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United Utilities

Water for the North West

BNHGUnited Utilities

North West Transfer Strategic Resource Option

Gate 2: Biodiversity Net Gain and Natural Capital Assessment

Wood Environment & Infrastructure Solutions UK Limited – October 2022

Report for

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Contents

1. Introduction

1.1 Purpose of this Report

This report presents the Biodiversity Net Gain (BNG) and Natural Capital (NC) Assessment for United Utilities' (UU's) North West Transfer (NWT) Strategic Resource Option (SRO) and supports the Gate 2 submission to the Regulators Alliance for Progressing Infrastructure Development (RAPID). This assessment for Gate 2 represents the best available information at the time, and includes recommendations for further evidence collection and assessment during Gate 3.

1.2 The North-West Transfer SRO

The NWT SRO is one of 17 schemes promoted by Ofwat in the PR19 Final Determination to identify new strategic water resources to meet projected supply deficits as a consequence of population growth and climate change. The NWT SRO is a combination of the United Utilities Sources (UUS) and Vyrnwy Aqueduct (UUVA) SROs. Both the UUS and UUVA SROs have progressed through Gate 1 (July 2021) of RAPID's gated process and UU has now prepared its Gate 2 submission for a combined NWT SRO Full Solution.

The NWT SRO promotes cost efficient source options, selected to facilitate transfer volumes by the release of raw water directly from Lake Vyrnwy into River Vyrnwy or transferred through a new River Vyrnwy bypass pipeline into the River Severn as part of the Severn Thames Transfer (STT) SRO. The NWT SRO provides new sources to be brought online if water were to be transferred out of region, maintaining resilience for customers in the North West. The NWT SRO comprises two principal components:

- new sources to offset water transferred out of region from Lake Vyrnwy as part of the STT SRO; and
- enabling works on the Vyrnwy Aqueduct to allow treated water from regional UU sources to be transferred by pumping into the Vyrnwy Aqueduct to maintain customer supplies (for transfer volumes greater than 50 Ml/d).

The purpose of Gate 2 is to enable detailed feasibility, concept design and multi-solution decision making, building on the work undertaken during Gate 1 to further develop the NWT SRO programme and option design. To inform concept solution designs and reduce uncertainty in costs and benefits, the potential environmental effects of the NWT SRO identified in Gate 1 are considered further in a series of updated overarching assessments, including this BNG and NC Assessment. The assessment builds on Gate 1 by taking account of:

- the sub-options being taken forward at Gate 2 including updated design information;
- regulator feedback (during Gate 1 including RAPID's Gate 1 decision and during the preparation of the Gate 2 submission); and
- further, topic-specific evidence collection and assessment work.

A total of 14 sub-options are proposed for the NWT SRO (13 supply options and one enabling works option). The source options are geographically spread across UU's supply area (as shown in

Figure 1.1), and include groundwater and river abstractions. Of the 13 source options, nine are included in the NWT Full Solution, with the remaining four held in reserve. The sub-options are summarised in **Table 1.1**.

Table 1.1 Sub-options included in the NWT SRO

Option ID	Option name	Description	Capacity (Ml/d)	Part of NWT Full Solution?
WR015	[✂]	[✂]	40	Yes
WR049d	[✂]	[✂]	40	Yes
WR076	[✂]	[✂]	25	Yes
WR102b	[✂]	[✂]	17	Yes
WR105a1	[✂]	[✂]	4.5	No
WR106b	[✂]	[✂]	8.5	No
WR107a2	[✂]	[✂]	10	Yes
WR107b	[✂]	[✂]	12	Yes
WR111	[✂]	[✂]	9	Yes
WR113	[✂]	[✂]	3	Yes
WR144	[✂]	[✂]	5	No
WR149	[✂]	[✂]	13	Yes
STT041b	[✂]	[✂]	58	No
STTA4	[✂]	[✂]	n/a	Yes

1.3 Biodiversity Net Gain and Natural Capital

What are Biodiversity Net Gain and Natural Capital?

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 seeks to provide a means of quantifying losses or gains in biodiversity value bought about by changes in land use, and when designed and delivered well, BNG can secure benefits for nature, people and places, and for the economy[1].

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

[1] 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/

wealth, health, wellbeing and culture and seeks to demonstrate the value of the natural environment for people and the economy[2].

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 natural capital 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.

The NWT SRO includes no source options in Wales. A 7 km section of the Vyrnwy Aqueduct to the northeast of Oswestry passes through Wales, but at the time of writing no construction activities associated with Option STTA4 are confirmed in this section, so the requirements of the Environment (Wales) Act 2016 and the Wellbeing of Future Generations (Wales) Act 2015 do not apply. The detailed design of Option STTA4 will continue to be progressed following Gate 2. Should further design work identify that works are required within Wales, this will be considered in Gate 3, including in the context of relevant Welsh legislation.

