Cambridge Waste Water Treatment Plant Relocation Project
Anglian Water Services Limited

Appendix 20.11: Milton Water Recycling Centre Discharge Consent: Water Quality and Ecological Assessment

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Milton Water Recycling Centre Discharge Consent: Water Quality and Ecological Assessment

Anglian Water

1st February 2022

FINAL

Milton Water Recycling Centre Relocation Project

Project no. 4020267

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Table of contents

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1. Introduction

1.1 Background and purpose of assessment

Anglian Water (AWS) operates a Water Recycling Centre at Milton, on the north side of Cambridge. It is currently dry weather flow non-compliant. As a result, AWS are seeking an interim permit from the Environment Agency (EA) to bring it into compliance with the Water Framework Directive (WFD). It is intended that this permit will remain in place until the new Cambridge Water Recycling Centre (WRC) goes into operation in 2027/8, at which point permit conditions for the new site will come into effect. As a result, a water quality and ecological investigation is required to assess the potential impacts of both the proposed interim permit conditions and the permit conditions for the new site, on receiving water bodies and protected sites downstream. The results of this investigation will be provided as supporting evidence for AWS's permit application. Pre-application consultation with the EA and Natural England (NE) has taken place (Letter ref: ASCNF/1033/V004, dated 09/10/2020) which has identified the need for AWS to provide further evidence in challenging the EA's proposed indicative consented limits for suspended solids and phosphorus.

This report therefore presents results of water quality modelling undertaken for suspended solids and phosphorus from one reach upstream of the current / proposed Cambridge WRC to the most downstream reach ending at the Wash. The report provides a preliminary Water Framework Directive (WFD) Compliance Assessment of the potential effect of both proposed permit scenarios on water body quality elements in the receiving waters downstream of the works. An HRA preliminary assessment of the effects on ecological receptors and designated sites within the zone of influence of the discharge is also presented within this report.

An assessment of the impact of flood flows on designated sites under the interim and proposed new works permits was undertaken. The findings of this are presented within Appendix G:, together with results from further water quality modelling.

2. Project Details

2.1 Site location and context

The current Milton WRC is located TL 47682 61575, just south of the A14, Milton, Cambridge.

The new Milton recycling centre is planned to be developed within 22ha of farmland, at a site North of the A14 between Fen Ditton and Horningsea, Cambridgeshire. The development will be centrally located at TL 49509 61017. For further details see Site Location Plan, in Appendix E: E.1.

2.2 Pre-Application Advice

Binnies (BUKL) and Sweco were asked to investigate the potential impacts of two proposed permit scenarios: an interim permit for the existing Cambridge WRC at Milton, and a new works permit for the future WRC.

Indicative permit conditions were specified by the Environment Agency (Letter ref: ASCNF/1033/V004, dated 09/10/2020) and were as follows:

- Interim permit for existing works:
  - increase in flow (from existing permit of 37,330 m^3/d) to reflect the current discharge volume 44,851m^3/d until the new works is built (current best estimate 2027)
  - Phosphorus – 0.5mg/l
  - Biochemical Oxygen Demand (BOD) – 11mg/l
  - Ammonia – 4mg/l
  - Total suspended solids (TSS) – 17mg/l

- Permit for the new works (proposed scenario):
  - Flow – 55,000m^3/d
  - Phosphorus – 0.4mg/l
  - Biochemical Oxygen Demand (BOD) – 11mg/l
  - Ammonia – 3mg/l
  - Total suspended solids (TSS) – 14mg/l

AWS's request for pre-application advice (18/05/2020) challenged the indicative permit limits set out by the EA for phosphorus and suspended solids. AWS have proposed that limits of 20 mg/l Suspended Solids and 1 mg/l phosphorus would be more appropriate for the interim permit and that 20 mg/l Suspended Solids and 0.5mg/l phosphorus would be appropriate for the new works. The EA advised that such a challenge would require "full justification" and that insufficient evidence had been provided to support this proposal at the time.

Natural England stated in their response for Discretionary Advice (DAS 15802/337077, dated 14/01/2021) that it would be helpful for AWS to give early consideration to the effects of an interim permit on the Cam Washes SSSI, rather than waiting until EA formally consults Natural England on its assessment of the permit application. NE stated that [in agreement with the EA] an early independent assessment of impacts to the Cam Washes SSSI in the form of a HRA would help to inform Natural England's views on this matter ahead of formal consultation by the EA.

2.3 Scope of the Report

The scope of works originally developed was as follows:

- Carry out a hydrology and water quality (phosphorus, suspended solids, ammonia, and BOD) assessment to inform a Stage 1 HRA and preliminary WFD assessment using the EA's SIMCAT-SAGIS model and available flood models for both the interim permit and the new works permit for a range of flow scenarios (low flow, high flow and flood scenarios).
- Using the results of the hydrological and water quality assessment, carry out a preliminary assessment of potential Impacts on Designated Sites (a Stage 1 HRA) and on WFD Status (a WFD compliance assessment).
- Using the results of a fluvial flood model for the Cam and Great Ouse, conduct an initial an assessment of the impact of flood flows on designated sites under the interim and proposed new works permits.

3. Methodology

3.1 Water quality modelling

Water quality modelling scenarios have been developed in line with the pre application advice set out in Section 2.2. These modelling calculations have been used to evaluate the scenarios and identify if they would cause an impact to designated sites and the WFD status. The three modelling scenarios considered were:

- Baseline (future)
- Interim permit
- Proposed permit

The SIMulation of CATchments (SIMCAT) model uses the Monte Carlo calculations, a standard mathematical method used for probabilistic modelling, and mass balance equations. The SIMCAT software provides estimates on a catchment wide scale, allowing more complex scenarios to be modelled where either multiple treatment works may interact.

SIMCAT software (version 15.8) was utilised to model the impacts in changes of flow, phosphorus, BOD and ammonia. However, it was not possible to model suspended solids within the current version of the SIMCAT model and therefore a separate mass balance assessment was undertaken.

The EA PR19 SIMCAT water quality models for the Wash were used in this assessment. The two SIMCAT models for phosphorus and BOD and ammonia were provided by Atkins and were the basis for both the Atkins Cambridge WRC Relocation assessment undertaken in 2018[1] and this assessment (note the models updated by Atkins in their assessment were not provided).

(a) EA PR19 SIMCAT model summary

The EA developed a baseline SAGIS-SIMCAT model for the rivers flowing into the Wash, which was built using data for the 2010 to 2012 period and was used in the Cambridge WRC relocation study[1]. According to the Cambridge WRC relocation study[1] the baseline SAGIS-SIMCAT model has incorrectly located Waterbeach WRC noting it discharges into the River Cam rather than the nearby IDB drain. This was removed during the Cambridge WRC relocation study, however for the purpose of this study it was kept in the baseline and interim scenario models as this study specifically looks at the impacts from Cambridge WRC. The EA model does not include the effect of AMP6 or 7-driven changes to effluent quality, nor does it include population growth.

Atkins[1] state the orthophosphate model (which this study has used for total phosphorus to meet discharge permit limits) underpredicts observed water quality but is within the confidence limits of the model output. However, there was lower confidence observed when using the ammonia and BOD model. The model fit for BOD was noted to be generally good, however, it was stated the model under-predicts ammonia concentrations upstream of Cambridge WRC and over-predicts downstream. This downstream under prediction is particularly marked for the 90%ile ammonia concentration. It suggests other sources of ammonia in the vicinity of Cambridge (e.g. urban runoff and CSOs) are not fully taken into account in the model since the shift from over prediction to under prediction occurs over this part of the model.

[1] Atkins (2018) Cambridge WRC Relocation report

(b) River reach network

The Wash catchment was divided into 19 reaches. For the purpose of this study, impacts of the proposed changes were only examined at one reach upstream of the current / proposed Cambridge WRC. The remaining reaches are located downstream with the most downstream reach ending at the Wash. For all three scenarios, results were also produced immediately upstream and downstream of Cambridge WRC. For the baseline (future) and interim permit scenario, results were also produced immediately upstream and downstream of Waterbeach WRC. However, Waterbeach WRC was removed from the proposed permit scenario as waste water flows from the Waterbeach catchment will be transferred by separate pumped transfer (pumping station and pipeline) from the Waterbeach catchment to the new treatment plant[2]. The reaches selected would identify determined concentrations throughout the full length of the water body, downstream of Cambridge WRC, to the Wash. Notably, some of these reaches will be located next to or within designated sites that will be assessed within the HRA (Appendix D and WFD compliance assessment (Section 3)). The location of the end of the reaches of interest for this study, Cambridge WRC and Waterbeach WRC can be found in Table 1 and Appendix E.2.

Table 1 Cambridge WRC, Waterbeach WRC and end of reach node locations

End of reach node number / WRC	Water body	Grid reference (x y)
333	Cam	547418 260187
Cambridge WRC	Cam	548355 261528
334	Cam	551004 265825
Waterbeach WRC	Cam	550459 266432
335	Cam	552180 267282
336	Cam	553609 270027
337	Cam	553572 274547
338	Ely Ouse (south Level)	553953 276454
339	Ely Ouse (south Level)	557284 284432
358	Ely Ouse (south Level)	560792 291915
359	Ely Ouse (south Level)	558937 299061
360	Ely Ouse (south Level)	558783 300768
361	Ely Ouse (south Level)	558757 301032

[2] Mott MacDonald (2021) [redacted]

End of reach node number / WRC	Water body	Grid reference (x y)
368	Tidal Great Ouse	559142 314640
398	Tidal Hundred Foot River	559139 314649
406	Tidal Hundred Foot River	560221 317255
417	Relief channel	560739 312697
418	Relief channel	560496 317489
419	Tidal Hundred Foot River	561364 318664
423	Tidal Hundred Foot River	561605 319223
430	Tidal Hundred Foot River	559777 324200

(c) SIMCAT scenarios

The SIMCAT models for total phosphorus was updated as follows for the three scenarios:

- Baseline (future)
  - Mean Flow: 52.574 Ml/d (52574 m^3/d)
- Interim permit
  - Mean Flow: 52.574 Ml/d (52,574 m^3/d)
  - Total phosphorus: 1 mg/l
- Proposed permit
  - Mean Flow: 64.471 Ml/d (64471,000 m^3/d)
  - Total phosphorus: 0.5 mg/l

In addition to the above adjustments, the effluent flow at the water recycling centres was updated for the estimated population growth to 2027, as per Appendix B of the Cambridge WRC Relocation report[1] for all three scenarios. Table 2 indicates the estimated population growth at WRCs in model catchment by 2027.

Table 2 Estimated population growth at WRCs in model catchment by 2027

Name	% Growth
Quendon	5.04
Newport	18.34
Audley End	4.42

Name	% Growth
Wendens Ambo	4.445
Great Chesterford	4.39
Sawston	3.35
Barley	3.57
Ashwell	2.30
Guilden Morden	3.53
Wrestlingworth	0.04
Tadlow	3.37
Bassingbourn WRC	3.58
Litlington WRC	3.56
Arrington	3.46
Royston WRC	4.94
Foxton (Cambs)	3.54
Haslingfield	3.48
Bourn WRC	3.46
Cambridge	3.91
Waterbeach	3.51

Total phosphorus values for 16 WRCs were also updated to reflect the AMP6 and AMP7 phosphorus removal scheme limits, as per Appendix A of the Cambridge WRC Relocation report[1]. Table 3 and Table 4 indicates the phosphorus limit applied for AMP6 and AMP7, respectively.

