



Dŵr Cymru Welsh Water

# Water Resources Management Plan 2024

Biodiversity and Ecosystem Resilience

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## Report for

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## Document revisions

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3	Updated for revised draft WRMP	11/07/23
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# Contents

<b>1.</b>	<b>Introduction</b>	<b>5</b>
1.1	Background and purpose of this report	5
1.2	DCWW revised draft Water Resources Management Plan	5
	WRMP24 process	5
	Relationship with the Regional Plan	5
	About the WRMP24	6
1.3	Ecosystem Resilience	6
1.4	Biodiversity Net Gain and Natural Capital	7
1.5	Requirements for WRMPs	8
<b>2.</b>	<b>Approach to the Biodiversity Net Gain and Natural Capital assessments</b>	<b>10</b>
2.1	Overview of approach	10
	Biodiversity Net Gain approach	10
	Natural Capital Assessment Approach	10
2.2	Sequential process	11
2.3	Methodology	11
	Stage 1- Initial screening	11
	Stage 2- Biodiversity Net Gain baseline calculation	12
	Stage 3- Natural Capital Assessment	13
	Stage 4 – Biodiversity Net Gain Assessment with mitigation	17
	Stage 5 – Natural Capital Assessment using the Biodiversity Net Gain Assessment with mitigation	19
	Stage 6 – Identifying Potential Biodiversity Opportunity Areas	19
<b>3.</b>	<b>Assessment outcomes for the feasible options</b>	<b>20</b>
3.1	Feasible options included in the assessment	20
3.2	Biodiversity Net Gain (Stage 2) outcomes	20
3.3	Natural Capital (Stage 3) outcomes	20
<b>4.</b>	<b>Assessment outcomes for the Preferred Programme</b>	<b>22</b>
4.1	Introduction	22
4.2	Preferred Programme	22
<b>5.</b>	<b>Summary</b>	<b>24</b>

Table 2.1	Carbon sequestration of land use from EA WRPG Supplementary Guidance	14
Table 2.2	Benefit Transfer Values: Natural Hazard Regulation	15

Table 2.3	Benefit transfer values: provisioning services supporting agriculture	16
Table 2.4	Components included within the adapted farm income method	17
Table 2.5	Off-site habitat enhancement rules used to calculate habitat area required to achieve 10% net gain	18
Table 4.1	Preferred Programme summary	23
A summary of the SMNR Principles and Wellbeing Goals for Wales, which have been considered in the assessment		0

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Figure 2.1	The sequential process followed for the NC and BNG assessments	11
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Appendix A	SMNR Principles
Appendix B	Conversion from UKHab to Broad Habitats
Appendix C	Results of Stage 2 (feasible options) BNG calculations
Appendix D	Results of Stage 3 (feasible options) Natural Capital calculations
Appendix E	Qualitative assessment of water purification service (Preferred options only)

# 1. Introduction

## 1.1 Background and purpose of this report

Water companies in England and Wales have a statutory requirement to prepare a Water Resources Management Plan (WRMP) every five years. The latest Water Resource Planning Guideline (WRPG) produced by the regulatory bodies<sup>1</sup> (Ofwat, The Environment Agency (EA) and Natural Resources Wales (NRW)) states that water companies are required to ensure their WRMP delivers net biodiversity gain where appropriate, and uses a proportionate natural capital approach. This report is driven by this requirement and demonstrates how Dŵr Cymru Welsh Water (DCWW) will meet its requirements through the assessment of its revised draft WRMP24 feasible options and preferred plan.

## 1.2 DCWW revised draft Water Resources Management Plan

### WRMP24 process

DCWW is currently finalising its WRMP 2024 which, once approved, will set out DCWW's preferred supply side and demand management options ('the preferred options') for resolving the predicted deficits in its supply demand balance, and to achieve its long term targets.

As part of the preparation of WRMP24, DCWW published its Draft Water Resources Management Plan 2024 (Draft WRMP24) for consultation between the 16<sup>th</sup> November 2022 and 22<sup>nd</sup> February March 2023, following submission to the Welsh Government. Taking into account the responses received to the consultation, a Revised Draft Water Resources Management Plan 2024 (Revised Draft WRMP24) has subsequently been prepared and submitted to Welsh Government for approval.

### Relationship with the Regional Plan

The Water Resources West (WRW) Regional Plan covers the management of water resources in the North West of England, the West Midlands and the cross-border catchments with Wales. It includes all or part of the operational areas of DCWW, Hafren Dyfrdwy, Severn Trent Water (STW), United Utilities (UU) and South Staffordshire Water (SSW).

WRW is taking an integrated approach to preparing the Regional Plan and the individual company WRMPs and aims to provide a Regional Plan that is multi-sector and takes account of the water supply needs of non-public water supply (non-PWS) abstractors as well as public water supplies. WRW member water companies, including DCWW, have used a regionally consistent set of methodologies to reflect local, regional and national needs into the development of the plans.

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<sup>1</sup> Ofwat, NRW & EA (2022), Water Resources Planning Guideline, Version 12 – Updated March 2023

## About the WRMP24

DCWW provides water and sewerage services to some 3 million customers in much of Wales and small parts of Cheshire and Herefordshire in England. It also has over 100,000 business customers, and in total delivers more than 850 million litres of drinking water every day. This can increase by up to 20 per cent during a hot summer. Most of the water DCWW abstracts is supplied from impounding reservoirs, although significant volumes are abstracted from lowland river sources such as those on the Rivers Wye and Usk in South East Wales, the River Towy in South West Wales and the River Dee in North Wales. Groundwater accounts for less than 5 per cent of water supplies by DCWW but at a local level, may be the whole supply.

In previous WRMPs, DCWW identified and implemented significant asset investment to manage the implementation of the Water Framework Directive (WFD) and Habitats Directive through abstraction licence changes. Demand management and leakage reduction by at least 15% during AMP7 was also mandated by regulatory expectation.

DCWW's supply demand balances (SDB) have been generated for each of the company's 23 water resource zones (WRZs). This has identified that three zones would not be resilient under the most likely planning scenario within the 25-year period to 2050. The zones with an identified shortfall are South East Wales Conjunctive Use System (SEWCUS), Tywi Gower and Lleyn Harlech-Barmouth.

As part of the WRMP development process, DCWW identified a long list of feasible supply-side and demand-side options to resolve the forecast WRZ deficits. These options were subject to a staged filtering process designed to establish the best-value plan for DCWW taking into account the regional plan requirements. Welsh Water's revised draft WRMP24 therefore proposes:

- For Lleyn Harlech – Barmouth WRZ, the deficit will be overcome by demand management measures only for household and non-household customers (e.g. leakage / network improvement programmes, metering enhancements, water efficiency audits, grey water recycling, rainwater harvesting, etc.).
- For SEWCUS WRZ and Tywi Gower WRZ, the deficit will be overcome by demand management measures and four supply-side options.

This assessment considers all of the feasible supply-side options individually, and subsequently the five preferred supply side options together.

### 1.3 Ecosystem Resilience

The Environment (Wales) Act of 2016 includes the following duties:

- Section 6: sets out a duty to require all public authorities (including statutory undertakers such as DCWW) to seek to "*maintain and enhance biodiversity*", and to "*promote the resilience of ecosystems*";
- Section 7: requires publication of a list of species and habitats of principal importance for maintaining and enhancing biodiversity. Lists of Section 7 priority species and habitats have been produced as a result, and should be accounted for in maintaining and enhancing biodiversity.

Sustainable Management of Natural Resources (SMNR)<sup>2</sup> and the DECCA framework for Net Benefits to Biodiversity<sup>3</sup> are integral to maintaining and enhancing these duties.

The SMNR Principles aim to utilise natural resources in a way, and at a rate, that maintains and enhances the resilience of ecosystems and the benefits they provide. In doing so, the needs of present generations are met without compromising the ability of future generations to meet their needs. Following the SMNR Principles will also help to achieve the Wellbeing Goals, which have been put in place to improve the social, economic, environmental and cultural wellbeing of Wales<sup>4</sup>. These goals are established in the Well-being of Future Generations (Wales) Act 2015. The application of the SMNR Principles and a Wellbeing approach can help to identify solutions which provide multiple benefits under appropriate management. **Appendix A** sets out the SMNR Principles and Wellbeing Goals, in relation to the scope of this assessment.