BNG and NC for Strategic Resource Options

RAPID's Gate 2 guidance (April 2022[3]) sets out the following requirements for BNG and NCA in England at Gate 2:

"Biodiversity net gain (England only): This should support the net gain actions in the Government's 25 year Environment plan and aim to meet the likely future requirements as per the Environment Act…

…Natural capital Assessment (NCA): A NCA should be completed/updated at the solution level and used to support identification of best value solutions. The NCA should be consistent with WRMP24 guidelines supplementary guidance on Regional and WRMPs (including any differences in assessment requirements for Wales).

Methodologies should be consistent with any relevant legislation, guidance and follow best practice. This includes, where relevant, WRMP24, All Company Working Group guidance and the Environment Agency Invasive Non-native Species risk assessment tool."

More detail of the approaches is provided in the All Company Working Group (ACWG) guidance (October 2020[4]), which sets out a requirement for an environmental assessment to be undertaken for each SRO. The relevant approaches set out in the ACWG guidance are discussed in more detail in **Section 2**.

In line with the guidance, and in keeping with UU's emerging wider strategies on Biodiversity Net Gain, this assessment considers the potential losses of biodiversity associated with the NWT, the associated extent of net gain that may therefore be delivered by UU, and takes the first steps towards identification of opportunity areas for providing that net gain. Both biodiversity and natural capital are considered within the assessments, and are being used to inform decision-making in UU regarding the development of the sub-options individually and the NWT Full Solution as a whole. The assessments will continue to be developed, and used to further refine the options and their associated net gain opportunities, beyond Gate 2.

[2] UK Government (2021), Enabling a Natural Capital Approach (ENCA) – Updated 20 August 2021
[3] RAPID (April 2022). Strategic regional water resource solutions guidance for gate 2.
[4] All Company Working Group (October 2020). WRMP environmental assessment guidance and applicability with SROs

1.4 Structure of this Report

The remainder of this report sets out:

- In **Section 2**, the methodology applied to the assessment;
- In **Section 3**, the results of the assessments;
- In **Section 4**, conclusions of the assessment at Gate 2, and recommendations to improve the evidence collection and assessment during Gate 3.

2. Methodology

2.1 Context

All sub-options that are considered part of the NWT SRO are also included in UU's draft Water Resources Management Plan 2024 (dWRMP24). As a result, all of the sub-options in the NWT have already been assessed as feasible options in the WRMP, using the approach set out in the Water Resource Planning Guidance (WRPG, 2021). In order to provide continuity and consistency with the WRMP, the WRPG approach has been applied to, and referred to in, the NWT SRO assessment. This is instead of referring to the ACWG guidance[5], although recognising that both approaches are identical in their objectives and take the same approaches, with the ACWG guidance specifically stating that it develops "*an environmental assessment method for SROs which is aligned to the draft Water Resource Planning Guideline… for WRMP24*".

This assessment has therefore been undertaken in line with the BNG and NC Assessments completed for UU's draft WRMP in 2022 and no additional evidence collation or assessment, beyond that completed for the draft WRMP, has been undertaken. This means that, in line with the WRMP assessments, and taking account of the evidence currently available for the NWT, the assessment uses areas of habitat, but does not specifically consider rivers (as linear features). Recommendations are included in **Section 4** in order to incorporate rivers into later stages of assessment.

The methodology applied here was provided to regulators for consultation in the form of a Method Statement in May 2022[6]. It is in line with the advice note provided by Natural England to United Utilities in September 2022[7].

2.2 Overview of Approach

Biodiversity Net Gain Approach

The BNG Assessment is based on use of the Defra Biodiversity Metric 3.0, to assess losses of biodiversity as a result of the NWT SRO sub-options[8]. A GIS-based system has been adopted, using national datasets, to provide comprehensive coverage of habitat data.

To ensure that the NWT SRO contributes to the conservation and enhancement of biodiversity and delivers BNG, Defra's Biodiversity Metric 3.0 has been used to demonstrate how net gain could be achieved on and off-site. NWT SRO sub-options that need planning permission will, as of November 2023, be legally required to provide BNG of 10% in England, pursuant to the Environment Act (2021). Some NWT SRO sub-options may not require planning permission as they may be deemed 'permitted development' such that the 10% requirement will not apply; however,

[5] All Companies Working Group (2020) WRMP environmental assessment guidance and applicability with SROs.
[6] Wood (2022) *North West Transfer Strategic Resource Option Gate 2: Overarching Environmental Assessments Method Statement*
[7] *Natural England – Biodiversity Net Gain advice for developing BNG*, September 2022
[8] 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.

for the purposes of this assessment only, the 10% BNG requirement has been applied to all sub-options.

