Cambridge Water

RICARDO

BIODIVERSITY NET GAIN AND NATURAL CAPITAL ASSESSMENT

Draft Water Resources Management Plan 2024

Cambridge Water

Ricardo ref. ED16326 Issue: 3 17/01/2023

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Customer reference:
Cambridge Water (CW): Water Resource Management Plan 2024 (WRMP24) Environmental Assessment

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Ricardo reference:
ED16326

Date:
17/01/2023

Ricardo is certified to ISO9001, ISO14001, ISO27001 and ISO45001.

Front Cover Image:
Linton Water tower, Rivey Hill, Cambridge Water

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EXECUTIVE SUMMARY

This report outlines the Natural Capital and Biodiversity Net Gain assessment that has been completed to support the Cambridge Water Resources Management Plan 2024 (WRMP24), water companies in England and Wales are required to produce a WRMP every five years. The Plan sets out how the company intends to maintain the balance between supply and demand for water over the long-term planning horizon in order to ensure security of supply in each of the water resource zones making up its supply area.

Through an extensive optioneering process, considering a wide range of potential options to balance future supply and demand, Cambridge Water has selected a feasible and preferred list of options. This list includes both demand side and supply side options, of which only the latter requires Natural Capital (NC) and Biodiversity Net Gain (BNG) assessments. The results generated from undertaking the Natural Capital and Biodiversity Net Gain assessments of these supply side options are presented within this report.

Ten supply side options were selected into Cambridge Water's preferred programme which required Stages 4 (Biodiversity Net Gain) and 5 (Natural Capital) assessments. This report provides the results generated from undertaking the Natural Capital and Biodiversity Net Gain assessments (including assessment of habitat enhancement opportunities). The approaches taken are in line with relevant guidance, notably the WRPG 2024 Supplementary Guidance on Environment and Society in Decision-making. Any options within the Plan that need planning permission are legally required to provide BNG of 10% in England due to the Environment Act (2021), thus all options included within the preferred programme and any reasonable alternatives demonstrate that 10% BNG can be reached if required.

The key outcomes of the assessments were that the greatest impacts on biodiversity and the associated regulating ecosystem services tend to be associated with options with long pipelines and or reservoir creation. However, all schemes included within the preferred programme can meet the 10% BNG requirement. Key opportunities for biodiversity opportunity areas in close proximity to the options in the Preferred Programme and reasonable alternatives are also outlined within this report.

1. INTRODUCTION

1.1 BACKGROUND AND PURPOSE OF 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 (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 Cambridge Water will meet these requirements in the assessment of their WRMP24 feasible options and preferred programme.

The purpose of this report is to provide a Biodiversity Net Gain (BNG) and Natural Capital Assessment (NCA) of the Cambridge Water options. This is to provide information related to a preliminary assessment of BNG and NCA losses and benefits.

This report applies the latest methodologies for the BNG, and NC assessments as set out in the WRMP24 water-resources supplementary guidance[1] and the All Company Working Group (ACWG) guidance[2].

1.2 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, when designed and delivered well, BNG can secure benefits for nature, people and places, and for the economy[3].

NCA 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 natural capital 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[4].

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.

1.3 BIODIVERSITY NET GAIN AND NATURAL CAPITAL REQUIREMENTS FOR WRMPS

The purpose of a WRMP is to set out how a water company will achieve a secure supply of water for its customers whilst protecting the environment and demonstrate that it is resilient to a range of future challenges including more extreme droughts, climate change, population growth.

As part of the WRMP, water companies must demonstrate that they have considered a range of environmental legislation and guidance, including the Environment Bill 2020 and the Environment Act 2021. Additionally, the EA has published separate supplementary guidance on Environment and Society in decision-making[5] , which provides more detail about the expectation for NCA in England, and how a NCA 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" (WRPG Supplementary Guidance[8]) together with supporting water companies within WRW to promote plans that have the potential to deliver wider environmental and social benefits.

[1] 2021 03023 RMP24 SG -ES Decision-making- England

[2] Mott MacDonald Limited (2020). All Companies Working Group WRMP environmental assessment guidance and applicability with SROs. Published October 2020

[3] 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/

[4] UK Government (2021), Enabling a Natural Capital Approach (ENCA) – Updated 20 August 2021

[5] EA (2021) WRPG 2024 supplementary guidance – Environment and society in decision-making. Published 24/03/2021

The requirements for a BNG and NCA of a water company WRMP are outlined in the 2022 WRPG, as shown in **Box 1**.

Box 1. WRPG 2022

Section 4.1.1 High-level considerations

England

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.

Consider your duty to conserve biodiversity under section 40 of the Natural Environment and Rural Communities (NERC) Act (2006) and the list of species and habitats of principal importance set out in section 41 of the Act (England).

Takes a catchment-based approach.

2. APPROACH TO THE BIODIVERSITY NET GAIN AND NATURAL CAPITAL ASSESSMENTS

2.1 OVERVIEW OF APPROACH

2.1.1 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 options[6]. A GIS-based system has been used, using national datasets, to provide comprehensive coverage of habitat data.

To ensure Cambridge Water's preferred programme contributes to the conservation and enhancement of biodiversity and delivers biodiversity net gain, Defra's Biodiversity metric 3.0 has been used to demonstrate how net gain could be achieved on and off-site. Any options within the plan that need planning permission are legally required to provide a minimal BNG of 10% in England due to the Environment Act 2021. This is not a legal requirement of the WRMP itself, but it is logical to meet this requirement within the plan to demonstrate Cambridge Water's commitment to protecting and enhancing biodiversity and demonstrate that a minimum 10% BNG can be achieved when required.

The draft BNG and NCA report has been completed for the list of feasible and preferred options.

For options within the preferred programme, Potential Biodiversity Opportunity (PBO) areas have been identified. These sites will lie within 5km of the option location and are based on a scoring system largely based on the Lawton principles, which is outlined in **Section 2.3.** 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.

2.1.2 Natural Capital Assessment Approach

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

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

In addition to those services required as a minimum, a **food production** ecosystem service metric has also been considered (**Agriculture**). Furthermore, the assessment of social benefits is advocated by the Regulators' Alliance for Progressing Infrastructure Development (RAPID), therefore the additional ecosystem services of **recreation and tourism** has been included to support this requirement.

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

The NC Assessment is based on the BNG Metric 3.0 data for permanent loss, temporary loss and mitigation required to meet the minimum 10% net gain. The habitats are categorised into broad habitats which is used as the NC baseline data required for the qualitative, quantitative and monetisation of ecosystem services. The GIS and BNG assumptions followed through into the NC assessment. The following sections summarises the NC and BNG approaches, assumptions and limitations for each ecosystem service.

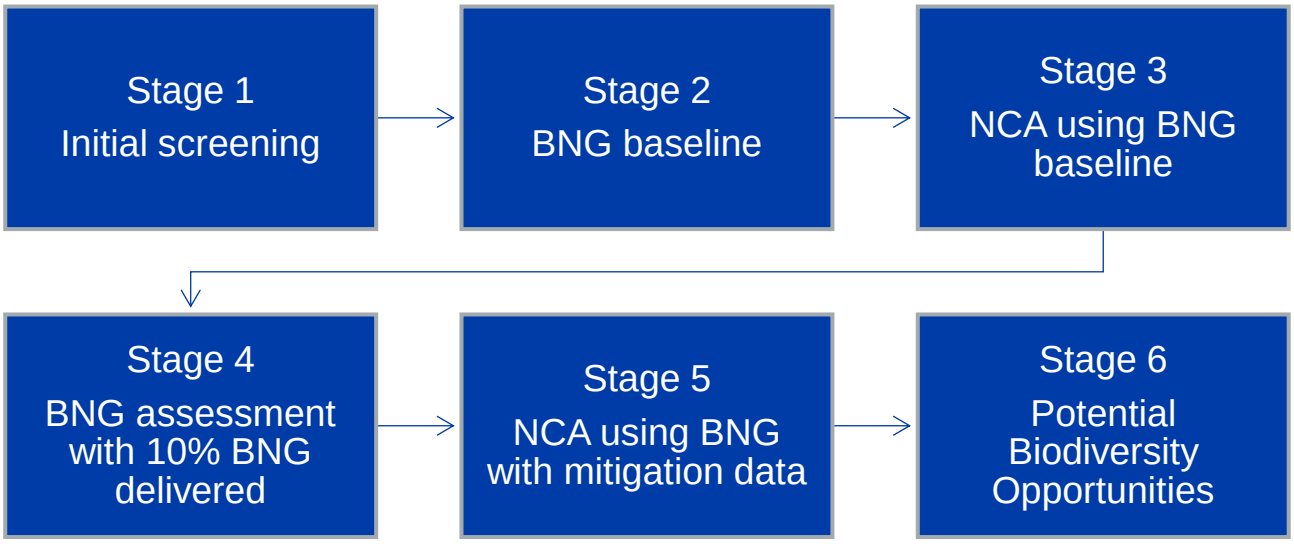
[6] While a newer version of the metric, v3.1, has now been released, v3.0 has been used for these assessments to provide consistency across multiple WRMPs and through the stages of assessment

