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Cambridge Water WINEP Options Assessment

Assessment of Wider Environmental Benefits and
calculation of Benefit-Cost Ratios for selected
INNS options

Cambridge Water

June 2023



Notice

This document and its contents have been prepared and are intended solely as information for Cambridge Water and used in relation to The assessment of wider environmental benefits and the calculation of benefit-cost ratios for selected INNS options

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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits, and subsequent benefit-cost ratios for selected Cambridge Water options. This document details the method and results of the Invasive Non-Native Species (INNS) Options Assessment for Cambridge Water's Water Resources WINEP for PR24. The approach used was developed with reference to the EA's WINEP Options development guidance document (v3 – July 2022) and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

2. Method

2.1. Options

There is one INNS WINEP Option proposed by Cambridge Water. The action ID and driver code (brackets) for this option is shown below:

- 08CW100006 (INNS_IMP) – Funding to ensure the Cherry Hinton Reservoir site INNS area is managed and funding for 3rd party INNS projects in target catchments.

2.2. Screening / qualitative assessment against WINEP metrics / other metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flood
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

Our initial expectation on options within the INNS drivers are shown in Table 2-1 below. Through a qualitative assessment and screening, we deemed it unlikely for there to be wider benefits achieved through the INNS options.

We assigned a value of -3 to +3 where a value of 0 indicates no effect, 1 indicates a low or negligible effect, 2 a moderate effect, 3 a high effect (positive or negative), a summary of which is shown in Table 2-1.

Table 2-1 - Qualitative Assessment of Water Resource Options

Ecosystem Service	08CW100006 (INNS_IMP)	Justification for score
Biodiversity	+1	Removal/control of INNS improves biodiversity by removing pressure on native species, but it is challenging to capture the actual condition improvement as measured by the Biodiversity Metric 3.1. Option by option consideration will be considered to see if specific circumstances allow for INNS removal to make any significant difference to biodiversity.
Water purification by habitat	0	Benefit relates to wetland habitat quantity which will not be affected by INNS removal. Metric does not capture quality changes.
Water quality (benefits)	+1	Removal/control of INNS may improve aquatic habitats by removing pressure on native species and resulting bankside vegetation composition may indirectly improve water quality. However, unlikely that INNS removal/control alone will be sufficient to affect WFD status (WINEP approach uses NWEBS which is predicated on WFD status change).
Water supply	0	No effect on water supply.
Climate regulation (sequestration/emissions)	0	WINEP metric, Farmscoper and ENCA datasets do not distinguish habitats with or without INNS.
Recreation – including angling	0	ORVal tool is based on land use change and does not capture impacts of individual species removal.
Food - shellfish	0	Metric focussed on coastal habitat which is not relevant in this scheme.
Air Quality – pollution removal	0	Metric focussed on broad habitat types and is not specific enough to capture individual species removal.
Hazard Regulation – flood	0	Metric focussed on wetland habitat quantity which will not be affected by INNS removal. Metric does not capture quality changes.
Volunteering	0	Option specified will not create volunteering opportunities.
Education	0	Option specified will create education opportunities.

Our high-level assessment has scoped out all benefit categories for quantitative assessment. This partly reflects that the relationships between options and benefit categories are either non-causal or too granular to be measured. In some cases, we have determined the possibility for a relationship, but we lack the data needed to quantify the benefit.

2.3. Quantitative assessment

As no wider benefits were scoped in during stage 1 (no options scored +2 or higher, or -2 and lower), no quantitative assessment was undertaken and therefore the methodology is not provided.

2.4. Cost/benefit analysis

2.4.1. Benefits

As no wider benefits were scoped in during stage 1 (no options scored +2 or higher, or -2 and lower), no monetary evaluation of the options was undertaken and therefore the methodology is not provided.

2.4.2. Costs

To be included at a later date if costing is to be reported. If not, this report will act as a standalone benefits assessment for the option.

2.4.3. Benefit – cost ratios and options assessment reporting

To be included at a later date if costing (and the subsequent calculation of benefit-cost ratios) is to be reported. If not, this report will act as a standalone benefits assessment for the option.

3. Results

A summary of the assessment results for Option 08CW100006 are presented in Table 3-1.

The option involves funding to ensure CH Res site INNS area is managed and also funding for third party INNS projects in target catchments. The action will be taken within the water company boundary. No wider benefits were scoped in due to the nature of this option, which is consistent with the high-level screening presented in the methodology. A particular focus was given to the biodiversity ecosystem service; however, there is a lack of information and therefore baseline and post-option BNG conditions cannot be established.

Table 3-1 – Options results summary

Unique identification (UID) number	Unique identification name for the bundle of measures	Description of measures	Benefit (£)	Whole life cost (£)	Net present value (NPV) (£)	Benefit cost ratio (BCR) (£1 cost: £x benefits)
INNS_IMP	Funding for INNS management	<ul style="list-style-type: none"> INNS control/removal within the water company boundary 	No wider benefits scoped in due to nature of option.	TBD	TBD	N/A

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South Staffordshire Water and Cambridge Water WINEP Options Assessment

Assessment of Wider Environmental Benefits under
WINEP for NERC-Driven Action IDs

South Staffordshire Water and Cambridge Water

June 2023



Notice

This document and its contents have been prepared and are intended solely as information for South Staffordshire Water and Cambridge Water and used in relation to the wider environmental benefits for selected measures.

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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (the EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits, and subsequent benefit-cost ratios for selected South Staffs Water (SSW) and Cambridge Water (CAM) options. This document details the method and results for the surface water catchment-scale measures for South Staff Water and Cambridge Water's Water Resources WINEP for PR24. The approach used was developed with reference to the EA's WINEP Options Development Guidance document (v3 – July 2022)¹ and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

¹ [Water industry national environment programme \(WINEP\) methodology - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/108242/water-industry-national-environment-programme-winep-methodology.pdf)

2. Method

2.1. Options

The actions assessed in this report are the full collection of measures associated with the NERC Biodiversity Priority driver. The Action IDs, driver codes, and option descriptions for the actions assessed in this report are shown in Table 2-1 below. Because only the preferred option is assessed for each action, from here onwards the terms 'action' and 'option' are used interchangeably.

Table 2-1 - Option descriptions and main assumptions

Action ID	Operational Catchment	Driver Code	Option	Description
08CW100007	Cam and Ely Ouse	NERC_IMP	Preferred	Implement site management plans to enhance terrestrial habitats and species as identified in AMP7 investigations.
08CW100012	Cam and Ely Ouse	NERC_IMP	Preferred	Implementation of river restoration measures to improve brown trout habitat as identified in AMP7: Mill River, River Mel, River Shep, Hoffer Brook, Cherry Hinton Brook, Vicars Brook (Hobson's Brook), River Granta.
08SS100005	Blithe Rivers and Lakes	NERC_IMP	Preferred	Implement site management plans to enhance terrestrial habitats and species as identified in AMP7 investigations.

2.2. Implement Site Management (SSW and CAM Measures)

The scope of Action IDs 08CW100007 and 08SS100005 cover 38 and 49 sites, respectively². The Options Assessments Reports (OARs) set out over 20 distinct measures but for simplicity of assessment these have been grouped into six categories, which are:

- Woodland management;
- Grassland management;
- Hedgerow management;
- Riparian management (including wetland creation);
- Set up new bird or bat boxes; and
- Establish new grassland habitat.

Full details of baseline habitat type, quality and extent have not been provided. Rather, SSW/CAM have given indicative applicability of each measure to each site based on the presence/absence of baseline habitat at each site. The assumption is therefore that, if the baseline habitat is present, the measure will be applied as per Table 2-2 below. The grassland management and riparian action have two sub-strands. In most cases, the aim of the grassland management measure is to convert modified grassland to semi-natural grassland (assumed to be neutral). However, there are three sites at Cherry Hinton and Fleam Dyke (CAM C5, CAM C6, CAM F2) where the existing grassland is calcareous grassland in moderate condition. In these cases, the aim of the measure is to improve the condition of that grassland. The riparian action could involve either tree planting (assumed to be new wet woodland) or wetland creation (assumed to be new reedbed) assumed to be applied in equal proportions³.

² See separate 'costings' spreadsheet for details.

³ As agreed with SSW/CAM driver lead.

Table 2-2 - Baseline land cover applicability for implement own site management habitat measures (Action IDs 08CW100007 and 08SS100005)

Measure	Baseline Applied to	Aim (assumed effect) of Measure
Woodland management	Deciduous woodland	Improve habitat condition
Grassland management	Modified grassland	Convert to semi-natural (neutral) grassland
	Calcareous grassland	Improve habitat condition
Hedgerow management	Native-species hedgerow	Improve habitat condition
Riparian management - establishing new reedbeds	Modified grassland	Convert to reedbed
Riparian management - establishing new woodland	Modified grassland	Convert to wet woodland
Set up new bird or bat boxes	Buildings	Add bird or bat boxes to buildings
Grassland creation	Modified grassland	Convert to semi-natural (neutral) grassland

In the absence of baseline habitat areas / lengths, we have inferred the area of applicability of each measure (Table 2-3) by reference to the annual cost (£) / measure / site provided by SSW/CAM against standard annual cost (£) / measure / ha as indicated by the Environment Agency or with reference to payment rates available for equivalent measures in Countryside Stewardship (see Appendix A for details). Where source payment rates contain an upfront capital element this was annuitized, and where source payment rates are from a historic year these were inflated to present day using the CPIH deflator.

Table 2-3 – Measure land cover area by company (Action IDs 08CW100007 and 08SS100005)

Measure	£ / site / yr ⁴	£ / ha / yr ⁵	ha / site	CAM sites	CAM area (ha)	SSW sites	SSW area (ha)
Woodland management	750	904	0.83	29	24.07	42	34.86
Grassland management	400	132	3.03	36	109.09	43	130.30
Hedgerow management	350	2130	0.16	31	5.09	18	2.96
Riparian management - establishing new reedbeds	400	637	0.63	4	2.51	11	6.91
Riparian management - establishing new woodland	400	390	1.03	4	4.10	11	11.28
Grassland creation	500	185	2.7	2	5.41	1	2.70

2.3. Brown Trout Measures (CAM Measure)

The scope of Action ID 08CW100012 involves a combination of individual measures applied to seven prioritised water bodies in the Cam Ely & Ouse Management Catchment (Mill River, River Mel, River Shep, Hoffer Brook, River Granta, Vicars Brook, Cherry Hinton Brook). The measures are intended to protect and enhance brown trout habitat and include:

- Channel realignment;
- Gravel augmentation;
- Creation of in-channel features (e.g., berms, deflectors, wood dams);

⁴ Provided by SSW/CAM – see ‘costings’ spreadsheet.

⁵ See 3.Appendix A for details.

- Removal or set-back of flood defence embankment;
- Bank reprofiling;
- Improved fish passage (e.g., weir removal);
- Removal / replacement of hard bank protection;
- Wetland habitat creation;
- Riparian tree-planting;
- Riparian tree management, and;
- Establish a riparian buffer.

Details of the location (Ordnance Survey grid reference), reach and length or area of each measure have been provided for each waterbody⁶ and have been used to determine measure quantity as set out in Table 2-4. In some cases, the cumulative length of measure directly affecting the waterbody (not including wetland habitat and riparian buffers) exceeds the actual length of the waterbody. How this has been addressed for benefits assessment is set out in subsequent sections.

Table 2-4 - Measure quantities (km, unless stated) by waterbody (Action ID 08CW100012)

Measure	Mill River	River Mel	River Shep	Hoffer Brook	River Granta	Vicars Brook	Cherry Hinton Brook
Channel realignment	0	1.25	0	0	1.45	0.5	0.93
Gravel augmentation	0.46	3.35	1.84	2.95	6.98	3.5	3.92
In-channel features	0.85	3.35	2.9	2.6	7.31	1.38	5.79
Embankment removal	0.1	0.1	0.56	0	0.16	0.55	0.16
Bank reprofiling	0.86	0.86	0.7	0.43	7.59	0	0
Improved fish passage	0	0	0.05	0	0.6	0	0.05
Remove/replace hard bank protection	0	0	0.005	0	0.68	0	0.06
Wetland habitat (ha)	7	21	3	23	30	2	8
Riparian tree-planting	2	2	0.96	0.44	4.3	2.35	0.14
Riparian management	1.11	1.11	0.22	0.58	2.2	0.55	1.36
Riparian buffer (ha)	1.68	1.68	0.68	0	1.68	0.65	0

2.4. Screening / qualitative assessment against WINEP metrics / other metrics

2.4.1. WINEP Recommended Metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flooding
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)

⁶ See 'Chalk Rivers summary Measures and costs' spreadsheet.

- Food – shellfish
- Air Quality
- Education
- Volunteering

Within the guidance, metrics are provided for each environmental benefit category. Given the current state of information regarding the catchment measures we cannot always measure the environmental benefit category as directed under the recommended metrics. In these cases, we have looked to alternative and supplementary metrics as defined in the WINEP guidance. See Sections 2.4.2 and 2.5.7 for further detail on the use of alternative metrics.

A qualitative assessment was completed for each of the environmental benefit categories, for each WINEP option (represented by the last two digits of the Action ID). A value was assigned from -3 to +3 where a value of 0 indicates no effect, 1 indicates a low or negligible effect, 2 a moderate effect, 3 a high effect (positive or negative). This qualitative assessment is based on professional judgement from the Atkins Natural Capital Specialists.

Table 2-5 - Qualitative Assessment of WINEP option for Action IDs 08CW100007 and 08SS100005

	Biodiversity	Water purification	Water quality	Water supply	Climate regulation	Recreation*	Recreation* - angling	Food -shellfish	Air Quality	Hazard regulation	Volunteering	Education
Woodland management	+2		+1		+1	+1			+1	+2	+1	
Grassland management	+2		+1		+2	+2			+2	+1	+1	
Hedgerow management	+2		+1		+1	+1			+1	+1	+1	
Riparian management	+2	+2	+1		+2	+2	+1		+2	+2	+1	
Bird/bat boxes	+1										+1	+1
Grassland creation	+2		+1		+2	+2			+2	+1	+1	

* Applies only to 08SS100005 where there are sites with public access. See Appendices - Recreation.