Potential Biodiversity Opportunity (PBO) areas have been identified for all NWR SRO sub-options. These sites are all within 5km from the sub-option locations and are based on a scoring system largely reflecting the Lawton principles[9], as explained further in **Section 2.7**. These sites should then be used in conjunction with the results from the Biodiversity Metric, with the metric calculating how much mitigation would be required, and the PBO identification showing potentially beneficial locations for off-site mitigation.

Natural Capital Assessment Approach

The following ecosystem services have been considered in the assessment. This is line with the ACWG and WRPG supplementary guidance, and is as agreed in the Method Statement (Wood, 2022):

- Biodiversity;
- Climate regulation;
- Natural hazard regulation;
- Water purification;
- Water regulation;
- Health & wellbeing- as represented by Recreation and Tourism;
- Agriculture.

"Biodiversity and habitat" is assessed using Biodiversity Net Gain as the most appropriate metric, as described in **Section 2.3**. Assessment of the remaining ecosystem services is explained in **Section 2.4**.

2.3 Biodiversity Net Gain Baseline Calculations

Areas of habitats were calculated in QGIS. The CORINE land cover dataset[10] 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 Priority Habitats Inventory[11], covering all nationally mapped areas of priority habitat;
- 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 sub-option using GIS data provided by UU:

[9] Prof. J. Lawton (2010), Making Space for Nature. Report for the UK Government
[10] https://www.data.gov.uk/dataset/cd2c59e7-afd9-471d-a056-c5845619dcd7/corine-land-cover-2018-for-the-uk-isle-of-man-jersey-and-guernsey
[11] https://www.data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england

- 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 was made using grid references and illustrations provided by UU;
- 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 where the impact was classed as permanent to recognise the longer time period for 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 sub-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.

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.

2.4 Natural Capital Assessment

Data sources, gaps, and assessment

The NCA has been completed using the data sources described below, as recommended by the ACWG environmental assessment guidance for SROs[12] and the WRPG WRMP24 Supplementary Guidance on Environment and Society in Decision-Making[13].

Natural Capital stocks

The assessment for the NC approach is based on the same available open-source data as used for the BNG Assessment. The habitat types used for BNG were converted to broad habitat types, to provide a summary of the stock (i.e. the 'amount') of Natural Capital associated with each sub-option, which is used as the basis for 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 has been 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[14]. The UK National Ecosystem Assessment (NEA) differentiates semi-natural grassland from improved and amenity grassland, as semi natural grassland has a much higher species-richness[15]. Where a

[12] All Company Working Group (2020). WRMP environment assessment guidance and applicability with SROs
[13] Environment Agency (2020) Water resources planning guideline 2024 supplementary guidance- Environment and society in decision-making (England).
[14] Office for National statistics (2018) Developing semi-natural grassland ecosystem accounts
[15] UK Habitat Classification Working Group (2018). UK Habitat Classification - Habitat Definitions V1.0 at hhtp://ecountability.co.uk/ukhabworkinggroup-ukhab

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 the Department for Business, Energy, and Industrial Strategy (BEIS) Carbon Values. As the prices published by BEIS are in £2020, 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 WRPG Supplementary Guidance

Land use type	C seq rate (t/CO2e/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[16], 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.

Table 2.2 Benefit Transfer Values: Natural Hazard Regulation[17]

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 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. Thus only a qualitative assessment has been undertaken. The qualitative assessment was based on habitat data, proximity to watercourses and Water Framework Directive (WFD) status information from the EA's Catchment Explorer. A score of between -1 (least impact) to -5 (greatest impact) has been assigned to each option.

Water Regulation

The WRPG does not require the monetisation of Water Regulation services. It is considered that, with the available information, this service is best represented by the Water Framework Directive (WFD) Compliance Assessment. To avoid double counting, therefore, the WFD Compliance Assessment report should be referred to directly for the assessment of this service.

Recreation and Tourism

The Outdoor Recreation Valuation Tool (ORVal)[18] was used to estimate recreation demand from greenspaces, as a proxy for recreation value. Both open greenspaces and public footpaths were considered.

[16] https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca#enca-services-databook

[17] References:

- Forest Research (2018). Valuing flood regulation services of existing forest cover to inform natural capital accounts.
- Morris & Camino (2011) UK National Ecosystem Assessment Economic Analysis Report, School of Applied Sciences, Cranfield University.