The Environment (Wales) Act 2016 sets out ecosystem resilience as *“the capacity of ecosystems to deal with disturbances, either by resisting them, recovering from them, or adapting to them, whilst retaining their ability to deliver services and benefits now and in the future”*. Key considerations for ecosystem resilience are set out in the DECCA framework<sup>5</sup>, which is defined as:

- Diversity, including biological, geological and physical diversity;
- Extent, with bigger ecosystems likely to be more resilient;
- Connectivity within and between ecosystems;
- Condition; and
- Aspects of ecosystem resilience, including adaptability, recovery and resilience.

Welsh Government aims to achieve ecosystem resilience and Net Benefits to Biodiversity through the application of SMNR<sup>7</sup>.

## 1.4 Biodiversity Net Gain and Natural Capital

DCWW is currently using the Defra biodiversity metric to support its duties under the Environment (Wales) Act 2016. Defra metric is being applied to all biodiversity baseline studies and net gain assessments across the company, alongside the DECCA approach, until a Welsh metric becomes available<sup>6</sup>. In line with this approach, and for consistency with the methodologies agreed across Water Resources West (as discussed in **Section 1.4**), in this report the duties of the Environment (Wales) Act 2016 are considered under the general headers of Biodiversity Net Gain (BNG) and Natural Capital (NC).

Although BNG and NC are terms not ordinarily used in Wales outside DCWW, they provide a consistent framework that is appropriate for assessing a strategic plan and comparing the relative

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<sup>2</sup> <https://naturalresources.wales/media/678063/introducing-smnr-booklet-english-final.pdf>

<sup>3</sup> <https://www.gov.wales/sites/default/files/publications/2019-05/environment-wales-act-2016-biodiversity-resilience-ecosystems-frequently-asked-questions.pdf>

<sup>4</sup> <https://gov.wales/well-being-future-generations-act-essentials-html#section-60668>

<sup>5</sup> <https://cdn.cyfoethnaturiol.cymru/media/696279/ecosystem-resilience-in-a-nutshell-1-what-is-ecosystem-resilience.pdf>

<sup>6</sup> Dŵr Cymru Welsh Water (2022) Doing the Right Thing for Nature 2022.

costs and benefits of supply options; they also provide the basis for more detailed consideration of Net Benefits to Biodiversity and ecosystem resilience at later stages of planning and implementation.

Consistent with Net Benefits to Biodiversity, BNG is an approach to the development of land and marine management that aims to leave biodiversity in a measurably better condition than prior to development. BNG provides a means of quantifying losses or gains in biodiversity value brought about by changes in land use, which differs from Welsh approaches in terms of a greater reliance on quantification, but when designed and delivered well, BNG secures benefits for nature, people and places, and for the economy<sup>7</sup>. The assessment approach described in **Section 2** also allows for going beyond BNG to the identification of potential 'opportunity areas', if appropriate, taking account of the connectivity and extent components of the DECCA approach. The approach provides a consistent foundation for the assessment of Net Benefit for Biodiversity in the WRMP, which will be developed at later stages of planning and implementation with site-specific details and appropriate regional priorities.

NC studies key components of nature which are essential for the long-term provision of benefits on which society relies. These components can have a direct or indirect value to people. A NC approach, which has been followed in this assessment, understands that nature underpins human wealth, health, wellbeing and culture and seeks to demonstrate the value of the natural environment for people and the economy<sup>8</sup>. This is consistent with the SMNR Principles and the Wellbeing goals for Wales.

Natural assets provide ecosystem services such as regulating floods and improving air quality, and those ecosystem services provide benefits such as reducing the chance a house will flood or improved health. This benefit can then be valued through use of NC metrics, and can be used to help in the support of delivery of targets, such as putting a value on the potential delivery of BNG.

## 1.5 Requirements for WRMPs

The requirements of a water company's WRMP with regards to Ecosystem Resilience, BNG and Natural Capital Assessment (NCA) are outlined in the 2023 WRPG, and include:

*"Ensure your plan contributes to the conservation and enhancement of biodiversity, delivers net biodiversity gain where appropriate, delivers environmental gain and uses a proportionate natural capital approach."*

*"If your plan affects Wales, ensure your plan delivers biodiversity and environmental requirements and uses a proportionate natural capital approach."*

*Consider the biodiversity and resilience of ecosystems duty, the section 7 biodiversity lists and duty under the Environment (Wales) Act and Nature recovery action plan for Wales if you supply customers in Wales or your plan affects sites in Wales."*

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<sup>7</sup> Natural England (2021), Biodiversity Net Gain – more than just a number. Accessible via: <https://naturalengland.blog.gov.uk/2021/09/21/biodiversity-net-gain-more-than-just-a-number/>

<sup>8</sup> UK Government (2021), Enabling a Natural Capital Approach (ENCA) – Updated 20 August 2021



The supplementary guidance on Environment and Society in decision-making<sup>9,10</sup>, published by NRW and the EA, provides more detail about the expectation for NCA or ecosystem resilience in England and Wales respectively, and how a NCA and ecosystem resilience can support decision-making. The purpose of this is to allow water companies and Regional Groups to “*make decisions that do not devalue, and look to enhance the value of the natural world for society benefit*” together with supporting water companies within WRW to promote plans that have the potential to deliver wider environmental and social benefits.

In Wales, the Welsh Government *Guiding Principles for Developing Water Resources Management Plans (WRMPs)*<sup>11</sup> state that:

*“Ecosystems are at the core of a water company’s service delivery and, as such, you should take an ecosystem-based approach when planning, designing and delivering your services. The principles of Sustainable Management of Natural Resources (SMNR) should underpin your WRMP and enable you to take an ecosystems approach...”*

*“You should assess the ecosystem service provision of any option within your WRMP as this will promote a consistent and integrated approach to environmental valuation across water company planning. This consistency support accountability, transparency and helps with stakeholder engagement. You can do this by taking a natural capital or equivalent approach.*

*When considering the environmental and social costs of schemes to maintain a secure water supply, the method used should be proportionate to the size of the problem. You should use the ‘building blocks’ approach, making a qualitative, quantitative then monetary assessment if necessary. You should explain and justify which method you use within your plan.”*

The methodology presented in **Section 2** takes these requirements in to account and has been designed both to meet the requirements and expectations of Welsh Government, and to provide consistency with assessments across the Water Resources West companies.

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<sup>9</sup> EA (2021) WRPG 2024 supplementary guidance – Environment and society in decision-making. Published 24/03/2021

<sup>10</sup> NRW (2021) WRPG 2024 supplementary guidance – Environment and Society in decision-making (Wales). Published 07/04/2021

<sup>11</sup> Welsh Government (2022) Guiding Principles for Developing Water Resources Management Plans (WRMPs) 2022: guidance

## 2. Approach to the Biodiversity Net Gain and Natural Capital assessments

### 2.1 Overview of approach

As discussed in Section 1.3 and 1.4, the assessments are undertaken under the headers of BNG and NC, for consistency with the agreed Water Resources West methodology.

#### Biodiversity Net Gain approach

The BNG assessment of the revised draft WRMP is based on use of the Defra Biodiversity Metric v3.0<sup>12</sup> (which was the most up to date version at the time that the assessments commenced across Water Resources West), to assess losses of biodiversity as a result of the options. All feasible options are assessed for potential loss of biodiversity and natural capital individually. For the Preferred Plan, where required, the metric is then used to demonstrate how a gain in biodiversity could be achieved on and off-site.

A GIS-based system has been used for the assessment, using national datasets, to provide comprehensive coverage of habitat data, and allow a consistent approach for all options and locations.

#### Natural Capital Assessment Approach

The WRPG Supplementary Guidance states that NCAs should include, as a minimum, the following five ecosystem services:

- Biodiversity and habitat;
- Climate regulation;
- Natural hazard regulation;
- Water purification;
- Water regulation.

And that in Wales, an additional ecosystem service should be included:

- Recreation and tourism.

At the project outset (across the Water Resources West companies), a review was undertaken of other ecosystem services, through which it was agreed that the following additional services would be taken into account:

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<sup>12</sup> While a newer version of the metric, v3.1, has now been released, v3.0 has been used for these assessments to provide consistency across multiple WRMPs and through the stages of assessment

- ‘Health & Well-being’ services, which will support compliance with the Well-being of Future Generations Act (Wales) 2015. This is currently considered to be inherent in the services listed above and is not assessed in its own right.
- Agriculture.