Table 2-6 - Qualitative Assessment of WINEP option for Action ID 08CW100012

	Biodiversity	Water purification	Water quality	Water supply	Climate regulation	Recreation	Recreation - angling	Food -shellfish	Air Quality	Hazard regulation	Volunteering	Education
Channel realignment	+1		+2								+1	
Bank reprofiling	+1		+2								+1	
Removal of hard bank protection	+1		+2								+1	

	Biodiversity	Water purification	Water quality	Water supply	Climate regulation	Recreation	Recreation - angling	Food -shellfish	Air Quality	Hazard regulation	Volunteering	Education
Gravel augmentation	+1		+2								+1	
Improved fish passage	+1		+2				+1				+1	
Wetland habitat creation	+3	+2			-1	+2				+2	+1	
Riparian tree-planting	+3				+3	+2			+3	+2	+1	
Riparian tree management	+1				-2	+1	+1		-1	-1	+1	
Riparian buffer	+1				+1	+1			+1	+1	+1	
In-channel features (narrowing)	+1		+2								+1	
Removal/set-back of embankment	+1		+2								+1	

Options scoring +2 or higher (or -2 and lower) were taken forward for quantitative assessment. The following WINEP metrics were scoped in and assessed as part of the WINEP assessment:

- Biodiversity (Section 2.5.1) – WINEP recommended metric
- Climate regulation (Section 2.5.2) – WINEP recommended metric and alternative metric (via FARMSCOOPER)
- Recreation (Section 2.5.3) – WINEP recommended metric
- Air quality (Section 2.5.4) – WINEP recommended metric and alternative metric (via FARMSCOOPER)
- Hazard regulation (Section 2.5.5) – WINEP recommended metric
- Water purification by habitat (Section 2.5.6) – WINEP recommended metric
- Water quality (Section 2.5.7) – WINEP recommended metric and alternative metric (via FARMSCOOPER)

2.4.2. Additional ecosystem services

As referenced above, we have utilised additional ecosystem service metrics to quantify and monetise environmental benefits where the WINEP recommended metrics have not been suitable. The additional benefits we have captured through these metrics are:

- Water quality – externalities and damages reduction
 - Nitrate
 - Phosphorus
 - Sediment
- Air quality (emissions)
 - Ammonia
- Climate regulation (reduced Greenhouse Gas (GHG) emissions)

- Methane
- Nitrous Oxide
- Energy Use

To calculate the additional metrics above, the FARMSCOPER tool is used. FARMSCOPER is a Defra-funded, peer-reviewed decision support tool, developed by ADAS⁷.

2.5. Quantitative / Monetary Assessment

2.5.1. Biodiversity

All Action IDs are scoped into this assessment.

Quantification

The Biodiversity Metric 3.1 Calculation Tool⁸ was used to calculate biodiversity units pre- and post-scheme for all catchment measures. Baseline assessments were undertaken for the four baseline habitat areas, alongside post-scheme assessments for each of the eight measures. A biodiversity habitat unit impact was then calculated for each of the measures versus each of the applicable baseline habitats and applied across each catchment.

The inputs and biodiversity units per baseline habitat (Table 2-7) and measure (Table 2-8) are shown below – these are scaled up by the hectares (or km for river units) shown in Table 2-3 and Table 2-4 against the relevant baseline habitats.

⁷ FARMSCOPER is able to make predictions for reduction in pesticides and faecal indicator organisms (FIO). However, pesticide predictions are only made on a percentage basis so cannot be quantified in meaningful units against which avoided damage or removal costs could be estimated. Information is not available on the monetary value of avoided FIO inputs. We do not report on either of these aspects.

⁸ Biodiversity Metric 3.1 Tool [The Biodiversity Metric 3.1 - JP039 \(naturalengland.org.uk\)](https://naturalengland.org.uk/jp039)

Table 2-7 - Baseline BNG units per habitat per hectare

Baseline Habitat Type	Mapping to Metric Tool Habitat	Condition	Distinctiveness	Units / ha
Deciduous Woodland	Woodland – Other woodland; broadleaved	Poor	Medium	4.00
Degraded / Disturbed Grassland	Grassland – Modified grassland	Poor	Low	2.00
Chalk Grassland	Grassland – Lowland calcareous grassland	Moderate	High	12.00
Hedgerow	Hedgerow – Native hedgerow, associated with bank or ditch	Poor	Medium	4.00
Watercourse	Rivers – Other rivers and streams	Moderate	High	12.00

Table 2-8 – Measure (Scenario) BNG units per hectare

Action ID	Measures	Mapping to Metric Tool Habitat	Condition	Distinctiveness	Units / ha
08CW100007 and 08SS100005	Woodland management	Woodland – Other woodland; broadleaved	Moderate	Medium	6.80
	Grassland management - non-chalk sites	Grassland - Neutral grassland	Moderate	Medium	3.40
	Grassland management - chalk sites	Grassland - Lowland calcareous grassland	Good	High	13.40
	Hedgerow management	Native hedgerow - Associated with bank or ditch	Moderate	Medium	7.59
	Riparian management - wetland	Wetland - Reedbeds	Moderate	High	6.27
	Riparian management - woodland	Woodland and forest – Wet woodland	Moderate	High	4.71
	Grassland creation	Grassland - Neutral grassland	Moderate	Medium	3.40
008CW100012	Channel realignment	Rivers – Other rivers and streams	Fairly Good	High	13.87
	Gravel augmentation	Rivers – Other rivers and streams	Fairly Good	High	13.87
	In-channel features (berms, deflectors, wood dams)	Rivers – Other rivers and streams	Fairly Good	High	13.87
	Embankment removal	Rivers – Other rivers and streams	Fairly Good	High	13.87
	Bank reprofiling	Rivers – Other rivers and streams	Fairly Good	High	13.87
	Improved fish passage / Weir removal	-	-	-	-
	Removal/replacement of hard bank protection	Rivers – Other rivers and streams	Fairly Good	High	13.87

Action ID	Measures	Mapping to Metric Tool Habitat	Condition	Distinctiveness	Units / ha
	Wetland habitat creation	Lakes – Ponds (non-priority habitat)	Poor	Medium	3.86
	Riparian tree-planting	Line of Trees - Associated with bank or ditch	Moderate	Low	1.96
	Riparian tree management	Hedgerow – Native hedgerow, associated with bank or ditch	Moderate	Medium	2.09
	Riparian buffer	Cropland – Arable field margins tussocky	N/A	Medium	3.86

Valuation

The WINEP guidance does not recommend using a monetary value for biodiversity.

2.5.2. Climate regulation (carbon sequestration)

Quantification

Carbon sequestration rates used to quantify this service were predominantly those recommended in the WINEP guidance, shown in Table 2-9, alongside additional values from ENCA and other reliable sources. The mapping of these values to the baseline habitats and measures, is shown in Table 2-10 and Table 2-11.

Table 2-9 - Carbon sequestration values from WINEP guidance (only values used as part of this assessment are reported)

Land cover	Value (tCO ₂ e / ha / year)	Source
Enclosed Farmland	0.107	WINEP recommended
Semi-natural grassland	0.397	WINEP recommended
Woodland	6.700	WINEP recommended
Freshwaters, etc.	0	WINEP recommended

Table 2-10 - Mapping of baseline habitats to carbon sequestration values

Baseline habitat	Mapping
Modified Grassland	Enclosed Farmland
Woodland	Woodland
Chalk Grassland	Semi-Natural Grasslands

Table 2-11 - Mapping of measures to carbon sequestration values

Measure	Scenario Mapping
Woodland management	Woodland (national broadleaf average)
Grassland management - non-chalk sites	Semi-natural grasslands
Grassland management - chalk sites	Semi-natural grasslands
Hedgerow management	Not applicable as not creating a land-use change.
Riparian management - wetland	Freshwaters, etc.

Measure	Scenario Mapping
Riparian management - woodland	Woodland (national broadleaf average)
Grassland creation	Semi-natural grasslands
Channel realignment	Not applicable as not creating a land-use change.
Gravel augmentation	Not applicable as not creating a land-use change.
In-channel features (berms, deflectors, wood dams)	Not applicable as not creating a land-use change.
Embankment removal	Not applicable as not creating a land-use change.
Bank reprofiling	Not applicable as not creating a land-use change.
Improved fish passage / Weir removal	Not applicable as not creating a land-use change.
Removal/replacement of hard bank protection	Not applicable as not creating a land-use change.
Wetland habitat creation	Freshwaters, etc.
Riparian tree-planting	Woodland (national broadleaf average)
Riparian tree management	Enclosed farmland and Woodland (national broadleaf average)
Riparian buffer	Semi-natural grasslands

Valuation

Monetary values are based on the BEIS greenhouse gas emission values⁹, as recommended in the WINEP guidance. The full timeseries of BEIS carbon values (central value) are used from 2020 to 2050 in order to calculate a 30-year monetary benefit value. Each year is discounted in line with the HMT Greenbook¹⁰ and collated for the baseline and scenario to calculate the monetary impact of the measures on carbon sequestration over 30 years.

2.5.3. Recreation

To estimate the change in visitor numbers the ORVal tool is recommended in WINEP guidance. However, the ORVal tool was unable to be used within this assessment as the precise locations of the works are required to be able to estimate the impact on the recreational value in the ORVal tool. At the time of assessment, the precise location of the measures was unknown. Therefore, an alternative method was used. The alternative method uses the Office for National Statistics (ONS) 2021 data on change in recreational value (visitor spend) associated with change in land cover. This approach also assumes that the sites have the potential for recreational access, so it may overstate the value if in reality the sites are not accessible to the public.

Future assessments should consider using ORVal methodologies if the location specific data is available.

Quantification

This methodology, using the ONS (2021) data on the visitor spend associated with broad habitat types / land cover, does not produce a quantitative value.

The ONS (2021) method uses area-based values (£/ha) directly for broad habitat types / land cover. The area of broad habitat (by type) is therefore a proxy indicator of the quantity of service provision.

Valuation

ONS 2021 values represent mean national recreational values, based on broad habitat types and are provided in £ / ha values. These values have been applied to the area of broad habitat types in the baseline and scenario of each option, to provide a valuation of the recreation benefits provided by the baseline and scenario habitat types.

⁹ [Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation)

¹⁰ [Green Book supplementary guidance: discounting - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting)

Table 2-12 shows the mapping from land cover as per the ONS data to baseline land cover categories in the catchments and additional value required for the measures (in the case of new wetland creation).

Table 2-12 - Recreation values per hectare used for the baseline and measures

Land cover	Value (£ / ha) £2020
Enclosed Farmland	£73
Woodland	£102
Wetland	£1091
Grassland	£213

Table 2-13 shows the mapping for each measure. Highlighting the land cover changes from the baseline to the post-measure land cover for the measure scoped in for recreation benefits.

Measures from Action ID 08SS100005 and 08CW100007 have been scoped out as no recreational impact is anticipated given that the majority of the sites are not publicly accessible. For Action ID 08CW100012, the measures that were implemented within the channel of a watercourse were unable to be assessed using this methodology, hence these measures are also excluded from Table 2-13.

Table 2-13 - Recreation 30-year Present Value (PV) impact per hectare for measures

Measure	Baseline	Post-Measure	Impact (30 yr PV £ / ha)
Wetland habitat creation	£1,832	£22,041	£20,210
Riparian tree-planting	£1,832	£2,359	£528
Riparian tree management	£2,359	£2,442	£83
Riparian buffer	£1,832	£2,636	£805

2.5.4. Air Quality – pollution removal

To estimate the change in air pollution removal rates, the Jones et al. (2017) values are used. This database is recommended within the WINEP guidance.

Quantification

The Jones et al. (2017) database takes area-based values (£/ha) directly for broad habitat types/ land cover. The area of broad habitat (by type) is therefore a proxy indicator of the quantity of service provision.

Valuation

The Jones et al. (2017) database provides the £/ha values for broad habitat types in 2012 prices for a timeseries from 2015 to 2030. To generate a 30-year monetary benefit the 2030 values have been used as an average for the 30-year assessment period. These values have been uplifted from 2012 prices to 2020/21 prices using the CPIH Index Tool and are shown in Table 2-14.

Table 2-14 – Air quality pollution removal database of values

Land cover	Air Pollution Removal Value (£/ha) 2020 / 2021 prices
Urban woodland	517.37
Rural woodland	148.87
Woodland	161.33
Enclosed farmland	8.04
Urban grassland	90.45
Semi-natural grassland	10.78
Mountain moor & heath	9.61

Land cover	Air Pollution Removal Value (£/ha) 2020 / 2021 prices
Urban fresh / saltwater	-11.49
Open water, wetland & floodplain	8.10
Coastal margins	15.38

2.5.5. Hazard regulation - flood

In the WINEP guidance, the quantification of this service is described only in terms of the contribution of woodlands and wetlands. Therefore, we have quantified the impact of this service for the measures which have woodland and/or wetlands that are impacted as a result of the action.

Quantification

This methodology follows the WINEP guidance. For wetland, we refer to Morris and Camino (2011) using their estimated value of an additional hectare for flood control and storm buffering service. For woodland we refer to Broadmeadow et al (2018), who estimate the volume of water stored by woodland as (278 m³ / ha).

Valuation

The WINEP recommended approach to valuing this service is a 'replacement cost approach'. The value of an additional hectare of flood control and storm buffering by inland is used as a proxy for the value of the service provided by wetlands (WINEP Wider Environmental Outcome Metrics spreadsheet), shown in Table 2-15. This value is applied to all wetland created under the wetland creation measure. For woodland, we multiply the volumetric storage value above by the £ / m³ / yr values (0.43) from Broadmeadow et al (2018), referred to in the Wider Environmental Outcome Metrics spreadsheet.

Table 2-15 - Hazard regulation monetary values

Broad habitat	Value (£ / ha, 2020)	Source
Wetland	0.43	Morris and Camino (2011). UK NEA.
Woodland	117.82	Broadmeadow et al (2018). Valuing flood regulation services of existing forest cover to inform natural capital accounts

2.5.6. Water purification by habitat

In the WINEP guidance, the quantification of this service is described only in terms of the contribution of wetlands. Therefore, we have quantified the impact of this service for the measures which have wetlands that are impacted as a result of the action.

Quantification

This methodology, using the WINEP recommended metrics, uses the marginal water quality benefits provided by an additional hectare of inland wetland does not produce a quantitative value.

The Morris and Camino (2011) method uses area-based values (£/ha) directly for wetlands. The area of wetland created is therefore a proxy indicator of the quantity of service provision.