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

2.3.1 Stage 1 – Initial screening

This high-level qualitative scoring was necessary to assist with the development of the SEA and support detailed screening of options (and associated ecosystems) for the identification the preferred programme. The scoring also fed into Multi Criteria Decision Analysis (MCDA) and helped to support early decision making using the feasible options. Scores from 0 to +3 to 0 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 were used to inform early stages of the options appraisal process and MCDA at a high level. The information assessed at Stage 1 was used was then used to support the more detailed assessment at Stage 2.

2.3.2 Stage 2 – Biodiversity Net Gain baseline calculation

2.3.2.1 Baseline habitat area and condition – terrestrial habitats

Areas of habitats were calculated in QGIS. The CORINE land cover dataset[7] 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:

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

- The Priority Habitats Inventory[8], 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 Zone of Influence (ZoI) was calculated for each option using GIS data provided by Cambridge Water:

- 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.
- For pipelines, a 30m buffer (15m on each side) was assumed around polyline shapefiles.
- For above ground infrastructure (e.g. buffering plant), a 15m buffer was assumed around polygon 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 ran 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.

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.

2.3.2.2 Baseline habitat area and condition – rivers

The Biodiversity Metric requires the assessment of the following characteristics of rivers/streams and canals.

- River type and distinctiveness.
- Condition.
- Riparian zone encroachment.
- In-watercourse encroachment.
- Strategic significance.
- Dealing with risk: difficulty of creation and enhancement/ restoration, time to target condition and spatial risk.

The data sources and how they are used for the assessment are described in the sections below.

Rivers, streams or canals were included in the assessment and in the report when temporary or permanent impacts were considered likely due to the work footprint crossing the watercourses (e.g. pipeline without further information regarding the construction method and the use of trenchless processes) or being located within 10m of the top of the bank of the watercourse.

2.3.2.2.1 Condition

The rivers and streams condition assessment for the Biodiversity Metric is based on the extent and diversity of observed physical features in the river channel and riparian zone (including the physical structure of vegetation) as well as the extent and types of any human modifications. The rivers and streams condition assessment, called the River Metric Survey, is based on geomorphic principles and comprises largely desk-based reach-scale assessment, which indicates the current hydro-geomorphological river type, and a sub-reach scale field survey to inform the river type and assess its baseline condition (the Monitoring of River Physical habitat (MoRPh) survey). No MoRPh surveys were undertaken at this stage and therefore a default '*moderate condition'* was given to the watercourses to be temporarily or permanently impacted by the options.

[8] https://www.data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england

2.3.2.2.2 River Type and Distinctiveness

The river type is based on the Priority Habitats classification, as defined under section 41 of the Natural Environmental and Rural Communities Act 2006. Priority River Habitats include the following river types:

- Riverine water bodies of high hydro-morphological/ ecological status;
- Chalk rivers;
- Watercourses with water crowfoot assemblages (Habitats Directive Annex I habitat H3260); and
- Active shingle rivers.

The distinctiveness assessment is desk-based. At this stage, all watercourses were assumed to be of high distinctiveness and therefore classified as '*other rivers and streams'*.

2.3.2.2.3 Riparian zone encroachment

Riparian zone is defined as a 10 m zone from the bank top and urban development within the riparian zone is termed 'riparian encroachment'. This multiplier has been added to Biodiversity Metric 3.0 and therefore, was not included in the Gate 1 assessments. Riparian zone encroachment is considered in the metric as either no encroachment, minor, moderate or major considering distance of the development from the river channel or area (calculated as %) of encroachment within the 10 m riparian zone.

No riparian encroachment was assumed present at this stage.

2.3.2.2.4 In-watercourse encroachment

In-watercourse encroachment refers to any development within the riverbank (bank face) or river channel. This multiplier has been added to Biodiversity Metric 3.0 and therefore, was not included in the Gate 1 assessments. In-watercourse encroachment is considered in the metric as minor or major based on how far the development has encroached into the river channel (% width) or along the bank (% length).

No in-watercourse encroachment was assumed present at this stage.

2.3.2.2.5 Strategic significance

Strategic significance of each river, stream or canal within the zone of influence considers whether it is present within local and catchment plans, Catchment Planning Systems, River Basin Management Plans and Priority Habitats for Restoration. This category gives value to watercourses that are identified for action, which could enable biodiversity objectives to be met. At this stage, a high strategic significance was assumed, and all watercourses were assumed to be mentioned in the local and catchment plans.

2.3.2.2.6 Calculation of net gains/ losses

Construction impacts considers both permanent and temporary construction associated with the Cambridge Water's options in relation to impacted rivers and streams. Nine options have been considered as potentially resulting in impacts to the watercourses due to their proximity with the watercourses (i.e. within 10m of the top of the banks) and the requirement for pipelines. For the purposes of this assessment, permanent construction is defined as infrastructure located within 10m of the watercourses and temporary construction is defined as intersections of the proposed pipeline route with watercourses <2m wide, where it is assumed that an open cut method will be used. However, it has been assumed that no river will be permanently lost, and that permanent construction works will result in an impact to the river condition and riparian encroachment level.

The calculation of net loss/ gain within the Biodiversity Metric 3.0 only considers direct impacts resulting in river loss. The baseline river scores are then adjusted for the associated impacts (gains or losses) related to construction. This is assessed following construction and prior to river re-instatement and assumes typical good practice construction methods and mitigation will be used, such that potential for downstream effects of construction will be fully mitigated, i.e., there will be no change in river condition. Changes to riparian encroachment were included in the assessment to reflect the presence of bankside structures associated with the crossing of a river or stream. This part of the assessment identifies high risk areas where the proposals will result in a significant loss of biodiversity and offsetting will be more onerous or may identify an 'irreplaceable habitat' that should be avoided, such as certain priority habitats.

The following assumptions have been made when assessing the impact of construction on rivers and streams:

- Intersections of the proposed pipeline route with watercourses <2 m wide will impact on a 20 m length of the watercourse; and

- Requirement of new infrastructures to potentially be located within 10m of the watercourses have been assumed to result in permanent impacts upon the watercourses (e.g. decrease of the river condition from moderate to poor and major encroachment of the riparian habitat). As such, and without further information, it has been assumed that these watercourses will not be 'permanently lost' and that the length of the river will be retained but impacted by the construction works (i.e. poor condition and major riparian encroachment). This assumption related to options 37Ai, 37Aii, 38A, 38B and 57.

The gains and losses are calculated assuming all river habitat within the zone of influence from construction impacts will be lost and reinstated with the same river habitat.

2.3.3 Stage 3- Natural Capital Assessment

2.3.3.1 Data sources, gaps, and assessment

The NCA has been completed using the data sources outlined in **Section 2.3.2.1**, as recommended by the All Company Working Group (ACWCG) environmental assessment guidance for SROs[9] and the EA Water Resources Planning Guideline (WRPG) WRMP24 Supplementary Guidance on Environment and Society in Decision-Making[10].

The tools outlined in the WRMP guidance have been reviewed for these assessments and where feasible these have been used. Where not used for a specific service, this has been justified as requested in the guidance noting that many tools have limitations or need a level of detail not necessarily currently available. As such we have applied the WRMP supplementary guidance approach to account for qualitative, quantitative and monetised assessments where proportionally appropriate. Further details on assumptions are outlined in **APPENDIX A**.

2.3.3.2 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 option. The conversion from the detailed habitat layers to broad habitat was undertaken and 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[11]. The UK NEA differentiates semi-natural grassland from improved and amenity grassland, as semi natural grassland has a much higher species-richness[12]. 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.

