

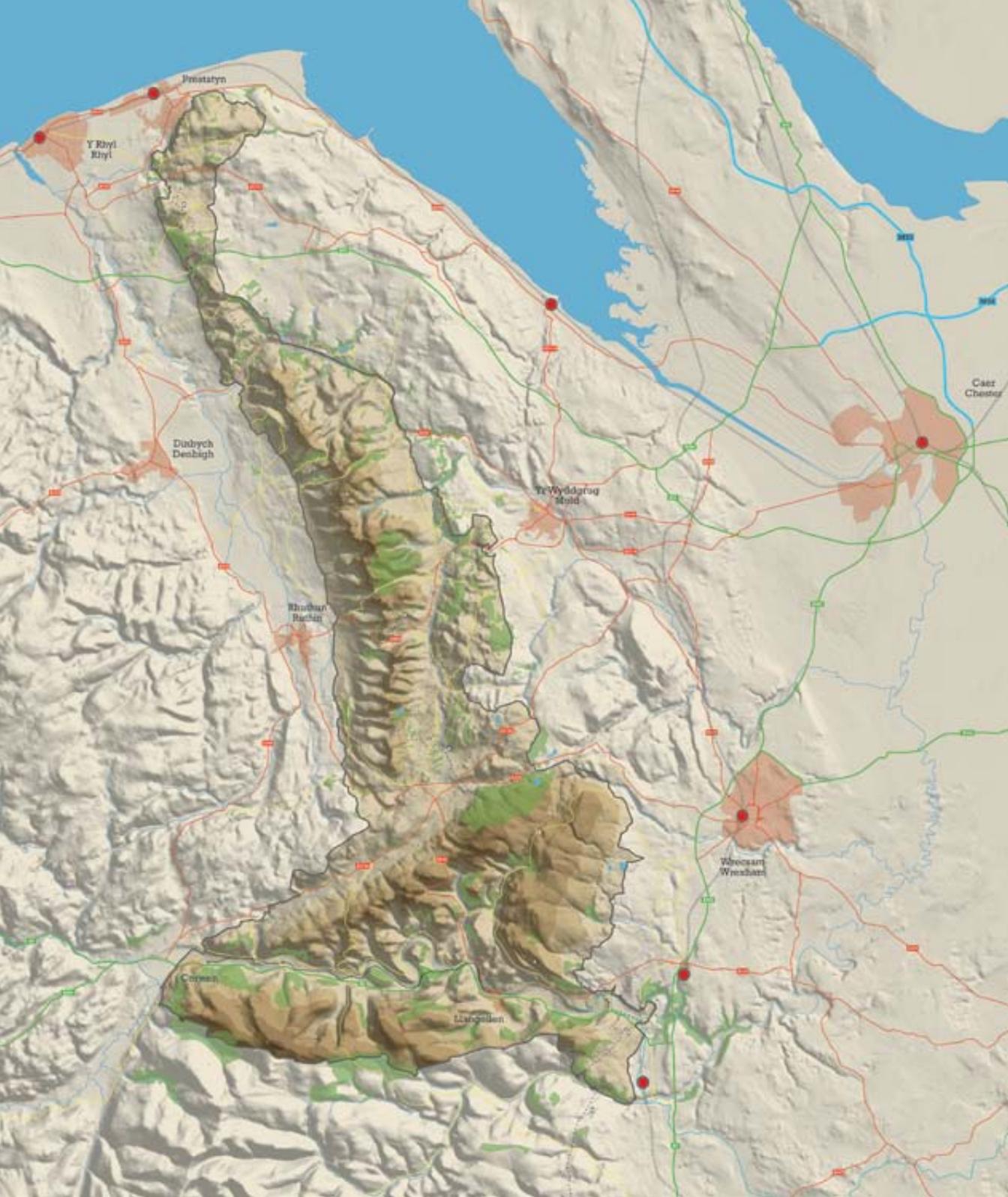


**Bryniau Clwyd a
Dyffryn Dyfrdwy**
Clwydian Range
and Dee Valley

Ardal o Harddwch Naturiol Eithriadol
Area of Outstanding Natural Beauty

Working with a Changing Climate

A guide to adaptation in the Clwydian Range and Dee Valley AONB



What the Clwydian Range and Dee Valley does for us

This special landscape:

- Is a home for people and various species of flora and fauna
- Supports the economy, including farming and tourism
- Provides food, fuel and materials from its fields, forests and quarries
- Provides local water supplies and helps to manage flood risk
- Helps to regulate the local climate and provide a clean, healthy atmosphere
- Contributes to a strong sense of place for local communities and visitors
- Provides opportunities for leisure, recreation, exercise, enjoyment, health and wellbeing for all
- Is a physical record of our cultural heritage

Introduction

The natural beauty of the Clwydian Range and Dee Valley AONB must be conserved and enhanced, but it is also a living and working landscape which is continuing to change over time. Climate change is having an increasing influence on the area and we need to take action to adapt. This guide aims to help those working and living in the area to do just that.

Setting the scene

The Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB) is the dramatic upland frontier of north Wales, embracing some of the UK's most wonderful countryside.

The Clwydian Range is an unmistakeable chain of purple heather-clad summits, topped by Britain's most strikingly situated hillforts.

Beyond the windswept Horseshoe Pass, over Llantysilio mountain, lies the glorious Dee Valley with historic Llangollen, a famous market town rich in cultural and industrial heritage.

Offa's Dyke Path traverses this specially protected area, one of the least discovered yet most welcoming and easiest to explore of Britain's finest landscapes.

The designation of the Clwydian Range and Dee Valley as an AONB means that its natural beauty must be conserved and enhanced. It is, however, also a living and working landscape which provides vital resources and services within the AONB and to the surrounding area.

The Clwydian Range and Dee Valley has evolved over time, shaped by geological forces, climate and human activity, and this evolution is ongoing. Climate change is expected to have a major influence in the coming decades, and we need to manage this process, taking action to adapt to the impacts and make the best of the opportunities.

Purpose of this guide

This guide has been designed to help those working and living in and around the AONB to understand the potential effects of a changing climate and take action to adapt. It is not a statement of policy, but sets out a range of issues and options for discussion and consideration.

It is aimed primarily at a professional audience, but it is hoped that the information provided will also be interesting and useful for other residents, local businesses and community groups.



Heather Moorland on Moel Famau. Denbighshire Countryside Services.

How the climate is changing

Although the global climate has been relatively stable for thousands of years, recent extreme weather events and longer-term trends suggest it is now changing due to human activity. Climate change is expected to continue, causing hotter, drier summers, warmer wetter winters, more extreme weather and sea-level rise in Wales and the rest of Britain.

Historic climate

Wales has a maritime climate, with weather that is mild and often cloudy, windy and wet. Although the climate in Wales and the rest of the world has been relatively stable for the last 10,000 years, there have been periods of extreme change in the past.

350 million years ago, warm tropical seas covered the land, depositing the limestone found in the Clwydian Range and Dee Valley. 100 million years later, Wales had a desert climate, while the valleys of the AONB were carved out by glacial movement during a series of ice ages, the most recent of which ended around 14,000 years ago.

