Cyfoeth Naturiol Cymru
Natural Resources Wales

Communicating landscape change from adaptation and mitigation in a changing climate

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White Consultants, Charlie Falzon Associates.

Report No 396

www.naturalresourceswales.gov.uk

About Natural Resources Wales

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We will realise this vision by:

- Maintaining and developing the technical specialist skills of our staff;
- Securing our data and information;
- Having a well-resourced proactive programme of evidence work;
- Continuing to review and add to our evidence to ensure it is fit for the challenges facing us; and
- Communicating our evidence in an open and transparent way.

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Report number:	396
Publication date:	March 2020
Contract number:	JMB/LANDMAP/Climate
Contractor:	White Consultants: Environment Ltd
Contract Manager:	Jill Bullen
Title:	Communicating landscape change from adaptation and mitigation in a changing climate.
Author(s):	**White, S., Falzon, C., Bell, H.**
Restrictions:	None

Recommended citation for this volume:

White, S., Falzon, C., Bell, H. 2020. Communicating landscape change from adaptation and mitigation in a changing climate. NRW Report No: 396, 125 pp, Natural Resources Wales, Bangor.

Contents

List of Figures

List of Tables

1. Crynodeb Gweithredol

Mae'r newid yn hinsawdd Cymru yn debygol o gael effeithiau sylweddol yn uniongyrchol (e.e. newid o ran gorchudd tir) ac yn anuniongyrchol (e.e. drwy ddylanwadu ar benderfyniadau ynghylch defnydd tir) ar gymeriad, priodweddau ac arbenigrwydd lleol y dirwedd. Mae digwyddiadau llifogydd a sychder, tywydd eithafol amlach, erydiad arfordirol, tanau gwyllt, clefydau sy'n effeithio ar orchudd coed yn ogystal â newid i orchudd tir, cynefinoedd a dosbarthiad rhywogaethau yn enghreifftiau o sut y gallai'r dirwedd newid i raddau mwy neu lai, yn y tymor byr neu hir.

Gallai mesurau addasu er mwyn mynd i'r afael ag effeithiau newid yn yr hinsawdd eu hunain effeithio ar gymeriad, priodweddau ac amwynder gweledol y dirwedd. Er enghraifft, gallai caniatáu llifogydd dan reolaeth mewn gorlifdiroedd mwy gyda chynnydd mewn llystyfiant lled-naturiol newid cymeriad rhai lloriau dyffrynnoedd a gallai plannu rhywogaethau mwy gwydn o goed i gymryd lle rhywogaethau llai hyblyg newid cymeriad rhai ardaloedd coediog.

Mae newidiadau amlwg i'r dirwedd hefyd yn debygol o ddod i'r amlwg yn sgil mesurau lliniaru, fel cynhyrchu ynni adnewyddadwy, yn enwedig gwynt a solar, a'r bwriad i ehangu coetiroedd ar gyfer dal a storio carbon.

Yng Nghymru, mae LANDMAP yn adnodd allweddol o ran tystiolaeth am dirwedd lle mae nodweddion, priodweddau a dylanwadau ar y dirwedd yn cael eu cofnodi a'u gwerthuso er mwyn creu set ddata sy'n gyson yn genedlaethol. Mae LANDMAP wedi cael ei ddefnyddio fel yr adnodd sylfaenol ar gyfer ystyried sut y gallai hinsawdd sy'n newid effeithio ar y dirwedd.

Yng nghyd-destun presennol ymatebion polisi i newid yn yr hinsawdd a chyhoeddi Argyfwng Hinsawdd, mae mesurau addasu a lliniaru posibl wedi'u cysylltu ag 14 math o dirwedd. Mae'r rhain yn nodi newidiadau yn y dirwedd a newidiadau gweledol a sut y gallai'r rhain effeithio ar gymeriad a phriodweddau'r dirwedd hyd at 2050. Mae'r ardaloedd yn cynnwys ucheldir ac iseldir agored a choediog, ymylon arfordirol, ardaloedd adeiledig a dŵr.

Mae'r adroddiad yn adeiladu ar astudiaeth Rhan I a nododd effeithiau posibl oherwydd newid yn yr hinsawdd. Yn yr adroddiad Rhan II hwn, nodir y cyd-destun, y canllawiau a'r cyngor cyffredinol yn yr adran ragarweiniol ac yna trafodir pob math o dirwedd yn ei dro. Mae'n rhoi crynodeb o'r cymeriad presennol a'r newid tebygol sy'n deillio o Ran I, mesurau addasu a lliniaru posibl a gwybodaeth gefndirol am werth, dosbarthiad y mathau o dirwedd a pherygl llifogydd.

2. Executive Summary

The changing climate of Wales is likely to have significant direct (e.g. changing land cover) and indirect (e.g. by influencing land use decisions) impacts on landscape character, quality and local distinctiveness. Flooding and drought events, more frequent extreme weather, coastal erosion, wildfires, diseases affecting tree cover and changing land cover, habitats and species ranges are examples of how the landscape may change to a greater or lesser degree, in the short or long term.

Adaptation measures to address the effects of climate change in themselves may have an effect on landscape character, qualities and visual amenity. For example, allowing controlled flooding in larger floodplains with an increase in semi-natural vegetation may change the character of some valley floors and planting more resilient tree species to replace less adaptable species may change the character of some wooded areas.

Marked landscape changes are also likely to be evident from mitigation measures, such as renewable energy generation, especially wind and solar, and the planned expansion of woodland to sequestrate carbon.

In Wales, LANDMAP is a key landscape evidence resource where landscape characteristics, qualities and influences on the landscape are recorded and evaluated into a nationally consistent data set. LANDMAP has been used as the baseline resource to consider how a changing climate may impact upon landscape.

In the current context of policy responses to climate change and a declared Climate Emergency potential adaptation and mitigation measures have been associated with 14 landscape types. These identify landscape and visual changes and how these may impact upon landscape character and qualities to 2050. The areas include open and wooded uplands and lowlands, coastal edge, built up areas and water.

The report builds on a Part I study which identified potential climate change effects. In this Part II report, the overarching context, guidance and advice is set out in the introductory section and then each landscape type is addressed in turn. This sets out a summary of existing character and likely change derived from Part I, possible adaptation and mitigation measures and background information on value, the distribution of landscape types and flood risk.

3. Introduction

3.1. Introduction

Natural Resources Wales (NRW) appointed White Consultants in October 2019 to prepare this report entitled 'Communicating landscape change from adaptation and mitigation in a changing climate'. This follows on from Part I of the study 'LANDMAP, Landscape and a Changing Climate' by Berry, R., Dwyer, J., Gaskell, P., Lake, J., Powell, J. and Young I, published in March 2019 (https://cdn.naturalresources.wales/media/688626/eng-landmap-landscape-and-a-changing-climate.pdf?mode=pad&rnd=131989289330000000), which identifies the direct and indirect impacts of projected climate change by 2050 on the landscape characteristics and qualities that we recognise today in Wales. It organises the analysis into the effects on 14 LANDMAP landscape types (LMP_14).

This Part II report identifies potential adaptation and mitigation measures and the resulting landscape and visual changes and how these may impact upon landscape character and qualities. This is the focus of the study.

The brief sets out the following objectives:

- Communicate place-related adaptation and mitigation action linked to landscape types to 2050.
- Help visualise what landscape change might look like with adaptation and mitigation interventions in place in the landscapes we are familiar with set in a context of policy responses to climate change and a declared Climate Emergency.

3.2. Relationship with Sustainable Management of Natural Resources (SMNR)

The Environment Act (Wales) 2016 defines sustainable management of natural resources (SMNR) as 'using natural resources in a way and at a rate that maintains and enhances the resilience of ecosystems and the benefits they provide.'

This report is intended to inform relevant SMNR principles as set out by NRW, namely:

- Scale – considering the appropriate spatial scale for action
- Evidence- providing evidence to inform actions
- Multiple benefits – taking into account the benefits and intrinsic value of the landscape and visual component of natural resources and ecosystems
- Long-term – taking account of the short, medium and long-term consequences of actions
- Preventative action – taking action to prevent significant damage to ecosystems
- Building resilience – taking account of the resilience of ecosystems taking into account diversity, connections, scale, condition and adaptability.

3.3. Summary of likely changes in Wales by 2050

Climate change predictions for Wales to 2050 are summarised in terms of these four basic scenarios of climate change:

- Warmer mean temperatures, average annual temperatures are projected to increase by 2.3^{0} C
- Hotter, drier summers, daily maximum temperatures are projected to increase by 3.4 ^{0} C
- Warmer wetter winters/wetter summers, rainfall is projected to increase in winter on average by 14% and decrease in summer by 16%
- More frequent extreme weather

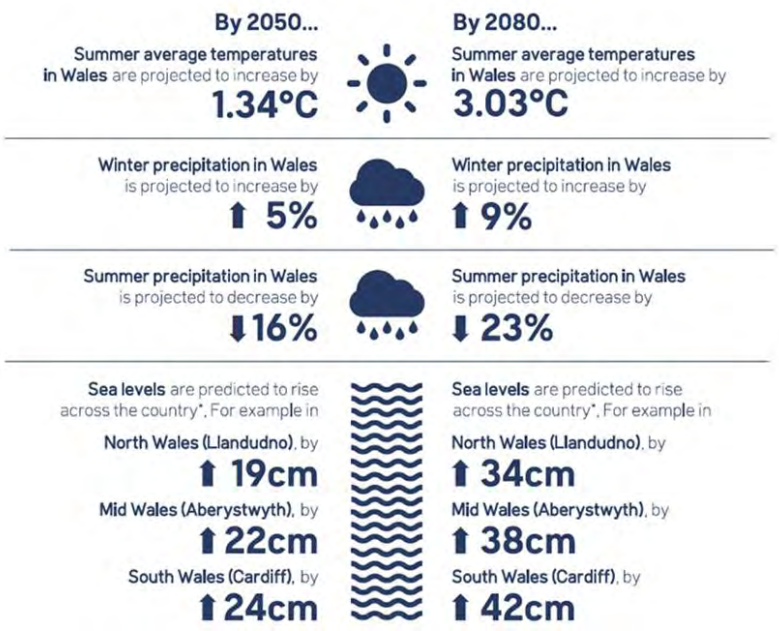

Figure 1 Climate change projections by 2050 and by 2080 for Wales
(Source: Welsh Government (2), 2019)

Each of these scenarios have the potential for the following direct outcomes:

- Rise in sea levels
- Longer growing season
- Migration of pests, invasive species and diseases
- Drying out, desiccation and erosion of wetlands and soils
- Stress on some trees and plants
- More flooding events
- Frequent high winds/storms
- Wild fires

3.4. Definitions for adaptation and mitigation

Definitions for adaptation and mitigation (IPCC, 2014) are as follows:

- **Adaptation** is defined as the process of adjustment to actual or expected climate and its effects in order to either lessen or avoid harm or exploit beneficial opportunities.
- **Mitigation** is defined as the process of reducing emissions or enhancing sinks of greenhouse gases (GHGs), so as to limit future climate change.

3.5. Guidance and advice

Landscape and seascape- related advice should be taken into account to ensure that measures integrate as far as possible and/or contribute positively to character. This will vary depending on the landscape type and are as follows for terrestrial types:

- LANDMAP data at a more detailed level within each type. Consider visual and sensory aspects as a priority but ensure that other aspects, particularly the landscape habitats and historic landscape aspects are considered.
- National planning policy and guidelines including woodland, biodiversity, green infrastructure and flood management.
- Peatland Code which is a voluntary standard issued by the IUCN UK National Committee.
- NRW Area Statement principles.
- NRW SoNaRR1 (NRW, 2016) including opportunities for tree planting to reduce flood risk.
- NRW regulations and regulatory guidance to works in any main river, watercourse or waterbody.
- National Park and AONB management plan policies and guidelines where relevant. Consider the relevance of such policies in areas adjacent to designated landscapes.
- Local authority policy and guidelines especially in relation to renewable energy and to land allocation.
- Glastir and future single Sustainable Farming Scheme to optimum levels to promote biodiversity and water/flood management whilst reflecting the productivity of the land.
- Best-practice guidance on making woodlands more resilient. (See *www.naturalresources.wales/guidance-and-advice/environmental-topics/woodland-management/planning-for-the-future/making-woodlands-more-resilient/?lang=en*)

For marine and coastal types the following guidance/advice should also be taken into account in addition to the guidance above:

- Welsh National Marine Plan, the national strategy for flood and coastal erosion risk management, flood risk management plans, and shoreline management plans.
- Seascape character information at both the national level of marine character areas and NRW offshore wind sensitivity study, and where available, local seascape character assessments. These have been published by Natural Resources Wales

(https://naturalresources.wales/evidence-and-data/maps/marine-character-areas/?lang=en).

3.6. Overview of the Welsh landscape

Part I of the LANDMAP climate change study (Berry, R. et al, 2019) divides the Welsh landscape into 14 broad LANDMAP types called LMP14 landscapes. The process for deriving and classifying these is set out in the Part I report (page 153, 8.1). The types are illustrated in the summary map, Figure 2, showing the NRW operational areas (derived from the Part 1 report).

Key national level statistics related to LANDMAP Visual and Sensory value and flooding vulnerability to climate change are set out in Table 1. These are in the order that each type is considered in this report rather than the Part 1 report order.

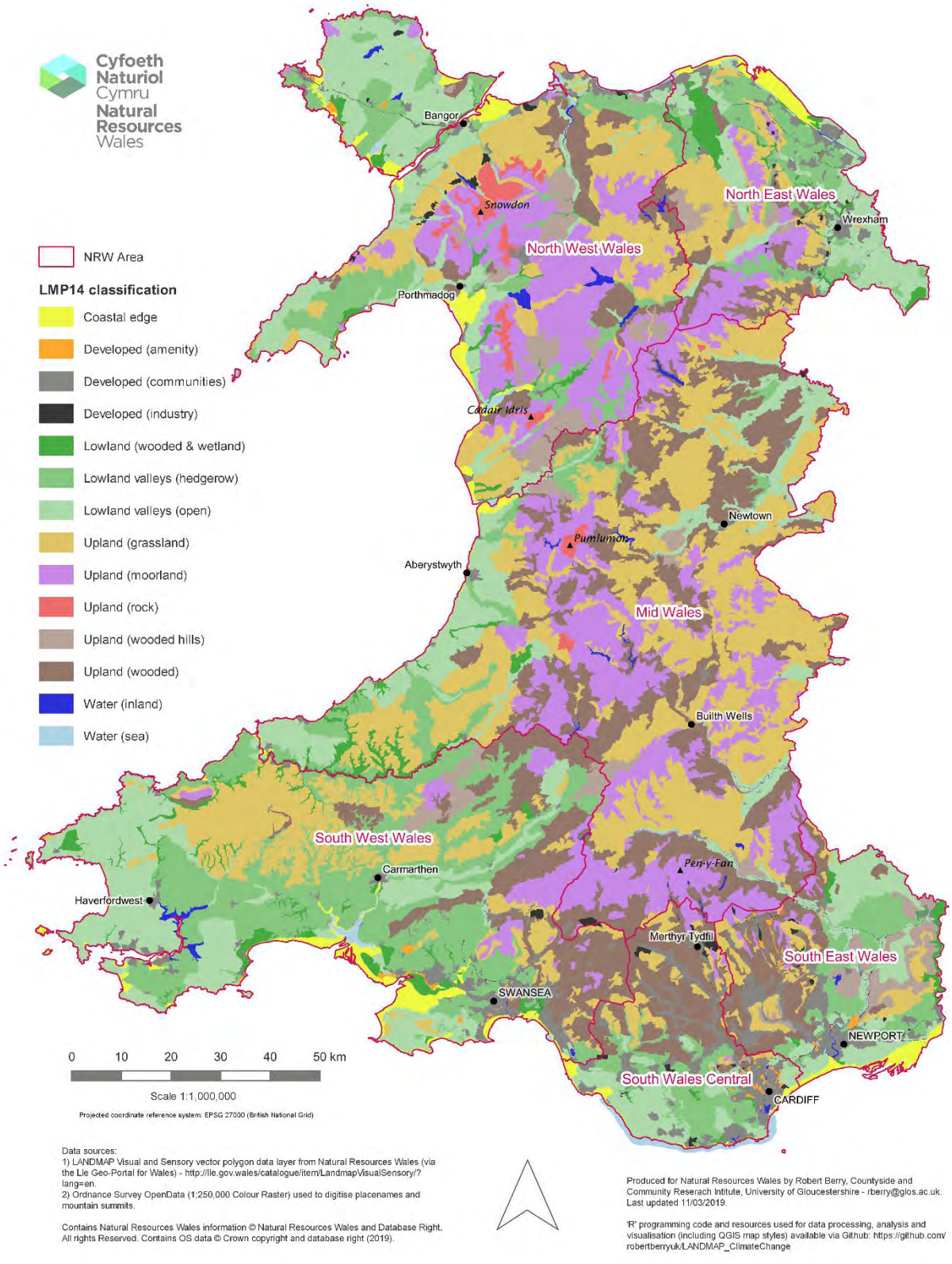

Figure 2 LMP14 landscape classification with NRW Operating Areas

Table 1 Summary table of selected national-level statistics for LMP14 landscapes

LMP14 number Prefixed by LMP14_	LMP14 Landscape Type	Area (% total Wales)	<=1m ASL % total area within each LMP14 Type	Flood Zone 2 (% total area within each LMP14 Type)	Flood Zone 3 (% total area within each LMP14 Type)	Landscape Value (% total area within each LMP14 Type)			
						Low	Moderate	High	Outstanding
1	Upland (wooded)	15.73	0.01	2.26	1.91	2.97	45.32	45.96	5.75
2	Upland (moorland)	14.44	0	0.54	0.48	2.85	10	52.85	34.31
3	Upland (rock)	0.81	0	0.34	0.28	0	0.66	0.06	99.28
4	Upland (grassland)	23.17	0.01	2.44	2.11	0.59	62.29	35.3	1.82
5	Upland (wooded hills)	3.26	0	1.11	0.96	6.14	34.73	55.09	4.05
6	Lowland valleys (hedgerow)	15.03	0.06	5.28	4.38	0.27	52.72	40.55	6.46
7	Lowland valleys (open)	16.59	0.34	17.82	16.24	1.11	66.14	28.16	4.58
8	Lowland (wooded & wetland)	2.37	3.53	19.5	17.24	2.01	16.81	71.31	9.88
9	Coastal edge	2.45	50.94	60.32	59.22	0	8.45	56.44	35.12
10	Developed (communities)	4.47	0.5	16.8	12.75	0	0	0	0
11	Developed (amenity)	0.24	1.28	25.26	20.96	20.29	68.27	8.5	2.93
12	Developed (industry)	0.43	0.31	5.07	4.02	78.7	5.75	13.72	1.83
13	Water (sea)	0.51	44.59	64.39	64.26	0	0	19.52	80.48
14	Water (inland)	0.5	13.83	78.08	75.57	0	29.46	29.27	41.27

3.7. Structure of the report

The report is structured by LMP_14 type in numerical order considering:

- Existing summary and characteristics
- Summary of change and objectives to support positive landscape character in future
- Adaptation to the outcomes of climate change
- Mitigation actions to eliminate or reduce emissions and conserve biodiversity
- Key facts and comments on value, spread of landscape types and flood risk.

4. Landscape Types adaptation and mitigation measures

LMP14_1 Upland (wooded)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises of hillsides, scarp slopes and plateaux with more than 50% of woodland cover, with a significant proportion of coniferous plantations. Its highest concentration is to the south of the Brecon Beacons National Park on the tops of the South Wales valleys but it occurs in large blocks in mid Wales (e.g. Tywi Forest, Dyfnant Forest) and north Wales (Clocaenog), where it is closely associated with upland areas. The type comprises 15.7% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Woodland is dominated by post-1919 plantations, mainly coniferous, with ancient woodland being concentrated in narrow valleys and with some 18th-19th century plantations.
- Extensive afforested areas comprising large blocks of conifer, often angular in design, contrast with adjacent moorland and upland grassland, as well as with deciduous woodland fringes on steep hillsides and hilltops.
- The intervening open landscape is now characterised by high levels of stocking for sheep with limited arable cultivation, and rare surviving patches of semi-natural grazing land intermixed with enclosed farmland.
- This landscape is largely enclosed (87%), mostly by a mixture of boundaries including stone walls, managed hedges, hedgerows with trees, and fences.
- Low levels of dispersed settlement dominated by small-scale farmsteads and linear settlements, which developed to serve cattle rearing and sheep-grazing economies.
- Contrast of texture and colour, with woodlands close to key population centres (e.g. South Wales valleys) in landscapes previously visually dominated by industry, often integrating reclaimed sites into the woodland.
- Seasonal colour is apparent in areas of older woodland, in areas of recently introduced broadleaved species, and where larch is still present although evergreen conifers continue to dominate.

LMP14_1 Upland (wooded)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to maintain and possibly increase tree cover overall, increasing native broadleaf woodland as well as mixed woodlands, but remove trees from former peaty soils as part of schemes to reinstate peat bogs. In places, a regime of coppicing and the introduction of biomass may be appropriate. Large areas within this landscape type are put forward as a priority area for wind energy. This will need to be located and designed to minimise landscape and visual impacts especially on national designated landscapes and settlements nearby. Micro-hydro systems may be appropriate where they can be integrated and do not impact adversely on ecosystems. Informal recreation such as walking and cycling should continue to be enhanced increasing existing networks.

LMP14_1 Upland (wooded)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by drought conditions brought about by hotter drier summers, and the effects of pests and diseases from an overall increase in average temperature. Some changes to species may occur, with less Sitka Spruce in the south and eastern areas and on well drained and south-facing slopes, and more mixed forestry with species targeted on areas with specific favourable conditions.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
The main changes are related to the impacts of pests and diseases and the longer growing season resulting from warmer temperatures. There may be some change in the mix of species as some are more susceptible to drought, disease and pests, including a reduction in some broadleaved species such as oak and ash in upland areas.	Introduce primarily drought and disease resistant native tree species with mixed woodland in places. Ensure that introductions do not bring the risk of new strains of disease and promote diversity. Consider the role of soils in the transmission of disease, e.g. avoid heavy, poorly drained soils in the case of *Phytopthera ramorum.* Allow natural regeneration of woodland and other areas to allow scrub and ultimately trees to establish to optimise the diversity of species and resistance to disease. Use and develop techniques to speed up natural regeneration such as planting small numbers of trees to encourage birds to perch drop seeds. Changes to character are likely to be a less continuous broadleaf woodland cover with the loss of ash and some oak but an increase in diversity as other resilient species establish. In the longer term (50 years +) genetic resistance in native tree species will allow for further regeneration. Larch woodlands will be largely lost and replaced with mixed woodland/plantation giving a more diverse appearance. Shrubs such as juniper may thrive in drier conditions.
The most significant decline is likely to be Sitka spruce which prefers moist and wet conditions. Changes in the wetter western part of Wales might not be so great but drier summer conditions will see a reduction of areas suitable for Sitka Spruce in the south and eastern parts of the country.	Reduce/remove Sitka Spruce when ready for harvesting and replace with a wider variety of species, mainly deciduous, in drier areas. Redesign planting to reflect topography and soften woodland edges with a variety of shrub and broadleaf species. Ensure that planting allows for broadleaves along riparian corridors and spaces for wetland and other habitats. See UK Forestry Standard (UKFS) guidelines for landscape. There will be a reduction in area of monoculture conifer plantations and more diverse tree and plant cover. Colour and texture will be more varied, and

	the dark green and straight edges of plantations will be reduced over time through Forest Resource Planning.
Plant communities may alter as tree species composition changes and there are higher levels of disturbance (e.g. through wildfire).	Reduce fire risk by including firebreaks and where possible cut back gorse, bramble and bracken, especially in proximity to woodland edges. New woodland planting needs to have designed-in fire risk mitigation especially close to built up areas Block drains to maximise moisture retention and to minimise the risk of undergrowth and peaty soil fires. Reduce/remove monocultural coniferous woodland, and introduce a mix of deciduous and coniferous woodland species. Provide corridors in a variety of habitats, including watercourses and wetlands and glades and rides within woodland. Potentially there will be a significant seasonal change in colour and texture, as well as in the shape of woodland and in the way it reflects the topography of its setting. An increase in woodland will reinforce one of the area's key characteristics.
Main outcome 2	
Surface water is likely to decrease and will be less visible in the hotter drier summers. There will be a reduction in soil moisture and upland bog areas in the summer months.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Where soil desiccation occurs, buried archaeological remains may be exposed and at risk of rapid deterioration. New archaeological assets may be revealed by soil parching.	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management. Any change in landscape character is likely to be minimal
Surface water is likely to decrease and will be less visible in the hotter drier summers. There will be a reduction in soil moisture in the summer months.	Increase trees and semi-natural vegetation in riparian corridors and in headwaters areas/slopes to control fast runoff and smooth out flows. Increase measures such as leaky dams, straw bale dams, willow and other tree structures to increase water retention. Dredge ponds and lakes to a range of depths where appropriate to increase resilience to drying up whilst still supporting biodiversity including marginal and other aquatic vegetation. Fence off watercourses in places. There may be an increase in tree cover and semi-natural vegetation related to water bodies within the landscape type.

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Reduce/remove monocultural coniferous woodland, and introduce a mix of deciduous and coniferous woodland species. Provide corridors in a variety of habitats, including watercourses and wetlands and glades and rides within woodland. Allow natural regeneration of woodland and other areas to allow scrub and ultimately trees to establish to optimise the diversity of species and resistance to disease. (*Above Pantperthog, Gwynedd)*

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Increase trees and semi-natural vegetation in riparian corridors and in headwaters areas/slopes to control fast runoff and smooth out flows. (*Above Parson's Bridge, Ceredigion).*

LMP14_1 Upland (wooded)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Construct wind turbines on technically feasible sites in line with policy avoiding land with vulnerable biodiversity, including broadleaf woodland, nationally designated and other sensitive landscapes and heritage assets and their settings.	This landscape type occurs in many priority areas for wind energy. This type of development would be most likely on plateau and wide ridge tops and necessitate clearing of surrounding coniferous forestry which would increase openness and create new patterns locally and overall would be widely visible. Increased sizes of arrays and heights of turbines would result in a major change in character and extent of intervisibility as well as the potential for cumulative effects on sensitive receptors.
Increase instream hydro-electric power avoiding watercourses with significant biodiversity interest and landscape features such as waterfalls in visited areas .	Built structures on watercourses modify their natural character and form potential barriers to movement of wildlife, including fish. Small-scale, discreet structures, potentially reflecting local character and integrated by appropriate native riparian vegetation may be appropriate.
Increase biomass - short rotation sweet chestnut, alder, willow, birch, sitka spruce.	The pattern of tree cover would be changed, reducing the height of tree growth and introducing a faster cycle of cropping, leading to more diversity

	and openness (compared to permanent woodland).
Action	**Potential effect on landscape character, qualities and visual amenity**
In small intervening areas of pasture, reduce livestock numbers in order to minimise methane emissions and ammonia. Change grazing regimes. Introduce breeds less likely to emit methane.	Pastures will appear less intensively used and smaller in area increasing semi-natural character. Some ungrazed areas will eventually run to scrub and to woodland. In others, alternative management decisions e.g. to opt for biomass, will increase diversity of character and enclosure (compared to pasture).
Introduce silvopasture system combining shrubs, trees and grasses to improve carbon sequestration compared to pasture.	This land use would result in a more enclosed and textured and thus may appear out of character compared to better defined traditional field and woodland patterns.
Increase planting of primarily native resilient trees/woodland on a phased basis to sequester carbon and mitigate run off. Avoid planting on peaty soils.	As woodland blocks expand and coalesce, the sense of enclosure could be markedly reinforced. There may be also be changes to character as trees and woodland composition change.