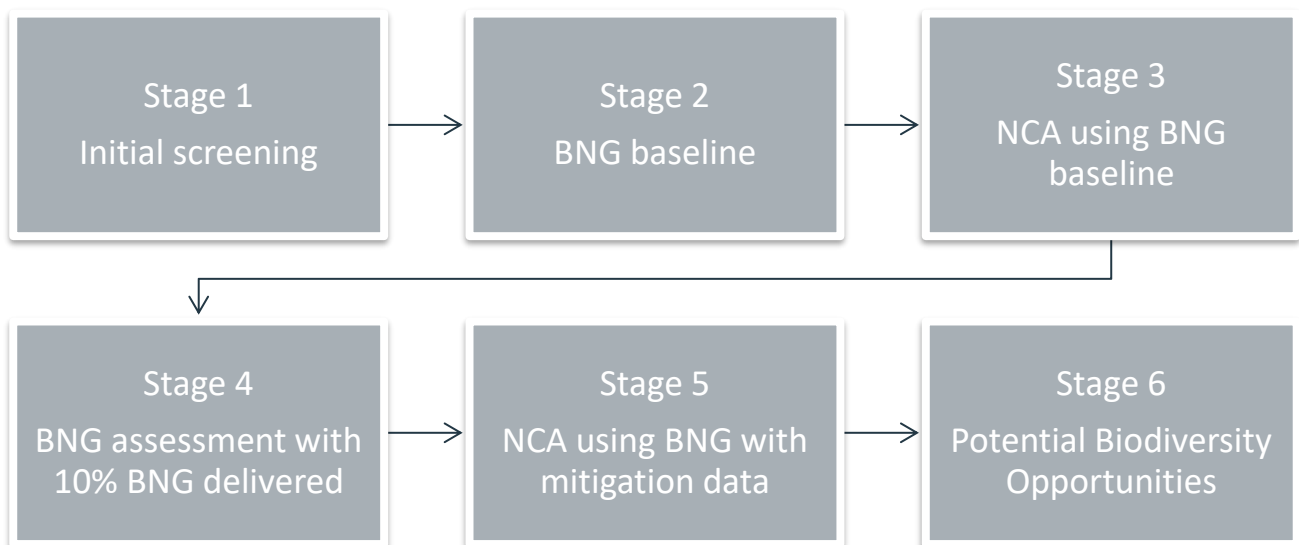
For consistency across the companies in Water Resources West, all of the ecosystem services listed above are included in the assessments for all companies, including this report for DCWW.

## 2.2 Sequential process

Throughout the WRMP process, BNG and NCA have been considered in increasing levels of detail, proportionate to the wider WRMP programme. **Figure 2.1** shows the sequential process followed for the assessments. The approach taken for feasible options and consequent programmes of options is as follows:

- Feasible options – Stages 1 to 3 of **Figure 2.1**
- Preferred programme– Stages 1 to 6 of **Figure 2.1**.

**Figure 2.1 The sequential process followed for the NC and BNG assessments**



## 2.3 Methodology

### Stage 1- Initial screening

Stage 1 comprised an initial screening process, using high-level qualitative scoring. This was necessary to assist with the development of the Strategic Environmental Assessment (SEA) of the WRMP and support detailed screening of options for the inclusion in the Preferred Plan. The scoring also fed into Multi Criteria Decision Analysis (MCDA) (ValueStream1) and helped to support early decision making using the feasible options.

For each option, scores ranging from +3 to -3 were awarded for each ecosystem service metric as a reflection of the potential level of benefit and disbenefit associated with the metric (allowing for benefits and disbenefits to be recognised separately where appropriate). Overall scores were calculated based on magnitude, scale, and duration of expected impacts, with each of magnitude and duration also being scored between -3 to +3, following the same rules as for the ecosystem services. A brief commentary was also included to describe the benefits or disbenefits.

The results of the Stage 1 assessments of the WRMP options are not presented in this report, as they were used only to inform preliminary stages of assessment and were superseded by subsequent stages of assessment.

## Stage 2- Biodiversity Net Gain baseline calculation

### Baseline habitat area and condition

Areas of habitats were calculated in QGIS. The CORINE land cover dataset<sup>13</sup> forms the basis of the habitat data, providing continuous coverage across the whole of the UK. This has been supplemented by other datasets where available, to provide improved resolution:

- The NRW Terrestrial Phase 1 Habitat Survey dataset<sup>14</sup>, which provides comprehensive habitat cover for Wales;
- National Forest Inventory 2018, to provide improved information about areas of forestry;
- OS Zoomstack, providing data about areas of open water and urban extents.

The footprint of impact was calculated for each option using GIS data provided by DCWW:

- Where shapefile polygons were available for on-site infrastructure such as water treatment works or pumping stations, they were used directly;
- Where polygons were not available, a best estimate of area and location was made using grid references and illustrations provided by DCWW;
- For pipelines, a 30m buffer (15m on each side) was assumed around polyline shapefiles.

All areas were defined as having either a temporary or permanent loss of habitat. Pipelines were assumed to have a temporary impact, unless passing through woodland. The latter was classed as permanent to recognise the longer time period to reinstatement. All other types of infrastructure were classed as permanent. The areas of permanent and temporary loss were mapped over the habitat data and run through a model that identified habitats which would be impacted by the construction and operation of the option. This model prioritises the habitat layers that have high resolution, importance and validity. This ensured that the most accurate and important data was not missed due to overlapping data of lower resolution.

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<sup>13</sup> <https://www.data.gov.uk/dataset/cd2c59e7-afd9-471d-a056-c5845619dcd7/corine-land-cover-2018-for-the-uk-isle-of-man-jersey-and-guernsey>

<sup>14</sup> <https://lle.gov.wales/catalogue/item/TerrestrialPhase1HabitatSurvey/?lang=en>

All habitats were assumed to be in moderate condition (except those where only 'poor' or 'n/a' applies). The resulting habitat and condition data were then input to the Defra Biodiversity metric 3.0 spreadsheet in order to calculate the net loss.

The resulting losses have been assigned to groups from 0-5, by ranking each option according to the total number of Area-Based Habitat Units (ABHU) lost, and the average ABHU per hectare.

## Stage 3- Natural Capital Assessment

### Data sources, gaps, and assessment

The NCA has been completed using the data sources described below, as recommended by the All Company Working Group (ACWG) environmental assessment guidance for Strategic Resource Options (SROs)<sup>15</sup> and the WRPG WRMP24 Supplementary Guidance on Environment and Society in Decision-Making<sup>16</sup>.

### Natural Capital stocks

The assessment for the NC approach is based on the same available open-source data as used for the Stage 2 BNG assessment. The habitat types used for BNG were converted to broad habitat types to give the total area of each broad habitat impacted by each WRMP option. This provides a summary of the stock (i.e. the 'amount') of NC, which is used as the basis for the Ecosystem Service calculations. The conversion from the detailed habitat layers to broad habitat is outlined in **Appendix B**.

Broad habitat groupings were determined following the broad groups identified for calculation of carbon sequestration by land use from the EA's Supplementary Guidance (see **Table 2.1** below). Modified grassland was classified as arable land and not grassland, as per advice from the Office for National Statistics (ONS) in developing a semi-natural grassland ecosystems account<sup>17</sup>. The UK NEA differentiates semi-natural grassland from improved and amenity grassland, as semi natural grassland has a much higher species-richness<sup>18</sup>. Where a land cover class could belong in multiple broad habitat groups, it was placed within the one that had a lower carbon sequestration rate, to give a more conservative estimate of benefits.

### Climate regulation (carbon sequestration)

The carbon sequestration rates for NC stocks have been taken from the EA WRPG Supplementary Guidance, as shown in **Table 2.1**. Carbon sequestration rates of the relevant NC assets have been converted into monetary values using UK Government Carbon Values. At the time of developing the methodology, the prices published by the (now former) Department for Business, Energy and

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<sup>15</sup> All Company Working Group (2020). WRMP environment assessment guidance and applicability with SROs

<sup>16</sup> Environment Agency (2022) Water resources planning guideline supplementary guidance – Environment and society in decision-making - England. Published 3<sup>rd</sup> February 2022.