Table 3 AMP6 phosphorus removal scheme

Name	AMP6 phosphorus limit (mg/l)	Date in force
Ashwell	1	01/04/2020
Foxton (Cambs)	1	01/04/2020
Guilden Morden	1	01/04/2020
Haslingfield	2	01/04/2020
Wrestlingworth	1	01/04/2020

Table 4 AMP7 phosphorus removal scheme

Name	PR19 fair share permit limit required (mg/l)
Bassingbourn	0.5
Bottisham	1
Bourn	0.5
Burwell	0.7
Coton	0.8
Elmdon	1
Linton	0.5
Litlington	0.5
Newport	1
Quendon	1
Shudy Camps	1

The Total phosphorus in the EA PR19 model used in the future baseline scenario were not adjusted from the EA PR19 model and the values in this scenario and were left as 0.817 mg/l, 0.158 mg/l and 4.05 mg/l, respectively.

(d) Suspended solids – mass balance assessment

A spreadsheet-based mass balance assessment was undertaken to understand the change in suspended solid concentrations downstream of the WRCs of interest for the three scenarios. Suspended solid

concentrations were derived from the EA river water quality archive[3]. Mean suspended solids concentration was calculated for each sampling location within the reach (identified in Table 1) from approximately 3 years of data taken between 2010 and 2015, data was not available for more recent periods. Data from EA sampling points, for both effluent and river, either close to or upstream of the reach of interest were used. River flow information for each reach was predicted from the SIMCAT model. The baseline scenario is based on the observed suspended solids concentrations only, due to the lack of information for Waterbeach WRC, the concentrations were assumed to be equal to Cambridge WRC. The interim and proposed permit scenarios use the following suspended solid concentrations:

- Baseline
    - Suspended solids: Cambridge WRC 5.33 mg/l and Waterbeach WRC 5.33 mg/l
- Interim permit
    - Suspended solids: Cambridge WRC 20 mg/l and Waterbeach WRC 5.33 mg/l
- Proposed permit
    - Suspended solids: Cambridge WRC 20 mg/l and Waterbeach WRC 0 mg/l

For the suspended solid assessment, the effluent flow and suspended solid concentration for each reach of interest is assumed to mix completely with the river flow and suspended solid concentration in (or upstream of) that reach to predict suspended solids at the end of that reach. The mixing of discharge within the river is described by the mass balance equation:

$$T = \frac{FC + fc}{F + f}$$

Where:

- F is the river flow upstream of the discharge
- C is the concentration of suspended solids in the river upstream of the discharge
- f is the flow of the discharge
- c is the concentration of suspended solids in the discharge
- T is the concentration downstream of the discharge

For the interim and proposed permit scenarios the suspended solid load from the existing works was subtracted from the river suspended solids load which is based on observed data (and would inherently include the baseline suspended solids load).

(e) Assumptions and limitations

It is assumed the SIMCAT models provided by Atkins are the PR19 models which were developed and calibrated by the EA and the parameter values within the model are valid for this assessment. No further calibration was undertaken.

[3] Environment Agency (2021) https://environment.data.gov.uk/water-quality/view/landing

Waterbeach was removed from the proposed permit scenario as it is assumed the proposed permit limits takes into account the waste-water flows from the Waterbeach catchment which will be transferred to the new treatment plant.

It is assumed information provided for the AMP6 and AMP7 phosphorus removal schemes (Appendix A of the Cambridge WRC Relocation report[1]) and the assumed population increases (Appendix B of the Cambridge WRC Relocation report) are still valid.

The mass balance assessment for suspended solids is limited to a certain extent by the lack of available recent (within the last five years) good quality data. The mass balance assessment only considers mixing of river and effluent quality and does not consider other processes affecting suspended sediment concentration such as deposition and entrainment. In addition, because of the lack of information on suspended solids throughout the river reach, the impact of the interim and proposed permits on the reach of interest is based on the nearest upstream river data point (and the permits' conditions) rather than the continual mixing and transport of sediment downstream.

There are a number of assumptions associated with using a stochastic water quality model like SIMCAT. Mixing is assumed to have taken place downstream of the discharge points. A log normal distribution of determinands is also assumed, for all determinands of interest. Effluent flows are represented using a three-parameter log normal distribution and river flows are represented using a normal distribution.

Due to the low confidence in the ammonia, BOD and DO model (as described in the Cambridge WRC Relocation report[1]) the results for the three scenarios for these determinands have not been presented in this report. It is recommended that this SIMCAT model is updated further, including additional calibration if required, before these results are presented.

3.2 WFD Compliance Assessment

The Water Framework Directive is implemented in England and Wales by the Water Environment (Water Framework Directive) Regulations 2017. The WFD aims to protect and enhance the quality of the surface waters and groundwater in England and Wales. It takes a holistic approach to the sustainable management of water by considering the interactions between surface water, groundwater, and water-dependant ecosystems. Under the WFD, the term 'water body' is the basic management unit and is defined as all or part of a river system or aquifer. Water bodies form a constituent part of a 'River Basin District', for which 'River Basin Management Plans' (RBMP) are developed by classifying the current condition (i.e. status or potential) of surface waters and groundwater bodies.

The RBMP sets objectives, based on the WFD, for water bodies to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP – for artificial (A) or heavily modified water bodies (HMWB)) within a set timeframe, typically by 2027). The RBMP WFD cycle of assessments takes place every six years and therefore objectives which have not been achieved in RBMP Cycle 2 (2016) may roll on to the RMBP cycle 3 (2021), and so on to the next assessment.

The relevant RBMP for the scheme is the Anglian River Basin District 2015 RBMP (Environment Agency, 2016)[4]. To ensure compliance with the WFD, consideration is given to whether the interim and new permit proposals have the potential to; i) cause deterioration of a water body from its current status or potential; and/or, ii) prevent future attainment of GES where this is not already achieved. This WFD Compliance Assessment considers potential effects on WFD water bodies in relation to the proposed scheme. The EA is the Competent Authority for implementation of the WFD in England. This WFD Compliance Assessment is considered alongside other wider environmental assessments carried out for the scheme including a Habitats Regulations Assessment (HRA).

(a) Water Body Classification and Assessment Guidance

Under the WFD, water bodies are classified on the condition of a suite of quality elements (Table 5).

Table 5 Water quality elements assessed for WFD water body classification in WFD Compliance Assessment

Water body type	Assessment	Classification element	Specific quality elements	
			Rivers	Lakes
Surface water	Ecological status/ potential	Biological	• Macrophytes and Phytobenthos • Benthic invertebrate fauna • Fish fauna	• Phytoplankton • Macrophytes and Phytobenthos • Benthic invertebrate fauna • Fish fauna
		Physico-chemical	• Thermal conditions • Oxygenation conditions	• Transparency • Thermal conditions • Oxygenation conditions

[4]Environment Agency (2016) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718327/Anglian_RBD_Part_1_river_basin_management_plan.pdf

Water body type	Assessment	Classification element	Specific quality elements	
			Rivers	Lakes
			• Biochemical Oxygen Demand • Salinity • Acidification status (pH) • Acid neutralising capacity • Ammonia • Nutrient conditions	• Salinity • Acidification status (pH) • Nutrient conditions
		Specific pollutants	• Arsenic (As) • Copper (Cu) • Iron (Fe) • Zinc (Zn) • Manganese (Mg)	• Copper (Cu)
		Hydromorphology	• Quantity and dynamics of water flow • Connection to groundwater bodies • River continuity • River depth and width variation • Structure and substrate of the river bed • Structure of the riparian zone	• Quantity and dynamics of water flow • Residence time • Connection to the groundwater body • Lake depth variation • Quantity, structure and substrate of the lake bed • Structure of the lake shore
	Chemical Status		• Priority hazardous substances • Priority substances • Other pollutants	• Priority hazardous substances • Priority substances • Other pollutants
Groundwater	Quantitative Status		• Saline or other intrusions • Surface water • Groundwater dependent terrestrial ecosystems • Water balance	
	Chemical Status		• Saline or other intrusion • Drinking Water Protected Areas • General quality assessment	

The key environmental objectives against which new developments must be assessed are whether they are likely to:

- Cause deterioration of status (or potential) of a water body; and

- Prevent the achievement of GEP or GES in a water body; and
- Prevent the delivery of HMWB mitigation measures.

A ruling by the Court of Justice of the European Union called the 'Bund Ruling'[5] in 2014 provided clarification on how the Directive's environmental objectives should be interpreted when assessing a scheme's effect on a WFD water body:

- 'Deterioration of the status' of the relevant body of surface water includes a fall by one class of any element of the 'quality elements' within the meaning of Annex V of the WFD even if the fall does not result in the fall of the status of the body of surface water as a whole;
- Consent for the development must not be granted by an authorising authority where a scheme may cause a deterioration in the status of a body of surface water or where it jeopardises the attainment of Good surface water status or Good ecological potential and Good surface water chemical status by the date laid down in the Directive, unless a derogation is granted; and
- If the quality element is already in the lowest class, any deterioration of that element represents deterioration of status within the meaning of WFD Article 4(1) (a) (i).

The ruling does not clearly define whether 'quality elements' include the hydromorphological and physico-chemical supporting elements. However, these supporting elements underpin the status of the biological quality elements and therefore risks of deterioration and consequent effects on biology need to be considered. Guidance by the EC Common Implementation Strategy (CIS) on exemptions according to Article 4.7 (EC CIS, 2017)6 highlights that deterioration in any of these supporting conditions indicates a significant risk to one or more of the biological quality elements. Therefore, any deterioration in these conditions will influence any decisions on whether a proposed modification may lead to deterioration and therefore require an Article 4.7 exemption test. Consequently, using a precautionary principle approach, for this assessment, any fall in the classification of any element (quality or supporting), or any deterioration of an element already in its lowest class will trigger the requirement for the Article 4.7 derogation.

Environment Agency guidance (2016789) which is currently considered 'best practice' for assessing multiple water bodies, have been used as a general guide for this assessment. The various steps undertaken for this WFD Compliance Assessment are summarised below and shown in Figure 1.

[5] See Case Ruling C-461/13 Bund für Umwelt und Naturschutz Deutschland e.V. versus Bundesrepublik Deutschland: [redacted]

[6] EC Common Implementation Strategy (CIS) for the Water Framework Directive – Guidance Document No. 35 Exemptions to the Environmental Objectives according to Article 4 (7) - [redacted]

[7] Environment Agency (2016) Water Framework Directive compliance of physical works in rivers.

[8] Environment Agency. (2016). Water Framework Directive compliance of physical works in rivers. Screening step 1.3: WFD deterioration and risk to water body status objectives.

[9] Environment Agency (2016). Water Framework Directive compliance of physical works in rivers. Activity definitions.

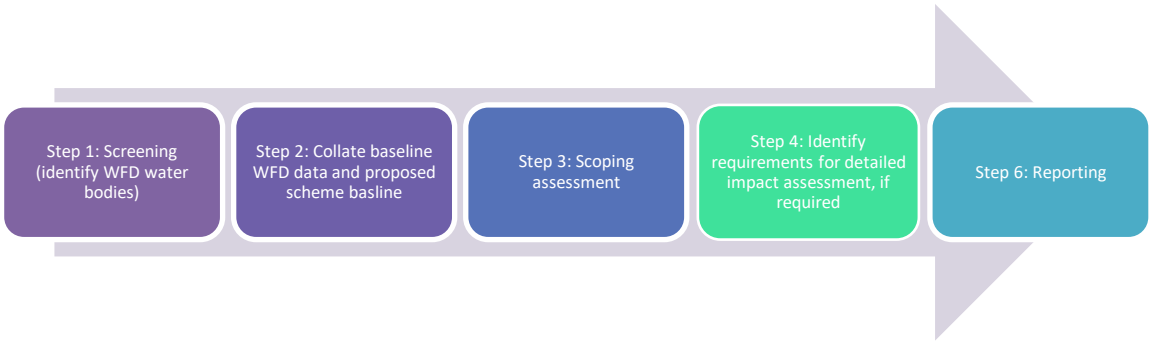


Figure 1 Steps in the WFD Compliance Assessment process.