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Consider large scale wind energy development in plateau forest plantation.The size of turbine and array should respond to the scale and pattern of landform and landcover and be set back from the skyline wherever possible. Cumulative effects on sensitive receptors including communities would need to be taken into account. (Pen y Cymoedd).

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Reduce/remove Sitka Spruce when ready for harvesting and replace with a wider variety of species, mainly deciduous, in drier areas. Redesign planting to reflect topography and soften woodland edges with a variety of deciduous and shrub species. (Near Pennal, Gwynedd).

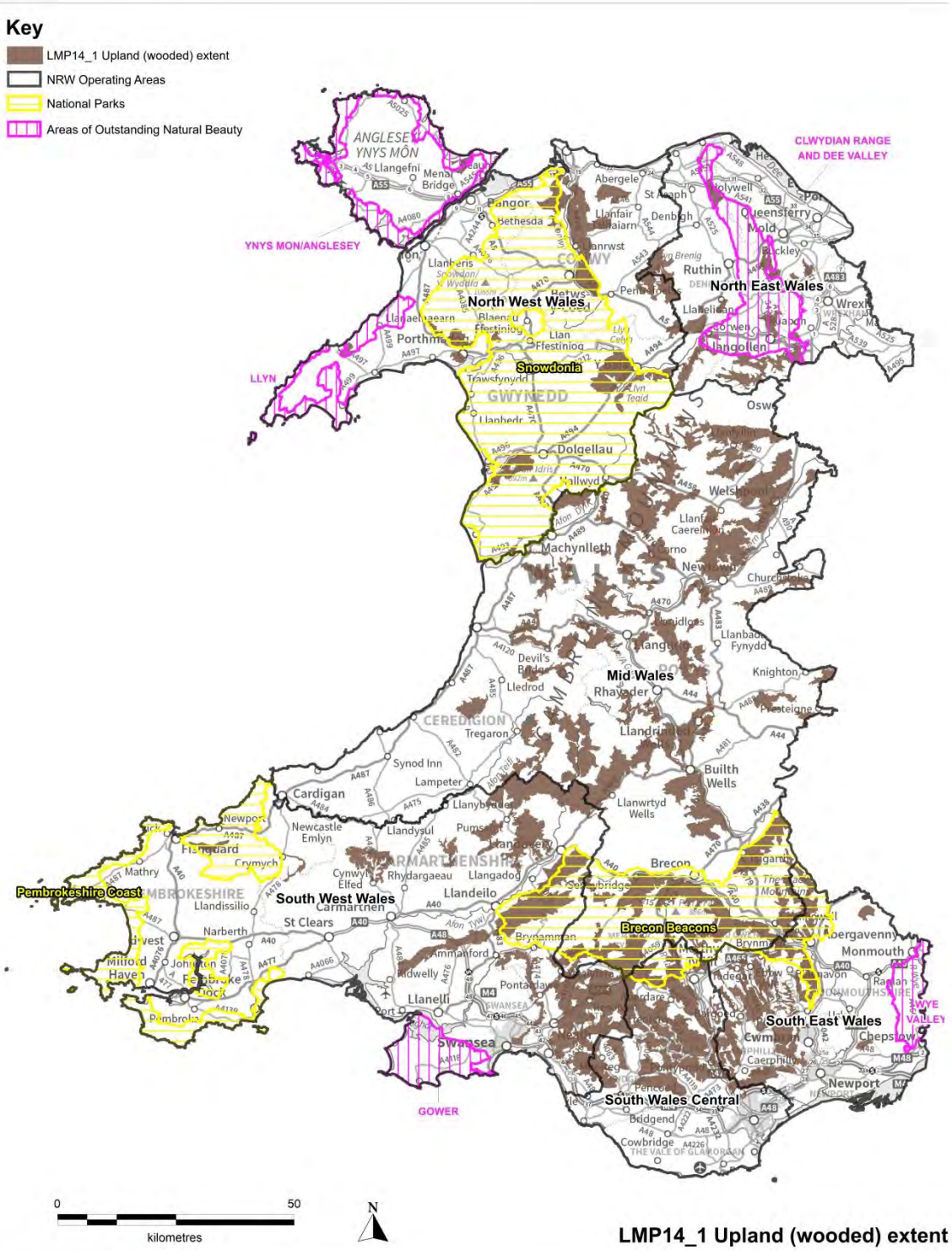
LMP14_1 Upland (wooded)			
KEY FACTS and comments			
Overall area (km^2)	3344	***Area** (% of Wales)*	16
Landscape value (%)			
Low	*Moderate*	***High***	***Outstanding***
3	45	46	6
Comment	Just over half of this landscape type is considered to be of high or outstanding value. There is an equal proportion of mainly moderate value. This indicates a significant potential for increasing value with a change of land management away from blanket coniferous plantation towards a more varied, woodland cover with a high proportion of deciduous broadleaves.		
National Parks (% of area)		**AONBs** (% of area)	
17.4		5.5	
Comment	This type is associated with the upland National Parks, especially Brecon Beacons but also Snowdonia, often forming the fringes to the Upland moorlands and interspersed with the upland grassland. A small area lies in and around the Clwydian Range and Dee Valley AONB. Improvement of character is particularly important in these areas.		

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	23	1944	The greatest extent of this landscape type is found in Mid Wales (almost twice as much coverage as the next greatest, South West Wales). The greatest percentage occurs in South Wales Central.
North East Wales	9	219	
North West Wales	8	409	
South East Wales	20	383	
South Wales Central	30	560	
South West Wales	17	1000	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	There is minimal risk from sea level rise. There is some risk in a few discrete areas as a result of fluctuations in runoff from storm events and winter rainfall. Measures are needed to reduce runoff to avoid flooding in downstream lowland areas.
0	2.3	1.9	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_2 Upland (moorland)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type consists of upland, hillside & scarp slopes, and hill and lower plateau moorland with a variety of habitats including tussocky grass, heather, scrub and bracken. It is strongly represented in Snowdonia/Eryri National Park and Brecon Beacons National Park, and is particularly evident in the Berwyn and Cambrian Mountains. This landscape type comprises just over 14% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Largely open and unenclosed landscapes with an upland moorland character, extensive views, open horizons and skylines. Where enclosures occur, they tend to be large-scale and regular, sometimes associated with the establishment of new farms in the late 18th and 19th centuries.
- Considerable variety, ranging from the very dry, rocky limestone pavements in southern parts of Brecon Beacons, the deep peaty heather-clad hags of Y Berwyn, to the long tussocky grasslands and bogs of the Cambrian Mountains.
- Noticeable changes in seasonal colour and texture from heather, bracken and semi-natural vegetation, the result of centuries of use as grazing and resources for surrounding communities.
- Generally sparse tree cover except for the intervening large-scale post-1919 Forestry Commission plantations in geometric blocks, contrasting with moorland vegetation. Historic woodland in valleys retaining evidence of timber and fuel exploitation.
- Extensive traces of prehistoric archaeology, relict industrial mineral mining, quarrying and 20th century military activity. This landscape contains some of the best evidence for prehistoric settlement and land use in Wales.
- Settlements are infrequent, and are mostly confined to moorland fringes. These include smallholdings and medieval and later farms with stone-built traditional architecture.
- Plentiful evidence of transhumance and droving, including droveways, tracks running out to open moors, and the remains of ‘hafodau’ or summer farms.
- Notably tranquil with a sense of remoteness and exposure, associated with low levels of night time light pollution.
- Decline in traditional use of moorland has resulted in scrub and vegetation growth, which threatens the ecological interest of this landscape type. The traditional use of upland moorland has declined since the 19th century, as its use as amenity land and forestry has increased.

LMP14_2 Upland (moorland)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

Given its high to outstanding value, the key objective is to maintain and enhance the existing moorland landscape and, in particular, peatlands. This will include ensuring that carbon capture and water carrying capacity to help mitigate flooding downstream is maximised, and that the type continues to provide a rare wildlife habitat. Smaller plantation forestry blocks within the type should be removed, where beneficial for peatland restoration with added landscape improvement. Other tree growth should be removed where it is detrimental to high conservation value habitats and important historic assets. Development that significantly impacts on the extensive views that

this landscape offers should be discouraged although a balance with windfarm development will need to be struck. A balance with maintaining and improving the function and health of peatlands would also need to be carefully considered. Appropriate techniques should be applied for maintaining optimal conditions on the various types of upland moorland, including grazing, cutting, scrub removal and the management of drainage including blocking.

LMP14_2 Upland (moorland)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by hotter, drier summers altering surface water conditions and leading to changes in plant communities. Warmer mean temperatures are also likely to increase the length of the growing season and potentially increase threats from invasive species.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Warmer temperatures will create more favourable conditions for grasses and shrubby vegetation to grow at higher elevations, leading to possible upward movement of the moorland line.	Control scrub and Molinia by cutting and appropriate grazing by cattle or other suitable livestock. Block drains to maximise moisture retention to optimise the peatland habitat and minimise the risk of erosion. Restore to wet heath or to blanket bog if feasible. Reseed with appropriate heather and/or other appropriate species. There may be an increase in variation in texture and colour, depending on the scale of management. Where Molinia has been dominant, adaptation measures to eradicate it will result in a richer texture and colour, and will improve biodiversity overall.
Some invasive species (such as rhododendron) may extend their range to higher elevations in upland western areas under warmer conditions. Warmer, wetter, winters may lead to the spread of fungi.	Ensure adequate control of invasive species, and non-native evergreens where they are detrimental to high conservation value habitats and important historic assets. Prioritise removal in areas that are significant invasive species seed sources. Where possible hand pull seedlings, carry out mechanical flailing, cut stumps and apply appropriate herbicide if necessary. Remove infected plant individuals in closed containers, or burn on site. Landscape change is not likely to be widespread. Locally, the removal of species such as rhododendron will result in lower ground cover, more openness and less colour during flowering periods. Deciduous woodland may succeed along valley sides over time, with a richer ground flora, contrasting to the open uplands.

Outcome	Adaptation and its potential effect on landscape character, qualities and visual amenity
Increased stress on trees (plantations) in exposed areas due to low or infrequent summer rainfall.	Generally, an objective is to remove coniferous plantations from peat moorlands unless there are conservation or other reasons to maintain them, and restore to heather and/or other natural vegetation. Otherwise thin, remove and replace with species resistant to drier conditions. Replant/encourage woodlands in areas less vulnerable to drying out. As existing coniferous blocks are removed, there will be less visual disruption of sweeps of upland, more openness and a change in colour and texture. Where coniferous plantations are replaced with deciduous species in appropriate locations, usually associated with valley sides and dips, the effect will be to soften the appearance of woodland cover with a semi-natural character.
Drying out of peatbogs and reduced summer rainfall will cause changes in upland vegetation such as loss of mosses and peat forming species. Coarse grass species are likely to increase but bare ground may develop where peat is exposed to wind and water erosion, and the surface too friable for vegetation to take hold.	Control scrub and Molinia by cutting and grazing by cattle, ponies or wethers (castrated male sheep) at appropriate densities. Block drains/grips to maximise moisture retention and to minimise the risk of erosion and creation of peat hags (e.g. Waun Figen Felin bog). Restore to wet heath or to blanket bog if feasible. Reseed or translocate plants such as heather and/or other appropriate species. Fence out livestock from sites sensitive to erosion. Fencing enclosure would interrupt openness to an extent and create different grazing regimes either side. Pools and wet areas may result in the presence of patches of greener, lusher plant species and mosses, creating a local visual contrast with drier areas.
Destabilised surfaces following erosion or wildfire, increased risk of wildfire with parched vegetation and combustible dry material.	Fire risk management through vegetation control and nature restoration for priority habitats. Reduce the risk of fire by ensuring that scrub, gorse, bracken and Molinia is grazed and cut. Carry out controlled burning, establish fire breaks, monitoring and improved emergency responses. Create new reservoirs or ponds to provide a water source for combating fire. Block drains to maximise moisture retention and to minimise the risk of erosion and wildfire. Restore to wet heath or to blanket bog if feasible. Pools and wet areas may result in the presence of

	patches of greener, lusher plant species and mosses, creating a local visual contrast with drier areas. Firebreaks would introduce a new pattern into the landscape.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Upland streams may dry up in summer as the regulating nature of upland vegetation is reduced/altered.	Reduce stress on water sources by fencing off water bodies and considering alternative ways to water stock, especially upland cattle. Block drains to maximise moisture retention and to minimise the risk of erosion. Restore to wet heath or to blanket bog if feasible. Create ponds, and dredge out if necessary, to maximise water holding capacity. Fence off riparian corridors and increase trees and semi-natural vegetation to control fast runoff and smooth out flows. Increase in stream measures such as leaky dams, willow and other structures to slow flow as both a benefit to summer and flood flows. Reducing stocking levels could have the effect of increasing scrub and Molinia, and eventually trees, which would reduce the sense of openness. In stream valleys openness could also decrease with scrub and trees and wet patches. Overall, this would give textural variation and increase diversity to an extent.
Where peat dries out, carbon-based archaeological remains that have been preserved by the waterlogged conditions (e.g. buried archaeology, paleo-environmental records), are at risk from drying out and more rapid destruction and erosion. Although these are not always visible in the landscape, they represent potential loss of a cultural asset.	Report any exposure of carbon-based archaeology to the relevant Archaeological Trust and follow advice. Measures may include rehydration of the site by blocking drainage or other measure and fencing to prevent the risk of trampling by people and livestock. Change to wider landscape character is likely to be minimal but locally restoration of peatlands would restore character.

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Control scrub, bracken (and Molinia) by cutting and appropriate grazing by cattle or other suitable livestock. (Below Moel y Llyn, Ceredigion).

© Charlie Falzon 2017

Block drains to maximise moisture retention and to minimise the risk of erosion. Restore to wet heath or to blanket bog if feasible. (Pumlumon, Powys)

© Clwydian Range and Dee Valley AONB 2018.

The wildfire in August 2018 caused catastrophic damage to 250 hectares on Llantysilio Mountain, part of the Clwydian Range and Dee Valley AONB. Moorland needs protection with firebreaks and other measures.

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Protect and restore peatlands as a carbon sink and to retain precipitation to prevent downstream flooding - block up drains/grips, ditches and open gullies. (Near Maentwrog, Gwynedd).

LMP14_2 Upland (moorland)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Protect and restore peatlands as a carbon sink and to retain precipitation to prevent downstream flooding- block up drains/grips, ditches and open gullies.	Removing drainage including drain/grip blocking will reinforce upland moorland character with reduced erosion, drying out and increase in suitable species. Locally, there could be ponds and an increase in wet patches, which may result in the presence of patches of greener, lusher plant species and mosses, creating a visual contrast with the drier areas. Overall, there would be a reinforcement of key landscape characteristics.

Action	Potential effect on landscape character, qualities and visual amenity
Where peatland can be restored, remove coniferous plantations and birch/scrub/bracken encroachment.	Removal of existing smaller coniferous blocks within the type would create a more open landscape as well as a change in colour and texture. Where coniferous plantations are replaced with deciduous species in appropriate locations, such as minor valley sides, the effect will be to soften the look and feel of any woodland cover in an otherwise open landscape. Overall, there would be a reinforcement of key landscape characteristics.
Reduce livestock methane emissions, especially cattle and sheep, by reduction in numbers, and change in grazing and feed regimes.	The removal of livestock is likely to promote a succession in vegetation to Molinia or scrub and in places to tree cover and woodland. Fencing off some areas such as valley sides and riparian corridors with appropriate grazing in remaining areas may balance this objective with retention of open heath vegetation character on upland exposed tops and slopes. Overall, there would be an increase in enclosure and variety of habitats. A change in the feed regime is unlikely to have an effect on landscape character.
Manage livestock levels at appropriate timescales and numbers to reduce scrub and Molinia. Fence out selectively and temporarily to minimise trampling and water stress	The main change would be increase in diversity of sward/vegetation cover in well managed areas with fencing defining different regimes. Pools and wet areas may result in the presence of patches of greener, lusher plant species and mosses, creating a visual contrast with the drier areas. However, overall this measure would reinforce key heathland characteristics.
Introduce wind turbines where technically feasible. Avoid land with vulnerable biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	This landscape type occurs in some priority areas for wind energy. Increased sizes of arrays and heights of turbines would result in a major change in character and extent of intervisibility as well as the potential for cumulative effects on sensitive receptors. Turbines would be particularly noticeable on skylines. It would introduce prominently vertical built structures with associated infrastructure into an otherwise horizontally extensive gently rolling landscape, modifying its sense of remoteness and open character. Access roads on moorland could modify the drainage regime locally which may adversely affect peatland..

© Charlie Falzon 2018

Introduce wind turbines where there is no conflict with peatland management and protection and in line with policy. (Rheidol wind farm, Ceredigion)

© Ecodyfi 2019

Develop low key instream hydro-electric power avoiding watercourses with particular biodiversity interest. (Near Mallwyd, Gwynedd).

LMP14_2 Upland (moorland)

KEY FACTS and comments

Overall area (km^2)	3069	***Area** (% of Wales)*	14.4

Landscape value (%)

Low	*Moderate*	***High***	***Outstanding***
3	10	53	34

Comment	A third of this landscape type is outstanding value and around a half is high. The area is highly sensitive in terms of landscape character and the conservation and reinstatement of peatlands is a primary objective.

National Parks (% of area)	**AONBs** (% of area)
35	15.6

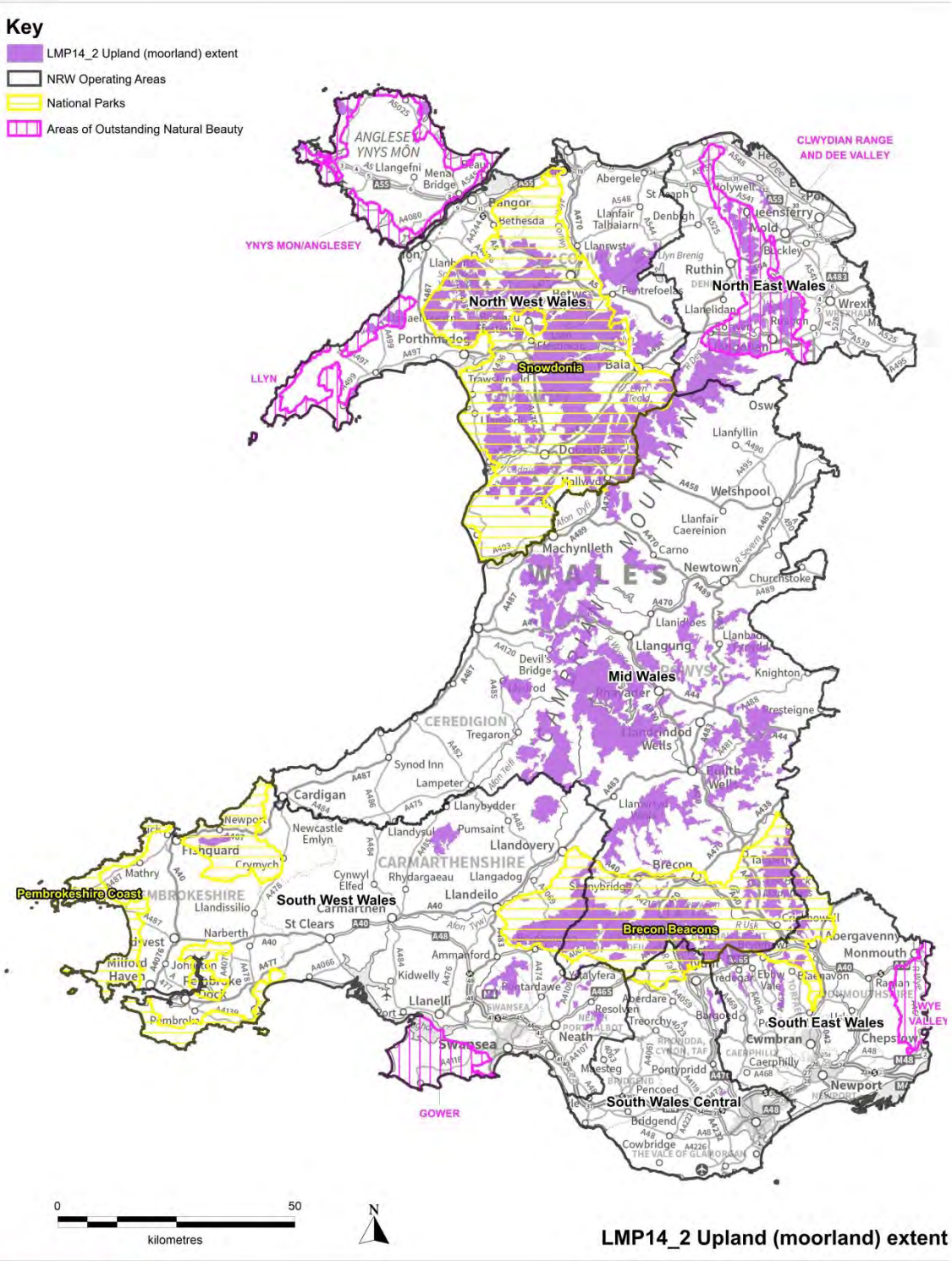
Comment	A considerable proportion of this landscape type lies within National Parks such as Snowdonia/Eryri and Brecon Beacons, with a proportion in AONBs such as the Clwydian Range and Dee Valley, and Llŷn, all of whose special qualities need to be respected. Most of the remainder lies within the Cambrian Mountains, Radnor Hills and Mynydd Epynt.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	23	1945	Upland (moorland) occupies just under a quarter of the land area covered by the mid and northern areas, and about or just below a tenth of land covered by the southern areas. In terms of actual land cover, a significant proportion is found in Mid Wales. 77% of this landscape type (3205km^2) occurs in the Mid and North West Wales.
North East Wales	23	588	
North West Wales	24	1260	
South East Wales	10	197	
South Wales Central	10	193	
South West Wales	7	148	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	There is very limited risk of flooding within this landscape type. However, as these areas are part of the upland catchment for lower surrounding areas, there may be a need to modulate flow where appropriate to reduce the risk of downstream flooding.
0	0.5	0.5	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_3 Upland (rock)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type occupies the highest parts of Wales' mountainous topography with ridges, cwms, high buttresses and outcrops, rocky peaks and often angular skylines including Pumlumon, the Rhinogydd, Cadair Idris, the Aran and the Arenig, Moelwynion and the mountains around Snowdon. It comprises 0.81% of the area of Wales covered by LANDMAP, 99% is of outstanding landscape value.

Landscape characteristics and qualities

- This landscape reflects Wales's remarkably varied geology, with exposed locations and shallow soils, with more than a quarter of the type being taken up by rock outcrops, cliffs, slate, shale and scree.
- Large parts are designated for their national and international significance by virtue of their character, height and ruggedness, their sense of wildness, important habitats and geology.
- They are notable for their tranquillity and remoteness from settlements, although historic extensive grazing is evident. Other evidence of human activity is occasionally seen in the form of former mineral and stone working, cairns and tracks.
- Their mountainous character is in strong contrast to the settled valleys and more gently undulating upland landscapes around them.
- Their spectacular dramatic craggy slopes and summits have long held a strong appeal to walkers and climbers, with panoramic views.
- Some parts contain distinctive species such as feral goats, and nationally-important habitats such as sub-montane vegetation, mires and blanket bog.

LMP14_3 Upland (rock)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to conserve its outstanding character, which can be of national and/or international value, whilst accommodating appropriate low key recreation to support health and wellbeing. Development that impacts negatively on the sense of tranquillity and wildness, including visual intrusion, should be avoided. Livestock numbers should be reduced which is likely to result in the scrubbing up of heavily grazed areas, which will help reduce the risk of erosion and runoff, as well as enhancing biodiversity. In some cases, this may entail a managed shift towards natural regeneration. This should be balanced with maintaining designated special qualities defined for an area. Where appropriate, low-level renewables such as micro hydro should be supported (although unpredictable flow rates may render this impractical) avoiding adverse impacts on biodiversity/fish movement.

LMP14_3 Upland (rock)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by warmer mean temperatures enabling spread of vegetation to higher elevations and loss of alpine plant communities.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Landscape changes will be subtle and relate largely to an increase in vegetation (such as coarse grasses, scrub and bracken) growing at higher elevations.	Manage bracken and coarse grasses where they encroach on identified patches of sensitive flora. Use selective patterns of grazing to reduce potential encroachment. Cut bracken where feasible. Remove birch and rhododendron. The vegetation patterns may change but measures taken are likely to control shrubby growth so overall the character is unlikely to change to a large degree.
Fewer days with peaks covered in snow in winter. More surface water in winter.	Manage water flows by allowing flooding in controlled areas, optimising peat bog capacity and controlled release avoiding erosion of exposed soils and peats. Consider draining patches where waterlogging might inhibit rare flora and bryophytes. The lack of snow is likely to change perception of the uplands and increased surface water is likely to modify access and character at a local level.
Alpine plant communities may disappear, reducing overall biodiversity.	Monitor possible migration of plant communities to new/higher sites under new climatic conditions. Manage accordingly, considering translocation if feasible. At a landscape scale the change in plant communities is unlikely to be apparent but there will be a loss in biodiversity interest.
Main outcome 2	
Hotter drier summers will result in decrease in surface water availability and visibility.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Surface water less visible in summer, with drying up of shallow pools and lakes.	Consider in stream minor rock dams to hold water ensuring migratory fish are accommodated. Excavate pools where feasible to ensure a range of depths. If necessary, carry out selective diversions, blocking up of drains and streams, avoiding potential downstream impacts on e.g. bryophytes and moisture loving plants. The change in landscape character is likely to be localised, along valley floors and riparian corridors.
Increased erosion as a result of	Selectively block drains and ditches to slow flow

extreme storm events.	but avoid build-up of water adjoining and above areas sensitive to significant flows e.g. bare gravels on slopes, peaty slopes etc. Selectively promote the growth of vegetation to hold soils. If appropriate, fence out selective areas to prevent poaching & erosion. The change in landscape character is likely to be localised, along valley floors and riparian corridors.

© Simon White 2014

Consider reducing livestock numbers which is likely to result in the scrubbing up of heavily grazed areas, which will help reduce the risk of erosion and runoff, as well as enhancing biodiversity. In some cases, this may include a managed shift towards natural regeneration. (Above Llyn Gwynant, Gwynedd).