<sup>17</sup> Office for National statistics (2018) Developing semi-natural grassland ecosystem accounts

<sup>18</sup> UK Habitat Classification Working Group (2018). UK Habitat Classification - Habitat Definitions V1.0 at <http://ecountability.co.uk/ukhabworkinggroup-ukhab>

Industrial Strategy (BEIS) were in £2020, so GDP deflators were used to adjust them to the £2019 base year of modelling.

It is not possible to quantify the non-spatial changes in biodiversity and habitat ecosystem services arising from habitat condition improvement. To avoid overestimating the beneficial impact of the change in non-traded carbon sequestration value following BNG habitat creation / reinstatement, this value has been calculated by summing the change in non-traded carbon sequestration value during construction (the temporary loss), the permanent loss and creation.

The monetisation is based on the size of the area, temporary or permanent loss, and biodiversity value of the habitats affected. Higher biodiversity value habitats (e.g., woodland, lowland meadows, heathland) have higher carbon sequestration monetised value. The higher biodiversity habitats are typically more difficult to recreate following completion of the construction phase so loss and reinstatement of these habitats will result in a greater impact relative to lower value habitats (e.g., arable fields or modified grassland).

**Table 2.1 Carbon sequestration of land use from EA WRPB Supplementary Guidance**

Land use type	C seq rate (t/CO <sub>2</sub> e/ha/yr)
Woodland (deciduous)	4.97
Woodland (coniferous)	12.66
Arable land	0.10
Pastoral land	0.39
Grassland	0.39
Heathland & shrub	0.7
Urban	0

### Natural hazard regulation

For the purposes of this assessment, natural hazard regulation has been taken to refer to regulation of flooding. Monetary values were sourced per broad habitat type from existing studies conducted in the UK. Values for woodland and wetlands/ floodplains broad habitat types were identified using the Enabling a Natural Capital Approach (ENCA) Services Databook<sup>19</sup>, where the associated studies were evaluated to ensure their suitability for benefit transfer.

An annual monetary value was only derived for the flood regulating services of woodland and wetland/ floodplain assets (see **Table 2.2**). Robust monetary values for other broad habitat types, and which could be considered comparable to the values in **Table 2.2**, are not currently available. As a result, it has not been possible to provide a monetised estimate of other services.

<sup>19</sup> <https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca#enca-services-databook>

**Table 2.2 Benefit Transfer Values: Natural Hazard Regulation<sup>20</sup>**

Broad habitat type	Annual value	Reference
Woodland	115 (£2018/ha)	Forest Research (2018) & ENCA Services Databook
Freshwater (Open waters/ wetlands/ floodplains)	407 (£2011/ha)	Morris & Camino (2011) & ENCA Services Databook

### Water purification

The WRPG supplementary guidance does not require the monetisation of Water Purification services, as these services are highly dependent on local factors (e.g. proximity to a water body) and there are limited tools available to provide accurate monetised assessment. For feasible WRMP options, an assessment was undertaken at Stage 1, based on habitat data and WFD status information from the EA's Catchment Explorer. As noted at the start of **Section 3.1**, that assessment has not been included here because it was superseded by later stages of assessment. For options included in the Preferred Plan, a revised assessment was undertaken using similar information but also incorporating proximity to watercourses, with a score of between -1 (least impact) and -5 (greatest impact) being assigned to each option.

### Water regulation

The WRPG supplementary guidance does not require the monetisation of Water Regulation services. It is considered that, with the available information, this service is best represented by the WFD Compliance Assessment. To avoid double counting, therefore, the WFD Compliance Assessment report completed for the revised draft WRMP<sup>21</sup> should be referred to directly for the assessment of this service.

### Recreation and tourism

The Outdoor Recreation Valuation Tool (ORVal)<sup>22</sup> was used to estimate recreation demand from greenspaces, as a proxy for recreation value. Both open greenspaces and public footpaths were considered.

A conditional percentage was applied to the footpath values depending on the number of footpath intersections (and therefore alternative routes) present, as follows:

- If there are no intersections, and therefore no alternative routes, then 100% of the footpath value is taken;
- If there are 1-2 intersections present, then 50% of the value is taken;

<sup>20</sup> Values from Forest Research (2018). *Valuing flood regulation services of existing forest cover to inform natural capital accounts*. And Morris & Camino (2011) *UK National Ecosystem Assessment Economic Analysis Report*, School of Applied Sciences, Cranfield University.

<sup>21</sup> WSP (2023) Water Resources Management Plan 2024 Water Framework Directive Compliance Assessment, July 2024.

<sup>22</sup> <https://www.leep.exeter.ac.uk/orval/>

- If there are 3-4 intersections present, then 25% of the value is taken;
- If there are 5+ intersections present, 10% of the value is taken.

The use of the ORVal tool has uncertainties surrounding the ‘true’ impact that the construction of an option may have on recreation and tourism, with ORVal potentially giving an overstated account of the impact. This uncertainty has been further reduced by using the conditional multipliers approach outlined above. Additionally, the uncertainty has been reduced by assuming that the impact to recreation and tourism will be, in almost all cases, a temporary impact, although at this stage of assessment and when using the ORVal tool, the actual duration of impact (e.g. a footpath closure) is not known. However, at this level of assessment, ORVal remains the recommended and most informative data set to use. The ORVal values are priced to £2016, and the values have been adjusted to £2019 for this assessment.

## Agriculture

This assessment adopts the same principles for ecosystem services associated with agriculture as outlined in the UK Natural Capital Accounts, i.e. the distinction between what is considered ‘natural capital’ and what is ‘produced capital’ is defined as the “point at which vegetable biomass is extracted”<sup>23</sup>. For the purposes of this assessment, to estimate the annual value per hectare of ecosystem services relevant to agricultural production, an adaptation of the whole-farm income method outlined by the UK Office of National Statistics (ONS) Natural Capital Accounts was used<sup>24</sup>. This approach was used as opposed to the industry residual value method adopted for the 2020 ONS Natural Capital Accounts as it allows for differentiation between the provisioning services associated with different farm types (in this case arable and pasture) and was therefore considered more appropriate for this assessment. The marginal values estimated per hectare derived from this method (presented in **Table 2.3** below) remain comparable to the estimated industry residual value per hectare reported by the ONS for their 2020 accounts (£241.80/ ha in 2018).

**Table 2.3 Benefit transfer values: provisioning services supporting agriculture**

	All farm types (average value/ha, 2019)	Arable (cropping) (average value £/ha, 2019)	Pasture (grazing livestock) (average value £/ha, 2019)
Northwest (United Utilities)	236.83	279.86	207.34
Wales (Welsh Dŵr Cymru)	155.65	NA	158.57
West Midlands (Severn Trent)	325.26	408.86	206.56
East of England (South Staffs Water)	365.68	354.99	286.29

<sup>23</sup> ONS (2017) Principles of Natural Capital Accounting. [Last accessed 29/04/2021] Accessible via: <https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/principlesofnaturalcapitalaccounting>

<sup>24</sup> Office for National Statistics (ONS), 2019. UK natural capital accounts methodology guide: October 2019, s.l.: ONS



These values represent the average farm output level estimate of the industry residual value for farms in the relevant areas. Data was obtained from the Farm Business Survey<sup>25</sup> and was subject to the following high-level calculation:

$$\frac{\text{Average output from agriculture} - \text{Average costs for agriculture}}{\text{Average total farm area (ha)}}$$

The original method outlined by the ONS (2019) was adapted after calculations with Southeast specific data resulted in a negative residual value per hectare for both arable and pasture. This would imply that the provisioning services of these natural assets have no inherent value and that they do not contribute to agricultural production. It is concluded in the literature that a probable explanation of negative resource rents is that they reflect market distortions such as subsidies<sup>26</sup>. The original method outlined by the ONS excludes subsidies and agri-environment payments and activities from their calculation; however, the adapted method adopted for this assessment includes these factors. An overview of what is included is outlined in **Table 2.4**.

The total annual benefit values calculated for this assessment make use of the Southeast estimated averages calculated for each of the variables and component for each of the high-level farm types associated with this assessment (arable and pasture).