Recent changes

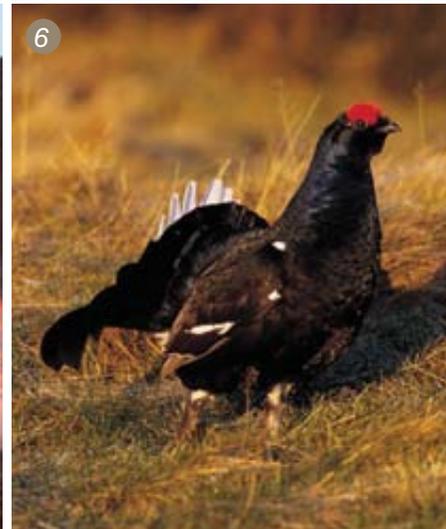
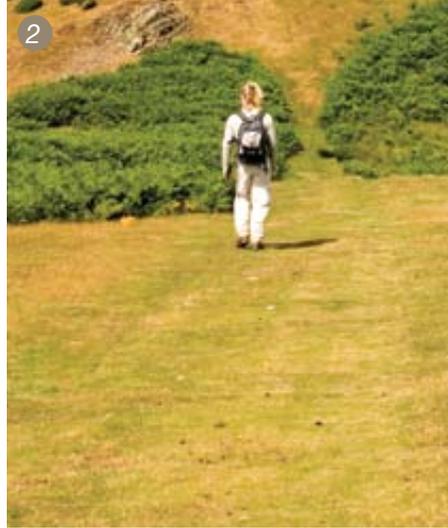
Global average temperatures have increased over the last century and the 10 warmest years since records began have all occurred in the last 16 years. Sea-levels are also rising by around 3mm per year.

Numerous records have been broken for extreme weather in recent years. The UK's wettest summer in 100 years and wettest autumn since records began were in 2012 and the highest temperatures ever recorded were during the 2003 heatwave. In December 2013, the highest storm surge in sixty years caused flooding along the North Wales coast.

Future projections

Recent changes in the global climate have been linked to increasing atmospheric concentrations of greenhouse gases such as carbon dioxide. This is largely due to human activity, such as burning fossil fuels, deforestation, peatland drainage and some farming practices.

Global climate change is projected to continue, causing hotter, drier summers, warmer, wetter winters, more extreme weather, drought, heatwaves, heavier rainfall, and accelerating sea-level rise in Wales and the rest of Britain over coming decades.



Impacts on the AONB and surrounding areas

The impacts of climate change could include:

1. Flooding
2. Drought and heatwaves
3. Erosion, landslip and loss of soil
4. Pollution of watercourses
5. Wildfires
6. Changes to habitats and species
7. Effects on crops, livestock and forestry
8. Damage to buildings and infrastructure
9. Effects on the health and wellbeing of people

Impacts on the AONB and surrounding areas

Changing weather patterns and sea-level rise will have a direct impact on all parts of the Clwydian Range and Dee Valley AONB and the surrounding area. There could be positive and negative consequences, depending on how we respond.

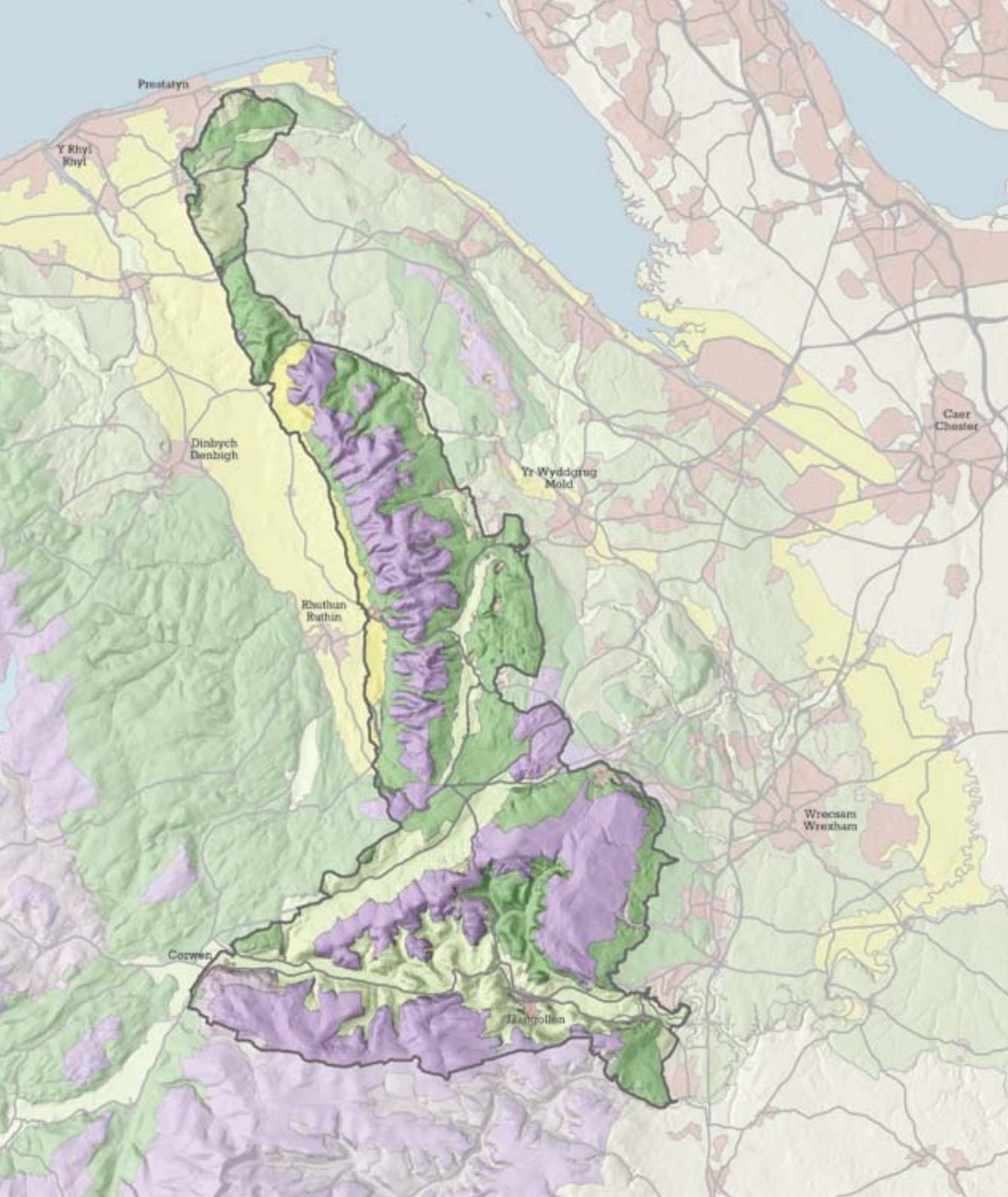
Direct impacts of changing weather patterns and sea-level rise

All parts of the AONB and surrounding areas could be affected by the direct impacts of changing weather patterns and sea-level rise. There could be positive and negative consequences, depending in part on how we respond. For example:

- Long periods of dry weather could lead to drought, reduced flows in rivers and streams, drier soil, and wildfires
- At other times of year heavier rainfall and storms could increase the risk of flooding, erosion and landslip

- Along the coast, sea-level rise and coastal storms could increase flood risk and erosion
- The local climate could become less suitable for some habitats and species, while upwards and northwards migration could bring other species into parts of the AONB
- The timing of seasonal events could change, including flowering, breeding and migration, which could affect synchronisation between species and important events like pollination
- Agriculture and forestry could face changing yields, increased risks of pests and diseases, and damage from flooding, drought and storms
- The types of food we have access to could change, and prices and availability could be affected for example by damage to crops or disruption of supply chains
- Extreme weather could affect the health and wellbeing of communities and damage buildings and infrastructure, but milder winters could reduce cold-related deaths

The actions that we take to respond to climate change could also have an impact on the AONB and surrounding areas. These are considered in the following section.



