



# **Informal Habitat Regulations Assessment**

South Lincolnshire Reservoir

November 2022

Confidential

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## Acronyms and abbreviations

Acronym	Definition
AA	Appropriate Assessment
CEMP	Construction and Environmental Management Plan
cSAC	Candidate Special Area of Conservation
CTMP	Construction Traffic Management Plan
DAF	Dissolved Air Flootation
DO	Deployable Output
EA	Environment Agency
EAR	Environmental Appraisal Report
ECJ	European Court of Justice
GAC	Granular Activated Carbon
HRA	Habitats Regulations Assessment
INNS	Invasive Non-Native Species
IROPI	Imperative Reasons of Overriding Public Interest
LSE	Likely Significant Effects
MI/d	Megalitres per day
NLSE	No Likely Significant Effects
NSN	National Site Network
PEAR	Preliminary Environmental Appraisal Report
POM	Programme Of Measures [WFD measures required to improve waterbody status]
PS	Pumping station
pSPA	Proposed Special Protection Area
RAPID	Regulators' Alliance for Progressing Infrastructure Development
RGF	Rapid Gravity Filter
SAC	Special Area of Conservation
SEA	Strategic environmental assessment
SIP	Site Improvement Plan
SNCB	Statutory Nature Conservation Body
SPA	Special Protection Area
SR	Service Reservoir
SRO	Strategic Resource Option
SSSI	Site of Special Scientific Interest
ToLS	Test of Likely Significance
UKWIR	UK Water Industry Research
WFD	Water Framework Directive
WRMP	Water Resources Management Plan
WRMP19	Water Resources Management Plan 2019
WRMP24	Water Resources Management Plan 2024
WSR	Water Supply Reservoir
WRSE	Water Resources South East



<b>Acronym</b>	<b>Definition</b>
WRC	Water Recycling Centre
WRZ	Water Resource Zone
WSW	Water Supply Works
WTW	Water Treatment Works
ZoI	Zone of Influence

# Executive summary

This report presents the results of the informal Habitats Regulations Assessment (HRA) Stage 2 Appropriate Assessment (AA) undertaken for the South Lincolnshire (SLR) Strategic Resource Option (SRO). This report assesses the potential effects of the Scheme on Special Protection Areas (SPAs), Special Conservation Areas (SCAs) and Ramsar Sites.

Mott MacDonald Ltd undertook this informal HRA and AA as part of gate two in August 2022, following the methodology in the *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15)*.

This appendix supports the Environmental Appraisal Report (EAR) that accompanies the gate two submission to Regulators' Alliance for Progressing Infrastructure Development (RAPID).

The HRA Stage 1 Screening concluded that the SLR Scheme as proposed by Anglian Water is likely to result in Likely Significant Effects on the following Designated Sites:

- The Wash SPA (UK9008021)
- The Wash Ramsar (UK11072)
- The Wash and North Norfolk Coast SAC (UK0017075)
- Humber Estuary SPA (UK9006111)
- Humber Estuary SAC (UK0030170)
- Humber Estuary Ramsar Site (UK11031)
- Baston Fen SAC (UK0030085)

Consequently, the Scheme has progressed to Stage 2 AA as several pathways and potential effects were identified at screening.

This informal HRA AA considered that the Scheme is located sufficiently distant from the Designated Sites at the Wash and Humber Estuary to exclude significant adverse effects as a result of noise, light, dust or other human disturbances during the construction phase assuming that best practices and proposed mitigation measures are implemented. This AA also considered that with appropriate mitigation measures in place the Scheme is not expected to have an adverse effect on the integrity of Baston Fen SAC for the construction and the operation phases of the Scheme.

During the operation phase, however, the Scheme has the potential to adversely affect the integrity of The Wash and the Humber Estuary Designated Sites and functionally linked habitats used by their qualifying species through the following pathways:

- Changes to water levels and flows due to the new abstraction from the River Trent and inter-catchment transfer into the River Witham, water storage and emergency discharge drawdown flows leading to fluctuations in water temperature regimes and salinity levels downstream.
- Physical damage as a result of changes in flow velocity and sediment fluxes leading to changes in natural coastal/estuarine processes; functionally linked habitat degradation as a result of water quality changes.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species. Sediments can transport pollutants and microplastics to estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is

depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying species.

- Biological disturbance including changes to habitat availability including functional linked habitat used by qualifying species; changes in species abundance or distribution; potential for populations to be displaced from current foraging/spawning areas; direct mortality of fish species as a result of entrainment in intake infrastructure; changes in natural succession; introduction of new pathways for spread of non-native invasive species as a result of inter-catchment water transfers.

These effects may lead to changes to:

- The extent and distribution of qualifying habitats
- The structure and function of the qualifying habitats
- The supporting processes on which habitats of qualifying species rely

Additionally, the identified effects have the potential to reduce the extent and quality of functional linked habitats supporting qualifying species' populations.

The recommended mitigation measures detailed within this document assume a worst-case scenario at this stage, in the absence of detailed survey data or local records. Mitigation measures have been proposed for both construction and operation phases at all sites.

In addition to best practice measure for construction, the mitigation measures proposed to avoid effects during the construction phase include sensitive timings of works to avoid key periods for overwintering bird populations. It is also recommended that a Construction Environmental Management Plan (CEMP) be put in place that would include the proposed mitigation measures in this AA as well as any other specific measures identified following an HRA undertaken at project level.

At this stage some effects are still uncertain and therefore adverse effects on the Designated sites' integrity cannot be excluded. Further studies are recommended to address uncertainty and would include:

- Hydrodynamic modelling of flows and salinity into The Wash Designated Sites.
- Studies and modelling of the water demand from the River Trent and the River Witham are needed to identify whether the changes in the water levels and flows as a result of the operation of the South Lincolnshire Reservoir would have an effect on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction is also required to determine the effect of nutrient loading. An investigation on the possible effects on changes in salinity and sediment transport is also recommended.
- Additional information about the Scheme, including a further assessment and modelling of the effects of the inter-catchment transfer from the River Trent to the River Witham are needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended.
- Finally, the adverse effects identified through this HRA may be compounded through the more frequent and intense effects of climate change, including heat waves, droughts, floods and rising sea levels. Therefore, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for mid and long-term effects on the Designated Sites and functional linked land located downstream of the Scheme.

An in-combination assessment was undertaken with other plans or projects and identified potential effects in-combination with:

- Fenland Reservoir SRO – potential effects on The Wash SPA (bird qualifying species) and The Wash and North Norfolk Coast SAC / Ramsar Site (common seals, otters and saltmarsh vegetation).
- Viking Link electrical interconnector project extending from Revsing, Jutland, (Denmark) to Bicker Fen, Lincolnshire (UK) – potential effects include increased turbidity and site run off (pollution) into

River Witham and Skerth Drain (tributary of South Forty-foot drain) hydrologically connected to The Wash Designated Sites.

- Minworth SRO – potential effects on The Humber Estuary SAC and Ramsar Site river lamprey (*Lampetra fluviatilis*) and sea lamprey (*Petromyzon marinus*) populations.

It should be noted that the conclusions contained in this document are based on preliminary, indicative design assumptions available at this time, commensurate with the stage of Scheme development the project is at and are primarily informed by available, appropriate desktop information. As the Scheme development progresses to inform a future application for development consent, further survey work and assessments would be undertaken to inform and fulfil the regulatory requirements applicable at the time. Further design iterations would require revisions to this document and may result in changes to the current conclusion.

# 1 Introduction

## 1.1 Background

A new strategic reservoir in Lincolnshire, referred to as the South Lincolnshire Reservoir (SLR), has been proposed for development as one of several nationally strategic water resource options required to address increasing deficits in public water supply. The scheme is being promoted by Anglian Water and Affinity Water and is being progressed through the fast-tracked delivery framework overseen by the Regulatory Alliance for Progressing Infrastructure Development (RAPID).

The SLR Habitat Regulations Assessment (HRA) carried out as part of the RAPID gate one submission considered four scheme concepts, which were selected from a longer list of potential solutions in consultation with stakeholders. This report includes the informal HRA carried out for the preferred Scheme (referred to as the Scheme in this report) with all its indicative components (reservoir footprint, indicative transfer routes and proposed abstraction).

## 1.2 Assumptions and limitations

Information provided by third parties, including publicly available information and databases, is considered correct at the time of publication. Due to the dynamic nature of the environment, conditions may change in the period between the preparation of this report, and the undertaking of the proposed works. Further scheme design iterations would be taken in consideration in the next HRA undertaken at gate 3.

Any uncertainties surrounding, and limitations of, the assessment process are acknowledged and highlighted. Recommendations for avoidance and mitigation measures to address the potential adverse effects on the integrity of the Designated Sites identified by this report are also based on the information available at the time of the assessment. It is acknowledged that the requirement for mitigation may change as the design of the Strategic Resource Option (SRO) progresses. This is expected to be through increasing the level of detail available during later stages of option development for subsequent gateways if the relevant options are progressed.

At this stage in the process the informal HRA is based on currently available desk-based information and no specific surveys have been undertaken. This is appropriate for the current stage of the process, and the HRA would be updated for the consenting process when further design detail on the options and more detailed biological data, which can include data collected on site, is available.

## 2 Habitats Regulations Assessment process

### 2.1 Habitats Regulations Assessment process

There is a requirement under the Conservation of Habitats and Species Regulations 2017 (as amended) (“the Habitats Regulations”) to determine if a plan or project may have an adverse impact on a site designated under the same (or preceding Regulations) prior to any consent or permission being determined. The process of undertaking this assessment is known as an HRA. The Conservation of Habitats and Species Regulations 2017 (as amended) (“the Habitats Regulations” transpose the Habitats Directive and Wild Birds Directives into English and Welsh law. Regulations 63(1) - (9), 64 and 68 of the Habitats Regulations set out the requirements for assessment of impacts on National Network Sites.

The Habitats Regulations include measures to establish and maintain a network of sites protecting habitats which in themselves are valuable as well as for the species they support. These sites form a network that across Europe that have been historically known as Natura 2000, and domestically now known as the National Site Network (NSN). Within the UK, this network consists of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs), proposed and candidate SPAs and SACs (pSPAs and cSACs). This network also extends to marine environments, with wetland sites of international importance (Ramsar sites) also treated equally within this assessment framework. These sites are collectively referred to in this report as ‘Designated Sites’.

The Habitats Regulations are set out in Parts which implement the requirements of the Directives, with Part 2 including provisions for the selection and designation of sites and Part 6 providing provisions to ensure that assessment of plans and projects are fully considered before being granted consent or permission. They also define the nature of and roles of statutory bodies, competent authorities and the appropriate nature conservation body and the requirements for information to be submitted to these bodies to enable them to undertake the required assessments.

Although the Habitats Regulations have been amended by The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019, due to the UK’s exit from the EU, the effect of these amendments is largely related to wording and requirements and processes remain the same, as protection levels remain unchanged. As such existing EU guidance<sup>1</sup> and preceding case law from the European Court of Justice (ECJ)<sup>2 3 4</sup> remains valid as a source of direction and interpretation of the requirements of the legislation, although it should be noted that much case law has now been incorporated into guidance and/or best practice.

The HRA process consists of four stages, each stage being informed by the one preceding, to ensure an iterative and objective assessment. If the conclusion of Stage 1 Screening is that there would be No Likely Significant Effects (NLSE) on any features of a Designated Site, there is no requirement to undertake further stages. Similarly, if the Stage 2 AA concludes there would be no adverse effect on integrity of the Designated Site, then the assessment is concluded. The HRA stages are summarised within Table 2.1 below.

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<sup>1</sup> European Commission (2018). Managing Natura 2000 Sites - The provisions of Article 6 of the ‘Habitats’ Directive 92/43/CEE [online] available at: [EN\\_art\\_6\\_guide\\_jun\\_2019.pdf \(europa.eu\)](#) (last accessed April 2022).