**Table 2.4 Components included within the adapted farm income method**

Variable	Components included
<b>Output from agriculture</b>	<ul style="list-style-type: none"> <li>• Output from agriculture (excl. subsidies and agri-environment payments)</li> <li>• Subsidies and payments to agriculture (excl. agri-environment payments)</li> <li>• Agri-environment and related payments (incl. HFA)</li> <li>• Basic Farm payment</li> <li>• Output from diversification</li> </ul>
<b>Costs for agriculture</b>	<ul style="list-style-type: none"> <li>• Costs for agriculture (excluding agri-environment activities)</li> <li>• Costs for agri-environment work</li> <li>• Costs of diversification out of agriculture</li> <li>• Costs associated with Basic Payment Scheme</li> </ul>

## Stage 4 – Biodiversity Net Gain Assessment with mitigation

This stage is only undertaken for the Preferred Programme of WRMP options, where any of the options within the Preferred Programme will result in a notable loss of habitat.

The calculation of net loss/gain within the Biodiversity Metric 3.0 considers both direct impacts resulting in habitat loss (whether permanent or temporary) and changes in habitat condition. The areas required to achieve 10% net gain for each option have been identified based on the baseline habitats present within the option footprint, and following the requirements of the Biodiversity Metric 3.0. This has included requirements such as requiring the same habitat (for High

<sup>25</sup> <https://farmbusinesssurvey.co.uk/>

<sup>26</sup> Obst, C., Hein, L., & Edens, B., (2016). National Accounting and the Valuation of Ecosystem Assets and their Services, Environ Resource Econ 64, pp 1-23.

distinctiveness habitats) or replacement with the same habitat type or one of higher distinctiveness (for low distinctiveness habitats).

For the purposes of this assessment, it was assumed that the impact footprint as defined above comprises the entire site area. That is, from a planning perspective, it is assumed that the net gain requirement can be calculated directly as 10% of the biodiversity losses that were identified at Stage 2.

All habitats within the construction buffer are assumed to be lost and re-instated with the existing baseline habitat type and restored to the same condition, except those that will be replaced by permanent above-ground infrastructure.

The off-site mitigation used in the assessments is intended to provide an indicative area of off-site habitat required to achieve 10% net gain for the options. Habitats, where possible, were used in the same proportions as the baseline habitats, excluding habitats which do not provide BNG units and are not possible to enhance within the metric (e.g., Urban-sealed surface). Moderate to Very high distinctiveness habitats were mitigated through off site enhancement e.g., poor to moderate or moderate to good. It is not possible to enhance cropland in the Biodiversity Metric, so consequently modified grassland was used for off-site mitigation to offset impacts to crop land using a change in habitat type from poor condition Modified grassland to moderate condition Neutral grassland. Examples are shown in **Table 2.5** below.

**Table 2.5 Off-site habitat enhancement rules used to calculate habitat area required to achieve 10% net gain**

On-site baseline habitat lost	Off-site habitat pre-mitigation		Off-site habitat post-mitigation	
	Habitat	Condition	Habitat	Condition
<b>Cropland</b>	Modified grassland	Poor	Other neutral grassland	Moderate
<b>Modified grassland</b>	Modified grassland	Moderate	Other neutral grassland	Moderate
<b>Other neutral grassland</b>	Neutral grassland	Moderate	Other neutral grassland	Good
<b>Woodland (broad leaved)</b>	Modified grassland	Moderate	Woodland (broad leaved)	Moderate
<b>Woodland (mixed)</b>	Modified grassland	Moderate	Woodland (mixed)	Moderate
<b>Traditional orchards</b>	Modified grassland	Moderate	Traditional orchards	Moderate
<b>Floodplain wetland mosaic (CFGM)</b>	Modified grassland	Moderate	Floodplain wetland mosaic (CFGM)	Moderate
<b>Lowland calcareous grassland</b>	Lowland calcareous grassland	Moderate	Lowland calcareous grassland	Good

## **Stage 5 – Natural Capital Assessment using the Biodiversity Net Gain Assessment with mitigation**

This stage has also only been undertaken for the Preferred Programme, where any of the options within the Preferred Programme will result in a notable loss of habitat.

The NCA undertaken in Stage 5 presents the temporary and permanent loss as at Stage 3, and also takes account of the areas planned for habitat creation and habitat improvement, including consideration of required mitigation for BNG (as calculated at Stage 4).

Between Stages 3 and 5, updated option information was received from DCWW for some options, which in some cases has resulted in the temporary and permanent impacts differing slightly between the stages of assessment. Besides this, the same data sources were used in both Stage 3 and 5.

At this stage, with the data currently available, only the impacts of habitat succession can be quantified and not a change in habitat condition. For example, the impact on natural capital of land changing from arable to semi-natural grassland can be quantified, but that of an area of semi-natural grassland changing condition from moderate to poor cannot be quantified. Quantification of land use change has taken place for natural hazard regulation and climate sequestration by calculating the monetary value of the baseline and post mitigation environment and subtracting the baseline from the post mitigation value.

## **Stage 6 – Identifying Potential Biodiversity Opportunity Areas**

For the Preferred Plan, where any of the options within the Preferred Programme will result in a notable loss of habitat, Potential Biodiversity Opportunity (PBO) areas have been identified. These sites are all within 5km of the option locations, and have been identified based on a scoring system that pools together more than 20 datasets (including distance, local planning authority, proximity to designated sites, water company ownership), assigns scores to them so they could be prioritised, and identifies the most suitable PBOs for habitat restoration or creation. The scoring system is largely based on the Lawton principles<sup>27</sup>, whereby effort should be made for new/enhanced habitats to be actively incorporated into a healthy ecological network (including landscape corridors, buffer zones, sustainable use areas, etc.), rather than being isolated. The system also considers variables from the Biodiversity Metric, the outputs from which should be used in conjunction with the PBOs, to identify sites with relevant habitat types.

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<sup>27</sup> Prof. J. Lawton (2010), Making Space for Nature. Report for the UK Government

## 3. Assessment outcomes for the feasible options

### 3.1 Feasible options included in the assessment

DCWW's feasible options list includes both demand side and supply side options, of which only the latter require assessment in this report (i.e. assuming that the demand-side options will not involve any land-take). The supply side options are presented in **Appendix C**.

### 3.2 Biodiversity Net Gain (Stage 2) outcomes

The results of the Stage 2 Biodiversity Net Gain calculations are presented for all options in **Appendix C**.

There are nine options that are not expected to have any impact on biodiversity as they do not involve any new land-take. In general, permanent infrastructure such as new water treatment works or pumping stations is proposed to be located on areas of relatively low-value habitat or existing hardstanding.

There are eight options in group 4 or 5, i.e. with the greatest impact on biodiversity. These are associated with temporary works for pipeline installations, with greater impact for longer pipelines and those crossing areas of higher value habitat. The types of habitats that would be disturbed by pipeline construction vary, with extensive areas of modified grassland but also some higher value habitat including woodland and wetland/peatland (notably for Option MSC01). Although these impacts will be temporary, the detail of the duration of works is not known at this stage, and appropriate mitigation will need to be put in place to minimise impacts, including avoiding areas of high-value habitats.

### 3.3 Natural Capital (Stage 3) outcomes

The results of the Stage 3 Natural Capital calculations are presented for all options in **Appendix D**.

#### Climate regulation

Impacts on climate regulation are generally proportionate to biodiversity losses, with higher value habitats including woodlands and wetlands generally providing the greatest extent of climate regulation. While the majority of impact would be associated with temporary works, higher value habitats should still be avoided (e.g. avoiding loss of trees during implementation of Option SEW009, which could take many years to return to maturity), with careful mitigation where avoidance is not possible (e.g. avoiding longer term impact to peatlands during implementation of Option MSC01).

#### Natural hazard regulation

Natural hazard regulation has been quantitatively assessed only for woodland, with the greatest losses associated with the pipeline for Option SEW009, which crosses the greatest extent of

woodland. Other habitats also play a role in natural hazard regulation, for example avoiding long-term impact to upland habitats. Temporary or permanent works in the floodplain also have the potential to increase flood risk, with the potential for greater impact if disturbing natural habitats.

### Water purification

As explained in **Section 2**, the water purification ecosystem service has not been quantified. However, in general, options that score highly for climate regulation or natural hazard regulation may also be expected to score highly for water purification, since similar habitats (e.g. woodland and wetland) are expected to provide that ecosystem service most effectively. This may particularly be the case where woodland or wetland habitats provide a buffer alongside a watercourse.

