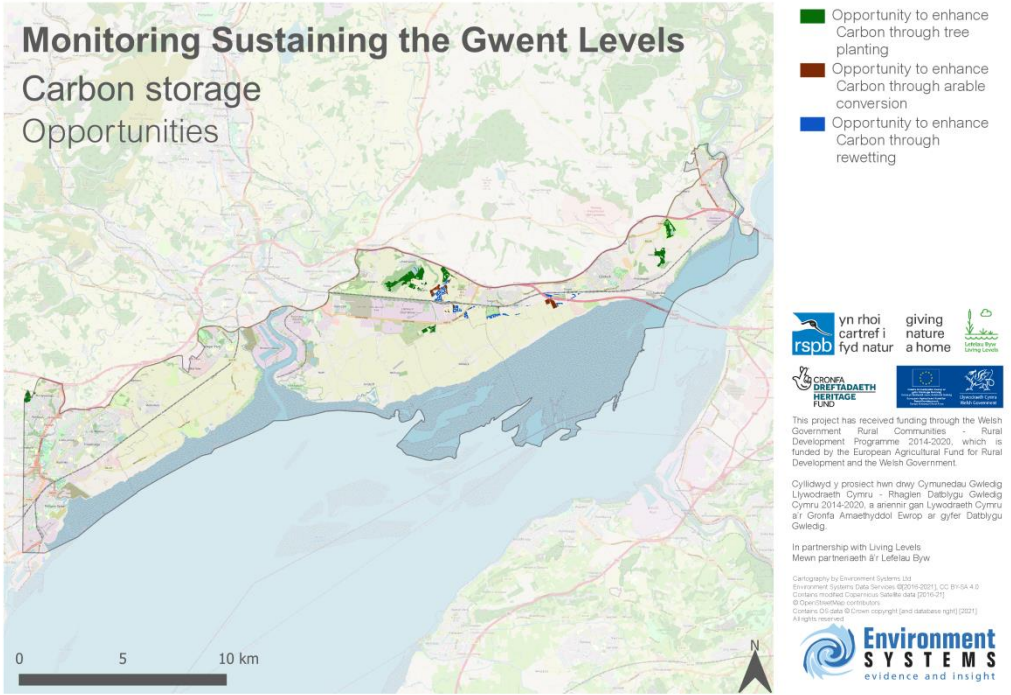
Tree planting sites highlights the planting that would generate the highest connectivity increase for the woodland network, as well as for increasing carbon storage.

Conversion of arable land into a semi-natural state will enhance carbon storage. Although most land will be farmed, there are ways of increasing carbon by regenerative agricultural techniques.

Set-aside schemes that focus on diversifying field margins are also possibilities; turning arable into clover fields, or other nitrogen-fixing crops; planting standard trees along hedgerows; sowing wildflower meadows (with appropriate management).

Rewetting opportunities require particularly flat, highly productive grassland sites that are close to existing surface water or reens. This could

Tree planting and re-wetting can be combined using wet-friendly tree species like alder, willow, birch. If managed correctly these can develop into carr-woodland and possibly into bog woodland in the far future