2.3.3.3 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 Natural Capital 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 currently possible to quantify the non-spatial changes in biodiversity and habitat ecosystem services arising from habitat condition improvement. This is because only planned habitat creation is deciduous woodland and there is significant uncertainty in terms of current condition of woodland due to lack of on-site data. 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

[9] All Company Working Group (2020). WRMP environment assessment guidance and applicability with SROs

[10] Environment Agency (2020) Water resources planning guideline 2024 supplementary guidance- Environment and society in decision-making (England).

[11] Office for National statistics (2018) Developing semi-natural grassland ecosystem accounts

[12] UK Habitat Classification Working Group (2018). UK Habitat Classification - Habitat Definitions V1.0 at hhtp://ecountability.co.uk/ukhabworkinggroup-ukhab

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

2.3.3.4 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 ENCA Services Databook[13], 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

Broad habitat type	Annual value	Reference
Woodland	115 (£2018/ha)	Forest Research (2018) & ENCA Services Databook[14]
Freshwater (Open waters/ wetlands/ floodplains)	407 (£2011/ha)	Morris & Camino (2011) & ENCA Services Databook[15]

2.3.3.5 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, at this stage, only a qualitative assessment rather than a monetised assessment of this service has been undertaken. This qualitative assessment is based on habitat data and WFD status information from the EA's Catchment Explorer.

2.3.3.6 Water Regulation

The WRPG does not require the monetisation of Water Regulation services. It is considered that this service is well represented by the Water Framework Directive (WFD) compliance assessment, so to avoid double counting, Water Regulation has been screened out of the assessment for options in the feasible list, for options in the preferred programme Water Regulation will be assessed in the form of a non-monetary assessment.

2.3.3.7 Recreation and Tourism

The Outdoor Recreation Valuation Tool (ORVal)[16] was used to estimate recreation demand from greenspaces, as a proxy for recreation value. Both open greenspaces and public footpaths were considered.

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

[14] Forest Research (2018). Valuing flood regulation services of existing forest cover to inform natural capital accounts.

[15] Morris & Camino (2011) UK National Ecosystem Assessment Economic Analysis Report, School of Applied Sciences, Cranfield University.

[16] 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 the 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.

2.3.3.8 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"[17]. For the purposes of this assessment, to estimate the annual value per ha 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[18]. 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)
Southeast England (Cambridge Water)	129.2	335	155.30

These values represent the average farm output level estimate of the industry residual value for farms in the Northwest of England. Data was obtained from the Farm Business Survey (England)[19] 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 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[20]. The original method outlined by the ONS excludes

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

[18] Office for National Statistics (ONS), 2019. UK natural capital accounts methodology guide: October 2019, s.l.: ONS

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

[20] 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.

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
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

2.3.4 Stage 4 – Biodiversity Net Gain Assessment with mitigation

This stage is only undertaken for the preferred programme.

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 a minimum 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 included requirements such as requiring the 'same habitat type' (for high distinctiveness habitats) or replacement with the 'same habitat type or one of higher distinctiveness' (for low distinctiveness habitats).

The off-site mitigation required used in the assessments is intended to provide an indicative area off site habitat required to achieve a minimum 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, 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
Cropland	Modified grassland	Poor	Other neutral grassland	Moderate
Modified grassland	Modified grassland	Moderate	Other neutral grassland	Moderate
Other neutral grassland	Other neutral grassland	Moderate	Other neutral grassland	Good
Woodland (broad leaved)	Modified grassland	Poor	Woodland (broad leaved)	Moderate
Woodland (mixed)	Modified grassland	Poor	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

Where the enhancement of the habitat would result in the change of the broad habitat type (e.g., grassland to woodland), this was considered, in the metric calculation sheet, as the creation of habitat rather than the enhancement of the habitat present off-site. It should be noted that where 'felled woodland' has been identified in the baseline habitat, it cannot be recreated despite the requirement of the metric for the 'same habitat'. Where this is the case, 'broadleaved woodland' creation has been proposed instead.

Offsite enhancement measures for rivers were calculated based on the assumption that offsite enhancement would occur within the same waterbody and included removal of minor encroachment within the watercourse and/or increase of the river condition from poor to moderate condition across a length of watercourse sufficient to achieve a 10% net gain for each option.

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

This stage is only undertaken for the preferred programme.

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 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.

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 ENCA Services Databook[21], where the associated studies were evaluated to ensure their suitability for benefit transfer.

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 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.

It has not been possible to monetise the recreation and tourism benefits of the component with BNG uplift as the details of the habitat creation opportunities have not been agreed, therefore these cannot be assessed using the ORVal tool. It is unknown whether new habitat creation sites will provide additional recreation facilities as public access is unknown.

2.3.5.1 Stage 5 additions in comparison to Stage 3

As a proportionate approach has been taken there are key differences with the water purification, water regulation and natural hazard regulation assessments between Stage 3 and 5. The additional work carried out in Stage 5 for these ecosystem services is outlined below.

Water purification

In addition to the qualitative assessment carried out in Stage 3, a baseline quantitative assessment for Water purification was undertaken using the Natural Environment Valuation Online (NEVO)[22] .

Water regulation

A high-level assessment has been undertaken, based on the WFD status of a waterbody and the CAMS data to assess the water resource availability, identify water bodies status and potential deterioration caused by the construction and operation of the scheme.

Natural hazard regulation

For the purposes of this assessment, flooding was determined to be the most significant natural hazard risk, however, the drought risk has also been considered. A high-level qualitative assessment has been undertaken based on the EA flood risk zones[23], this assessment examined the grassland and woodland that would be

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

[22] https://sweep.ac.uk/portfolios/natural-environment-valuation-online-tool-nevo/

[23] https://flood-map-for-planning.service.gov.uk/location

impacted within the ZoI and considered both the temporary and permanent loss caused by the construction and operation of the option. The drought risk has been considered in relation to the Catchment Abstraction Management Strategy (CAMS) data with the impact to groundwater and surface water impact reviewed at a high level. This approach has enabled a high-level assessment of key questions related to economics, drought mitigation, water storage, and natural function related to water course to be provided.

2.3.6 Stage 6 – Potential Biodiversity Opportunity areas identification

For options within the preferred programme 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 (as shown in **Table 2.6**). A bespoke model has been developed, as outlined in **Figure 2.1**. It pools together more than 20 datasets (outlined in **Table 2.6**) to identify the PBOs, assign scores to them so they could be prioritised, and identify the most suitable PBOs for habitat restoration or creation. The scoring system is largely based on the Lawton principles[24], 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. GIS processes such as buffering were carried out on each dataset (where applicable), scores were assigned, and the modified datasets were then rasterised at a 5m resolution (for computational efficiency). These raster layers were added together and constraints such as building, railways, roads and planned developments were removed. This dataset was then polygonised, then the areas of each polygon and associated scores (based on the criteria) were calculated. Areas of less than 0.5ha were removed. The overall score was calculated, and the dataset assigned IDs and exported into shapefile and excel spreadsheet formats that prioritise PBO sites based on an overall score. Sites can then be linked to the outputs from the BNG calculations based on requirement for habitat type and location.

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 Local Planning Authority (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
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	National Priority Focus Areas, 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 in R	>5 ha	1-5 ha	<1 ha	-

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

3. ASSESSMENT OF THE REVISED FEASIBLE OPTIONS

This section outlines:

- The options in the feasible list for Cambridge Water's WRMP24
- The final outcomes of the assessment area at an option-level for each of the options in the feasible list for Cambridge Water's WRMP24.

3.1 FEASIBLE OPTIONS INCLUDED

Through an extensive optioneering process, considering a wide range of potential options to balance future supply and demand, Cambridge Water has selected the most suitable options to make up the feasible options list. This list includes both demand side and supply side options, of which only the latter required a BNG and NCA. The supply side options are presented in **Table 3.1**.