© Peter Smyly 1997-2020

Monitor possible migration of plant communities to new/higher sites under new climatic conditions. Manage accordingly, considering translocation if feasible. (Cwm Glas, Gwynedd).

LMP14_3 Upland (rock)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Temporarily fence out areas from grazing and manage to prevent erosion and removal of embedded carbon.	Fenced areas will be covered by a mix of grasses and scrub where there is a build-up of soils and peats. Small areas will take on a softer feel. Locally, fencing will be visual intrusive until grasses become established and bind the underlying soils. Potentially significant change to visual amenity.

LMP14_3 Upland (rock)

KEY FACTS and comments

Overall area (km^2)	172	***Area** (% of Wales)*	1

Landscape value (%)

Low	*Moderate*	***High***	***Outstanding***
0	1	0	99

Comment	The vast majority of this type is outstanding value. The area is highly sensitive in terms of landscape character and conservation is the primary objective.

National Parks (% of area)	**AONBs** (% of area)
3.4	0

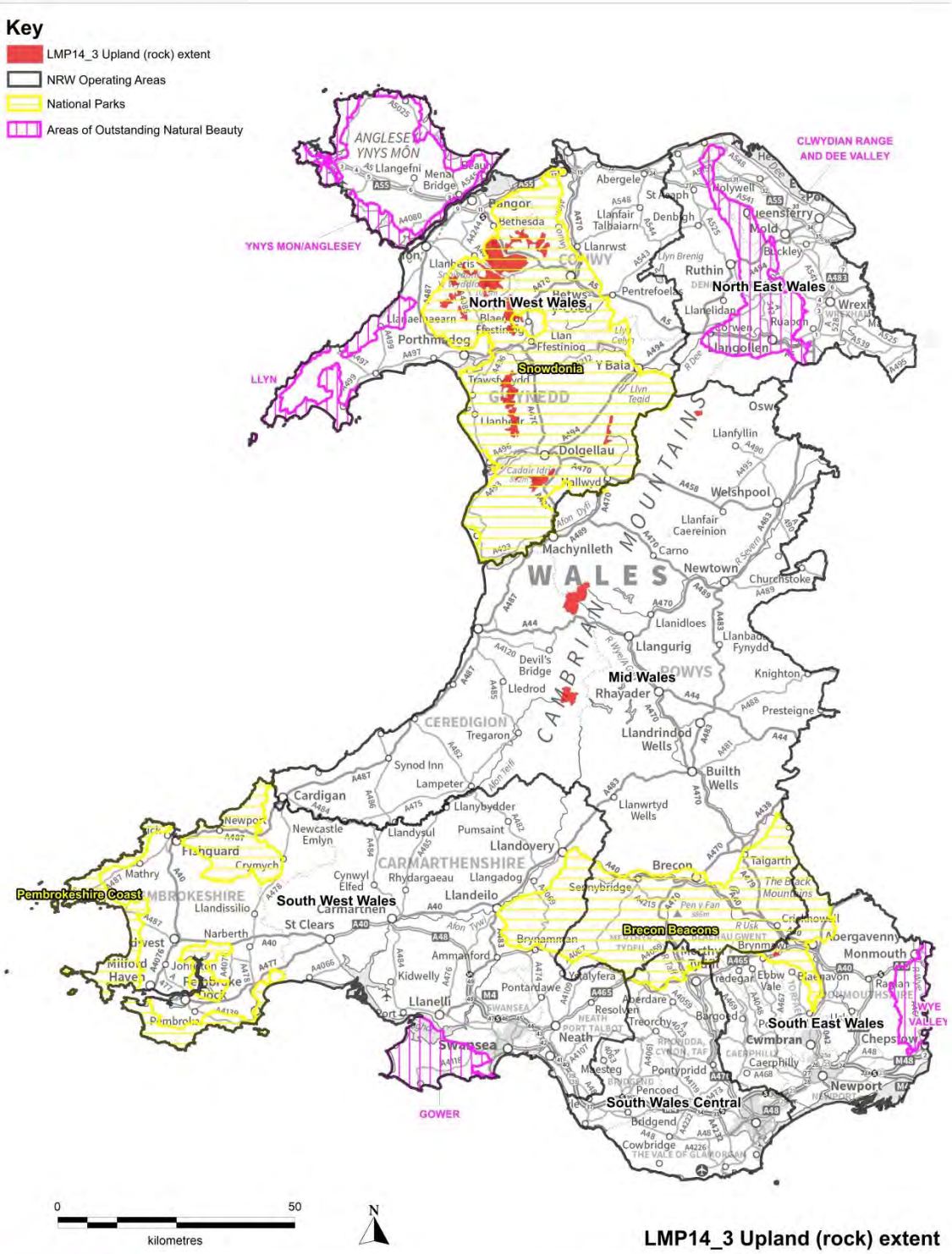
Comment	A considerable proportion (83%) of this landscape type lies within Snowdonia/Eryri National Park whose special qualities need to be respected.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	29	The relative rarity of this landscape type is reflected in the limited spread. It occurs mainly in the North West Wales area, but also in the Cambrians including Pumlumon in Mid Wales.
North East Wales	0	0	
North West Wales	3	142	
South East Wales	0	1	
South Wales Central	0	0	
South West Wales	0	0	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	There is no risk from sea level rise. However, as these steep slopes are part of the upland catchment for lower surrounding areas, there may be a need to modulate flow where appropriate to reduce the risk of downstream flooding.
0	0.3	0.3	



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Data Sources:
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Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_4 Upland (grassland)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

Largest single LMP14 type comprising upland valleys, hillsides, lower plateaux and scarp slopes with open grazing being more than 50% of the land use. Some areas are internationally and nationally valued for nature conservation. This landscape connects uplands and lowlands, acting as a both a buffer and as a conduit to biodiversity migration and for regulating the flow of water. It is widespread in eastern Powys, forms a significant part of the hinterland of Ceredigion, Pembrokeshire and Carmarthenshire, occurs extensively in Denbighshire and overlooks the open lowlands along the north west coast of Gwynedd. This landscape type occurs in just under a quarter (23.27%) of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Permanent pasture for sheep with limited suckler cows predominates, interspersed with wet rush/rhos pasture, although formerly mixed with arable.
- Strongly enclosed by a mix of boundary materials, including hedges (especially in eastern areas), fences and stone walls. Post and wire fencing is common, and fields on the lower slopes are bounded by dense, previously laid, hawthorn hedges designed to contain sheep.
- Limited presence of woodland, and few hedgerow trees, although there are substantial blocks of post 1919-coniferous plantations. Some discrete areas of ancient woodland occur.
- Low scrub and bracken are common on valley sides (ffridd). Some parkland exists, although much less common than in lowland areas.
- Open and sparsely settled, with isolated farmsteads and hamlets.
- Some deserted settlements and prehistoric monuments (concentrated in unenclosed land), with historic mineral mines and quarrying marked in the landscape by their spoil heaps.
- Timber-framed buildings and other mainly 19th century farm buildings contribute strongly to character.
- Remaining inland and coastal grazed commons, heath and moor are valuable habitats due to enclosures and post-1940 agricultural improvement.
- Open, panoramic landscapes with extensive views and often dark night skies.

LMP14_4 Upland (grassland)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The overall objective is to sustain agricultural production, including the restoration of a mixed farming system with arable. This may entail the management of grazing in some areas by reducing livestock numbers, noting that in other places under-grazing can be an issue. A further objective should be to increase the amount and diversity of tree, hedgerow and grassland species, and to enhance those areas that lie within designated areas. In some places this may entail encouraging natural regeneration. This includes small woodlands and, where possible, the replacement of post and rail fencing with hedgerows. Large areas within this landscape type are put forward as priority areas for wind and solar energy. This will need to be located and designed to minimise landscape and visual impacts especially on national designated landscapes and settlements nearby. This landscape type may contain areas suitable for other sources of renewable energy, including hydro, biomass, and small scale anaerobic digestion, taking into account the need to minimise landscape and visual impacts.

LMP14_4 Upland (grassland)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by hotter and drier summer creating stress on trees and plants and the increased threats from pests and diseases caused by a warmer mean temperature. Changes are difficult to predict as expected climate change both supports grassland and puts stress on some species in plant communities.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Decrease in quality and extent of hedgerows, more gaps, loss of some hedgerow trees, increase in post and wire fencing and field sizes.	Do not cut hedgerows to less than 2m high and trim every 3 years at most frequent. Use fallow field margins or headlands either side of hedgerows to reduce stress on hedges and hedge trees and increase biodiversity. Plant/encourage native hedgerow species that are resistant to drought, pathogens and pest species. Plant more resilient native hedge plants in new hedges and in gaps along with most tolerant existing species. Avoid removing hedges where possible, but if so, replace with post and wire fencing and increase margins/headlands and thicken hedges elsewhere. Plant/select other species of tree to increase cover (20-70m spacing) to optimise resilience if losses occur. Consider use of hedgerows/trees as shelter belts in more exposed locations. Consider creating strategic buffers/gaps to reduce the risk of spread of disease. Hedgerows may become scarcer and change in composition but may become slightly thicker and more treed, increasing enclosure in a larger scale landscape.
Some reduction in the variety of tree species in response to stresses on vegetation from drier summers and from pests and disease such as Ash.	Introduce drought and disease resistant primarily native tree species. Ensure that introductions do not bring the risk of new strains of disease. Allow natural regeneration in woodlands and hedgerows where existing species are known to survive and resist disease. Optimise species diversity. Introduce silvo-pasture systems by extending and developing woodland and allowing livestock to forage. Where woodlands have been overgrazed, temporarily fence them in to encourage an understorey to develop, and to encourage natural regeneration.

	The variety and extent of tree cover may reduce in places and increase elsewhere and the character may change slightly, including changes in texture and colour.
Grassland may benefit in terms of creating a longer growing season. Arable farming may increase.	Optimise extensive grass feeding of livestock, moving away from cereal feeding. Support the restoration of mixed farming, including arable, where appropriate. In some areas revert land from intensive pastures to permanent low input grassland to provide variety of grazing regimes. Retain ffridd in places as an edge and connecting habitat. Greening of the landscape may occur earlier in the year though drier and hotter conditions in summer may result in drying out of vegetation relatively early in the summer. In some areas a shift to arable will result in a change in pattern, enclosure, texture and colour. This may make some areas appear less remote and more lowland in character.
Where soil desiccation occurs, buried archaeological remains may be exposed and at risk of rapid deterioration. New archaeological assets may be revealed by soil parching.	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management. The change in landscape character is likely to be minimal.
Main outcome 2	
Rainfall patterns in summer will affect local conditions.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Surface water will be less visible in summer months.	Increase trees and semi-natural vegetation in riparian corridors and in headwaters areas/slopes to control fast runoff and smooth out flows. Increase measures such as leaky dams, straw bale dams, willow and other tree structures to increase water retention. Dredge ponds and lakes to range of depths where appropriate to increase resilience to drying up whilst still supporting biodiversity including marginal and other aquatic vegetation. Fence off watercourses in places. Consider reducing livestock numbers to reduce pressure on waterbodies. Extend the variety of grassland regimes and species, including reverting to rough grassland, especially around headwaters, regulating water flow and improving its quality.

	There may be an increase in tree cover and semi-natural vegetation related to water bodies within the landscape type, reducing openness.
Increased risk of flooding in upland valleys.	Increase trees and semi-natural vegetation in riparian corridors, valley floors and sides and in headwaters areas to control fast runoff and smooth out flows. Increase measures such as leaky dams, straw bale dams, willow and other tree structures to slow flow. There may be an increase in tree cover and semi-natural vegetation related to water bodies within the landscape type, reducing openness.
Opportunities to enhance biodiversity	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Create connected habitats and allow natural regeneration where appropriate.	Connection of linear habitat corridors and large scale semi-natural habitat patches would increase enclosure and apparent 'untidiness' of the landscape accompanied by a visible increase in wildlife. The semi-natural areas are likely to be located on more exposed upland areas and poor soils, in river corridors/floodplains, steeper slopes and woodland. The balance of the landscape character would change with the patchwork of agricultural fields interspersed with semi-natural areas giving greater contrast and variety. Within the fields, an increase in hedgerows, trees and headlands linking patches would increase enclosure.

Manage Molinia grassland, including grazing regimes, to support peat-forming vegetation communities. Pilot areas to explore different techniques should be trialled. (Cambrians).

Flooding in upland valleys can avoid flooding downstream if release is managed. (Above Tre'r Ddol, Ceredigion).

© Charlie Falzon 1999

Where woodlands have been overgrazed, temporarily fence them in to encourage an understorey to develop, and to encourage natural regeneration. Allow natural regeneration in woodlands. (Above Cwm Cletwr, Ceredigion).

© Charlie Falzon 1999

Optimise extensive grass feeding of livestock. Increase tree cover and semi-natural vegetation. (Above Llanfachreth, Gwynedd).

LMP14_4 Upland (grassland)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase wind turbines on technically feasible sites in line with policy avoiding land with vulnerable biodiversity interest, nationally designated and other sensitive landscapes and heritage assets, and their settings.	This landscape type occurs in many priority areas for wind energy. Increased sizes of arrays and heights of turbines would result in a major change in character and extent of intervisibility as well as the potential for cumulative effects on sensitive receptors. Development would be particularly noticeable on skylines and may affect adjacent landscape types. Areas with large-scale rectilinear field patterns away from traditional settlements would be most appropriate, and tranquil areas with irregular topography and small-scale field pattern and intervisible with designated landscapes least appropriate.
Increase solar farms in line with policy avoiding the better agriculturally productive land, land with biodiversity interest, nationally designated and other sensitive landscapes, such as widely visible slopes and tops, and heritage assets, and their settings.	This landscape type occurs in many priority areas for solar energy. Solar arrays would lead to a marked increase in built form in the countryside modifying its rural character. Development would be particularly noticeable on slopes and in open countryside without high hedges (+3m) and trees. Flat or plateau areas with large-scale rectilinear field patterns with hedges would be most appropriate, and tranquil, sloping areas with irregular small-scale field pattern or no enclosure, and intervisible with national designations, least appropriate.

Action	Potential effect on landscape character, qualities and visual amenity
Increase in-stream hydro-electric power avoiding watercourses with vulnerable biodiversity interest.	Built structures on watercourses modify their natural character and form potentially creating barriers to movement of wildlife. Small-scale, discreet structures, potentially reflecting local character and integrated by appropriate native riparian vegetation may be appropriate.
Increase small scale anaerobic digestion plants where appropriate.	Built structures of semi-industrial character with associated access can modify rural character. Siting to avoid widely visible locations and skylines, associate with existing large-scale farm buildings and integrate with native tree and hedge planting is likely to be most appropriate.
Reduce/remove livestock grazing to reduce methane and ammonia and reduce impact on soils. Promote additives to feed to reduce livestock emissions.	The area of extensive improved pasture may be reduced and replaced by either arable, less intensive pasture or semi-natural vegetation/woodland dependent on land capability, including soils, and other factors. Potentially, meat production may be carried out intensively in sheds. This would substantially change the character of this landscape type, creating more intensively used productive open landscapes in parts, potentially with large agricultural structures, and more enclosed semi-natural less productive areas elsewhere. Appropriate colour and materials used for structures could mitigate effects. A change in the feed regime is unlikely to have an effect on landscape character.
Convert from silage to hay. Introduce short/medium ley grassland.	A more traditional form of extensive management would mean fields would take on a more traditional aesthetic.Overall there would be a minimal change in landscape character and biodiversity/soil health may be enhanced with associated benefits and prevalence of wildlife with a richer variety of flora adding colour and texture.
Increase biomass (transitional option) e.g. short rotation birch, or willow/ poplar/sweet chestnut coppice or perennial crops such as Miscanthus.	Biomass differs in character from pasture due to the height of the crop, and requires large-scale mechanised cropping. Planting in this type may be limited due to field patterns and exposure. Large-scale rectilinear field patterns with hedges would be most appropriate and areas with irregular small-scale field pattern would be least appropriate.
Increase planting of primarily native resilient trees and hedgerows to sequester carbon (especially along contours). Avoid planting on peaty soils.	Planting would increase enclosure in a predominantly open landscape, modifying its character. There may be also be changes to character as trees and woodland composition change.
Increase planting of primarily native resilient trees/woodland	Planting would increase enclosure in a predominantly open landscape, potentially

on a phased basis to sequester carbon and provide shelter in places. Avoid planting on peaty soils.	markedly modifying its character. Planting may be targeted mainly in lower valley sides and floors. Ffridd should be retained in places to maintain habitat diversity and one of the key characteristics of the area. There may be changes to character as trees and woodland composition change.

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There are opportunities to increase planting of resilient native species in extensive areas of grassland (such as above), to reduce the effect of desiccation, to provide shelter and reduce the risk of runoff and soil erosion. (Near Y Garn, Cletwr valley, Ceredigion)

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Increase wind turbines on technically feasible sites in line with policy. (South Wales coalfield plateau).

LMP14_4 Upland (grassland)

KEY FACTS and comments

Overall area (km^2)	4925	***Area** (% of Wales)*	23

Landscape value (%)

Low	*Moderate*	***High***	***Outstanding***
1	62	35	2

Comment	A third is high value with the largest proportion being of moderate landscape value. The area is therefore less sensitive than some other landscapes but care is needed in implementing change and there is a major opportunity for improvement.

National Parks (% of area)	**AONBs** (% of area)
15.2	15.5

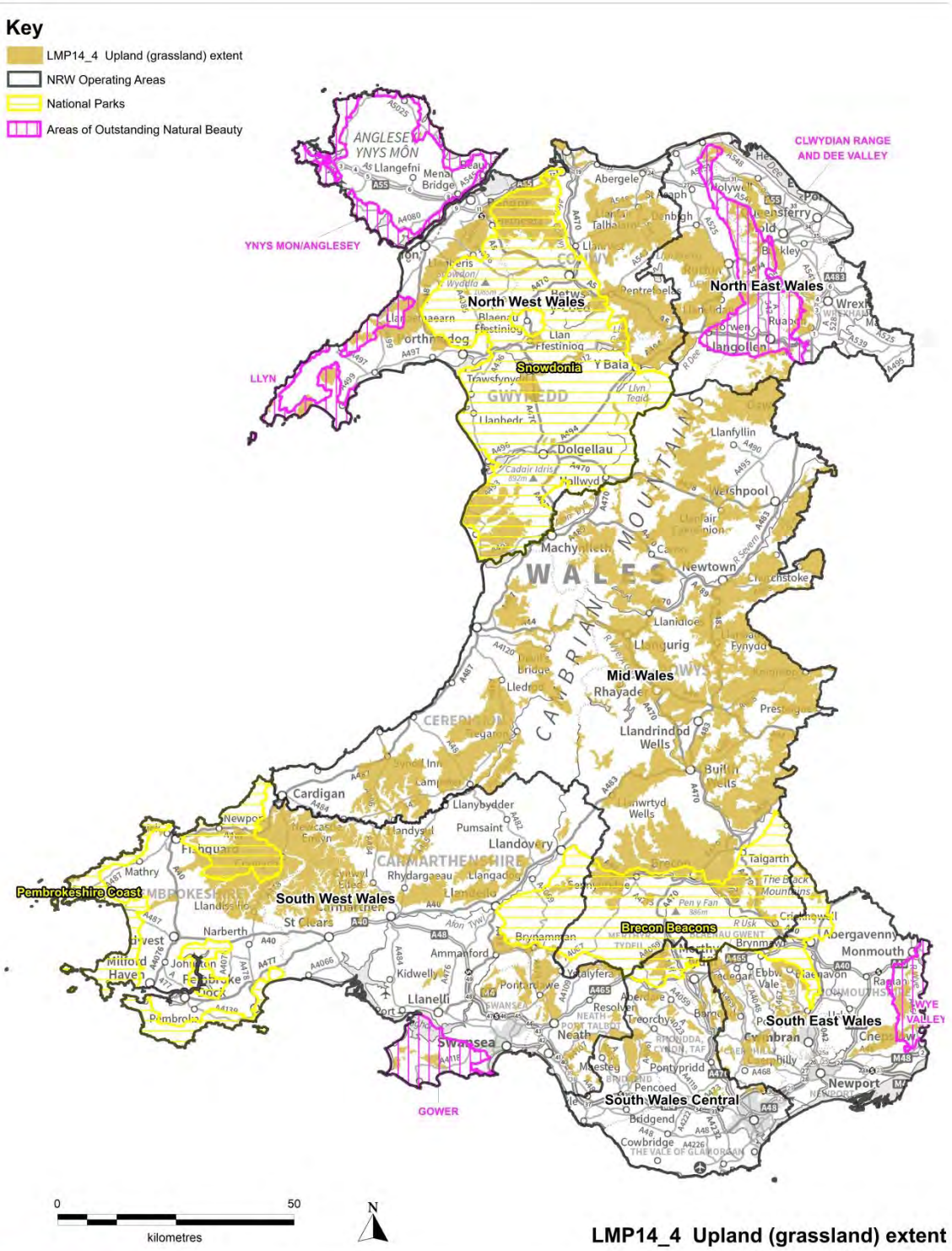
Comment	There are examples of the type in all National Parks either forming the main upland such as in the Preselis in Pembrokeshire Coast or acting as transitional slopes in Snowdonia and Brecon Beacons. It also occurs in smaller patches in AONBs such as Cefn Bryn in Gower or the Trellech plateau in the Wye Valley.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	32	2746	This landscape type occupies a significant area of the eastern part of the Mid Wales, extending in a virtually unbroken block north from the Brecon Beacons to Llangollen. It occurs least in South Wales Central and South East Wales. It is a major link between the Upland Moorland and Lowland Valley landscapes.
North East Wales	22	557	
North West Wales	20	1028	
South East Wales	10	194	
South Wales Central	9	174	
South West Wales	17	1010	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	There is zero risk from sea level rise. There is some risk in a few discrete areas as a result of fluctuations in runoff from storm events and winter rainfall. Measures are needed to reduce runoff to avoid flooding in downstream lowland areas.
0	2.4	2.1	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_5 Upland (wooded hills)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type consists of hillsides, scarp slopes, plateaux and areas with more woodland (20-50% of land area) than the Upland (grassland) type, but less than the Upland (wooded) landscape type. It comprises a mix of open agricultural land of fields and substantial woods. This landscape type is found in discrete patches across Wales such as the Trellech plateau and Chepstow Wood in Monmouthshire, between the Dyfi valley and Cadair Idris, and west of Betws y Coed. It comprises 3.26% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Woodland is dominated by post-1919 plantations, with a mixture of broadleaf and coniferous in places, with a scattering of ancient woodland on hilltops, hillsides and some narrow valleys and some 18th-19th century plantations also in evidence.
- Woodland is on valley sides and hilltops providing a strong landscape element and sense of enclosure to the lower adjacent land , framing views from the higher ground.
- This landscape type reflects the massive growth in extent of enclosed farmland since the 18th century, at the cost of common grazing, although about a proportion remains unenclosed.
- Boundaries include stone walls, managed hedges, hedgerows with trees, and occasionally fences.
- Although some valley sides contain 17th century or earlier enclosures, much of the enclosure dates from the 19th century, around a dispersed settlement pattern of farmsteads established or rebuilt in the same period, which worked a lower proportion of arable land than other upland types.
- Like other landscape types it now has high levels of stocking for sheep with no arable cultivation, and surviving patches of unenclosed land with semi-natural vegetation.

LMP14_5 Upland (wooded hills)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to increase tree cover overall, increasing native broadleaf woodland as well as mixed woodlands and modifying conifer plantations. In places a regime of coppicing and the introduction of biomass might be feasible. Additionally, to support and enhance agricultural activity, adapting to what can be produced in a changing climate. Limited solar farms (on plateau tops) and micro hydro systems may be appropriate where they can be integrated and do not impact adversely on ecosystems. Informal recreation such as walking and cycling should continue to be enhanced increasing existing networks where possible.

LMP14_5 Upland (wooded hills)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by both warmer mean temperatures (which will increase risk of damage from pests and disease), and from hotter drier summers, which will put stress on trees. These are factors that work both in favour of tree growth and against more widespread planting, with tree planting highly dependent on local conditions.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Pests and diseases are likely to increase with species such as Larch, Ash, Oak and Spruce already affected.	Introduce drought and disease resistant species to increase diversity in plantations, broadleaf woodland and hedgerows, focusing on primarily native trees where possible, promoting diversity. Ensure that introductions do not bring the risk of new strains of disease. Consider the role of soils in the transmission of disease, e.g. avoid heavy, poorly drained soils in the case of *Phytopthera ramorum.* Allow natural regeneration of woodland and other areas to allow scrub and ultimately trees to establish to optimise the diversity of species and resistance to disease. Use and develop techniques to speed up natural regeneration such as planting small numbers of trees to encourage birds to perch drop seeds. Changes to character are likely to be a decrease in continuous plantations and broadleaf woodland cover with the loss of ash and some oak but an increase in diversity as other resilient species establish. In the longer term (50 years +) genetic resistance in native tree species will allow for further regeneration. Larch plantations will be largely lost and replaced with mixed woodland/ plantation giving a more diverse appearance. Shrubs such as juniper may thrive in more open areas and drier conditions.
Wetter winters may decrease areas favourable for tree growth due to more waterlogged soil conditions on flatter ground, which are not favourable to root growth.	Allow fallen timber to break down into wet areas. Plant or allow regeneration of suitable waterlogging tolerant species e.g. willow and alder carr. There may be changes to woodland structure locally, where woodlands dominated by trees that normally favour drier, well drained soils are replaced with trees that prefer wet soils such as alder and willow.
Warmer, drier summers and	Optimise extensive grass feeding of livestock,

less frequent frosts benefit grass and bracken which are likely to spread raising the moorland line.	moving away from cereal feeding. Shift from improved grassland to semi-improved permanent or short to medium grass leys with a mixed seed to improve botanical interest. Introduce silvopasture systems by extending and developing woodland and allowing livestock to forage the grasses and scrub beneath. Manage bracken and gorse by cutting. Greening of the landscape may occur earlier in the year though drier and hotter conditions in summer may result in drying out of vegetation relatively early in the summer. If strategy followed, grasslands may look rougher and more colourful where seed mixes and grass varieties are introduced, and where foraging is managed within shrubs and woodland.
Hotter drier summers and more frequent storms with high winds may work against successful tree growth at higher elevations/ exposed locations due to increased stress from low and/or infrequent rainfall and wind-throw.	Where it is desirable to maintain or extend tree growth at higher elevations, plant a mix of tree and shrub species, comprising varieties that are tolerant to drier/windy conditions. Locate away from exposed and south facing locations to optimise shade and minimise wind and storm effects. Exposed south/south west facing slopes may become more open with increased grassland. North facing slopes may become more treed. The composition of and seasonal colour of woodlands may change with drought tolerant species.
Where soil desiccation occurs, buried archaeological remains may be exposed and at risk of rapid deterioration. New archaeological assets may be revealed by soil parching.	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management. Any change in landscape character is likely to be minimal.
Main outcome 2	
Increase in the likelihood of wildfires.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Hotter drier summers, will potentially increase the likelihood of wildfires.	Reduce fire risk by including firebreaks and ensuring that gorse, bramble and bracken is cut, especially in proximity to woodland edges. Block drains to maximise moisture retention and to minimise the risk of undergrowth and peaty soil fires.