### Recreation and tourism

Potential impacts on recreation and tourism have been valued using the Orval tool. This indicates the extent of use of publicly accessible areas and footpaths, and how highly valued those areas are, providing a useful quantitative comparison between options. Temporary losses of recreational benefits, as calculated using the Orval tool (described in **Section 2**), have been valued at between £0 and -£411,412 per year per option. The losses are associated with disruption to public footpaths, assuming that footpaths crossed by the pipeline route could not be used during construction. In general, options with longer pipelines and those in more highly populated/visited areas experience the greatest losses of value (the former because a longer pipeline has the potential to cross more footpaths; the latter because footpaths in highly populated/visited areas tend to have a higher value). This is a precautionary view associated with relatively short-lived impacts, since mitigation such as footpath diversions is likely to be put in place during pipeline construction. Nonetheless, the relative level of impact between options provides a useful indication of potential disturbance, albeit temporary, to landscape and recreational opportunities that may be valued by visitors.

Only one option (SEW007) has been assessed as having any permanent loss of recreational benefit, since most permanent works do not intersect with areas of open greenspace or public footpaths as shown in Orval. Option SEW007 is a reservoir with a footpath around its perimeter, where the level of the reservoir would be raised. However, it is highly probable that a new footpath would be created above the height of the new top water level, and therefore there would not, in fact, be a long-term loss of recreational opportunity associated with this option.

### Agriculture

Temporary losses of the agriculture service have been valued at between £0 and -£33,602 per year per option. The greatest losses relate to long pipelines that cross extensive areas of farmland and are associated with temporary loss of usable land during the construction period (which would subsequently be reinstated).

Permanent losses of the agriculture service are limited. Only a small proportion of the options involve any permanent loss of agricultural land, and in those cases the spatial extent is limited.

## 4. Assessment outcomes for the Preferred Programme

### 4.1 Introduction

This section presents the Stage 4 and Stage 5 assessments for DCWW's revised draft WRMP24. These stages of assessment have been carried out for the supply options that are included in the Preferred Programme, which include:

- Options SEW052, SEW166 and SEW168 in SEWCUS WRZ;
- Options TWG012 and TWG014 in Tywi Gower WRZ.

Option SEW052 – 'Afon Lwyd' has been included within the 'Preferred Plan' for the purposes of the environmental assessments as it may be required to support a potential bulk supply to the Canal and River Trust. Its inclusion enables DCWW to ensure they are being proactive in understanding any potential environmental effects associated with the option.

### 4.2 Preferred Programme

The results of the BNG assessment for the Preferred Programme are presented in **Table 4.1**, which shows that the options that form part of the Preferred Programme are expected to have minimal impact on biodiversity. Only two of the five options within the programme, SEW052 and TWG014, have been identified as having any negative impact on habitat extent or quality, and both would be very minor in. The impacts associated with SEW052 would be predominantly temporary, associated with construction of a relatively short pipeline across farmland with low biodiversity value, and permanent impacts of less than 1 ABHU associated with a pumping station. The biodiversity losses associated with TWG014 are also less than 1 ABHU.

With minor impacts on biodiversity, losses of NC and ecosystem services will be correspondingly minor. The NC and ecosystem service losses for options SEW052 and TWG014 can be referred back to in **Appendix D**, and a qualitative assessment of the water purification ecosystem service is provided (for the preferred options only) in **Appendix E**.

Impacts on the aquatic environment have not been quantified as part of this assessment (rivers and lakes are included as areas within the biodiversity assessment, but river systems as a whole, and their associated ecology, are not explicitly assessed). However, it is clear from the WFD compliance assessment<sup>28</sup>, which has concluded overall compliance of the Preferred Programme with the WFD, that impacts on the water environment are also minor. Therefore, it may be inferred that any impacts on NC associated with the rivers themselves will also be negligible or minor.

The very limited impact associated with the Preferred Programme does not drive a large-scale strategic response, since the two options with any impact are a large distance from each other, and are each very minor in scale. As a result, Stages 4-6 of the methodology have not been carried out. BNG calculations could still be carried out during option implementation (if in line with DCWW and

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<sup>28</sup> WSP (2023) DCWW Water Resources Management Plan: Water Framework Directive Compliance Assessment.

wider Welsh Government expectations at the time). Opportunities should be sought, associated with the individual options, for providing local benefit, in line with the DECCA framework, SMNR and the Welsh Wellbeing Goals.

**Table 4.1 Preferred Programme summary**

Option ID	On-site losses		Mitigation requirements
	On-site area (ha)	On-site baseline units (ABHU)	
<b>SEW052</b>	-1.7 ha	-7.6	Temporary loss of habitat associated with short pipeline crossing areas of predominantly modified grassland. Opportunities for enhancement during reinstatement should be considered.  Minor loss of habitat associated with new pumping station. Opportunities to provide mitigation and enhancement of biodiversity and ecosystem resilience should be considered during design and implementation.
<b>SEW166</b>	0	0	None
<b>SEW168</b>	0	0	None
<b>TWG012</b>	-0.04 ha	0	None. New buildings/infrastructure would be located on existing hardstanding.
<b>TWG014</b>	-0.02 ha	-0.11	Minor loss of habitat. Opportunities to provide mitigation and enhancement of biodiversity and ecosystem resilience should be considered during design and implementation.
<b>TOTAL</b>	<b>-1.76 ha</b>	<b>-7.71 ABHU</b>	

## 5. Summary

This report has presented the Biodiversity and Ecosystem Resilience Assessments that have been undertaken for DCWW's revised draft WRMP 2024. The approaches taken are in line with relevant guidance, notably the WRPG Supplementary Guidance on Environment and Society in Decision-making.

For the feasible options in the WRMP, this report has identified losses of biodiversity associated with all options that involve any temporary or permanent land-take. To provide a comparable measure of losses and gains, and for consistency across Water Resources West, the losses have been assessed using the Defra biodiversity metric v3.0. The calculations were based on spatial land use and habitat datasets with national coverage. Associated NC losses have been calculated for an agreed selection of ecosystem services. The assessment shows that the greatest impacts on biodiversity and associated regulating ecosystem services tend to be associated with options with long pipelines, particularly where they cross areas of woodland, wetland or peatland. Permanent above-ground infrastructure such as water treatment works or pumping stations are generally planned on existing DCWW sites with hardstanding or modified grassland, therefore resulting in negligible or modest losses of biodiversity.

The biodiversity losses were re-calculated for the five options in the Preferred Programme. Of these, three were identified not to have any impact on biodiversity, involving little or no new infrastructure. The other two are small in scale and would have limited impact on biodiversity and ecosystem service provision. As a result, the quantitative preferred options assessments were not progressed. However, while the very limited impact associated with the Preferred Programme does not drive a large-scale strategic response, opportunities to provide local benefit, in line with the DECCA framework, SMNR and the Welsh Wellbeing Goals, should still be considered during plan implementation.



# Appendix A

## SMNR Principles

A summary of the SMNR Principles and Wellbeing Goals for Wales, which have been considered in the assessment

SMNR Principles	Adaptive management	Manage adaptively by planning, monitoring, reviewing and where appropriate, changing actions
	Scale	Consider the appropriate spatial scale for action
	Collaboration and engagement	Promote and engage in collaboration and cooperation
	Public Participation	Make appropriate arrangements for public participation in decision-making
	Evidence	Take account of all relevant evidence, and gather evidence in respect of uncertainties
	Multiple benefits	Take account of the benefits and intrinsic value of natural resources and ecosystems
	Long term	Take account of the short-, medium- and long-term consequences of actions.
	Preventative action	Take action to prevent significant damage to ecosystems
	Building resilience	(i) diversity between and within ecosystems; (ii) the connections between and within ecosystems; (iii) the scale of ecosystems; (iv) the condition of ecosystems (including their structure and functioning); (v) the adaptability of ecosystems
Welsh Wellbeing Goals	A globally responsible Wales	A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.
	A prosperous Wales	An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including action on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.
	A Wales of vibrant culture and thriving Welsh language	A society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation.
	A Wales of cohesive communities	Attractive, viable, safe and well-connected communities.

A more equal Wales

A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio-economic background and circumstances).

A healthier Wales

A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.