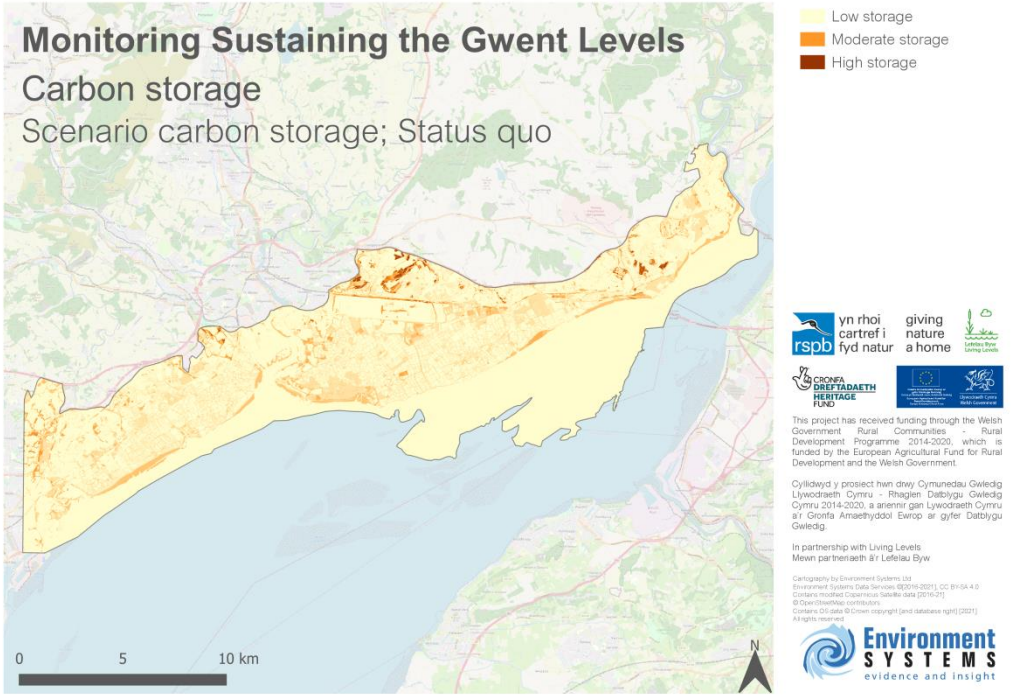


Carbon Storage
Scenario model – status quo

Permanent grassland is given over to arable production. Tilling the soil for agriculture releases stored carbon, and distributes carbon-rich organic matter.

Some of the land is sold for urban and industrial development, drastically reducing the vegetated biomass available.

The neglect of ditches and reens results in an increase in hedgerows, which does improve carbon storage for those areas.

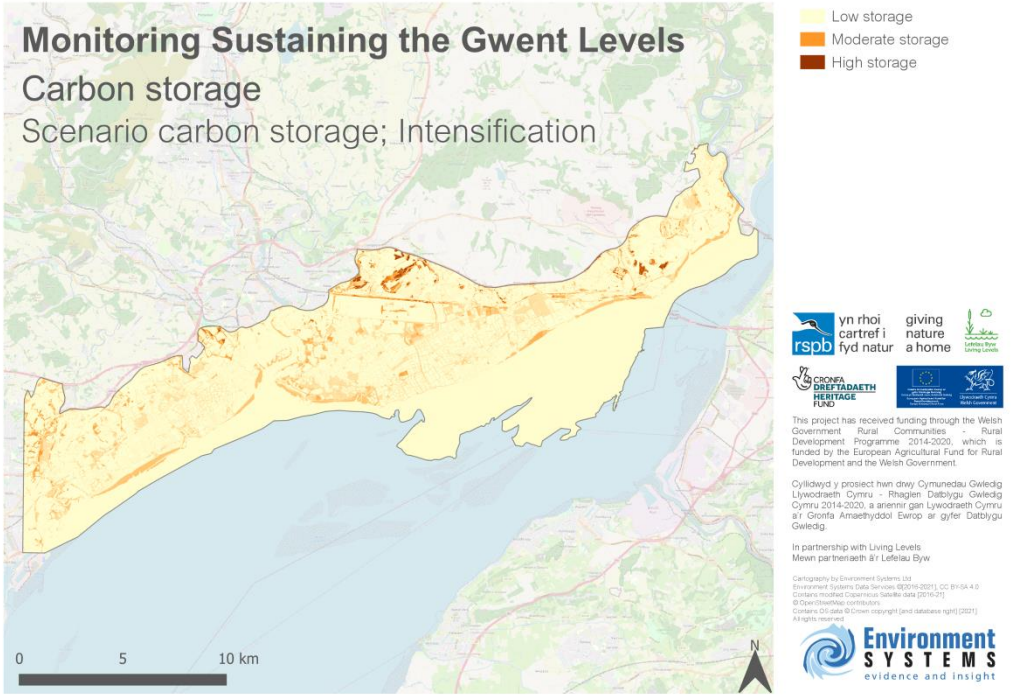


Carbon Storage
Scenario model – intensification

The most significant effect upon the carbon content of the soil is from mechanical cultivation. With more land converted for arable practises, more soil is susceptible to mechanical means.