	Reduce/remove monocultural coniferous woodland, and introduce a mix of deciduous and coniferous woodland species. Provide corridors in a variety of habitats, including watercourses and wetlands and glades and rides within woodland. Potentially there will be a significant seasonal change in colour and texture, as well as in the shape of woodland and in the way it reflects the topography of its setting.
Main outcome 3	
Increase in the length of the growing season.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Warmer mean temperatures will lengthen the growing season and may also enable trees and shrubby plants to grow at higher elevations, resulting in a raising of the moorland line.	Extend tree planting introduce drought and disease resistant primarily native tree species in woodland and mixed woodland in places, avoiding peaty soils. Introduce silvopasture systems by extending and developing woodland allowing livestock to forage the grasses and scrub beneath. Where woodlands have been overgrazed, temporarily fence them in to encourage an understorey to develop, and to encourage natural regeneration. Otherwise, remove trees and shrubs where their encroachment is at odds with the management of species rich grasslands and heaths. There would be a further reduction in openness with trees becoming a larger component in the landscape both as woodland and silvopasture. This would both reinforce and slightly modify character.
Conifer planting on upland hills may increase as warmer growing seasons and rising CO_2 concentrations will stimulate productivity and timber production where soil water and nutrient availability allows.	Undertake further conifer planting but with a wider variety of species including broadleaves. Design planting to reflect topography and soften woodland edges with a variety of shrub and broadleaf species. Ensure that planting allows for broadleaves along riparian corridors and spaces for wetland and other habitats. There is likely to be an increase in conifer plantations but avoiding monoculture, with more diverse tree and plant cover. Colour and texture would be more varied, and the dark green and straight edges of plantations would be avoided.
Improved growth may also occur among other tree species.	Plant broadleaf woodland further up slopes avoiding exposed areas.

Climatic conditions in central and eastern Wales are likely to remain favourable for growing broadleaved species, and oak and ash suitability will remain high although woodland plant communities may alter in response to changes in temperature and moisture.	Allow natural regeneration elsewhere to optimise the diversity of types and resistance to disease. Increased broadleaf woodland planting and natural regeneration would reinforce its wooded and enclosed character.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
A longer growing season may cause improvement of land at higher altitudes or even in places expansion of farmland into upland areas, reducing rough grassland, and may result in outdoor grazing of livestock earlier in spring and later in autumn.	Optimise extensive grass feeding of livestock, moving away from cereal feeding. Shift from improved grassland to semi-improved permanent or short to medium grass leys with a mixed seed to improve botanical interest. Introduce silvopasture systems by extending and developing woodland and allowing livestock to forage the grasses and scrub beneath. Retain and support a strong tree and hedge cover with resilient species to provide shelter for livestock against storm events. In places, areas with more fertile soil and previously rough grassland may become more intensively managed and areas enclosed by plantation woodlands may become more open, so that a patchwork of fields will develop with hedgerows and shelterbelts. This may be balanced by an increase of woodland elsewhere.

Shift from improved grassland to semi-improved permanent or short to medium grass leys with a mixed seed to improve botanical interest. Retain and support a strong tree and hedge cover to provide shelter for livestock against storm events. (Ceredigion).

Create connected habitats and allow natural regeneration where appropriate. Increase planting of primarily native resilient trees/woodland on a phased basis to sequester carbon and provide shelter in places. (Above Cwm Cletwr, Ceredigion)

LMP14_5 Upland (wooded hills)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase solar farms in line with policy avoiding the better agriculturally productive land, land with biodiversity interest, nationally designated and other sensitive landscapes, such as widely visible slopes, and heritage assets and their settings.	Increase in built form in the countryside modifying its rural character. Development would be particularly noticeable on slopes and in open countryside without high hedges (+3m) and trees. Flat or plateau areas with large-scale rectilinear field patterns with hedges would be most appropriate, and tranquil, sloping areas with irregular small-scale field pattern or no enclosure, least appropriate.
Increase instream hydro-electric power avoiding watercourses with significant biodiversity interest.	Built structures on watercourses modify their natural character and form potentially creating barriers to movement of wildlife. Small-scale, discreet structures, potentially reflecting local character and integrated by appropriate native riparian vegetation may be appropriate.
Increase biomass - short rotation sweet chestnut, alder, willow, birch, sycamore, sitka spruce.	This landscape type may not be capable of supporting biomass for fuel in industrial quantities, although potentially appropriate on flatter plateaux. Changes to the landscape are likely to be minimal, especially where it sits between woodlands or replaces conifer plantations.
Increase wind turbines on technically feasible sites in line with policy avoiding land with vulnerable biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	Only limited areas are proposed to be part of priority areas. Larger arrays and higher turbines would result in a major change in character and extent of intervisibility which could also affect designated landscapes. Development would have wide effects and would be particularly noticeable on skylines in this varied hilly landscape. This mitigation measure may not be appropriate for most of this type due to the character of woodland and landform. Areas with large-scale conifer plantations may be the most appropriate.
Reduce/remove livestock grazing to reduce methane and ammonia and reduce impact on soils. Promote additives to feed to reduce livestock emissions..	Pastures will eventually run to scrub and to woodland in some places. In others, alternative management decisions e.g. to opt for biomass or an expansion in woodland cover or in semi-natural grassland may result in significant changes locally.
Increase planting of primarily native resilient trees/woodland on a phased basis to sequester carbon and mitigate run off. Avoid planting on peaty soils.	As woodland blocks expand and coalesce, the sense of enclosure would be reinforced. There may be also be changes to character as trees and woodland composition change.
Introduce silvopasture system to improve carbon sequestration where appropriate.	This land use usually combines shrubs, trees and grasses, and thus may appear out of character compared to traditional field and woodland patterns. Changes to landscape character may be

	substantial where this is in more open areas that are allowed to run to a scrub and wooded environment.

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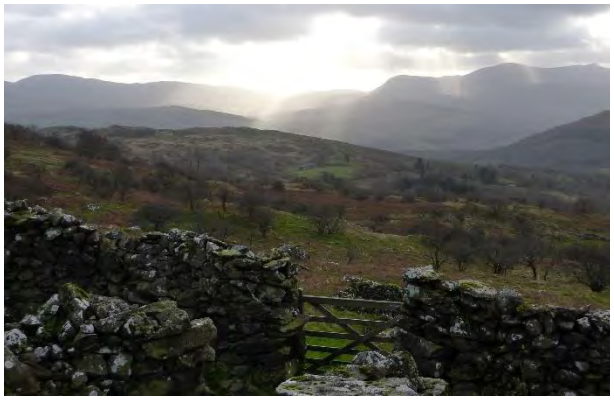
Small scale hydro-electric in stream dam and pipe inlet (Brecon Beacons.)

© Simon White 2020

Turbine housing and pipe outlet. The building, though small, looks noticeable and out of character due to an inappropriate stain finish. (Brecon Beacons.)



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Allow livestock to forage. Where woodlands have been overgrazed, temporarily fence them in to encourage an understorey to develop, and to encourage natural regeneration. (Below Cors y Garnedd.)

LMP14_5 Upland (wooded hills)

KEY FACTS and comments

Overall area (km^2)	693	***Area** (% of Wales)*	3

Landscape value (%)

Low	*Moderate*	***High***	***Outstanding***
6	35	55	4

Comment	Almost two thirds of this landscape type is considered to be of high or outstanding values, with around a third moderate and a small proportion of low value. The area does not cover a large area nationally but its woodland cover makes a significant contribution to landscape character locally. The values indicate potential for increasing value with a change of land management away from single species coniferous plantation in places towards a more varied, largely deciduous woodland cover.

National Parks (% of area)	**AONBs** (% of area)
6.2	6

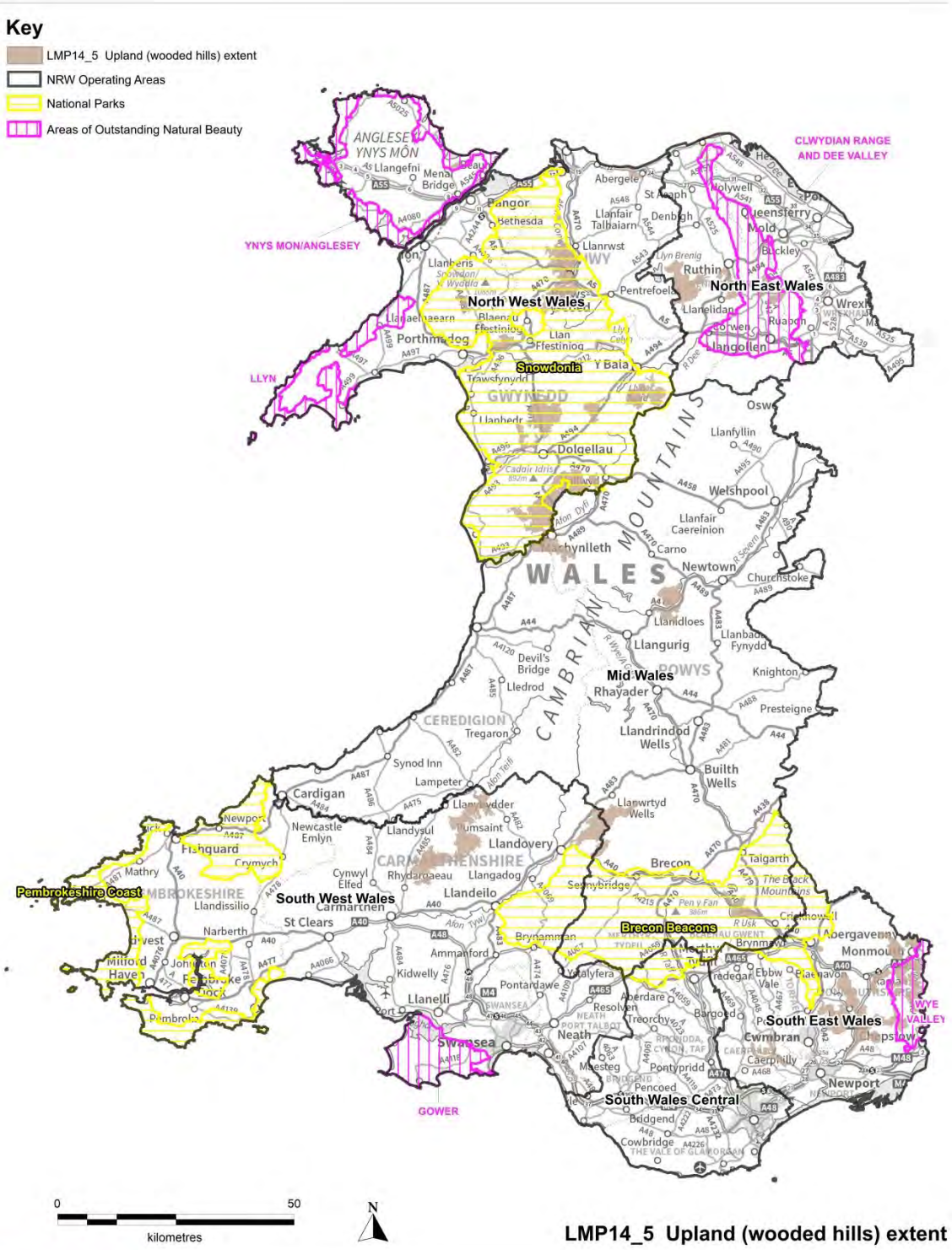
Comment	This type has a small presence in national designations occurring in the Snowdonia National Park such as on the slopes north of the Dyfi valley, Brecon Beacons at Glanusk and the Wye Valley AONB, forming the wooded plateau and tributary valley sides.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	4	305	In terms of coverage, the mid and northern areas contain more than twice as much of this type as do the three southern areas (663km^2 against 309km^2). In contrast to the extent of Upland (wooded hills) landscape type, this type is singularly lacking in South Wales Central.
North East Wales	3	63	
North West Wales	6	295	
South East Wales	9	170	
South Wales Central	0	4	
South West Wales	2	135	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	There is zero risk from sea level rise. There is some risk in a few discrete areas as a result of fluctuations in runoff from storm events and winter rainfall. Measures are needed to reduce runoff to avoid flooding in downstream lowland areas.
0	1.1	1.0	



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Data Sources:
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Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_6 Lowland Valleys (hedgerow)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises valleys and rolling lowlands enclosing a mosaic of farmland and small woodland, characterised by hedgerows and hedgerow trees. It is strongly represented in Pembrokeshire, Carmarthenshire and Monmouthshire, and also occurs in significant parts of the Llŷn Peninsula and Flintshire. This type comprises 15% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- The field pattern is a strong patchwork character enclosed by hedges in a settled tree rich landscape with small woodlands.
- Most of this area exhibits a mix of boundaries including hedgerows with trees and managed hedges. Gorse and thorn hedges are more common nearer the coast. It has the second-highest proportion of hedgebanks (cloddau) of any of the landscape types, concentrated in the south-west.
- Fields often consist of ryegrass-dominated swards, managed intensively for dairy produce. There has been a reduction in permanent pasture with associated decline in biodiversity.
- A varied pattern of dispersed and, more rarely, village-based settlement, reflecting the importance of the earlier practice of mixed farming.
- Ancient woodland is strongly represented, predominantly of sessile oak, ash and hazel in drier areas, with willow and alder carr in the wetter parts. Post 1919 softwood plantations are present in discrete areas.
- Parkland is another strong characteristic of this landscape type.

LMP14_6 Lowland Valleys (hedgerow)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to maintain, support and enhance agricultural production, intensive in places, adapting to what can be grown in a changing climate. Renewable energy such as solar and biofuels should be supported in the least sensitive landscapes and on less productive land . All these uses should be integrated to avoid widely visible unsightly development with reinforcing tree and managing hedge cover to provide more shelter, leading to more enclosure in places. In addition, flood management, biodiversity and recreation all need to be accommodated with a network of linking corridors and patches. L Settlement away from the coast should avoid vulnerable areas subject to flooding, avoid productive agricultural land, and be based in locations and with layouts supporting convenient walking, cycling and public transport.

LMP14_6 Lowland Valleys (hedgerow)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by hotter drier summers and effects of pests and disease on hedgerow species from generally warmer mean temperatures. Vegetation changes in field boundaries (hedgerows) are likely to be more significant than changes in grassland.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Drier conditions and pathogens/disease are likely to impact on the species mix in hedgerows and result in more gaps and potentially loss of some hedgerows and hedgerow trees (e.g. Ash). More post and wire fencing may be in evidence as hedgerows decline.	Plant and select tree species which are resistant to drought in drier areas and disease. Allow natural regeneration to optimise the diversity of types and resistance to disease. Do not cut hedgerows to less than 2m high and trim every 3 years at most frequent. Use fallow field margins or headlands either side of hedgerows to reduce stress on hedges and hedge trees and increase biodiversity. Plant/encourage native hedgerow species that are resistant to drought, pathogens and pest species. Plant more resilient native hedge plants in new hedges and in gaps along with most tolerant existing species. Retain and repair clawdd. Avoid removing hedges where possible, but if so, increase margins/headlands and thicken hedges elsewhere. Plant/select other species of tree to increase cover (20-70m spacing) to optimise resilience if losses occur. Consider use of hedgerows/trees as shelter belts in more exposed locations. Consider strategic gaps to minimise risk of spread of disease. There may be localised changes to character as trees and woodlands composition change. Existing characteristic oak/ash woodland may be particularly affected. Hedgerows may become scarcer and change in composition but may become slightly thicker and more treed, increasing enclosure in a slightly larger scale landscape.
Some reduction in water quality [and possibly quantity].	Minimise pesticide/herbicide use in arable areas. Ensure adequate facilities for slurry containment. Reduce livestock numbers to reduce pressure on waterbodies, and shift away from close-cropped mono-cultural pasture to maximise retention. Minimise runoff by increasing hedgerow/tree planting along contours. Promote the use of natural drainage systems to support water

	purification, e.g. reed, willow and alder carr. Changes in land management (e.g. increased grassland diversity, minimal use of pesticides/ herbicides) may result in field systems looking less manicured. Expanding hedgerows will reinforce the sense of enclosure.
Some reduction in the variety of tree species.	Plant and select tree species which are resistant to drought in drier areas and disease. Allow natural regeneration to optimise the diversity of types and resistance to disease. There may be localised changes to character as trees and woodlands composition change. Existing characteristic oak/ash woodland may be particularly affected.
Arable farming may increase in area with new types of crops adapted to drier conditions.	Promote minimum tillage and crop rotation, using cover crops to retain carbon and moisture and to build fertility. Minimise the use of pesticides. Ensure that any increase in arable is located in appropriate areas, where soils, water, slopes and elevation will support such development. Retain and support a strong tree and hedge cover (as above) to form a framework to integrate changing crops within fields and structures such as poly tunnels. Tree belts can assist in protecting crops and supporting essential productivity. The scale of landscape may increase with larger field sizes but with an increased diversity of textures and colours, set within a stronger framework. Tree cover may need to increase to integrate structures and overall enclosure may increase.
Higher risk of storm damage, including windthrow, particularly in exposed locations.	Manage fallen trees to retain some fallen trees for biodiversity whilst clearing others to allow access and possible replanting with more resilient native tree and edge shrub species. Consider planting and locating small woodlands and hedgerows to optimise resistance to storm conditions, especially where windthrow may result in structural damage. The landscape is likely to appear less manicured with more fallen trees and gaps in woodland. Elsewhere purpose built shelterbelts may form a different element in the landscape

Buried archaeological remains may be exposed where soil desiccation occurs and at risk of rapid deterioration. New archaeological assets may be revealed by soil parching.	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management. The change in landscape character is likely to be minimal.

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In open landscapes such as the above, restore strong tree and hedge cover (especially on contours) to provide shelter and to hold water and soils. (Near Aberystwyth, Ceredigion.)

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Redesign and increase woodland cover to provide shelterbelts and reduce the risk of wind-borne desiccation. (Near Newtown, Powys.)

© Simon White 2018

Trees and outgrown hedges can integrate and shelter new crops such as grape vines. (Pembrokeshire.)

LMP14_6 Lowland Valleys (hedgerow)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase solar farms in line with policy avoiding the better agriculturally productive land, land with biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	Parts of this landscape type are allocated as priority areas for solar energy which would result in a marked increase in built form in the countryside modifying its rural character. However, the hedged nature of the type offers some enclosure and built in mitigation if managed correctly. Flat or plateau areas with large-scale rectilinear field patterns with hedges would be most appropriate. Development would be particularly noticeable on slopes and in more open countryside without high hedges (+3m) and trees. Tranquil, sloping areas with irregular small-scale field pattern or no enclosure, and intervisible with national designations, would be least appropriate.
Increase wind turbines on technically feasible sites in line with policy avoiding land with vulnerable biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	Parts of this landscape type are allocated as priority areas for wind energy. Larger arrays and turbine heights would result in a major change in character and may be inappropriate in parts due to landscape pattern and landform. The extent of intervisibility could also affect designated landscapes. Areas with large-scale rectilinear field patterns away from traditional settlements would be most appropriate, and tranquil areas with irregular small-scale field pattern and intervisible with designated landscapes least appropriate.
Increase instream hydro-electric power avoiding watercourses with vulnerable biodiversity interest.	Built structures on watercourses modify their natural character and form potentially creating barriers to movement of wildlife. Small-scale, discreet structures, potentially reflecting local character and integrated by appropriate native riparian vegetation may be appropriate.
Increase anaerobic digestion plants.	Built structures of semi-industrial character with associated access can modify rural character. Siting to avoid widely visible locations and skylines, associate with existing large-scale farm buildings and integrate with native tree and hedge planting is likely to be most appropriate.
Increase biomass (transitional option)- short rotation willow/poplar/sweet chestnut coppice or perennial crops such as Miscanthus.	Biomass differs in character from traditional arable crops and pasture due to the height of the crop, and requires large-scale mechanised cropping. Large-scale rectilinear field patterns with hedges would be most appropriate and areas with irregular small-scale field pattern would be least appropriate. Juxtaposition with solar energy could be appropriate to create an energy landscape.

Action	Potential effect on landscape character, qualities and visual amenity
Increase in woodland for carbon sequestration and hedgerow cover.	A substantial increase in woodland such as on floodplains as well as on valley sides would have a marked effect, increasing enclosure. It is unlikely that changes in character will be obvious in the short term but will be more substantial in the long term, as woodlands grow and hedgerow corridors are thickened up with trees. Depending on the variety of species, there could be a significant change in texture and colour.
Implement no-till/plough agriculture.	Cut stems would remain after cropping before rotting down over time. However, overall there would be a minimal change in landscape character and biodiversity/soil health may be enhanced with associated benefits and increase in wildlife.
Convert from silage to hay. Introduce short/medium ley grassland.	A more traditional form of extensive management would mean fields would take on a more traditional aesthetic. Overall there would be a minimal change in landscape character and biodiversity/soil health may be enhanced with associated benefits and prevalence of wildlife with a richer variety of flora adding colour and texture.
Reduce/remove livestock grazing to reduce methane and ammonia and reduce impact on soils. Promote additives to feed to reduce livestock emissions.	The area of extensive improved pasture may be reduced and replaced by either arable, less intensive pasture or semi-natural vegetation/woodland dependent on land capability and other factors. Potentially, meat production may be carried out intensively in sheds. This would substantially change the character of pastoral lowlands, creating more intensively used productive open landscapes in parts, potentially with large agricultural structures, and more enclosed semi-natural less productive areas elsewhere. Suitable colour and materials used in agricultural buildings would contribute to mitigation. A change in the feed regime is unlikely to have an effect on landscape character. Habitat corridors and patches should be maintained even in more intensively managed areas.
Cover over slurry pits (to reduce methane emissions)	Minimal change in landscape character providing neutral colours such as black, dark grey or dark/olive green used as storage tank and cover colours, and the units are associated with existing larger scale agricultural buildings.
Minimise use of fossil-fuel based machinery.	A reduction in the use of cropping or pest/weed control machinery, could lead to changes in land management, which in turn could result in changes to the landscape, e.g. from arable to pasture or woodland. Alternatively, more efficient equipment

	might require changes to field patterns to optimise its use.

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Fence out watercourses and plant up banks to strengthen them against the risk of erosion and pollution. (Near Dol-y-Bont, Ceredigion.)

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Replant hedgerows and allow development and thickening, introduce resilience and diversity in species. (Near Abergynolwyn, Gwynedd)

© Simon White 2017

Locate solar farms on relatively flat sites with high hedges and screening vegetation such as trees, especially to the north.(Llancayo, Monmouthshire- solar farm in far field apparently at the foot of a treed slope.)

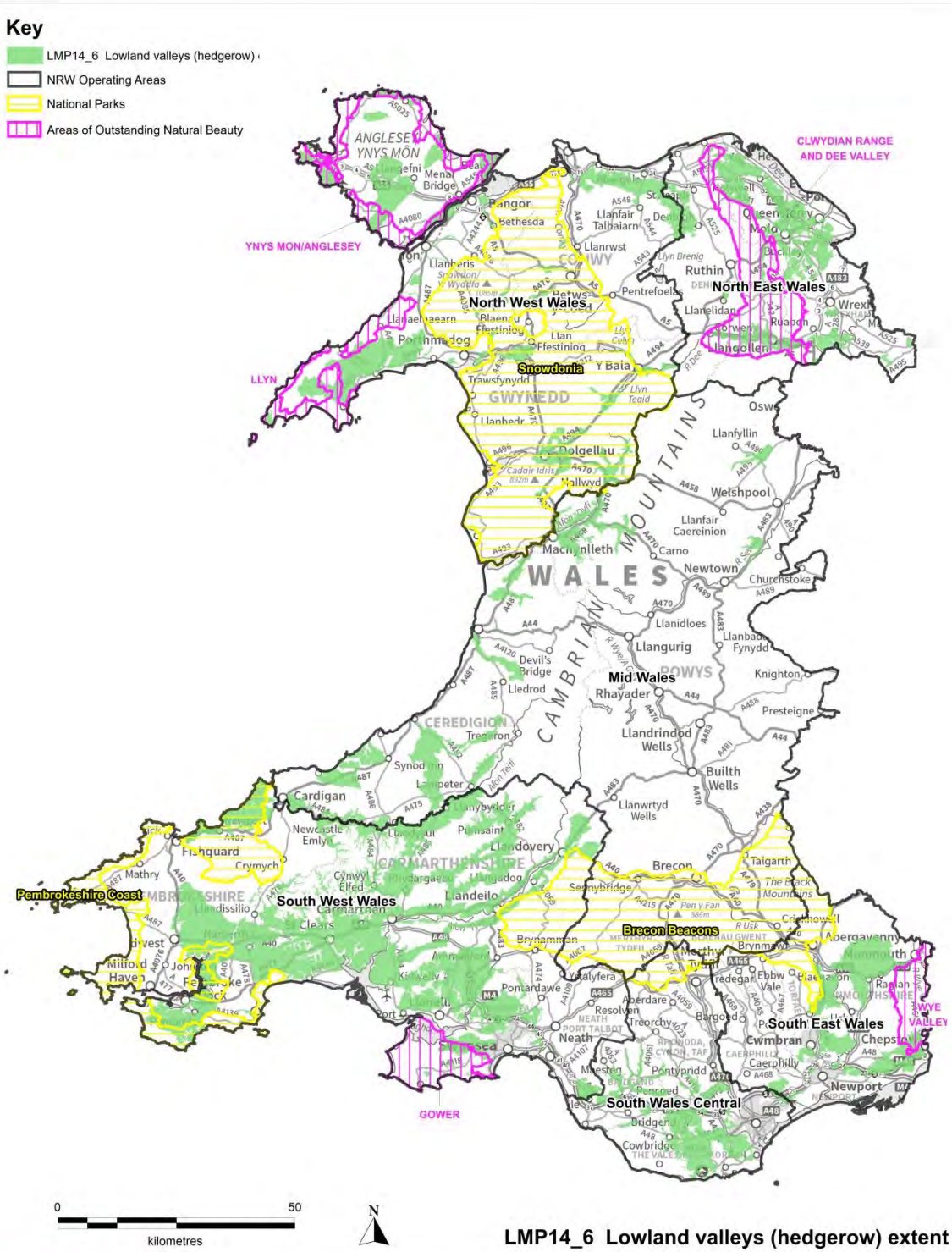
© Simon White 2017

Locate biomass in sites enclosed by hedges and trees where possible with crop fitting the nature of the site eg willow in valley bottom.(Drayton, Warwickshire.)