<sup>2</sup> Landelijke Vereniging tot Behoud van de Waddenzee/ Nederlandse Vereniging tot Bescherming van Vogels, European Court of Justice, Case C-127/02 ‘Waddenzee 2002’

<sup>3</sup> Sweetman et al v An Bord Pleanala, European Court of Justice, Case C-258/11 ‘Sweetman 2011’

<sup>4</sup> People over Wind/Sweetman v Coillte Teorante, European Court of Justice Case C-323/17 ‘People over Wind 2017’

**Table 2.1: HRA Stages**

Stage	Description
Screening (Stage One)	<p>This is the process which identifies the potential effects upon the Designated Sites and considers if these are likely to be significant (see definitions below).</p> <p>Screening is an iterative process and before moving to Stage Two it can be repeated if required.</p> <p>Proposals to mitigate any likely significant effects cannot be considered at the screening stage.</p> <p>If the Screening (Stage 1) identifies that the project or plan, alone or in combination, may have likely significant effects on a Designated Site and/or its features of interest, or if there is uncertainty, the competent authority must undertake an Appropriate Assessment (Stage 2) of the implications for that Site in view of that Site's conservation objectives.</p>
Appropriate Assessment (Stage Two)	<p>This stage involves the consideration of the predicted adverse effects of the project or plan either alone, or in combination with other projects or plans, on the integrity of the Designated Site with respect to the Site's structure, function and conservation objectives.</p> <p>Additionally, where mitigation has been proposed to avoid or minimise likely significant effects, this stage includes assessment of the likely effectiveness of any mitigation applied.</p> <p>A key outcome of the Appropriate Assessment is to identify whether the integrity of the Designated Site(s) is likely to be adversely affected by the plan/project.</p>
Assessment of Alternative Solutions (Stage Three)	<p>If the mitigation measures applied and assessed during Appropriate Assessment cannot avoid adverse effects on the integrity of a Designated Site, this stage examines alternative ways of achieving the objectives of the project or plan that avoid adverse effects on the integrity of the Designated Site.</p>
Assessment where no alternative solutions exist and where adverse effects remain (Stage Four)	<p>If no suitable alternative solutions are available, Stage Four requires an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest ("IROPI"), it is considered that the project or plan should proceed.</p> <p>In making this assessment, it is important to recognise that it would be appropriate to the likely scale, importance and impact of the proposed project. If it is impossible to avoid or mitigate the adverse impact, it must be demonstrated that there is IROPI.</p>

Source: Mott MacDonald, 2022

This informal assessment has been undertaken in an iterative and objective manner following the above stages, with reference to best practice guidance and relevant case law, notably that provided by the Waddenzee case (ECJ 2002) and Sweetman (ECJ 2011) to inform the interpretation and therefore correct application of the terms 'likelihood', 'significance' and 'in combination'.

Mott MacDonald Ltd undertook this HRA following the methodology in the *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15)*<sup>5</sup>.

## 2.2 Screening assessment methodology

The initial list of sites for the HRA screening was derived by adopting a distance-based threshold of 10km, whilst including more distant sites subject to longer pathways; this included those sites which were hydrologically connected via surface- or groundwater catchments. This is based on the premise that most significant effects on qualifying features of Designated Sites would occur within a maximum of a 10km radius<sup>5</sup>. This distance of 10km is defined as the Zone of Influence (Zoi) of the SLR scheme (including the reservoir and associated infrastructure), which has been extended where appropriate to capture all potential effects on Designated Sites.

In undertaking this informal HRA, a number of steps were undertaken to identify the relevant information to inform the assessment. Information gathered to inform the screening included the identification of:

<sup>5</sup> UKWIR (2021). Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15), 287p.

- Any SPA/SAC/pSPA/cSAC/Ramsar sites, including any marine or marine elements of these sites within the potential Zol, and any known areas of land outside the site boundary itself, which plays an important role in supporting the site and its features of interest (functionally linked land).
- Potential effects resulting from the project.
- The Zol of these effects, noting this may extend some distance from the site and are not confined to activities on or adjacent to the site.
- Any viable pathways for the project to the receptor (Designated Sites themselves or functionally linked land).
- The features of interest of the Designated Site(s) in question.
- The conservation objectives of the Designated Site, including any site sensitivities given within any supplementary advice, site improvement plan, or equivalent document published by the relevant SNCB.

The above information was reviewed in respect of each feature of interest and potential development effect / impact pathway to inform an assessment of any LSE or adverse effects on integrity. Key aspects and terms used in this assessment are defined below:

- **Likelihood:** where an effect was considered to be potentially significant, then the assessment of its of occurrence was based on the likelihood of it occurring and not certainty that it would occur. Effects are scoped in unless there was evidence to the contrary demonstrating that they would not occur, e.g., there being no valid pathway, or the absence of the species in that area, at that time.
- **Significance:** the significance of any effect is considered objectively, against the scale and nature of the impact in relation to those of that particular feature or condition and in relation to the extent of that feature or condition over the entire Designated Site. A significant effect within this assessment is one which, if it occurred, would lead to a decline in the quality or status of the habitats or distribution, abundance, etc. of feature(s) of interest.
- **In-combination:** the assessment of in-combination effects considers those projects or plans which:
  - Are currently in operation.
  - Those which are actually proposed – defined by being a valid live planning application, or any referenced with a local plan where there is a strong likelihood of them being undertaken within a reasonable time period, specified within that plan.

In line with relevant case law, this assessment is undertaken in the absence of mitigation (including measures embedded into the SRO where these are intended for the avoidance of effects).

Where likely significant effects were identified the assessment has taken these effects through to Stage 2 AA.

## 2.3 Appropriate Assessment approach and methodology

### 2.3.1 Approach

Where a plan or project is likely to, or has the potential to, give rise to LSE upon a Designated Site, an assessment must be made of the implications on the integrity of that site in view of that site's structure, function and conservation objectives and taking into account any site-specific supplementary advice or site improvement plan.

Where mitigation measures are to be applied to eliminate or reduce any effects identified in screening, these may be considered within the AA.

Potential effects may be direct or indirect and are dependent on the relationship between the source (proposed options' actions) and the receptor (the qualifying features of the Designated Site(s)). The significance of an impact is relative to the sensitivity, existing condition and conservation status of the qualifying features of the site and the scale of the impact in space and time.



Potential effects on the qualifying features of the Designated Site(s) are evaluated with respect to the scale, extent and nature of the impact, for example the area of habitat affected, changes in hydrodynamics, potential changes in species distribution, and the duration of the impact. Given the high-level nature of the assessment at this informal, early stage it is not always possible to determine the exact scale and extent of the impact, when this is the case, a precautionary approach is taken when evaluating the significance of the impact.

This HRA Stage 2 AA has been formulated using the following approach:

- Review the sites identified at Stage 1 and confirm any additions or exclusions.
- Assessment of the construction and operation effects of the Scheme.
- Assessment of the Designated Sites' characteristics and identification of their conservation objectives.<sup>6</sup>
- Identification of the aspects of the proposed Scheme that would significantly impact the conservation objectives of the Designated Site(s)<sup>7</sup>; and
- Identification of other plans and projects with potential for in-combination effects.

This assessment has been undertaken in accordance with the following guidance:

- GOV.UK (2019) Appropriate Assessment - Guidance on the use of Habitats Regulations Assessment.<sup>8</sup>
- UK Water Industry Research (UKWIR, 2021) Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans.<sup>9</sup>
- European Commission (EU, 2018) Managing Natura 2000 sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.<sup>10</sup>

### 2.3.2 Consultation

Informal consultation has been undertaken with Natural England and the Environment Agency. Both organisations had the opportunity to review and comment on the initial findings of the informal HRA prior to submission.

### 2.3.3 Potential effects considered as part of the HRA

Following UKWIR (2021) guidance and given the nature of the Scheme, the potential effects considered in this assessment are summarised in Table 2.2. Proposed distances are also provided following the same guidance to ascertain if, where a pathway has been identified, the impact is likely to affect the habitats or species for which the Designated Site(s) are designated.

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<sup>6</sup> Habitats Sites descriptions, qualifying features and conservation objectives are given in Appendix A.

<sup>7</sup> This is the Appropriate Assessment given and tabulated in Sections 4, 5 and 7.

<sup>8</sup> UK Government (2019). Guidance on the use of Habitats Regulations Assessment [online] available at: [Appropriate assessment - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414242/AA-Guidance-2019.pdf) (last accessed April 2022).

<sup>9</sup> UKWIR (2021). Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15), 287p

<sup>10</sup> European Commission (2018). Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE [online] available at: [EN\\_art\\_6\\_guide\\_jun\\_2019.pdf \(europa.eu\)](https://ec.europa.eu/eia/press_corner/news/2018/04/04_en_art_6_guide_jun_2019.pdf) (last accessed April 2022).

**Table 2.2: Potential effects and proposed Zone of Influence**

<b>Broad categories of potential effects on Designated Sites (with examples)</b>	<b>Examples of activities resulting in effects and proposed ZOI</b>
<b>Physical loss</b> Destruction (including offsite effects) e.g. foraging habitat, smothering	Development of built infrastructure associated with the Scheme, e.g., reservoir embankments and access routes <sup>11</sup> . Physical loss is only likely to be significant where the boundary of the Scheme extends within the boundary of the Designated Site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated or where natural processes link the Scheme to the site, such as through hydrological connectivity downstream, or the Scheme effects the linking habitat).
<b>Physical damage</b> Habitat degradation Erosion Trampling Fragmentation Severance/barrier effects Edge effects	Development of built infrastructure associated with the Scheme, e.g., reservoir embankments and access routes. Physical loss is only likely to be significant where the boundary of the Scheme extends within the boundary of the Designated Site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated or where natural processes link the Scheme to the site, such as through hydrological connectivity downstream, or the Scheme effects the linking habitat).
<b>Non-physical disturbance</b> Noise Visual presence Light pollution	<b>Noise from construction activities</b> Taking into consideration the noise level generated from general building activity (c. 122dB(A)) and considering the lowest noise level identified in guidance as likely to cause disturbance to waterbird species (although this guidance is designed primarily for estuarine birds it was considered appropriate to use for this plan), it is concluded that noise effects could be significant up to <b>1km</b> from the boundary of the Designated Site (UKWIR 2021). <b>Noise from vehicular traffic during construction of the Scheme</b> Noise from construction traffic is only likely to be significant where the transport route to and from the Scheme is within <b>500m</b> of the boundary of the Designated Site(s). <b>Plant and personnel involved in operation of the Scheme</b> These effects (noise, visual/human presence) are only likely to be significant where the boundary of the Scheme extends within or is adjacent to an offsite area of known foraging, roosting, breeding habitat that support species for which a Designated Site is designated. <b>Schemes that might include artificial lighting</b> , e.g., for security around a temporary pumping station. Effects from light pollution are more likely to be significant where the boundary of the Scheme is within <b>500m</b> of the boundary of the Designated Site
<b>Water table/ availability</b> Drying Flooding/storm water Changes to surface water levels and flows Changes to groundwater level and flows	Change to water levels and flows due to water abstraction, storage and drainage interception associated with inland Schemes. These effects are only likely to be significant where the boundary of the Scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the Scheme and the Designated Site and whether the Scheme is up or downstream from the Designated Site.
<b>Toxic contamination</b> Water pollution Soil contamination Air pollution	<b>Reduced dilution in downstream or receiving waterbodies due to changes in abstraction or reduced compensation flow releases to river systems.</b> These effects are only likely to be significant where the boundary of the Scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the Scheme and the Designated Site, and sometimes whether the Scheme is up or downstream from that site. Air emissions associated with plant and vehicular traffic during construction and operation of the Scheme.

<sup>11</sup> It is acknowledged that infrastructure associated with the construction of the reservoirs may have an impact on Habitats Sites. However, for the purposes of this informal HRA, only the construction footprint of the reservoir itself has been used to determine the potential for significant effects.

**Broad categories of potential effects on Designated Sites (with examples)**      **Examples of activities resulting in effects and proposed Zol**

	<p>The effect of dust is only likely to be significant where site is within or in close proximity to the boundary of a Designated Site. Without mitigation, dust and onto the public road network and then deposited/spread by vehicles on roads up to <b>500m from large sites, 200m from medium sites, and 50m from small sites</b> as measured from the site exit (UKWIR 2021). Effects of road traffic emissions from the transport route to be taken by the Scheme traffic are only likely to be significant where the Designated Site falls within <b>200 metres</b> of the edge of a road affected.</p>
<p><b>Non-toxic contamination</b>                  Nutrient enrichment (e.g., of soils and water)                  Algal blooms                  Changes in turbidity                  Changes in sedimentation/silting                  Air pollution (dust)</p>	<p><b>Changes to water salinity, nutrient levels, turbidity, thermal regime due to increased water abstraction, discharges, storage, or reduced compensation flow releases to river systems.</b></p> <p>These effects are only likely to be significant where the boundary of the Scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the Scheme and the Designated Site, and sometimes whether the Scheme is up or downstream from that site.</p> <p>Emissions of dust during the earthworks, construction of plant and tunnel/pipeline construction associated with Schemes.</p>
<p><b>Biological Disturbances</b>                  Direct mortality                  Changes to habitat availability                  Changes in species abundance or distribution                  Out-competition by non-native species                  Introduction of disease                  Introduction of invasive species</p>	<p><b>Killing or injury due to construction activity.</b></p> <p>Likely to be a risk where the boundary of the Scheme extends within or is directly adjacent to the boundary of the Designated Site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a Designated Site is designated).</p> <p><b>Changes in habitat availability, such as reductions in wetted width of rivers from abstraction or reduced compensation flow.</b></p> <p>These effects are only likely to be significant where the boundary of the Scheme extends within the same ground or surface water catchment as the Designated Site. However, these effects are dependent on hydrological continuity between the Scheme and the Designated Site, and sometimes whether the Scheme is up or downstream from that site.</p> <p><b>Creation of new pathway for spread of non-native invasive species.</b></p> <p>This effect is only likely to be significant where the Scheme is situated within the Designated Site or an upstream tributary of the Designated Site, but also for inter-catchment water transfers.</p>

Source: Adapted from: UK Water Industry Research (2021)<sup>12</sup>.

**2.3.4 Assumptions and standard best-practice mitigation measures**

**2.3.4.1 Overview**

A number of standard best practice mitigation measures have been considered at the Appropriate Assessment stage.