[18] https://www.leep.exeter.ac.uk/orval/

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

- If there are no intersections, and therefore no alternative routes, then we take 100% of the footpath value;
- If there are 1-2 intersections present, then 50% of the value is taken;
- If there are 3-4 intersections present, then 25% of the value is taken;
- And 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 construction may have on recreation and tourism, with ORVal potentially giving an overstated account of the impact. This uncertainty has been reduced by using a developed conditional multipliers approach as 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*"[19]. For the purposes of this assessment, to estimate the annual value per hectare (ha) of ecosystem services relevant to agricultural production, an adaptation of the whole-farm income method outlined by the ONS Natural Capital Accounts was used[20]. 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 (UU)	236.83	279.86	207.34
Wales (Welsh Water Dŵr Cymru)	155.65	NA	158.57

[19] ONS (2017) Principles of Natural Capital Accounting. [Last accessed 29/04/2021] Accessible via: https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/principlesofnaturalcapitalaccounting
[20] Office for National Statistics (ONS), 2019. UK natural capital accounts methodology guide: October 2019, s.l.: ONS

West Midlands (Severn Trent)	325.26	408.86	206.56
East of England (South Staffs Water)	365.68	354.99	286.29

These values represent the average farm output level estimate of the industry residual value for farms in the North West of England. Data was obtained from the Farm Business Survey (England)[21] and was subject to the following high-level calculation:

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

The original method outlined by the ONS (2019) was adapted after calculations with South East of England 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[22]. 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 South East 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
Output from agriculture	• Output from agriculture (excl. subsidies and agri-environment payments) • Subsidies and payments to agriculture (excl. agri-environment payments • Agri-environment and related payments (incl. HFA) • Basic Farm payment • Output from diversification
Costs for agriculture	• Costs for agriculture (excluding agri-environment activities) • Costs for agri-environment work • Costs of diversification out of agriculture • Costs associated with Basic Payment Scheme

2.5 Biodiversity Net Gain Assessment, with mitigation

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

[21] https://farmbusinesssurvey.co.uk/

[22] 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.

areas required to achieve 10% net gain for each sub-option have been identified based on the baseline habitats present within the sub-option footprint, and following the requirements of the Biodiversity Metric 3.0. This included requirements such as needing the same habitat (for high 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.

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 schemes. 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, and so 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**
Cropland	Modified grassland	Poor	Other neutral grassland	Moderate
Modified grassland	Modified grassland	Moderate	Other neutral grassland	Moderate
Other neutral grassland	Neutral grassland	Moderate	Other neutral grassland	Good
Woodland (broad leaved)	Modified grassland	Moderate	Woodland (broad leaved)	Moderate
Woodland (mixed)	Modified grassland	Moderate	Woodland (mixed)	Moderate
Traditional orchards	Modified grassland	Moderate	Traditional orchards	Moderate
Floodplain wetland mosaic (CFGM)	Modified grassland	Moderate	Floodplain wetland mosaic (CFGM)	Moderate
Lowland calcareous grassland	Lowland calcareous grassland	Moderate	Lowland calcareous grassland	Good

2.6 Natural Capital Gain Assessment

The assessment of NC gain takes account of the areas planned for habitat creation and habitat improvement, including consideration of required mitigation for BNG (as calculated above).

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 NC of land changing from arable land 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.

2.7 Identifying Potential Biodiversity Opportunity Areas

Potential Biodiversity Opportunity (PBO) areas have been identified, in the vicinity of the works associated with each sub-option. These sites are all within 5km of the sub-option locations, and have been identified based on a scoring system (as shown in **Table 2.6**). A bespoke model has been developed, which pools together more than 20 datasets (those listed in **Table 2.6**) to identify the PBOs, assign scores to them so they can be prioritised, and identifies the most suitable PBOs for habitat restoration or creation. The scoring system is largely based on the Lawton principles[23], 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. In addition to the datasets listed in **Table 2.6**, 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.

Table 2.6 Scoring criteria for Potential Biodiversity Opportunity areas

Scoring criteria	Dataset/source	Score			
		3	2	1	0
Distance to pipeline	Pipeline options	<1 km	1-3 km	3-5 km	>5 km
Within same LPA as scheme/option – county boundaries	Pipeline options Ordnance Survey GB Counties	Yes	-	-	No
Non-statutory designation	Local wildlife sites, proposed country parks, ecosites	Yes	-	-	No

[23] Prof. J. Lawton (2010), Making Space for Nature. Report for the UK Government

Proximity to statutory sites	National Nature Reserves, Ramsar sites, Special Areas of Conservation, Special Protection Areas, SSSI sites, Local Nature Reserves	Within 2 km	Within 5 km	-	No
Strategic significance designation	Canal conservation and restoration, green networks, local greenspace, special landscape, sites for green infrastructure	Yes	-	-	No
Proximity to ancient woodland	Ancient Woodland England and Wales	0.3 km	1 km	-	No
Owned/operated or managed by the relevant water company/companies	Information provided by relevant water company	Yes	-	-	No
Identified as common land	Common Land England	-	-	No	Yes
Size	Calculated using QGIS	>5 ha	1-5 ha	<1 ha	-

3. Assessment Results

3.1 Biodiversity Net Gain Assessment

The results of the BNG Assessment for all sub-options is presented in **Table 3.1**. This shows the losses that would occur from both temporary and permanent land take. The gains have been calculated to achieve 10% net gain in response to both temporary and permanent losses. As discussed in Section 2, while not all of the sub-options may require planning permission (in which case there would not be a statutory requirement for BNG), 10% net gain has been assumed for all activities involving land take, and includes temporary activities.