LMP14_6 Lowland Valleys (hedgerow)			
KEY FACTS and comments			
Overall area (km^2)	3195	***Area** (% of Wales)*	15
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
0	53	41	6
Comment	Just under half of this type is outstanding or high in value. The rest is moderate value. Care is needed in implementing change and there is opportunity for improvement.		
National Parks (% of area)		**AONBs** (% of area)	
6.4		16.6	
Comment	The majority of this type occurs outside national designations. Some lie in lowland valleys such as in Snowdonia National Park and in coastal areas such as in Pembrokeshire Coast and Ynys Mon AONB. There are substantial areas lying within the setting of designations.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	5	411	This type is significantly higher proportionally and in extent in South West Wales. It is fairly evenly spread across other areas apart from Mid Wales where it forms a relatively small proportion of the area.
North East Wales	14	359	
North West Wales	13	647	
South East Wales	13	247	
South Wales Central	13	250	
South West Wales	26	1534	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise is minimal. The risk of periodic flooding covers a small percentage of the area but measures to reduce risk will need to be undertaken.
0	5.3	4.4	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_7 Lowland Valleys (open)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type is a pastoral landscape of farms and fields in a rolling or flat lowland landscape, defined by its relative lack of hedgerow trees and a lower proportion of woodland than in other lowland landscape types. It comprises just under 17% of the area of Wales.

Landscape characteristics and qualities

- Rural communities in a predominantly dispersed pattern of farmsteads and hamlets and villages mostly in south west Wales. Courtyard farms including threshing barns in places.
- Patterns of fields and farmstead architecture testify to a varied farming economy. Working fields enclosed from the medieval period tend to become larger than in other lowland landscapes. 18th-20th century enlargement of fields with straight boundaries, bringing organised regularity to parts of the landscape and enabling intensive modern agriculture which contributes to its sense of openness.
- There are a mixture of boundaries including managed hedges and a small proportion of hedgerows with trees. Many hedges are thorn hedges resulting from 19th century improvement and enclosure. It has the highest proportion of hedgebanks (cloddau) of any of the landscape types, mostly concentrated in the south west.
- Parkland occurs in places, and areas of historic commons and rough grazing are very rare but significant as habitats.
- These are open landscapes with a strong sense of their relationship to other landscape types - of coastal edges, the sea, up valleys and to historic houses and farmsteads and their associated modern agricultural barns and buildings.

LMP14_7 Lowland Valleys (open)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to maintain, support and enhance agricultural production, intensive in places, adapting to what can be grown in a changing climate. Renewable energy including solar and biofuels should be supported in the least sensitive landscapes and on less productive land. All these uses should be integrated to avoid widely visible unsightly development with additional tree and hedge cover if required. Combined with the need for more shelter, this may mean a change towards more enclosure in places. In addition, flood management, biodiversity and recreation all need to be accommodated with a network of linking corridors and patches. Low energy settlement should avoid vulnerable areas, especially subject to flooding, avoid productive agricultural land, and be based on locations and layouts supporting convenient walking, cycling and public transport.

LMP14_7 Lowland Valleys (open)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by changes in vegetation by an increase in pests and disease from warmer mean temperatures, and stress caused by shortage of water in hotter drier summers.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Tree cover will be under most stress with losses in places.	Manage the decline in existing woodland and trees in drier areas with selected felling over time and plant and select tree species which are resistant to drought. Manage and plant native trees and woodlands in areas with access to groundwater, along riparian corridors and on north facing slopes. Give particular consideration to suitable long term parkland tree replacement. Consider tree belts to provide shelter to crops in more exposed areas. There may be localised changes to character as trees and woodlands composition and location change. Shelterbelts may be a new element in places. Overall, the trend of loss of tree cover should be balanced by replacement planting in more suitable locations.
Some tree species may decline from spread of pests and disease (e.g. Oak, Ash, Sitka Spruce) while others may be introduced.	Plant and select tree species which are resistant to drought in drier areas and disease concentrating on broadleaves. Allow natural regeneration to optimise the diversity of types and resistance to disease. There may be localised changes to character as trees and woodlands composition change. Existing characteristic oak/ash woodland may be particularly affected.
Decrease in quality and extent of hedgerows, more gaps, loss of some hedgerow trees, increase in post and wire fencing and field sizes.	Do not cut hedgerows to less than 2m high and trim every 3 years at most frequent. Use fallow field margins or headlands either side of hedgerows to reduce stress on hedges and hedge trees and increase biodiversity. Plant/encourage native hedgerow species that are resistant to drought, pathogens and pest species. Plant more resilient native hedge plants in new hedges and in gaps along with most tolerant existing species. Retain and repair clawdd. Avoid removing hedges where possible, but if so, increase margins/ headlands and thicken hedges elsewhere. Plant/select other species of tree to increase cover to optimise resilience if losses occur. Consider use of hedgerows/trees as shelter belts in more exposed locations.

	Hedgerows may become scarcer and change in composition but may become slightly thicker and more treed, increasing enclosure in a slightly larger scale landscape.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Arable farms may increase in area with adoption of new forms of crops (e.g. vineyards).	Retain and support a strong tree and hedge cover (as above) to form a framework to integrate changing crops within fields and structures such as poly tunnels. Tree belts can assist in protecting crops and supporting essential productivity. The scale of landscape may increase with larger field sizes but with an increased diversity of textures and colours, set within a stronger framework. Tree cover may need to increase to integrate structures and overall enclosure may increase.
Decrease in natural biodiversity (e.g. to plant communities and assemblages) but with potentially limited changes in landscape appearance.	Take all opportunities to optimise biodiversity through conservation of semi-natural habitat patches and corridors including watercourses, woodland, hedgerows, rough grazing, common, and patches of wetland and heathland. If the measures above are undertaken then the landscape character would become more diverse and inhabited by wildlife.
Decrease in surface water visible in summer months with low stream flows and shrinkage and possible temporary disappearance of some shallow ponds and lakes.	Increase trees and semi-natural vegetation in riparian corridors and in headwaters areas to control fast runoff and smooth out flows. Increase measures such as leaky dams, straw bale dams, willow and other tree structures to slow flow as both a benefit to summer and flood flows. Dredge ponds and lakes to range of depths where appropriate to increase resilience to drying up whilst still supporting biodiversity including marginal and other aquatic vegetation. Fence off watercourses in places. Consider reducing livestock numbers, especially cattle, and/or find alternative water supply to reduce pressure on waterbodies. There may be a slight increase in tree cover and semi-natural vegetation related to water bodies within the landscape type.
Buried archaeological remains may be exposed where soil desiccation occurs and at risk of rapid deterioration. New	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management..

archaeological assets may be revealed by soil parching.	The change in landscape character is likely to be minimal.
Main outcome 2	
Lowland valleys are at risk from increased likelihood of flooding from wetter winters and more frequent and intense, storms.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Increase in waterlogged soils in winter in poorly drained areas.	Consider two options- improving soil drainage feeding into watercourses or other waterbodies such as existing or new ponds or allowing areas to regenerate as semi-natural areas. If the measures above are undertaken then the landscape character may become more diverse.
Flood damage in winter is likely to increase due to waterlogged conditions over catchments and higher levels of run-off during intense storms.	Increase trees and semi-natural vegetation in riparian corridors, steep slopes and in headwaters areas (possibly outside the type) to control fast runoff, reduce erosion and smooth out flows. Conserve and increase wetlands to store water and smooth flow. Increase measures dependent on the size of watercourse such as re-naturalising watercourses, leaky dams, straw bale dams, willow and other tree structures to slow flow. Identify adequate areas to store flood water, reconnecting the watercourse with floodplain if necessary, avoid location of infrastructure or dwellings within these areas and implement measures to protect adjacent areas such as bunding and walls. However, the latter measure is expensive which may prohibit widespread implementation. Move development away from most vulnerable areas over time but encourage recreational use that does not rely on vulnerable structures. In the short term consider measures to allow structures to float in flood waters (eg static caravans) although this may not be effective as a long term solution. Potential for a marked change in character from tree planting and semi-natural regeneration within type and adjacent types. Floodplains could be transformed into a mixture of wetland, woodland, semi-natural areas and seasonal low intensity pasture, with very limited development. Adjacent better drained land would be under more pressure from both development and more intensive agriculture. Overall, there could be a greater level of contrast between these areas than at present.

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Measures are needed to make floodplains less vulnerable to damage- Meifod Valley- flooding of fields around River Vyrnwy.

© Simon White 2018

Trees and outgrown hedges can integrate and shelter new crops such as grape vines. (Pembrokeshire.)

LMP14_7 Lowland Valleys (open)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase solar farms in line with policy avoiding the better agriculturally productive land, land with biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	Parts of this landscape type are allocated as priority areas for solar energy which would result in a marked increase in built form in the countryside modifying its rural character. This would increase built form in the countryside and may have particular effect in this area due to its limited hedgerow and tree cover. Development would be particularly noticeable on slopes and in open countryside without high hedges (+3m) and trees. Flat or plateau areas with large-scale rectilinear field patterns with hedges would be most appropriate, and tranquil, sloping areas with irregular small-scale field pattern or no enclosure, and intervisible with nationally designated landscapes, least appropriate.
Increase wind turbines on technically feasible sites in line with policy avoiding land with vulnerable biodiversity interest, nationally designated and other sensitive landscapes and heritage assets and their settings.	Parts of this landscape type are allocated as priority areas for wind energy. Larger arrays and turbine heights would result in a major change in character and may be inappropriate in parts due to landscape pattern and landform. The extent of intervisibility could also affect designated landscapes.Areas with large-scale rectilinear field patterns away from traditional settlements would be most appropriate, and tranquil areas with irregular small-scale field pattern and intervisible with designated landscapes least appropriate.
Increase instream hydro-electric power avoiding watercourses with vulnerable biodiversity interest.	Built structures on watercourses modify their natural character and form potentially creating barriers to movement of wildlife. Small-scale, discreet structures, potentially reflecting local

	character and integrated by appropriate native riparian vegetation may be appropriate.
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase anaerobic digestion plants.	Built structures of semi-industrial character with associated access can modify rural character. Siting to avoid widely visible locations and skylines, associate with existing large-scale farm buildings and integrate with native tree and hedge planting is likely to be most appropriate.
Increase biomass (transitional option)- short rotation willow/poplar/sweet chestnut coppice or perennial crops such as Miscanthus.	Biomass differs in character from traditional arable crops and pasture due to the height of the crop, and requires large-scale mechanised cropping. Large-scale rectilinear field patterns with hedges would be most appropriate and areas with irregular small-scale field pattern would be least appropriate. Juxtaposition with solar energy could be appropriate to create an energy landscape.
Increase in woodland for carbon sequestration.	A substantial increase in woodland such as on floodplains as well as on valley sides would have a marked effect, increasing enclosure and texture in the landscape.
Implement no-till/plough agriculture to maintain carbon in the soil.	Cut stems would remain after cropping before rotting down over time. However, overall there would be a minimal change in landscape character and biodiversity/soil health may be enhanced with associated benefits and increase in wildlife.
Convert from silage to hay to maintain carbon in the soil. Introduce short/medium ley grassland.	A more traditional form of extensive management would mean fields would take on a more traditional aesthetic. Overall there would be a minimal change in landscape character and biodiversity/soil health may be enhanced with associated benefits and prevalence of wildlife with a richer variety of flora adding colour and texture.
Reduce/remove livestock grazing to reduce methane and ammonia and reduce impact on soils. Promote additives to feed to reduce livestock emissions.	The area of extensive improved pasture may be reduced and replaced by either arable, less intensive pasture or semi-natural vegetation/woodland dependent on land capability and other factors. Potentially, meat production may be carried out intensively in sheds. This would substantially change the character of pastoral lowlands, creating more intensively used productive open landscapes in parts, potentially with large agricultural structures, and more enclosed semi-natural less productive areas elsewhere. A change in the feed regime is unlikely to have an effect on landscape character. Habitat corridors and patches should be maintained even in more intensively managed areas.

Action	Potential effect on landscape character, qualities and visual amenity
Cover over slurry pits (to reduce methane emissions)	Minimal change in landscape character providing neutral colours such as black, dark grey or dark/olive green used as storage tank and cover colours, and the units are associated with existing larger scale agricultural buildings.
Minimise use of fossil-fuel based machinery.	A reduction in the use of cropping or pest/weed control machinery, could lead to changes in land management, which in turn could result in changes to the landscape, e.g. from arable to pasture or woodland. Alternatively, more efficient equipment might require changes to field patterns to optimise its use.

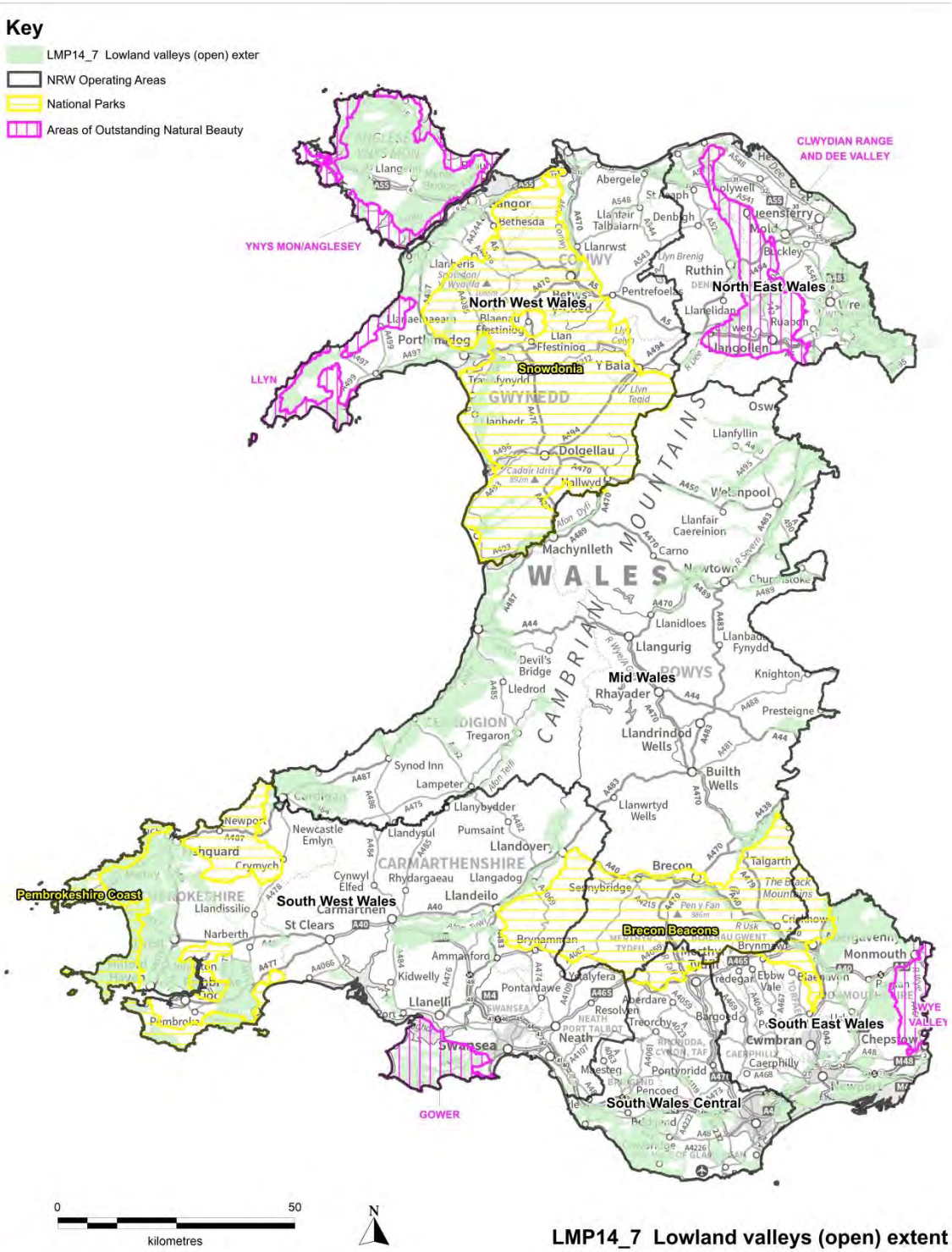
Locate solar farms on relatively flat sites with high hedges and screening vegetation such as trees, especially to the north. (Llancayo, Monmouthshire.)

Locate biomass in sites enclosed by hedges and trees where possible with crop fitting the nature of the site eg willow in valley bottom.(Drayton, Warwickshire.)

LMP14_7 Lowland Valleys (open)			
KEY FACTS and comments			
Overall area (km^2)	3525	***Area** (% of Wales)*	17
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
1	66	28	5
Comment	Around a third of the type is outstanding or high value, with the majority moderate. The area is therefore less sensitive than some other landscapes but care is needed in implementing change and there is opportunity for improvement.		
National Parks (% of area)		**AONBs** (% of area)	
9.9		23.9	
Comment	The type has a relatively low percentage of nationally designated landscape but also includes areas within the settings of the designations. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	10	814	His type is spread fairly evenly across the operating areas with the greatest proportion in South East Wales and the greatest overall area in South West Wales. The lowest proportion is in Mid Wales.
North East Wales	16	407	
North West Wales	18	913	
South East Wales	20	376	
South Wales Central	14	265	
South West Wales	17	1023	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise is very limited/nil but the area in flood zones 2 and 3 is marked. Measures within the area are therefore essential to minimise adverse effects. Measures within associated catchment areas are also necessary to reduce the potential for flooding within the area.
0	17.8	16.2	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_8 Lowland (wooded and wetland)
SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type has a relatively high proportion of woodland and wetland alongside pasture in places. There is a rich diversity of plant communities, some of which are nationally and locally designated. The wooded part of the type occurs in river valleys, often on steep slopes such as the Teifi, Mawddach and Wye valleys and north of Mynydd Hiraethog but also on the coast, such as at Pembrey Forest. Wetland includes Cors Caron and Crymlyn Bog National Nature Reserves, and on the Gwendraeth near Kidwelly. It comprises 2.37% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Older woodland and linear wetlands are often evident as an intricate network following the tranquil pastoral and wooded valley sides of watercourses.
- Wetlands and marshy pasture can cover large flat areas and have a very high nature conservation interest. Discrete and rare areas of wet grassland and rough grazing habitats have survived.
- Coniferous plantations are present, such as on reclaimed dunes.
- Some of this landscape type is enclosed, with managed hedges or hedges with individual hedgerow trees dominant, with stone walls and cloddau also present. These historic hedgerows, copses and blocks of woodland provide a framework for visual appreciation of historic settlements, houses and farmsteads.
- Dispersed settlements, with patterns of small-scale fields managed as smallholdings lie on drained wetland and common pastures.
- There is a strong sense of time depth and pattern, with a recognisable local character, diversity and texture. Scenic quality is generally higher where associated with species diversity.

LMP14_8 Lowland (wooded and wetland)
SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

Given its value, rarity and dispersal, the emphasis in this area is to maintain and enhance its qualities and to increase its extent, encouraging corridors and linkages between patches where possible. Woodlands should be managed to optimise biodiversity and provide carbon sequestration, and recreation in parts. Wetlands should be optimised for retention of water and biodiversity. Low input agriculture should continue to be supported, but optimising biodiversity, soil and water management.

LMP14_8 Lowland (wooded and wetland)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by hotter drier summers and effects of pests and disease on tree cover and hedgerow species from generally warmer mean temperatures.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Some reduction or loss of tree species (beech, larch, ash, Sitka Spruce) may occur as a result of pests and disease.	Plant and select tree species which are resistant to drought in drier areas and disease. Allow natural regeneration to optimise the diversity of types and resistance to disease. There may be localised changes to character as trees and woodlands composition change. Existing characteristic oak/ash woodland may be particularly affected.
Vegetation composition of woodland may alter, though this may only be apparent at certain times of year (e.g. reduction in springtime flowering plants.)	Where possible, plant and select appropriate native tree species which are resistant to drought in drier areas, and to disease. Allow natural regeneration to optimise the diversity of types and resistance to disease. Allow a variety of conditions to encourage diversity in the ground flora which may also include natural regeneration. Depending on the species lost and/or replaced, there may be some changes within woodlands. For example, changes from coniferous to deciduous or vice versa, or changes in hardwood species, varieties will alter the light, colour, texture and understorey.
Water quality may decline in summer months. Low flows and increased water temperature will impact on aquatic ecosystems making them potentially less effective at delivering services such as filtering water and storage. Drier conditions may result in loss of water, particularly from feeder streams in the lowland (open) landscape. Temporary ponds may disappear.	Optimise retention of water in watercourses through appropriate management e.g. leaky dams, straw bale dams, willow and other tree structures and creating narrower low flow sinuous channels if appropriate. Manage riparian corridors, optimising tree and other planting. Dredge ponds to a range of depths where appropriate in terms of maintaining biodiversity to increase resilience to drying up whilst still supporting marginal and other aquatic vegetation. Increase the number of waterbodies to store water with associated marginal and edge planting. Promote the use of natural drainage systems to support water purification, e.g. reed, willow and alder carr. Minimise runoff by increasing tree or hedge

	planting along contours. Fence off watercourses and/or livestock numbers to reduce pressure on waterbodies. Shift away from close-cropped mono-cultural pasture to maximise retention. Minimise pesticide/herbicide use in agricultural land. Increase trees and scrubbier semi-natural vegetation within catchments, especially on steeper slopes, to control fast runoff and regulate flows. Manage soils to maximise their capacity to hold moisture. In some cases, allow fallen scrub and trees to break down in anaerobic wet ground in order to increase capacity to hold carbon. Changes in management may increase the amount of water visible at various times of year with associated semi-natural vegetation. Agricultural land management may result in field systems looking less manicured. Expanding hedgerows will reinforce the sense of enclosure, possibly reducing the size of fields.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Hedgerows may decrease in extent and species composition as a result of pests, disease, and stress from drier conditions.	Do not cut hedgerows to less than 2m high and trim every 3 years at most frequent. Use fallow field margins or headlands either side of hedgerows to reduce stress on hedges and hedge trees and increase biodiversity. Plant/encourage native hedgerow species that are resistant to drought, pathogens and pest species. Plant more resilient native hedge plants in new hedges and in gaps along with most tolerant existing species. Retain and repair clawdd. Avoid removing hedges where possible, but if so, increase margins/ headlands and thicken hedges elsewhere. Hedgerows may become scarcer and change in composition but may become slightly thicker and more treed, increasing enclosure in a slightly larger scale landscape.
Where soil desiccation occurs, buried archaeological remains may be exposed and at risk of rapid deterioration. New archaeological assets may be revealed by soil parching.	Report any asset exposure to the relevant Archaeological Trust and follow their advice on site management.. The change in landscape character is likely to be minimal.

Main outcome 2	
Warmer, wetter winters may lead to increased water logging of soils, higher river levels and more frequent flooding.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Wetter conditions may result in significant fluctuations in water levels.	Increase trees and scrubbier semi-natural vegetation, especially on steeper slopes, to control fast runoff and regulate flows. Conserve and increase wetlands to store water and smooth flow. Fence out and plant up alongside riverbanks to minimise erosion. There may be greater amounts of standing water in flat low lying areas and these should be part of flood management. In these areas there may be changes in the associated vegetation, with a loss of species less adapted to fluctuations in water but increasing wetland species. In some areas the sense of enclosure may increase as a result of increased tree and scrub cover in currently open areas. These are likely to be localised.
Seasonal flooding is likely to increase due to already waterlogged areas struggling to contain run-off during intense storms.	Increase trees and semi-natural vegetation in riparian corridors, valley sides and bottoms especially steep slopes to control fast runoff, reduce erosion and sediment deposition and smooth out flows. Conserve and increase wetlands to store water and smooth flow. Increase the amount willow and alder carr in order to slow the rate of flow where necessary and appropriate. Increase measures dependent on the size of watercourse such as re-naturalising watercourses, leaky dams, straw bale dams, willow and other tree structures to slow flow. Manage soils to maximise their capacity to hold water. Whilst surface water may be less apparent in summer months, water will be more in evidence in winter especially flat low lying areas with more waterlogged soils, and potential for more frequent flood events. Adaptation measures will lead to increased tree and hedge enclosure on valley sides and floors.

Outcome	Adaptation and its potential effect on landscape character, qualities and visual amenity
Higher risk of storm damage, particularly in exposed locations, and windthrow.	Manage fallen trees to retain some fallen trees for biodiversity whilst clearing others to allow access and possible replanting with more resilient native tree and edge shrub species. In some areas natural regeneration may be appropriate. The landscape is likely to appear less manicured with more fallen trees and gaps in woodland.

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Slow down the rate of flow by increasing the amount of wet woodland, and by allowing natural scrub to develop or planting up upstream banks. Dam minor watercourses to increase storage capacity. (Farchynys, Gwynedd)

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Allow fallen scrub and trees to break down in anaerobic wet ground to avoid release of carbon to the atmosphere. (Near Mawddach estuary, Gwynedd.)

LMP14_8 Lowland (wooded and wetland)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	Potential effect on landscape character, qualities and visual amenity
Increase instream hydro-electric power avoiding watercourses with significant biodiversity	Built structures on watercourses modify their natural character and form potential barriers to movement of wildlife. Small-scale, discreet

interest.	structures, potentially reflecting local character and integrated by appropriate native riparian vegetation may be appropriate.
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase in woodland for carbon sequestration.	A substantial increase in woodland could have a marked effect, increasing enclosure and texture in the landscape. Wetlands should generally be avoided.
Convert from silage to hay allowing more arisings to remain on fields. to maintain carbon in the soil. Biodiversity/soil health may be enhanced with associated benefits e.g. carbon sequestration and moisture retention.	In the limited areas of grassland, fields would be managed in a more traditional extensive way with a more traditional aesthetic appearance with greater prevalence of wildlife. Overall there would be a minimal change in landscape character which may be beneficial.
Reduce livestock numbers to reduce methane emissions and ammonia.	Likely to result in fields looking rougher and scrubby, with uphill creep of scrub and tree cover. Overall, unlikely to be significant in this landscape type, although dependent on extent of any reduction in livestock.

Promote the use of natural drainage systems to support water purification, e.g. reed, willow and alder carr. (Near Mawddach estuary, Gwynedd.)

Increase trees and scrub semi-natural vegetation within catchments, especially on steeper slopes, to control fast runoff and regulate flows. (Near Bontddu, Gwynedd.)