Table 3.1. Supply side options developed by Cambridge Water

WRMP24 Ref.	Option type	Option Name
CWC24-01A	Groundwater enhancement	Combined Ouse gravel sources - Fenstanton to St Ives (01A)
CWC24-01B	New groundwater	Combined Ouse gravel sources - Fenstanton to St Ives (1B)
CWC24-37Ai	Water re-use	Northstowe greywater reuse or similar growth large storage
CWC24-37Aii	Water re-use	Northstowe greywater reuse or similar growth small storage
CWC24-38A	Water re-use	Site-scale rainwater harvesting (Northstowe or similar growth)
CWC24-38B	Water re-use	Northstowe rainwater harvest or similar growth small storage
CWC24-57	New surface water abstraction	River CAM abstraction & treatment works
CWC24-71	Water re-use	Anglian Water (AWS) Milton Wastewater Treatment Works (WWTW) effluent discharge re-use
CWC24-73A	External potable bulk supply/transfer	Fens Reservoir internal potable water transfer (Chatteris)
CWC24-75Ai	External potable bulk supply/transfer	AWS potable transfer through CAM area 5Mld
CWC24-75Aii	External potable bulk supply/transfer	AWS potable transfer through CAM area 5Mld with main cost
CW24-75Aiii	External potable bulk supply/transfer	AWS potable transfer through CAM area 5Mld with main cost and 0.3ha blending plant
CWC24-75Bi	External potable bulk supply/transfer	AWS potable transfer through CAM area 10Ml/d
CWC24-75Bii	External potable bulk supply/transfer	AWS potable transfer through CAM area 10Ml/d with main cost
CW24-75Biii	External potable bulk supply/transfer	AWS potable transfer through CAM area 10Mld with main cost and 0.4ha blending plant
CWC24-75Ci	External potable bulk supply/transfer	AWS potable transfer through CAM area 15Mld
CWC24-75Cii	External potable bulk supply/transfer	AWS potable transfer through CAM area 15Mld with main cost

WRMP24 Ref.	Option type	Option Name
CW24-75Ciii	External potable bulk supply/transfer	AWS potable transfer through CAM area 15Mld with main cost and 0.5ha blending plant

3.2 STAGE 2 (BIODIVERSITY NET GAIN OUTCOMES)

3.2.1 Biodiversity Net Gain – Terrestrial habitats

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

Temporary losses of habitat (associated with pipeline construction) vary between 0 and -47.92 Area Based Habitat Units (ABHU) per option. The greatest losses are associated with options that have the longer lengths of new pipeline that will need to be installed. The types of habitats that would be disturbed by pipeline construction vary, with extensive areas of modified grassland but also some high value habitat (e.g., traditional orchards, floodplain wetland mosaic, lowland raised bog or fens) which may require bespoke compensation.

Permanent losses of habitat include those associated with new permanent above-ground infrastructure. Permanent losses vary between 0 and -559.34 ABHU per option. The greatest losses are generally associated with the creation of new reservoir such as option CWC24-37Ai/37Aii and CWC24-38A/38B. In general, permanent infrastructure such as new water treatment works or pumping stations would be located on areas of relatively low-value habitat, although there are a small number proposed to be located on areas that are currently woodland but also some high value habitat (e.g. traditional orchards, floodplain wetland mosaic or fens).

Options which may require bespoke compensation due to the impacts to high value habitats (fens and/or lowland raised bog) include options CWC24-37Ai/37Aii, CWC24-38A/38B and CW24-73A.

3.2.2 Biodiversity Net Gain – Rivers

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

Temporary losses of watercourse habitat (associated with pipeline construction) vary between 0 and -3 River Units (RU) per option. The greatest losses are associated with options that have the longer lengths of new pipeline that will need to be installed.

Assumed 'permanent losses' of watercourse habitat resulting in the decrease of river condition and encroachment within the riparian habitat (associated with new infrastructure located within riparian habitat) vary between 0 and -18.84RU per option. The greatest losses are associated with option located along a greater length of watercourses, without further information regarding the distance from the top of the banks.

Impacts from operational activities have not been assessed at this stage and would require further considerations regarding habitat degradation (i.e. likely to impact on the flow, geomorphology, water level, water depth and geomorphology of reaches). This has the potential to alter habitat structure and function and associated aquatic ecological communities

3.3 STAGE 3 (NATURAL CAPITAL OUTCOMES)

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

3.3.1.1 Climate regulation

Temporary losses of the climate regulation service have been valued at between £0 and -£1,121 per year per option, the greatest losses relate to long pipelines.

Permanent losses of the climate regulation service have been valued at between £0 and -£830 per year per option. The greatest losses are associated with large scale development in relation to option CWC24-73A which would require a large, permanent loss of arable land.

3.3.1.2 Natural hazard regulation

Temporary losses of the natural hazard regulation service (with a focus on flooding) have been valued at between £0 and -£257 per year per option. As with climate regulation, the greatest losses relate to long pipelines.

Permanent losses of the natural hazard regulation service have been valued at between £0 and -£174 per year per option, the greatest losses are associated with the loss of arable land.

3.3.1.3 Recreation and tourism

Temporary losses of recreational benefits, as calculated using the Orval tool, have been valued at between £0 and -£95,017, 608 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).

The values obtained from Orval provide a useful comparison between options. However, they should not be compared to the other monetised services that are discussed here, because the Orval values are considered to be incomparably high.

3.3.1.4 Agriculture

Temporary losses of the agriculture service have been valued at between £0 and -£33,320 per year per option. The greatest losses relate to long pipelines that cross extensive areas of farmland.

Permanent losses of the agriculture service have been valued at between £0 and -£42,625per year per option. Again, the greatest losses are associated with large scale development in relation to option CWC24-37A and CWC24-38A/B which would require a large, permanent loss of arable land.

4. ASSESSMENT OUTCOMES FOR THE PREFERRED PROGRAMME

4.1 INTRODUCTION

This section presents the Stages 4-6 assessments for Cambridge Water's WRMP24. These stages of assessment have been carried out for the options that are included in the preferred programme.

The preferred programme contains ten supply-side options, these are outlined in **Table 4.1**.

Table 4.1. Supply-side options included in the preferred programme

WRMP24 Ref.	Option Name
CWC24-01A	Combined Ouse gravel sources Fenstanton to St Ives 01A
CWC24-01B	Combined Ouse gravel sources Fenstanton to St Ives 01B
CWC24-37Aii	Northstowe greywater reuse or similar growth small storage
CWC24-38B	Northstowe rainwater harvest or similar growth small storage
CWC24-57	River CAM abstraction & treatment works
CWC24-71	AWS Milton WWTW effluent discharge reuse
CWC24-73A	Fens Reservoir internal potable water transfer Chatteris
CWC24-75Aiii	AWS potable transfer through CAM area 5Mld with main cost and 0.3ha blending plant
CWC24-75Biii	AWS potable transfer through CAM area 5Mld with main cost and 0.4ha blending plant
CWC24-75Ciii	AWS potable transfer through CAM area 5Mld with main cost and 0.5ha blending plant

The Stages 4 (BNG) and 5 (Natural Capital) assessments will be presented first, for the preferred programme (**Section 4.2**). Subsequently, in **Section 4.3**, the Opportunity Mapping (Stage 6) will be presented.

4.2 PREFERRED PROGRAMME

4.2.1 Stage 4 (Biodiversity Net Gain) outcomes – Terrestrial habitats

The results of the BNG assessment for the preferred programme, with regards to terrestrial habitats (ABHU) are presented in **Table 4.2**. Overall the results indicate the losses that would occur from both temporary and permanent land take[25]. Gains have been calculated to achieve a minimum of 10% net gain in response to both temporary and permanent losses. Whilst not all options may require planning permission (in which case there would not be a statutory requirement for BNG), it was agreed with Cambridge Water that a minimum 10% net gain should be assumed for all activities involving land take and should include temporary activities. The latter was agreed on the basis that the activities could last for two years or longer, which is the threshold at which the habitat loss is required to be calculated in the BNG metric[26]. Inclusion of temporary habitat loss should be included in the calculations where the original baseline habitat will not be recreated in the same or better condition within 2 years from the initial impact.

It should be noted that the available baseline information indicates that options CW24-37Aii, CW24-38B and CW24-73A are likely to result in unacceptable loss of high value habitats (fens and/or lowland raised bog) and

[25] *It should be noted that the total area assessed for options 37Aii and 38B is considerably larger than the actual size of the schemes. This is due to the current uncertainty of the specific scheme location. Once locations have been confirmed the impact of these schemes is likely to be less.*

[26] Stephen Panks , Nick White, Amanda Newsome, Jack Potter, Matt Heydon, Edward Mayhew , Maria Alvarez, Trudy Russell, Sarah J. Scott, Max Heaver, Sarah H. Scott, Jo Treweek, Bill Butcher and Dave Stone (2021). Biodiversity metric 3.0: Auditing and accounting for biodiversity – User Guide. Natural England

therefore bespoke compensation will be required and has not been calculated nor included further within the metric and within this report.