Valuation

The value of the marginal water quality benefits provided by an additional hectare of inland wetlands is used as a proxy for the value of the service provided by wetlands and shown in Table 2-16. This value is applied to all wetland created under the wetland creation measure.

Table 2-16 – Water purification monetary values

Broad habitat	Value (2020 prices)	Units	Source
Wetland	£350	£ / ha	Morris and Camino (2011). UK NEA.

2.5.7. Alternative metric – FARMSCOPER

Quantification

FARMSCOPER can be used to quantify and value improvement in water quality in terms of avoided environmental externalities by estimating **nitrate, phosphorus and sediment losses** produced from agricultural land. FARMSCOPER¹ is also able to estimate GHG emissions (**methane, nitrous oxide and carbon dioxide**) and air pollutant emissions (**ammonia**) associated with land management activities. FARMSCOPER also provides % change in plant protection products and change in faecal indicator organism loads but there are no value transfer functions available for these, so the evaluation has focused on the pollutants mentioned above.

Scoped out all measures under Actions IDs 08SS100005 and 08CW100007 given that none of them are implemented on actual farmland. Only terrestrial measures under Action ID 08CW100012 could be assessed, as the in-channel measures would not be measurable within FARMSCOPER. Proxy methods were used to represent certain measures where no in-built FARMSCOPER methods or established approaches were an exact representation (e.g., Riparian tree planting was treated as Method 80 – Establish new hedgerows) hence these values should be used with caution.

Valuation

Using FARMSCOPER as an additional analysis tool to the WINEP recommended tools provides greater information in relation to water quality (avoided pollutant loading), climate regulation (avoided GHG emissions) and air quality regulation (avoided ammonia emissions). Table 2-17 below summarises the monetary values used for each component.

Table 2-17 - Monetary valuation figures and sources

Ecosystem service	Monetary value (£ / kg removed, 2021)	Source
Water Quality - Nitrate	1.1	FARMSCOPER
Water Quality - Phosphorus	36.7	FARMSCOPER ¹¹
Water Quality - Sediment	0.4	FARMSCOPER
Air Quality - Ammonia	8.1	GOV UK Air quality appraisal: damage cost guidance ¹²
Climate Regulation - Methane	The full timeseries of BEIS carbon values (central value) are used from 2020 to 2050 in order to calculate a 30-year monetary benefit value.	BEIS ¹³
Climate Regulation - Nitrous oxide		BEIS
Climate Regulation - Energy use		BEIS

Justification for the use of the additional metric

Monetisation of these services was undertaken using ENCA guided approaches, and standard water quality damage costs as quoted in the FARMSCOPER guidance.

¹¹ FARMSCOPER <https://adas.co.uk/services/farmscoper/>

¹² GOV UK Air quality appraisal: damage cost guidance <https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance>

¹³ BEIS (2021) <https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation>

3. Results

A summary of the assessment results for the measures assessed are presented in Table 3-1.

A summary of the additional WINEP metric total changes in monetary value per option are presented in Table 3-2.

Detailed results tables which include the baseline and scenario values for each ecosystem service are provided in the following appendices:

- BNG - Appendix A - Table 3-4
- Climate regulation - Appendix C - Table 3-5
- Recreation - Appendix D - Table 3-6
- Air quality pollutant removal - Appendix E - Table 3-7
- Hazard regulation (flooding) - Appendix F - Table 3-8.
- Water purification by habitat - Appendix J – Table 3-12.

Results for the additional metrics are in the following appendices:

- Air quality (pollution reduction) – Ammonia - Appendix G - Table 3-9.
- Water quality (pollution reduction) - Appendix H - Table 3-10.
- Climate regulation (carbon and GHG emissions reduction) - Appendix I - Table 3-11.

Table 3-1 – Total change in ecosystem service values as a result of the Actions – WINEP metrics

	Climate Regulation	Recreation (Alternative method)	Air Quality Removal	Natural Hazard Management	Water Purification	Water Quality	TOTAL
ID	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30yr £PV	30 yr Total £PV
08CW100007	£291,131	NA	£20,789	£43,754	£27,352	NA	£383,026
08CW100012	£175,664	£1,290,009	£12,209	£876,828	£624,585	£5,083,004	£8,062,299
08SS100005	£495,242	£93,080	£42,713	£120,357	£75,232	NA	£826,624

Refer to Task 2 outputs for change in biophysical values.

Biodiversity									
ID	Baseline Units			Post-Intervention Units			% Change from baseline		
	Habitat	Hedgerow	River	Habitat	Hedgerow	River	Habitat	Hedgerow	River
08CW100007	358	102	0	610	193	0	70	89	0
08CW100012	287	14	749	473	39	846	65	179	13
08SS100005	442	59	0	792	112	0	79	90	0

Table 3-2 – Total change in ecosystem service values as a result of the Actions – Suppl. metrics

Action ID	Change in monetary value (£ 30 Year PV 2020-21)		
	Water Quality Nitrate, Phosphorus and Sediment removal	Air Quality Avoided Ammonia emissions	Climate Regulation Avoided GHG emissions
08CW100007	NA	NA	NA
08CW100012	£41,513	£7,940	£199,315
08SS100005	NA	NA	NA

Refer to Task 2 outputs for change in biophysical values.

Analysis and interpretation of results

The impacts of the three actions (08CW100007, 08CW100012 and 08SS100005) presented in Table 3-1 above. The actions with the largest natural capital impact (overall) is 08CW100012, this is largely driven by the water quality benefits associated with this action, however other ecosystem services with large benefits associated with this action are natural hazard management, water purification recreation, climate regulation and air quality removal. The water quality benefits associated with actions 08CW100012 are not represented within the other two actions in Table 3-1, as 08CW100012 is the only action which has in channel measures which drive the water quality benefits, the other two measures do not include measures which will significantly improve the water quality in order to quantify it within this study. In addition to the in-channel measures in 08CW100012, this action also has a large area of wetland creation which drives large benefits in the natural hazard management and water purification ecosystem services, the other two actions (08CW100007 and 08SS100005) do not have as large wetland areas, which is reflected in the smaller benefits in the natural hazard management and water purification ecosystem services. Again, the other two actions do not have wetland creation measures within their scope, thus they do not receive as high benefit values within the natural hazard management and water purification ecosystem services.

By contrast the other measures are dominated by more conventional catchment solutions (i.e. woodland, grassland and hedgerow management) with benefits, especially for carbon sequestration, air quality removal and recreation.

Across all actions there are biodiversity unit increases. The hedgerow unit increases are the largest overall as the percentage increase ranges from 90-172% for each of the three actions, Table 3-2. The habitat and river unit increases are also large with habitat unit increases ranging from 65-79% and the river unit increase being 13% (only assessed for one action). River units are only calculated for action 08CW100012 as this is the only action in which in-channel BNG is likely to be significantly impacted, as this action includes in-channel measures such as channel realignment, gravel augmentation, in-channel features (berms, deflectors, wood dams), embankment removal, bank reprofiling, improved fish passage/weir removal and removal/replacement of hard bank protection.

Appendices

Appendix A. Calculation of annuitized measure costs

Annual costs (£ / ha / yr) for measures under Actions 08CW100007 and 08SS100005 were determined with reference to capital and annual management costs from the following sources:

- Natural England - NE (2022). <https://www.gov.uk/countryside-stewardship-grants>
- Environment Agency – EA (2015a). Cost estimation for land use and run-off: summary of evidence.
- Environment Agency – EA (2015b). Cost estimation for habitat creation: summary of evidence.

Source costs were first adjusted to 2020/21 values with reference to CPIH deflators. Capital costs were annuitized assuming an asset life of 30 years and a finance cost of 5% and added to management costs to derive a total annual cost estimate. Countryside stewardship payment rates may overstate actual costs as they include an element income forgone from agricultural production which are not relevant to SSW/CAM's own sites. However, they have been used in the absence of readily available alternative cost sources for specific actions.

Table 3-3 – Determination of annual costs (£ / ha /yr) for measures under Actions 08CW100007 and 08SS100005.

Measure	Woodland management	Grassland management	Hedgerow management*	Riparian management – woodland	Riparian management – reedbeds	Grassland restoration
Capital Cost (£ / ha)			17.22 (per m) + 7.06 (per m)	4,000	1,361	
Management Cost (£ / ha)	1,000	132	10 (per 100m / yr)	75	380	185
Valuation year	2022	2020	2020	2010	2005	2020
Source	NE (2022)	NE (2022)	NE (2022)	EA (2015a)	EA (2015b)	NE (2022)
Equivalent measure	WD1 Woodland improvement	GS6 Management of species rich grassland	BN7 Hedgerow gapping up + BN9 Hedgerow supplement (50% length) BE3 Hedgerow management (50% length)	Floodplain woodland establishment (central value)	Re-establishment of reedbeds	GS7 Restoration towards species rich grassland
2020/21 Capital cost (£)			1,214	4,835	1,867	
2020/21 Mgmt cost (£)	904	132	10	91	521	185
Annual cost (£ / ha / yr)	904	132	2,130	390	637	185

* The OAR description of hedgerow measures covers more than just management and refers to gapping up, laying and underplanting. We have therefore assumed that half the hedgerow length will have significant investment (BN7 + BN9) and the remainder will only need management (BE3). BN7 and BN9 costs refer to both sides of hedgerow whilst BE3 refer to one side of a hedgerow only but we assume that SSW/CAM will manage both. We also assume that a hedgerow is 4m wide to convert from length to area.

Appendix B. Biodiversity

Table 3-4 - Biodiversity net gain (BNG) units for pre- and post- catchment-scale measures

Action ID	Action name	Habitat units			Hedgerow units			River units		
		Baseline	Scenario	Change	Baseline	Scenario	Change	Baseline	Scenario	Change
08CW100007	Woodland management	96.28	163.68	67.40	NA	NA	NA	NA	NA	NA
	Grassland management - non-chalk sites	214.24	364.21	149.97	NA	NA	NA	NA	NA	NA
	Grassland management - chalk sites	23.63	26.39	2.76	NA	NA	NA	NA	NA	NA
	Hedgerow management	NA	NA	NA	108.60	206.07	97.47	NA	NA	NA
	Riparian management - wetland	8.20	25.71	17.51	NA	NA	NA	NA	NA	NA
	Riparian management - woodland	5.02	11.82	6.80	NA	NA	NA	NA	NA	NA
	Grassland creation	10.82	18.39	7.57	NA	NA	NA	NA	NA	NA
	TOTAL	358.20	610.20	252.01	108.60	206.07	97.47	NA	NA	NA
08CW100012	TOTAL	287.1	473.1	186.0	14.3	38.8	24.5	749.1	845.9	96.9
08SS100005	Woodland management	139.42	237.02	97.60	NA	NA	NA	NA	NA	NA
	Grassland management	260.61	443.03	182.42	NA	NA	NA	NA	NA	NA
	Hedgerow management	NA	NA	NA	63.00	119.54	56.54	NA	NA	NA
	Riparian management - wetland	22.55	70.71	48.15	NA	NA	NA	NA	NA	NA
	Riparian management - woodland	13.82	32.54	18.72	NA	NA	NA	NA	NA	NA
	Grassland creation	5.41	9.19	3.78	NA	NA	NA	NA	NA	NA
	TOTAL	441.81	792.49	350.68	63.00	119.54	56.54	NA	NA	NA

Appendix C. Climate regulation

Table 3-5 – Climate Regulation quantitative and monetary detailed results

Action ID	Action name	Monetary (30-year £PV)		
		Baseline	Scenario	Change
08CW100007	Woodland management	£963,213	£963,213	£0
	Grassland management - non-chalk sites	£68,459	£254,001	£185,542
	Grassland management - chalk sites	£4,670	£4,670	£0
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£2,620	£0	−£2,620
	Riparian management - woodland	£1,604	£100,443	£98,839
	Grassland creation	£3,457	£12,828	£9,371
	TOTAL	£1,044,024	£1,335,155	£291,131
08CW100012	Wetland creation	NA*	NA*	−£94,687
	Riparian tree-planting	NA*	NA*	£303,858
	Riparian buffer	NA*	NA*	£17,466
	Riparian tree management	NA*	NA*	−£50,973
	TOTAL	NA*	NA*	£175,664
08SS100005	Woodland management	£1,394,813	£1,394,813	£0
	Grassland management	£83,274	£308,970	£225,696
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£7,207	£0	−£7,207
	Riparian management - woodland	£4,416	£276,487	£272,072
	Grassland creation	£1,727	£6,409	£4,681
	TOTAL	£1,491,437	£1,986,679	£495,242

* Refer to Task 2 Outputs

Appendix D. Recreation

Table 3-6 – Recreation detailed monetary benefits

Action ID	Action name	Monetary (30-year £PV)		
		Baseline	Scenario	Change
08CW100007	NA	NA	NA	NA
08CW100012	Wetland creation	NA*	NA*	£1,285,809
	Riparian tree-planting	NA*	NA*	£2,059
	Riparian buffer	NA*	NA*	£1,751
	Riparian tree management	NA*	NA*	£389
	TOTAL	NA*	NA*	£1,290,009
08SS100005	Woodland management	£6,428	£6,428	£0
	Grassland management	£16,793	£49,196	£32,404
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£4,261	£63,898	£59,638
	Riparian management - woodland	£2,611	£3,649	£1,038
	Grassland creation	£0	£0	£0
	TOTAL	£30,092	£123,172	£93,080

* Refer to Task 2 Outputs

Recreation has only been assessed for 08SS100005 at four sites which are known to have public access, namely Blithfield, Chelmarsh, Hayley Green and Sedgley Beacon.