In this WFD Compliance Assessment, effects arising from any modifications have been categorised using a colour coded system which is adopted in the assessment tables. This system is used to indicate the existing WFD classification, as presented in the RBMP, for each element and the predicted scale of effect (in terms of potential for a change in WFD class for each element) associated with the modifications on each WFD element. The system used in this WFD Compliance Assessment is presented in Table 6 and Table 7.

Table 6 Colour coded system utilised to indicate existing WFD classification in WFD Compliance Assessment.

WFD classification (baseline)	
	Bad classification
	Poor classification
	Moderate classification (or 'does not Support Good')
	No status
	Does not require assessment
	Supports good
	Good classification
	High classification

Table 7 Colour coded system utilised to indicate predicted scale of effect to elements in this WFD Compliance Assessment

Scale of effect	
- - -	High risk of deterioration (e.g. long term (6 years or more) and potential deterioration in current classification or any deterioration in Bad at a water body scale) or risk to achieving Good Ecological Status / Potential.
- -	Medium risk of deterioration (e.g. medium to long term (between 4 to 6 years) and potential change within the current classification is expected at a water body scale).
-	Low risk of deterioration (e.g. localised or short-term effect (3 years or less)).
/	Negligible effect / no risk.
+	Potential to improve (e.g. effects have the potential to lead to minor localised or short-term benefits (1-6 years)).

+ +	Significant potential improvement (e.g. effects have the potential to lead to permanent / long term improvements (6 years or more) in WFD classification at a water body scale).

(b) Screening

Initially, a high-level screening was undertaken to identify WFD water bodies (based on their locations) that could be affected by the scheme, and the physical modifications being undertaken by the scheme, which have the potential to affect any surface water and groundwater bodies. Water bodies were identified using the Environment Agency's Catchment Data Explorer[10].

Water bodies identified were then either 'screened in' or 'screened out' of further assessment by determining whether the scheme activities have the potential to lead to any non-temporary effects on the water body.

(c) Collate Baseline WFD Data and Proposed Scheme Baseline

Baseline information on the 'screened in' water bodies was collated for this report from the following data sources:

- The RBMP: Anglian River Basin District RBMP (Environment Agency, 2016a);
- The Environment Agency's Catchment Data Explorer for RBMP Cycle 2 (2019) baseline classification data[10];
- WFD Water Bodies in England: 2015 status, objectives and protected area designations for the update to the River Basin Management Plans - Cycle 2 dataset;
- The Environment Agency's Water Quality Data Archive[11]; and,
- Ecology data obtained from the Environment Agency's Ecology and Fish Data Explorer (2017, 2019)[12].

These provided the initial baseline information for undertaking the overall assessment including: reason for designation, current overall WFD status, objectives, and ecological and chemical status. Classification data for individual biological quality elements, supporting hydromorphological and physico-chemical elements, as well as protected area designations was also collated. This step also included the collation of the WFD mitigation measures from the Environment Agency, for A/HMWBs, which aim to support as good an ecological system as possible. This step also includes the collation of WFD mitigation measures from the Environment Agency, for A/HMWBs, which aim to support as good an ecological system as possible. If A/HMWB are screened in, the outcomes are included in the Scoping Assessment Tables undertaken as part of Step 3.

(d) Scoping Assessment

This step of the assessment determines which quality elements associated with water bodies that have been 'screened in' require a detailed assessment. A scoping assessment of the potential impacts from the interim and new works permit scenarios on each of the relevant WFD elements was undertaken.

This stage assessed whether the proposed increase in effluent could prevent a water body from achieving GES or GEP. Where deterioration was predicted, the assessment considered if this

[10] EA Catchment Data Explorer - https://environment.data.gov.uk/catchment-planning/
[11] Environment Agency (2019) Water Quality Data Archive https://environment.data.gov.uk/water-quality/view/
[12] Environment Agency (2017 and 2019) Ecology and Fish Data Explorer https://environment.data.gov.uk/ecology/explorer/

deterioration would be limited in class deterioration to less than 10%. These rules were applied for the determinands phosphate and suspended solids.

The potential for an impact on one WFD element to have a secondary impact on a different element was considered. In some cases, the secondary impact may pose a greater risk to water body deterioration than the direct change, where even a localised and short-term direct impact on a physical quality element may have long term consequences for biological quality elements. This means for example that for one quality element, which may not pose a risk of non-compliance in itself, may still need mitigating in order to avoid a secondary impact which could cause risk of deterioration.

This step determined whether there was a likelihood of a non-temporary effect (i.e. permanent or significant enough to extend over a six-year period) to potentially cause deterioration in the status of individual quality elements at the water body level. This step also allows for the identification of some mitigation to be built-in, and to set out where further work is needed to verify that the proposed mitigation can be delivered and will be effective in preventing a deterioration in status or ability to meet water body objectives.

(e) Detailed Assessment

A detailed assessment was not part of the scope for this project; however, the scoping assessment outlines the required water bodies and quality elements that require further assessment to be undertaken.

3.3 HRA approach

The completion of an HRA follows a stepped process, further details of this can be found in Appendix D:. This HRA comprises the first stages of the HRA process, an HRA Stage 1 Screening, further Stage 2 Appropriate Assessment may be required to demonstrate no impact to the national network of site integrity. The Stage 1 Screening within Section 6 and in Appendix D: of this report has utilised screening matrices based upon a table template taken from the Design Manual for Roads and Bridges (2009). This template has been used as the basis to represent the screening data as it is a recognised, standard tool that allows for comparable and concise assessment.

4. Water quality modelling results

SIMCAT modelling has been used to determine the impact of interim permit and proposed new permit for total phosphorus. A mass balance equation was used to determine the impact of current discharge and future discharge for the suspended solids (see Section 3.1(d)).

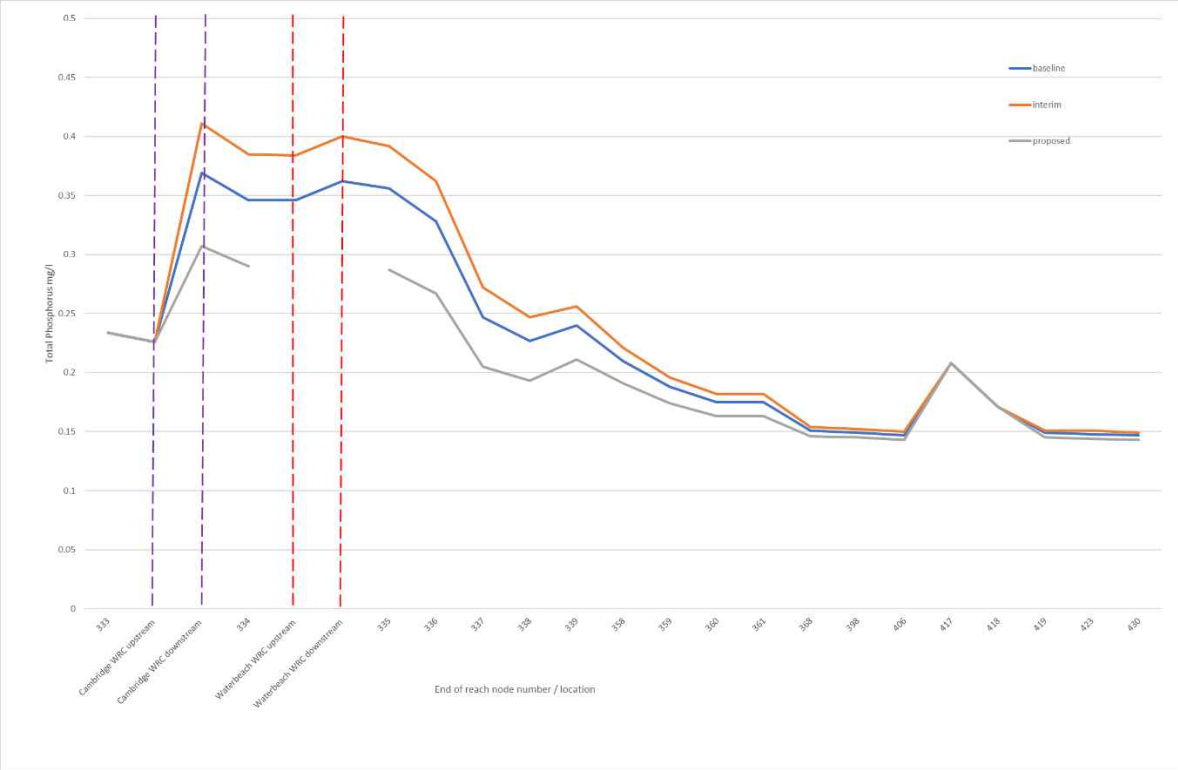
(a) Total phosphorus

The SIMCAT model produces a range of statistics that include mean, standard deviation, 90 percentile, 95 percentile and 99 percentiles for determinands along the defined river reaches. For flow, the model produces mean 90% exceedance, 95% exceedance and 99% exceedance. The results from the three scenarios can be found in Appendix C and graphs in Appendix F.4. For the purpose of this study, the mean results have been discussed below.

All three scenarios were shown to have an increase in total phosphorus (TP) immediately downstream of Cambridge WRC (see Appendix C and Figure 2). Downstream of this the TP concentration started to decrease. For the baseline and interim permit scenarios an increase was observed again immediately downstream of Waterbeach WRC. As expected, where Waterbeach WRC was removed from the proposed permit scenario, this increase was not observed. Excluding two increases in TP concentration at the end of reach 339 and 417, as seen in Figure 2, the TP concentration decreased downstream of the WRCs toward the bottom of the modelled catchment reach. These increases are not linked to the discharge from Cambridge WRC due to the distance from the discharge point.

Throughout the catchment the proposed permit scenario was observed to have lower mean concentrations when compared to the baseline and interim permit scenarios. The interim scenario was observed to have the highest concentrations across the catchment.

Figure 2 Predicted mean total phosphorus in the reaches of interest for the three scenarios



(b) Suspended solids

A mean suspended solids value of 6.56mg/l was observed in the River Cam, upstream of Cambridge WRC[1]. The immediate downstream impact from Cambridge WRC for the baseline scenario is unclear. However, when the 20mg/l suspended solids discharge from Cambridge WRC was included for both the interim and proposed permit scenario an increase was predicted. The increase predicted in the proposed scenario at this point was higher than the interim scenario, which is assumed to be associated with the overall increase in effluent flow. A summary of the results can be seen in Table 8 and in Appendix F.2.

Table 8 Predicted suspended solids downstream of Cambridge and Waterbeach WRC for the three scenarios

Location	End of reach node number	Predicted suspended solids downstream (mg/l)		
		Baseline	Interim	Proposed
Upstream	333	6.56	6.56	6.56
Cambridge WRC Immediately downstream	334			
Waterbeach WRC Immediately downstream	335		9.07	9.54
Downstream	336			
Downstream	337	13.04	13.21	13.27
Downstream	338		13.18	13.23
Downstream	339	6.60	7.30	7.44
Downstream	358	10.41	10.68	10.75
Downstream	359	5.49	5.98	6.08
Downstream	360		5.92	6.04
Downstream	361	7.60	7.93	8.00
Downstream	368		7.74	7.77
Downstream	398		7.73	7.75
Downstream	406		7.72	7.75
Downstream	417	6.23	6.38	6.41
Downstream	418	4.40	4.58	6.22
Downstream	419	82.87	81.77	81.57
Downstream	423		81.78	81.58
Downstream	430	57.63	56.96	56.84

For all three scenarios an increase in suspended solids was observed at the end of reach 337. It is highly unlikely this increase is related to Cambridge and / or Waterbeach WRC based on the mass balance calculations for the interim and proposed permit scenarios and is likely to be associated with the large tributary that is immediately upstream of this sampling point. From the end of reach 337, the concentration progressively decreases downstream (except for end of reach 339), noting reach 368 downstream is tidal, until the end of reach 419 where there was a large increase in suspended solids concentrations in the observed data (based on a low number of samples). There were no observed data available for the tidal sections at the end of reaches 368, 398 and 406 therefore data from reach 361 was used for the mass balance calculation for the interim and proposed permit scenarios.