The total terrestrial habitat units lost as a result of the preferred programme in the absence of offsite mitigation are calculated to be -1436.75 ABHU ('on-site baseline - on-site post intervention). A minimum 10% net gain could be achieved through reinstating 378.12 ABHU on-site (total onsite post intervention) and creating or enhancing off site habitats to provide an additional 1633.66 ABHU (total difference between off-site post intervention and off-site post-intervention for all options).

Table 4.2. Stage 4 Biodiversity Net Gain outcomes – Terrestrial habitats

Option ID	Land cover loss type	On-site baseline (ABHU)	On-site post-intervention (ABHU)	On-site net % change	Off-site baseline (ABHU)	Off-site post-intervention (ABHU)	Total net unit change (ABHU)
01A	Temporary	6.39	5.67	-11.26%	1.10	2.54	0.72
	Permanent	1.08	0	-100%	0.84	2.04	0.12
01B	Temporary	9.48	8.95	-5.62%	1.32	2.86	1.01
	Permanent	3.35	0	-100%	3.08	6.78	0.34
37A ii	Temporary	-	-	-	-	-	-
	Permanent	559.34	0	-100%	415.80	1036.17	+61.04
38B	Temporary	-	-	-	-	-	-
	Permanent	559.34	0	-100%	415.80	1036.17	+61.04
57	Temporary	62.39	59.02	-5.41%	7.04	16.99	+6.57
	Permanent	223.77	0	-100%	213.18	460.04	+23.09
71	Temporary	66.92	56.90	-14.97%	13.20	30.58	+7.36
	Permanent	15.18	0	-100%	13.86	30.65	+1.61
73A	Temporary	296.76	247.63	-16.56%	138.60	219.90	+32.17
	Permanent	8.79	0	-100%	11.44	21.21	+0.98
75A iii	Temporary	1.91	1.84	-3.50%	0.20	0.46	+0.20
	Permanent	0.66	0	-100%	0.55	1.29	+0.07
75B iii	Temporary	1.95	1.88	-3.50%	0.19	0.46	+0.20
	Permanent	0.88	0	-100%	0.67	1.64	+0.09
75 Ciii	Temporary	1.97	1.90	-3.50%	0.19	0.46	+0.20
	Permanent	1.10	0	-100%	1.39	3.31	+0.82
Total		**1814.87**	**378.12**	-	**1237.35**	**2871.01**	**196.91**

4.2.2 Stage 4 (Biodiversity Net Gain) outcomes – River habitats

The results of the BNG assessment for the preferred programme, with regards to river habitats are presented in **Table 4.3**. Only five options have been assessed as having a potential impact to watercourses.

The table shows the losses that would occur from both temporary and 'permanent' impacts to watercourses. The gains have been calculated to achieve a minimum of 10% net gain in response to both temporary and permanent losses. Whilst not all of the options may require planning permission (in which case there would not be a statutory requirement for BNG), it was agreed with Cambridge Water that a minimum 10% net gain should be assumed for all activities involving land take and should include temporary activities. The latter was agreed on the basis that the activities could last for two years or longer, which is the threshold at which BNG is required.

The total river units lost as a result of the preferred programme are calculated to be -54.74 RU ('difference in total RU across all options between on-site baseline and on-site post intervention). A minimum 10% net gain could be achieved through reinstating 8.63 RU on-site and enhancing off-site river habitat to provide an additional 61.79 RU (difference between total offsite baseline RU and off-site post-intervention RU).

Table 4.3 Stage 4 Biodiversity Net Gain outcomes – River habitats

Option ID	Land cover loss type	On-site baseline (RU)	On-site post-intervention (RU)	On-site net % change	Off-site baseline (RU)	Off-site post-intervention (RU)	Total net unit change (RU)
01A	Temporary	-	-	-	-	-	-
	Permanent	-	-	-	-	-	-
01B	Temporary	-	-	-	-	-	-
	Permanent	-	-	-	-	-	-
37Aii	Temporary	-	-	-	-	-	-
	Permanent	21.39	2.55	-88.06%	34.78	55.91	2.30
38B	Temporary	-	-	-	-	-	-
	Permanent	21.39	2.55	-88.06%	34.78	55.91	2.30
57	Temporary	1.10	0.30	-72.38%	3.24	4.17	0.13
	Permanent	13.80	1.65	-88.06%	22.63	36.39	1.60
71	Temporary	0.83	0.23	-72.38%	2.42	3.11	0.09
	Permanent	-	-	-	-	-	-
73A	Temporary	4.14	1.14	-72.38%	12.42	15.97	0.56
	Permanent	-	-	-	-	-	-
75Aiii	Temporary	0.24	0.07	-72.38%	0.75	0.95	0.03
	Permanent	-	-	-	-	-	-
75Biii	Temporary	0.24	0.07	-72.38%	0.75	0.95	0.03
	Permanent	-	-	-	-	-	-
75Ciii	Temporary	0.24	0.07	-72.38%	0.75	0.95	0.03
	Permanent	-	-	-	-	-	-
Total		**63.37**	**8.63**	**-**	**112.52**	**174.31**	**7.07**

4.2.3 Stage 5 (Natural Capital) outcomes

The results of the Natural Capital Assessment for the preferred programme are presented in **Table 4.4**.The locations provided for the assessment of options 37Aii and 38B were considerably larger than the planned schemes due to the specific locations of the schemes not yet being confirmed at the time of writing this report. The BNG and NCA assessment results are therefore likely to be an overestimate of the impacts of these schemes.

Table 4.4 Stage 5 Natural Capital outcomes

Option ID	Climate regulation			Natural hazard regulation			Recreation		Agriculture		
	Temporary loss (£/year)	Permanent loss (£/year)	Total future (£/year)	Temporary loss (£/year)	Permanent loss (£/year)	Total future (£/year)	Temporary loss (£/year)	Total future (£/year)	Temporary loss (£/year)	Permanent loss (£/year)	Total future (£/year)
01A	-17	-2	11	0	0	0	-34799	Assume 100% restored	-776	-84	-84
01B	-27	-6	2	0	0	0	-34799		-1286	-300	18
37Aii	0	-957	3350	0	-22	446	0		0	-42625	-42625
38B	0	-957	3350	0	-22	446	0		0	-42625	-42625
57	-185	-1005	1961	0	-202	375	-73425		-8861	-12659	-12659
71	-187	-123	390	0	-27	93	-70556		-8099	-1997	-1997
73A	-830	-118	1428	0	-33	351	-95017		-33320	-661	-661
75Aiii	-6	-2	3	0	0	0	0		-290	-101	-101
75Biii	-6	-3	1	0	0	0	0		-295	-134	-134
75Ciii	-6	-4	7	0	0	0	0		-300	-168	-168

4.2.3.1 Climate regulation

In the supply options in the Preferred Programme, the maximum loss of the climate regulation service would be -£830 and the maximum gain would be £3350 per year per option. The option with the highest overall loss is 73A, due to the large area of arable land that would permanently be lost. Based on the BNG outputs, a net gain of the climate regulation service could ultimately be achieved for all options.

The largest gain is provided by options 37A and 38B, noting however that the assessed footprint for this scheme is larger than what will be required if the option is developed in the future. Schemes which affect larger areas or habitats with higher distinctiveness require more mitigation, therefore resulting in a larger area of habitat enhancement off site to offset the greater initial impact, leading to a higher monetary gain being provided. The largest gain is likely to actually be provided by scheme 57.

The smallest losses are attributed to options with minimal capital works required. For example, Option 01A requires recommissioning boreholes and therefore does not require much additional large infrastructure on site. Therefore, negligible habitat loss will be incurred from construction.

4.2.3.2 Natural hazard regulation

In the supply options in the preferred programme, 37Aii and 38 show greatest gains per year but as noted above there is uncertainty around these figures. Actual greatest gain is likely to be provided by option 57. Following the BNG presented, a net gain of the natural hazard regulation service could ultimately be achieved for all options.