Appendix E. Air pollutant removal

Table 3-7 – Air pollutant removal detailed monetary benefits

Action ID	Action name	Monetary (30-year £PV)		
		Baseline	Scenario	Change
08CW100007	Woodland management	£116,493	£116,493	£0
	Grassland management - non-chalk sites	£25,852	£34,648	£8,797
	Grassland management - chalk sites	£637	£637	£0
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£989	£996	£7
	Riparian management - woodland	£606	£12,148	£11,542
	Grassland creation	£1,306	£1,750	£444
	TOTAL	£145,883	£166,673	£20,790
08CW100012	Wetland creation	NA*	NA*	£102
	Riparian tree-planting	NA*	NA*	£14,227
	Riparian buffer	NA*	NA*	£332
	Riparian tree management	NA*	NA*	-£2,452
	TOTAL	NA*	NA*	£12,209
08SS100005	Woodland management	£168,692	£168,692	£0
	Grassland management	£31,447	£42,147	£10,700
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£2,722	£2,741	£19
	Riparian management - woodland	£1,667	£33,439	£31,772
	Grassland creation	£652	£874	£222
	TOTAL	£205,180	£247,893	£42,713

* Refer to Task 2 Outputs

Appendix F. Natural hazard regulation - flood

Table 3-8 – Natural Hazard Regulation – Flood – Detailed Monetary Benefits

Action ID	Action name	Wetland area created (ha)	Replacement cost equivalent (£ / yr)	30-year £PV
08CW100007	Woodland management	£53,984	£53,984	£0
	Grassland management - non-chalk sites	£0	£0	£0
	Grassland management - chalk sites	£0	£0	£0
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£0	£38,124	£38,124
	Riparian management - woodland	£0	£5,629	£5,629
	Grassland creation	£0	£0	£0
	TOTAL	£53,984	£97,738	£43,754
08CW100012	Wetland creation	NA*	NA*	£869,707
	Riparian tree-planting	NA*	NA*	£5,468
	Riparian buffer	NA*	NA*	£3,573
	Riparian tree management	NA*	NA*	-£1,919
	TOTAL	NA*	NA*	£876,828
08SS100005	Woodland management	£78,173	£78,173	£0
	Grassland management	£0	£0	£0
	Hedgerow management	£0	£0	£0
	Riparian management - wetland	£0	£104,861	£104,861
	Riparian management - woodland	£0	£15,496	£15,496
	Grassland creation	£0	£0	£0
	TOTAL	£78,173	£198,530	£120,357

* Refer to Task 2 Outputs

Appendix G. Avoided air pollution– ammonia (FARMSCOPER)

Table 3-9 - Air Pollutant - Ammonia, detailed quantitative and monetary results

Action ID	Action name	Monetary change
		30-year £PV
08CW100007	NA	NA
08CW100012	Wetland creation	NA
	Riparian tree-planting	£3,725
	Riparian buffer	£4,868
	Riparian tree management	-£653
	TOTAL	£7,940
08SS100005	NA	NA

Appendix H. Avoided water pollution combined - nitrate, phosphorus, sediment (FARMSCOPER)

Table 3-10 – Water pollutant- Phosphorus, detailed quantitative and monetary results

Action ID	Action name	Monetary change
		30-year £PV
08CW100007	NA	NA
08CW100012	Wetland creation	NA
	Riparian tree-planting	£19,478
	Riparian buffer	£25,453
	Riparian tree management	-£3,418
	TOTAL	£41,513
08SS100005	NA	NA

Appendix I. Avoided GHG emissions (FARMSCOPER)

Table 3-11 - Carbon emissions, detailed quantitative and monetary results

Action ID	Action name	Monetary change
		30-year £PV
08CW100007	NA	NA
08CW100012	Wetland creation	NA
	Riparian tree-planting	£93,516
	Riparian buffer	£122,208
	Riparian tree management	-£16,409
	TOTAL	£199,315
08SS100005	NA	NA

Appendix J. Water purification by habitat

Table 3-12 - Water purification by habitat detailed monetary benefits

Action ID	Action name	Wetland area created (ha)	30-year £PV
08CW100012	Wetland creation	93.62	£624,585

Appendix K. FARMSCOPER methods and assumptions

As stated in Task 2, pollutant losses, from the fields, for nitrate, phosphorus and sediment are taken from FARMSCOPER. Damage costs per kilogram of phosphorous were derived from DEFRA (2006) as used in FARMSCOPER. The FARMSCOPER tool also predicts NH3 emission figures associated with fertilizer use and livestock waste for a representative farm. Damage costs per kilogram of pollutant derived from UK government guidance on air quality damage costs (Defra 2021). Additionally, FARMSCOPER predicts the N2O, CH4 and CO2 emissions values. All greenhouse gas sequestration and emissions were monetised using the UK Government’s latest figures for valuation of greenhouse gas emissions (BEIS, 2021).

Catchments are representative of a ‘Mixed combinable’ farm type. All farms are assumed to be within NVZs. The rainfall is less than 600mm per year, according to the [met office annual averages](#). Within the ‘Cam Rhee and Granta’ Management catchment 64% of the farms are Free Draining, 18% of farms are Drained Arable and 18% are Drained for Arable and Grassland (FS Upscale). FARMSCOPER scenarios are run for each of these scenarios, the final results are weighted accordingly. FARMSCOPER (FS) methods were then applied to the baseline for each of the WINEP methods. Table 3-13 below details the FARMSCOPER methods and key assumptions used for the analysis. Monetisation of the FS outputs is done through damage costs.

Table 3-13 - FARMSCOPER methods and key assumptions per measure from Task 2

Methodology	FARMSCOPER (FS) method and assumptions
Floodplain wetland habitat	NA
Riparian tree-planting	Establish riparian buffer strips (with priors)
Riparian buffer	Establish riparian buffer strips (with priors)
Riparian tree management	30% of the tree planting benefits to be added as losses to the baseline, to represent coppicing

FARMSCOPER provides changes at farm level for representative or bespoke farms created by the user and changes in pollutant loading are calculated by applying the specified mitigation methods (e.g., cover crops), or by changing input parameters to represent land use or management change (e.g., arable reversion). The impacts of measures therefore vary depending on the farm types created. Many farm types can be represented in a catchment so the impact will represent the number and type of farms that take up the measure. Rather than running multiple assessments of the same measure across multiple farms based on estimate farm-level uptake, we instead calculated unit area impacts for the measure per ha of land to which the measure could be applied, using a pro-rata effect for the dominant farm types in the catchment (>10% representation) where the farm type information was sourced from the June Agricultural Survey 2019 data for relevant WFD Operational Catchments that accompanies the FARMSCOPER tool. In some cases, scaling farm level impacts to unit area impacts was challenging as area information is not explicit in how the environmental impact is calculated (hedgerows, buffer strips). We have assumed in these cases that the area is the same as the area provided in the FARMSCOPER Cost tool which is used to inform cost-effectiveness calculations. However, this may potentially over-estimate the unit area impact. Again, caution should be applied to those values.

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South Staffordshire Water and Cambridge Water WINEP Options Assessment

Assessment of Wider Environmental Benefits for
licence capping to prevent further deterioration and
sustainability reductions

South Staffordshire Water and Cambridge Water

June 2023



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Document history

Document title: Assessment of Wider Environmental Benefits for licence capping to prevent further deterioration and sustainability reductions

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Benefits Assessment for client comment	A Slattery	M-C Jalaguier	M Image	A Bulcock	05/05/23
2.0	Final issue – no changes required from client	A Slattery	M-C Jalaguier	M Image	A Bulcock	14/06/23

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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits for selected South Staffordshire Water and Cambridge Water options. This document details the method and results of three options assessments for South Staffordshire Water's (SSW) and Cambridge Water's (CAM) Water Resources WINEP for PR24. The approach used was developed with reference to the EA's WINEP Options Development Guidance document (v3 – July 2022)¹ and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

The three options assessments and relating water company include:

- Licence capping to prevent further deterioration – SSW (WFDGW_ND SSW)
- Licence capping to prevent further deterioration – CAM (WFDGW_ND CAM)
- Sustainability reduction – CAM (WFD_ND_WRFlow CAM)

The two licence capping options have core obligations for WFD groundwater (GW) status and the sustainably reduction option has a core obligation for WFD (surface water (SW)) status. All three options are actions (to prevent deterioration) (ND).

¹ [Water industry national environment programme \(WINEP\) methodology - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/108111/water-industry-national-environment-programme-winep-methodology.pdf)

2. Method

2.1. Options

Table 2-1 provides information for the action and driver. The headings below the table outline the actions in more detail. Because only the preferred option is assessed for each action, from here onwards the terms ‘action’ and ‘option’ are used interchangeably.

Table 2-1 – Option information

Water company:	WINEP action ID:	Action name:	Action description	Primary driver:	Primary driver description:
SSW	08SS100002	Various subcomponent s a-x within various GW bodies	Licence Capping to prevent deterioration	WFDGW_ND ²	GW no deterioration measures relating to water resource or water quality
CAM	08CW100002	Various subcomponent s a-x within various GW bodies	Licence Capping to prevent deterioration	WFDGW_ND	GW no deterioration measures relating to water resource or water quality
CAM	08CW100001	Various subcomponent s a-ae located at specific sites on Cam, Rhee etc.	Sustainability reductions	WFD_ND_WRFlow ³	Action to prevent deterioration of ecological status from flow pressures (SW)

2.1.1. WFDGW_ND SSW

SSW found the groundwater balance test failing under any growth scenario. The Environment Agency only accepted the licence capping option as the ND methodology operates a “one out all out” approach, hence no other option was acceptable.

The licence capping option will constrain increases in abstraction and thereby prevent deterioration under WFD of the waterbodies in which the company operates. The capping is feasible as the licence conditions will remain that allow the company to meet peak demand event whilst constraining growth.

Investigations and subsequent reporting undertaken are included in following reports:

- South Staffordshire Water AMP7 No Deterioration Programme: Tame Anker Mease Birmingham-Lichfield Groundwater Body Assessment
- South Staffordshire Water AMP7 No Deterioration Programme: Tame Anker Mease Burton groundwater Body Assessment
- South Staffordshire Water AMP7 No Deterioration Programme: Worcestershire Middle Severn Sandstone Groundwater Body Assessment
- South Staffordshire Water AMP7 No Deterioration Programme: Staffordshire Trent Valley Sandstone Groundwater Body Assessment
- ND_INV Conclusions and Recommendations Summary report SSW WINEP3 No Deterioration Investigation Programme

² Driver code applicable to contaminated land remediation, however, not explicitly outlined in the WFDGW_ND SSW and WFDGW_ND CAM OARs.

³ WRFlow action code corresponds to water resource flow.

The licence capping locations include the following GW waterbodies: GB40401G301000, GB109054044570, GB109054044710, GB40401G300500, GB40401G301000, GB40401G301000, GB40401G301000, GB40401G300500, GB40401G301000, GB40401G301000, GB40401G301000, GB40401G301000, GB40401G301000, GB40401G301000, GB40401G301200, GB40401G301600, GB40401G301600, GB40401G301600, GB40401G300500, GB40401G300500, GB40401G300500, GB40901G300800, GB40901G300800, GB40901G300800, and GB109054044750.

No abstraction reduction volumes (Ml/d) and no cost data were provided to support this options assessment.

2.1.2. WFDGW_ND CAM

The CAM historic licences exceed deployable output required, impact on the environment and risk of deterioration of WFD targets. The Environment Agency require capping changes to historic recent actual baseline with the aim to improve WFD status, protect sensitive areas, prevent deterioration and/or implement objectives for groundwater (GW) quantity, quality and/or land contamination.

The licence capping locations include the following GW waterbodies: GB40501G400500, GB40501G402200, and GB40501G445700.

No abstraction reduction volumes (Ml/d) and no cost data were provided to support this options assessment.

2.1.3. WFD_ND_WRFlow CAM

The option aims to prevent deterioration from the current WFD status within a catchment⁴ by implementing licence capping as per the Environment Agency guidance.

The sustainability reduction locations include the following waterbodies: GB105033037590, GB105033037610, GB105033037820, GB105033038030, GB105033038060, GB105033038080, GB105033038120, GB105033042690, GB105033043070, GB105033043090, GB105033043100, and GB105033043190.

The reduction volumes were provided for all sites, however, no cost data were provided to support this options assessment.

2.2. Screening / qualitative assessment against WINEP metrics / other metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience, and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flood
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

The initial qualitative assessment of the WFDGW_ND SSW, WFDGW_ND CAM and WFD_ND_WRFlow CAM options are shown in Table 2-2, Table 2-3 and Table 2-4, respectively. The tables show a value of -3 to +3 has been assigned to each ecosystem service, where a value of 0 indicates no effect, (+/-) 1 indicates a low or negligible effect, (+/-) 2 a moderate effect, (+/-) 3 a high effect (positive or negative).

Table 2-2 - Qualitative assessment of the WFDGW_ND SSW option

⁴ Assumed the Cam and Ely Ouse Management Catchment based on waterbody locations.

Ecosystem Service	Score	Justification for score
Biodiversity	0	No available data to assess the effect on biodiversity. The option is focused on GW waterbodies, hence is unlikely to affect biodiversity.
Water purification by habitat	0	This metric relates to wetland habitat extent which is not relevant to this option.
Water quality (benefits)	0 *	No available data to assess the effect on water quality. The option may prevent further deterioration in water quality.
Water supply	0 *	No available data to assess the effect on water supply. The option may prevent further deterioration in water supply.
Climate regulation (sequestration/emissions)	0	No available data to assess the effect on climate regulation.
Recreation – including angling	0	The option specified will not create recreational opportunities.
Food - shellfish	0	This metric focussed on coastal habitat which is not relevant to this option.
Air Quality – pollution removal	0	No effect on air quality.
Hazard Regulation – flood	0	No available data to assess the effect on hazard regulation.
Volunteering	0	The option specified will not create volunteering opportunities.
Education	0	The option specified will not create education opportunities.

* The impact on water quality has been marked at 0 because it is not possible to assess. There is potential for benefit but would require more data to enable expert judgement assessment. Although the option has the potential to increase water supply the benefit is set at zero because the additional water by definition would not be available for abstraction.

Table 2-3 - Qualitative assessment of the WFDGW_ND CAM option

Ecosystem Service	Score	Justification for score
Biodiversity	0	No available data to assess the effect on biodiversity. The option is focused on GW waterbodies, hence is unlikely to affect biodiversity.
Water purification by habitat	0	This metric relates to wetland habitat extent which is not relevant to this option.
Water quality (benefits)	0 *	No available data to assess the effect on water quality. The option may prevent further deterioration in water quality.
Water supply	0	No available data to assess the effect on water supply. The option may prevent further deterioration in water supply.
Climate regulation (sequestration/emissions)	0	No available data to assess the effect on climate regulation.
Recreation – including angling	0	The option specified will not create recreational opportunities.
Food - shellfish	0	This metric focussed on coastal habitat which is not relevant in this option.
Air Quality – pollution removal	0	No effect on air quality.
Hazard Regulation – flood	0	No available data to assess the effect on hazard regulation.
Volunteering	0	The option specified will not create volunteering opportunities.
Education	0	The option specified will not create education opportunities.