(c) Flow

Table 9 shows the variation in mean flow downstream of the Cambridge and Waterbeach WRCs for the reaches of interest. For the baseline (future) and interim permit scenarios, the effluent flow discharging to the watercourse is assumed to be the same at 44.851 Ml/d. For the proposed permit scenario for the proposed Cambridge WRC, the effluent flow is 55.0 Ml/d. The flow rates were then multiplied by 1.1722 to convert to mean river flow.

This results in a maximum increase in mean river flow when compared to the baseline and interim scenarios of 4.20%. As river flows increase downstream, the impact of the proposed scenario permit is diminished, noting that from reach 368 downstream the river is tidal. The mean flow change from future baseline and interim scenarios to the proposed new works scenarios is also presented in Figure 3 as a flow accretion profile.

Table 9: Mean flow variation downstream of the Cambridge and Waterbeach WRCs.

Node	Location	Mean flow (ML/d)		Percentage change (%)
		Baseline & Interim	Proposed New Works	
333	US	226.5	226.5	0.00%
Cambridge WRC (334)	Cambridge WRC	283.1	295	4.20%
Waterbeach WRC (335)	Waterbeach WRC	299.9	311.6	3.90%
336	DS	316.1	326.6	3.32%
337	DS	392.7	403.2	2.67%
338	DS	501.0	511.4	2.08%
339	DS	553.8	564.2	1.88%
358	DS	734.3	744.8	1.43%
359	DS	942.7	953.2	1.11%
360	DS	1076.4	1086.8	0.97%
361	DS	1076.7	1087.2	0.98%
368	DS	2682.6	2693.1	0.39%
398	DS	2897.5	2908	0.36%
406	DS	2980.9	2991.3	0.35%
417	DS	-	-	-
418	DS	-	-	-
419	DS	3329.0	3339.5	0.32%
423	DS	3334.1	3344.6	0.31%
430	DS	3448.5	3459	0.30%

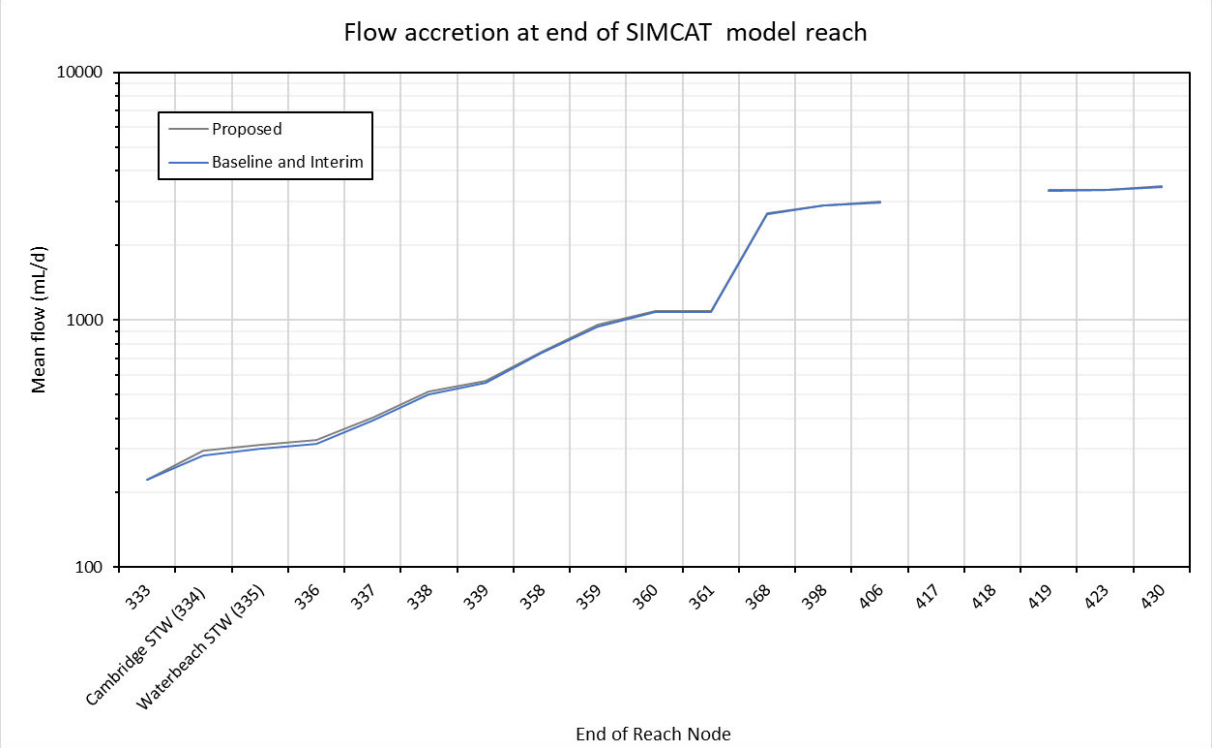


Figure 3 Flow accretion profile at the end of each SIMCAT model reach.

5. WFD Compliance Assessment

5.1 Screening and Baseline Data Collation

The screening process considered 17 surface water bodies, two groundwater bodies and 12 protected areas upstream and downstream of the existing and proposed discharge locations. The results of the screening process are shown in Appendix A: and the baseline data for the screened in water bodies presented in Appendix B: The water bodies and protected areas considered at screening stage are shown in the following drawings within Appendix E.

- Protected Areas;
- WFD Surface Water Body Map; and,
- WFD Groundwater Body Map

This screening stage of assessment concluded that the following WFD water bodies and protected areas required a WFD scoping assessment:

- Cam - GB105033042750;
- Ely Ouse (South Level) - GB205033000070;
- Cam and Ely Ouse Woburn Sands - GB40501G445700;
- Fenland SAC;
- River Cam Eutrophic Zone - UKENRI91;
- Old West & Ely Ouse UKENRI90;
- Ely Ouse and Cut-off Channel NVZ S390; and,
- Anglian Chalk NVZ

These water bodies and protected areas were screened in following a review of SIMCAT model results and the potential for impacts on WFD quality elements. The baseline data for these water bodies were collated and summarised in Scoping Assessment.

5.2 Scoping assessment

The Scoping assessment has reviewed the potential for impacts on the screened in water bodies and protected areas listed below. The assessment is presented in a table for each water body. The assessment for each protected area is presented within the table of the overlapping water bodies.

The assessment considered whether any change in phosphorus or suspended solids concentrations could cause significant deterioration to the screened in water bodies under either the proposed interim or new works scenarios. Significant deterioration is defined by the following criteria:

- A class deterioration. For example, if water quality modelling predicted an increase in phosphate causing a water body currently classified as ‘Moderate’ ecological status to drop to ‘Poor’ status; and,
- A deterioration of more than 10% in phosphate concentrations.

Table 10 Scoping Assessment for the Cam water body

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		Interim permit	**New works permit**		
Hydromorphological Supporting Elements					
Hydrological Regime				n/a	
Quantity and dynamics of water flow		Under the proposed interim and new works scenarios, there is no anticipated impact upon these hydromorphological supporting elements.			/
Connection to groundwater bodies					/
River continuity					/
Morphological conditions					
River depth and width variation					/
Structure of the riparian zone					/
Structure and substrate of the riverbed		The morphological conditions for this water body have not been assessed, however historic TSS data provides an indication of conditions. Figure 4 in Appendix F.1 provides the temporal trend in TSS on the River Cam at Bottisham Lock from 2012 to 2014 (most recent available data and approximately 5km downstream from the current Cambridge WRC). The data shows that the mean TSS is 9mg/l, however in the winter months there are peaks in concentrations (22mg/l and 52mg/l in 2012/13 and 2013/14 respectively). Although the data is limited and dated, this suggests that TSS conditions are affected by periodic inputs, rather than a constant point source, such as WRC's. Despite constant sediment inputs from point sources, TSS remains low for most of the monitoring period. Mass balance calculations have been undertaken to estimate how TSS concentrations may change with the interim permit for Cambridge WRC. Although both scenarios have the same permit there will be an increase in effluent flows once the proposed permit is in place which will influence concentrations.		n/a	/

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		Figure 8 in Appendix F.2 presents the estimated TSS concentrations downstream of the existing Cambridge WRC with 17mg/l and 20 mg/l permits. Within the Cam water body (model nodes 335 to 337), there is an increase in TSS concentration downstream of the WRC (335) in both scenarios (17mg/l and 20mg/l) however the increase is similar, 1.95 and 2.51 mg/l respectively. Further downstream (337), the change is much less, -0.2 and 0.2mg/l respectively, with the effect from the current Cambridge WRC decreasing downstream. In addition, Figure 8 also demonstrates that TSS downstream is also affected by other inputs as it increases in all scenario's, this is likely due to the confluence with the Burwell Lode water body. Typically, average total TSS discharged from a WRC is about half of the permit 95%ile value to allow for fluctuations, therefore the mass balance calculations undertaken for this assessment are likely to have overestimated TSS concentrations in the water body for both interim permit scenarios. There are no environmental quality standards for TSS, however as an indication, the Freshwater Fish Directive (with due recognition that this directive was repealed under the WFD) gives a Guideline Standard of an annual mean of 25mg/l[13]. Both interim permit scenarios presented are substantially below this mean throughout the Cam water body with a maximum of 13mg/l at the most downstream monitoring point for both scenarios. As a consequence, amending the TSS permit to either 17mg/l or 20mg/l is unlikely to have significant effect on TSS, and therefore the structure and substrate of the riverbed, in the Cam water body at a water body scale, especially as the WRC will likely operate a substantially lower discharge than the concentrations included in the mass balance calculations. In addition, the Cam water body is 28km in length and the Cambridge WRC discharges into the water body approximately 12km from the upstream extent, further limiting effects at a water body scale.	Figure 9 in Appendix F.2 presents the estimated TSS concentrations downstream of the new Cambridge WRC outfall with 14mg/l and 20 mg/l permits. Within the Cam water body (model nodes 335 to 337), there is an increase in TSS concentration downstream of the WRC (335) in both scenarios however the increase is similar, 1.7 and 3.0mg/l respectively. Further downstream (337), the change is less, -0.6 and 0.2mg/l respectively, with the effect from the current Cambridge WRC decreasing downstream. As mentioned with regards to the interim permits, average total TSS discharges from a WRC is about half of the permit 95%ile value to allow for fluctuations, therefore this assessment is likely to have overestimated TSS in the water body for both proposed permit scenarios. In addition, Figure 9 also demonstrates that TSS downstream is also affected by other inputs as it increases in all scenario's, this is likely due to the confluence with the Burwell Lode water body. Both proposed permit scenarios are below the 25mg/l Freshwater Fish Directive guideline standard throughout the Cam water body with a maximum of 12.5 and 13.2mg/l respectively. As a consequence, amending the TSS permit to either 14mg/l or 20mg/l is unlikely to have a significant effect on TSS, and therefore the structure and substrate of the riverbed, in the Cam water body, especially as the WRC will likely operate a substantially lower discharge than the concentrations included in the mass balance calculations. In addition, the Cam water body is 28km in length and the new Cambridge WRC will discharge into the water body approximately 12km from the upstream extent, further limiting effects at a water body scale.		
Physico-chemical Supporting Elements					

[13] The Freshwater Fish Directive has been repealed and replaced with the WFD, however the threshold provides a useful indicator of acceptable TSS conditions.