It is recommended that Anglian Water work closely with Natural England and the Designated Site owners/managers to discuss the specific mitigation measures to be included at the project stage HRA. The agreed mitigation measures would be expected to form part of planning requirements and/or conditions of relevant environmental permits, and their implementation managed through contractual obligations with supervision from an Environmental Clerk of Works.

**2.3.4.2 Assumptions during construction**

The following assumptions constitute best practice for the SLR Scheme; they are largely control measures that are essential features of the project and would be integrated into the construction phase. These are not considered to be targeted mitigation to avoid or reduce significant effects or adverse effects on Designated Sites but can mitigate for some of the Scheme effects and therefore only mentioned at the AA stage. Any further mitigation would be detailed in the subsequent sections.

<sup>12</sup> UK Water Industry Research (UKWIR, 2021). *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans (21/WR/02/15)*.

During the development of the design every opportunity for avoiding potential effects on Designated Sites (e.g., through alternative transfer routes, micro siting, etc.) should be taken.

Best practice for the Schemes design, pollution control, biosecurity, disturbance, and the Construction and Environmental Management Plan (CEMP) include:

### Pollution control

- Indirect construction-related pollution is identified as one key pathway through which Designated Sites may be affected. There is extensive guidance on environmental good practice during construction which can be relied on (at this level) to prevent significant adverse effects on a Designated Site occurring. The best-practice procedures detailed in the following documents should be followed for all construction works derived from the Scheme, as a minimum standard:
  - CIRIA C741 Environmental good practice on site guide (Charles and Edwards, 2015).<sup>13</sup>
  - CIRIA C532 Control of water pollution from construction sites (Masters-Williams et al. 2001).<sup>14</sup>
  - Environment Agency's Pollution Prevention Guidance Notes<sup>15</sup> including PPG1: General Guide to Prevention of Pollution (July 2013); PPG5: Works and maintenance in or near water (October 2007), PPG6: Pollution prevention guidance for working at construction and demolition sites (April 2010); PPG21: Pollution incident response planning (March 2009); PPG22: Dealing with spills (April 2011).
  - The installation of sediment traps near or in watercourses or the use of cofferdams should be specified as appropriate as the Scheme design progresses.
  - Compliance with the provisions of the *Health and Safety at Work Act 1974, the Environmental Protection Act 1990, the Environment Act 1995, the Clean Air Act 1993 and the regulations made thereunder, including the Control of Substances Hazardous to Health Regulations (SI 2002/2677)* would be required with regard to air quality management.
  - Mitigation plans to help mitigate air quality impacts to support this should include an Air Quality/Dust Management Plan and a Construction Traffic Management Plan (CTMP).

### Biosecurity

- Biosecurity measures would be in place to ensure the management of invasive non-native species on construction sites and during controlled activities. The following considerations would be given pre-construction:
  - Invasive non-native species (INNS) risk assessment to be undertaken at site feasibility stage.
  - Where INNS are identified, legal requirements and mitigation plan developed at early planning stage.
  - INNS to be included on all site method statements including CEMP and any Ecological Protection Plans. INNS risk to be managed by Clerk of Works and INNS brief given to all site contractors.
- Where a species requires long-term management (such as Japanese knotweed *Fallopia japonica*), a specific INNS management plan should be developed.
- The best-practice procedures detailed in the following documents should be followed to reduce the spread of INNS for all construction works derived from the Scheme, as a minimum standard:
  - CIRIA Manual C679 'Invasive species management for infrastructure managers and the construction industry'; The Knotweed Code of Practice – managing Japanese Knotweed on development sites'.

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<sup>13</sup> Charles P. and Edwards P (2015) *Environmental good practice on site guide*. CIRIA C741, 260p.

<sup>14</sup> Masters-Williams H., Heap A., Kitts H. et al. (2001) *Control of water pollution from construction sites*. CIRIA C532, 27p.

<sup>15</sup> Note, the Environment Agency Pollution Prevention Guidance Notes have been withdrawn by the Government, although the principles within them are robust and still form a reasonable basis for pollution prevention measures. Documents are still available online at: [\[ARCHIVED CONTENT\] Environment Agency - Pollution prevention advice and guidance \(PPG\) \(nationalarchives.gov.uk\)](#) (last accessed April 2022).

### Disturbance - noise

- It is proposed that construction activities should be conducted in accordance with noise limits agreed with the LPA to avoid disturbance.
- Construction related noise disturbance should be minimised by implementing best practice such as BS 5228-1:2009+A1:2014 (The British Standards Institute, 2008).<sup>16</sup>

### Disturbance - light

- Lighting would be kept to a minimum to reduce disturbance. Should the works be undertaken at night and flood lighting required, lighting should be kept to a minimum, and hooded spotlights directed away from potentially suitable habitat for qualifying species of Designated Sites, to reduce disturbance while ensuring standards for health and safety.
- The potential impact of artificial light may be minimised through the implementation of best practice such as '*Guidance Notes for the Reduction of Obtrusive Light*' (Institute of Lighting Professionals, 2011).<sup>17</sup>

### Construction Environmental Management Plan

A CEMP must be developed prior to construction, including measures to ensure that the risk of uncontrolled discharges from construction is reduced (including sediment management) and detailing an Emergency Response Plan in the event of a pollution incident. This plan must be prepared for all works and include the industry best practice measures listed above and any targeted mitigation measures identified during the formal HRA.

#### 2.3.4.3 Assumptions during operation

No general assumptions are made for the operation phase at this stage of the design development.

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<sup>16</sup> The British Standards Institute, 2008. BS 5228-1:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise*. BSI Standards Limited, London.

<sup>17</sup> Institution of Lighting Professionals (2020) Guidance note for the reduction of obtrusive light. Guidance Note1/20.

## 3 Habitats Regulations Assessment

### 3.1 Scheme overview

The SLR scheme includes the development of a new embanked raw water reservoir for water storage for public water supply. It also comprises abstractions from the River Witham and River Trent, raw water transfers, treatment works, and distribution into supply.

Key scheme parameters include:

- River Trent maximum abstraction and transfer flow to River Witham: 300MI/d (Megalitres per day)
- River Witham maximum abstraction and transfer flow to reservoir: 400MI/d
- Reservoir total capacity: 55MCM
- Reservoir usable volume: 50MCM
- Treatment distribution flow <sup>18</sup>: 150MI/d

#### 3.1.1 Reservoir overview

The proposed reservoir site is shown in Figure 3.1, and is located approximately 7km southeast of the town of Sleaford, between the settlements of Swaton, Scredington and Helpringham in the North Kesteven District Council area. South Kesteven District Council's administrative boundary is approximately 100m south of the polygon, south of the A52 Holland Road. The Peterborough to Lincoln railway line runs along the north-eastern boundary with the North Beck watercourse situated just north of the site boundary.

An indicative concept plan has been developed for the scheme. This indicative concept has been established to provide reference for cost and carbon estimation in gate two. The summary provisional details are provided below, but much work is still required to develop the scheme and the final details would develop accordingly.

The provisional reservoir parameters are:

- At its greatest dimensions the reservoir is about 2.6km wide and 3.2km long to the embankment toe.
- The embankment crest is estimated at 26mAOD (above ordnance datum) making the embankment an average of 14m above the typical existing ground level at the toe. This is with approximate relative embankment elevations of maximum 19m and minimum of 5m above existing ground levels.
- The total perimeter length of the crest is about 8.5km and the estimated reservoir surface area is 4.8km<sup>2</sup>.

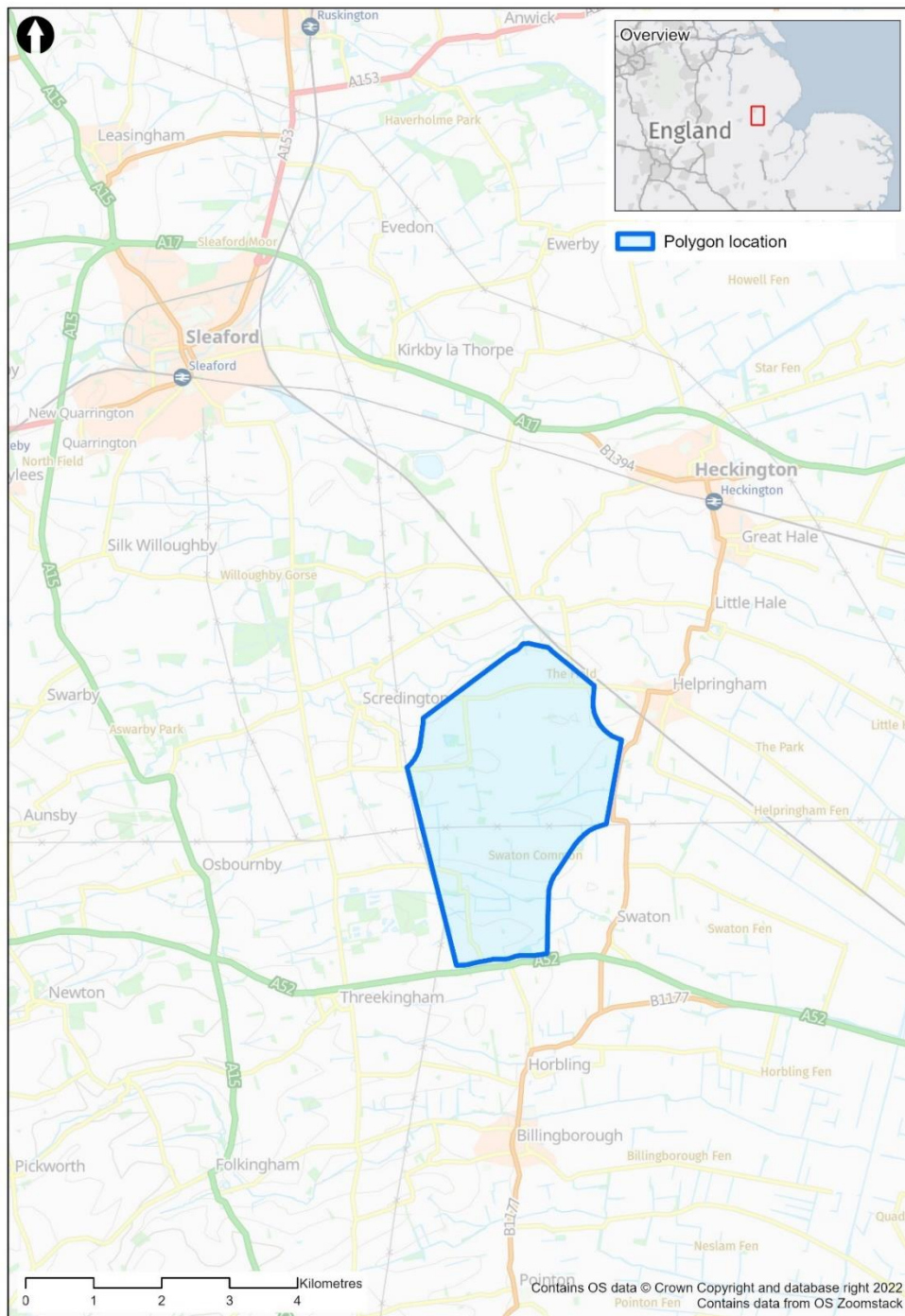
The reservoir would include key infrastructure necessary for its safe operation, including intake and outtake structures; drawdown facilities; a spillway and water sampling facilities. The reservoir would also be expected to provide benefits beyond public water supply. Opportunities to incorporate facilities to enable recreation (such as a visitor centre and parking), infrastructure to improve health and wellbeing (such as multi-use footpaths, quiet areas and leisure opportunities) and careful design to enhance and encourage biodiversity are planned and would be developed further, with the features that would deliver these wider benefits being subject to further assessment and consultation. Landscaping would be carefully designed surrounding the reservoir to minimise the visual impact of

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<sup>18</sup> The proposed capacity of the water treatment works and transfer pipelines has been updated since this assessment was completed. The figures quoted in the gate two report include a scheme deployable output of 166MI/d and works capacity up to 180MI/d. These changes are not anticipated to have any material impact on the completed assessments.

the reservoir whilst ensuring it sits within the existing landscape and delivers wider recreational and biodiversity benefits.

**Figure 3.1 Site context map**



### 3.1.2 Raw water, transfer and treatment

It is proposed that water would be abstracted from the River Witham. The abstraction location has currently been assumed, for indicative purposes, to be at an intake between Chapel Hill and Langrick Bridge. The precise abstraction location would be identified following further detailed work (including stakeholder engagement) for gate three. The current design includes the transfer of water into the reservoir by about 18km of 1600mm (millimetres) diameter steel pipeline.

However, the precise abstraction location would be identified following further detailed work (including stakeholder engagement) for gate three. The proposed abstraction rate from the River Witham is up to 400MI/d when flows allow. This is subject to further assessment undertaken in collaboration with the Environment Agency (EA) to develop an abstraction rate which is licensable. The associated abstraction licence is expected to stipulate a minimum flow and minimum water level requirement at the point of abstraction below which it would not be possible to abstract. Abstraction to fill the reservoir would only be possible during high flow periods.