Table 3.1 also shows the total habitat units lost as a result of the NWT SRO Full Solution, which are calculated to be -683 Area-Based Habitat Units (ABHU) (third column in the table). This includes both permanent and temporary losses combined: a breakdown of the two can be found in **Appendix B**.

10% net gain could be achieved through reinstating 549 ABHU on-site (fourth column in **Table 3.1**), and creating or enhancing habitat equating to 207 ABHU off-site (ninth column in the table).

Table 3.1 Calculated biodiversity losses and gains associated with the NWT SRO sub-options

	On-site baseline		On-site future		Off-site baseline		Off-site future		Total change	
	Sum of On-site area	Sum of On-site baseline units[1]	Sum of On-site post intervention units[2]	Sum of On-site net change	Sum of Off-site area	Sum of Off-site baseline units[3]	Sum of Off-site post intervention units[4]	Sum of Off-site net change	Total net change[5]	% change compared to baseline
NWT SRO FULL SOLUTION										
[✂]	33.27	-92.53	65.71	-26.82	12.05	52.36	89	+36.64	+9.82	+11%
[✂]	63.35	-293.36	237.38	-55.98	28.65	129.14	215.95	+86.81	+30.83	+11%
[✂]	14.12	-47.55	35.95	-11.6	4.26	15.31	32.06	+16.75	+5.15	+11%
[✂]	0.49	-1.69	0	-1.69	0.53	1.89	3.77	+1.88	+0.19	+11%
[✂]	11.27	-27.86	26.15	-1.71	1.52	6.71	11.4	+4.69	+2.98	+11%
[✂]	48.84	-102.55	93.56	-8.99	6.70	29.48	49.85	+20.37	+11.38	+11%
[✂]	0.23	-1.02	0	-1.02	0.37	1.61	2.73	+1.12	+0.1	+10%
[✂]	8.66	-4.3	2.62	-1.68	0.78	3.42	5.54	+2.12	+0.44	+10%
[✂]	17.74	-82.71	63.01	-19.7	9.70	42.68	71.06	+28.38	+8.68	+10%
[✂]	7.20	-29.63	24.22	-5.41	2.30	9.02	17.66	+8.64	+3.23	+11%
TOTAL	**205.17**	**-683.20**	**548.60**	**-134.60**	**66.86**	**291.62**	**499.02**	**+207.40**	**+72.80**	**+11%**
RESERVE SUB-OPTIONS										
[✂]	46.03	-133	99.2	-33.8	15.65	68.2	115.9	+47.7	+13.9	+10%
[✂]	0.46	-2.02	0	-2.02	0.73	3.19	5.42	+2.23	+0.21	+10%
[✂]	16.79	-62.25	51.54	-10.71	5.3	21.12	38.35	+17.23	+6.52	+10%
[✂]	6.61	-17.93	13.98	-3.95	1.92	8.45	14.29	+5.84	+1.89	+11%

1 Calculated in Defra metric v3.0 from the habitats currently present within the site footprint
2 Units associated with habitat that will only be temporarily impacted during construction, and subsequently restored
3 Estimated baseline value of off-site land that would be needed to achieve 10% net gain, assuming the rules set out in Section 2.5
4 Increased value of off-site land resulting from proposed habitat creation or enhancement, following the rules set out in Section 2.5
5 Total net change is calculated as On-site net change + Off-site net change

3.2 Natural Capital Assessment

The results of the NCA for all sub-options are presented in **Table 3.2**, and summarised below.

Climate regulation

Temporary losses of the climate regulation service have been valued at between £0 and -£430 per year per sub-option. Permanent losses of the climate regulation service have been valued at between £0 and -£1,471 per year per sub-option. These are relatively modest, but involve some extent of loss of woodland. Opportunities to avoid routing pipelines through woodland should be sought, to reduce these losses.

Assuming the BNG presented in **Section 3.1**, a net gain of the climate regulation service could ultimately be achieved.

Natural hazard regulation

Temporary losses of the natural hazard regulation service (with a focus on flooding) have been valued at between £0 and -£122 per year per sub-option. Permanent losses of the natural hazard regulation service have been valued at between £0 and -£495 per year per sub-option. Again, these are relatively modest, but the sub-options with the greatest loss (Options WR049d and WR149) have lengths of pipeline that intersect with deciduous woodland. Opportunities to avoid routing pipelines through woodland should be sought, to reduce these losses.

Assuming the BNG presented in **Section 3.1**, a net gain of the natural hazard regulation service could ultimately be achieved.