# Appendix B

## Conversion from UKHab to Broad Habitats

Land Cover Classification	Broad habitat type
Cropland – Cereal crops	Arable
Modified grassland	Semi natural grassland
Heathland and shrub	Heathland and shrub
Lowland mixed deciduous woodland	Deciduous woodland
Neutral grassland	Semi natural grassland
Lakes – pond	Freshwater
Other coniferous woodland	Coniferous woodland
No habitat	Urban
Broadleaved woodland	Deciduous woodland
Poor semi-improved grassland	Semi natural grassland
Other rivers and streams	Freshwater
Eutrophic standing waters	Freshwater
Other coniferous woodland	Coniferous woodland
River and streams	Freshwater
Sparsely vegetated land	Sparsely vegetated land
Lowland heathland	Heathland and shrub
Other woodland mixed	Deciduous woodland
Traditional orchards	Semi natural grassland
Lowland meadows	Semi natural grassland
Floodplain wetland mosaic	Semi natural grassland
Traditional orchards	Semi natural grassland
Bramble	Heathland and shrub

# Appendix C

## Results of Stage 2 (feasible options) BNG calculations

Option ID	Option name/ description	Total area (ha)	Temporary						Permanent						Habitat summary
			Temp. area (ha)	Total units lost (ABHU)	Standar- dised units (ABHU /ha)	ABHU rank	ABHU/h a rank	group	Perm. Area (ha)	Total units lost (ABHU)	Standar- dised units (ABHU /ha)	ABHU rank	ABHU/h a rank	group	
SEW005A	GREAT_SPRINGS_TO_C OURT_FARM	-67.3	-63.1	-267.9	4.24	3	2	4	-4.2	-32.0	7.7	1	3	3	Long pipeline crosses areas of predominantly modified grassland and arable, with some woodland and wetland. New WTW on area of modified grassland (pasture)
SEW005C	GREAT_SPRINGS_TO_LL ANDEGFEDD	-86.0	-81.4	-343.8	4.22	3	2	4	-4.6	-39.3	8.5	1	3	3	Long pipeline crosses areas of predominantly modified grassland and arable, with some woodland and wetland
SEW007	TALYBONT_RESERVOIR	-5.5	0	0	0	0	0	0	-5.5	-33.3	6.0	1	3	3	Loss of woodland and grassland, which would be flooded from increased reservoir height. This would be replaced with open water habitat.
SEW009	GRWYNE_RESERVOIR	-50.9	-34.8	-211.9	6.09	3	3	5	-16.1	-89.9	5.6	1	2	2	Pipeline crosses areas of predominantly modified grassland and coniferous woodland, with some higher value habitats including heathland, broadleaved woodland and wetland
SEW022	PONTHIR_AND_WENT WOOD	-37.5	-34.9	-165.4	4.74	2	2	3	-2.6	-19.3	7.4	1	3	3	Pipeline crosses areas of predominantly modified grassland, with some woodland and other grassland
SEW022A	PONTHIR_STANDALON E	-4.4	-3.6	-13.5	3.73	1	2	2	-0.8	-3.5	4.4	1	2	2	Relatively short pipeline crosses areas of predominantly modified grassland and unvegetated/developed land
SEW036A	PANT-YR-EOS	-5.7	-5.0	-21.0	4.24	1	2	2	-0.8	-6.5	8.4	1	3	3	Relatively short pipeline crosses areas of predominantly modified grassland, with some woodland
SEW036B	YNYS-Y-FRO	-4.0	-3.0	-12.0	4.00	1	2	2	-1.0	-5.5	5.4	1	2	2	Relatively short pipeline crosses areas of predominantly modified grassland, with some woodland
SEW036C	PANT-YR- EOS_AND_YNYS-Y-FRO	-8.6	-6.8	-29.3	4.29	1	2	2	-1.8	-12.0	6.7	1	3	3	Pipeline crosses areas of predominantly modified grassland, with some woodland
SEW044	SCHWYLL_BOREHOLES	-42.9	-37.6	-136.2	3.62	2	2	3	-5.3	-40.9	7.7	1	3	3	Pipeline route crosses areas of predominantly modified grassland and developed land, with some arable and woodland
SEW052	AFON_LWYD	-1.7	-1.6	-6.9	4.27	1	2	2	-0.1	-0.7	5.7	1	2	2	Short pipeline route crosses areas of predominantly modified grassland
SEW053	AFON_LWYD_TO_LL ANDEGFEDD_RESERVOIR	-2.9	-2.4	-7.9	3.29	1	2	2	-0.5	-3.6	8.0	1	3	3	Short pipeline route crosses developed land, woodland and modified grassland
SEW063	NANTYBWCH_WASTE WATER	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint
SEW064	WENTWOOD	-33.2	-31.2	-151.9	4.86	2	2	3	-2.0	-15.8	8.1	1	3	3	Pipeline route crosses areas of predominantly modified grassland, with some grassland, arable and woodland
SEW067	CARDIFF_EAST_AND_C OGG_MOORS	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint
SEW166	MEMORIAL	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint
SEW167	WYE_TO_SEVERN_TREN T	-183.9	-183.9	-878.7	4.78	3	2	4	0	0	0	0	0	0	Long pipeline crosses areas of largely modified grassland, but with some woodland and wetland
SEW168	LLWYNON_GRAVITY_M AIN_UPGRADES	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint

Option ID	Option name/ description	Total area (ha)	Temporary						Permanent						Habitat summary
			Temp. area (ha)	Total units lost (ABHU)	Standar- dised units (ABHU /ha)	ABHU rank	ABHU/h a rank	group	Perm. Area (ha)	Total units lost (ABHU)	Standar- dised units (ABHU /ha)	ABHU rank	ABHU/h a rank	group	
MSC01	Clawren Transfer	-35.4	-34.1	-469.3	13.8	3	3	5	-1.4	-11.1	8.2	1	3	3	Pipeline crosses considerable extents of high value habitat including broadleaved woodland, fen, grasslands, mires and peat
MSC02	New zonal connection to North Ceredigion	-66.6	-62.9	-248.3	4.0	3	2	4	-3.7	-40.8	11.0	1	3	3	Long pipeline route crosses areas of predominantly modified grassland and some developed/unvegetated land
MSC06a	Llyn Egnant Dam Raising - 0.5m	-1.0	0	0	0	0	0	0	-1.0	-8.9	8.6	1	3	3	Loss of grassland, which would be flooded from increased reservoir height. This would be replaced with open water habitat.
MSC06b	Llyn Egnant Dam Raising - 1.0m	-2.2	0	0	0	0	0	0	-2.2	-18.2	8.3	1	3	3	Loss of grassland, which would be flooded from increased reservoir height. This would be replaced with open water habitat.
MSC07	Llechryd WTW Distribution Options - Upgrades to automate Deri Goch WPS	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint
MSC08	Upsize Llechryd WTW	0	0	0	0	0	0	0	0	0	0	0	0	0	Proposed works are all within existing site, with no/negligible new footprint
TWG03	Bryn Gwyn WTW upgrade	-0.2	-0.2	-0.7	4.4	1	2	2	0	0	0	0	0	0	Proposed works are all within existing site, on areas of hardstanding or modified grassland
TWG09	Upsize Llangyfelach WPS	-0.003	0	0	0	0	0	0	-0.003	0	0	0	0	0	Proposed works are all on existing areas of hardstanding
TWG11	Bryn Gwyn Felindre WTW supply to Llanon	-0.02	0	0	0	0	0	0	-0.02	-0.2	8.7	1	3	3	New pumping station location appears to be an area of woodland/ scrub
TWG12	Crai distribution- upsize Christopher Rd WPS Pontardawe Booster	-0.04	0	0	0	0	0	0	-0.04	0	0	0	0	0	Proposed works are all on existing areas of hardstanding
TWG13	Crai distribution options- Rezoning Pontardawe and Cwmdu bridge valve isolation	-59.0	-41.6	-177.7	4.3	2	2	3	-17.3	-127.9	7.4	2	3	4	Pipeline crosses extensive areas of modified grassland, but also broadleaved woodland and small extents of high-value habitats including wetland and grassland habitats
TWG14	Ystradfellte - Reverse flow through Tonna Control Valve	-0.02	0	0	0	0	0	0	-0.02	-0.1	6.9	1	3	3	Proposed location for pumping station covers amenity grassland and potentially woodland
TWG15	Llyn y Fan Fach for regulation	-125.9	-113.5	-595	5.2	3	2	4	-12.4	-105.3	8.5	2	3	4	Pipeline crosses extensive areas of modified grassland, but also broadleaved woodland and heathland
TWG26	Brywn Gwyn distribution options- Carn Powell SRV to Llannon SRV	0	0	0	0	0	0	0	0	0	0	0	0	0	No land-take required