It is proposed that flows in the River Witham would be supported via a transfer from the River Trent. Up to 300MI/d would be abstracted from the River Trent, with an intake currently assumed for indicative purposes to be located near Newark-on-Trent (although, as with the River Witham abstraction, the precise abstraction location would be identified following further detailed work for gate three) and transferred by about 10km of 1400mm diameter steel pipeline to the River Witham near Claypole. Without mitigation, there is a risk of INNS transferring between catchments (see EAR).

The current design includes the transfer of water into the reservoir by about 18km of 1600mm (millimetres) diameter steel pipeline. The potential for the raw water transfer to the reservoir from the River Witham into the South Forty Foot Drain (SFFD) and then into the reservoir, using open channel, to deliver additional benefits has been identified as an opportunity. This opportunity is being investigated further and would be confirmed during the next stage of project development.

Further work is planned for the next stage to confirm the locations of the abstraction points and routes for the transfers. This would involve landowner engagement, environmental surveys, and preliminary ground investigations. The information provided in this report and accompanying appendices are assumptions based on indicative locations only at this stage. The indicative transfer routes for are shown in Figure 3.2.

The abstraction facilities are expected to comprise an intake structure, a transfer pumping station (TPS) and pipeline.

### 3.1.3 Water treatment and potable transfers

Stored water would subsequently be abstracted from the reservoir and treated to a potable quality. It is proposed that a WTW is located on land adjacent to the reservoir with a peak throughput capacity of 180MI/d.

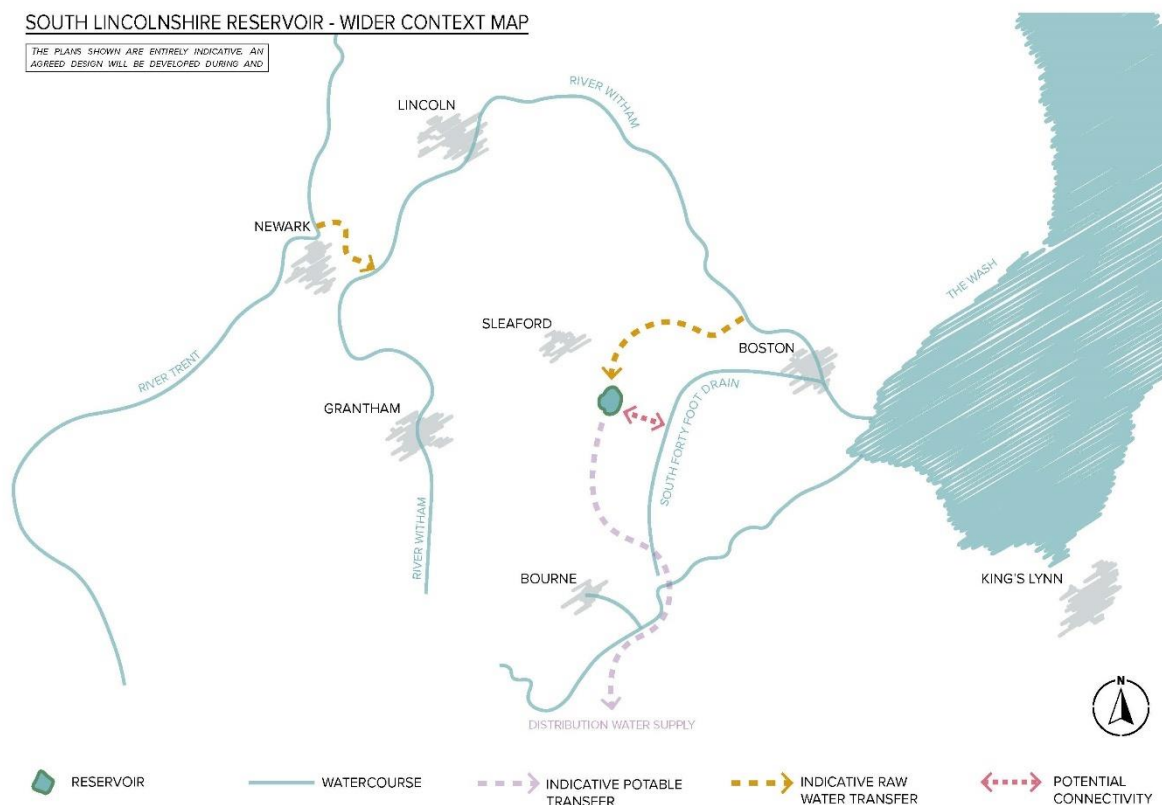
It is proposed that the treated water would be transferred by an approximate 37km 1100mm diameter steel pipeline into the potable supply network by an existing Anglian Water Service Reservoir. The reservoir is to supply over 500,000 homes in Lincolnshire and the south-west of the Anglian region.

Further work is planned for the next stage to confirm the routes for the transfers involving landowner engagement, environmental surveys, and preliminary ground investigations. The information provided in this report and accompanying appendices are assumptions based on indicative locations only at this stage.

See Figure 3.2 for an illustration of indicative proposed transfer corridor locations.



**Figure 3.2 Proposed transfer routes**



### 3.1.4 Summary of operation and use

Development and operation of the reservoir would be subject to the Reservoirs Act 1975 (as amended by the Floods and Water Management Act 2010). The embankments and associated water retaining elements of the reservoir would need to be maintained and supervised in accordance with the Act to maintain public safety.

Provision of emergency drawdown must be designed in accordance with the Reservoirs Act. The preferred solution at this stage is to discharge to the SFFD, but this is to be further modelled and confirmed as part of the next stage of development. Although the risk of needing to fully drawdown the reservoir is very low, there is a need for regular testing and maintenance to confirm functionality. This would involve the opening and testing of relevant valves and gates. Test flows are envisaged to be held in a pond to avoid disruption and to enable water to be returned back to the reservoir.

The operation and maintenance of the water treatment works and the distribution water supply system inclusive of distribution pump stations are expected to be in constant regular use according to water supply demand. The water supply components would need regular inspections and maintenance activities in accordance with the requirements of the respectively installed equipment.

### 3.1.5 Associated features

It is proposed that there would be a need for associated infrastructure and other features such as environmental mitigation to minimise the impacts of the reservoir, as well as enhancement opportunities. The location and design of the additional infrastructure has not been established and would therefore need to be confirmed at the next phase of scheme development.

### 3.1.6 Option selection for water abstraction, discharge and transfer routes

A separate option selection process has been used to identify indicative locations for water abstraction and discharge and potential transfer routes to convey the water from the abstraction points to the SLR and from the SLR to the water supply network. Potential abstraction and discharge points from river reaches determined from gate one work were identified and subsequently indicative transfer routes were developed. The methodology for determining indicative transfer routes involved five stages:

- Collation of constraints
- Develop criteria for selection
- Route selection
- Evaluation of routes
- Preferred route environmental assessment

The outcome was the identification of preferred route options for RAPID gate two.

A longlist of three potentially feasible transfer route options were identified for each of the three route locations (nine routes in total, three options for each of 'River Trent to River Witham', 'River Witham to SLR' and 'SLR potable water pipeline'). These options were identified based on high-level environmental and engineering screening criteria and overarching criteria relating to:

- Environmental designations
- Ancient woodland
- World Heritage sites
- Scheduled Monuments
- Grade I Listed structures
- Registered Parks and Gardens
- Existing infrastructure and main river crossings
- Environment Agency flood zones

Environmental and engineering Red – Amber - Green (RAG) assessments were then completed for the nine longlisted routes, and the route options were selected for consideration in gate two:

- River Trent to River Witham transfer –was identified as the preferred option as it had less impact on ancient woodland and heritage assets than other routes considered, as well as having less impact on agricultural land from permanent land take and being more remote from designated sites.
- River Witham to SLR –was identified as the preferred option as the other identified routes both ran directly through the proposed Heckington Fen solar park adding risk to the routes in terms of deliverability and construction timescales, and this also avoided priority habitat and was located in less flood zone 2 and 3 than the other options considered.
- SLR potable water pipeline –was identified as the preferred option due to its length and proximity outside of designated sites (SSSI and SAC) compared to the other options considered.

The scheme, and indicative transfer routes, abstractions, and associated infrastructure, would be subject to further analysis and stakeholder engagement and consultation between gate two and three.

## 3.2 Stage 1 Screening Review

The Stage 1 Screening identified ten Designated Sites within the Zol of the proposed reservoir site. These are:

- The Wash SPA (UK9008021) (approximately 23 km east of the Scheme)

- The Wash and North Norfolk Coast SAC (UK0017075) (approximately 23 km east of the Scheme)
- The Wash Ramsar Site (UK11072) (approximately 52.5 km north of the Scheme)
- Humber Estuary SPA (UK9006111) (approximately 52.5 km north of the Scheme)
- Humber Estuary SAC (UK0030170) (approximately 52.5 km north of the Scheme)
- Humber Estuary Ramsar Site (UK11031) (approximately 52.5 km north of the Scheme)
- Baston Fen SAC (UK0030085) (approximately 2 km south west of the Scheme)
- Nene Washes SPA (UK9008031) (approximately 9 km south east of the Scheme)
- Nene Washes SAC (UK0030222) (approximately 9 km south east of the Scheme)
- Nene Washes Ramsar (UK11046) (approximately 9 km south east of the Scheme)

For seven of the ten sites – the Wash SPA and Ra, The Wash and North Norfolk Coast SAC, The Humber Estuary SPA, SAC and Ramsar, and Baston Fen SAC – LSE could not be ruled out and, therefore, this scheme has progressed to the next HRA stage – Appropriate Assessment. There are no LSE predicted on the Nene Washes SPA, SAC and Ramsar as the proposed works are downstream of and sufficiently distant from the designated sites that no pathways exist.

A map with the scheme location in relation to the designated sites and buffer considered is provided in Appendix A. Full HRA screening review is presented in Appendix B. Information on the Designated Sites is provided in Appendix C, including qualifying features, conservation objectives, and threats and pressures to site integrity.

### 3.3 Stage 2 Appropriate Assessment

#### 3.3.1 Scope

Seven sites are assessed in the Stage 2 Appropriate Assessment of this report:

- The Wash SPA
- The Wash and North Norfolk Coast SAC
- The Wash Ramsar Site
- Humber Estuary SPA
- Humber Estuary SAC
- Humber Estuary Ramsar Site
- Baston Fen SAC (UK UK0030085)

#### 3.4 Potential effects on Designated Sites

The potential effects of the construction and operation phases for the Scheme are described below, considering the type, size, and scale of the Scheme.

An assessment of each potential effect on the integrity of the designated sites is made, in view of the sites' structure, function and conservation objectives. Where adverse effects may affect the Designated Site integrity, mitigation measures are also proposed in the following section.

At this stage, a worst-case scenario is assumed, with effects and required mitigation measures outlined in section 2.3.4.

##### 3.4.1 The Wash SPA

The Wash is numerically the most important area in Britain for wintering waterfowl, taking waders and wildfowl together. It is also the most important area in Britain in early autumn for moulting waders. The Wash is important also to certain wintering passerines, to breeding waders and terns, and to certain seabirds.

The Wash qualifies under Article 4(1) because it supports 30 breeding pairs of little terns *Sterna albifrons* (2% of the British population) and 220 pairs of common terns *Sterna hirundo* (2%); and because it supports 130 Bewick's swans *Cygnus cygnus* (3%) in winter.

The Wash qualifies under Article 4(2) as an internationally important wetland by supporting in winter an average of 163,000 waders and also 51,000 wildfowl; and because it supports on average the following internationally important numbers of individual species: 17,000 dark-bellied brent geese *Branta bernicla bernicla* (12% of the European wintering population), 7,300 pinkfooted geese *Anser brachyrhynchus* (7%), 16,000 shelducks *Tadorna tadorna* (12%), 1,700 pintails *Anas acuta* (2%), 24,000 oystercatchers *Haematopus ostralegus* (3%), 5,500 grey plovers *Pluvialis squatarola* (7%), 500 sanderlings *Calidris alba* (3%), 7,500 knots *Calidris canutus* (21%), 29,000 dunlins *Calidris alpina* (1%), 8,200 bar-tailed godwits *Limosa lapponica* (1%), 3,700 curlews *Numenius arquata* (1%), 4,331 redshanks *Tringa totanus* (5%) and 980 turnstones *Arenaria interpres* (2%).

In addition, the site qualifies because of its national importance to other migratory birds. Wintering birds include 3,900 wigeon *Anas penelope* (2% of the British wintering population), 220 goldeneye *Bucephala clangula* (1%), 130 gadwall *Anas strepera* (3%), 830 common scoters *Melanitta nigra* (2%), 260 black-tailed godwits *Limosa limosa* (6%) and probably several gull species (*Larus*). Important populations of wintering passerines are also supported.

The salt-marshes support a diverse breeding bird population, including over 4,000 pairs of black-headed gulls *Larus ridibundus* (2%), shelducks and numerous wader species. Breeding redshanks occur at exceptionally high densities, and the breeding population of this species is undoubtedly of national importance although its exact size is still being assessed.

#### 3.4.1.1 Construction effects

##### Reservoir construction effects

The proposed location of the South Lincolnshire Reservoir is sufficiently distant from The Wash SPA (located approximately 23km east of the Scheme) to exclude noise, light and dust effects during the construction phase of the new reservoir.