Adapting to change

The priorities for adaptation will be different in different parts of the landscape:

- Rolling lowlands and coastal areas
- Upland areas
- Hill slopes
- River valleys
- Low-lying flood plains
- Built environment

Each of these is explored in turn on the following pages.

Adapting to change

We need to adapt to climate change and address the causes, while conserving and enhancing the natural beauty of the AONB. Our approach to adaptation will require careful planning, design and implementation, and in some cases planning permission or other consents may be required. Everyone has a role to play.

Overview

There are actions that can be taken now to adapt to the impacts of climate change and benefit from the opportunities. We also need to reduce our impact on the climate by cutting greenhouse gas emissions. It will be important to consider what happens in the AONB and surrounding areas, and how they might affect each other. For example, managing upland areas to reduce rainwater runoff can help to manage flood risk in the towns and villages downstream.

The priorities and practical solutions will vary for different types of landscape in and around the AONB. This section is structured around these different landscape types, which are highlighted in the map opposite and represented in the illustrations on the following pages.

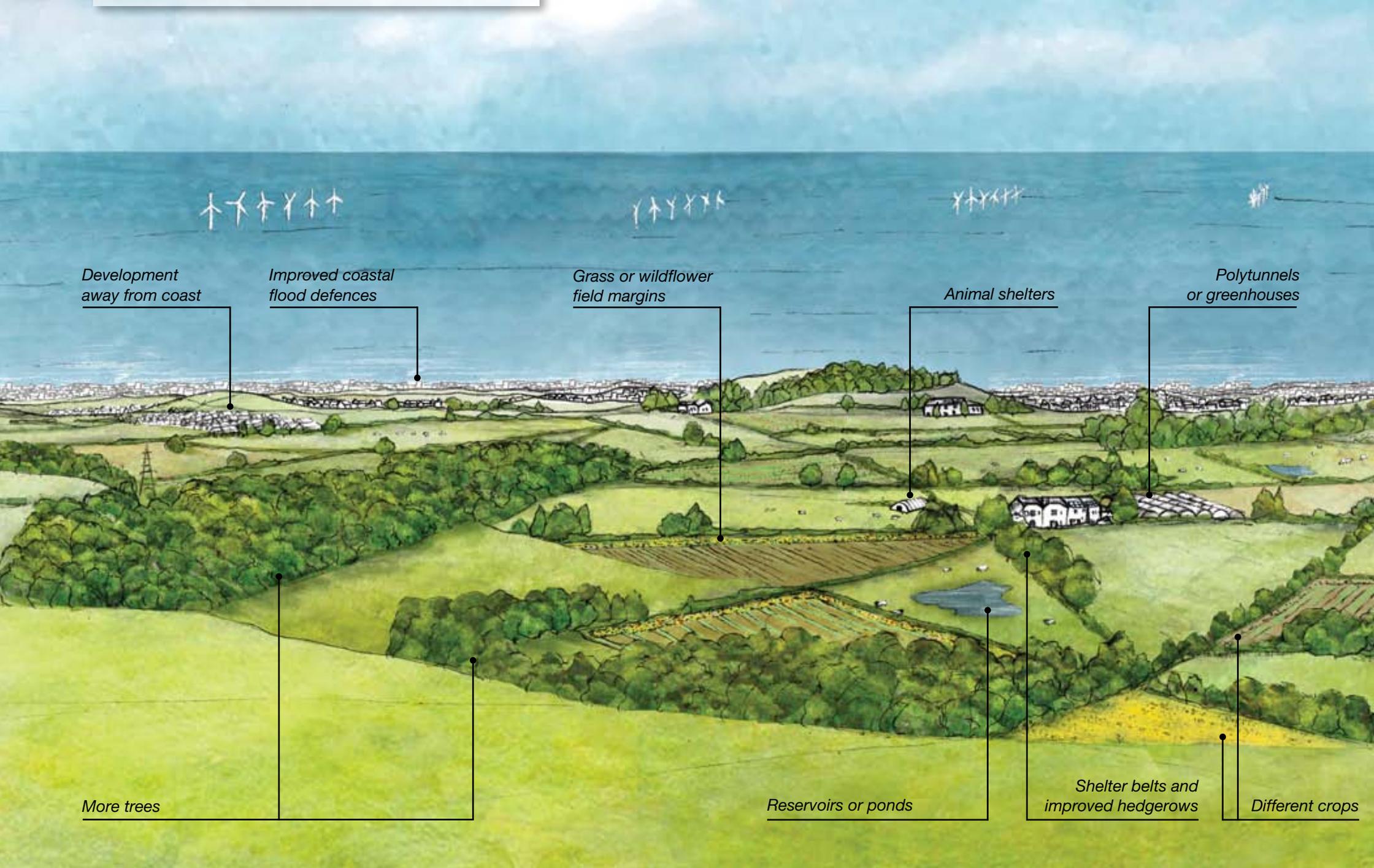
The landscape illustrations are not actual views of real locations and the adaptation measures shown are not planned projects, just examples of the possibilities.

Individuals can implement some actions directly, while others need to be part of a coordinated programme or strategy. For example, measures to reduce flood risk need to be planned in the context of the coastal or catchment flood risk management plans. Choices will need to be made to strike the right balance between different priorities. The Welsh Government's Natural Environment Sectoral Adaptation Plan and Natural Resource Management approach, the AONB Management Plan and the relevant local authorities' Local Development Plans explain how this can be achieved.

Careful planning, design and implementation will be important. Some actions may need planning permission or other consents, for example new buildings or infrastructure. Particular care will be needed in relation to heritage assets, protected habitats or species, and other designations such as open access land. The natural beauty of the AONB must also be conserved or enhanced in the process.

Everyone has a role to play in tackling climate change. After looking at the adaptation options, this guide provides information for farmers, land managers, forestry and woodland managers, planners, policymakers, residents and businesses.

Rolling lowlands and coastal areas



Development away from coast

Improved coastal flood defences

Grass or wildflower field margins

Animal shelters

Polytunnels or greenhouses

More trees

Reservoirs or ponds

Shelter belts and improved hedgerows

Different crops

Rolling lowlands and coastal areas

This area in the north of the AONB features a traditional farmland patchwork of fields, with curving belts of woodland, scattered trees and mature hedgerows. Farming is a mixture of dairy, beef, sheep and arable.