Water purification

As explained in **Section 2**, the water purification service has not been quantified or monetised, but a qualitative assessment is presented in **Appendix C**. Similar to natural hazard regulation, impacts on water purification would be relatively modest. The sub-options likely to experience the greatest loss (WR049d and WR149) intersect areas of woodland and wetland along the pipeline route. Opportunities to avoid routing pipelines through those habitats, and to avoid disturbing land in the vicinity of surface watercourses, should be sought to minimise the losses.

Recreation and tourism

Temporary losses of recreational benefits, as calculated using the Orval tool (described in **Section 2**), have been valued at between £0 and -£787,395 per year per sub-option. The losses are associated with disruption to public footpaths, applying a worst-case assumption that footpaths crossed by the pipeline route could not be used during construction. In general, sub-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).

None of the sub-options have been assessed as resulting in any permanent loss of recreational benefit, since they do not intersect with areas of open greenspace or public footpaths as shown in Orval.

The values obtained from Orval provide a useful comparison between sub-options. However, they result in values for the 'recreation and tourism' ecosystem service that are often considerably higher than the regulating services discussed above. Further work is required in future stages of assessment, to ensure the values are comparable between ecosystem services. For example, mitigation (e.g. provision of alternative footpath routes) is likely to substantially reduce the impact from the worst-case presented here, and most impacts will be relatively short-lived.

Agriculture

Temporary losses of the agriculture service have been valued at between £0 and -£12,201 per year per sub-option, with the greatest impact again being associated with Option WR049d. This is due to the long pipeline associated with this sub-option which crosses extensive areas of farmland.

Permanent losses of the agriculture service have been valued at between £0 and £-585 per year per sub-option, with the greatest impact being associated with Option STT041b. This is due to the relatively large area required for the water treatment works that is part of the sub-option.

Table 3.2 Calculated Natural Capital losses and gains associated with the NWT SRO sub-options

Option ID	Climate regulation			Natural hazard regulation			Recreation		Agriculture		
	temporary loss (£/year)	permanent loss (£/year)	Total future (£/year)[1]	temporary loss (£/year)	permanent loss (£/year)	Total future (£/year)	Temporary loss (£/year)	Total future (£/year)	Temporary loss (£/year)	Permanent loss (£/year)	Total future (£/year)
NWT SRO FULL SOLUTION											
[✂]	-£ 101	-£ 745	£1, 511	-£ 54	-£ 245	£ 533	-£124,818	Assume 100% restored	-£ 2,989	-£ 506	Assume 100% of temporary loss restored, but 0% of permanent loss
[✂]	-£ 430	-£ 1,153	£ 2,705	-£ 79	-£ 462	£ 853	-£ 787,395		-£ 12,201	-£ 42	
[✂]	-£ 85	-£ 187	£ 390	-£ 21	-£ 57	£ 124	-£ 172,360		-£ 2,622	-£ 537	
[✂]	£ 0	-£ 26	£ 71	-£ 2	-£ 5	£ 22	£ 0		-£ 731	-£ 3	
[✂]	-£ 78	£ 0	£ 0	£ 0	£ 0	£ 0	-£ 13,918		-£ 2,988	-£ 3	
[✂]	-£ 270	-£ 220	£ 670	-£ 18	-£ 74	£ 154	£ 0		-£ 11,280	-£ 7	
[✂]	£ 0	-£ 2	£ 0	£ 0	£ 0	£ 0	£ 0		£ 0	-£ 48	
[✂]	-£ 1	-£ 136	£ 290	-£ 6	-£ 46	£ 105	-£ 90,898		-£ 35	£0	
[✂]	-£ 76	-£ 1,471	£ 2,570	£ 0	-£ 495	£ 847	-£ 177,413		-£ 2,544	£0	
[✂]	-£ 50	-£ 48	£ 220	£ 0	-£ 15	£ 59	£ 0		-£ 1,436	-£ 79	
RESERVE SUB-OPTIONS											
[✂]	-£160	-£775	£1,597	-£122	-£254	£611	-£124,818	Assume 100% restored	-£4,733	-£585	Assume 100% of temporary loss restored, but 0% of permanent loss
[✂]	£-	-£3	£408	£0	£2	£54	£0		£0	-£95	
[✂]	-£101	-£552	£1,028	-£106	-£186	£420	-£194,841		-£3,260	-£21	
[✂]	-£26	-£93	£184	-£38	-£30	£92	£0		-£652	-£31	

1 Future values are calculated based on the habitat areas derived to achieve 10% BNG, as presented in **Table 3.1**, using the unit values defined in Section 2

3.3 Mapping of Potential Biodiversity Opportunity Areas

Potential Biodiversity Opportunity Areas have been identified according to the methodology set out in **Section 2**. A heat-map demonstrating the distribution of areas potentially suitable for biodiversity opportunities is presented in **Figure 3.1**. This shows all NWT supply options[24], with those included in the NWT Full Solution in red, and the reserve options in orange. Higher scores indicate areas of potentially greater opportunity.