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements	Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
Ammonia (Phys-chem)		Subject to further model verification and discussions with the Environment Agency.	N/A	/
Biological Oxygen Demand (BOD)				
Dissolved Oxygen (DO)				
Phosphate		To understand the potential risk of deterioration to this quality element, the Total Phosphorus concentrations required conversion to mean orthophosphate (ortho-P). As no ortho-P data was available as an output of the SIMCAT modelling, values were estimated as mean TP multiplied by 0.7 (this is a generally accepted 'rule of thumb' and further explanation is set out within the Addendum in 7.3Appendix G: These values therefore provide an indication of the future concentrations under the proposed interim permit scenario but should be observed with caution. WFD classification boundaries for the water body were calculated based on altitude and mean observed alkalinity from the WIMS monitoring point on the River Cam at Bottisham Lock. Most recent available ortho-p data was obtained for 2019 from the River Cam at Bottisham Lock (approximately 5km downstream from the current Cambridge WRC). Mean ortho-p concentrations were recorded as 0.38mg/l within the upper range of the 'Poor' classification. Figure 10 in Appendix F.3 shows that highest concentrations were observed during the Summer months (0.48mg/l in June 2019) with slightly lower concentrations during the Winter months (0.26mg/l in December 2019). This seasonal variation would suggest that concentrations at this location are heavily influenced by Cambridge WRC and the low flow Summer months provide a reduced dilution effect. At the WIMS monitoring point River Cam Dimmocks Cote Road Bridge (approximately 13km downstream from the current Cambridge WRC), mean ortho-p concentrations were recorded as 0.30mg/l during 2019. The reduced seasonal variation observed at this site (Figure 11 in Appendix 7.3F.3) in 2019, may suggest that the Cambridge WRC and Waterbeach WRC are not the dominant source of ortho-p and concentrations may be influenced by the Swaffham-Bulbeck Lode and Burwell Lode water bodies.		/

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		1mg/l Phosphorus Figure 16 in Appendix F.4 presents the modelled ortho-p concentrations upstream and downstream of the existing Cambridge WRC with a 1mg/l permit compared to the future baseline. There is no change predicted upstream of the WRC (model nodes 333 and 334 just upstream of Cambridge WRC), however downstream of the WRC an increase in ortho-p concentration is predicted at each model node (up to and including node 337). The greatest change is shown just downstream of the existing Cambridge WRC (334) and at the end of reach 334 with an increase of 0.029 mg/l and 0.027 mg/l respectively. The extent of increase remains similar for most of the water body from Cambridge WRC up to the end of reach 336. It is possible that this level of change remains similar due to the influence of Waterbeach WRC on ortho-p levels. All model results under this scenario are within the Poor WFD class, are not anticipated to cause deterioration from this class (Poor status threshold is 1.124mg/l) and remain close to the Moderate status threshold. Despite this, modelling has predicted the percentage deterioration to exceed the 10% deterioration limit permitted at all points downstream of the existing Cambridge WRC (334) within the Cam water body. The maximum deterioration is predicted to be 11.38% at the node just downstream of Cambridge WRC. Downstream of this node, the percentage deterioration remains similar with minor exceedances of the 10% deterioration threshold but a decrease with distance from Cambridge WRC. As seven of the model node results are indicating a deterioration of greater than 10%, amending the permit from 0.5mg/l to 1mg/l could increase the potential for eutrophic conditions within the water body, particularly during the summer low flow months. This could therefore lead to impacts on a water body scale and prevent this quality element reaching its Moderate status objective by 2027. A further assessment of the impacts under the 1mg/l scenario, is therefore required.	**0.5mg/l Phosphorus** Figure 17 in Appendix F.4 presents the modelled ortho-p concentrations upstream and downstream of the proposed new works outfall under a 0.5mg/l permit scenario compared to the future baseline. At each model node within the Cam water body downstream of Cambridge WRC, there is a predicted reduction in ortho-p concentrations (mg/l) leading to an improvement in status from 'Poor' to 'Moderate'. Substantial improvements are predicted just downstream of the existing Cambridge WRC (334) and at the end of reach 334 with a 16% reduction in ortho-p at both model nodes. This improvement continues at the downstream nodes of the water body with a 19.4% improvement in ortho-p at end of reach 335 and 18.6at the end of reach 336. It is likely that the removal of Waterbeach WRC under the new works permit scenario is sustaining a predicted reduction in ortho-p concentrations to the downstream limit of the Cam water body. As there are substantial reductions in ortho-p concentrations predicted downstream of the new works outfall, from 'Poor' to 'Moderate' class, it is considered that the AWS proposed permit limit of 0.5mg/l (instead of 0.4mg/l specified by the EA) for Phosphorus, will not have a significant impact upon the Phosphate quality element. It is likely there will be a very marginal decrease in the amount of improvement at 0.5mg/l, however this would be at no risk to the objectives of this quality element.	As deterioration of more than 10% is predicted to occur under the interim scenario for this element, further assessment should be undertaken and appropriate measures identified to mitigate impacts. No further assessment is required under the 0.5mg/l new works permit scenario due to a predicted reduction in ortho-p concentrations.	/
pH		The increase in discharge under the proposed interim permit is not considered to result in any significant adverse effects on this element at the water body scale.	The increase in discharge under the proposed new works permit is not considered to result in any significant adverse effects on this element at the water body scale.	No further assessment is required.	/

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
Temperature		The increase in TSS under the proposed interim permit and new works permit is not considered to result in any significant adverse effects on this element at the water body scale. Given that there is only a marginal increase predicted in concentrations of TSS and no changes to vegetation cover are proposed, temperature is not anticipated to be affected on a water body scale. Storm events and events from diffuse sources are more likely to have impacts on temperature levels at a water body scale.	The increase in TSS under the proposed new works permit and new works permit is not considered to result in any significant adverse effects on this element at the water body scale. Given that there is only a marginal increase predicted in concentrations of TSS and no changes to vegetation cover are proposed, temperature is not anticipated to be affected on a water body scale. Storm events and events from diffuse sources are more likely to have impacts on temperature levels at a water body scale.	No further assessment is required.	/
Specific Pollutants					
Specific Pollutants		Under the proposed interim and new works scenarios, there is no anticipated increase in any of the Specific pollutants for this water body.		N/A	/
Chemical					
Priority Substances		Under the proposed interim and new works scenarios, there is no anticipated increase in any of the priority substances, and therefore no impact on this water body element.		N/A	/
Priority Hazardous Substances		Under the proposed interim and new works scenarios, there is no anticipated increase in any of the priority hazardous substances, and therefore no impact on this water body element.		N/A	/
Biological Quality Elements					
Biological Quality Elements		As part of this commissioned work, Ammonia, BOD and DO have not been assessed as part of the model. Further verification of the model and communication with the EA is required. Therefore, at this stage, the impacts on the biological quality elements cannot yet be fully quantified.			
Fish		With regards to the potential effects the changes in the TSS permit may have on fish, as detailed in the structure and substrate of the riverbed section, both scenarios for the interim permits will result in TSS concentrations in the water body that are substantially lower than the former Freshwater Fish Directive Guideline Standard of 25mg/l (used as an indication in the absence of a standard). As ortho-p concentrations are predicted to exceed the 10 percent threshold at two model node points and are close to exceeding this threshold at all other points downstream of Cambridge WRC, there is the potential for adverse impacts on fish populations within the water body. An increase in ortho-p concentrations over an extended period may increase the risk of eutrophic conditions in the water body and subsequently affect the taxonomic diversity, richness and abundance of fish. This could	The modelled results assessed for TSS predict small increases within the Cam water body under the proposed permit of 0.5mg/l. However, predicted concentrations fall significantly below the 25mg/l threshold of the Freshwater Fish Directive which would indicate acceptable conditions for fish. Furthermore, as phosphate concentrations are predicted to improve under this scenario there will be no adverse impacts upon this biological quality element. Further assessment will not be required at this stage	Further assessment on the impacts of the proposed interim permit on fish populations within this water body is required.	/

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		include a shift from intolerant to more pollutant tolerant taxa. Such conditions could also prevent fish movement and subsequent populations upstream, beyond the existing Cambridge WRC. Additionally, there is potential for any adverse impacts on fish populations, to impact protected sites within this water body such as the Fenland SAC and Cam Washes SSSI. Spined loach (*Cobitis taenia)* is a qualifying feature for the Fenland SAC and the species is present in the downstream Ely Ouse (South Level) water body. A prolonged deterioration in phosphate concentrations from current levels may lead to adverse impacts on this sensitive fish species. Further assessment on the impacts on fish under the interim permit scenario will therefore be required to ensure no deterioration will occur to overall water body status and objectives.			
Invertebrates		Given the amendments to TSS under the proposed interim permit (20mg/l), are predicted to lead to only minor increases in TSS concentrations, no impacts to invertebrates at a water body scale from TSS are predicted. However, as ortho-p concentrations are predicted to exceed the 10 percent threshold at two model node points and are close to exceeding this threshold at all other points downstream of Cambridge WRC, there is the potential for adverse impacts on invertebrate communities at water body scale. An increase in phosphate concentrations over an extended period of several years may increase the risk of eutrophic conditions in the water body and could lead to permanent impacts on invertebrates. Impacts could include a reduction in taxon abundance and richness of sensitive taxa such as caddis fly and mayfly. This could in turn reduce the ability of fish to feed on invertebrates within the water body. Such adverse impacts could negatively affect the Fenland SAC. A decrease in invertebrates such as mayfly larvae, gammarids and chironomids could in turn have an adverse impact upon the Spined loach (*Cobitis taenia)* population (a qualifying feature of the SAC). Consequently, further assessment of the impacts on invertebrates will be required to ensure no deterioration from Good status will occur to this biological quality element.	Given the amendments to TSS under the proposed new works permit (20mg/l), are predicted to lead to only minor increases in TSS concentrations, no impacts to invertebrates at a water body scale from TSS are predicted. Furthermore, as phosphate concentrations are predicted to reduce under the proposed new works permit there will be no adverse impacts upon this biological quality element. Further assessment will not be required at this stage	Further assessment on the impacts of the proposed interim permit on invertebrates within this water body is required.	/