* The impact on water quality has been marked at 0 because it is not possible to assess. There is potential for benefit but would require more data to enable expert judgement assessment. Although the option has the potential to increase water supply the benefit is set at zero because the additional water by definition would not be available for abstraction.

Table 2-4 - Qualitative assessment of the WFD_ND_WRFflow option

Ecosystem Service	Score	Justification for score
Biodiversity	0 *	No available data to assess the effect on biodiversity. The option may prevent further deterioration in ecological status of the water bodies.
Water purification by habitat	0	This metric relates to wetland habitat extent which is not relevant to this option.
Water quality (benefits)	0 *	No available data to assess the effect on water quality.
Water supply	0	No available data to assess the effect on water supply. The option may prevent further deterioration in water supply.
Climate regulation (sequestration/emissions)	0	No available data to assess the effect on climate regulation.
Recreation – including angling	0	The option specified will not create recreational opportunities.
Food - shellfish	0	This metric focussed on coastal habitat which is not relevant in this option.
Air Quality – pollution removal	0	No effect on air quality.
Hazard Regulation – flood	0	No available data to assess the effect on hazard regulation.
Volunteering	0	The option specified will not create volunteering opportunities.
Education	0	The option specified will not create education opportunities.

* The impact on water quality and biodiversity have been marked at 0 because they are not possible to assess. There is potential for benefit but would require more data to enable expert judgement assessment. Although the option has the potential to increase water supply the benefit is set at zero because the additional water by definition would not be available for abstraction.

This high-level assessment has scoped out all benefit categories for quantitative assessment. This partly reflects that the relationships between options and benefit categories are either non-causal or too granular to be measured. In some cases, the possibility for a relationship is determined, but the data available is not suitable to be able to quantify the benefit.

2.3. Quantitative assessment

As no wider benefits were scoped in during the Stage 1 qualitative assessment (no options scored +2 or higher, or -2 and lower), no quantitative assessment was undertaken for any option and therefore the methodology is not provided.

3. Results

A summary of the assessment results for three options are presented in Table 3-1.

All three options involve abstraction volume reductions either from GW or SW. Despite the focus on water quality and water supply, the qualitative assessment highlights no impacts or benefits from all three options due to the action to prevent deterioration.

A lack of information and baseline data for abstraction reduction volumes (M/d) and input water quality data resulted in no quantitative assessment being undertaken. Furthermore, a lack of cost data resulted in no cost-benefit analysis being undertaken for all options.

No wider environmental benefits, as described under WINEP, were scoped in for quantitative assessment due to the nature of the options, which is consistent with the high-level screening presented in the methodology.

Table 3-1 – Options results summary

Unique identification (UID) number	Unique identification name for the bundle of measures	Description of measures	Benefit (£)	Whole life cost (£)	Net present value (NPV) (£)
WFDGW_ND SSW	Licence Capping to prevent deterioration	<ul style="list-style-type: none"> Constrain the increases in abstraction and thereby prevent deterioration under WFD GW waterbodies 	No wider benefits scoped in due to nature of option	TBD	TBD
WFDGW_ND CAM	Licence Capping to prevent deterioration	<ul style="list-style-type: none"> Constrain the increases in abstraction and thereby prevent deterioration under WFD GW waterbodies 	No wider benefits scoped in due to nature of option	TBD	TBD
WFD_ND_WRFlow CAM	Sustainability reductions	<ul style="list-style-type: none"> Apply licence capping at specific sites to prevent deterioration of ecological status from SW flow pressures 	No wider benefits scoped in due to nature of option	TBD	TBD

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South Staffordshire Water WINEP Options Assessment

Assessment of Wider Environmental Benefits for
the installation of Eel Screen at Chelmarsh
Reservoir

South Staffordshire Water

June 2023



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Document history

Document title: Assessment of Wider Environmental Benefits for the installation of Eel Screen at Chelmarsh Reservoir

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Eel Screen Benefits Assessment for client comment	A Slattery	J Berrill	M Image	A Bulcock	05/05/23
2.0	Final issue – no changes required from client	A Slattery	J Berrill	M Image	A Bulcock	14/06/23

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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits, and subsequent benefit-cost ratios for selected South Staffordshire Water options. This document details the method and results of the Chelmarsh Eel Screens (EE_IMP) Options Assessment for South Staffordshire Water's (SSW) Water Resources WINEP for PR24. The approach used was developed with reference to the EA's WINEP Options Development Guidance document (v3 – July 2022) and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

The presence of European Eels (*Anguilla Anguilla*) in Chelmarsh Reservoir has been confirmed¹ and, as such, SSW have an obligations under The Eels Regulations (England and Wales), 2009 to upgrade the current screens at the Hampton Loade Water Treatment Works (WTW) intake to ensure they meet best practice and thus omit eels.

¹ Chelmarsh Reservoir Eel Surveys (January 2023) APEM.

2. Method

2.1. Options

There is one EE_IMP WINEP Option proposed by SSW. The action ID and driver code (brackets) for this option is shown below:

- 08SS100001 (EE_IMP) – Installation of Eel Screen at Chelmarsh Reservoir

The option driver is for the scheme to improve diversion structures to prevent the entrainment of eel (for example screening intakes) and to address barriers to the passage of eels within the adjacent waterbody (R. Severn), for example building and maintaining eel screens.

2.2. Screening / qualitative assessment against WINEP metrics / other metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience, and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flood
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

The initial expectation on options within the EE_IMP drivers are shown in Table 2-1 below. Through a qualitative assessment and screening, it is deemed it unlikely for there to be wider benefits achieved through the EE_IMP option.

A value of -3 to +3 has been assigned to each ecosystem service, where a value of 0 indicates no effect, 1 indicates a low or negligible effect, 2 a moderate effect, 3 a high effect (positive or negative), a summary of which is shown in Table 2-1.

Table 2-1 - Qualitative Assessment of Water Resource Options

Ecosystem Service	08SS100001 (EE_IMP)	Justification for score
Biodiversity	+1	Screens reduce the number of eels entrained, but it is challenging to capture the actual condition improvement as measured by the Biodiversity Metric 3.1. Tool ² . Each option will be considered individually to see if specific circumstances allow for eel screens to make any significant difference to biodiversity.
Water purification by habitat	0	Benefit relates to wetland habitat extent which will not be affected by eel screens.
Water quality (benefits)	0	It is unlikely that eel screens alone will be sufficient to affect WFD status (WINEP approach uses NWEBS which is predicated on WFD status change).
Water supply	0	No effect on water supply.
Climate regulation (sequestration/emissions)	0	No effect on climate regulation.
Recreation – including angling	0	Eels are not fished and hence not assessed as part of recreation (angling).
Food - shellfish	0	Metric focussed on coastal habitat which is not relevant in this scheme.
Air Quality – pollution removal	0	No effect on air quality.
Hazard Regulation – flood	0	No effect on hazard regulation.
Volunteering	0	Option specified will not create volunteering opportunities.
Education	+1	Option specified will create education opportunities through an eel employee awareness programme, but the benefits cannot be quantified as the absolute number of people educated is not known. Additionally, the WINEP metric cannot quantify this benefit as the metric uses the number of educational visits by school children to nature reserves which is not applicable to this option. Therefore, a small benefit has been assumed.

This high-level assessment has scoped out all benefit categories for quantitative assessment. This partly reflects that the relationships between options and benefit categories are either non-causal or too granular to be measured. In some cases, the possibility for a relationship is determined, but the data available is not suitable to be able to quantify the benefit.

2.3. Quantitative assessment

As no wider benefits were scoped in during the Stage 1 qualitative assessment (no options scored +2 or higher, or -2 and lower), no quantitative assessment was undertaken and therefore the methodology is not provided.

² [Biodiversity metric: calculate the biodiversity net gain of a project or development - GOV.UK \(www.gov.uk\)](https://www.gov.uk/guidance/biodiversity-metric)

3. Results

A summary of the assessment results for Option 08SS100001 (EE_IMP) are presented in Table 3-1.

The option involves installing eel screens at Chelmarsh Reservoir. Additionally, the company intends on implementing an annual trap/release programme for mature eels from Chelmarsh Reservoir. No wider environmental benefits, as described under WINEP, were scoped in due to the nature of this option, which is consistent with the high-level screening presented in the methodology.

A particular focus was given to the biodiversity ecosystem service; however, there is a lack of information and baseline data and therefore, pre- and post-option BNG conditions cannot be established. Education benefits may be present, however, there is a lack of available information on the number of people educated and the WINEP metric cannot be used to quantify this.

Table 3-1 – Options results summary

Unique identification (UID) number	Unique identification name for the bundle of measures	Description of measures	Benefit (£)	Whole life cost (£)	Net present value (NPV) (£)
EE_IMP	Installation of Eel Screen at Chelmarsh Reservoir	<ul style="list-style-type: none"> • Eels screen at Chelmarsh Reservoir intake • Annual trap/release programme for mature eels 	No wider benefits scoped in due to nature of option.	TBD	TBD

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South Staffordshire Water WINEP Options Assessment

Assessment of Wider Environmental Benefits and
calculation of Benefit-Cost Ratios for selected
INNS options

South Staffordshire Water

June 2023



Notice

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1.0	INNS Benefits Assessment for client comment	MC Jalaguier	B Holdridge	M Image	A Bulcock	31/03/23
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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits, and subsequent benefit-cost ratios for selected South Staffordshire Water options. This document details the method and results of the Invasive Non-Native Species (INNS) Options Assessment for South Staffordshire Water's (SSW) Water Resources WINEP for PR24. The approach used was developed with reference to the EA's WINEP Options development guidance document (v3 – July 2022) and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

2. Method

2.1. Options

There is one INNS WINEP Option proposed by SSW. The action ID and driver code (brackets) for this option is shown below:

- 08SS100003 (INNS_IMP) – Programme of monitoring and management at sites with INNS and a company awareness programme.

2.2. Screening / qualitative assessment against WINEP metrics / other metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flood
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

Our initial expectation on options within the INNS drivers are shown in Table 2-1 below. Through a qualitative assessment and screening, we deemed it unlikely for there to be wider benefits achieved through the INNS options.

We assigned a value of -3 to +3 where a value of 0 indicates no effect, 1 indicates a low or negligible effect, 2 a moderate effect, 3 a high effect (positive or negative), a summary of which is shown in Table 2-1.

Table 2-1 - Qualitative Assessment of Water Resource Options

Ecosystem Service	08SS100003 (INNS_IMP)	Justification for score
Biodiversity	+1	Removal/control of INNS improves biodiversity by removing pressure on native species, but it is challenging to capture the actual condition improvement as measured by the Biodiversity Metric 3.1. Option by option consideration will be considered to see if specific circumstances allow for INNS removal to make any significant difference to biodiversity.
Water purification by habitat	0	Benefit relates to wetland habitat quantity which will not be affected by INNS removal. Metric does not capture quality changes.
Water quality (benefits)	+1	Removal/control of INNS may improve aquatic habitats by removing pressure on native species and resulting bankside vegetation composition may indirectly improve water quality. However, unlikely that INNS removal/control alone will be sufficient to affect WFD status (WINEP approach uses NWEBS which is predicated on WFD status change).
Water supply	0	No effect on water supply.
Climate regulation (sequestration/emissions)	0	WINEP metric, Farmscoper and ENCA datasets do not distinguish habitats with or without INNS.
Recreation – including angling	0	ORVal tool is based on land use change and does not capture impacts of individual species removal.
Food - shellfish	0	Metric focussed on coastal habitat which is not relevant in this scheme.
Air Quality – pollution removal	0	Metric focussed on broad habitat types and is not specific enough to capture individual species removal.
Hazard Regulation – flood	0	Metric focussed on wetland habitat quantity which will not be affected by INNS removal. Metric does not capture quality changes.
Volunteering	0	Option specified will not create volunteering opportunities.
Education	+1	Option specified will create education opportunities through the company awareness programme, but the benefits cannot be quantified as the absolute number of people educated is not known. Additionally, the WINEP metric cannot quantify this benefit as the metric uses the number of educational visits by school children to nature reserves which is not applicable to this option. We have assumed a small benefit.

Our high-level assessment has scoped out all benefit categories for quantitative assessment. This partly reflects that the relationships between options and benefit categories are either non-causal or too granular to be measured. In some cases, we have determined the possibility for a relationship, but we lack the data needed to quantify the benefit.

2.3. Quantitative assessment

As no wider benefits were scoped in during stage 1 (no options scored +2 or higher, or -2 and lower), no quantitative assessment was undertaken and therefore the methodology is not provided.

2.4. Cost/benefit analysis

2.4.1. Benefits

As no wider benefits were scoped in during stage 1 (no options scored +2 or higher, or -2 and lower), no monetary evaluation of the options was undertaken and therefore the methodology is not provided.

2.4.2. Costs

To be included at a later date if costing is to be reported. If not, this report will act as a standalone benefits assessment for the option.

2.4.3. Benefit – cost ratios and options assessment reporting

To be included at a later date if costing (and the subsequent calculation of benefit-cost ratios) is to be reported. If not, this report will act as a standalone benefits assessment for the option.

3. Results

A summary of the assessment results for Option 08SS100003 are presented in Table 3-1.

The option involves monitoring and managing INNS within SSW sites. Additionally, the company intends on implementing a company awareness programme to educate employees on INNS and their control/removal. No wider benefits were scoped in due to the nature of this option, which is consistent with the high-level screening presented in the methodology.

A particular focus was given to the biodiversity ecosystem service; however, there is a lack of information and baseline data and therefore, post-option BNG conditions cannot be established. Table 3-2 shows the SSW sites with INNS identified, however, there is no information on the extent of INNS present in the sites. Education benefits may be present due to the provision of educational sessions within the water company, however, there is a lack of available information on the number of people educated and the WINEP metric cannot be used to quantify this.