These maps and the data from which they are created can be used to identify high-scoring sites that present good opportunities for habitat creation within a wider network. These are most extensive in the areas in lighter greens and yellows in **Figure 3.1,** although localised opportunities may still be found elsewhere. Opportunities for delivering gain within the vicinity of individual sub-options should be considered, so that the habitat gain is provided close to the losses, and in order to provide the benefit to local communities. However, gaining an overview of the optimal options associated with the combined suite of sub-options in the NWT Full Solution may allow more integrated and effective opportunities to be identified.

Opportunities for habitat creation will be considered further during Gate 3, in consultation with local planning authorities and other stakeholders and alongside the further development of the sub-options. This will account for the wider strategy that is currently being developed within UU to deliver BNG across its capital programme, and which includes the identification of opportunities for BNG across UU's wider landholdings. The ongoing work, leading towards Gate 3, will inform the BNG strategy for any planning applications associated with the NWT SRO Full Solution (as appropriate).

[24] Figure 3.1 does not include Option STTA4. The option would involve numerous small working areas, distributed along the Vyrnwy aqueduct. As a result, when the associated opportunity areas are mapped, they cover an extensive area along the aqueduct. This was felt to unreasonably skew the distribution of effort from the other options (most of which involve more extensive works). However, requirements for BNG and opportunities for local delivery should nonetheless be considered for STTA4 during design and implementation.

4. Summary and Recommendations

4.1 Summary

This report has presented the BNG and NC Assessments that have been undertaken to inform UU's NWT SRO Gate 2 submission. The approaches taken are in line with relevant guidance, including the WRPG 2024 *Supplementary Guidance on Environment and Society in Decision-making*, and the ACWG (2020) *WRMP environmental assessment guidance and applicability with SROs*.

Losses of biodiversity are associated with all NWT SRO sub-options that involve any temporary or permanent land-take. The losses have been assessed using the Defra Biodiversity Metric v3.0, based on spatial land use and habitat datasets with national coverage. Associated NC losses have been calculated for an agreed selection of ecosystem services.

From November 2023, BNG is to become a mandatory requirement for developments that require planning permission in England following the enactment of the Environment Act 2021. In this context, a 10% net gain has been assumed for all activities associated with the sub-options that involve land take, including temporary activities. This has been calculated for each sub-option using the Defra metric. Simple rules have been applied, to assign likely habitat types for off-site habitat creation and enhancement. The extents of the habitat gain have been used to calculate the associated NC gain.

When considering the NWT SRO Full Solution cumulatively, the total biodiversity losses are -683 ABHU. 10% net gain could be achieved through reinstating 549 ABHU on-site, and creating or enhancing habitat equating to 207 ABHU off-site.

An opportunity mapping exercise has been carried out to identify potentially beneficial areas to locate the net gain associated with the sub-options and the NWT SRO Full Solution. The mapping has taken into account a range of factors including (*inter alia*) local designations, proximity to statutory sites and proximity to ancient woodland. Taking these types of factors into account when identifying off-site opportunities for net gain allows a strategic approach to be taken to providing benefits to local communities, and incorporating habitats into wider ecological networks. Further work is anticipated within UU towards selecting optimal sites, building on the mapping exercise that has been undertaken so far, and in consultation with local planning authorities. This will account for the wider strategy that is currently being developed within UU to deliver BNG across its capital programme, and which includes the identification of opportunities for BNG across UU's wider landholdings. The ongoing work, leading towards Gate 3, will inform the BNG strategy for any planning applications associated with the NWT SRO Full Solution (as appropriate).

4.2 Recommendations

Further work is recommended following the Gate 2 submission, to:

- Validate the habitat data assigned in GIS, through site surveys;
- Expand or refine the quantified/monetised assessments, including calculation of net present value (taking account of the likely implementation timescales of the sub-

options). In addition, a wider range of ecosystem services could be considered, if updated guidance becomes available;

- Incorporate riverine habitats into the assessments. Physical habitat surveys (MoRPh) are proposed for 2023, which will allow the rivers associated with the NWT SRO sub-options to be better characterised, and will enable the identification of reaches that would benefit from hydro-morphological improvements;
- Identify opportunities for habitat creation, in consultation with local planning authorities and other stakeholders. This will combine the opportunity mapping that has been carried out so far for the NWT SRO with UU's wider work, to develop approaches to systematically identifying potential opportunity sites, which can be discussed with stakeholders.