This site is hydrologically connected to The Wash SPA via the South Forty-Foot Drain (located 5km from the Scheme construction area). However, considering the nature of these connections through a slow small, slow flowing ditch network and the distance to the construction area, it is unlikely that any pollution events during the construction phase would have any potential adverse effects as they would be contained and/or diluted before reaching the Designated Site assuming best practice and mitigation measures are implemented.

Any effects of contamination during the construction phase are considered to be temporary and localised and not expected to affect the Designated Site.

##### Transfer construction effects

The Wash SPA is located approximately 23km from the transfer route with limited hydrological connectivity. Therefore, it is sufficiently distant to exclude adverse effects on this Designated Site and its qualifying species due to noise, light, visual or human disturbance during the construction phase of the transfer. Additionally, there is no potential for the physical loss, degradation or fragmentation of supporting habitats, including functional linked land for this Designated Site due to construction activities assuming best practice and mitigation measures are implemented.

#### 3.4.1.2 Operation effects

##### Abstraction effects

###### Changes in flows

The Witham/Haven estuary, located at the mouth of the River Witham, transitions into the larger wash embayment. The embayment is approximately 25km in length from the landward side to the entrance

of the embayment from the North Sea and is located within the counties of Norfolk and Lincolnshire. The Witham/Haven estuary primarily contains extensive saltmarshes and mudflats whilst the larger wash area contains extensive saltmarshes, intertidal banks of mud and sand, shallow waters and deeper channels, and supports breeding/non-breeding and overwintering migrant wildfowl and wading bird species.

On the basis of current modelled scenarios, water transfer from the River Trent could result in dramatic flow increases throughout the year, with proportionately greater impact in summer. The increase would be most pronounced at the point of transfer into the River Witham, and the effect would be dampened with distance downstream.

The results of the hydrological modelling indicate decreases in flows at the Witham outlet. The most pronounced decreases would be seen in the winter months with seasonality and environmental cues largely triggering when abstraction would occur.

Abstraction rules shall ensure that Hands Off Flow (HOF) conditions are maintained and thus reduction in flows would only occur at certain times of year in medium and high flow periods. Overall, reductions in flows would be maximal during the winter months (December to March) whereas in the summer months (June to September), little would be abstracted from the river system (Table 3.1).

**Table 3.1: Changes in flows at the outlet of the River Witham system**

Month	Average of Baseline	Average of with abstractions	Average of %change
January	2804.5	2351.7	19
February	2704.0	2259.9	19
March	2120.2	1736.9	20
April	1453.1	1189.7	17
May	951.2	794.2	12
June	630.6	544.3	8
July	504.5	448	5
August	480	422.4	5
September	466	407.4	5
October	793	671.5	9
November	1509	1257	15
December	2227	1864.1	17

Source: Mott MacDonald

The transfer from the Trent is unlikely to occur at a constant rate throughout the year. In reality, it would stop when there is sufficient water in the Witham system, and it would also be subjected to HOF conditions on the Trent.

The proposed transfer of flows from the River Trent into the upper Witham system would result in increased flows in the River Witham, down to the abstraction point at Langrick Bridge. This would increase the potential for abstraction, allowing transferred flows to be taken out as a minimum when the transfer is operated.

Habitats within the Wash embayment are subject to significant daily changes in flow velocity from flooding and draining of the waterbody into the North Sea. Flow conditions are in constant flux and the habitats associated with these areas are adept at coping with stressors derived from these changes. The proposed changes to flow in the River Witham outlet are unlikely to significantly affect estuarine habitats that are subject to greater daily background changes due to the tidal nature of the Wash embayment.

Any changes are likely to be below natural ecosystem variation, therefore it is anticipated that any changes to flow should be negligible when considering the environmental conditions of the whole

ecosystem. However, there is still a degree of uncertainty associated with this prediction, and therefore further studies are recommended specifically in relation to those months when reductions in flows are expected to be greater. During this time (November to April) it is important to understand the potential for changes in sediment transport, in addition to changes in flow, and potential effects on the estuary protected habitats. This would include an additional hydro dynamic modelling of the Wash and analysis of salinity changes.

Level 2 WFD assessments indicate that a potential major adverse risk (risk of deterioration) to the Witham – conf Cringle Bk to conf Brant (ID: GB105030056780), the Witham – conf Brant to conf Catchwater Drain (ID: GB105030062370), the Witham - conf Catchwater Drain to conf Bain (ID: B205030062425) and the Lower Witham conf Bain to Grand Sluice (ID: GB205030062426) can have significant adverse effects due to the transfer of water from upstream and subsequent abstraction at this waterbody leading to changes in water quality, velocity and level, which could impact on biological status elements. Further WFD assessment would be required as the SLR Scheme is further developed (i.e. for gate three and beyond) to improve the levels of certainty for the WFD related risks outlined before.

#### *Changes in water quality*

A change in flow due to new abstractions may alter the opportunity for dilution of pollutants, increasing the concentration of pollutants/contaminants. This could have an impact on ecology downstream of the abstractions.

Water abstraction from the River Trent and its transfer into the River Witham could also lead to changes to water quality due to increased turbidity and sedimentation that could affect natural estuarine-coastal processes downstream, potentially worsening the sediment accretion which is already happening in the Wash embayment<sup>19</sup>.

The saltmarshes, wading birds and coastal lagoons at the Wash are dependent on freshwater availability and maintaining levels of dissolved oxygen. Increased suspended sediment can smother the estuarine floor leading to anoxic conditions, affecting primary productivity by decreasing the light levels needed for photosynthesis and reducing habitat complexity of coastal ecosystems. Qualifying bird species can be adversely affected by sedimentation altering estuarine processes and food webs on which they depend. Additionally, sediments can also transport pollutants and microplastics to the Wash estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds. Sedimentation effects may be worsened by the projected increase in the frequency and intensity of storm and flood events triggered by climate change, leading to less-resilient ecosystems.

Habitats found within the Witham/Haven estuary and wider Wash embayment are extremely tolerant to changes in salinity. The average annual salinity in the Wash embayment is over 31 parts per thousand (ppt) (Dare et al., 2004). Salinity decreases gradually between the entrance to the embayment and the bayhead. It becomes polyhaline<sup>20</sup> in the intertidal zone of the bayhead, and mesohaline in the river mouths. It is the densest saltwater type that is classified as "brackish." Mesohaline conditions comprise salt concentrations between 5 and 18 ppt. Communities in this ecological group are salt marshes characterized by very low species diversity and low plant stature<sup>21</sup>. Overarchingly, habitats found within the Wash are generally considered to be euryhaline, meaning that salinity concentrations change regularly. Salinity conditions are widely fluctuating within saltmarsh habitats. No clear salinity gradient can be determined with saltmarsh elevation as the interaction of tidal submergence, rainfall and evapotranspiration produces extensive fluctuation in salinity across the marsh.

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<sup>19</sup> Natural England, 2014. Site Improvement Plan: The Wash. Available from <http://publications.naturalengland.org.uk/publication/5327498292232192>. Accessed 23/08/2022

<sup>20</sup> Polyhaline is a salinity category term applied to brackish estuaries and other water bodies with a salinity between 18 and 30 ppt.

<sup>21</sup> <http://nora.nerc.ac.uk/id/eprint/15037/>

Therefore, all saltmarsh plants, independent of their distribution across the marsh, exhibit high salt tolerance (Natural England and RSPB, 2014). The estimated changes in salinity at the mouth of the wash are predicted to be less than 0.2ppm and therefore it is considered that this would not alter the conditions of the habitats in the wash.

Further modelling is, therefore, required to understand the changes which may take place due to the transfer from the Trent and abstraction from the River Witham on flow velocity, water quality, turbidity, water level and temperature particularly during spring/summer. Further studies including field-based hydraulic and river physical habitat investigations to enable some quantification of potential impacts on aquatic ecology are recommended. A detailed review of the baseline ecological data is also recommended.

#### *Non-native invasive species*

An invasive non-native species risk assessments was carried out for the Scheme and identified an overall Medium risk of INNS in the receptor waterbody. Although the proposed transfers would not introduce a new hydrological connection between the different catchments the abstraction from the River Trent and River Witham could potentially increase habitat suitability for several non-native species - therefore it is critical potential mitigations measures be investigated to prevent further spread of INNS at the abstraction locations.

The proposed transfers from the River Trent involve raw water and as such there is a risk of INNS transmission. As these transfers involve freshwater transfers the potential for the establishment of new INNS in coastal and saline habitats is reduced; however, it cannot be excluded. Mitigation measures are therefore required to reduce this risk.

#### **Emergency drawdown effects**

The new reservoir would be lined with clay and therefore, no anticipated potential adverse effects have been identified on the groundwater or surface water during the operation phase. However, there is a residual risk of flooding if the proposed reservoir embankments were to fail in an uncontrolled manner. The probability of such a failure is very low in a non-impounding reservoir because the risk from a dam breach is managed by the design, maintenance, and emergency plan under the Reservoir Safety Act 1975, including an emergency drawdown. Rapid drawdown facilities would include:

- Emergency drawdown system - The system for rapid evacuation of water in the event of an emergency requirement. Currently envisaged to be siphons with pipes that run over the embankment and a low-level outlet.
- Emergency drawdown control and valve house - A structure set into the embankment that would houses the controls to the emergency drawdown valves.
- Emergency drawdown pond - A pond used to hold and return water from testing of the emergency drawdown system. Would also allow slow release of water to watercourse, if required, at a reduced flow rate to not overwhelm the local system.
- Emergency drawdown energy dissipation and weir- A structure at the outlet of the emergency drawdown siphons and used to dissipate the energy and control the outflow with controlled erosion.
- Emergency drawdown embankment/ditch widening- An improved section of channel to restore navigation and provide the capacity in the local drain system to convey emergency drawdown flows to suitable receptors. This channel would be shaped to minimise the works required to make it navigable in the future.
- Spillway - An unreinforced grass spillway to control overtopping and connect the reservoir to the local drain network without other systems needing to be functioning or used.

The preferred solution at this stage is to discharge to South Forty Foot Drain which is hydrologically connected to The Wash, but this is to be further modelled and confirmed as part of the next stage of development. Therefore, potential indirect adverse effects on The Wash SPA integrity from emergency drawdowns during operation activities cannot be ruled out at this stage.

### 3.4.2 The Wash Ramsar Site

A vast intertidal embayment incorporating one of the largest and most important areas of estuarine mudflats, sandbanks and saltmarsh in Britain. Counts of wintering waterbirds reach 320,673 individuals and include nationally and internationally important numbers of numerous species, notably up to 17,000 passerines (perching songbirds). The site is also of outstanding international importance for passage birds, notable waders, and supports various breeding birds, an important shell fishery, and the largest breeding colony in Europe of the seal *Phoca vitulina*.

#### 3.4.2.1 Construction effects

##### Reservoir construction effects

The reservoir construction effects are expected to be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

##### Transfer construction effects

The transfer construction effects are expected to be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

#### 3.4.2.2 Operation effects

The reservoir operation effects are expected to be similar for The Wash Ramsar Site qualifying bird species as the ones listed above for The Wash SPA.

Additionally, there is potential for the loss or damage of the Ramsar qualifying vegetation an indirect result of physical habitat damage and habitat degradation due to changes in salinity, water quality and sediment transport. These could be within the Designated Sites itself and/or in adjacent areas functioning as supporting habitats.

Overarchingly, habitats found within The Wash Ramsar Site are generally considered to be euryhaline, meaning that salinity concentrations change regularly. Salinity conditions are widely fluctuating within saltmarsh habitats. No clear salinity gradient can be determined with saltmarsh elevation as the interaction of tidal submergence, rainfall and evapotranspiration produces extensive fluctuation in salinity across the marsh. Therefore, all saltmarsh plants, independent of their distribution across the marsh, exhibit high salt tolerance (Natural England and RSPB, 2014). The estimated changes in salinity at the mouth of The Wash are predicted to be less than 0.2ppm and therefore it is considered that this would not alter the conditions of the habitats in The Wash.

### 3.4.3 The Wash and North Norfolk Coast SAC

The Wash is the largest embayment in the UK. It is connected via sediment transfer systems to the north Norfolk coast. Together, the Wash and North Norfolk Coast form one of the most important marine areas in the UK and European North Sea coast, and include extensive areas of varying, but predominantly sandy, sediments subject to a range of conditions. Qualifying habitats include Atlantic salt meadows *Glauco-Puccinellietalia maritimae*, coastal lagoons, large shallow inlets and bays, Mediterranean saltmarsh scrub, intertidal mudflats and sandflats, reefs, subtidal sandbanks and Glasswort and other annuals colonising mud and sand.

The embayment supports a variety of mobile species, including a range of fish, otter *Lutra lutra* and common seal *Phoca vitulina*. The extensive intertidal flats provide ideal conditions for common seal breeding and hauling-out.

#### 3.4.3.1 Construction effects

##### Reservoir construction effects

The reservoir construction effects are expected to be similar for The Wash and North Norfolk Coast SAC qualifying habitats and species as the ones listed above for The Wash Ramsar Site.