There are small villages and farms scattered across the rolling lowlands and a continuous band of development along the coastal plain. Infrastructure along the coast includes a railway and roads, and offshore wind turbines can also be seen from here.

Adapting to climate change in this area could include:

- Cultivating a more diverse range of crops, such as garlic, rocket, maize, blueberries, grapes, sunflowers and soya that can cope with warmer weather, less reliable water supplies and changes in pests and diseases
- Creating small on-farm ponds or reservoirs to store water for irrigation or for animals to drink and using water more efficiently
- Using fertiliser more efficiently to reduce the amount washing off fields and causing enrichment of streams and rivers
- Planting shelter belts and improving hedgerows to protect animals and crops from extreme weather

The rolling lowlands to the north of the AONB support a diverse mix of agriculture, so adapting these activities to future weather conditions will be a priority. Towards the coast, coping with sea-level rise, more powerful storms and erosion will be important.

- Maintaining strips of grass or wildflowers around arable fields to reduce rainwater run-off and soil erosion, enhance biodiversity and connect habitats
- Converting some arable fields to pasture, mechanical compaction relief of pastures, and drain or ditch blocking in suitable locations to reduce rainwater run-off and reduce flood risk downstream, as part of a catchment-wide strategy
- Improving coastal flood defences to manage flood risk in line with sea-level rise, as planned along the coast at Rhyl as part of the coastal flood defence strategy
- Using polytunnels where appropriate to allow high-value crops to be grown in a controlled environment and installing appropriately designed animal shelters in suitable locations
- Using renewable energy technologies, such as anaerobic digesters to convert farm waste to energy, suitably sized wind turbines or solar panels
- Constructing new buildings and facilities to accommodate additional tourism and planning future settlements away from areas at risk of coastal flooding

Upland areas

Enhanced and connected habitats including heather moorland

Dry stone wall provides shelter and microclimate

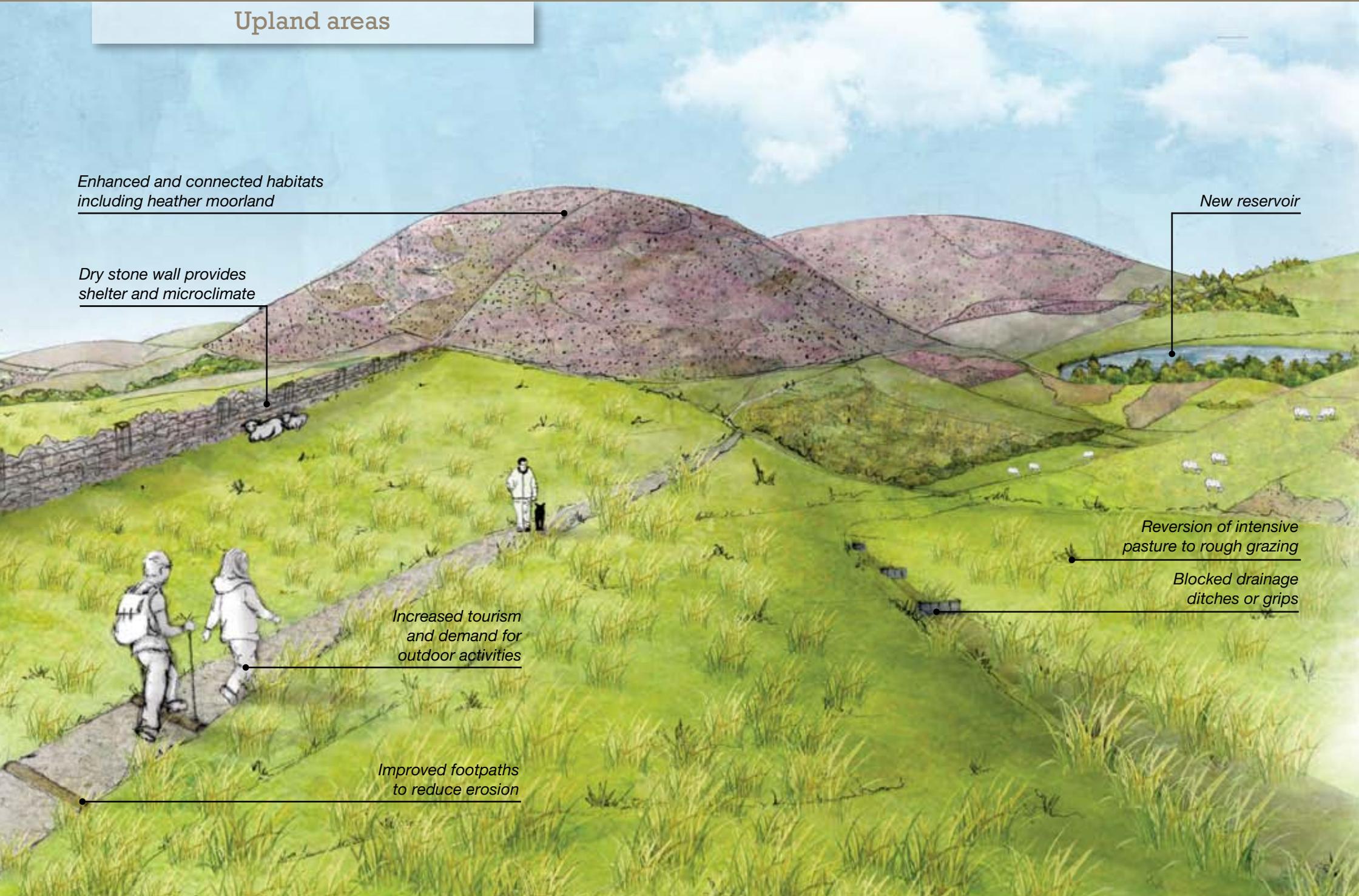
New reservoir

Reversion of intensive pasture to rough grazing

Blocked drainage ditches or grips

Increased tourism and demand for outdoor activities

Improved footpaths to reduce erosion



Upland areas

The round-headed hills, many of which are topped by Iron Age hillforts, are one of the most striking features of the Clwydian Range and Dee Valley AONB. There are expanses of purple heather and bilberry moorland across these upland areas, with pockets of blanket bog and areas of grassland grazed by sheep.

The areas of open access land and footpaths here are popular with walkers, including Offa's Dyke National Trail, which follows much of the ridgeline of the Clwydian Range.

Adaptating to climate change in this area could include:

- Increasing the area of heather moorland, heath and similar land cover, blocking drainage ditches or grips in appropriate locations, mechanical compaction relief of upland pastures and reverting land from intensive pastures to rough grazing or scrub to reduce rainwater run-off
- Restoring and enhancing habitats with high carbon storage potential including peatland, dwarf shrub heath, acid grassland, fen, marsh, swamp and bog

Adaptation priorities in upland areas will include storing water and managing downstream flood risk, making habitats more resilient, reducing the risk of wildfires and controlling erosion.