Table 3-1 – Options results summary

Unique identification (UID) number	Unique identification name for the bundle of measures	Description of measures	Benefit (£)	Whole life cost (£)	Net present value (NPV) (£)	Benefit cost ratio (BCR) (£1 cost : £x benefits)
INNS_IMP	INNS monitoring and management	<ul style="list-style-type: none"> INNS monitoring and management Company awareness programme 	No wider benefits scoped in due to nature of option.	TBD	TBD	N/A

Table 3-2 – INNS present within SSW Sites

Site name	<i>Buddleia</i>	<i>G. tinctoria</i>	<i>I. glandulifera</i>	<i>P. fragans</i>	<i>P. Laurocerasus</i>	<i>Rhododendron spp</i>
Brindley Bank			✓			
Blithfield					✓	✓
Crumpwood		✓	✓			
Chelmarsh	✓					
Churchill					✓	
Hinksford	✓		✓			
Hulme Springs		✓	✓			
Kinver			✓		✓	
Pipe Hill			✓			
Shenstone					✓	
Somerford						✓
Slitting Mill			✓	✓		✓

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South Staffordshire Water WINEP Options Assessment

Assessment of Wider Environmental Benefits under
WINEP for WFD IMP WRFlow-Driven Action IDs

South Staffordshire Water

June 2023



Notice

This document and its contents have been prepared and are intended solely as information for South Staffordshire Water and used in relation to the assessment of wider environmental benefits for selected schemes.

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Document history

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Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for Client comment	A Slattery	M Howell	M Image	A Bulcock	05/05/23
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1. Background

The Water Industry National Environment Programme (WINEP) for England is a process jointly developed by the Environment Agency (the EA), Department for Environment, Food and Rural Affairs (DEFRA) and the Water Services Regulation Authority (Ofwat). The WINEP informs water companies of the actions they need to take to meet the obligations and targets set out in the Water Industry Strategic Environmental Requirements (WISER), environmental legislation, and UK Government policy. The UK Government's 25 Year Environmental Plan outlines the Government's ambition to leave the environment in a better state than we found it for the next generation and the Environment Act 2021 sets out the outcomes water companies are expected to meet in the next price review (PR24). Through their WINEP actions, water companies have the opportunity to create sustainable ecosystems and increase environmental value, build resilient communities and support economic growth.

This document is one of the documents provided by Atkins that provide an assessment of the wider environmental benefits of the South Staffordshire Water (SSW) option 08SS100025 (Darnford Brook Ecological Improvements). Note, no costs were provided hence this report could not assess any benefit-cost ratios. The approach used was developed with reference to the EA's WINEP Options Development Guidance document (v3 – July 2022)¹ and WINEP Wider Environmental Outcome Metrics spreadsheet (v2.1 – April 2022).

¹ [Water industry national environment programme \(WINEP\) methodology - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/105222/water-industry-national-environment-programme-winep-methodology.pdf)

2. Method

2.1. Options

The option assessed in this report is associated with the action to improve ecological status (surface water) primary driver (WFD_IMP_WRFflow) (Table 2-1). This report only assesses the preferred option for Action ID 08SS100025, hence from here onwards the terms 'action' and 'option' are used interchangeably.

Table 2-1 - Option description

Action ID	Operational Catchment	Driver Code	Option	Description
08SS100025	Tame from River Anker to River Trent	WFD_IMP_WRFflow	Preferred	Implement environmental measures which will target hydromorphology and water quality pressures identified on Darnford Brook.

2.2. Darnford Brook measures

The scope of Action ID 08SS100025 involves a combination of individual measures applied to Darnford Brook, a sub-catchment within the Tame from River Anker to River Trent WFD surface waterbody. Measures focus on a 4.1 km reach between walkover locations DB-02 (SK 13891 08649) and DB-07 (SK 16963 09600), shown in Figure 2-1. The measures are intended to protect and reduce the hydromorphology and water quality pressures and include:

- Grassland management;
- Riparian buffer creation;
- Changing farming techniques - cover crops;
- Fencing (post and wire, sheep netting and electric fencing);
- Introduce in-channel flow deflectors;
- Coarse sediment re-introduction;
- Riparian tree management;
- Re-profiling of banks;
- Cease dredging;
- Changing farming techniques - spraying schedules;
- Site monitoring;
- Seasonal macroinvertebrate monitoring; and,
- Seasonal spot flow gauging.

Details of each measure's location, reach and length or area have not been fully provided. Therefore, where information was not available, Atkins' specialists undertook GIS mapping from measure details to determine the measure quantities as set out in Table 2-2. For the river measures highlighted in Table 2-2, the cumulative length of measure directly affecting the waterbody exceeds the actual length of the waterbody (4.1 km); Section 2.4.2 outlines how this has been addressed for benefits assessment.

Table 2-2 - Measure quantities (ha and/or km) by waterbody (Action ID 08SS100025)

Measure	Length of measure (km)	Area of measure (ha)	Notes
Grassland management	4.1	22.82	<u>Length of measure:</u> Focus on all riparian grassland fields adjacent to the 4.1 km reach between DB-02 and DB-07 (Figure 2-1). <u>Area of measure:</u> Area mapped in GIS for all riparian grassland fields.

Measure	Length of measure (km)	Area of measure (ha)	Notes
Riparian buffer creation	2.6	2.08	<u>Length of measure:</u> Focus on the length of all riparian arable fields adjacent to the waterbody (total length includes both bank lengths). <u>Area of measure:</u> Assumed 4 m width on each bank (8 m total).
Changing farming techniques - cover crops	4.1	60.96	<u>Length of measure:</u> The 4.1 km reach between DB-02 and DB-07 (Figure 2-1). <u>Area of measure:</u> Area of spring sown ² crops in farms whose land is adjacent to the 4.1 km reach.
Fencing (post and wire, sheep netting and electric fencing)	2.32	0.46	<u>Length of measure:</u> Focus on the length of all riparian grassland fields adjacent to the waterbody. <u>Area of measure:</u> Assumed the measure creates a 2 m grass buffer.
Introduce in-channel flow deflectors*	3.8	N/A	<u>Length of measure:</u> Focus on 3.8 km reach between DB-02 and DB-07, including the 400 m reach between DB-05 and the confluence with Fisher-wick Brook, where straightening and over-widening are most prevalent.
Coarse sediment re-introduction*	2.6	N/A	<u>Length of measure:</u> Focus on 2.6 km reach between DB-03 and DB-07.
Riparian tree management	3.08	N/A	<u>Length of measure:</u> Focus on length of the waterbody where riparian buffer creation is not taking place (see above) (total length includes both bank lengths).
Re-profiling of banks*	1.55	N/A	<u>Length of measure:</u> Focus on 1.2 km reach between DB-02 and DB-03 and the 350 m reach between DB-05 and the confluence with Fisher-wick Brook.
Cease dredging*	0.5	N/A	<u>Length of measure:</u> Focus on 500 m reach adjacent to Darnford Moors Golf Course.
Changing farming techniques - spraying schedules	N/A	N/A	No specific location and no available information for spraying or monitoring schedules.
Site monitoring	N/A	N/A	
Seasonal macroinvertebrate monitoring	N/A	N/A	
Seasonal spot flow gauging	N/A	N/A	

*River measures.

² We have assumed that South Staffs Water will take a more holistic approach to the cover cropping measure, targeting not just riparian fields, but all spring sown crops in farms which have a riparian margin. We have assumed a field side length of 282 m (Farmscoper default assumptions) meaning a total riparian field area of 231.24 ha which covers both sides of the river. According to Agricultural Census data a typical farm in the Tame (Lower) catchment has 41.3% of fields next to watercourses. We have therefore calculated the total eligible farm area as 559.89 ha. Again, according to Agricultural Census data, if we pro-rata the area of spring sown crops (spring barley, maize, peas, potatoes) for the whole catchment to the eligible farm area, this gives a value of 60.96 ha.

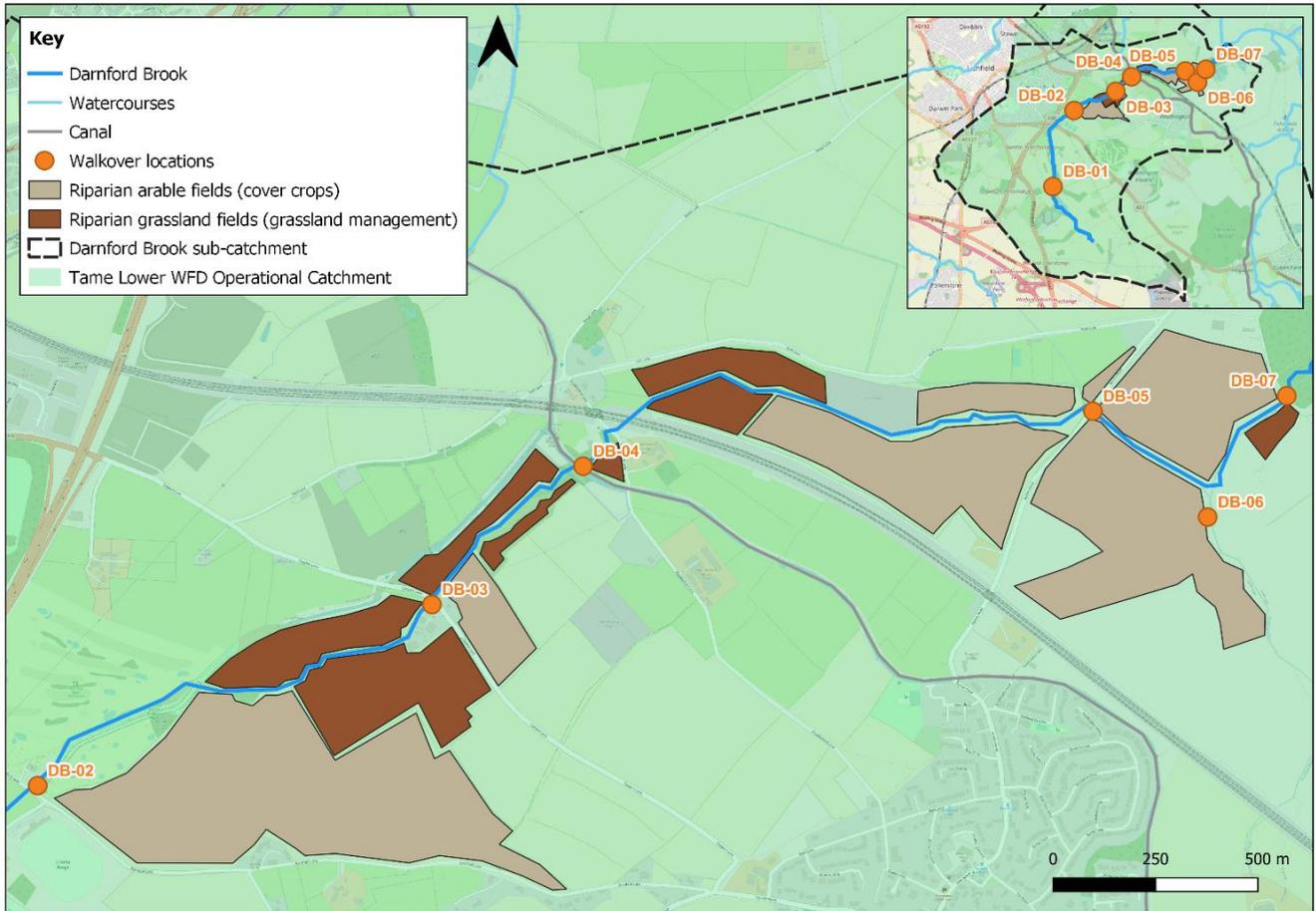


Figure 2-1 - Action ID 08SS100025 location

Atkins' specialists used available information and GIS mapping to generate the baseline and scenario habitat register for each measure. Full details of habitat types and condition are outlined in Table 2-4.

2.3. Screening / qualitative assessment against WINEP metrics / other metrics

2.3.1. WINEP Recommended Metrics

The WINEP guidance recommends that options are assessed against four wider environmental outcomes (Natural Environment, Net Zero, Catchment Resilience and Access, Amenity and Engagement) which incorporate 11 environmental benefit (ecosystem service) categories:

- Biodiversity
- Climate Regulation
- Hazard Regulation – flooding
- Water Quality
- Water Purification
- Water Supply
- Recreation (including angling)
- Food – shellfish
- Air Quality
- Education
- Volunteering

Within the guidance, metrics are provided for each environmental benefit category. Given the current state of information regarding the measures we cannot always measure the environmental benefit category as directed under the recommended metrics. In these cases, we have looked to alternative and supplementary metrics as defined in the WINEP guidance. See Sections **Error! Reference source not found.** for further detail on the use of alternative metrics.

A qualitative assessment was completed for the WINEP option (Table 2-3). A value was assigned from -3 to +3 where a value of 0 indicates no effect, 1 indicates a low or negligible effect, 2 a moderate effect, 3 a high effect (positive or negative). This qualitative assessment is based on professional judgement from the Atkins Natural Capital Specialists.

Measures scoring +2 or higher (or -2 and lower) were taken forward for quantitative assessment, with one case where a measure scoring +1 was also taken forward upon the judgement of the Atkins Natural Capital Specialist. The following ecosystem services were scoped in and assessed as part of the WINEP assessment:

- Biodiversity (Section 2.4.1) – WINEP recommended metric
- Water quality (Section 2.4.2) – WINEP recommended metric and supplementary metric (via FARMSCOPER)
- Air quality (Section 0) – WINEP recommended metric and supplementary metric (via FARMSCOPER)
- Climate regulation (Section 0) – WINEP recommended metric and supplementary metric (via FARMSCOPER)
- Hazard regulation (Section 2.4.5) – WINEP recommended metric
- Recreation (Section 2.4.6) – WINEP recommended metric and alternative method (via ONS)

Table 2-3 - Qualitative assessment of WINEP measures for Action ID 08SS100025

Measure	Biodiversity	Water purification	Water quality	Water supply	Climate regulation	Recreation	Recreation - angling	Food -shellfish	Air Quality	Hazard regulation	Volunteering	Education
Grassland management	+2		+1	+1	+2	+1			+2	+1		
Riparian buffer creation	+2		+1	+1	+2	+2			+2	+2		
Changing farming techniques - cover crops	+1*		+1	+1	+2				+2	+1		
Fencing (post and wire, sheep netting and electric fencing)	+2		+1		+1					+1		
Introduce in-channel flow deflectors	+2		+2	+1	+1		+1			+1		
Coarse sediment re-introduction	+2		+2	+1	+1		+1			+1		
Riparian tree management	+2		+1		+1	+1	+1		+1	+1		
Re-profiling of banks	+2		+2		+1	+1	+1		+1	+1		
Cease dredging	+2		+2		+1		+1			-1		
Changing farming techniques - spraying schedules	<i>Scoped out of the assessment as unlikely to impact WINEP metrics.</i>											
Site monitoring	<i>Scoped out of the assessment as unlikely to impact WINEP metrics.</i>											
Seasonal macroinvertebrate monitoring	<i>Scoped out of the assessment as unlikely to impact WINEP metrics.</i>											
Seasonal spot flow gauging	<i>Scoped out of the assessment as unlikely to impact WINEP metrics.</i>											

*Scoped into the assessment, although the impact is expected to be low or negligible.