# Appendix D

## Results of Stage 3 (feasible options) Natural Capital calculations

Option ID	Option name/ description	Total area (ha)	Temporary impacts					Permanent impacts				
			Area	Climate Regulation	Natural Hazard Regulation	Recreation and Tourism	Agriculture	Area	Climate Regulation	Natural Hazard Regulation	Recreation and Tourism	Agriculture
			Ha	£2019/year	£/year	£2019/year	£2019/year	Ha	£2019/year	£/year	£2019/year	£2019/year
SEW005A	GREAT_SPRINGS_TO_COURT_FARM	-67.27	-62.91	-£428.81	-£414.20	-£113,126.70	-£11,597.96	-4.1497	-£1,132.15	-£379.40	£0.00	-£163.26
SEW005C	GREAT_SPRINGS_TO_LLANDEGFEDD	-85.97	-81.3763	-£560.32	-£479.01	-£126,716.45	-£3,779.00	-4.6728	-£1,549.86	-£517.99	£0.00	-£3.52
SEW007	TALYBONT_RESERVOIR	-5.52	0	£0.00	£0.00	£0.00	£0.00	-5.52	-£600.00	-£796.00	-£6,738.97	-£647.00
SEW009	GRWYNE_RESERVOIR	-50.92	-34.7748	-£483.66	-£837.99	-£411,412.21	-£5,389.95	-16.1423	-£12,041.22	-£1,891.16	£0.00	£0.00
SEW022	PONTHIR_AND_WENTWOOD	-37.47	-32.5816	-£269.30	-£158.10	£0.00	-£5,782.30	-2.6148	-£679.88	-£214.30	£0.00	-£162.89
SEW022A	PONTHIR_STANDALONE	-4.40	-3.6173	-£17.52	-£46.85	£0.00	-£518.85	-0.7856	-£5.50	£0.00	£0.00	-£162.89
SEW036A	PANT-YR-EOS	-5.73	-3.8359	-£26.11	-£49.29	-£66,737.17	-£773.48	-0.7738	-£306.35	-£90.66	£0.00	£0.00
SEW036B	YNYS-Y-FRO	-4.02	-1.87	-£12.79	-£13.98	-£8,076.44	-£378.79	-1.0263	-£788.34	-£120.24	£0.00	£0.00
SEW036C	PANT-YR-EOS_AND_YNYS-Y-FRO	-8.63	-5.706	-£38.90	-£63.31	-£66,737.17	-£1,152.27	-1.8001	-£1,094.68	-£210.89	£0.00	£0.00
SEW044	SCHWYLL_BOREHOLES	-42.94	-37.6188	-£249.94	-£431.03	-£160,445.29	-£5,788.63	-5.2767	-£2,535.12	-£618.20	£0.00	£0.00
SEW052	AFON_LWYD	-1.74	-1.6144	-£10.32	-£22.30	£0.00	-£305.56	-0.1257	-£0.61	-£17.91	£0.00	-£24.46
SEW053	AFON_LWYD_TO_LLANDEGFEDD_RESERVOIR	-2.85	-2.3	-£12.00	-£22.00	£0.00	-£263.00	-0.45	-£114.00	-£79.00	£0.00	-£14.00
SEW063	NANTYBWCH_WASTEWATER	0	0	£0.00	£0.00	£0.00	£0.00	0	£0.00	£0.00	£0.00	£0.00
SEW064	WENTWOOD	-33.19	-28.9425	-£251.78	-£111.24	£0.00	-£5,263.44	-1.9549	-£674.41	-£214.30	£0.00	-£0.87
SEW067	CARDIFF_EAST_AND_COGG_MOORS	0	0	£0.00	£0.00	£0.00	£0.00	0	£0.00	£0.00	£0.00	£0.00
SEW166	MEMORIAL	0	0	£0.00	£0.00	£0.00	£0.00	0	£0.00	£0.00	£0.00	£0.00
SEW167	WYE_TO_SEVERN_TRENT	-183.88	-168.57	-£1,345.00	-£1,063.00	-£200,599.00	-£33,602.00	-15	-£5,349.00	-£1,793.00	£0.00	-£1.00
SEW168	LLWYNON_GRAVITY_MAIN_UPGRADES	0	0	£0.00	£0.00	£0.00	£0.00	0	£0.00	£0.00	£0.00	£0.00
MSC01	Claerwen Transfer	-35.43	-34.07	-£3,398.00	-£19.00	-£2,747.00	-£806.00	-£1.35	-£408.00	-£137.00	£0.00	-£38.00
MSC02	New zonal connection to North Ceredigion	-66.59	-62.89	-£395.00	-£82.00	£0.00	-£11,550.00	-£3.70	-£2,059.00	-£434.00	£0.00	£0.00
MSC06a	Llyn Egnant Dam Raising - 0.5m	-1.03	0	£0.00	£0.00	£0.00	£0.00	-£1.03	-£27.00	£0.00	£0.00	-£8.00
MSC06b	Llyn Egnant Dam Raising - 1.0m	-2.19	0	£0.00	£0.00	£0.00	£0.00	-£2.19	-£55.00	£0.00	£0.00	-£53.00
MSC07	Llechryd WTW Distribution Options - Upgrades to automate Deri Goch WPS	0	0	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
MSC08	Upsize Llechryd WTW	0	0	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
TWG03	Bryn Gwyn WTW upgrade	-0.16	0	£0.00	£0.00	£0.00	£0.00	-£0.16	-£1.00	£0.00	£0.00	£0.00
TWG09	Upsize Llangyfelach WPS	-0.0025	0	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00
TWG11	Bryn Gwyn Felindre WTW supply to Llanon	-0.023	0	£0.00	£0.00	£0.00	£0.00	-£0.02	-£8.00	-£3.00	£0.00	£0.00
TWG12	Crai distribution- upsize Christopher Rd WPS Pontardawe Booster	-0.04	0	£0.00	£0.00	£0.00	£0.00	-£0.04	£0.00	£0.00	£0.00	£0.00
TWG13	Crai distribution options- Rezoning Pontardawe and Cwmdru bridge valve isolation	-58.97	-41.68	-£338.00	-£13.00	-£12,138.00	-£4,097.00	-£17.34	-£509.00	-£2,031.00	£0.00	£0.00

Option ID	Option name/ description	Total area (ha)	Temporary impacts					Permanent impacts				
			Area	Climate Regulation	Natural Hazard Regulation	Recreation and Tourism	Agriculture	Area	Climate Regulation	Natural Hazard Regulation	Recreation and Tourism	Agriculture
			Ha	£2019/year	£/year	£2019/year	£2019/year	Ha	£2019/year	£/year	£2019/year	£2019/year
TWG14	Ystradfellte - Reverse flow through Tonna Control Valve	-0.02	0	£0.00	£0.00	£0.00	£0.00	-£0.02	-£7.00	-£1.00	£0.00	£0.00
TWG15	Llyn y Fan Fach for regulation	-125.89	-113.51	-£1,254.00	£0.00	-£115,770.00	-£15,520.00	-£12.37	-£4.73	-£1,449.00	£0.00	£0.00
TWG26	Brywn Gwyn distribution options- Carn Powell SRV to Llannon SRV	0	0	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00	£0.00

# Appendix E

## Qualitative assessment of water purification service (Preferred options only)

Option ID	WFD water body physico-chemical status (2021)	Habitats present- extent of woodland and wetland	Proximity to watercourse	Summary of losses	Qualitative score (-1 to -5)
<b>SEW052</b>	Good	Pipeline crosses predominantly modified grassland.	Route relatively close to Afon Lwyd	No impact on high-value habitats, and largely temporary impact, but in proximity to surface watercourses	-2
<b>SEW166</b>	n/a- no impact on habitat condition or extent				0
<b>SEW168</b>	n/a- no impact on habitat condition or extent				0
<b>TWG012</b>	n/a- no impact on habitat condition or extent				0
<b>TWG014</b>	Moderate In both River Neath and Neath canal.	Minor loss of modified grassland.	Not in proximity to any watercourse	Very small impact, and only on low value habitats, not in proximity to surface watercourses	-1