- Connecting and improving habitats, including heather moorland, to make them more resilient and enable wildlife to adapt. Even where this is done some upland species such as Black Grouse could eventually decline or migrate either to higher elevations or northwards as temperatures rise
- Managing gorse and bracken more intensively, as the risk of encroachment could increase in upland areas
- Strengthening measures to reduce wildfire risk, including controlled burning, monitoring and emergency response
- Building a new reservoir or reservoirs on the edge of these areas where appropriate, as part of a strategy for water management across the catchment area
- Accommodating growth in leisure activities and increasing use of footpaths, open access areas and other visitor facilities due to warmer weather and a potential decline in overseas travel
- Improving the maintenance of footpaths and other areas susceptible to erosion

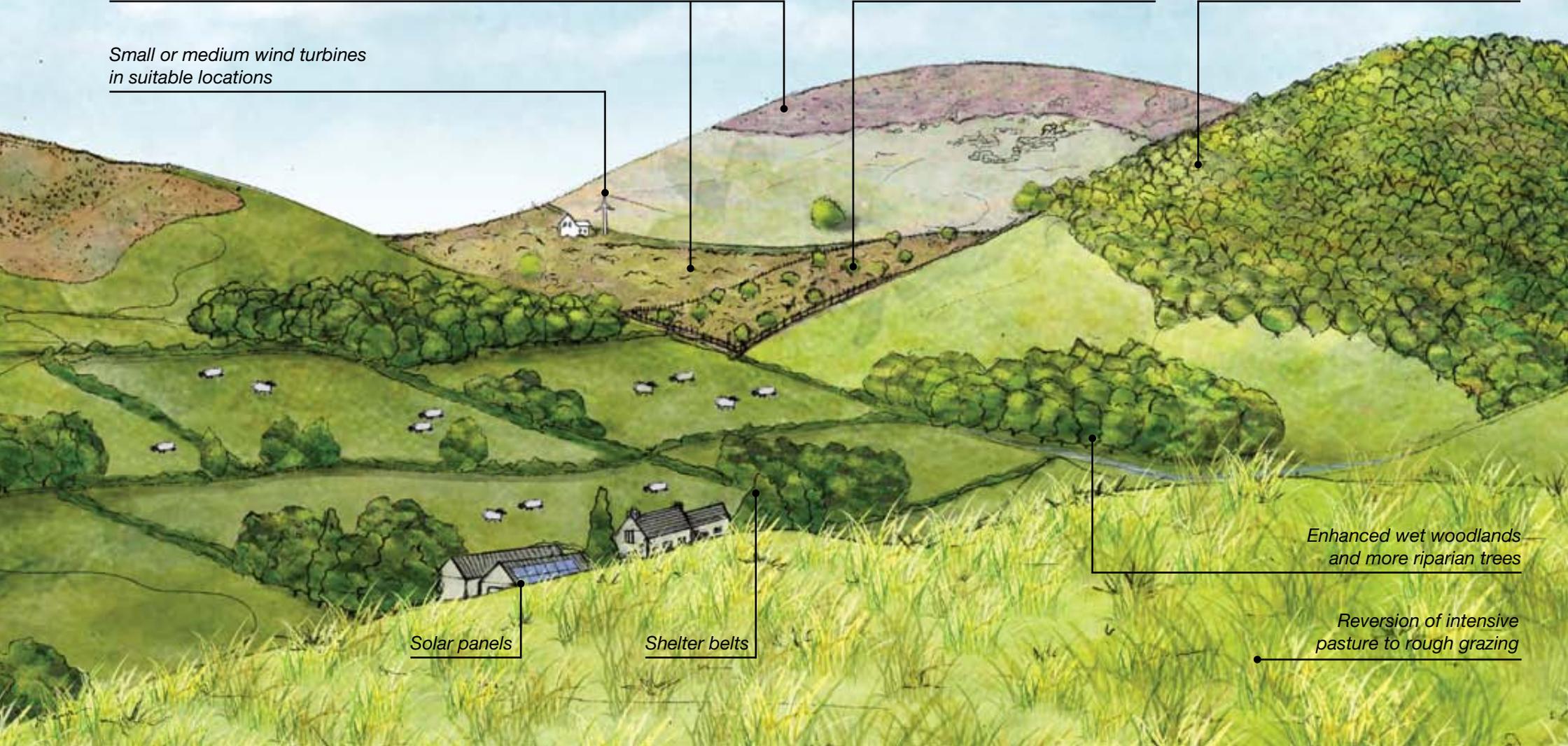
Hill slopes

Enhanced and connected habitats including heather moorland, scrub and ffrith

Small or medium wind turbines in suitable locations

Improved and fenced clough woodland

Increased forestry and woodland cover and more diverse mix of species



Solar panels

Shelter belts

Enhanced wet woodlands and more riparian trees

Reversion of intensive pasture to rough grazing

Hill slopes

The hill slopes of the Clwydian Range and Dee Valley are generally steep, with 'v' shaped valleys with wooded slopes known as clough woodlands, rounded glacial valleys or cwms and limestone outcrops.

There is a mixture of different habitats and uses on the hillsides, including hedgerow-enclosed fields with grazing sheep, scrubland or ffrith with gorse and bracken, clough woodlands, and coniferous forestry plantations.

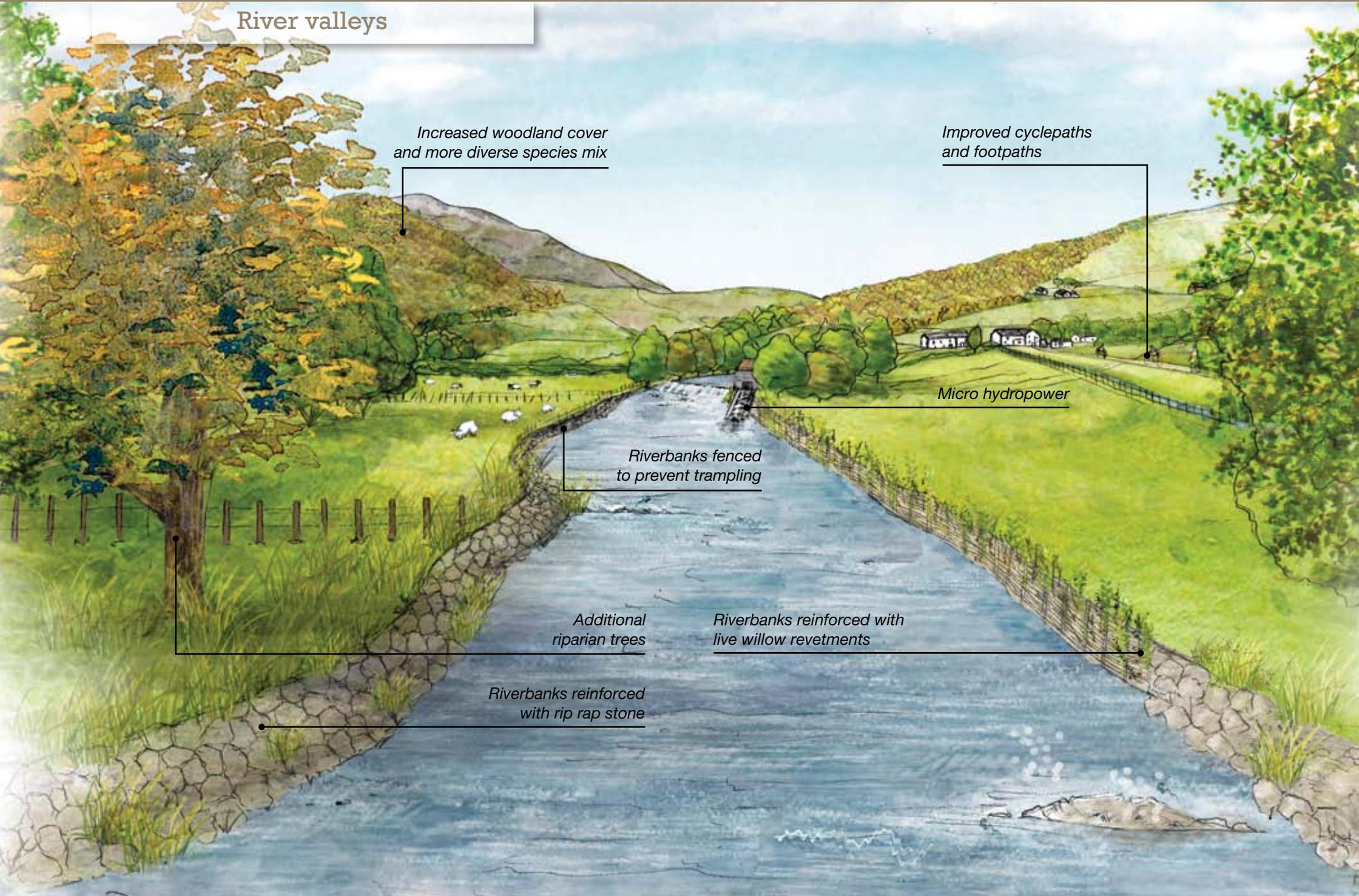
Adaptating to climate change in this area could include:

- Connecting fragmented habitats including ffrith and clough woodlands to improve resilience and enable wildlife to adapt
- Fencing clough woodlands to slow water flow and improve habitat for declining species such as ring ouzels
- Enlarging forestry and woodland areas and adapting their management to produce more fuel and timber for construction, store more carbon, introduce a wider variety of species including broadleaved species, enhance biodiversity, and create a more natural edge to plantations which works with the contours of the hillsides

Adapting forestry to increase resilience to climate change and extreme weather damage will be a priority on the hill slopes of the AONB. Improving habitats and managing rainwater run-off, erosion, landslip and wildfires will also be important.

- Planting or enhancing existing wet woodlands at the base of hill slopes, mechanical compaction relief of pastures, blocking drainage ditches in suitable locations, and reverting land from intensive pastures to rough grazing or scrub to reduce rainwater run-off and help to reduce flood risk downstream
- Clearing strips of land and undertaking controlled burning in appropriate areas to reduce the risk of wildfires, along with monitoring and emergency response
- Improving the stability of slopes to reduce erosion and landslip, for example by increasing cover of appropriate trees and other vegetation
- Using renewable energy technologies, such as anaerobic digesters, suitably sized wind turbines or solar panels

River valleys



*Increased woodland cover
and more diverse species mix*

*Improved cyclepaths
and footpaths*

Micro hydropower

*Riverbanks fenced
to prevent trampling*

*Additional
riparian trees*

*Riverbanks reinforced with
live willow revetments*

*Riverbanks reinforced
with rip rap stone*

River valleys

The steep-sided river valleys in the AONB feature a mosaic of wet pasture, broadleaved woodland, mixed woodland and parkland trees. The sections of the Rivers Dee, Alyn and Wheeler which are within the AONB are relatively narrow and fast-flowing, with riparian trees along a significant length of the riverbanks.

The river valleys are also where most of the communities and transport networks in the AONB can be found. Adaptation of the built environment is considered in a separate section.

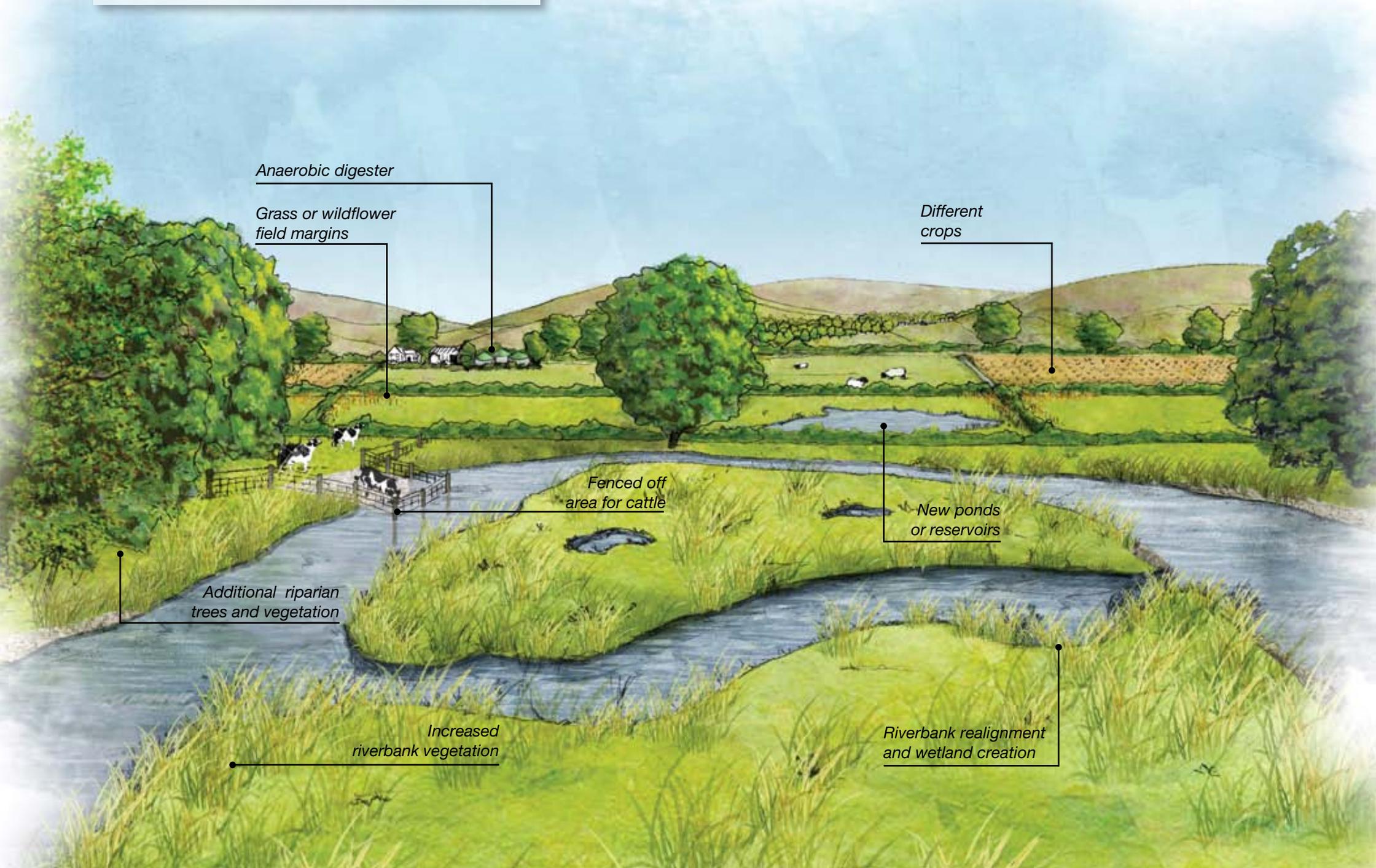
Adaptating to climate change in this area could include:

- Improving or altering flood defences as part of a wider catchment management strategy, such as:
 - Works planned to enlarge the culvert which the Nant Pigyn watercourse flows through in Corwen
 - Managed realignment of riverbanks in suitable rural areas to create flood storage and reduce downstream flood risk
- Maintaining existing flood defences in built up areas and riverbanks in rural areas where relevant
- Avoiding unnecessary residential development in the flood plain or designing it appropriately to avoid increasing risk

Flooding is a risk in parts of the valleys of the Rivers Dee, Alyn and Wheeler. Reducing rainwater run-off, adapting agricultural activities, managing water quality in the rivers and protecting habitats will all be priorities in these parts of the AONB.

- Flood-proofing existing properties and infrastructure at risk
- Fencing off riverbanks and creating fenced, concreted drinking areas for livestock, to prevent trampling and reduce erosion
- Increasing the number of riverbank trees and other plants to reduce erosion, provide shade, and create a comfortable microclimate for livestock and aquatic species
- Planting additional trees and hedges in appropriate locations to slow down rainwater run-off, provide fuel and store carbon
- Managing woodlands for biodiversity and planting a wider range of appropriate species to improve resilience
- Connecting fragmented habitats such as broadleaved woodlands to improve resilience and allow species to migrate
- Accommodating increasing visitor numbers, including increased traffic and use of public transport, footpaths and cycle routes
- Using renewable energy technologies, such as microhydropower where river ecology and water management circumstances allow, anaerobic digesters, suitably sized wind turbines or solar panels

Low-lying flood plains



Anaerobic digester

*Grass or wildflower
field margins*

*Different
crops*

*Fenced off
area for cattle*

*New ponds
or reservoirs*

*Additional riparian
trees and vegetation*

*Increased
riverbank vegetation*

*Riverbank realignment
and wetland creation*

Low-lying flood plains

Either side of the Clwydian Range are relatively flat areas of farmland in the flood plains of the River Clwyd to the west and the River Dee to the east. These areas are a patchwork of small to medium fields, mature hedgerows, small blocks of broadleaved woodlands and a diverse mix of arable and livestock farming.

The rivers meander through these areas towards the coast. Flooding is a natural function and annual feature of the floodplains. High tides in the River Clwyd north of St Asaph, and in the River Dee between Shocklach and the Dee Estuary, reduce the capacity for the rivers to drain and exacerbate flood risk. Climate change could increase the frequency, duration and extent of flooding in these areas.

Adapting to climate change in these areas could include:

- Managing flood risk, for example by:
 - Improving field drainage where agricultural use a priority
 - Creating ponds or wetlands and realigning riverbanks in suitable areas to increase floodwater storage
 - Flood-proofing existing properties and infrastructure at risk and avoiding unnecessary new residential development in the flood plain or designing it appropriately to manage risk

Managing flood risk will be increasingly challenging in low-lying flood plains, due to heavier rainfall and rising sea-levels in tidal stretches of the Rivers Clwyd and Dee. Adapting agricultural practices will also be a priority in these locations.

- Fencing off riverbanks and creating fenced, concreted drinking areas for livestock, to prevent trampling and reduce erosion
- Increasing the number of riverbank trees and other plants to reduce erosion, provide shade, and create a comfortable microclimate for livestock and aquatic species
- Cultivating a more diverse range of crops, such as garlic, rocket, maize, blueberries, grapes, sunflowers and soya to cope with warmer weather, less reliable water supplies and changes in pests and diseases
- Creating small on-farm ponds or reservoirs to store water for irrigation or for animals to drink and using water more efficiently
- Using fertiliser more efficiently to reduce the amount washing off fields and causing enrichment of streams and rivers
- Planting new hedgerows or enhancing existing ones to provide shelter and connect habitats
- Maintaining grass and wildflower buffer strips around arable fields to reduce run-off and erosion, enhance biodiversity and connect habitats
- Using renewable energy technologies, such as anaerobic digesters, suitably sized wind turbines or solar panels

Built environment

Flood protection for properties at risk

Shutters to prevent overheating

Solar panels

Green roof

Water butt

Biomass boiler and wood store

Native hedgerows

Wildlife gardens

Allotments for growing food



Built environment

The AONB has two towns - Llangollen and Corwen - a number of villages, hamlets and isolated buildings, and numerous heritage sites including Chirk Castle, Dinas Bran and Pontcysyllte aqueduct. Nearby towns include Wrexham, Mold and Flint to the east, Denbigh and Ruthin to the west, and Rhyl and Prestatyn to the north.

Major infrastructure includes a railway and roads along the coast and the overhead electrical lines that cut through the Morwynion valley and cross the hills above Tremeirchion, Llandegla and Minera. Adapting the built environment could include:

- Flood-proofing properties in areas at risk, for example installing temporary flood barriers or sandbags, fitting air vent covers, using water resistant materials on ground floors, and raising electrics and other valuables above flood levels
- Avoiding unnecessary new residential development in the flood plain or designing it appropriately to manage risk
- Installing water-efficient fittings in buildings and water butts to collect and store rainwater for watering gardens
- Reducing the risk of overheating during heatwaves, for example by installing shutters or blinds to keep out direct sunlight

New and existing buildings and infrastructure will need adapting to ensure they remain safe and comfortable as the climate changes. Improving energy efficiency, using renewable energy and encouraging wildlife will also be important.

- Making buildings more energy efficient, with insulation, double or triple glazing, and high efficiency boilers and lights
- Fitting solar panels and other renewable energy technologies such as wood-fuelled boilers where appropriate, or investing in community-scale renewable energy projects
- Planting more trees in streets, other public spaces and gardens for shading and cooling
- Increasing areas of permeable outdoor surfaces to help absorb rainwater and reduce overheating in summer, including paths, driveways and back gardens or green roofs on suitable buildings
- Making gardens more attractive to wildlife and pollinators, resilient to changing weather conditions and water shortages, and creating allotments on underused land to grow local food
- Protecting infrastructure from extreme weather such as heatwaves, floods or storms or moving it away from areas of risk

Most of these measures can be applied to new and existing buildings and even heritage sites with appropriate care in design, planning and implementation.



View out to the coast from the agricultural lowlands. Cadwyn Clwyd.

Understanding your role, responsibilities and options

Everyone has a role to play in tackling climate change. Getting it right will need the understanding, enthusiasm and involvement of all those living or working locally. Dialogue and partnership working will be important in addition to the actions of individual stakeholders. Progress is being made, but more needs to be done.

Farmers and land managers

Farmers and land managers have a critical role to play because of their importance to the local economy and their influence over large areas of the landscape. As a result, their response to climate change will affect communities and the wider environment across the AONB and beyond, whether or not they take action to adapt.