2.3.2. Supplementary metrics

As referenced above, we have utilised supplementary metrics to quantify and monetise environmental benefits where the WINEP-recommended metrics have not been suitable. The additional benefits (ecosystem services) we have captured through these metrics are:

- Water quality (externalities and damages reduction)
 - Nitrate
 - Phosphorus
 - Sediment
- Air quality (emissions)
 - Ammonia
- Climate regulation (reduced greenhouse gas (GHG) emissions)
 - Methane
 - Nitrous oxide

- Energy use (carbon dioxide)

This assessment used the FARMSCOPER tool to calculate the additional services above, outlined in Section 0). FARMSCOPER is a Defra funded, peer-reviewed decision support tool, developed by ADAS³.

Justification for the use of the additional metric

Monetisation of these services was undertaken using ENCA-guided approaches, and standard water quality damage costs as quoted in the FARMSCOPER guidance.

³ FARMSCOPER is able to make predictions for reduction in pesticides and faecal indicator organisms (FIO). However, pesticide predictions are only made on a percentage basis so cannot be quantified in meaningful units against which avoided damage or removal costs could be estimated. Information is not available on the monetary value of avoided FIO inputs. We do not report on either of these aspects.

2.4. Quantitative / Monetary Assessment

2.4.1. Biodiversity

Quantification

The Biodiversity Metric 3.1 Calculation Tool⁴ was used to calculate biodiversity units pre- and post-scheme for all the measures. An assessment was undertaken for all the measures and included the baseline and scenario habitats and conditions shown in Table 2-4.

Table 2-4 - Measure baseline and scenario habitat and condition

Measure	Baseline Area (ha)	Baseline Habitat	Baseline Condition	Scenario Area (ha)	Scenario Habitat	Scenario Condition
Grassland management	22.82	Grassland - Modified Grassland, not in strat	Moderate	22.82	Grassland - Neutral Grassland, not in strat	Moderate
Riparian buffer creation	3.28 *	Cropland, Cereal Crops	N/A	4.48 **	Woodland - wet woodland, not in local strat, condition - moderate 50% Cropland - Arable field margins tussocky 50%	Wet woodland – Moderate Arable Field margins - N/A
Changing farming techniques - cover crops	60.96	Cropland, Cereal Crops	N/A	60.96	Temporary grass and clover ley 50% Arable field margins tussocky 50%	N/A
Fencing (post and wire, sheep netting and electric fencing)	3.28 *	Cropland, Cereal Crops	N/A	6.10 **	Cropland - Arable field margins tussocky	N/A
Riparian tree management	3.08 km	Line of Trees - Associated with bank or ditch	Poor	3.08 km	Line of Trees - Associated with bank or ditch	Moderate
River measures	4.1 km	Other rivers and streams	Poor	8.45 km ⁵	Other rivers and streams	Fairly poor

*Baseline (total) riparian area along the 4.1 km reach, assuming 4 m area on each bank.

**Baseline riparian area plus the measure areas.

Valuation

The WINEP guidance does not recommend using a monetary value for biodiversity. Instead, the value is assessed with respect to the % change in units between baseline and scenario (i.e. Biodiversity Net Gain).

⁴ Biodiversity Metric 3.1 Tool [The Biodiversity Metric 3.1 - JP039 \(naturalengland.org.uk\)](https://naturalengland.org.uk)

⁵ Baseline (4.1 km reach) plus the measures: introduce in-channel flow detectors (3.8 km), coarse sediment re-introduction (2.6 km, re-profiling of banks (1.55 km), and cease dredging (0.5 km).

2.4.2. Water quality

This assessment uses the National Water Environment Benefits Survey (NWEBS)⁶ to estimate the water quality – bundled benefits of the measures. NWEBS reports average willingness to pay values for various component indicators representing status changes in water quality per km of rivers at and per km² of GB lakes. The components correspond broadly to WFD ecological status indicators, though are not strictly equivalent. For rivers, the values are specific to individual management catchments.

The measures are within the Tame from River Anker to River Trent waterbody (currently Poor ecological status) located in the Tame Anker and Mease management catchment and Humber river basin district.

Quantification

Table 2-5 outlines the screening of measures against the six water quality indicators, these include:

- Fish – will the measure(s) improve fish populations in the water body?
- Plants – will the measure(s) improve plant populations in the water body?
- Other animals such as invertebrates – will the measure(s) improve the populations of other animals e.g., macro invertebrates in the water body?
- Water clarity – will the measure(s) improve the turbidity and aesthetic appearance of water, i.e., less cloudy?
- The condition of the river channel and flow of water – will the measure(s) return the water body to a more natural state?
- Suitable for recreational contact – will the measure(s) make the water more suitable for water sports recreation, i.e., reduction in pollution causing health problems, such as sewage/faecal indicators and/or chemical quality.

As mentioned in Section 0, the cumulative length of measure (8.45 km) directly affecting the waterbody exceeds the actual length of the waterbody (4.1 km). This means that in some locations more than one measure will be applied. Assessing this effect is challenging as we do not know exactly where and which measures will co-apply. In many cases, applying two or measures to the same site will not have an additive effect. Therefore, we simplify the assessment by proportioning the lengths of measures to the actual waterbody length (4.1 km). This involves an implicit and conservative assumption that the effect of measures is not additive (Table 2-5).

Terrestrial methods were deemed unlikely to have a significant impact on the waterbody to justify an improvement in component status, hence only the river measures are assessed for this service. For these, the assessment of whether measures affect component and how much effect they have is made by expert opinion judgement (Table 2-5, Table 2-6).

Table 2-5 – NWEBS screening and proportioned lengths of measures

Measure	Fish	Plant	Animals and inverts	Water clarity	River channel condition	Recreation	Total length of measure (km)	Proportioned length of measure (km)
Introduce in-channel flow deflectors	X		X	X	X		3.8	1.84
Coarse sediment re-introduction	X	X	X		X		2.6	1.26
Re-profiling of banks	X	X	X	X	X		1.55	0.75
Cease dredging	X	X	X	X	X		0.5	0.24
							8.45	4.1

Table 2-6 – Lengths of measures (km) and proposed Water Framework Directive status changes

⁶ Environment Agency (2013) Updating the National Water Environment Benefit Survey values: summary of the peer review.

		Number of km improved					
Indicator		Fish	Plant	Animals and inverts	Water clarity	River channel condition	Recreation
WFD status change		Poor-Mod	Poor-Mod	Poor- Mod	Poor-Mod	Poor- Mod	Poor- Mod
Measure	Introduce in-channel flow deflectors	1.844	1.844		1.844	1.844	
	Coarse sediment re-introduction	1.26	1.26	1.26		1.26	
	Re-profiling of banks	0.752	0.752	0.752	0.752	0.752	
	Cease dredging	0.243	0.243	0.243	0.243	0.243	

Valuation

As NWEBS values are provided based for each step-change in status (i.e., Moderate to Good), as opposed to a value for each category of status, and does not apply to the baseline and assesses only the value of any net changes in component status under the measures. Table 2-7 outlines the NWEBS values applied to component status changes in the Tame Anker and Mease management catchment.

Table 2-7 – NWEBS values applied to Water Framework Directive river status changes in the Tame Anker and Mease management catchment (2012 prices, central value)

	£k/km/yr, £2012
WFD status change	Poor to Moderate
Sensitivity	Central
Tame Anker and Mease	29.3

The lengths of measures and proposed WFD status change for each of the six indicators are demonstrated in **Error! Reference source not found.** A 75% confidence adjustment was used in line with the B£ST Guidance⁷ to conservatively reflect uncertainty over whether the estimated outcomes would be delivered. We assume that the benefits stack across indicators (i.e. the effect is cumulative), hence the same lengths are applied multiple times to different indicators.

⁷ CIRIA (2019). Guidance to assess the benefits of blue and green infrastructure using B£ST.

2.4.3. Air quality – pollution removal

To estimate the change in air pollution removal rates, the Jones et al. (2017)⁸ values are used. This database is recommended within the WINEP guidance and the values are based on empirical evidence across a range of atmospheric pollutants at broad habitat level.

Quantification

The Jones et al. (2017) database takes area-based values (£/ha) directly for broad habitat types. The area of broad habitat (by type) is therefore a proxy indicator of the quantity of service provision.

Valuation

The Jones et al. (2017) database provides the £/ha values for broad habitat types in 2012 prices for a timeseries from 2015 to 2030. To generate a 30 year monetary benefit the 2030 values have been used as an average for the 30 year assessment period. These values have been uplifted from 2012 prices to 2020/21 prices using the CPIH Index Tool and are shown in Table 2-8. These values are applied to the area of each broad habitat type within the baseline and scenario, to provide a valuation of the air quality pollution removal in the baseline and scenario in Table 2-9.

Table 2-8 – Air quality pollution removal database of values

Land cover	Air Pollution Removal Value (£/ha) 2020 / 2021 prices
Urban woodland	517.37
Rural woodland	148.87
Woodland	161.33
Enclosed farmland	8.04
Urban grassland	90.45
Semi-natural grassland	10.78
Mountain moor & heath	9.61
Urban fresh / saltwater	-11.49
Open water, wetland & floodplain	8.10
Coastal margins	15.38

Table 2-9 - Measure baseline and scenario habitat type mapped to air quality value

Measure	Broad habitat type		Mapping	
	Baseline	Scenario	Baseline	Scenario
Grassland management	Cereal Crops	Neutral Grassland	Enclosed Farmland	Semi-natural Grassland
Riparian buffer creation	Cereal Crops	Wet woodland 50% Arable field margins tussocky 50%	Enclosed Farmland	Semi-natural Grassland
Changing farming techniques – cover crops	Cereal Crops	Temporary grass and clover ley 50% Arable field margins tussocky 50%	Enclosed Farmland	Enclosed Farmland

⁸ [Enabling a Natural Capital Approach \(ENCA\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/enabling-a-natural-capital-approach)

2.4.4. Climate regulation

Quantification

The quantification of this ecosystem service is with respect to annual carbon sequestration rates for eligible habitat types, with reference to lookup tables provided in WINEP guidance⁹, shown in Table 2-10. The mapping of these values to the baseline habitats and measures, is shown in Table 2-11 and Table 2-12.

Table 2-10 - Carbon sequestration values from WINEP guidance (only values used as part of this assessment are reported)

Land cover	Value (tCO ₂ e / ha / year)	Source
Enclosed Farmland	0.107	WINEP recommended
Semi-natural Grassland	0.397	WINEP recommended

Table 2-11 - Mapping of baseline habitats to carbon sequestration values

Baseline habitat	Baseline mapping
Modified Grassland	Enclosed Farmland
Cereal crops	Enclosed Farmland

Table 2-12 - Mapping of measures to carbon sequestration values

Measure	Scenario habitat	Scenario mapping
Grassland management	Neutral Grassland	Semi-natural Grassland
Riparian buffer creation	Wet woodland 50% Arable field margins tussocky 50%	Semi-natural Grassland
Changing farming techniques - cover crops	Temporary grass and clover ley 50% Arable field margins tussocky 50%	Enclosed Farmland

Valuation

Monetary values are based on the BEIS greenhouse gas emission values¹⁰, as recommended in the WINEP guidance. The full timeseries of BEIS carbon values (central value) are used from 2020 to 2050 in order to calculate a 30-year monetary benefit value. Each year is discounted in line with the HMT Greenbook¹¹ and collated for the baseline and scenario to calculate the monetary impact of the measures on carbon sequestration over 30 years.

⁹ Cited in Defra's ENCA ([Enabling a Natural Capital Approach \(ENCA\) - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca)) and used in the Environment Agency's Natural Capital Register and Account Tool (NCRAT).

¹⁰ [Valuation of greenhouse gas emissions: for policy appraisal and evaluation - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation)

¹¹ [Green Book supplementary guidance: discounting - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting)

2.4.5. Natural hazard regulation

In the WINEP guidance, the quantification of this service is described only in terms of the contribution of woodlands and wetlands. Therefore, the impact of this service is quantified for the woodland habitat area included in the measure (note, the measure does not cover wetland habitat).

Quantification

This methodology follows the WINEP guidance, using the value of an additional hectare of flood control and storm buffering by inland wetlands does not produce a quantitative value. The Morris and Camino (2011) method uses area-based values (£/ha) directly for woodland. The area of woodland created is therefore a proxy indicator of the quantity of service provision.

Valuation

The WINEP recommended approach to value this service is a 'replacement cost approach'. The value of an additional hectare of flood control and storm buffering is used as a proxy for the value of the service provided by woodland (WINEP Wider Environmental Outcome Metrics spreadsheet), shown in Table 2-13.

Table 2-13 - Hazard regulation monetary values

Broad habitat	m ³ water stored/yr	Value £/m ³ /yr (2020 prices)	Value (£/ha/yr)	Source
Woodland	274	0.43	117.82	Morris and Camino (2011). UK NEA.

2.4.6. Recreation

The WINEP guidance recommends using the Outdoor Recreation and Valuation (ORVal) tool to assess recreation benefits. The ORVal tool measures visitor numbers and welfare values of parks and paths. In the underlying economic model, habitat types included in the survey influence visit numbers in different ways. So, if habitat types are altered where there is existing recreational access (park, public footpath etc.) or if new recreational sites are created then ORVal will predict the change in visits and value accordingly.

Only Darnford Moors Golf Course (adjacent to the proposed riparian buffer creation measure) is recorded as a park in ORVal, however the tool does not show any welfare value or visitor data for this park. Therefore, an alternative method was used, referencing Office for National Statistics (ONS) 2021¹² data on change in recreational value (visitor spend) associated with change in land cover. Future assessments should consider using ORVal methodologies if the location specific data is available.

Other measures from 08SS100025 which have been scoped out as there is no associated recreational access or because assessing the recreational benefit associated with in-channel measures has methodological challenges¹³.