A qualitative assessment looking at flood zones and area coverage of woodland and grassland has also been carried out for the supply-side options in the preferred programme. Results are presented in **APPENDIX E**. Qualitative assessments to investigate drought risk have also been undertaken. These have used sub-catchment CAMS data to assess the water availability for each option at drought (Q95), pre-drought (Q70) and normal flow (Q50) conditions. From this information a risk rating has been assigned to each option. Options identified as 'Low risk' are unlikely to result or exacerbate drought condition impacts within the catchment. This may be because a surplus of water is already present, or the option will have no effect on water abstraction. Moderate risk options pose a chance to affect water availability. Water may be available for abstraction under some flow conditions but not others, or further information is required to make a more accurate assessment. High risk options will almost certainly contribute to an occurring drought. Water is likely unavailable in conditions where the option would be in use.

4.2.3.3 Water purification

At a sub-catchment level, the water purification has been studied for the 10 options in the preferred programme using the NEVO tool. These results are outlined in **Table 4.5**. This table also highlights which sectors are the Reason for Not Achieving Good (RNAG) in relation to WFD compliance.

Table 4.5. NEVO tool results for options in the preferred programme

Option ID	Quality elements			Commentary based on RNAG	Risk rating
	Dissolved Oxygen (mg/l)	Nitrogen (mg/l)	Phosphorus (mg/l)		
01A	No water quality data currently available through NEVO			Failing due to high phosphates from poor livestock management, poor nutrient management and continuous sewage discharge. PFOS is another cause, with the source under investigation, and PBDE with no specific source sector responsible.	Low
01B	No water quality data currently available through NEVO			Failing due to high phosphates from poor livestock management, poor nutrient management and continuous sewage discharge. PFOS is another cause, with the source under investigation, and PBDE with no specific source sector responsible.	Low

Option ID	Quality elements			Commentary based on RNAG	Risk rating
	Dissolved Oxygen (mg/l)	Nitrogen (mg/l)	Phosphorus (mg/l)		
37Aii	10.918	9.846	0.635	Failing due to poor ammonia, dissolved oxygen, invertebrates, and phosphates caused by poor soil management, contaminated land, transport drainage and urban development. Water industry has also affected flow, leading further to poor invertebrates and dissolved oxygen.	Low
38B	10.918	9.846	0.635	Failing due to poor ammonia, dissolved oxygen, invertebrates, and phosphates caused by poor soil management, contaminated land, transport drainage and urban development. Water industry has also affected flow, leading further to poor invertebrates and dissolved oxygen.	Low
57	10.918	9.846	0.635	Failing due to high phosphates from continuous sewage discharge by the water industry. PBDE also high with no specific sector responsible.	High
71	10.918	9.846	0.635	Failing due to high phosphates from continuous sewage discharge by the water industry. PBDE also high with no specific sector responsible.	Moderate
73A	9.892	11.611	0.822	Failing due to high phosphates caused by poor livestock management, poor nutrient management, and continuous sewage discharge. PFOS is another cause, with the source under investigation, and PBDE with no specific source sector responsible.	High
75Aiii	No water quality data currently available through NEVO			Failing due to high phosphates from continuous sewage discharge by the water industry. Other issues include land drainage by the agricultural sector which impacts the rivers flow.	Low
75Biii	No water quality data currently available through NEVO			Failing due to high phosphates from continuous sewage discharge by the water industry. Other issues include land drainage by the agricultural sector which impacts the rivers flow.	Low
75Ciii	No water quality data currently available through NEVO			Failing due to high phosphates from continuous sewage discharge by the water industry. Other issues include land drainage by the agricultural sector which impacts the rivers flow.	Low

4.2.3.4 Water regulation

Table 4.6 presents the CAMS data for each option under normal flow conditions (Q_{50}), pre-drought conditions (Q_{70}), and drought conditions (Q_{95}). 'Green' denotes that water is available under the given drought condition, 'Yellow' indicates that water abstraction is restricted, and 'Red' denotes that water is unavailable. For further analysis on the CAMS data see **APPENDIX E**.

Table 4.6 Water regulation assessment results for the preferred programme options

Option ID	Gains in WAFU / Savings in Demand on full implementation (Ml/d)	Water availability		
		Q_{95} CAMS Assessment	Q_{70} CAMS Assessment	Q_{50} CAMS Assessment
01A	0.55 Ml/d	Red	Red	Yellow
01B	4 Ml/d	Red	Red	Yellow
37Aii	0.6Ml/d	Red	Red	Yellow
38B	0.9Ml/d	Red	Red	Yellow
57	7 Ml/d	Red	Red	Yellow
71	7 Ml/d	Red	Red	Yellow
73A	50Ml/d	Red	Red	Yellow
75Aiii	5Ml/d	Red	Red	Red
75Biii	10ML/d	Red	Red	Red
75Ciii	15Ml/d	Red	Red	Red

4.2.3.5 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 -£95,017 per year per option, with the greatest impact being associated with option 73A. The losses are associated with disruption to public footpaths, assuming that footpaths crossed by the pipeline route could not be used during construction. It is assumed that all footpaths would be fully restored following the construction works.

There are not anticipated to be any permanent effects on recreation and tourism associated with the options in the Preferred Programme.

At this stage it has not been possible to monetise the recreation and tourism benefits of the component with BNG uplift as the details of the habitat creation opportunities have not been agreed, therefore these cannot be assessed using the ORVal tool. It is unknown whether new habitat creation sites will provide additional recreation facilities as public access is unknown.

4.2.3.6 Agriculture

In the supply options in the Preferred Programme, temporary losses to agriculture would be between £0 and £33,320 per year per option, whilst permanent losses to agriculture would be between £0 and £42,625 per year per option.

The option with the highest overall temporary loss is 73A, due to the large area of arable land that would permanently be lost.

4.3 MAPPING OF POTENTIAL BIODIVERSITY OPPORTUNITY AREAS

A heat-map demonstrating the distribution of areas potentially suitable for biodiversity opportunities is presented in **Figure 4.1** with higher scores indicating areas of potentially greater opportunity.

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 4.1**. 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 best potential opportunities for habitat creation within a wider network. These are most extensive in the areas in lighter greens and yellows in **Figure 4.1**, although localised opportunities may still be found elsewhere. It may be important to consider opportunities within the vicinity of individual options, so that the habitat gain is provided close to the losses, and in order to provide the benefit to local communities. **Figure 4.2** shows 10 PBO sites with the highest scores which are near the Fen Drayton Lakes Nature Reserve and the Ouse Fen Nature Reserve, this figure represents the area highlighted in a box in **Figure 4.1.**

Figure 4.1 Potential Biodiversity Opportunity area tool output of options within the Preferred Programme