### Transfer construction effects

The transfer construction effects are expected to be similar for The Wash and North Norfolk Coast SAC qualifying habitats and species as the ones listed above for The Wash Ramsar Site.

#### 3.4.3.2 Operation effects

The reservoir abstraction effects are expected to be similar for The Wash and North Norfolk Coast SAC qualifying habitats and species as the ones listed above for The Wash Ramsar Site.

Additionally, The Wash and North Norfolk Coast SAC is designated for supporting otters *Lutra lutra*. Otters can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the Scheme may be used by these qualifying species when they are functionally linked to the Designated Site (linkage habitat). Populations in coastal areas utilise shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Therefore, otters can potentially be adversely affected by habitat degradation as a result of changes in water quality leading to a reduction in their food supply.

The water quality modelling study (Mott Mac Donald, 2022) has indicated that changes in water quality are expected to be small and compliant with WDF objectives and therefore no significant effects are anticipated. However, an increase in flows during spring/summer can affect fish species spawning season and juvenile growth indirectly affecting otter populations through changes to food supply.

The Wash and North Norfolk Coast SAC is also designated for supporting the largest colony of common seals *Phoca vitulina* in the UK, with some 7% of the total UK population. The extensive intertidal flats here and on the North Norfolk Coast provide ideal conditions for breeding and hauling out. Changes in water quality and flows, including changes in sediment transport could potentially affect the intertidal banks of sand, mud and shallow water at The Wash as well as functional linked land used by these qualifying species. Changes to supporting processes including sediment movement and hydrodynamic regime can affect common seal habitats and habitats that the species relies on. The sediment movement is mostly influenced by tide and wave-driven water flow and hydrodynamic conditions that support this include the speed and direction of wave and tidal currents, seabed shear stress and wave exposure, which are not expected to be affected by this Scheme. However, the reduction in flow during high flow conditions could affect the quantity of the sediments reaching estuarine habitats changing natural water flow and sediment movement. Alterations to these processes could affect species presence and distribution.

Further studies are recommended to reduce the uncertainty the effects on The Wash common seal and otter populations.

#### 3.4.4 Humber Estuary SPA

The Humber Estuary is located on the east coast of England and comprises extensive wetland and coastal habitats. The estuary supports important numbers of waterbirds (especially geese, ducks and waders) during the migration periods and in winter. In summer, it supports important breeding populations of bittern *Botaurus stellaris*, marsh harrier *Circus aeruginosus*, avocet *Recurvirostra avosetta* and little tern *Sterna albifrons*.

In the non-breeding season, the area regularly supports 153,934 individual waterbirds (five year peak mean 1996/97 – 2000/01), including dark-bellied brent goose *Branta bernicla bernicla*, shelduck *Tadorna tadorna*, wigeon *Anas penelope*, teal *Anas crecca*, mallard *Anas platyrhynchos*, pochard *Aythya farina*, scaup *Aythya maril*, goldeneye *Bucephala clangula*, bittern *Botaurus stellaris*, oystercatcher *Haematopus ostralegus*, avocet *Recurvirostra avosetta*, ringed plover *Charadrius hiaticula*, golden plover *Pluvialis apricaria*, grey plover *P. squatarola*, lapwing *Vanellus vanellus*, knot *Calidris canutus*, sanderling *C. alba*, dunlin *C. alpina*, ruff *Philomachus pugnax*, black-tailed godwit *Limosa limosa*, bar-tailed godwit *L. lapponica*, whimbrel *Numenius phaeopus*, curlew *N. arquata*, redshank *Tringa tetanus*, greenshank *T. nebularia* and turnstone *Arenaria interpres*.

#### 3.4.4.1 Construction effects

##### Reservoir construction effects

The proposed new reservoir is located sufficiently distant from the Humber Estuary SPA (approximately 74.5 km northeast of the site) to exclude adverse effects on this Designated Site bird qualifying species due to noise, vibration, visual or human disturbance during the construction phase of the new reservoir assuming best practice and mitigation measures are implemented. Additionally, there is no potential for the physical loss, degradation or fragmentation of supporting habitats, including functionally linked land used by qualifying bird species.

##### Transfer construction effects

Humber Estuary SPA is located approximately 52.5 km from the transfer abstraction point in the River Trent. Therefore, it is sufficiently distant to exclude adverse effects on this Designated Site and its qualifying bird species due to noise, vibration, visual or human disturbance during the construction phase of the transfer assuming best practice and mitigation measures are implemented. Additionally, there is no potential for the physical loss, degradation or fragmentation of supporting habitats, including functional linked land for this Designated Site due to construction activities.

#### 3.4.4.2 Operation effects

##### Abstraction effects

During operation, water abstraction has the potential to result in habitat loss and degradation of the Designated Site itself and/or functionally linked land used by its bird qualifying species. Changes in water levels and flows as a result of the new abstraction in the River Trent can lead to changes to water quality downstream adversely affecting estuarine processes and feeding grounds of designated bird species. Abundant food resources attract wildfowl and waders to the site. If these are impacted by the above effects this could result in the habitat no longer being able to support the same numbers of populations for which the site is designated. At this stage, further studies are recommended to reduce uncertainty and to estimate the potential effects on the estuarine processes and its designated habitats and bird species.

Level 2 WFD assessments indicate that A potential major adverse risk (risk of deterioration) to the Trent from Soar to Beck (ID: GB104028053110) was identified as a result of the new surface water abstraction. Abstraction rates are expected to be <10% of the total volume of the Trent catchment and the change in flow and velocity has the potential to impact biological elements. Further investigation is required to determine the full extent of the impacts. A potential adverse risk was also identified due to potential for changes in water quality due to the surface water abstraction. Further WFD assessment would be required as the scheme is further developed (ie, for gate three and beyond) to improve the levels of certainty for the WFD assessment results. These studies should include investigations to determine potential changes in flow and water levels, changes in water quality, salinity and sediment transport. The investigations should take in consideration climate change scenarios.

#### 3.4.5 Humber Estuary SAC

This site has been identified as an area of importance for aquatic habitats including estuaries, mudflats and sandflats not covered by sea water at low tide, intertidal mudflats and sandflats, costal lagoons, Atlantic salt meadows and embryonic shifting dunes. As salinity declines upstream, reedbeds and brackish saltmarsh communities fringe the estuary. These are best represented at the confluence of the Rivers Ouse and Trent at Blacktoft Sands.

Significant fish species include river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* which breed in the River Derwent, a tributary of the River Ouse. Grey seals *Halichoerus grypus* come ashore in autumn to form breeding colonies on the sandy shores of the south bank at Donna Nook.

### 3.4.5.1 Construction effects

#### Reservoir construction effects

The proposed new reservoir is located sufficiently distant from the Humber Estuary SAC (approximately 74.5 km northeast of the site) to exclude adverse effects on this Designated Site habitats and qualifying species, including sea lamprey, river lamprey and grey seals due to noise, vibration, light, and human disturbance during the construction phase of the new reservoir assuming best practice and mitigation measures are implemented.

River and sea lamprey spawn in freshwater sites many kilometres upstream of the designated site. Therefore, activities during the construction of the reservoir may have adverse effects on functionally linked habitats used by these qualifying fish species. Further investigations are needed to identify key spawning areas in the Zol of the scheme to better determine adverse effects for these designated species.

The new reservoir and associated infrastructure are also located sufficiently distant from the designated site boundary to exclude noise, dust and light effects during construction. It is unlikely that any construction activities would have an adverse effect on the grey seal populations and the designated sandbanks, mudflats, sandflats, Atlantic salt meadows and reefs and associated vegetation at the Humber Estuary.

#### Transfer construction effects

The Humber Estuary SAC is located approximately 52.5 km from the transfer abstraction point in the River Trent. The abstraction point is hydrologically connected to the Humber Estuary SAC via the River Trent that feeds directly into this designated site. Therefore, there is a pathway for potential effects during construction, including pollution events and biological disturbances that cannot be dismissed at this stage.

Activities during the construction of the transfer and its associated intake infrastructure may lead to habitat loss and degradation of functionally linked habitats used by qualifying fish species. The Humber Estuary SAC is designated as an important migration route for both, river lamprey and sea lamprey between coastal waters and their spawning areas, therefore any changes to water and/or habitat quality has the potential to disrupt migratory patterns of these designated species.

The river lamprey and, to a lesser extent, sea lamprey, may use the watercourses within the Zol of this Scheme and are dependent on good water quality conditions. Changes in water quality due to run-off and pollution events during the construction of the intake infrastructure in the River Trent may lead to changes in turbidity and increased sedimentation that can also have negative effects on the life cycle of the qualifying species.

Grey seals are unlikely to be affected as the construction effects of the transfer are expected to be localised and of short duration and unlikely to affect the estuary due to the distance and the use of best practice measures.

### 3.4.5.2 Operation effects

During operation, changes to water levels and flows due to the new abstraction in the River Trent may lead to functionally linked habitat degradation and biological disturbances for the river lamprey and the sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas. Disturbance to qualifying species migratory routes may impact upon adult survival. Designated fish species migrating between the Humber Estuary upstream the River Trent may also be caught or entrained at the new intake point leading to fish mortality.

The Humber Estuary SAC is also designated for supporting grey seals that come ashore in autumn to form breeding colonies on the sandy shores of the south bank at Donna Nook. Changes in water quality and flows, including changes in sediment transport could potentially affect the

intertidal banks of sand, mud and shallow water at the Humber Estuary as well as functional linked land used by these qualifying species. Changes to supporting processes including sediment movement and hydrodynamic regime can affect grey seal habitats and habitats that the species relies on. The sediment movement is mostly influenced by tide and wave-driven water flow and hydrodynamic conditions that support this include the speed and direction of wave and tidal currents, seabed shear stress and wave exposure, which are not expected to be affected by this Scheme. However, the reduction in flow may affect the quantity of the sediments reaching estuarine habitats changing natural water flow and sediment movement is not significantly altered. Alterations to these processes could affect species presence and distribution.

There is also the potential for the loss or damage of the SAC qualifying vegetation as a result of changes in water levels and flows, sediment and nutrient loads leading to changes in natural succession. At this stage, further studies are recommended to reduce uncertainty and to estimate the potential effects on the estuarine processes and its designated habitats and species.

### 3.4.6 Humber Estuary Ramsar Site

The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.

The area regularly supports internationally important numbers of various species of breeding and wintering waterbirds. Many passage birds, notably internationally important populations of ringed plover and sanderling stage in the area. The site supports Britain's most south-easterly breeding colony of grey seal *Halichoerus grypus* and the dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad *Bufo calamita*.

The Humber Estuary Ramsar Site acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.

#### 3.4.6.1 Construction effects

The reservoir and transfer construction effects are expected to be similar for Humber Estuary Ramsar Site qualifying habitats, migratory fish species and grey seal populations and bird species as the ones listed above for the Humber Estuary SAC and SPA.

#### 3.4.6.2 Operation effects

Potential adverse effects during operation are expected to be similar to the ones described above for the Humber Estuary SPA and SAC qualifying habitats, fish and seal species.

Additionally, further studies are recommended to reduce uncertainty and to estimate the potential effects on dune slacks supporting the breeding site of the natterjack toad.

### 3.4.7 Baston Fen SAC

Baston Fen SAC comprises long strips of permanent pasture which are subject to regular winter flooding, interspersed with a series of old flooded borrow-pits with associated swamp and fen plant communities. Amongst the variety of fish which have been recorded from the site is the spined loach *Cobitis taenia*, significant populations of which occur in the Counter Drain and, to a lesser extent, in the River Glen. This site represents a key stronghold for this species within the Welland catchment.

### 3.4.7.1 Construction effects

#### **Transfer construction effects**

The proposed transfer route from the SLR potable water pipeline is situated approximately 2km from Baston Fen SAC and crosses the River Glen to the north east of the Designated Site, which is hydrologically connected to the site. Therefore, there is a pathway for potential effects due to construction, including potential pollution events and biological disturbances of functionally linked habitat used by spined loach populations.

The construction of river water course crossings has the potential to impact downstream water quality, increase sedimentation and affect the hydrological regime, resulting in adverse effects on functionally linked habitat used by the qualifying species.

The spined loach is a small bottom-living fish that prefers clear oxygen-rich waters and has a restricted microhabitat associated with a specialised feeding mechanism. They use a complex branchial apparatus to filter-feed in fine but well-oxygenated sediments. Optimal habitat is patchy cover of submerged (and possibly emergent) macrophytes, which are important for spawning, and a sandy (also silty) substrate, into which juvenile fish tend to bury themselves. Construction activities may lead to changes in water turbidity and increased sedimentation that can have adverse effects on the life cycle of this qualifying species.

Non-physical disturbance, including vibration effects during the construction of the transfer pipeline may affect functionally linked habitat used by spined loach, leading to changes in species distributions and habitat avoidance. Physical damage and disturbance of functionally linked habitat may displace populations from current spawning grounds and feeding areas, affecting adult survival.

Additionally, physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of spined loach. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised.

#### **Reservoir construction effects**

The proposed reservoir is located sufficiently distant from Baston Fen SAC (approximately 20 km away from the construction area) to exclude potential adverse effects during the construction phase on this Designated Site and its qualifying features.