Further improvement to grassland pasture and agricultural intensification decreases the floristic diversity, but decreases soil organic carbon content.

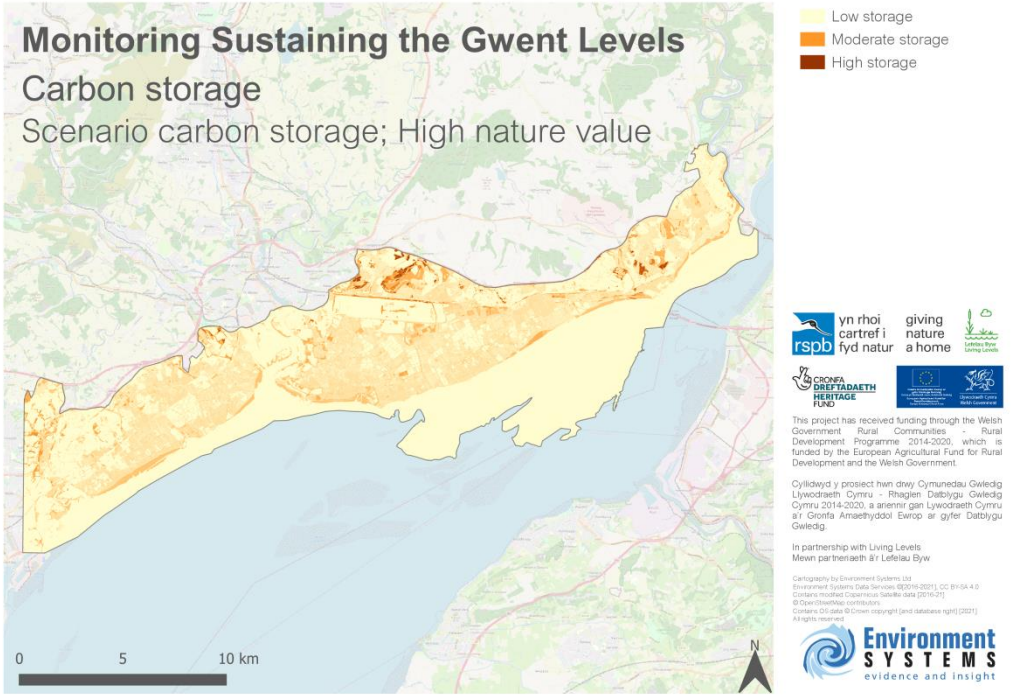
Some reens, ditches and hedgerows are removed in favour of pasture and arable, decreasing the available biomass and disturbing the soil, releasing the carbon stored within.



Carbon Storage
Scenario model – high nature value

Hedgerow and tree planting, where necessary, enhances the carbon cycle, and helps rebuild the soil organic carbon concentration.

Diverse field margins and increased species diversity within the grassing pasture, particularly those with different root depths, increases and stabilise the soil carbon storage.



Environment SYSTEMS
evidence and insight

Thank you

Samuel Pike (samuel.pike@envsys.co.uk)
Dr Katie Medcalf (katie.medcalf@envsys.co.uk)

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In partnership with Living Levels.
Mewn partneriaeth â'r Lefelau Byw.

Cronfa Amaethyddol Ewrop ar gyfer Datblygu Gwledig: Ewrop yn Buddsoddi mewn Ardaloedd Gwledig
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