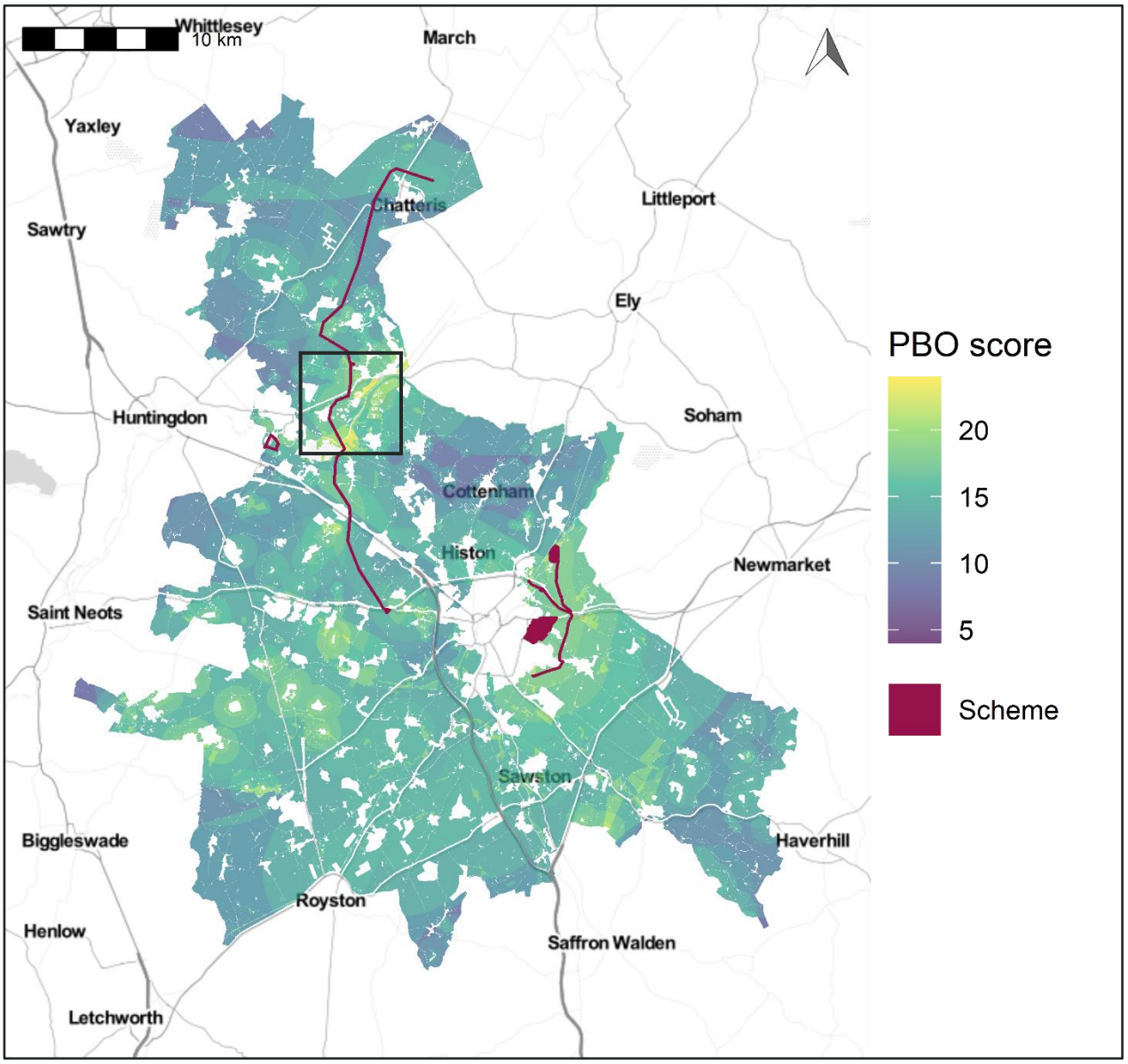
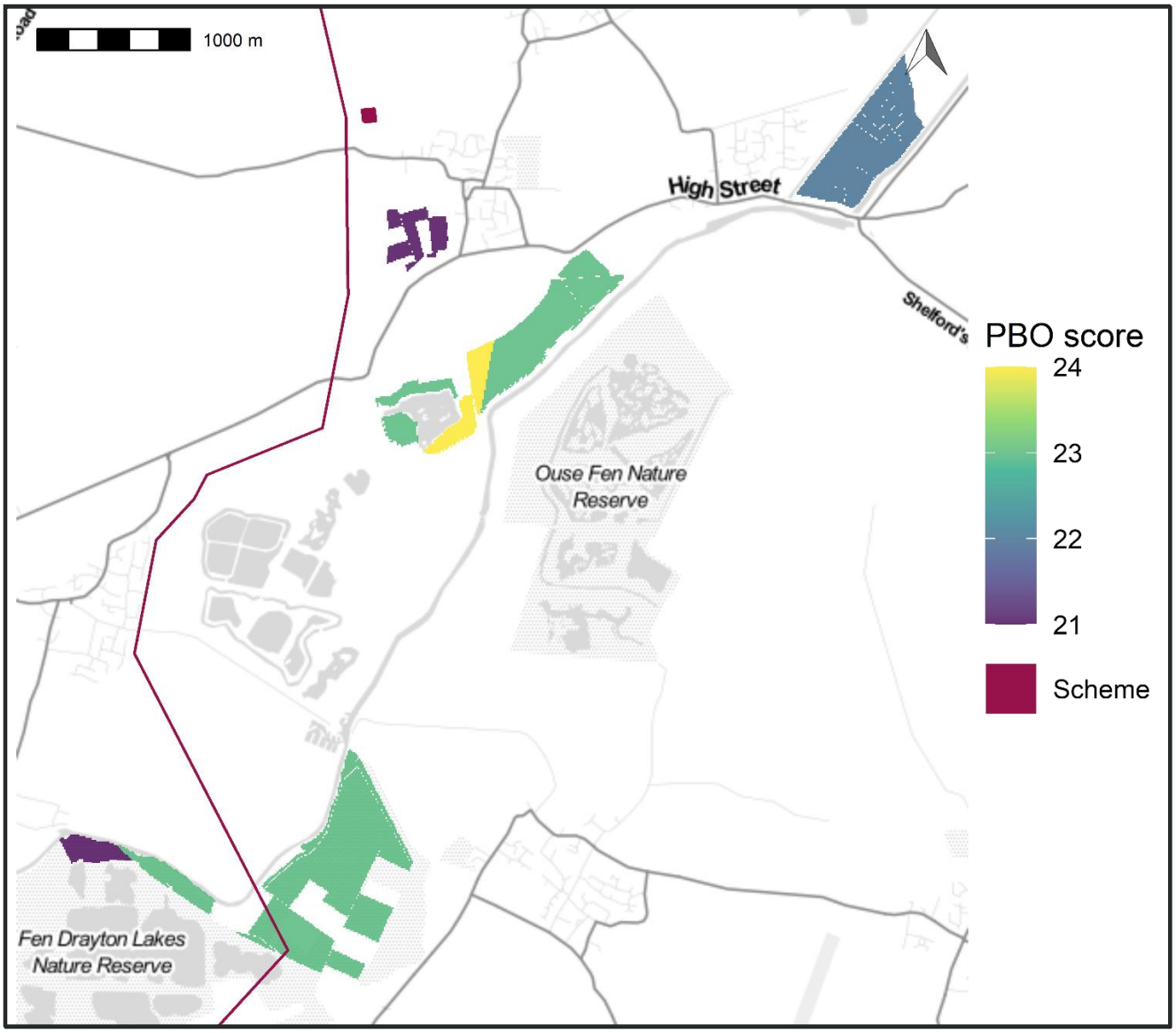


Figure 4.2 Top 10 Potential Biodiversity Areas identified for options within the Preferred Programme



5. SUMMARY

This report has presented the Biodiversity Net Gain and Natural Capital Assessments that have been undertaken for Cambridge Water's draft Water Resources Management Plan 2024. The approaches taken are in line with relevant guidance, notably the WRPG 2024 Supplementary Guidance on Environment and Society in Decision-making.

For the feasible options in the WRMP, this report has presented losses of biodiversity associated with all options that involve any temporary or permanent land-take. The losses have been assessed using the Defra biodiversity metric 3.0, based on spatial land use and habitat datasets with national coverage. Associated natural capital 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 and high value habitat (e.g., traditional orchards, floodplain wetland mosaic, lowland raised bog or fens). For permanent above-ground infrastructure such as water treatment works, the greatest losses tend to be associated with options located on areas that are currently woodland.

An opportunity mapping exercise has been carried out, identifying potential beneficial areas to locate the net gain associated with the preferred programme. The mapping takes into account a range of factors including

the Local Planning Authority, local designations, proximity to statutory sites, proximity to ancient woodland and others. Taking these types of factors into account when identifying off-site opportunities for net gain allows for a strategic approach to be taken to providing benefits to local communities and incorporating habitats into wider ecological networks. Further work is anticipated within Cambridge Water towards selecting optimal sites, building on the mapping exercise that has so far been undertaken.

APPENDICES

APPENDIX A NATURAL CAPITAL ASSUMPTIONS AND CAVEATS

Ecosystem service	Compliance level	Type of assessment	Caveats and assumptions
Biodiversity	Minimum	Qualitative	Full best practice not available at this stage as no data related to condition and extent of habitats, will require more detailed assessment at planning stage
	Minimum	Quantitative	Local Nature Recovery Strategy looked at but until more detail on options/preferences needed to understand exactly where BNG habitats will be best placed.
	N/a	Monetisation	Limited data to apply any proportional monetised approach at this stage. Would require more detailed assessment at planning stage and any future monetisation agree with regulators if required.
	Minimum	Qualitative	The final BNG uplift and mitigation sites will be decided following detailed design, any PBOs identified at this stage are only showing possible suitable locations.
Climate Regulation	Minimum	Qualitative	Knowledge of this in Hectares (Ha) provide an assessment of habitats with carbon storage potential that maybe lost (temporary and permanent) with a key focus on grassland and woodland.
Natural Hazard Regulation	Minimum	Qualitative	Based on flood zone intersection with ZoI, judgement of intersection has been carried out at a high-level.
Water Purification	Minimum	Quantitative	NEVO tool integrated to pull together sub-catchment information on Nitrogen, Phosphorus, Dissolved oxygen and pesticide concentration levels to provide a high-level assessment. Data only at sub catchment level (2 KM + gird) so course information.
	Not essential	Monetisation	Not feasible at this stage noting that best practice requires significant data that is not available for options at this stage.
Water Regulation	Minimum	Qualitative	High level assessment at this stage. Future and current abstractors need to be reviewed during stakeholder engagement at detailed planning stage.
	Minimum	Quantitative	Wider stakeholder engagement has not been carried out at this stage, due to programme uncertainty. Therefore, assessment of water reaming for other existing and future users has not been considered at this stage though recognise this is important.
Recreation	Not essential	Monetised (losses only) provided	Values only relate to recreational assets that will be lost temporarily.