#### **Operation effects**

No operation effects are anticipated for this option which could affect this Designated Site and its qualifying features.

**Table 3.2: Potential effects on designated sites and qualifying features**

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
<b>The Wash SPA (UK9008021) (approximately 23km)</b>	<p><b>ARTICLE 4.1</b></p> <p><b>During the breeding season the area regularly supports:</b></p> <p><i>Sterna albifrons, Sterna hirundo</i></p> <p><b>Over winter the area regularly supports:</b></p> <p><i>Cygnus columbianus bewickii, Limosa lapponica</i></p>	<p>The Wash SPA is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like light and noise disturbance during the construction phase. This designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash SPA, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying bird species.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on; New pathways for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit.</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>No effects from construction are anticipated. At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation and water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>
	<p><b>ARTICLE 4.2</b></p> <p><b>Over winter the area regularly supports:</b></p> <p><i>Anas acuta, Anas Penelope, Anas strepera, Anser brachyrhynchus Arenaria interpres, Branta bernicla bernicla, Bucephala clangula, Calidris alba, Calidris alpina alpina, Calidris canutus, Haematopus ostralegus, Limosa limosa islandica, Melanitta nigra, Numenius arquata, Pluvialis squatarola, Tadorna tadorna, Tringa totanus</i></p>	See 'Possible adverse effects before mitigation' listed above.	See 'Mitigation measures' listed above.	See 'Adverse effects after mitigation' listed above.
	<p><b>ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS</b></p> <p>400367 waterfowl (5-year peak mean 1991/92-1995/96) Including: <i>Cygnus columbianus bewickii, Anser brachyrhynchus, Branta bernicla bernicla, Tadorna tadorna, Anas penelope, Anas strepera, Anas acuta, Melanitta nigra, Bucephala clangula, Haematopus ostralegus, Pluvialis squatarola, Calidris canutus, Calidris alba, Calidris alpina alpina,</i></p>	See 'Possible adverse effects before mitigation' listed above	See 'Mitigation measures' listed above	See 'Adverse effects after mitigation' listed above.

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
<p><b>The Wash Ramsar (UK11072) (approximately 23 km)</b></p>	<p><i>Limosa limosa islandica, Limosa lapponica, Numenius arquata, Tringa totanus, Arenaria interpres</i></p> <p><b>Ramsar criterion 1</b></p> <p>The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.</p>	<p>The Wash Ramsar Site is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like light and noise disturbance during the construction phase. This designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash Ramsar Site, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat quality including disturbances to functional linked habitat; changes to productivity and natural succession; potential new pathway for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>No effects from construction are anticipated.</p> <p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, and water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying habitats; the structure and function of the habitats; and the supporting processes on which qualifying habitats rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including INNS assessments and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>
	<p><b>Ramsar criterion 3</b></p> <p>Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.</p>	<p>See 'Possible adverse effects before mitigation' listed above.</p>	<p>See 'Mitigation measures' listed above.</p>	<p>See 'Adverse effects after mitigation' listed above.</p>
	<p><b>Ramsar criterion 5</b></p> <p>Assemblages of international importance:</p> <p>Species with peak counts in winter:</p> <p>292541 waterfowl (5-year peak mean 1998/99-2002/2003)</p>	<p>The Wash Ramsar Site is located sufficiently distant from the proposed Scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash Ramsar Site, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor,</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management.</li> <li>TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit.</li> </ul>	<p>No effects from construction are anticipated.</p> <p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, and water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity,</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
<b>Ramsar criterion 6</b>	<p>Species/populations occurring at levels of international importance.</p> <p><b>Species with peak counts in spring/autumn:</b></p> <p>Eurasian oystercatcher, <i>Haematopus ostralegus ostralegus</i>, Grey plover, <i>Pluvialis squatarola</i>; Red knot, <i>Calidris canutus islandica</i>; Sanderling, <i>Calidris alba</i>; Eurasian curlew, <i>Numenius arquata arquata</i>, N. a. <i>arquata</i>; Common redshank, <i>Tringa totanus tetanus</i>; Ruddy turnstone, <i>Arenaria interpres interpres</i>;</p> <p><b>Species with peak counts in winter:</b></p> <p>Pink-footed goose, <i>Anser brachyrhynchus</i>, Dark-bellied brent goose, <i>Branta bernicla bernicla</i>, Common shelduck, <i>Tadorna tadorna</i>, Northern pintail, <i>Anas acuta</i>, Dunlin, <i>Calidris alpina alpina</i>, Bar-tailed godwit, <i>Limosa lapponica lapponica</i>,</p> <p><b>Species/populations identified subsequent to designation for possible future consideration under criterion 6.</b></p> <p>Species with peak counts in spring/autumn: Ringed plover, <i>Charadrius hiaticula</i>; Black-tailed godwit, <i>Limosa limosa islandica</i>.</p> <p>Species with peak counts in winter: European golden plover, <i>Pluvialis apricaria apricaria</i>; Atlantic Northern lapwing, <i>Vanellus vanellus</i>; Black-headed gull, <i>Larus ridibundus</i>.</p>	See 'Possible adverse effects before mitigation' listed above	See 'Mitigation measures' listed above	See 'Adverse effects after mitigation' listed above
<b>The Wash and North Norfolk Coast SAC (UK0017075) (approximately 23km)</b>	<p>1110 Sandbanks which are slightly covered by sea water all the time</p> <p>1140 Mudflats and sandflats not covered by seawater at low tide</p> <p>1160 Large shallow inlets and bays</p> <p>1170 Reefs</p>	<p>The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to this SAC, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects</p>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> </ul>	<p>No effects from construction are anticipated. At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, and water quality on this Designated Site located downstream of the Scheme.</p>



Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
1150 Coastal lagoons * Priority feature		<p>including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat quality including disturbances to functional linked habitat; changes to productivity and natural succession; potential new pathway for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham.</li> </ul>	<ul style="list-style-type: none"> <li>Environment Agency’s PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>These changes have the potential to adversely affect the extent and distribution of qualifying habitats; the structure and function of the habitats; and the supporting processes on which qualifying habitats rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including INNS assessments and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>
<p>1310 <i>Salicornia</i> and other annuals colonising mud and sand</p> <p>1330 Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>)</p> <p>1420 Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)</p>		<p>The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to this SAC, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat quality including disturbances to functional linked habitat; changes to productivity and natural succession; potential new pathway for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency’s PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a Construction and Environmental Management Plan which would include all the above</li> </ul>	<p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and thermal regime on the designated sites located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including INNS assessments and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
1365 Common seal ( <i>Phoca vitulina</i> )	<p>The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to this SAC, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p>This site is designated for supporting the largest colony of common seals in the UK, with some 7% of the total UK population. The extensive intertidal flats at The Wash and on the North Norfolk Coast provide ideal conditions for breeding and hauling out. Changes in water quality and flows, including changes in turbidity as a result of increased sedimentation could potentially affect the intertidal banks of sand, mud and shallow water as well as functional linked land used by these qualifying species.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation of functional linked land used by otters as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of otters.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat availability including functional linked habitat used by otters; changes in species abundance or distribution; potential for populations to be displaced from current feeding areas. Otters can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on. The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <p>CIRIA C741 Environmental good practice on site guide                      Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</p> <p>TIDE Toolbox: Guiding Estuarine Management.</p> <p>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</p> <p>Directional drilling would be used at all watercourses &gt;3m wide.</p> <p>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</p> <p>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</p> <p>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</p>	<p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and thermal regime on the designated sites located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including INNS assessments and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>	
1355 Otter ( <i>Lutra lutra</i> )	<p>The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects during the construction phase. However, this designated site is connected through the River Witham and small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash SPA, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p>Otters can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the Scheme may be used by these qualifying species when they are functionally linked to the designated site (linkage habitat). Therefore, otters can potentially be adversely affected by habitat degradation as a result</p>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <p>CIRIA C741 Environmental good practice on site guide.                      Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</p> <p>TIDE Toolbox: Guiding Estuarine Management</p> <p>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</p>	<p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, salinity and thermal regime on the designated sites located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity,</p>	