Quantification

This methodology, using the ONS (2021) data on the visitor spend associated with land cover, does not produce a quantitative value. The ONS (2021) method uses area-based values (£/ha) directly for land cover. The area of land cover (broad habitat type) is therefore a proxy indicator of the quantity of service provision.

Valuation

ONS 2021 values represent mean national recreational values, based on the baseline and scenario broad habitat types and are provided in £/ha values. Table 2-14 shows the mapping from broad habitat type as per the ONS data to baseline and measure land cover categories.

Table 2-14 - Recreation values per hectare used for the baseline and measure (only values used as part of this assessment are reported)

Land cover	Value (£/ha) £2020
Enclosed Farmland	£73
Woodland	£102

¹² [Tourism and outdoor leisure accounts, natural capital, UK: 2021 - ONS](#)

¹³ OrVAL can also predict change in visits associated with a change in water quality at recreational sites or footpaths which are adjacent to aquatic features. However, this is only sensitive to a very large change in water quality (Low to High) and it is not clear in the tool documentation how "Low" and "High" relate to formal measurements of water quality (i.e. WFD status). Moreover, there is potential for double counting as NWEBS is likely to capture some of this value. Therefore we have not applied this aspect of OrVAL to the assessment.

Table 2-15 shows the broad habitat type for the baseline and scenario mapped to recreation values for the measure scoped in for recreation benefits.

Table 2-15 – Measure baseline and scenario habitat type mapped to recreation value

Measure	Broad habitat type		Mapping	
	Baseline	Scenario	Baseline	Scenario
Riparian buffer creation	Cereal Crops	Wet woodland	Enclosed Farmland	Woodlands

2.4.7. Alternative metric – FARMSCOPER

Quantification

FARMSCOPER¹⁴ can be used to quantify and value improvement in water quality in terms of avoided environmental externalities by estimating **nitrate, phosphorus and sediment losses** produced from agricultural land. FARMSCOPER¹ is also able to estimate GHG emissions (**methane, nitrous oxide and energy use (carbon dioxide)**) and air pollutant emissions (**ammonia**) associated with land management activities. FARMSCOPER also provides percentage change in plant protection products and change in faecal indicator organism loads but there are no value transfer functions available for these, so the evaluation has focused on the pollutants mentioned above.

FARMSCOPER provides changes at farm level for representative or bespoke farms created by the user and changes in pollutant loading are calculated by applying the specified mitigation methods (e.g., cover crops), or by changing input parameters to represent land use or management change (e.g., arable reversion).

Quantification of the above metrics was done for the specific measures below following the outlined methods:

- Grassland management – Proxy method where updated input parameters into a new Create file reflect the change from improved to semi-natural (i.e., zero-input) grassland
- Riparian buffer creation – Method 14 (establish riparian buffer strips)
- Changing farming techniques - cover crops - Method 4 (establish cover crops in the autumn)
- Fencing (post and wire, sheep netting and electric fencing) - Method 76 (fence off rivers and streams from livestock)

Only terrestrial measures could be assessed, as the in-channel measures would not be measurable within FARMSCOPER. Proxy methods were used to represent certain measures where no in-built FARMSCOPER methods or established approaches were an exact representation (e.g., grassland management) hence these values should be used with caution.

The impacts of measures, therefore, vary depending on the farm types created. Many farm types can be represented in a catchment so the impact will represent the number and type of farms that take up the measure. This assessment was based on a Mixed Livestock Farm in the Tame Lower catchment following information sourced from the June Agricultural Survey 2019 data for relevant WFD Operational Catchments that accompany the FARMSCOPER tool.

Valuation

Using FARMSCOPER as an additional analysis tool to the WINEP recommended tools provides greater information in relation to **water quality (avoided pollutant loading), climate regulation (avoided GHG emissions)** and **air quality regulation (avoided ammonia emissions)**. Table 2-16 below summarises the monetary values used for each ecosystem service. Appendix J provides more information on the FARMSCOPER methods and assumptions applied.

Table 2-16 - Monetary valuation figures and sources

Ecosystem service	Monetary value (£/ kg removed 2021)	Source
Water Quality - Nitrate	-1.1	FARMSCOPER
Water Quality - Phosphorus	-36.7	FARMSCOPER
Water Quality - Sediment	-0.4	FARMSCOPER
Air Quality - Ammonia	-8.1	GOV UK Air quality appraisal: damage cost guidance ¹⁵
Climate Regulation - Methane	The full timeseries of BEIS carbon values (central value) are used from 2020 to 2050 to calculate a 30 year monetary benefit value.	BEIS ¹⁶
Climate Regulation - Nitrous oxide		BEIS
Climate Regulation - Energy use		BEIS

¹⁴ <https://adas.co.uk/services/farmscoper/>

¹⁵ GOV UK Air quality appraisal: damage cost guidance <https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance>

¹⁶ BEIS (2021) <https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation>

3. Results

A summary of the assessment results for the measures assessed are presented in Table 3-1.

A summary of the additional WINEP metric total changes in monetary value per option are presented in Table 3-2.

Detailed results tables which include the baseline and scenario values for each ecosystem service are provided in the following appendices:

- Biodiversity - 0 - Table 3-3
- Water quality - Appendix B - Table 3-4
- Air quality - pollutant removal - Appendix C - Table 3-5
- Climate regulation - Appendix D - Table 3-6
- Natural hazard regulation - Appendix E - Table 3-7.
- Recreation - Appendix F - Table 3-8

Results for the additional metrics are in the following appendices:

- Air quality (pollution reduction) – Ammonia - Appendix G - Table 3-9.
- Water quality (pollution reduction) - Appendix H - Table 3-10.
- Climate regulation (carbon and GHG emissions reduction) - Appendix I - Table 3-11.

Analysis and interpretation of results

The ecosystem service benefits of the measures under Action ID 08SS100025 include providing 388 habitat units, 9 hedgerow units, 67 river units and a £1,380,249 total 30-year PV change in ecosystem service value (Table 3-1). The largest driver for the monetary change is water quality with £1,330,410 30-year PV which reflects the largest BNG unit increase being the river units (168%). Both water quality value and the river units stem from the river measures (including introducing in-channel flow deflectors, coarse sediment re-introduction, re-profiling of banks, and ceasing dredging).

Notably, the other ecosystem services (air quality, climate regulation, and natural hazard regulation) present large benefits associated with the terrestrial measures, including grassland management, riparian buffer creation, changing farming techniques – cover crops, fencing, and riparian tree management (Table 3-1).

Table 3-2 highlights a £1,932,183 total 30-year PV change from the supplementary metric benefits of the measures, with the greatest benefit being GHG emissions (nitrous oxide, energy use (carbon dioxide), and methane) reductions (£1,232,418 total 30-year PV change).

Table 3-1 – Total change in ecosystem services as a result of Action ID 08SS100025

Biodiversity						Change in monetary value (30yr £PV)					TOTAL
BNG units Habitat	% change from baseline	BNG units Hedgerow	% change from baseline	BNG units River	% change from baseline	Water Quality	Air Quality	Climate Regulation	Natural Hazard Regulation	Recreation (Alt.)	
388	54	9	50	67	168	1,330,410	2,045	43,129	4,665	0	1,380,249

Table 3-2 – Supplementary WINEP metric total change in monetary value for Action ID 08SS100025

Change in monetary value (30yr £PV)			
Water Quality (Pollutants)	Air Quality (Pollutants)	Climate Regulation (GHG Emissions)	TOTAL
632,927	66,838	1,232,418	1,932,183

Appendices

Appendix A. Biodiversity

Table 3-3 - Biodiversity net gain (BNG) units for pre- and post- measures

Measure	Habitat Units			Hedgerow Units			River Units		
	Baseline	Scenario	Change	Baseline	Scenario	Change	Baseline	Scenario	Change
Grassland management	91.28	155.20	70.0%						
Riparian buffer creation	6.56	11.39	73.6%						
Changing farming techniques - cover crops	147.68	213.77	44.8%						
Fencing (post and wire, sheep netting and electric fencing)	6.56	7.42	13.1%						
Riparian tree management				6.16	9.18	49.0%			
River measures*							24.60	66.51	170.4%
TOTAL	252.1	387.8	54%	6.2	9.2	49%	24.6	66.5	170%

*Introduce in-channel flow deflectors, coarse sediment re-introduction, re-profiling of banks, and cease dredging.

Appendix B. Water quality

Table 3-4 – Water quality (NWEBS) detailed monetary results

		Benefits (£/yr)						TOTAL (£ 30-yr PV)
	Indicator	Fish	Plant	Animals and inverts	Water clarity	River channel condition	Recreation	
	WFD status change	Poor- Mod	Poor- Mod	Poor- Mod	Poor- Mod	Poor- Mod	Poor- Mod	
Measure	Introduce in-channel flow deflectors	8,266	8,266	0	8,266	8,266	0	608,187
	Coarse sediment re-introduction	0	5,656	5,656	0	5,656	0	312,096
	Re-profiling of banks	3,372	3,372	3,372	3,372	3,372	0	310,096
	Cease dredging	1,087	1,087	1,087	1,087	1,087	0	100,031
							TOTAL	1,330,410

Appendix C. Air quality - pollutant removal

Table 3-5 – Air pollutant removal detailed monetary results

Measure	Monetary (30 year £PV)		
	Baseline	Scenario	Change
Grassland management	5,507.25	7,381.18	1,874
Riparian buffer creation	501.98	672.78	171
Changing farming techniques - cover crops	14,710.98	14,710.98	0
TOTAL	20,720	22,765	2,045

Appendix D. Climate regulation

Table 3-6 – Climate regulation monetary detailed results

Measure	Monetary (30 year £PV)		
	Baseline	Scenario	Change
Grassland management	14,583.81	54,110.02	39,526
Riparian buffer creation	1,329.29	4,932.03	3,603
Changing farming techniques - cover crops	38,956.35	38,956.35	0
TOTAL	54,869	97,998	43,129

Appendix E. Natural hazard regulation

Table 3-7 – Natural hazard regulation – flood – Detailed monetary results

Measure	Monetary (30 year £PV)		
	Baseline	Scenario	Change
Riparian buffer creation	N/A	4,665.01	4,665.00
TOTAL	0	4,665	4,665

Appendix F. Recreation

Table 3-8 – Recreation detailed monetary results

Measure	Monetary (30 year £PV)		
	Baseline	Scenario	Change
Riparian buffer creation	554.15	774.59	220
TOTAL	554	775	220

Appendix G. Avoided air pollution– ammonia (FARMSCOPER)

Table 3-9 - Air pollutant – ammonia - Detailed monetary results

Measure	Benefit (30-yr £PV)
	Ammonia
Grassland management	£54,945.16
Riparian buffer creation	£5,208.80
Changing farming techniques – cover crops	£6,684.22
Fencing (post and wire, sheep netting and electric fencing)	£0.00
TOTAL	66,838

Appendix H. Avoided water pollution – nitrate, phosphorus and sediment (FARMSCOPER)

Table 3-10 – Water pollutant - Detailed monetary results

Measure	Benefit (30-yr £PV)			
	Nitrate	Phosphorus	Sediment	TOTAL
Grassland management	7,884.79	4,325.61	0.00	12,210
Riparian buffer creation	5,204.24	20,204.63	224,781.60	250,190
Changing farming techniques – cover crops	31,065.76	30,197.88	306,505.49	367,769
Fencing (post and wire, sheep netting and electric fencing)	355.97	2,400.56	0.00	2,757
TOTAL				632,927

Appendix I. Avoided GHG emissions – nitrous oxide, energy use (carbon dioxide) and methane (FARMSCOPER)

Table 3-11 – Avoided GHG emissions - Detailed monetary results

Measure	Benefit (30-yr £PV)
Grassland management	1,117,313
Riparian buffer creation	129,887
Changing farming techniques – cover crops	-15,361
Fencing (post and wire, sheep netting and electric fencing)	578
TOTAL	1,232,418

Appendix J. FARMSCOPER methods and assumptions

All FARMSCOPER outputs for each measure were scaled to the Darnford Brook sub-catchment, measure on GIS as equalling 2,571 ha. Pro-rata impacts across farm types (arable, lowland grazing) were calculated after calculating pro-rata impacts across drainage types (drained arable, drained arable grassland, free draining) based on information in FARMSCOPER Upscale for the catchment. Table 3-12 below details the FARMSCOPER methods and key assumptions used for the analysis. For simplicity, no prior uptake of measures was assumed though this likely overestimates the efficacy of interventions.

Table 3-12 - FARMSCOPER methods and key assumptions per measure

Measure	Methods and assumptions
All measures	Average rainfall 700-900 mm, based on Coleshill (Warwickshire) UK Climate Averages – Met Office – 708.22 mm per year average during the climate period 1991 to 2020.
All measures	Farm based on a Mixed Livestock Farm in the Tame Lower catchment, all NVZ, 46.4 % free draining, 15.2% drained arable, and 38.4% drained arable and grassland soils.
All measures	Darnford Brook sub-catchment 2,571 ha. The assessments for riparian buffer creation, cover crops, and fencing are scaled down to cover an area of 559.89 ha, which is a proxy for the total area of farms who have some land adjacent to the 4.1 km riparian zone.
Grassland management	Create three new FARMSCOPER Create files (to calculate weighted) with updated input parameters to reflect transition from modified (i.e., improved) to neutral (i.e., low-input / SN grassland). The new Create files have the same cropping areas as the baseline, but with adjusted count for Dairy Cows to Lambs livestock (<1 year) reduced by 0.912 and N (kg/ha), P2O5 (kg/ha), pig slurry (%), Pig fym (%) and poultry muck (%) for permanent pastures adjusted by the same factor. Any net manure balance will be ignored. This method aims to replicate that the area of PP that is being managed intensively has dropped, which means lower artificial inputs, lower stock numbers (of animals that would be potentially outside), and lower inputs from the pig and poultry manure. 22.82 ha grassland fields adjacent to Darnford Brook.
Riparian buffer creation	Method 14 (establish riparian buffer strips).
Changing farming techniques – cover crops	Method 4 (establish cover crops in the autumn). Note that FARMSCOPER only applies the measure to spring-sown crops with the area taken from the create file. 60.96 ha spring-sown crops in the target area. Assume 100% uptake with no prior application of equivalent measure (e.g. overwinter stubbles).
Fencing (post and wire, sheep netting and electric fencing)	Method 76 (fence off rivers and streams from livestock). Allow livestock to have access to the watercourse in the create files.

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