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

Table C-5.1. Results of the Biodiversity Net Gain calculations for terrestrial habitats

WRMP24 Ref.	Total area (ha)	Temporary impacts		Permanent impacts	
		Temporary area lost (ha)	Total units lost (ABHU)	Permanent area lost (ha)	Total units lost (ABHU)
CWC24-01A	5.33	5.08	-0.72	0.25	-1.08
CWC24-01B	4.74	3.84	-0.53	0.90	-3.35
CWC24-37Ai	186.03	-	-	186.03	-559.34
CWC24-37Aii	186.03	-	-	186.03	-559.34
CWC24-38A	186.03	-	-	186.03	-559.34
CWC24-38B	186.03	-	-	186.03	-559.34
CWC24-57	72.7	28.22	-3.37	44.48	-223.77
CWC24-71	32.6	26.59	-10.02	6.01	-15.18
CWC24-73A	107.49	105.13	-49.13	2.36	-8.79
CWC24-75Ai	0.80	0.80	-0.11	-	-
CWC24-75Aii	0.80	0.80	-0.11	-	
CWC24-75Aiii	1.17	0.87	-0.07	0.3	0.66
CWC24-75Bi	0.80	0.80	-0.11	-	-
CWC24-75Bii	0.80	0.80	-0.11	-	-
CWC24-75Biii	1.29	0.89	-0.07	0.4	0.88
CWC24-75Ci	0.80	0.80	-0.11	-	-
CWC24-75Cii	0.80	0.80	-0.11	-	-
CWC24-75Ciii	1.3961	0.8961	-0.07	0.05	1.10

Table C-5.2. Results of the Biodiversity Net Gain calculations for river habitats

WRMP24 Ref.	Total length (km)	Temporary impacts		Permanent impacts	
		Temporary length lost (km)	Total units lost (RU)	Permanent length lost (km)	Total units lost (RU)
CWC24-01A	-	-	-	-	-
CWC24-01B	-	-	-	-	-
CWC24-37Ai	1.55	-	-	1.55*	-18.84
CWC24-37Aii	1.55	-	-	1.55*	-18.84
CWC24-38A	1.55	-	-	1.55*	-18.84
CWC24-38B	1.55	-	-	1.55*	-18.84
CWC24-57	1.08	0.08	-0.80	1*	-12.15

WRMP24 Ref.	Total length (km)	Temporary impacts		Permanent impacts	
		Temporary length lost (km)	Total units lost (RU)	Permanent length lost (km)	Total units lost (RU)
CWC24-71	0.06	0.06	-0.60	-	-
CWC24-73A	0.3	0.3	-3	-	-
CWC24-75Aiii	0.02	0.02	-0.17	-	-
CWC24-75Biii	0.02	0.02	-0.17	-	-
CWC24-75Ciii	0.02	0.02	-0.17	-	-

* The project is currently located within 10m of the watercourse and therefore a worst-case scenario has been assumed (i.e. project to have permanent impacts on the watercourse resulting in a reduction of the river condition from moderate to poor and major encroachment within the riparian habitat).

APPENDIX D RESULTS OF STAGE 3 (FEASIBLE OPTIONS) NATURAL CAPITAL CALCULATIONS

dWRMP24 Ref.	Temporary impacts				Permanent impacts		
	Climate Regulation	Natural Hazard Regulation	Recreation and Tourism	Agriculture	Climate Regulation	Natural Hazard Regulation	Agriculture
	£2019/year	£2019/year	£2019/year	£2019/year	£2019/year	£2019/year	£2019/year
CWC24-01A	-17	0	-34,799	-776	-2	0	-84
CWC24-01B	-27	0	-34,799	-1,287	-6	0	-300
CWC24-37Ai	0	0	0	0	-957	-22	-42,625
CWC24-37Aii	0	0	0	0	-957	-22	-42,625
CWC24-38A	0	0	0	0	-957	-22	-42,625
CWC24-38B	0	0	0	0	-957	-22	-42,625
CWC24-57	-185	27	-73,425	-8,862	-1,005	-202	-12,659
CWC24-71	-187	0	-70,556	-8,099	-123	-27	-1,997
CWC24-73A	-830	0	-95,017	-33,320	-118	-33	-661
CWC24-75Ai	-17	0	-34,799	-776	-2	0	-84
CWC24-75Aii	-17	0	-34,799	-776	-2	0	-84
CW24-75Aiii	-6	0	0	-290	-2	0	
CWC24-75Bi	-6	0	0	-267	0	0	0
CWC24-75Bii	-6	0	0	-267	0	0	0
CW24-75Biii	-6	0	0	-295	-3	0	
CWC24-75Ci	-6	0	0	-276	0	0	0
CWC24-75Cii	-6	0	0	-276	0	0	0
CW24-75Ciii	-6	0	0	-300	-4	0	

APPENDIX E NATURAL HAZARD REGULATION ASSESSMENT RESULTS (PREFERRED PROGRAMME) DROUGHT AND FLOOD RISK

dWRMP24 Ref.	Estimated flood risk related to change/loss in habitats within ZoI	Estimated flood risk related to change/loss in habitats, related to permanent loss
01A	High	High
01B	High	High
37Aii	Low	Low
38B	Low	Low
57	Medium	Medium
71	Medium	Low
73A	Medium	Medium
75Aiii	Low	Low
75Biii	Low	Low
75Ciii	Low	Low

dWRMP24 Ref.	Drought risk
01A	Scheme requires recommissioning abstraction from a borehole in an area with restricted water available for licencing during normal flow conditions (Q50), with no water available under pre-drought (Q70) and drought (95) conditions. This therefore has the potential to have a high drought risk.
01B	Scheme requires recommissioning abstraction from a borehole in an area with restricted water available for licencing during normal flow conditions (Q50), with no water available under pre-drought (Q70) and drought (95) conditions. This therefore has the potential to have a high drought risk.
37Aii	This reservoir scheme will not abstract water from the waterbody, however it is located under restricted water availability conditions during normal low conditions (Q50), and no water availability under pre-drought (Q70) and post-drought (Q95) conditions, so therefore it has a medium risk.
38B	This reservoir scheme will not abstract water from the waterbody, however it is located under restricted water availability conditions during normal low conditions (Q50), and no water availability under pre-drought (Q70) and post-drought (Q95) conditions, so therefore it has a medium risk.
57	The abstraction of 22.2Ml/d at the River Cambridge would have a limited impact on low flows due to the HoF. The CAMS reveal a restricted water availability under normal conditions, and no water available under pre-drought (Q70) and drought (95) conditions, so it is therefore a low risk.
71	The scheme has no additional abstraction and would have a limited impact on low flows due to the HoF. The CAMS reveal a restricted water availability under normal conditions, and no water available under pre-drought (Q70) and drought (95) conditions, so it is therefore a low risk.
73A	The scheme has no additional abstraction from the waterbody however does involve water storage. The CAMS reveal a restricted water availability under normal conditions, and no water available under pre-drought (Q70) and drought (95) conditions, so it is therefore a medium risk.
75Aiii	No abstractions are included in this option as it is a potable water source from third party trade, while the CAMS identified no water available under normal, pre-drought and drought conditions, this option is not expected to increase drought risk and is therefore classified as low risk.
75Biii	No abstractions are included in this option as it is a potable water source from third party trade, while the CAMS identified no water available under normal, pre-drought and drought conditions, this option is not expected to increase drought risk and is therefore classified as low risk.
75Ciii	No abstractions are included in this option as it is a potable water source from third party trade, while the CAMS identified no water available under normal, pre-drought and drought conditions, this option is not expected to increase drought risk and is therefore classified as low risk.

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