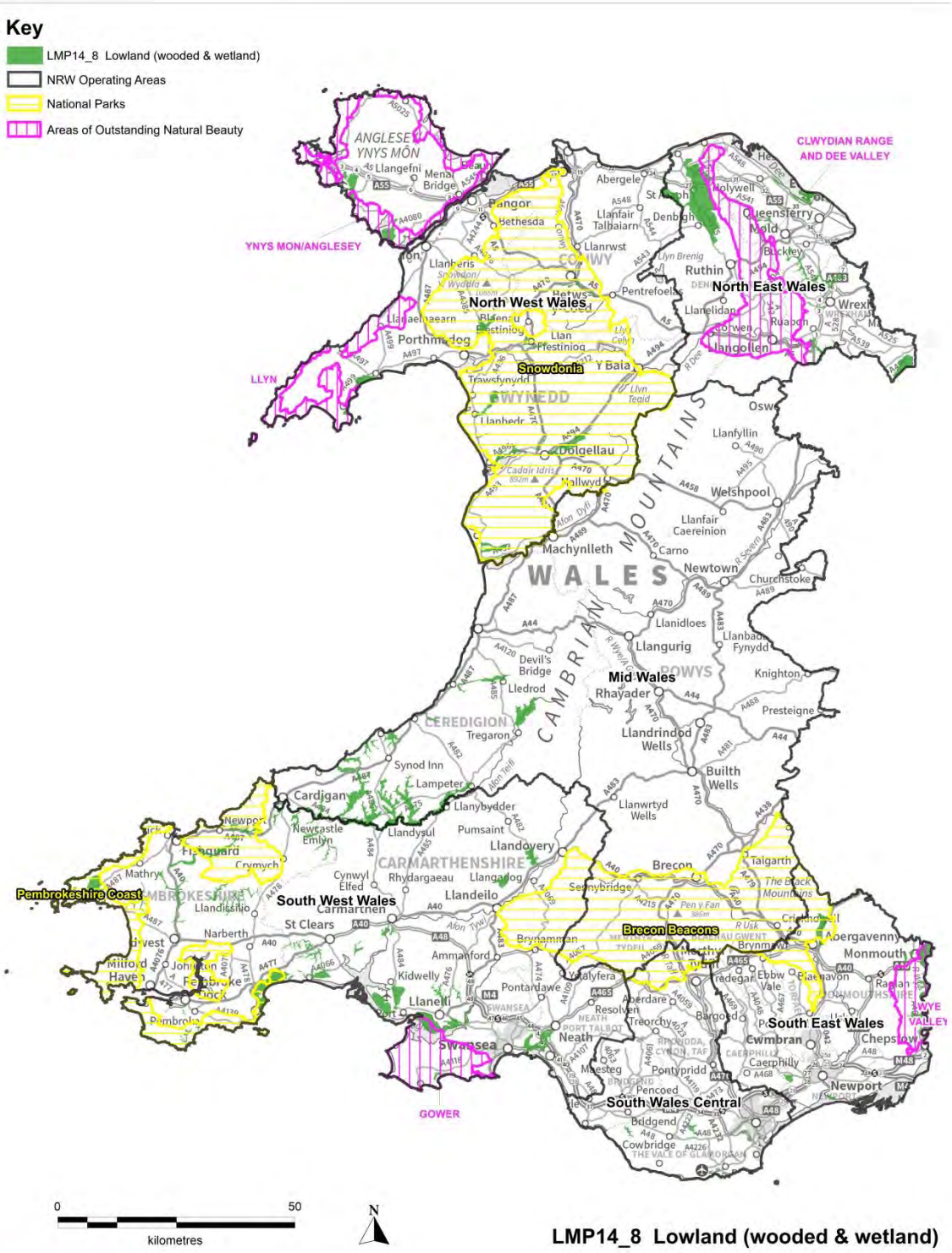
LMP14_8 Lowland (wooded and wetland)			
KEY FACTS and comments			
Overall area (km^2)	503	***Area** (% of Wales)*	2
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
2	17	71	10
Comment	Over 80% of this landscape type is considered to be of high or outstanding value with most of the rest moderate value. The area does not cover a large area nationally and is dispersed but it makes a significant contribution to landscape character locally.		
National Parks (% of area)		**AONBs** (% of area)	
2.3		4.9	
Comment	There is a proportion of this type in the national designations. The majority appears to be in National Parks with narrow wooded valleys and wetland occurring in Snowdonia, Brecon Beacons and the Pembrokeshire Coast. Woodland also occurs in the Wye Valley AONB and as coastal forest plantation in Ynys Mon AONB.		

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	1	123	This type occurs chiefly in North East Wales and South West Wales. It is virtually non-existent in South Wales Central. As a proportion of overall area, it is rarely found in Mid Wales. However, it occupies the second highest area of this type in Wales.
North East Wales	4	109	
North West Wales	2	78	
South East Wales	2	41	
South Wales Central	0	7	
South West Wales	4	243	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise is limited to coastal areas where natural managed retreat may be appropriate. The area at risk in flood zones 2 and 3 is notable. This is likely to coincide mainly with the wetland areas where flooding is a natural part of the landscape and its character. This landscape type may be suited to managed flooding to alleviate damage to more vulnerable areas.
4	19.5	17.2	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_9 Coastal edge

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type includes the intertidal zone, coastal wild land and small islands. Areas include the Burry Inlet and Dee saltmarsh, Traeth Lavan tidal sands, Morfa Harlech, Pendine Sands, Kenfig Burrows and Ramsey, Skomer and Caldey Islands. This type comprises 2.45% of the area of Wales.

Landscape characteristics and qualities

- The natural features of this type include the intertidal zone (beaches, mud and rocks), cliffs and cliff tops, steep slopes, coastal wild land such as heath, rough grassland and scrub, dunes, saltmarsh, and small islands. The rocky headlands and cliffs showcase geological formations from hard Pre-Cambrian granite through to soft liassic limestones.
- These landscapes have distinct sense of place related to semi-natural vegetation and rocky/sandy habitats and their associated colours.
- Man-made interventions include anti-invasion defences, fishing, maritime trade, features from relict industrial mineral mining and quarrying, coastal navigation (lighthouses, daymarks and coastguard houses) and sea defences - including timber groynes and breastwork defences, and more recent beach nourishment and rock beach structures.
- Settlement is sparse. Some areas are marked by nearby development, 20th century housing and amenity land, mostly golf courses and caravan and camping sites.
- Only a very small proportion (12%) of this landscape type is enclosed, mostly with stone walls (9%) and sometimes with fences (2%). Some headlands and dunes are used for rough grazing. Tree cover is also sparse, and focussed in more sheltered places, with prevailing winds creating a distinctive windblown profile.
- Rough grazing has conserved extensive areas of medieval and earlier archaeology.
- Historic features also extend into the intertidal zone, including fossil forests exposed on beaches affected by a rise in sea levels around 6,000 years ago.
- There is widespread access to these landscapes, including via coastal tracks and paths, and they have valued panoramic views, a sense of remoteness and wildness.
- The coast is frequently associated with low levels of light pollution and landscapes of outstanding or high importance for their scenic quality and character and highly valued seascapes often part of a designated Heritage Coast, National Park or AONB, generally associated with attractive views.

LMP14_9 Coastal edge

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to protect coastal edges where there are larger settlements and critical infrastructure (hold the line), stabilise coastal habitats where possible to resist erosion where feasible but elsewhere manage coastal retreat whilst optimising the potential and diversity of coastal and intertidal habitats (managed realignment and no active intervention). Settlement and infrastructure in rural locations will need careful management migrating to appropriate resilient locations respecting local character.

LMP14_9 Coastal edge	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by sea level rise, compounded by warmer wetter winters leading to more flooding in winter months, and more frequent and intense storms (again causing flooding, and storm surges with negative impacts on low lying areas).	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Sea level rise is likely to have a significant impact on coastal edge landform, vegetation and habitat. Overall there will be a loss of low-lying coastal land and habitats such as sand dunes, salt marsh and freshwater habitats.	Reinforce stability of natural systems and habitats. Where stability is more important than habitat value encourage the revegetation of dunes by restricting access to people and livestock. In line with the shoreline management plan allow natural realignment of the coastline away from settled areas with either managed realignment or no active intervention. Encourage a range of conditions to allow new and diverse coastal habitats to be formed to replace those lost where possible e.g. saltmarsh, mudflat or other intertidal areas. Monitor and adapt to dynamic change over time. The profile of the coastal edge will change significantly. It may mean a smaller proportion of productive agriculture and a larger proportion of semi-natural land prone to seasonal flooding, albeit smaller in overall area. New and existing settlement and infrastructure is likely to be reduced significantly in these areas. If the measures above are undertaken then the landscape and seascape character of low lying areas will change, becoming smaller, more dynamic and less settled, with abandoned structures. There will be a more abrupt edge between sloping land and the intertidal area.
Major erosion of landform of higher coastal areas e.g. cliffs/heaths etc	Where there is a major settlement or infrastructure along clifftops hold the line with a combination of hard coastal defences and/or management of coastal processes and sediment such as sandbanks offshore to reduce wave energy. Allow erosion of cliffs elsewhere in managed realignment to maintain coastal access and establish/encourage semi-natural vegetation where possible to help replace lost heaths and grassland. The latter may not be possible in areas of fast retreat.

	Features such as distinctive cliffs, headlands, coastal forts, lighthouses will be lost and those man-made features with a useful function will need to be relocated further inland. Some established cherished views will be changed but other features and views will be created. Damage to features will be unsightly. Overall, the coastal edge will become more dynamic, more raw and less settled in most places, with consequent adverse effects on character. Where there is coastal defence this will adversely change the natural character of the intertidal zone.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Sea level rise is likely to have a significant impact on transport and settlement.	Relocate infrastructure such as roads, railways, cycleways and long-distance footpaths in vulnerable locations to avoid disruption. Protect larger settlements and key infrastructure where feasible with coastal defences including use of multifunctional structures such as tidal lagoons. Increase resilience of some coastal structures to damage or flooding where appropriate. In other areas, in line with the shoreline management plan define a line and level for relocated settlement and infrastructure to deal with sea level rise and storm surges. This should be carefully planned to respect coastal character and avoid the most sensitive locations. Manage transitional duplication of buildings and structures ensuring that 'abandoned' structures are either removed or serve a useful new function. The seaside character of many areas is likely to significantly change with higher, larger and potentially intrusive coastal defences in some areas and damage or removal of historic features such as seafront or quayside buildings, walls and other structures. Settlement and infrastructure here will spread back and up from the coast, potentially increasing adverse effects on character.
Archaeological sites and historic landscapes along the coast edge, either in low-lying locations or on exposed cliffs, will be at risk of damage and loss due to sea level rise, coastal erosion and increased storm events.	Protection of these features is difficult and is unlikely to be economically justifiable. Recording of their location and characteristics with appropriate research and possible interpretation may be the only option. In exceptional circumstances features may be relocated (eg Clavell Tower in Kimmeridge, Dorset).

	Removal of evidence of past use and historical features, some of which are important landmarks, will have an adverse effect on coastal character.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Salt water intrusion will impact the coastal vegetation and land use, damaging agricultural land and protected natural habitat with losses of up to 2,300ha of Natura designated coastal habitat by 2100. Fresh water aquifers in coastal areas may also be affected by salt water intrusion.	Locate agricultural land away from flatter land subject to salt water intrusion and allow reversion to semi-natural vegetation and salt water habitat creation. Potentially increase intensity of agriculture in productive areas (with associated integrating landscape measures) to compensate for reduction in area. If possible, over time establish freshwater habitats at higher levels to compensate for loss of coastal habitats to salt water. Manage affected areas as salt water habitats. Locate less vulnerable fresh water aquifers to replace those affected by salt water. The flat coastal fringe will become less settled and productive with larger semi-natural salt water coastal habitats.

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Hard solutions to coastal defence may be appropriate to protect larger vulnerable coastal settlements. (Porthcawl seafront.)

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A small vulnerable settlement which will be below normal tide levels in 50 years- Fairbourne. Appropriate planned relocation of residents will be required over time.

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Erosion of boundary wall due to storm damage requires consideration of retreat of structures to resilient locations. (Southerndown, Vale of Glamorgan coast.)

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Coastal erosion of cliffs and features on them such as promontory forts remnant earthworks on clifftops. (Vale of Glamorgan coast.)

© PCNPA 2019

Monitoring coastal change in National Parks is essential to understanding how to plan ahead. (Porth y Rhaw, Pembrokeshire.)

© Simon White 2020

The cliff top access road has been relocated away from coastal edge. (Southerndown, Vale of Glamorgan coast.)

LMP14_9 Coastal edge	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Manage and increase coastal wetland habitats to optimise carbon sequestration (as a carbon sink) and biodiversity, and act as buffers to protect the areas further inland, allowing migration inland over time.	Change from cultivated or intensively managed areas or settlements to semi-natural areas. This will increase the natural character of the coastal zone which is also likely to reduce in size. There is potential for increasing recreational access.
Locate tidal lagoons along coast in technically feasible and appropriate areas.	Increase in built form in inshore waters and on the coast. Development would be particularly noticeable where located close to cliffs and could adversely affect nationally designated coastal areas. Locate along lower value and lower sensitivity developed and vulnerable levels coast. The dynamic coastal character would change with effects on coastal processes, biodiversity and

	seascape but with added potential for recreation and flood protection
Action	**Potential effect on landscape character, qualities and visual amenity**
Increase tidal stream development inshore.	Increase in minor built form beneath the surface and onshore could have localised effects on seascape and biodiversity requiring sensitive siting in exposed headlands and islands.

© Simon White 2017

Establishment of new coastal wetland habitat- saltmarsh at Cwm Ivy, Gower. Breaching of the seawall has led to killing of trees and scrub and former pasture is now changing to saltmarsh over time.

© Simon White 2013

Appropriate sites around the coastline need to be considered for tidal lagoons- site of the proposed Swansea Bay tidal lagoon.

LMP14_9 Coastal edge

KEY FACTS and comments

Overall area (km^2)	520	***Area** (% of Wales)*	2.45

Landscape value (%)

Low	*Moderate*	*High*	*Outstanding*
0	8	56	35

Comment	Over a third of the type is outstanding and over half is high value, with a small area of moderate. The area is very sensitive to change to landscape and seascape character.

National Parks (% of area)	**AONBs** (% of area)
2.2	9.8

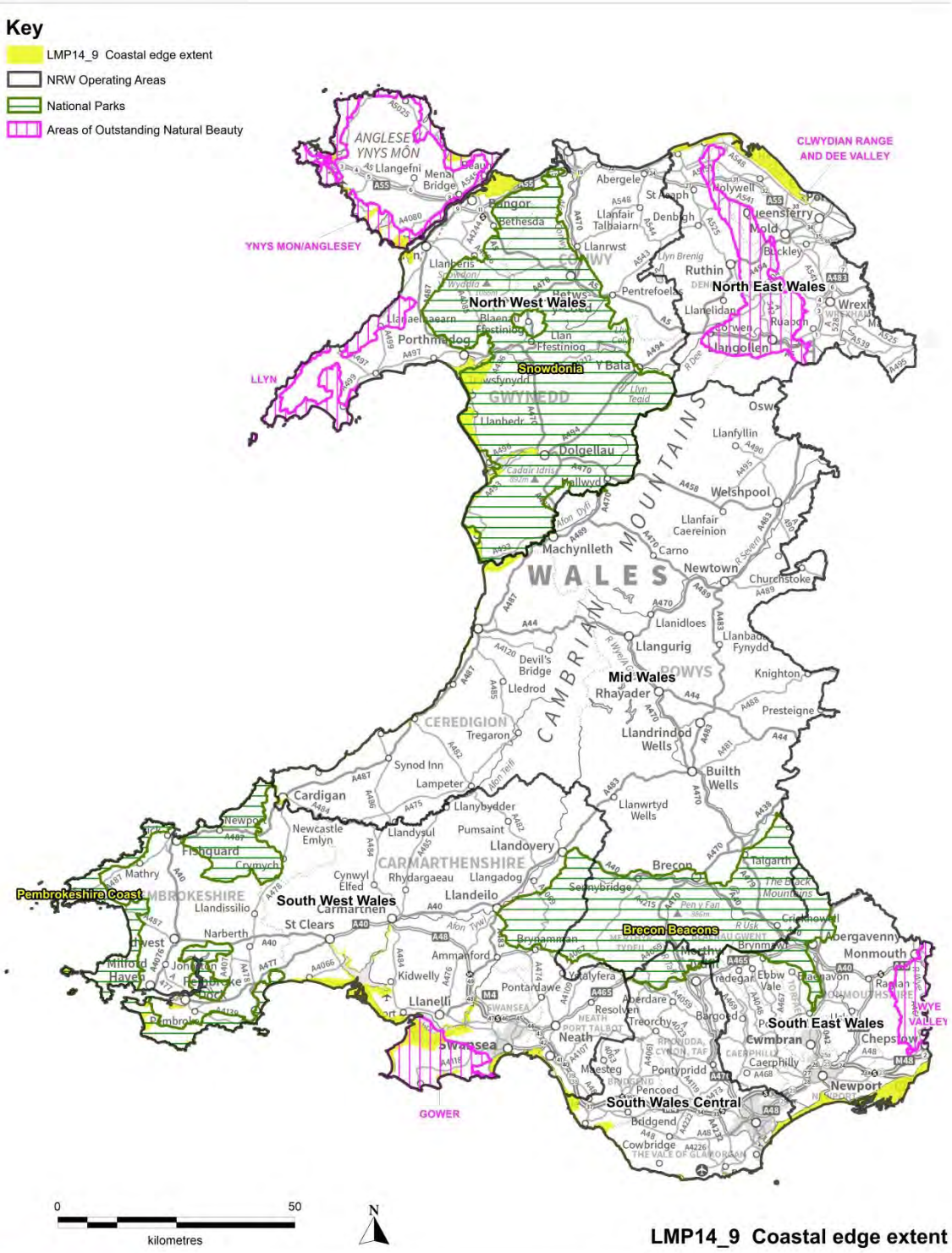
Comment	The type has a relatively low percentage of nationally designated landscape but also includes areas within the settings of the designations. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	29	This type is spread fairly evenly across the operating areas with the greatest areas in South West and North West Wales. The lowest proportion and area is in Mid Wales.
North East Wales	2	58	
North West Wales	3	168	
South East Wales	3	54	
South Wales Central	3	59	
South West Wales	3	197	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risks of sea level rise and in flood zones 2 and 3 are very high. Measures within the type are therefore essential to minimise adverse effects.
51	60.3	59.2	



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Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_10 Developed (communities)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises developed (communities) including urban communities, villages and larger rural settlement. Four fifths of the population of 2.5 million live in urban areas and a fifth in rural areas. This type comprises 4.47% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Urban areas with populations exceeding 10,000 are concentrated around the industries and coal fields of north-east Wales, along the resorts of the north Wales coast, around the ports of Pembroke and Milford Haven and in both ports and industrial centres of south Wales (including Swansea, Cardiff and Newport) extending inland up the valleys with their associated former coal fields. The larger centres have strong 19th through to 21st century growth with large civic and retail centres and housing both in regeneration areas such as docks as well as green field expansion. Smaller post-industrial settlements have more limited growth.
- Small market towns and ports are also a strong characteristic of Wales. 81 have been identified with the five largest towns (Aberystwyth, Milford Haven, Bangor, Carmarthen and Abergavenny) accounting for a fifth of the population resident in this category. These typically retain strongly characteristic historic settlement cores, 19th and 20th century growth being comparatively modest, although recent decades have seen some significant expansions of the coastal towns inland.
- Historic urban areas in Wales are dominated by their 19th century building stock, often hiding the cores of earlier buildings in historic cores or in chains of industrial settlements absorbed by later growth. These include market buildings, often built in materials reflecting the underlying geology and standing out in the landscape due to undulating topography.
- Smaller open spaces in urban areas and towns (see Developed Amenity for larger spaces) provide an important contrast and break from the built environment. Linear urban river corridors, greened former railway or canal corridors, small green spaces and street tree planting are important resources for wellbeing. Private residential gardens take up 35% of cities and towns' land area but this reduces in areas of high-density housing, and deprived areas are noticeably lower in tree cover.
- Busy roads and increased light pollution are concentrated in these urban areas and along their linking transport routes, this can contribute to a reduction in tranquillity.

LMP14_10 Developed (communities)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type in terms of adaptation is to increase effectiveness and connectivity of green infrastructure including resilient tree planting and widely adopting SuDS to absorb rainwater and reduce surface water flooding. In terms of mitigation, the emphasis is to reduce energy use such as cars through supporting walking, cycling and public transport and reducing space for the car, and to increase efficient sustainable energy production and use, and insulation in buildings.

LMP14_10 Developed (communities)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by warmer mean temperatures raising the potential risk from pests and disease and hotter drier summers putting additional stress on vegetation and trees.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Urban landscapes may alter as a result of climate change in both direct and indirect ways. Heat island effects are likely to exacerbate summer temperatures. Direct impacts such as warmer mean temperatures may increase pests and disease in vegetation and trees, causing a decline in quality or loss. Indirect impacts may result in changes to species mix of trees and plants utilised in open spaces, parks and streets.	Monitor the health of trees and other vegetation in streets and open spaces to identify stress, trends in pests and diseases and the most resilient species. Identify, manage and water the most important trees to ensure their survival in the medium term. Carry out a long-term programme of replacement with more resilient species, increasing the number overall, whilst maintaining character, scale and biodiversity value as far as possible. The most important trees in cities to maintain are large/'forest' species which have the most impact on microclimate and aesthetically e.g. planes, limes, hornbeams, oaks. Built form and transport infrastructure should accommodate these trees through retention and provision of sufficient space for roots and crowns and water (SuDS). The diversity of species and numbers of trees may reduce in the short/medium term as well as tree works being needed to manage the decline of individual trees where necessary. Numbers should increase in the longer term. Tree stress may be evident through premature leaf fall and autumn colouring but this may reduce in the longer term.
Rapid run off and limited percolation of water into the soil is likely to lead to drier soils and additional stress on trees/vegetation.	Reduce the area of the impervious hard standings and the discharge of rainwater from buildings directly into the surface water sewer system. Implement SuDS measures, to reduce risk of surface water flooding including under streets, in hard surface areas including parking, in green areas and create permanent and temporary water features. Ensure SuDS measures work closely with planting to support tree and shrub health. If implemented, the amount of impervious hard surface should reduce with the introduction of green elements such as swales to absorb surface water, and associated planting of trees. Permeable surfaces would also be more apparent. Overall,

	there may be an improvement in streetscape and small scale city spaces aesthetically and in terms of microclimate.
Settlements in areas with clay soils may experience additional subsidence of buildings during summer months. (Only shrinkable clay is susceptible to this- i.e. with montmorillonite).	Monitor subsidence and investigate if this is due to shrinkable clay or other reasons such as insufficient foundations or leaking drains/water supply. Retain nearby trees if at all possible as removal may lead to heave due to clay expansion in winter. Reinforce foundations of existing buildings as necessary to suit ground conditions. Design all new buildings with foundations to suit ground conditions and accommodate nearby trees. If implemented, tree cover should be protected with no noticeable change in character.
Water bodies (rivers, streams, canals, ponds) will have lower flows or dry up during summer months. Water bodies will exhibit increased water temperatures and be more susceptible to algal blooms.	Design water bodies to vary the width, depth and profile to optimise the use of, and access to, water bodies and the range of habitats leaving potential for permanent water in places. Surrounding water bodies with additional tree or shrub planting and green space may reduce evaporation. Manage water bodies carefully including removing algal bloom to avoid risk to health. Overall, there is likely to be a reduction in the amount of permanent water but an increase in the diversity of profile in watersides and the water bodies themselves.
Main outcome 2	
Other significant changes are increased potential for flood and storm damage during winter months.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Structures and settlement in coastal areas will be at higher risk of damage from flooding and wetter winters.	Increase resilience of coastal defences and vulnerable structures to maintain their functionality. Engineered functionality should be tempered with a strong design input to optimise elegance and potentially, multiple use of structures. This may mean less visual connection between the coastal strip and the sea or rivers due to the height of walls, and a harder coastal/river edge. However, there may be potential for creative structures which contribute to a new coastal character.
Historic structures are likely to be impacted by more severe weather conditions, in particular	The most important historic structures should be made more resilient using appropriate detailing and materials to ensure that character is not

impacts to building fabric from wetting/drying, freeze/thaw, storm damage, pests and fungal infestations of buildings, overflowing gutters and water management.	significantly changed. This may mean a programme identifying those most vulnerable and those which most urgently require attention, before irreparable damage is done. In exceptional cases, consideration may be given to relocating buildings to safer locations. If implemented, most important landmarks should be protected and remain in place with limited/no change in character.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Waterlogging may occur in winter months due to wetter conditions, and water quality may decline where combined sewers cannot manage additional flows.	Implement SUDs measures, to reduce risk of surface water flooding including storage of water beneath streets, in green areas and introduce appropriate water features. If implemented, streets may improve in character with an increased amount of tree and shrub planting, and swales.

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Retrofit shrub beds and gulleys capture surface water run off and feed large capacity underground storage with delayed discharge into the river. (Greener Grangetown SuDS scheme, Cardiff.)

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Swales and open aggregate drains in small open spaces and play areas to absorb surface water. Use of native species trees and hedging. Recent development on brownfield site. (Llandarcy, Swansea.)

LMP14_10 Developed (communities)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Optimise transport energy efficiency in existing built areas significantly reducing car use through various policies and including retrofitting convenient cycle routes for commuting and other destinations; increasing potential for walking through improving safety and new routes; retrofitting integrated public transport infrastructure including guided buses, trains and trams; zoning and building corridors of higher densities to support sustainable transport routes; reducing car parking.	Transport corridors would become less dominated by cars with increased public transport and walking/cycling infrastructure. This could increase complexity of the street scene which may be just attractive but also may increase tree planting which would help mitigate effects and improve character and visual amenity. Walking and cycling routes through green spaces, and in some cases creating green corridors, could add vitality and interest. Overall, the likely effect on urban character would be positive.
Optimise transport energy efficiency in new settlements and urban extensions through consideration of density, building corridors of higher densities to support sustainable transport routes with lower densities and open space elsewhere to support biodiversity and green space; focus transport on high quality integrated public transport infrastructure including guided buses, trains and trams; design as walking and cycling cities/settlements with fine-grained mixed-use, linking to public transport and incorporating convenient and safe cycle and walking routes for commuting and other destinations; limiting car parking.	Appropriately designed and implemented new settlements and urban extensions are likely to have a hierarchy of built form and transport corridors overlaid by a coherent and well connected green space network linking into the wider countryside as well as into the adjacent urban green corridors. This is likely to create a positive urban form which is complementary to both existing urban areas and the wider landscape. There will be an increase in electrification with overhead lines and poles and electric vehicle charging points. Appropriate standard designs to minimise street clutter need to be developed.
Lighting- reduce lighting to effective minimum required for safe streets, spaces and buildings avoiding light spill and converting to LED and other controlled lighting.	Reduced light spill will increase views of night skies and reduce impacts on adjacent landscapes and seascapes. LED public lighting can be an improvement provided it is warm in tone to avoid adverse effects on people and wildlife (circadian rhythms), and designed with elegant fittings and columns. It also is more focussed with less light

	spill. Overall, the effect is likely to be positive.
Action	**Potential effect on landscape character, qualities and visual amenity**
Implement green roofs and walls to optimise insulation and SUDs.	Green roofs and walls can provide interest, especially where they are visible from publicly accessible places. Overall, the effect is likely to be positive.
Implement solar energy on roofs.	Location of panels on large flat or preferably gently sloping south facing roofs would be particularly consistent with the modern aesthetic of retail, hotel, large scale housing blocks and office buildings and appropriate also at the domestic scale to minimise reliance on the grid. Panels can be detractive when seen in profile or from behind so panels should preferably be arranged at the same angle as a sloping roof or only one panel deep on a flat roof, preferably with the same height screening from the sides and rear. Panels should also be arranged in coherent rectilinear patterns with straight edges. In new housing, it is desirable for solar panels to be located on the south facing roofs but this has to be balanced with good practice urban design principles such as separation of public and private spaces and ease of access. Overall, solar panels are likely to be a minor detractive element, mitigated by good design.
Net zero emission/use buildings eg use of sunlight, passive solar gain, insulation and natural ventilation.(eg Passivhaus standard).	In new housing, it is desirable for housing to be orientated to optimise passive solar gain and use of sunlight but this has to be balanced with other good practice urban design principles such as separation of public and private spaces and ease of access. Overall, net zero emission buildings tend to have a distinctive character which differs from vernacular or 19th century buildings but can be designed positively and should be the future for almost all building design unless justified otherwise.