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
Macrophytes and Phytobenthos	Not assessed	Given the amendments to TSS under the proposed interim permit (20mg/l), are predicted to lead to only minor increases in TSS concentrations, no impacts to macrophytes and phytobenthos at a water body scale from TSS are predicted. However, as ortho-p concentrations are predicted to exceed the 10 percent deterioration threshold at two model node points and are close to exceeding this threshold at all other points downstream of Cambridge WRC, there is the potential for adverse impacts on this quality element. An increase in phosphate concentrations over an extended period of several years may increase the risk of eutrophic conditions in the water body. There is a risk that such conditions could lead to a proliferation of algae and large aquatic plants and consequently reduce DO levels within the water body. This could in turn lead to further impacts on invertebrate communities and fish populations such as the Spined loach (*Cobitis taenia)* is a qualifying feature for the Fenland SAC.	Given the amendments to TSS under the proposed new works permit (20mg/l), are predicted to lead to only minor increases in TSS concentrations, no impacts to macrophytes and phytobenthos at a water body scale from TSS are predicted. Furthermore, as phosphate concentrations are predicted to reduce under the proposed new works permit there will be no adverse impacts upon this biological quality element. Further assessment will not be required at this stage.	Further assessment on the impacts of the proposed interim permit on macrophytes and phytobenthos within this water body is required.	/
Protected Area Designations		**Eutrophic Sensitive Area River Cam UKENRI91** Due to the potential deterioration in Phosphate status outlined, under the interim permit scenario, there is an increased risk eutrophic conditions could occur within the Cam water body. Further assessment is required to determine the level of risk to this protected area. **Fenland SAC** As stated in the biological quality elements section, there is potential under the interim permit scenario for adverse impacts on this SAC. The SAC is located 8.9km from the existing Cambridge WRC adjacent to the Burwell Lode water body and is hydrologically connected to the River Cam. There is potential that a prolonged increase in ortho-p in the Cam water body could have a significant effect upon the designated site. Initial assessment has been undertaken on the potential impact to the site in the HRA, located in located in Section 6 and in full in Appendix D: Further assessment will be required as part of a Stage 2 HRA Appropriate Assessment.	**Eutrophic Sensitive Area River Cam UKENRI91** Due to the improvements predicted in Phosphate and only minor increases in TSS, under the proposed new works permit scenario, there is no increased risk that eutrophic conditions could occur within the Cam water body. Further assessment will not be required at this stage to determine the level of risk to this protected area. **Fenland SAC** Initial assessment has been undertaken on the potential impact to the site in the Stage 1 HRA, located in Section 6 and in full in Appendix D. Due to a predicted deterioration in TSS concentrations, further assessment will be required as part of a Stage 2 HRA Appropriate Assessment.	Further assessment of the impact on the Eutrophic Sensitive Area River Cam UKENRI91 under the proposed interim permit scenario. Further assessment as part of a HRA Stage 2 Appropriate Assessment is required to assess the risk to Fenland SAC under the proposed interim permit scenarios.	/

Table 11 Scoping Assessment for the Ely Ouse (South Level) water body

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		Interim permit	**New works permit**		
Hydromorphological Supporting Elements					
Quantity and dynamics of water flow		Under the proposed interim and new works scenarios, there is no anticipated impact upon these hydromorphological supporting elements.		N/A	N/A
Connection to groundwater bodies					
River continuity					
River depth and width variation					
Structure of the riparian zone					
Structure and substrate of the riverbed		The morphological conditions for this water body have not been assessed, however historic TSS data provides an indication of conditions. Figure 5 in Appendix F.1 provides the temporal trend in TSSs in the Ely Ouse (South Level) water body at Ten Mile Denver Sluice from 2018 to 2020 (most recent available data and approximately 45km downstream from the current Cambridge WRC). The data shows that the mean TSS is 11.3mg/l with peaks in concentrations during both winter and summer months (19.4mg/l in January 2018 and 18.7mg/l in July 2018). The absence of any seasonal trend in the data would suggest that TSS conditions are affected by periodic inputs, rather than a constant point source, such as WRC's. Despite constant sediment inputs from point sources, TSS remains low for most of the monitoring period. Mass balance calculations have been undertaken to estimate how TSS concentrations may change with the interim and proposed permits for Cambridge WRC. Although both scenarios have the same permit there will be an increase in effluent flows once the proposed permit is in place which will influence concentrations.		No further actions required as analysis has concluded that the proposed interim and new works permit limit of 20mg/l for TSS is not likely to risk compliance of this supporting element.	N/A

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		Figure 8 in Appendix F.2 presents the estimated TSS concentrations downstream of the existing Cambridge WRC with 17mg/l and 20 mg/l permits. Within the Ely Ouse water body (model nodes 338 to 361), an increase in TSS concentration is predicted from the baseline to the 20mg/l scenario. At model node 339 (the furthest upstream node in this water body with baseline data), a small increase in TSS concentration in the 17mg/l scenario is predicted (from 6.60mg/l to 7.04mg/l) and a slightly larger increase in the 20mg/l scenario (from 6.60mg/l to 7.30mg/l). However, this is considered to be a small increase of 0.70mg/l and this is also likely influenced by Ely (New) WRC, Ely WRC and Little Downham WRC near to model node 339, and Southery (Mill Dr) Storm Tank near to model node 359. Typically, average total TSS from a WRC is about half of the permit 95%ile value to allow for fluctuations, therefore the mass balance calculations undertaken for this assessment are likely to have overestimated TSS concentrations in the water body for both interim permit scenarios. There are no environmental quality standards for TSS, however the Freshwater Fish Directive (recognising that this directive was repealed under the WFD hence just referred to for indicative purposes) gives a Guideline Standard of an annual mean of 25mg/l[14]. Both interim permit scenarios presented are substantially below this mean throughout the Ely Ouse water body with a maximum of 12.9mg/l and 13.2mg/l at the most upstream monitoring point for the17mg/l and 20mg/l scenario scenarios respectively (node 338). As a consequence, amending the TSS permit to either 17mg/l or 20mg/l is unlikely to have significant effect on TSS, and therefore the structure and substrate of the riverbed, in the Ely Ouse (South Level) water body at a water body scale, especially as the WRC will likely operate a substantially lower discharge than the concentrations included in the mass balance calculations. The upstream extent of the Ely Ouse water body also lies a considerable distance (~15km) downstream of the new Cambridge WRC, further limiting effects at a water body scale.	Figure 9 in Appendix F.2 presents the estimated TSS concentrations downstream of the proposed new works outfall with 14mg/l and 20 mg/l permits. Under the 14mg/l scenario, there is an increase in TSS concentration downstream of the WRC (335) at model nodes 339, 359, 360, 361, and a decrease in concentrations at model node 358. Under the 20mg/l permit scenario, there is an increase from the baseline at every model node point. However, the increases predicted are small with largest rises in TSS at model node 339 (0.84mg/l) and 359 (0.59mg/l). This is likely due to the influence of Ely (New) WRC, Ely WRC and Little Downham WRC near to model node 339, and Southery (Mill Dr) Storm Tank near to model node 359. Further downstream of this point, the change is less 0.52 and 0.40mg/l respectively, with the effect from the current Cambridge WRC decreasing with distance downstream. As mentioned with regards to the interim permits, average total TSS from a WRC is about half of the permit 95%ile value to allow for fluctuations, therefore this assessment is likely to have overestimated suspended in the water body for both proposed permit scenarios. Both proposed permit scenarios are below the 25mg/l Freshwater Fish Directive guideline standard throughout the water body with a maximum of 12.5 and 13.2mg/l respectively. As a consequence, amending the TSS permit to either 14mg/l or 20mg/l is unlikely to have a significant effect on TSS, and therefore the structure and substrate of the riverbed, in the Ely Ouse water body, especially as the WRC will likely operate a substantially lower discharge than the concentrations included in the mass balance calculations. The upstream extent of the Ely Ouse water body also lies a considerable distance (15km) downstream of the new Cambridge WRC, further limiting effects at a water body scale.		

[14] The Freshwater Fish Directive has been repealed and replaced with the WFD, however the threshold provides a useful indicator of acceptable TSS conditions.

<table>
<tr><th>WFD Quality Elements</th><th>RMBP Cycle 2 (2016) Classification</th><th>Assessment of effects on quality elements</th><th>Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)</th><th>Risk to WFD compliance after mitigation</th></tr>
<tr><td colspan="2">Physico-chemical Supporting Elements</td><td colspan="3"></td></tr>
<tr><td>Ammonia (Phys-chem)</td><td></td><td rowspan="3">Subject to further model verification and discussions with the Environment Agency.</td><td rowspan="3">N/A</td><td rowspan="3">N/A</td></tr>
<tr><td>Biological Oxygen Demand (BOD)</td><td></td></tr>
<tr><td>Dissolved Oxygen (DO)</td><td></td></tr>
<tr><td>Phosphate</td><td></td><td colspan="2">SIMCAT modelling has been undertaken to show how phosphorus concentrations may change under the proposed new works permit scenarios. The future baseline was modelled to take account of the population growth and implementation of AMP6 and AMP7 schemes to 2027. To understand the potential risk of deterioration to this quality element, Total Phosphorus concentrations required conversion to mean orthophosphate (ortho-P). As no ortho-P data was available as an output of the SIMCAT modelling, values were estimated as mean TP multiplied by 0.7 (this is a generally accepted ‘rule of thumb’ and further explanation is set out within the Addendum in 7.3Appendix G: These values therefore provide an indication of the future concentrations under the proposed interim permit scenario but should be observed with caution. WFD classification boundaries for the water body were calculated based on altitude and mean observed alkalinity from the WIMS monitoring point at Ely Ouse Ely High Rd Bridge.

Most recent available ortho-p data were obtained for 2017 from Ely Ouse Ely High Rd Bridge (approximately 5km downstream from the current Cambridge WRC). Mean ortho-p concentrations were recorded as 0.38mg/l and within the upper range of the ‘Poor’ classification close to the Moderate classification threshold. Figure 12 in Appendix F.3 indicates very little seasonal variation in ortho-p at this location which may suggest concentrations are influenced by other inputs from the Old West River and Burwell Lode water bodies, as much as inputs from the WRCs upstream of this location.</td><td>No further assessment required of the impacts under the proposed interim or new works permit for this water body.</td><td>N/A</td></tr>
<tr><td colspan="2"></td><td><u>1mg/l Phosphorus</u>

The upstream extent of the Ely Ouse water body lies approximately 15 km downstream of the existing Cambridge WRC outfall. Figure 18 in Appendix F.4 presents the modelled ortho-p concentrations downstream of the existing Cambridge WRC with a 1mg/l permit compared to the future baseline. The modelled future baseline scenario predicts ortho-p concentrations to be within Moderate classification for all model nodes. The highest concentrations of ortho-p under the future baseline are at the end of reach 339. This is likely due to the influence of Ely (New) WRC, Ely WRC and Little Downham WRC.

When assessed against the proposed interim permit, there is a predicted increase in ortho-p concentrations at each</td><td><u>0.5 mg/l Phosphorus</u>
Figure 19 in Appendix F.4 presents the modelled ortho-p concentrations within Ely Ouse water body under a 0.5mg/l proposed new works permit scenario.