Adaptation will include making farms and uplands more resilient to changing weather patterns and responding to new business opportunities. Opportunities include growing new food or energy crops, meeting increasing demand for outdoor leisure activities, harvesting timber for fuel or generating renewable energy. Some could use marginal land, making land holdings more productive.

Some of these actions will also enable surrounding communities and the wider environment to adapt. In addition, farmers and land managers can support a catchment-wide approach to flood risk and water management, connect and enhance habitats for wildlife, and ensure reliable local food supplies.

Farming and land management also have an important influence on the carbon cycle. There are various ways that farmers and land managers can reduce their greenhouse gas emissions and store carbon in soils and vegetation, including trees.

It will be important to take a long-term view of the landholding or farm, to plan changes in management practices that protect soils and maintain productivity while conserving natural resources. Coordinating actions with neighbouring farms is also encouraged.

The Farming Futures website provides advice on how farmers and land managers can reduce their impacts on the climate and adapt. Farming Connect also offers related guidance. Financial support is available from the Welsh Government's Glastir scheme.

The Farmers Union for Wales has a position statement on climate change, and the National Farmers Union has information about climate change on its website. The National Trust has also published research and good practice which could benefit other landowners.

Forestry and woodland managers

Forestry and woodland management will face numerous challenges as a result of climate change, including changes in the suitability of the climate for different species, damage from extreme weather, drought and waterlogging, and changing pests and diseases.

Trees, and the way that we manage forests and woodlands, are also an important part of how we respond to climate change. For example, they store carbon, offer an alternative source of fuel and materials, provide habitat and shelter, stabilise slopes and riverbanks, reduce erosion, and help to absorb rainwater and manage flood risk.

Woodlands for Wales, the Welsh Government's 50 year strategy for woodlands and trees, describes how they can be help in the fight against climate change. Long-term planning will be essential if we are to achieve resilience and make the best use of resources.

Increasing the area of tree and woodland cover will be important, both in the countryside and the built environment. Tree planting should work with the character and contours of the landscape, for example by softening and creating a more natural edge to forests and woodlands. Avoiding clearfelling and encouraging a more diverse mix of tree species, ages and origins will also help to make forests and woodlands more resilient.



Natural Resources Wales is already adopting these practices for its own forests and woodlands, and offers guidance to other woodland managers on what they can do. The Glastir scheme provides funding for woodland creation and management. Advice is also available from Coed Cymru.



Planners and policymakers

It is essential that planners and policymakers understand the AONB, its importance to the surrounding region, and the significance of climate change for the local economy, communities and the environment. This will enable sustainable, long-term decision-making and the development of appropriate policies and strategies.

The challenges of climate change and many of the solutions transcend political boundaries. A coordinated, partnership approach will be needed, with local authorities, the AONB partnership, Welsh Government, Natural Resources Wales, and other relevant organisations and individuals working together. Suitable funding and enabling mechanisms will also need to be identified.

Planners and policymakers have a role to play in supporting and guiding the action of others to tackle the causes and consequences of climate change. This includes setting policy and strategy, creating incentives and providing information and advice.

The Climate Change Strategy for Wales and Planning Policy Wales set a national framework for action, supported by the Natural Environment Sectoral Adaptation Plan and the Natural Resource Management approach. The priorities for the Clwydian Range and Dee Valley are set out in the AONB Management Plan.

The relevant local authorities describe their preferred approach in their own plans and strategies. These include managing flood risk in partnership with Natural Resources Wales, supporting renewable and low carbon energy development, setting high standards for new buildings and encouraging improvements to existing buildings, while conserving and enhancing the natural beauty of the AONB.

These organisations are also reducing carbon emissions from their own facilities and services and adapting them to cope with climate change. This includes improving energy and water efficiency, using renewable energy, and managing land holdings appropriately. Public sector bodies are also responsible for minimising disruption to their services in extreme weather and coordinating emergency response.

Residents and businesses

Local residents and businesses can reduce their own impacts on the climate and adapt their properties and activities. They can also work with others on community projects or support the actions of other organisations, for example by contributing to the planning process or investing time and money in local projects.

Options for buildings, gardens and infrastructure are set out in the built environment section. The priority will be to protect properties from flooding in places at risk. Saving water is also worthwhile, particularly if the property has a water meter. Other measures, such as shutters for windows, could be fitted later.

Everybody can use less energy, for example by turning the heating down or installing insulation and double or triple glazing. Incentives like the Green Deal can help to cover the upfront costs. Walking, cycling, using public transport and driving less will also help. As well as reducing carbon emissions, these actions will save money.

Renewable energy can be used for suitable buildings, including solar panels, wood boilers, heat pumps, or a green electricity tariff if there are no other options. The Feed-in Tariff and Renewable Heat Incentive mean that generating your own energy can also generate a profit. Many communities are working together to



invest in larger projects such as micro hydropower, wind turbines or renewables for community buildings.

Most of these measures can apply to existing or new buildings, provided planning permission and other consents are obtained if needed. Many can even apply to historic buildings, although more care will be needed in design and installation. Cadw has published research and guidance on climate change and heritage, while the National Trust in Wales has won an award for improving energy efficiency and generating renewable energy at its own properties.

The Energy Saving Trust, local authorities and the North Wales Energy Advice Centre in Mold provide support and advice for local people and businesses.

Further information

There is a wealth of freely available information about climate change, how to adapt to it, and what you can do to reduce the impacts of your own activities. A number of organisations offer advice and support, including those listed here.

- The Clwydian Range and Dee Valley AONB
www.clwydianrangeanddeevalleyaonb.org.uk
- Local Authorities
www.denbighshire.gov.uk
www.flintshire.gov.uk
www.wrexham.gov.uk
- Cadwyn Clwyd
www.cadwynclwyd.co.uk
- Natural Resources Wales
www.naturalresourceswales.gov.uk
- The Welsh Government
www.wales.gov.uk
- The UK Climate Impacts Programme
www.ukcip.org
- The UK Climate Projections
www.ukclimateprojections.metoffice.gov.uk
- Climate UK
www.climateuk.net
- Farmers' Union of Wales
www.fuw.org.uk
- National Farmers' Union (NFU) and NFU Cymru
www.nfonline.com, www.nfu-cymru.org.uk
- Farming Futures
www.farmingfutures.org.uk
- Coed Cymru
www.coedcymru.org.uk
- Energy Saving Trust
www.energysavingtrust.org.uk/wales
- Cadw
www.cadw.wales.gov.uk
- National Trust
www.nationaltrust.org.uk



**Bryniau Clwyd a
Dyffryn Dyfrdwy**
Clwydian Range
and Dee Valley

Ardal o Harddwch Naturiol Eithriadol
Area of Outstanding Natural Beauty



*Asiantaeth Datblygu Gwledig
Rural Development Agency*



Cronfa Amaethyddol Ewrop ar gyfer Datblygu
Gwledig Ewrop yn Buddsoddi
mewn Ardaloedd Gwledig
The European Agricultural Fund for
Rural Development: Europe Investing in
Rural Areas



**Llywodraeth Cymru
Welsh Government**