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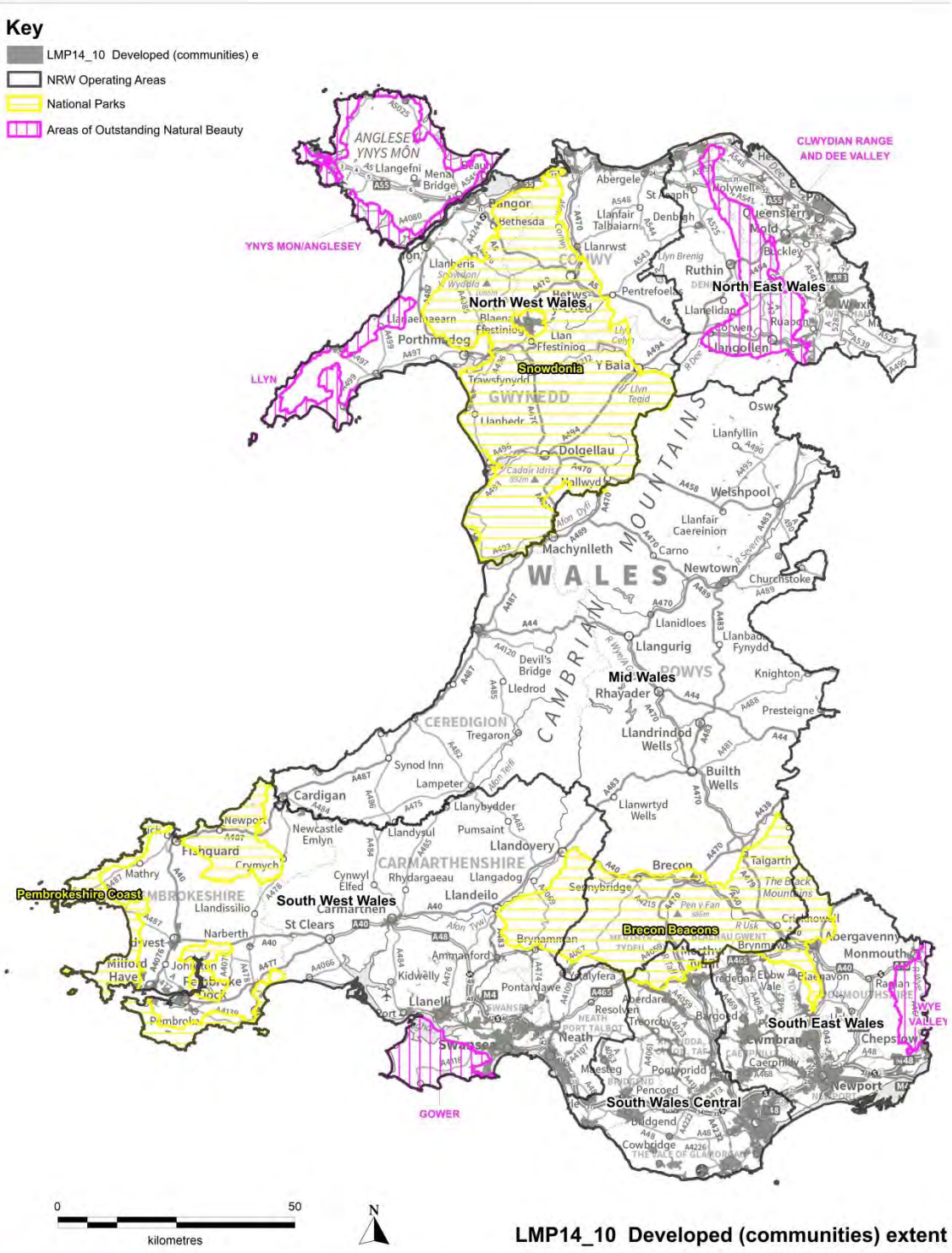
Cycle priority on minor streets along major cycling commuting routes. (National Cycle Route 8, Cardiff.)

LMP14_10 Developed (communities)			
KEY FACTS and comments			
Overall area (km^2)	951	***Area** (% of Wales)*	4.5
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
0	0	0	0
Comment	This type is not evaluated by LANDMAP.		
National Parks (% of area)		**AONBs** (% of area)	
0.5		0.8	
Comment	The type has a very low percentage within nationally designated landscapes but includes areas within the settings of the designations. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	1	60	The type is mainly associated with coastal areas and the South Wales (South Wales Central, South West Wales and South East Wales) with some locations inland. The lowest proportion is in Mid Wales.
North East Wales	5	128	
North West Wales	2	120	
South East Wales	11	220	
South Wales Central	14	272	
South West Wales	4	234	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise appears limited but important and the area in flood zones 2 and 3 is highly significant due to the concentration of people potentially affected. Measures to combat flooding are essential to minimise adverse effects.
1	16.8	12.8	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_11 Developed (amenity)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises amenity land, normally within larger urban areas, exceeding 10 hectares in size and informal open land exceeding 100 hectares in size. It forms green networks through urban areas and includes parks, sports fields, golf courses, river corridors and steep slopes, often wooded, and larger scale informal green space (sometimes reclaimed land). This type comprises 0.24% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Parkland, public gardens, golf courses and open space managed to accommodate intensive use. Some parkland may have historic importance and be listed, and contribute to the setting of historic features e.g. Bute Park, Cardiff and Clyne Gardens, Swansea.
- Reclaimed linear corridors from former railways, canals and reclaimed sites, former steel works and collieries acting as open space and access corridors with cultural value such as in the South Wales valleys.
- Semi-natural river corridors (e.g. Taf and Tawe) and steep slopes, both including woodland, subject to less intensive use.
- Coastal promenades and corniches such as at Swansea Bay and Cardiff (barrage).

LMP14_11 Developed (amenity)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to provide a well-connected network of multi-functional green space to optimise its value and use by the surrounding community. One of its most important roles is in flood management and storage to avoid flooding of the adjacent built areas. Other uses will include well-connected biodiversity corridors and patches, sustainable transport corridors, intensive food production by local communities, informal recreation and sport, improving the microclimate of the urban area and aesthetically pleasing green spaces contributing to well-being and quality of life.

LMP14_11 Developed (amenity)

ADAPTATION to outcomes of climate change

Main outcome 1

The most significant changes are likely to be caused by warmer mean temperatures raising the potential risk from pests and disease and hotter drier summers putting additional stress on vegetation and trees.

Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Urban landscapes may alter as a result of climate change in both direct and indirect ways. Heat island effects are likely to exacerbate summer temperatures. Direct impacts such as warmer mean temperatures may increase	Monitor the health of trees and other vegetation in open spaces to identify stress, trends in pests and diseases and the most resilient species. Identify, manage and water the most important trees in key parks to ensure their survival in the medium term.

pests and disease in vegetation and trees, causing a decline in quality or loss. Some species may disappear. Indirect impacts may result in changes to species mix of trees and plants utilised in open spaces and parks. More damage would be expected in lower intensity or unmanaged informal sites.	Carry out a long-term programme of replacement with more resilient species. Overall, increase the area of forest tree cover to maximise positive micro-climatic effect whilst maintaining character in parks with heritage value. Increase biodiversity as far as possible. Change management regimes to be less susceptible to drought allowing natural regeneration and low intervention in parts and more controlled regimes elsewhere. This is likely to be associated with intensity of use. The effect on character is likely to be less green vegetation visible during summer months although longer growing season may mean earlier greening of tree canopy in spring and extended autumn foliage. If the measures are implemented there will be more tree cover and enclosure and a more informal character to parks and open spaces.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
In hotter drier summers additional water may not be available to provide irrigation. Golf courses in particular may find it increasingly difficult to support high quality grassland. Some sites may lose green colouring in summer and turn brown.	Surface water should be managed with combination of SuDS and increased storage of rainwater within sites such as golf courses, including small reservoirs. The latter should be carefully integrated into the landscape of appropriate ground profiling and mitigating planting. In parks, close mown grass may be reduced in area to avoid stress. Water storage structures may have an adverse effect on landscape character but if designed well could contribute positively to character. It is likely that large areas of grassland will turn brown in the summer which will be an adverse effect. There may larger areas of longer grass and wildflowers.
Rapid run off and limited percolation of water into the soil is likely to lead to drier soils and additional stress on trees/vegetation.	Implement SuDS measures to absorb and store surface water to support vegetation and green areas. SuDS should create positive landscape features but it is likely that large areas of grassland will turn brown in the summer which will be an adverse effect.
Some historic structures may be affected by shrinking of clay soils in hot dry summers. (Only shrinkable clay is susceptible to this- i.e. with montmorillonite).	Monitor subsidence and investigate if this is due to shrinkable clay or other reasons such as insufficient foundations or leaking drains/water supply.

	Retain nearby trees if at all possible, appropriately managed, as removal may lead to heave to clay expansion in winter. Redesign and replace foundations of structures to suit ground conditions. If implemented appropriately, the structures should maintain their character and tree cover nearby should be protected with no noticeable change in character.
Water bodies (lakes, streams, ponds, rivers) will have lower flows or dry up during summer months. Water bodies will exhibit increased water temperatures.	Design water bodies to vary the width, depth and profile to optimise the use of, and access to, water bodies and the range of habitats leaving potential for permanent water in places. Surrounding water bodies with additional tree or shrub planting and green space may reduce evaporation. Manage water bodies carefully including removing algal bloom to avoid risk to health. Overall, there is likely to be a reduction in the amount of permanent water but an increase in the diversity of profile in watersides and the water bodies themselves.
Main outcome 2	
Other significant changes are increased potential for flood and storm damage during winter months.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Sea level rise may also impact some amenity sites in low-lying coastal areas, which will face increased risk of inundation from storm surges. This would lead to possible significant reduction in area and use and loss of trees and other vegetation.	Review if amenity areas are of sufficient existing value to retain and if they also contribute to flood defence of the urban area. If not, potentially allow controlled flooding, but maintain as green infrastructure. If the area is of particular value, increase resilience, maintain coastal defences and strengthen vulnerable structures to maintain their functionality. Engineered functionality should be tempered with a strong design input to optimise elegance and potentially, multiple use of structures. Reinforced flood defences may mean less visual connection between the coastal strip and the sea or larger rivers due to the height of walls, and a harder coastal/river edge. However, there may be potential for creative structures which contribute to a new coastal character.
More frequent extreme weather may bring a range of problems depending on site characteristics, including high winds, storm damage, and	Open spaces in urban areas play an important role in flood management and storage. This potential should be optimised as a priority to avoid flooding of the adjacent built areas whilst taking into consideration other uses.

localised flooding. This could lead to damage to trees and structures.	Monitor the health of trees and other to identify damage and the most resilient species. Carry out a long-term programme of replacement with more resilient species and manage existing trees without adversely changing their character i.e. avoid crown reduction wherever possible unless this is essential for tree health. Overall, increase the area of forest tree cover to compensate for potential tree loss. Monitor structures and take measures to either make them more resilient, relocate in less vulnerable locations or remove if necessary. Implement SuDS schemes to minimise the effect of flooding. Overall, these areas are likely to be more frequently flooded in winter which may provide additional interest although will reduce the potential for other uses. The vegetation cover in open spaces is likely to exhibit more signs of tree and other damage over time but this should be compensated by the increased number of trees.
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Warmer wetter winters will create problems of waterlogging of soil and increase the intensity of wetting/drying cycles.	Implement SuDS schemes to minimise the effect of flooding and focus waterlogging in acceptable areas. The effect on landscape character is likely to be an increase in the informality of parks and open spaces either with areas of flooding in winter or brown vegetation in summer.

Embankment close to river to contain flooding with associated riparian vegetation. (River Tawe, Swansea.)

Removal of riverside embankment and setting back to allow flood storage, create natural bank profile & provide area for biodiversity combining planting and natural regeneration. (River Tawe, Swansea.)

© Simon White 2020

Permanent water bodies in floodplain area for biodiversity. (River Tawe, Swansea.)

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Important trees in parks and formality should be maintained where appropriate but in less used areas long grass, wildflowers and informal management should be increase to support biodiversity. (Llandaff Fields, Cardiff.)

LMP14_11 Developed (amenity)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Optimise multiple uses of green space as green infrastructure- convenient and safe travel by cycle or walking, food production, energy production, optimal biodiversity corridors and patches, increasing woodland, as well as recreational, aesthetic, well-being, flood storage, and microclimatic modification functions.	The landscape character of parks is likely to change to accommodate a wider variety of uses and land cover. This may require an increase in enclosure. Access with associated movement is likely to increase in some locations to allow convenient travel to work. Intensive food production, including polytunnels and allotments, could adversely affect the open green character of spaces and would need to be integrated through careful siting and planting. Small-scale energy production such as solar panels may be appropriate in places, but not at a large scale. Woodland planting/management to encourage natural regeneration to help sequestrate carbon at a large scale would be most appropriate in informal open space areas. The function of open spaces as well connected biodiversity corridors and patches would be likely to increase the semi-natural character of spaces, reducing formality. Parks with historic interest need to be conserved and are likely to need sensitive measures in this respect.

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Cycle way in formal green corridor alongside river. (River Taff, Cardiff.)

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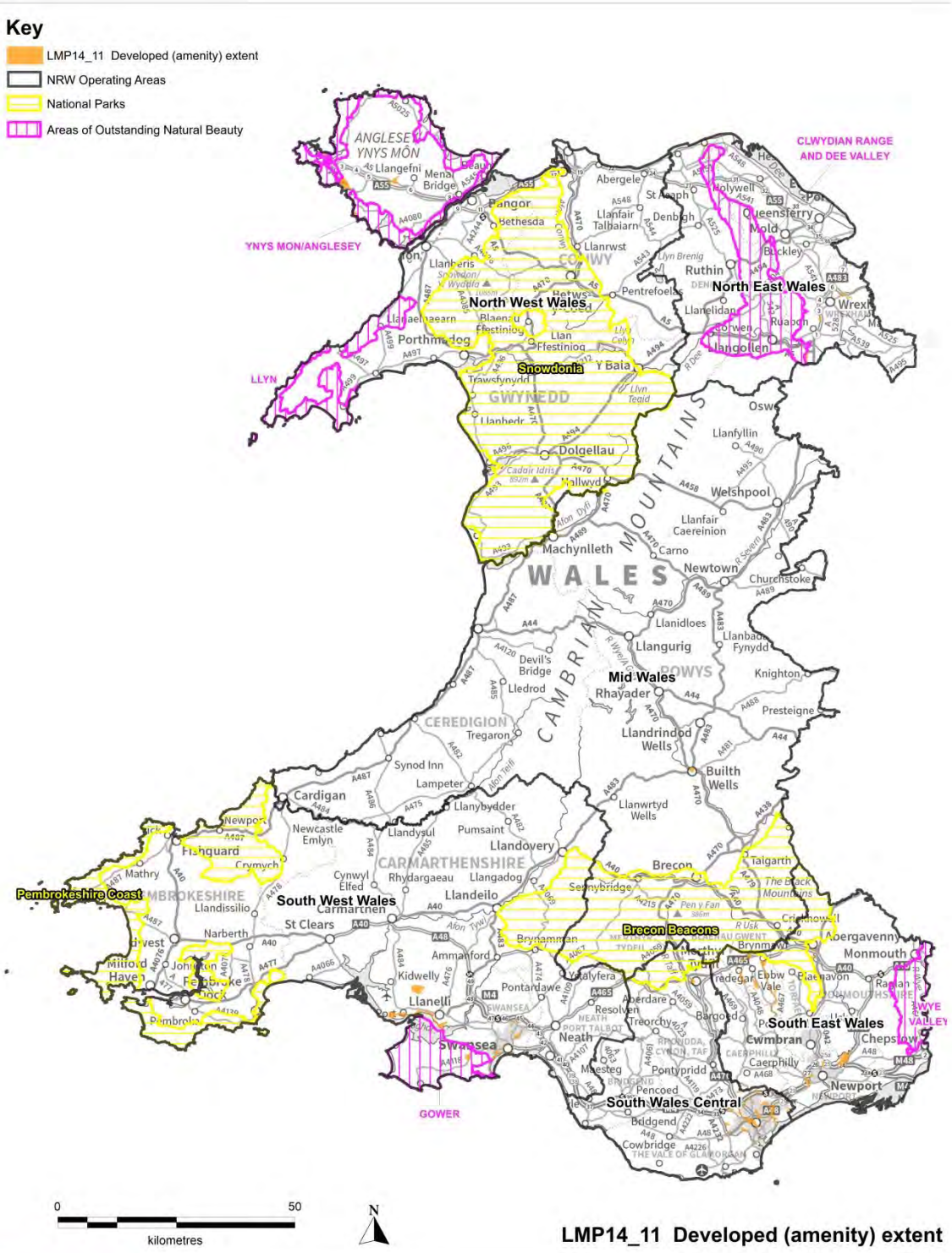
Cycle way on flood embankment in informal green corridor alongside river. (River Tawe, Swansea.)

LMP14_11 Developed (amenity)			
KEY FACTS and comments			
Overall area (km^2)	50	***Area** (% of Wales)*	0.24
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
20	68	9	3
Comment	Only 12% of the type is high or outstanding value, with the large majority moderate value. This does not equate to moderate sensitivity as this type is in close proximity to development and people, serving an important function enhancing quality of life. Care is needed in implementing change and there is opportunity for improvement.		
National Parks (% of area)		**AONBs** (% of area)	
0.02		0.3	
Comment	The type has a very small proportion within nationally designated landscapes or within the settings of the designations (Gower AONB). Particular care is needed in respecting the purposes and special qualities of the designations in these areas.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	1	The type is mainly associated with larger urban areas in coastal areas in South Wales (South Wales Central, South West Wales and South East Wales) with some locations inland in the valleys.
North East Wales	0	3	
North West Wales	0	6	
South East Wales	1	13	
South Wales Central	1	13	
South West Wales	0	15	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise appears limited and the area in flood zones 2 and 3 is significant as this indicates that these areas partly serve the function of flood storage and need to undertake this as effectively as possible.
1	25.3	21.0	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_12 Developed (industry)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises working and abandoned industrial sites exceeding 100 hectares in area. Such sites are often associated with large scale power generation, mineral extraction, infrastructure and transport networks and industrial plants that can include landmark-scale structures. It comprises just 0.43% of the area of Wales covered by LANDMAP.

Landscape characteristics and qualities

- Granite, limestone and aggregates quarries, and slate quarries in North West Wales punctuate the landscape across Wales.
- Quarrying for building stone now or in the past has left a distinctive mark on the landscape through disused quarries and locally distinctive stone buildings, and slate is the main roof covering over much of Wales.
- Lead and ore mines, some now quarried for stone, lie mainly in North East Wales.
- Opencast coal mines and reclaimed coal extraction sites in South Wales are large scale features which locally transform the landscape (e.g. Nant Helen/Onllwyn, Ffos-y-Fran/Merthyr Tydfil).
- The post-industrial character of the South Wales valleys is constrained by topography with development on the valley floors and lower slopes contrasting with the moorland and wooded adjacent landscape types.
- Tall stacks and associated emissions and lighting form major features in some landscapes and seascapes (e.g. Milford Haven refineries, power stations, Port Talbot steel works).
- Relict tips and spoil heaps from deep coal mining and other extraction are clearly evident in the landscape and often considered to detract from landscape character and the tranquillity and sense of place. However, some safe landforms have been retained, especially in South Wales, as markers of an important part of the area's history and culture and make sense of the associated settlements.
- Some industry and infrastructure has distinct cultural heritage value, prime examples include Blaenafon World Heritage Site and the nominated slate quarries of North Wales representing the slate workings, transport, infrastructure and distinctive communities of this area.
- Landfill tips rise above surrounding land and introduce movement and noise as well as odour, with filled areas being integrated into the landscape with smooth contours, grass and planting (e.g. Lamby Way, Cardiff).

LMP14_12 Developed (industry)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to manage surface water to avoid uncontrolled run off, erosion and pollution through SuDS, and to increase the resilience of planting to help water management and integrate the structures and uses into the wider landscape. Renewable energy should be supported where it does not adversely affect nearby sensitive landscapes.

LMP14_12 Developed (industry)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by increased fluctuations in the hydrological regime as a result of drier summers and wetter winters. Specialist plant communities may disappear, and some land slippage may occur on unstable slopes due to more intense storms and rainfall.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Limited changes to landform are likely, these will be limited to land slippage and subsidence on unstable slopes and spoil heaps as a result of increased soil moisture fluctuations, wetter winters and/or more intense rainfall during storm events.	Design and implement slopes including spoil heaps to be resilient to increased precipitation including appropriate profiling, grading of material, drainage and establishment of vegetation if appropriate. Slopes may appear more engineered with terraces and drainage which may have a minor adverse effect on character. Establishment of appropriate vegetation would be likely to better integrate former tips into the surrounding landscape.
Standing surface water is likely to increase during winter months but be less apparent during warmer and drier summer months, i.e. greater fluctuations in the hydrological regime with consequent impacts on local flora and fauna that occupy the sites.	Plan areas to accommodate temporary standing surface water as part of an overall SuDS which manages water and absorption on site, outflows and water quality. Flora and fauna may decrease but this may be minimised by an appropriate scheme which may improve the character of the site.
Plant diversity is likely to decrease as sensitive species disappear due to increased stress from fluctuating water regimes and/or pests and disease.	Plant and encourage resilient species over time to maintain vegetation cover combined with SuDS, with areas which may retain groundwater for longer periods. Flora and fauna diversity may decrease and sites may appear browner in summer months with a minor adverse effect on landscape character.
There is a potential risk of increased pollution from higher levels of run-off during periods of intense rainfall.	A SuDS should be implemented for all sites to manage high volumes of water, to treat water and to control output. Landscape character should be improved by appropriate SuDS schemes.
Developments and facilities adjacent to the coast or in floodplains may be subject to sea level rise (e.g. docks), river flooding and surface water flooding and storms leading to damage and possible	Redesign and raise docks if essential for the future economy to respond to rising sea level. Implement SuDs measures, to reduce risk of surface water flooding including green areas and water features. Increase resilience and effectiveness of coastal defences where necessary. This could be mitigated by high quality design combined with fit

interruption of activities.	for purpose structures. There may be an increase in the number and height/size of flood defences which could have an adverse effect on the relationship between land and water.

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Run off and resulting erosion may be a particular problem in steep sided sites, especially where vegetation cannot establish in hostile substrate. (Cwmystwyth).

© Simon White 2017

Docks unprotected by locks may be vulnerable to sea level rise. (River Neath.)

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Large permanent storage lagoons can enhance industrial estates (and road corridors) as well as provide biodiversity benefits. (Baglan Energy Park.)

© Simon White 2020

Seasonal flood storage ponds, also contribute to the green infrastructure and biodiversity of industrial estates. (Baglan.)

LMP14_12 Developed (industry)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Lighting- replace with LED and controlled lighting.	Minimise energy consumed by lighting whilst retaining safety through replacement with LED and other suitable lighting units, also minimising the unnecessary spread of light.
Solar energy in industrial and reclaimed sites.	Location on flat land in rectilinear sites and in association with large buildings would be consistent in character. Development would be particularly noticeable on steeper slopes and may be best avoided.
Solar energy on large industrial roofs.	Location on large flat or gently sloping roofs would be consistent with the industrial aesthetic.
Wind energy in industrial sites	Turbines of similar scale to existing buildings and structures and sited in an organised and balanced pattern would be in character, although visual clutter should be avoided. However, just siting on brownfield land or associated with buildings which are not widely visible could result in adverse effects on surrounding landscape character.
Use of waste minerals and material to capture $C0^2$.	Treat appropriate alkaline waste minerals and demolition waste (e.g. slag, tailings, concrete, cement) to optimally capture atmospheric $C0^2$. Techniques may include grinding material to fines, systematic spreading in thin layers on site and planting/seeding where possible in due course. Alternatively, if appropriate, spread very thinly over arable agricultural land. Treatment to be fully tested before implementation. Research on techniques is ongoing (see Renwick, P).

LMP14_12 Developed (industry)

KEY FACTS and comments

Overall area (km^2)	92	***Area** (% of Wales)*	0.4

Landscape value (%)

Low	*Moderate*	*High*	*Outstanding*
79	6	14	2

Comment	Only 16% of the type is high or outstanding value, with the large majority low value. The area is therefore less sensitive than some other landscapes but care is needed in implementing change and there is opportunity for improvement.