At each model node (338 to 361), there is a predicted reduction in ortho-p concentrations (mg/l). The decrease in levels of ortho-p would ensure no deterioration in class for this quality element. The model nodes with the greatest predicted reductions in ortho-p for this scenario are end of reach 338 (14.98%) and end of reach 339 (12.08%). It is likely that the removal of Waterbeach WRC under the new works permit scenario is a key reason for the improvements in predicted ortho-p concentrations at these model nodes.</td><td></td></tr>
</table>

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
		model node (model node 338 to 361) within the water body. Significantly, there are no increases in ortho-p that represent a deterioration in class from Moderate to Poor status or by more than 10% deterioration within class. The greatest deterioration from the future baseline scenario is at the end of reach 338 where concentrations increase from 0.159mg/l to 0.173mg/l (8.81%). This model node point is located just downstream of the confluence with the River Cam and concentrations are therefore likely to be heavily influenced by phosphate input from upstream on the Old West River water body. The extent of deterioration steadily decreases throughout the water body to 4.00% deterioration at the end of reach 361 (the furthest downstream of model nodes within the water body. Given this water body is between approximately 15 and 45km downstream of the existing Cambridge WRC outfall, and there are no exceedances of 10% deterioration, it is considered that the impacts from a 1mg/l permit are considerably reduced. The risk to deterioration of this quality element is therefore considered low and no further assessment is required.	As there are clear reductions in ortho-p concentrations predicted throughout this water body, it is considered that the AWS proposed permit limit of 0.5mg/l (instead of 0.4mg/l specified by the EA) for Phosphorus, will not have a significant impact upon the Phosphate quality element. It is likely there will be a very marginal decrease in the amount of improvement at 0.5mg/l compared with 0.4mg/l, however this would be at no risk to the status and objectives of this quality element.		
pH		The increase in discharge under the proposed interim permit is not considered to result in any significant adverse effects on this element at the water body scale.	The increase in discharge under the proposed new works permit is not considered to result in any significant adverse effects on this element at the water body scale.	/	N/A
Temperature		The increase in TSS under the proposed interim permit and new works permit is not considered to result in any significant adverse effects on this element at the water body scale. Given that there is only a marginal increase predicted in concentrations of TSS and no changes to vegetation cover are proposed, temperature is not anticipated to be affected on a water body scale. Storm events and events from diffuse sources are more likely to have impacts on temperature levels at a water body scale.	The increase in TSS under the proposed interim permit and new works permit is not considered to result in any significant adverse effects on this element at the water body scale. Given that there is only a marginal increase predicted in concentrations of TSS and no changes to vegetation cover are proposed, temperature is not anticipated to be affected on a water body scale. Storm events and events from diffuse sources are more likely to have impacts on temperature levels at a water body scale.	/	N/A
Specific Pollutants					
Specific Pollutants		Under the proposed interim and new works scenarios, there is no anticipated impact upon levels of Specific Pollutants.		/	N/A
Chemical					
Priority Substances				/	N/A

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
Priority Hazardous Substances		Under the proposed interim and new works scenarios, there is no anticipated impact upon levels of Specific Pollutants.			N/A
Other pollutants					N/A
Biological Quality Elements					
Biological Quality Elements		As part of this commissioned work, Ammonia, BOD and DO have not been assessed as part of the model. Further verification of the model and communication with the EA is required. Therefore, at this stage, the impacts on the fish quality element cannot yet be fully quantified.			
Fish		With regards to the potential effects the changes in the TSS permit may have on fish, as detailed in the structure and substrate of the riverbed section, both scenarios for the interim permits will result in TSS concentrations in the water body that are substantially lower than the former Freshwater Fish Directive Guideline Standard of 25mg/l, although it should be fully recognised that this directive was repealed under the WFD. Although an increase in ortho-p concentrations at each model node (338 to 361) is predicted within the water body, there are no increases in ortho-p that represent a deterioration in class from Moderate to Poor status or by more than 10% deterioration within class. The change in ortho-p concentrations from the future baseline scenario would therefore not be enough to adversely impact upon fish populations at a water body scale. Greatest impacts on fish in this water body are likely to be associated with discharge from other WRCs in proximity to this catchment, such as Stretham WRC, Ely (New) WRC, Ely WRC and Little Downham WRC. From the TSS and Phosphate data assessed, it is therefore unlikely that the proposed interim permit will lead to a deterioration in class for this biological quality element. Further assessment will not be required at this stage.	With regards to the potential effects the changes in the TSS permit may have on fish, as detailed in the structure and substrate of the riverbed section, both scenarios for the interim permits will result in TSS concentrations in the water body that are substantially lower than the former Freshwater Fish Directive Guideline Standard of 25mg/l although it should be fully recognised that this directive was repealed under the WFD. Furthermore, as phosphate concentrations are predicted to reduce under the proposed new works permit there will be no adverse impacts upon this biological quality element. From the data assessed, it is therefore unlikely that the proposed new works permit will lead to a change in class for this biological quality element. Further assessment will not be required at this stage.	No further assessment is required.	N/A

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (built in mitigation, additional measures (best practice) and monitoring required to reduce effects)	Risk to WFD compliance after mitigation
Invertebrates		Given the amendments to TSS under the proposed interim permit (20mg/l) are predicted to lead to only minor increases in TSS concentrations within this water body, no impacts to invertebrates at a water body scale from changes in TSS are predicted. Modelling results predicted an increase in Ortho-p concentrations at all points within this water body. However, the lack of any deterioration in class or exceedance by 10% would suggest that impacts on invertebrate populations from the proposed interim permit scenario would be negligible and not at a water body scale. Greatest impacts on invertebrates in this water bodyare likely to be associated with discharge from other WRCs in proximity to this catchment, such as Stretham WRC, Ely (New) WRC, Ely WRC and Little Downham WRC. From the data assessed, it is therefore unlikely that the proposed interim permit will lead to a deterioration from High class for this biological quality element. Further assessment will not be required at this stage.	Given the amendments to TSS under the proposed new works permit (20mg/l), are predicted to lead to only minor increases in TSS concentrations within this water body, no impacts to invertebrates at a water body scale from changes in TSS are predicted. Furthermore, as phosphate concentrations are predicted to reduce under the proposed new works permit there will be no adverse impacts upon this biological quality element. Greatest impacts on invertebrates would be associated with discharge from other WRCs in proximity to this catchment, such as Stretham WRC, Ely (New) WRC, Ely WRC and Little Downham WRC. From the data assessed, it is therefore unlikely that the proposed new works permit will lead to a deterioration from High class for this biological quality element. Further assessment will not be required at this stage.	No further assessment is required under the proposed interim or proposed new works permit scenarios.	N/A
Macrophytes and Phytobenthos	Not assessed	Given the amendments to TSS under the proposed interim permit (20mg/l) are predicted to lead to only minor increases in TSS concentrations within this water body, no adverse impacts to macrophytes and phytobenthos at a water body scale, are predicted. Modelling results predicted an increase in Ortho-p concentrations at all points within this water body. However, the lack of any deterioration in class or exceedance by 10% would suggest that impacts on macrophytes and phytobenthos populations from the proposed interim permit scenario would be negligible. From the data assessed, it is therefore unlikely that the proposed interim permit will lead to a deterioration for this biological quality element. Further assessment will not be required at this stage.	Given the amendments to TSS under the proposed interim permit (20mg/l) are predicted to lead to only minor increases in TSS concentrations within this water body, no adverse impacts to macrophytes and phytobenthos at a water body scale, are predicted. As phosphate concentrations are predicted to reduce under the proposed new works permit there will be no adverse impacts upon this biological quality element. Further assessment will not be required at this stage.	No further assessment is required under the proposed interim or proposed new works permit scenarios.	N/A
Protected Area Designations		**Eutrophic Sensitive Area Old West & Ely Ouse (UKENRI90)** No further assessment will be required given there are no predicted deteriorations in class or exceedances of 10% deterioration within class predicted for Phosphate within this water body.	**Eutrophic Sensitive Area Old West & Ely Ouse (UKENRI90)** No further assessment will be required given there are no predicted deteriorations in class or exceedances of 10% deterioration within class predicted for Phosphate within this water body.	No further assessment is required.	N/A

Table 12 Scoping Assessment for Cam and Ely Ouse Woburn Sands - GB40501G445700

WFD Quality Elements	RMBP Cycle 2 (2016) Classification	Assessment of effects on quality elements		Actions for WFD Compliance (including proposed mitigation during design and implementation of works)	Risk to WFD compliance after mitigation
Quantitative					
Saline or other intrusions		Under the proposed interim and new works scenarios, there is no anticipated impact upon these quality elements.		N/A	/
Surface Water					/
Groundwater dependent terrestrial ecosystems					/
Water balances					/
Chemical					
		As part of this commissioned work, Ammonia, BOD and DO have not been assessed as part of the model. Further verification of the model and communication with the EA is required. Therefore, at this stage, the impacts on the fish quality element cannot yet be fully quantified.			
Saline or other intrusion		Under the proposed interim and new works scenarios, there is no anticipated impact upon this quality element.		N/A	/
Drinking Water Protected Areas		**Cam and Ely Ouse Chalk DwPA** The existing Cambridge WRC lies just within the Cam and Ely Ouse Chalk DwPA. Under the 1mg/l phosphorus permit scenario, there are predicted exceedances of 10% just downstream of Cambridge WRC and close to 10% at all subsequent downstream model nodes within the Cam surface water body. Prolonged deterioration just downstream of the works for the duration of the interim permit is considered to potentially lead to deterioration of this 'at risk' DwPA. **Cam and Ely Ouse Woburn Sands DwPA** A small area (<0.5%) of the Cam and Ely Ouse Woburn Sands DwPA underlies the study area. For this reason and the distance this protected area lies downstream of the WRC, there is not anticipated to be any risk to the quality of this DwPA.	**Cam and Ely Ouse Chalk DwPA** The proposed Cambridge WRC lies just within the Cam and Ely Ouse Chalk DwPA. Under the 0.5mg/l phosphorus new works permit scenario, no predicted exceedances of 10% are predicted. Consequently, there is no anticipated risk to this DwPA. **Cam and Ely Ouse Woburn Sands DwPA** A small area (<0.5%) of the Cam and Ely Ouse Woburn Sands DwPA underlies the study area. For this reason and the distance this protected area lies downstream of the WRC, there is not anticipated to be any risk to the quality of this DwPA.	The Cam and Ely Ouse Chalk DwPA is classified as 'at risk'. Further assessment should be undertaken to ascertain the level of risk to this protected area under the interim permit scenario.	/

6. HRA Screening matrix

A Stage 1 HRA assessment (located in Appendix D) has been undertaken to evaluate the likely significant effects the proposed interim permit and the proposed new works permits would have on a range of designated sites and their qualifying features. Table 13 details the potential effects that are likely to arise for the proposed interim and new works permit scenarios. For further information, please see the full HRA report in 7.3Appendix D:.

This Stage 1 assessment has concluded in the absence of mitigation the proposed interim and new works permits will have a likely significant effect on a range of designated sites and their qualifying features.

Further assessment will be required in the form of a Stage 2 Appropriate Assessment.

Table 13 HRA Screening assessment of potential impact pathways against the designable features and their associated conservation objectives.

3.2.2 Screening assessment

Colour coding has been used in the 'impact pathway' column II as follows:

There is no impact pathway from the proposal to the qualifying feature

There is an impact pathway in principle, but significant effects from the proposal when considered alone can be ruled out

There is an impact pathway and significant effects cannot be ruled out.

Qualifying Feature	Assessment of likelihood of significant effect	
	I Relevant conservation objectives	II Potential impact pathway
Cam washes SSSI Snipe Unimproved grassland pasture **Fenland SAC** Great crested newts Spined loach **Wicken Fen SSSI** Marshland habitat **Upware bridge pit SSSI** Standing open water **Ely pits meadows** Wintering bittern Wintering bird assemblage **Chettisham meadows** Neutral grassland	Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; ○ The extent and distribution of qualifying natural habitats and habitats of qualifying species, ○ The structure and function (including typical species) of qualifying natural habitats, ○ The structure and function of the habitats of qualifying species,	**Water quality** **Proposed Interim Permit** The target levels of TSS and P for the proposed interim permit have been modelled against the current baseline in the catchment and are displayed in Appendix F2: Figure 5 and Appendix F5: Figure 15. Both graphs show an increase in P and TSS throughout the catchment under the interim permit, except in the Hundred Foot River with regards to TSS. Water quality reduces in terms of P in the River Cam by an average 0.028mg/l, Ely-Ouse by an average 0.012mg/l and Great Ouse by an average 0.003mg/l, the relief channel which is controlled by Denver sluice showed no change in the model, however this needs further exploration to determine if there is a likely change. TSS will also deteriorate under this scenario with the River Cam reducing water quality by an average of 1.34mg/lEly-Ouse by an average of 0.39mg/l and Great Ouse by an average of 0.14mg/l (node 368). Water quality which underpins a range of designable features is predicted to deteriorate under this new scenario. The source apportionment outputs displayed in the previous report by Atkins[15] shows that sewage treatment works is responsible for the increase of P in the catchment. Milton is one of