Appendix A
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 B
Results of BNG loss calculations

Option ID	Total Area (ha)	Temporary		Permanent	
		Area (ha)	Units lost (ABHU)	Area (ha)	Units lost (ABHU)
[✂]	33.27	28.70	-63.4	4.57	-29.2
[✂]	64.52	60.87	-282.8	3.65	-31.2
[✂]	14.12	11.05	-37.6	3.07	-10.0
[✂]	0.49	0	0	0.49	-1.7
[✂]	0.46	0	0	0.46	-2.0
[✂]	16.79	15.99	-48.3	0.79	-14.0
[✂]	11.27	11.25	-27.8	0.02	-0.1
[✂]	48.84	48.17	-96.3	0.67	-6.3
[✂]	0.23	0	0	0.23	-0.9
[✂]	8.66	8.27	-0.9	0.39	-3.4
[✂]	6.61	6.15	-14.6	0.46	-3.4
[✂]	17.74	13.51	-45.5	4.23	-37.2
[✂]	46.03	41.00	-101.5	5.03	-31.5
[✂]	7.20	0	0	7.20	-29.6

Appendix C
Qualitative assessment of water purification service

Option ID	WFD water body physico-chemical status (2019)	Habitats present- extent of woodland and wetland	Proximity to watercourse (using FZ2/3 as proxy)	Summary of losses	Qualitative score (-1 to -5)
NWT FULL SOLUTION					
[✂]	Moderate (urban pressures and contamination). Catchment improvement measures planned	Pipeline crosses predominantly urban and modified grassland. Some woodland	Avoids floodplain except for river intake	Some impact on high-value habitats, and limited extent in proximity to surface watercourse	-2
[✂]	Moderate (agriculture and urban pressures)	Pipeline crosses predominantly modified grassland. Some woodland and fen	Pipeline route crosses floodplain a number of times, for short distances	Impact on higher value habitats, and minor extent in proximity to surface watercourse	-3
[✂]	Moderate (agriculture and urban pressures)	Pipeline crosses predominantly cropland and modified grassland.	River intake and short length of pipeline are within floodplain	Limited impact on high-value habitats, and minor extent in proximity to surface watercourse	-1
[✂]	Moderate in overlying surface water bodies (urban, agriculture, contaminated land)	Minor extents of cropland, grassland, woodland	Some infrastructure (boreholes) is within floodplain	Limited impact on higher value habitats, and minor extent in proximity to surface watercourse	-1
[✂]	Moderate in overlying surface water bodies (agriculture pressures)	Pipeline crosses predominantly cropland	Not within floodplain	No impact on high-value habitats, and not in proximity to surface watercourses	-1

Option ID	WFD water body physico-chemical status (2019)	Habitats present- extent of woodland and wetland	Proximity to watercourse (using FZ2/3 as proxy)	Summary of losses	Qualitative score (-1 to -5)
[✂]	Moderate in overlying surface water bodies (urban pressures)	Pipeline crosses predominantly cropland and urban areas. Some modified grassland	Pipeline route crosses floodplain a number of times, for short distances	Limited impact on high-value habitats, and minor extent in proximity to surface watercourse	-1
[✂]	Good	Minor extent of modified grassland	Not within floodplain	No impact on high-value habitats, and not in proximity to surface watercourses	-1
[✂]	Moderate (urban and agriculture pressures)	Pipeline crosses predominantly urban areas	Pipeline route crosses minor channels (with no mapped floodplain) a couple of times, for short distances	Limited impact on high-value habitats, and limited extent in proximity to surface watercourses	-1
[✂]	Moderate in overlying surface water bodies (urban and agriculture pressures)	Pipeline crosses predominantly modified grassland, woodland and cropland. Some fen	Pipeline route crosses floodplain a couple of times, for short distances	Impact on high-value habitats, and limited extent in proximity to surface watercourse	-3
[✂]	Various- covers numerous water bodies	Predominantly modified grassland. Some crop land, woodland and small urban extent	Some infrastructure is within floodplain	Limited impact on higher value habitats, and minor extent in proximity to surface watercourse	-1
RESERVE SUB-OPTIONS					
[✂]	Moderate (urban pressures and contamination)	Pipeline crosses predominantly urban and modified grassland. Some woodland	Avoids floodplain except for river intakes	Some impact on high-value habitats, and limited extent in proximity to surface watercourse	-2
[✂]	n/a (overlying water course is not WFD water body)	Minor extent of modified grassland	Avoids floodplain	No impact on high-value habitats, and not in proximity to surface watercourses	-1

Option ID	WFD water body physico-chemical status (2019)	Habitats present- extent of woodland and wetland	Proximity to watercourse (using FZ2/3 as proxy)	Summary of losses	Qualitative score (-1 to -5)
[✂]	Moderate in overlying surface water bodies (urban and agriculture)	Pipeline crosses predominantly cropland and modified grassland.	Some infrastructure is within floodplain	Limited impact on high-value habitats, and limited extent in proximity to surface watercourse	-1
[✂]	Moderate (urban pressures)	Pipeline crosses predominantly urban and modified grassland	Some infrastructure is within floodplain	Limited impact on high-value habitats, and limited extent in proximity to surface watercourse	-1

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