National Parks (% of area)	**AONBs** (% of area)
0.04	0.3

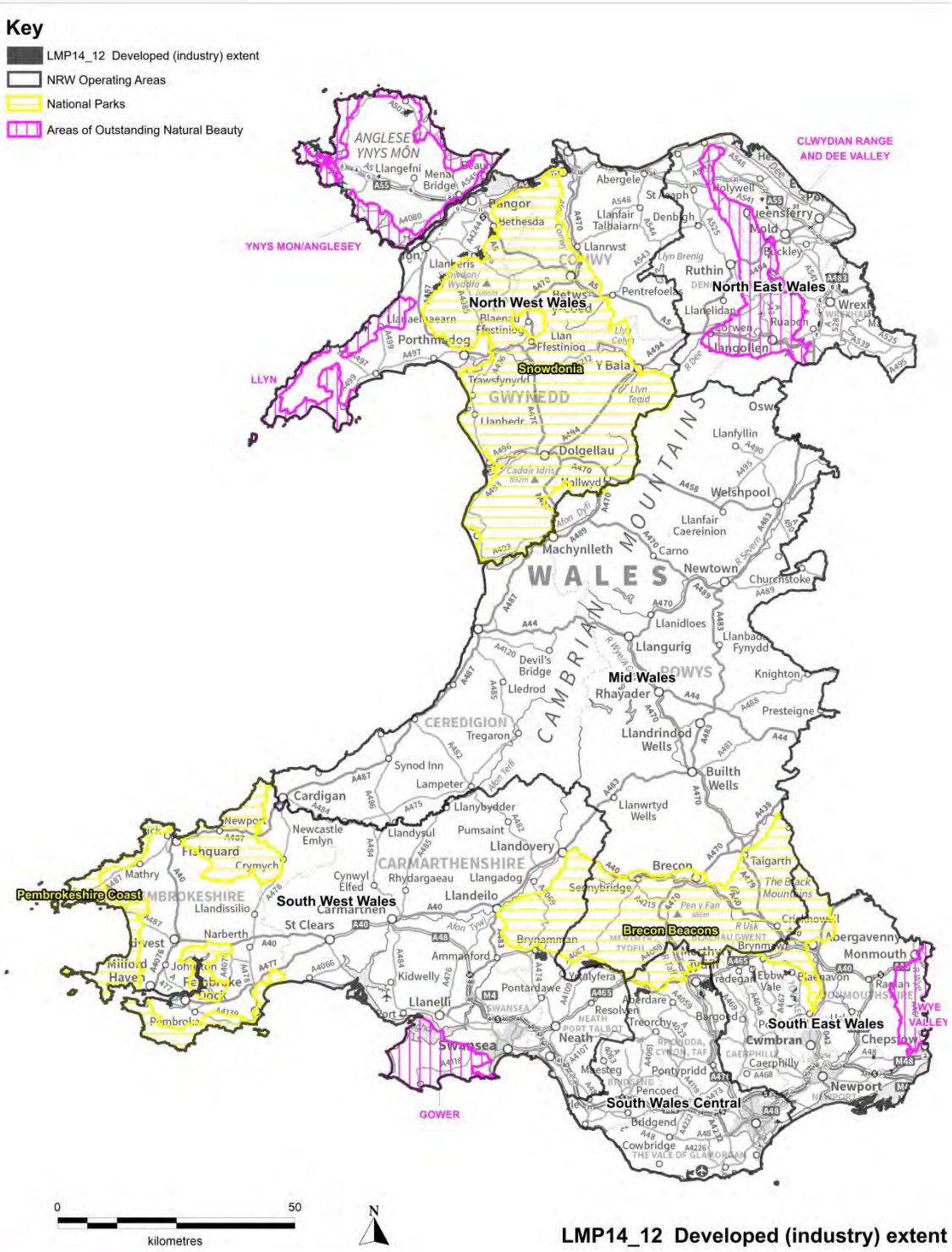
Comment	The type has a low percentage of nationally designated landscape but also includes areas within the settings of the designations. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.

Relationship with NRW operating areas

NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	7	The type is mainly associated with coastal areas and the South Wales valleys (South East Wales and South Wales Central) with some locations inland. The lowest proportion is in Mid Wales.
North East Wales	1	14	
North West Wales	0	24	
South East Wales	1	24	
South Wales Central	2	28	
South West Wales	0	17	

Flood risk

% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise appears very limited/nil and the area in flood zones 2 and 3 is also limited for the sites mapped. Measures to combat flooding are necessary to minimise adverse effects.
0	5.1	4.0	



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Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

LMP14_13 Waters (sea)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises some of the coastal waters around Wales focussing primarily on estuaries that extend inland such as the Conwy, Mawddach, Dyfi and the Three Rivers (Tywi , Tâf, Gwendraeth) and some areas above the low water mark. A third of this type is designated as a marine protected area such as Special Areas of Conservation, Special Protection Areas and Ramsar sites. This type only comprises 0.5% of the overall defined LANDMAP area in Wales. This area does not include the majority of the seascapes around Wales below the low water mark which are considered in the National Marine Character Areas (MCAs) for Wales study and local scale seascape character assessments.

Landscape characteristics and qualities

- Seascape character is generally remarkably varied and this LANDMAP type covers estuaries that run from the more exposed coastal edge deep inland increasing in enclosure.
- The coastal waters are tidal and dynamic, rising and falling and with strong flows in places, defined by a mix of low lying habitats and more resistant rising land such as rocks and cliffs, and with coastal wildlife.
- The coastal waters and estuaries are rich with a sense of history, being used as a major thoroughfare from prehistoric times – the movement of peoples along the Atlantic Seaboard from Spain to Scandinavia, the movement of the early Saints, and the development of cross-Atlantic and global trade more recently. There is evidence of centuries of use including adjacent coastal church towers, castles and landmarks and other navigational aids for seafarers. This landscape type in places contains wrecks of ships and other craft.
- These areas are popular for boating and fishing- both commercial and recreational. There are facilities for navigation in and adjacent to this landscape type including jetties, marinas and other moorings, and buoys and markers.

LMP14_13 Waters (sea)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to protect coastal edges where there are larger settlements and critical infrastructure but elsewhere manage coastal retreat whilst optimising the potential and diversity of coastal and estuarial intertidal habitats. Renewable energy projects may assist in protecting the coastal edge but should offer opportunities for habitat diversification. Extension of this landscape type through the submersion of the adjacent terrestrial landscape due to sea level rise is likely.

LMP14_13 Waters (sea)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by warmer mean temperatures which will affect water quality and potential impact on marine ecosystems and well as raise the risk from invasive species.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Warmer sea temperatures are likely to result in invasive species moving into coastal areas threatening protected native species.	Encourage a range of conditions for different habitats along the coast to allow migration of colder water species. Work to eradicate invasive species if feasible especially in Marine protected areas such as Special Areas of Conservation, Special Protection Areas and Ramsar sites. There may be a reduction in biodiversity overall with related reduction of interest.
Warmer temperatures may also give rise to more frequent algal blooms in the summer months and bacterial impacts on shellfish.	Difficult to adapt to algal blooms and bacterial infections. Treat algal blooms in most vulnerable areas if practical. There may be a reduction in biodiversity overall with related reduction of interest.
Main outcome 2	
More extreme weather (more intense and frequent storms) will increase likelihood of damage to natural habitat and man-made structures.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Tidal habitats may be significantly affected by storm surges and changes in depth, currents, and movement of sediment impacting habitats.	Allow natural realignment of the coastline and encourage range of conditions to allow new marine coastal habitats to be formed to replace those lost. Consider sediment management to protect most vulnerable areas. Monitoring and responding to dynamic change over time will be necessary. If the measures above are undertaken then the landscape and seascape character will change, becoming more dynamic and less settled.
More damage may be visible form storm surges, impacting manmade structures	Either strengthen or relocate necessary manmade structures to ensure they can accommodate rising sea levels and are less vulnerable to damage through severe weather and sea conditions. Priority should be given to safety and navigational features. Potential for localised change as structures are located further inshore or are more noticeable as higher and more robust features. Historic navigational features may be adversely affected.

Extreme weather events and acidification will threaten heritage assets including historic wrecks and prehistoric landscapes, through removal of protective soils and sediments, exposing them to more rapid decomposition.	Protection of these features is difficult and is unlikely to be economically justifiable. Recording of their location and characteristics with samples taken may be the only option. Localised changes with added short term interest, especially in the intertidal area.
Opportunities to optimise biodiversity	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Protect and expand kelp forest offshore to optimise biodiversity.	Kelp forests would increase interest in supporting wildlife and are likely to have limited effects on seascape but would need careful consideration in terms of effects on biodiversity and heritage.

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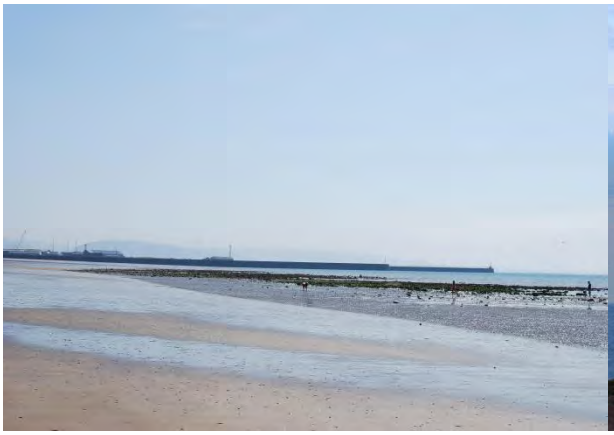
Structures may need to be modified to accommodate sea level rise and extreme weather. (Tywi estuary, Carmarthenshire.)

© Jill Bullen 2020

Marine features such as petrified forest are being exposed by the increased power of storms and resulting coastal processes and damage is likely to occur. Recording these features is essential before permanent loss. (Borth, Ceredigion.)

LMP14_13 Waters (sea)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Implement tidal lagoons along the coast in technically feasible areas.	Increase in built form in inshore waters and coast. Development would be particularly noticeable where located close to cliffs and could particularly adversely affect nationally designated coastal areas. The best locations may be ocation along coasts of lower value and lower sensitivity or where lagoons can help protect low lying areas vulnerable to flooding. The dynamic coastal character would change with effects on coastal processes, biodiversity and seascape but with added potential for recreation as well as flood protection.

Action	Potential effect on landscape character, qualities and visual amenity
Increase wind turbines offshore in technically feasible areas in line with policy and seascape sensitivity studies.	Increase in built form offshore modifying character and visual amenity. Development would be visible from long distances with wide effects, would be noticeable on horizons and could particularly adversely affect nationally designated coastal areas. Location far enough offshore and in definable clusters would minimise effects.
Increase tidal stream development inshore.	Increase in minor built form beneath the surface and onshore could have localised effects on seascape and biodiversity requiring sensitivity in siting around exposed headlands and islands.
Establish offshore wave energy offshore.	Increase in built form offshore and outer inshore modifying character. Most options in development are low and unlikely to be visible from long distances, and so effects could be minimal. However, onshore transmission structures would require sensitive siting.



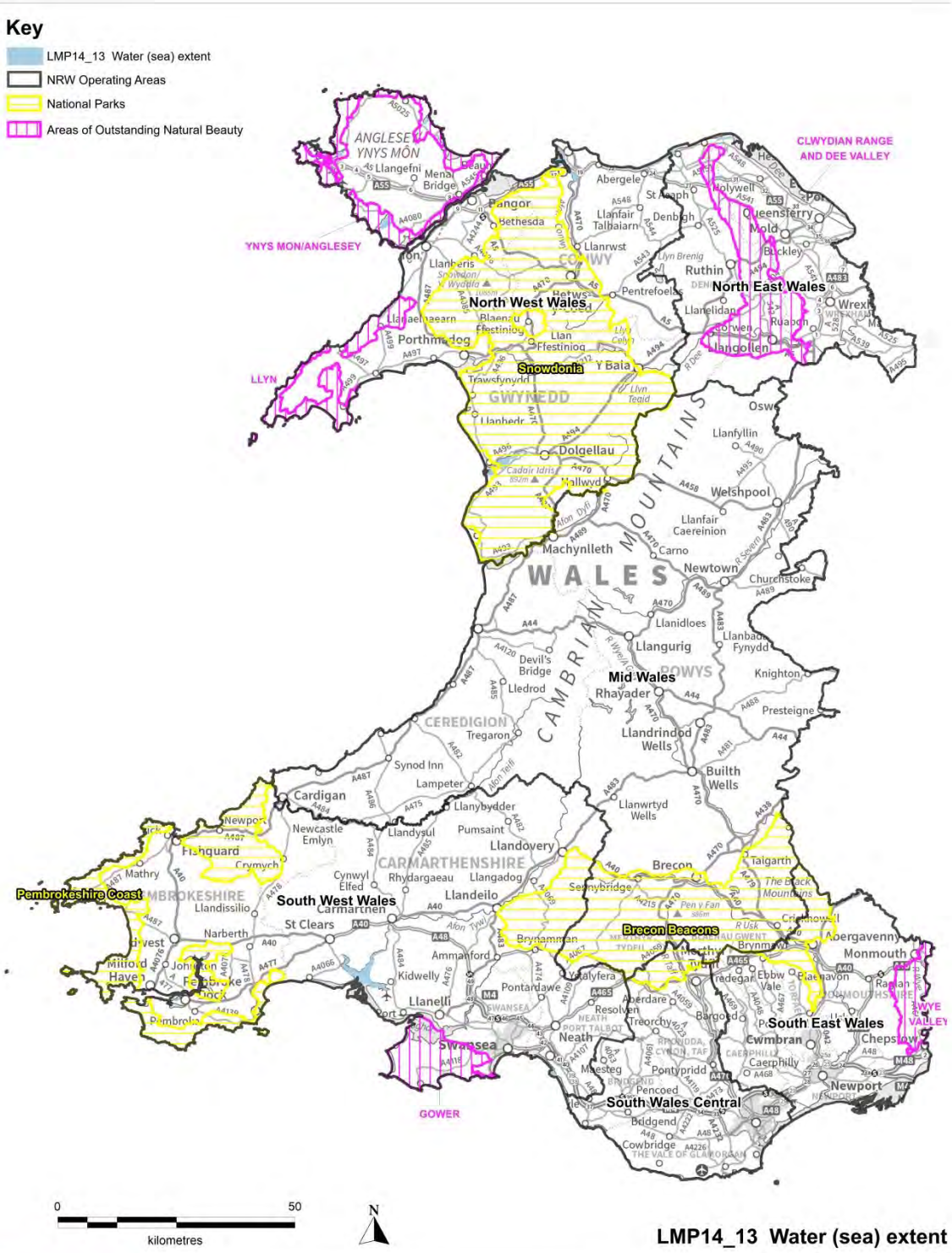
Appropriate sites around the coastline need to be considered for tidal lagoons. (Site of the proposed Swansea Bay tidal lagoon.)

Appropriate locations for offshore wind turbines to be identified. (Existing turbines off North Wales coast at Great Orme.)

LMP14_13 Waters (sea)			
KEY FACTS and comments			
Overall area (km^2)	108	***Area** (% of Wales)*	0.5
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
0	0	20	80
Comment	All the type is outstanding or high value. The area is therefore very sensitive to change affecting landscape and seascape character.		
National Parks (% of area)		**AONBs** (% of area)	
0.2		0.6	
Comment	The type has a relatively low percentage within nationally designated landscape as they lie outside these terrestrially defined areas. However, the areas can lie within the settings of the designations. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	6	The area classified as waters (sea) depends on interpretation of assessments within different areas. This type should be looked at in combination with the coastal edge landscape type.
North East Wales	0	4	
North West Wales	1	37	
South East Wales	0	0	
South Wales Central	3	48	
South West Wales	0	24	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The area is already inundated- the reason for the low amount 1m above sea level is that it extends out to sea from this defined area. Similarly this applies to the flood zones 2 and 3.
45	78.1	75.6	



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Date: January 2020
Status: Final

LMP14_14 Water (inland)

SUMMARY OF EXISTING LANDSCAPE CHARACTER

Summary description

This landscape type comprises of rivers that are typically more than 20 metres in width such as the Taf, glacial lakes such as the Teifi Pools, reservoirs such as in the Elan valley and impounded water, such as Cardiff Bay. This type only comprises 0.5% of the overall defined LANDMAP area in Wales.

Landscape characteristics and qualities

- Rivers include the Conwy, Usk, Wye and Taf and have a mix of rural and urban character, often forming the focus of major valleys.
- Glacial lakes such as Teifi Pools and Glaslyn are strongly associated with mountains, moors and heaths. Llangorse Lake is also glacial but with farmland adjacent.
- Reservoirs dating from the late 19th century and 20th century provide water storage and some are marked as dramatic feats of civil engineering with feature dams and water towers.
- Boundaries (mostly to fields) around these waters included in this landscape type are mixed (21.9% of land area) or fenced (11.5%).
- Cardiff Bay is a highly managed urban waterscape providing flood storage for the Taf and Ely rivers, a focus for development and used for recreation.
- The scenic quality of these landscapes, afforded by their combination of reflective water and contrasting edges such as rocky and vegetated slopes, is often combined with a strong sense of tranquillity – despite their often intense use for leisure and recreation and location close to busy amenity routes and roads. The sheltered, enclosed, intimate, views that extend down waterbodies or courses are framed by topography and land cover where visually enclosed.

LMP14_14 Water (inland)

SUMMARY OF CHANGE AND OBJECTIVES to support positive landscape character in future

The emphasis in this type is to maintain and enhance waterbodies to optimise storage and controlling the flow of water whilst protecting vulnerable features adjacent from flooding. Biodiversity within water bodies and adjacent need to be supported with measures which increase semi-natural features and characteristics. Reservoirs and renewable energy should be supported in the least sensitive landscapes and locations, with a secondary approach of mitigating with native planting. This may mean a change towards more enclosure in places. In addition, recreation for well -being benefits should be accommodated in existing and proposed water bodies.

LMP14_14 Water (inland)	
ADAPTATION to outcomes of climate change	
Main outcome 1	
The most significant changes are likely to be caused by hotter drier summers through reduced stream flows, decreased volumes of water in lakes and reservoirs, and impacts on water quality through increased temperatures and low flows. The largest impacts are on water bodies themselves (including rivers) with relatively minor effects occurring on adjacent vegetation.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Hotter, drier summers will reduce water volumes in lakes and reservoirs, with visible impacts including exposure of larger areas of lake and reservoir sub-surface areas during the summer months.	Increase tree cover, especially broadleaf, in the wider catchment and adjacent slopes to retain and release water over a longer period and modify the microclimate. Repair and conserve peatlands in the wider catchment to retain and release water over a longer period. Dredge man made water features and reservoirs if appropriate to range of depths where appropriate to increase resilience to drying up (eg Bosherston Lakes, Pembrokeshire). This would be targeted and managed very carefully to avoid damage to biodiversity including marginal and other aquatic vegetation. If the measures above are undertaken then the landscape character would become more diverse and wooded around this landscape type.
Reduced water volumes and flow in watercourses from hotter drier summers will have consequent impacts on aquatic biodiversity and may impact stream channel and bankside vegetation.	Renaturalise sections of larger watercourses where appropriate, e.g. where canalised, to vary the width, depth and profile to optimise the range of habitats and leave potential for permanent water in places and lower lying areas for streamside vegetation. Plant and encourage more drought tolerant native species. If the measures above are undertaken then the riverine character could become more diverse and inhabited by wildlife.
Increased levels of water storage may be required, for both agricultural uses, including livestock and arable management, and human consumption.	Larger reservoirs should be located in the least sensitive and diverse landscapes and carefully designed to optimise contribution to landscape character and other benefits such as biodiversity and recreation. Smaller scale farm water storage structures should be integrated carefully into the least obtrusive locations, preferably set into the ground rather than freestanding structures, and screened with

	native planting in character if necessary. Above ground tank structures should be associated with other large farm buildings. National guidelines for water storage should be prepared. The number of water bodies would increase with associated diversity in places. Tree cover may need to increase to integrate structures.
Main outcome 2	
Warmer wetter winters are likely to result in higher average stream flows through the winter months.	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
More frequent and intense storms are likely to result in localised flooding and in extreme cases impacts on river channels and course alterations. The unpredictability of occurrence and location of storms makes impacts difficult to determine.	Renaturalise watercourses including reducing canalisation where appropriate to vary the width, depth and profile to slow down flow. Increase trees and semi-natural vegetation in riparian corridors and in catchment to control fast runoff and smooth out flows. Accommodate flooding in controlled areas and protect vulnerable areas with bunding if appropriate Valley bottoms and floodplain may change character with more natural river courses, and a slight increase in tree cover and semi-natural vegetation related to water bodies.
Settlements and in-river structures in lowland areas may be more prone to flood damage.	Relocate most vulnerable development to areas not affected by flooding. Increase strength of river structures or remove. Use soft engineering structures to control flooding and plant where appropriate to help integration. Riverside development will change with associated change in character, especially in historic structures, with less residential and leisure use, and more defensive structures. There may be an increase in riparian planting.
Wetter conditions in winter may lead to soil erosion.	Increase tree planting, fence off areas to livestock, manage permanent pasture on steeper slopes and plant along riparian corridors to stabilise banks and reduce soil erosion. Avoid ploughing, using no till techniques where possible, especially on steeper slopes. There may be a slight increase in tree cover, pasture, no till agriculture and semi-natural vegetation around water bodies/watercourses.

Opportunities to optimise biodiversity	
Outcome	**Adaptation and its potential effect on landscape character, qualities and visual amenity**
Optimise biodiversity in corridors and patches.	Enhancing the GI function of rivers and reservoirs and lakes as corridors for aquatic species as well as riparian vegetation is likely to enhance the character and diversity of the landscape.

David Letellier © 2019

Debris carried down the River Wye in spate at Monmouth Bridge. Increased tree planting and capacity of peatlands in the upland catchment may reduce run off and subsequent spates and flooding downstream.

Liza Tomos © 2019

Drying out of reservoir during severe drought. Improved water holding capacity of surrounding uplands, restoring peat forming vegetation may counteract the drying up of upland reservoirs. (Nant y Moch.)

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Removal of river side embankment and setting back to allow flood storage, create natural river bank profile and provide area for biodiversity combining planting and natural regeneration. (River Tawe, Swansea.)

LMP14_14 Water (inland)	
MITIGATION actions to eliminate or reduce emissions and conserve biodiversity	
Action	**Potential effect on landscape character, qualities and visual amenity**
Implement hydroelectric power in reservoirs.	Additional structures associated with existing dams or integration into new dams/reservoirs. There is potential for retrofitted structures to be detractive if the existing dam has architectural merit e.g. the Elan Valley dams. Great care would be needed to respect the character of the existing infrastructure using appropriate architectural design and landscape mitigation.
Implement hydroelectric power associated with watercourses.	Structures along or adjacent to larger rivers are likely to have a localised visual impact on the watercourse and adjacent riparian corridor and, potentially, an impact on downstream flow and creating barriers to movement of wildlife e.g. fish. Great care would be needed to respect the character of the watercourse, minimising barriers to wildlife e.g. fish passes, carefully locating infrastructure in the least sensitive location, and using appropriate architectural design and landscape mitigation.

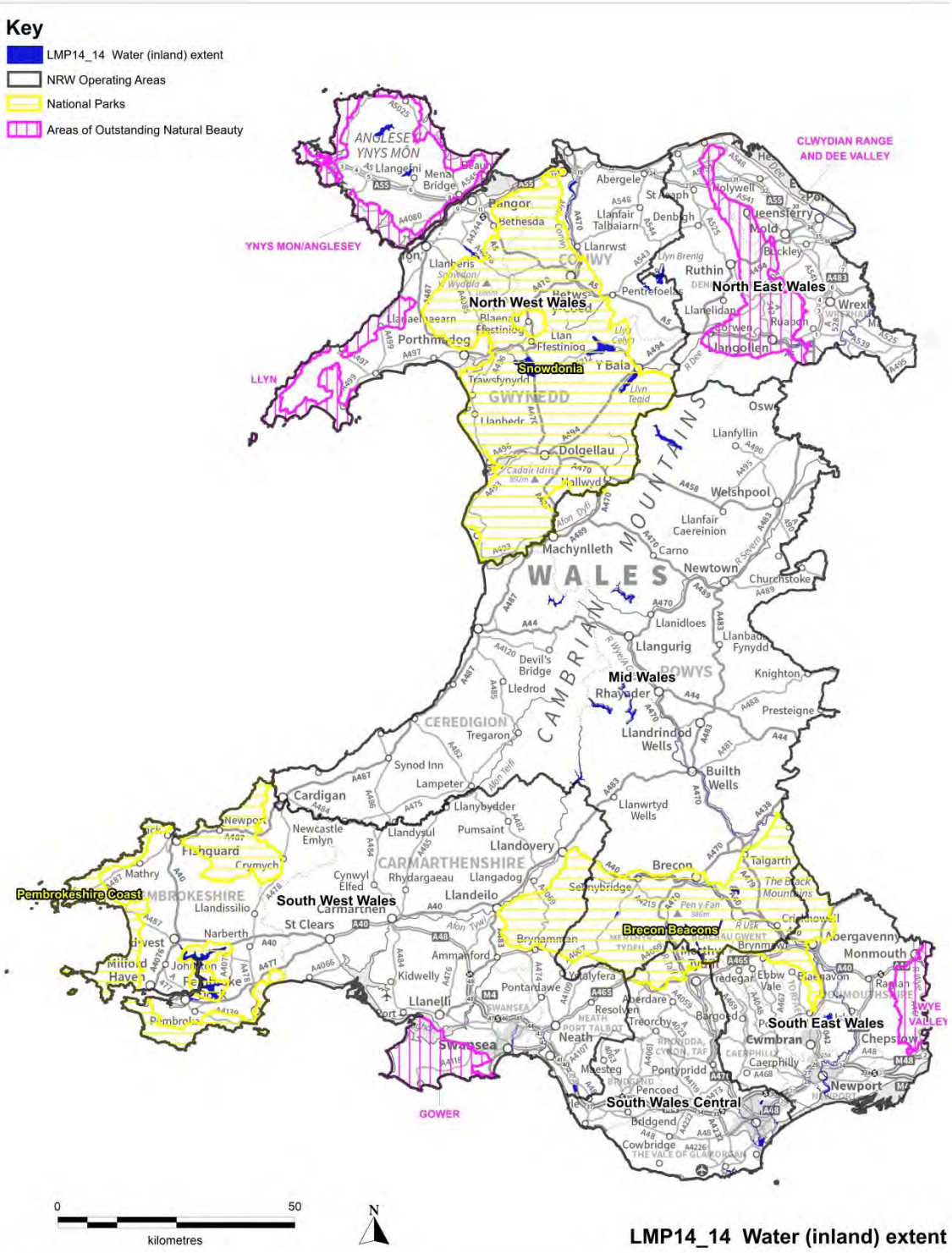
Simon White © 2018

Installing more powerful hydro-electric turbines in conjunction with existing dams may generate more renewable energy. Some dams already produces a small amount of energy from this source. (Caban Coch dam)

LMP14_14 Water (inland)			
KEY FACTS and comments			
Overall area (km^2)	106	***Area** (% of Wales)*	0.5
Landscape value (%)			
Low	*Moderate*	*High*	*Outstanding*
0	29	29	41
Comment	More than two thirds of the type is outstanding or high value. The area is very sensitive and care is needed in conserving character where possible.		
National Parks (% of area)		**AONBs** (% of area)	
1.2		0.1	
Comment	A proportion of this type lies inside nationally designated areas or in their setting, contributing to the special qualities. Particular care is needed in respecting the purposes and special qualities of the designations in these areas.		

Relationship with NRW operating areas			
NRW Area	*%*	*Area (km^2)*	*Comment*
Mid Wales	0	32	The area of this type is very small with reservoirs and lakes comprising the larger areas although rivers influence the character of larger areas overall. North West Wales (eg Trawsfynydd) and Mid Wales (eg Elan valley) have the largest areas of inland water although this is partly due to the mapping in the former area which also includes land adjacent.
North East Wales	0	6	
North West Wales	1	39	
South East Wales	1	10	
South Wales Central	0	6	
South West Wales	0	25	

Flood risk			
% total of LMP14 type area			*Comment*
Area <=1m ASL	*Area Flood Zone 2*	*Area Flood Zone 3*	The risk from sea level rise is focussed mainly in the Daugleddau (Eastern and Western Cleddau rivers) which is tidal. The area in flood zones 2 and 3 is marked as would be expected. The reason for the third of the area outside is due to some of the land adjacent being included in some regions. Measures to be resilient to inevitable flooding are needed.
14	64.4	64.3	



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Data Sources:
LANDMAP Visual and Sensory vector polygon data layer from Natural Resources Wales (via the Lle Geo-Portal for Wales)

Project: Communicating landscape change from adaptation and mitigation in a changing climate
Client: Natural Resources Wales
Date: January 2020
Status: Final

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