[15] Atkins (2018) Cambridge WRC Relocation report

Ouse Washes Ramsar Washland habitat Wintering bird assemblage Aquatic flora **Ouse Washes SAC** Spined Loach **Ouse Washes SPA** Ruff, Whooper swan, Hen Harrier, Gadwell, Mallard and; Black tailed godwit. **Wilbraham Fen** Neutral grassland	○ The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely, ○ The populations of qualifying species, and, ○ The distribution of qualifying species within the site.	seven sewage treatment works that are directly adjacent to the catchment. As such, it can be derived from the model that the proposed interim permit discharge will increase of P and TSS in the catchment. Whilst the influence of the discharge becomes reduced with distance downstream, increases of P and TSS can still be attributed to the discharge regime under the proposed interim permit. The reduction in water quality could influence both the diversity of macrophyte and aquatic invertebrate communities in the catchment. Generally, a reduction in water quality favours more pollutant tolerant macrophyte and aquatic invertebrate species. This in turn could have a knock-on effect to fish species, namely spined loach and bird species, by reducing the food supply. **Therefore, it is anticipated that without mitigation there could be a likely significant effect on a range of designable habitats and features for a number of designated site due to the deterioration of water quality from the proposed interim permit.**
		Water quality **Proposed New Permit** The target levels of TSS and P for the proposed interim permit have been modelled against the current baseline in the catchment and are displayed in Appendix F2: Figure 7 and Appendix F5: Figure 15. Figure 15 shows an improvement in P within the catchment, whilst TSS is set to deteriorate in Figure 7 under the new works permit, except in the Hundred Foot River. Water quality in terms of P improves in the River Cam by 0.111mg/l, Ely-Ouse by 0.020mg/l and Great Ouse by 0.005mg/l, the relief channel which is controlled by Denver sluice showed no change in the model, however this need further exploration to determine if there is a likely change. However, TSS is predicted to deteriorate under this scenario with the River Cam reducing water quality by an average of 0.1.60mg/l, Ely-Ouse by an average of 0.48mg/l and Great Ouse by an average of 0.17mg/l. Water quality which underpins a range of designable features is predicted to deteriorate in terms of TSS under this new scenario. The improvement in P could influence both the diversity of macrophyte and aquatic invertebrate communities in the catchment, positively. However, any improvement in P is lost by the deterioration of TSS. The reduction from TSS could influence both the diversity of macrophyte and aquatic invertebrate communities in the catchment. Generally, a reduction in water quality favours more pollutant tolerant macrophyte and aquatic invertebrate species. This in turn

		could have a knock-on effect to fish species, namely spined loach and bird species, by reducing the food supply. **Therefore, it is anticipated that without mitigation there could be a likely significant effect on a range of designable habitats and features for a number of designated site due to the deterioration of water quality from the proposed interim permit.**	
		Hydrological Change **Proposed Interim Permit** Under the target levels proposed in the interim permit there is an anticipated change in flow. Under the interim permit this would lead to an increase in flow from the existing permit of 37,330 m^3/d to 44, 851 m^3/d. This has the potential to cause hydrological change to designated sites and their qualifying features. Results of flood modelling undertaken to assess effects on designated sites are presented within the Addendum to this report in Appendix G. Detailed geomorphological assessment has not been undertaken about how sediment moves in this system. Therefore, using the precautionary principle, hydrological change will occur as part of the proposed interim permit. **It is anticipated that without mitigation there could be an impact to the qualifying features of a range of designated sites.** **Hydrological Change** **Proposed New works Permit** Under the target levels proposed new works permit there is an anticipated change in flow. An increase in flow from the interim permit of 44,851 m^3/d to 55, 000 m^3/d is anticipated. Modelling undertaken has shown that mean flow under the proposed permit scenario would lead to a maximum increase of 4.20% and an average increase of 1.45% from the future baseline and interim mean flow rates (please refer to Section 4 (c) of the main report). This change in flow has the potential to cause hydrological change to designated sites and their qualifying features. Results of flood modelling undertaken to assess effects on designated sites are also presented within the Addendum to this report in Appendix G.	

		. Detailed geomorphological assessment has not been undertaken about how sediment moves in this system Therefore, using the precautionary principle, hydrological change will occur as part of the proposed new works permit. **It is anticipated that without mitigation there could be an impact to the qualifying features of a range of designated sites.**	
		<u>Deterioration in Habitat</u> **Proposed interim permit** As previously discussed, the model currently predicts a deterioration in water quality for P and TSS, see Appendix F2: Figure 6 and Appendix F5: Figure 15 for further details. Water quality in terms of P reduces in the River Cam by 0.028mg/l, Ely-Ouse by 0.012mg/l and Great Ouse by 0.003mg/l, the relief channel which is controlled by Denver sluice showed no change in the model, however this need further exploration to determine if there is a likely change. TSS will also deteriorates under this scenario with the River Cam reducing water quality by an average of 1.34mg/l, Ely-Ouse by an average of 0.39mg/l and Great Ouse by an average of 0.14mg/l. Water quality which underpins a range of designable features is predicted to deteriorate under this new scenario. The source apportionment outputs displayed in the previous report by Atkins[16] shows that sewage treatment works are responsible for the increase of P in the catchment. Milton is one of seven sewage treatment works that are directly adjacent to the catchment. As such, it can be derived from the model that proposed interim permit discharge will increase of P and TSS in the catchment. Whilst the influence of the discharge becomes reduced with distance downstream, increases of P and TSS can still be attributed to the discharge regime under the proposed interim permit. The proposed permit levels could influence both the diversity of macrophyte, wetland habitats and mesotrophic grassland	

[16] Atkins (2018) Cambridge WRC Relocation report

		communities in the catchment. Generally, a reduction in water quality favours more pollutant tolerant macrophyte, terrestrial plant species, aquatic and terrestrial invertebrate species. This in turn could lead to a reduction in diversity in qualifying habitats, it also could cause simplification and/or loss of qualifying habitats due to changes in water quality. **It is anticipated that without mitigation there could be an impact to the qualifying features of a range of designated sites.**	
		<u>Habitat loss</u> **Proposed New Works Permit** The target levels of P and TSS for the proposed new works permit have been modelled against the current baseline in the catchment and are displayed in Appendix F2: Figure 7 and Appendix F5: 15. Both graphs show an increase in P and TSS throughout the catchment under the interim permit. Water quality in terms of P improves in the River Cam by 0.111mg/l, Ely-Ouse by 0.020mg/l and Great Ouse by 0.005mg/l, the relief channel which is controlled by Denver sluice showed no change in the model, however this need further exploration to determine if there is a likely change. However, TSS is predicted to deteriorate under this scenario with the River Cam reducing water quality by an average of 1.60mg/l, Ely-Ouse by an average of 0.48mg/l and Great Ouse by an average of 0.17mg/l. Water quality which underpins a range of designable features is predicted to improve under this new scenario. The improvement in P could have influence both the diversity of macrophyte and aquatic invertebrate communities in the catchment, positively. However, any improvement in P is lost by the deterioration of TSS. The proposed permit could influence both the diversity of macrophyte and aquatic invertebrate communities in the catchment. Generally, a reduction in water quality favours more pollutant tolerant macrophyte, terrestrial plant species, aquatic and terrestrial invertebrate species. This in turn could lead to a reduction in diversity in qualifying habitats, it also could cause simplification and/or loss of qualifying habitats due to changes in water quality. **It is anticipated that without mitigation there could be an impact to the qualifying features of a range of designated sites.**	

7. Conclusion

This water quality and ecological assessment has provided an assessment of the potential impact of the proposed interim and revised permits on concentrations of phosphorus, suspended solids in the receiving waters downstream of the works, and a preliminary assessment of ecological impacts within these waters and on designated sites within the zone of influence of the discharge.

Due to a low confidence in the ammonia, BOD and dissolved oxygen model, the results for the three scenarios for these determinands have not been presented in this report. It is recommended that this SIMCAT model is updated further, including additional calibration, before these results are presented. For this reason, only an assessment of phosphorus and suspended solids are presented.

7.1 Water quality modelling

All three scenarios (future baseline, interim, new works) were shown to have an increase in total phosphorus (TP) immediately downstream of Cambridge WRC. Downstream of this the TP concentration started to decrease. For the baseline and interim permit scenarios an increase was predicted again immediately downstream of Waterbeach WRC. Where Waterbeach WRC was removed from the new works permit scenario, this increase was not observed. Throughout the catchment the new works permit scenario was predicted to have lower mean concentrations when compared to the baseline and interim permit scenarios. The interim scenario was predicted to have the highest concentrations across the catchment.

Mass balance assessment for suspended solids found that under the 20mg/l suspended solids discharge from Cambridge WRC, an increase was predicted for both the interim and proposed permit. The increase predicted in the proposed scenario at this point was higher than the interim scenario, which is assumed to be associated with the overall increase in effluent flow.

For all three scenarios an increase in suspended solids was predicted at the end of reach 337, however this increase is likely to be associated with the large tributary that is immediately upstream of this sampling point. From this point, the concentration progressively decreases downstream (except for the end of reach 339), noting reach 368 downstream is tidal, until the end of reach 419 where there was a large increase in suspended solids concentrations in the observed data.

7.2 WFD Compliance Assessment

The Cam and Ely Ouse (South Level) surface water bodies were screened into this assessment following initial assessment of water quality modelling results. It was considered that amending the TSS permit to 20mg/l is unlikely to have significant effect on TSS, and therefore the structure and substrate of the riverbed, in the Cam water body at a water body scale.

For the Cam surface water body, under the interim permit of 1mg/l phosphorus, a deterioration by more than 10% for each model node point downstream of Cambridge WRC is predicted. Deterioration exceedances within class by more than 10% over a prolonged period, have potential to cause adverse impacts to the water quality and ecology of the water body. This could lead to eutrophic conditions and detrimental impacts on fish, invertebrates and macrophytes and phytobenthos within the Cam. The Fenland SAC was also identified as at risk under the interim permit scenario due to the proximity to the Cam water body and the presence of the qualifying feature Spined loach. Further assessment is therefore required on the impacts of the interim permit scenario due to predicted deterioration in phosphate.

Under the proposed new works permit of 0.5mg/l phosphorus, an improvement in phosphate concentrations was predicted. For the Ely Ouse (South Level) surface water body, no risks to status or objectives were identified under the interim or the proposed permit scenarios. No deterioration in class or exceedances of 10% within class were predicted and consequently, the water body can be screened out of any further assessment.

For the groundwater body, Cam and Ely Ouse Woburn Sands there is potential for impact upon the Cam and Ely Ouse Chalk DwPA. Under the 1mg/l phosphorus permit scenario, there are predicted exceedances of 10% just downstream of Cambridge WRC and close to 10% at all subsequent downstream model nodes within the Cam surface water body. Prolonged deterioration just downstream of the works for the duration of the interim permit is considered to potentially lead to adverse impact to this 'at risk' DwPA. Further assessment is therefore required.

7.3 HRA conclusion

The Stage 1 assessment evaluated the likely significant effects the proposed interim permit and the proposed new works permits would have on a range of designated sites and their qualifying features.

It has concluded that the proposed interim permit and the proposed new works permits has the potential to affect a range of designated sites due to a deterioration in water quality, hydrological change due to changes in flow regime, and habitat loss from changes to the water environment . As such the Stage 1 assessment has concluded in the absence of mitigation, the proposed permits will have a likely significant effect on a range of designated sites and their qualifying features.

A Stage 2 Appropriate Assessment is recommended to assess whether there will be any adverse effects to the integrity of each site identified at Stage 1.

Get in touch

You can contact us by:

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Calling our Freephone information line on **0808 196 1661**

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You can view all our DCO application documents and updates on the application on The Planning Inspectorate website:

https://infrastructure.planninginspectorate.gov.uk/projects/eastern/cambridge-waste-water-treatment-plant-relocation/