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
<p><b>Humber Estuary SPA (UK9006111)</b> (approximately 52.5 km)</p>	<p>Article 4.1 During the breeding season the area regularly supports: <i>Botaurus stellaris</i>, <i>Circus aeruginosus</i> 6.3% of the population in Great Britain, <i>Recurvirostra avosetta</i>, <i>Sterna albifrons</i> Over winter the area regularly supports: <i>Botaurus stellaris</i>, <i>Circus cyaneus</i>, <i>Limosa lapponica</i>, <i>Pluvialis apricaria</i>, (North-western Europe - breeding), <i>Recurvirostra avosetta</i> On passage the area regularly supports: <i>Philomachus pugnax</i></p>	<p>The Humber Estuary SPA is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like noise, light and human disturbance during the construction phase. However, this designated site is connected hydrologically via the River Trent that feeds directly into the estuary. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying bird species.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to the Humber estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent.</li> <li>Biological disturbance– Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>TIDE Toolbox: Waterbird Disturbance and Mitigation Toolkit.</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more</li> </ul>	<p>No effects from construction are anticipated.</p> <p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation and water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place at the Humber Estuary, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including biodiversity surveys, field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
		<p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>	<p>breeding grounds and interconnections to supporting habitats in this region).</p> <ul style="list-style-type: none"> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	
	<p>Article 4.2 Over winter the area regularly supports: <i>Calidris alpina alpine</i>, <i>Calidris canutus</i>, <i>Limosa limosa islandica</i>, <i>Tadorna tadorna</i>, <i>Tringa totanus</i> On passage the area regularly supports: <i>Calidris alpina alpine</i>, <i>Calidris canutus</i>, <i>Limosa limosa islandica</i>, <i>Tringa totanus</i></p>	See 'Possible adverse effects before mitigation' listed above	See 'Mitigation measures' listed above	See 'Adverse effects after mitigation' listed above
	<p>Article 4.2 – An internationally important assemblage of birds. In the non-breeding season, the area regularly supports: <i>Anas crecca</i>, <i>Anas penelope</i>, <i>Anas platyrhynchos</i>, <i>Arenaria interpres</i>, <i>Aythya ferina</i>, <i>Aythya marila</i>, <i>Botaurus stellaris</i>, <i>Branta bernicla bernicla</i>, <i>Bucephala clangula</i>, <i>Calidris alba</i>, <i>Calidris alpina alpina</i>, <i>Calidris canutus</i>, <i>Charadrius hiaticula</i>, <i>Haematopus ostralegus</i>, <i>Limosa lapponica</i>, <i>Limosa limosa islandica</i>, <i>Numenius arquata</i>, <i>Numenius phaeopus</i>, <i>Philomachus pugnax</i>, <i>Pluvialis apricaria</i>, <i>Pluvialis squatarola</i>, <i>Recurvirostra avosetta</i>, <i>Tadorna tadorna</i>, <i>Tringa nebularia</i>, <i>Tringa totanus</i>, <i>Vanellus vanellus</i>.</p>	See 'Possible adverse effects before mitigation' listed above	See 'Mitigation measures' listed above	See 'Adverse effects after mitigation' listed above
<p><b>Humber Estuary SAC (UK0030170) (approximately 52.5 km)</b></p>	<p>H1110 Sandbanks which are slightly covered by sea water all the time H1130 Estuaries H1140 Mudflats and sandflats not covered by seawater at low tide H1150 Coastal lagoons H1310 Salicornia and other annuals colonising mud and sand H1330 Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>) H2110 Embryonic shifting dunes H2120 Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ('White dunes') H2130 Fixed dunes with herbaceous vegetation ('Grey dunes') H2160 Dunes with <i>Hippophae rhamnoides</i></p>	<p>The Humber Estuary SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like dust, light and human disturbance during the construction phase. However, this designated site is hydrologically connected to the Scheme via the River Trent, that feeds directly into the estuary. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to the Humber estuarine environment, which can bioaccumulate.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent.</li> <li>Biological disturbance– Changes to habitat quality including disturbances to functional linked habitat; changes to productivity and natural succession.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>No effects from construction are anticipated. At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation, and water quality on this Designated Site located downstream of the Scheme. These changes have the potential to adversely affect the extent and distribution of qualifying habitats; the structure and function of the habitats; and the supporting processes on which qualifying habitats rely. Further assessment and modelling are, therefore, required to understand the changes which may take place on The Wash, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including biodiversity surveys and field-based hydraulic and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
S1095 Sea lamprey ( <i>Petromyzon marinus</i> ) S1099 River lamprey, ( <i>Lampetra fluviatilis</i> )		<p>The Humber Estuary SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like light, vibration and human disturbance during the construction phase. However, this designated site is hydrologically connected to the Scheme via the River Trent, that feeds directly into the estuary. This SAC is designated as an important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas. Any changes to water and/or habitat quality has the potential to disrupt migratory patterns of these designated species. Therefore, there is a pathway for potential adverse effects during construction and operation, including habitat loss and/or degradation of functionally linked habitat used by the designated fish species.</p> <p><b>During construction, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation as a result in changes in water quality affecting fish populations.</li> <li>Toxic contamination - water quality degradation from potential pollution events affecting functionally linked habitat used by migratory fish species.</li> <li>Non-toxic contamination - changes in turbidity leading to changes in sediment loading and silt deposition affecting functional linked habitat used by the qualifying fish species.</li> <li>Biological disturbance –changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas; direct mortality as a result of fish getting caught or entrained at the abstraction point in the River Trent.</li> </ul> <p><b>During operation, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation as a result in changes in water quality affecting fish populations.</li> <li>Toxic contamination - reduced dilution of pollutants due to water abstraction in the River Trent.</li> <li>Non-toxic contamination - changes in turbidity as a result of modification of flows leading to changes in sediment loading and silt deposition; changes in thermal regime due to increased water abstraction on the River Trent.</li> <li>Water table/ availability - change to water levels and flows due to new abstraction in the River Trent potentially affecting estuarine processes and environment affecting the life cycle of the sea lamprey and the river lamprey.</li> <li>Biological Disturbances - changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations (particularly relevant for migratory fish species). Disturbance to qualifying species may impact upon adult survival.</p>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>The application of industry good practice on 'Engineering in the Water Environment Good Practice Guide - Intakes and outfalls (SEPA)' and 'Screening for intake and outfalls: a best practice guide' (Environment Agency).</li> <li>Development of a CEMP which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>At this stage it is not possible to exclude potential adverse effects during the construction and operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation and water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place at the Humber Estuary, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including and field-based hydraulic, biodiversity surveys and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>
S1364 Grey seal ( <i>Halichoerus grypus</i> )		<p>The Humber Estuary SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like noise, light and human disturbance during the construction phase. However, this designated site is hydrologically connected to the Scheme via the River Trent, that feeds directly into the estuary. Therefore,</p>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this Scheme can be found in in section 3.3.4. These include:</p>	<p>No effects from construction are anticipated.</p> <p>At this stage it is not possible to exclude potential adverse effects during the operation phase of this Scheme, as uncertainty remains in relation to the changes in water levels and flows, sedimentation and</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
		<p>there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p>This SAC is designated as an important breeding area for the grey seal. Any changes to water and/or habitat quality has the potential to disrupt the life cycle of this designated species.</p> <p><b>During operation, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage – habitat degradation as a result of water quality changes may affect the breeding colony of grey seals</li> <li>Biological disturbance – changes in habitat availability and potential for designated species populations to be displaced from current areas.</li> <li>Non-toxic contamination – changes in turbidity leading to changes in sediment loading and silt deposition which may lead to smothering of functionally linked habitats.</li> <li>Toxic contamination – water pollution / changes to water quality (degradation). Sediments can transport pollutants and microplastics to estuarine environment, which can bioaccumulate in the prey of grey seals.</li> <li>Water levels/availability - Changes to water levels and flows due to direct intake from the River Trent</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>	<ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>TIDE Toolbox: Guiding Estuarine Management</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>A plan for improving existing habitats as well as increasing habitat suitability in the estuary (proposing new habitats along the coast and enhancing its connection to the shore) should be taken into consideration. This new/enhanced habitat would not only function as a fish refuge (as a compensation effect for habitat damage due to the intake/outfall structures), but also as a support for this site qualifying species, (as would deliver more breeding grounds and interconnections to supporting habitats in this region).</li> <li>Development of a CEMP which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>water quality on this Designated Site located downstream of the Scheme.</p> <p>These changes have the potential to adversely affect the extent and distribution of qualifying species, the structure and function of the habitats of qualifying species; and the supporting processes on which habitats of qualifying species rely.</p> <p>Further assessment and modelling are, therefore, required to understand the changes which may take place at the Humber Estuary, including changes on flow velocity, water quality, turbidity, water depth and temperature particularly during spring/summer. Additional studies including and field-based hydraulic, biodiversity surveys and river physical habitat investigations are also recommended to enable better quantification of potential effects and reduce uncertainty.</p>
<p><b>Humber Estuary Ramsar Site (UK11031) (Approximately 52.5km)</b></p>	<p><b>Ramsar criterion 1</b> The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SAC qualifying habitats.</p>	<p>See 'Mitigation measures' listed above for the Humber Estuary SAC qualifying habitats..</p>	<p>See 'Adverse effects after mitigation' listed above for the Humber Estuary SAC qualifying habitats.</p>
	<p><b>Ramsar criterion 3</b> The Humber Estuary Ramsar site supports a breeding colony of grey seals <i>Halichoerus grypus</i> at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SAC qualifying grey seal species.</p>	<p>See 'Mitigation measures' listed above for the Humber Estuary SAC qualifying grey seal species.</p>	<p>See 'Adverse effects after mitigation' listed above for the Humber Estuary SAC qualifying grey seal species.</p>
	<p>The dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad <i>Bufo calamita</i>.</p>			
	<p><b>Ramsar criterion 5</b> Assemblages of international importance: 153,934 waterfowl, non-breeding season (5 year peak mean 1996/97-2000/2001)</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SPA qualifying bird species.</p>	<p>See 'Mitigation measures' listed above for the Humber Estuary SPA qualifying bird species.</p>	<p>See 'Adverse effects after mitigation' listed above for the Humber Estuary SPA qualifying bird species.</p>
	<p><b>Ramsar criterion 6 – species/populations occurring at levels of international importance.</b></p> <p><b>Species with peak counts in spring/autumn:</b> <i>Pluvialis apricaria apricaria</i>, P. a. altifrons, <i>Calidris canutus islandica</i>, W &amp; Southern Africa (wintering) Dunlin, <i>Calidris alpina alpina</i>, W Siberia/W Europe <i>Limosa limosa islandica</i>, Iceland/W Europe <i>Tringa totanus totanus</i>,</p> <p><b>Species with peak counts in winter:</b> <i>Tadorna tadorna</i>, NW Europe European <i>Pluvialis apricaria apricaria</i>, P. a. altifrons Iceland &amp; Faroes/E</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SPA qualifying bird species.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SPA qualifying bird species.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SPA qualifying bird species.</p>

Designated sites	Qualifying features	Possible adverse effects before mitigation	Indicative Mitigation measures	Adverse effects after mitigation
	<p>Atlantic <i>Calidris canutus islandica</i>, W &amp; Southern Africa (wintering) Dunlin, <i>Calidris alpina alpina</i>, W Siberia/W Europe <i>Limosa limosa islandica</i>, Iceland/W Europe <i>Limosa lapponica lapponica</i>, W Palearctic.</p>			
	<p><b>Ramsar criterion 8</b> The Humber Estuary acts as an important migration route for both <i>Lampetra fluviatilis</i> and <i>Petromyzon marinus</i> between coastal waters and their spawning areas.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SAC qualifying fish species.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SAC qualifying fish species.</p>	<p>See 'Possible adverse effects before mitigation' listed for the Humber Estuary SAC qualifying fish species.</p>
<p><b>Baston Fen SAC (UK UK0030085) (approximately 2 km)</b></p>	<p>1149 Spined loach <i>Cobitis taenia</i></p>	<p>The proposed transfer route from SLR to Eaton is situated approximately 2 km south west of Baston Fen SAC and it crosses the River Glen which is hydrologically connected to this Designated Site. Therefore, there is a pathway for potential effects due to construction, including eventual pollution events and biological disturbances of functionally linked habitat used by spined loach populations. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised.</p> <p><b>During construction, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage – Physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle; functionally linked habitat degradation as a result of water quality changes in case of pollution events may also adversely affect spined loach populations.</li> <li>Non-physical disturbance – vibration effects affecting functional linked habitat leading to changes in species distributions as a result of habitat avoidance. Due to their relatively sedentary nature, spined loach may be susceptible to direct entrainment into pumps in water abstractions.</li> <li>Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas adversely affecting adult survival.</li> <li>Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by Spined loach. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of this qualifying species.</li> <li>Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; Changes to thermal regime due to increased water abstraction, and reduced compensation flow releases into the River Great Ouse; reduced oxygen levels affecting functional linked habitat used by Spined loach.</li> </ul>	<p>Standard best practice procedures should be followed during construction to limit construction-related disturbance and contamination. A detailed description of best practice procedures and mitigations of relevance to this scheme can be found in in section 3.3.4. These include:</p> <ul style="list-style-type: none"> <li>CIRIA C741 Environmental good practice on site guide.</li> <li>Environment Agency's PPGs (PPG1: General Guide to Prevention of Pollution; PPG6: Pollution prevention guidance for working at construction and demolition sites).</li> <li>To add fish screens at the intake and discharge structures to avoid potential fish entrapment as guided by (but not limited to): 'Screening for Intake and Outfalls: a best practice guide, (Environment Agency, Science Report - ISBN: 1 84432 361 7,2005) to avoid significant effects due to intake and outfall installations.</li> <li>Where possible, installation works for the intake/outfall should also avoid important nursery/spawning grounds of prey species.</li> <li>Biosecurity measures to ensure appropriate removal and/or management control of INNS at source.</li> <li>Directional drilling would be used at all watercourses &gt;3m wide.</li> <li>Specific mitigation to reduce increased sedimentation and silt deposition downstream of the proposed works should include silt screening around the area of works to limit the movement and redeposition of material.</li> <li>Development of a Construction and Environmental Management Plan which would include all the above proposed mitigation measures and any further measures identified at the project stage.</li> </ul>	<p>Assuming all proposed mitigation is implemented it is considered there would not be a significant change in:</p> <p>The extent and distribution of qualifying bird species; The structure and function of the habitats of qualifying species; and The supporting processes on which habitats of qualifying species rely.</p> <p>Consequently, with appropriate mitigation measures in place this scheme is not expected to have an adverse effect on the integrity of the SAC for the construction or operation phase of this scheme.</p>
		<p>No operation effects are anticipated</p>		

### 3.4.8 In-combination effects

#### 3.4.8.1 In-combination effects with other plans and projects

Adverse effects were identified during the operation stage that can affect the integrity of the following sites:

- The Wash SPA
- The Wash Ramsar
- The Wash and North Norfolk Coast SAC
- Humber Estuary SPA
- Humber Estuary SAC
- Humber Estuary Ramsar Site

Consequently, an in-combination assessment is required for this Scheme. The following developments have been identified within 10km of the Scheme (Table 3.3). This geographic distribution is based on UKWIR guidance (UKWIR, 2022).

**Table 3.3: Plans and developments within 10km of the SLR Scheme**

Planning Authority	Local Plan	Reference	Location/ Description	Potential for in-combination effects
Boston Borough Council	N/A	H04-0823-17	<p>North Ing Drove Donington Spalding.</p> <p>Works to facilitate the Viking Link electrical interconnector with an approximate capacity of 1400 megawatts (MW) extending from Revsing, Jutland, (Denmark) to Bicker Fen, Lincolnshire (UK) comprising:</p> <ul style="list-style-type: none"> <li>- Installation of two (2) subsea high voltage direct current (DC) cables between Mean Low Water Springs (MLWS) and landfall at Boygriff in East Lindsey;</li> <li>- Installation of two (2) onshore DC cables between the landfall at Boygriff and the converter station at North Ing Drove in South Holland;</li> <li>- Construction of associated Temporary Construction Compounds (TCC) and Temporary Works Areas (TWA) and temporary vehicle access arrangements required for DC and AC cable installation;</li> <li>- Erection of converter station buildings together with the formation of internal roads, permanent access road from the A52, erection of security fencing, formation of landscaping with associated temporary construction compounds;</li> <li>- Installation of up to six (6) onshore high voltage alternating current (AC) cables between the converter station at North Ing Drove and the existing Bicker Fen 400 kilovolt (400kV) Substation owned and operated by National Grid Electricity Transmission Plc (NGET);</li> <li>- Installation of link pillars along the AC cable route for inspection and maintenance purposes, these would be contained within fenced areas;</li> <li>- Installation of all associated drainage mitigation works; and</li> <li>- Installation of fibre-optic cable(s) with the high voltage AC and DC cables</li> </ul>	<p>Yes, Crosses River Witham between the two SLR abstraction locations (trenchless cable crossing at 525245, 349316) and runs across the transfer route between River Witham and A17.</p> <p>Potential increase in turbidity and site run off (pollution) into River Witham and Skerth Drain (tributary of South Forty-foot drain) hydrologically connected to The Wash Designated Sites.</p>



### 3.4.8.2 In-combination effect with other SROs

#### **Fenland Reservoir (FR) SRO**

The proposed FR includes the development of a new raw water reservoir for public water supply within the Anglian Water region. To provide water to the FR, water would be abstracted from the River Ouse and / or both the River Ouse and the River Delph (Ouse Washes). This water would then be conveyed to the FR. From the FR, a Water Treatment Works (WTW) would treat the water to drinking water quality standard, before it is pumped to one of three delivery locations: Bexwell, Bluntisham, and or Madingley. Water would be conveyed via suitably sized pipelines, incorporating river intakes, and transfer pumping stations.

The HRA undertaken for this Scheme has identified potential effects to the following sites:

- Ouse Washes SPA
- Ouse Washes Ramsar Site
- Ouse Washes SAC
- The Wash SPA
- The Wash Ramsar Site
- The Wash and North Norfolk Coast SAC

#### **Minworth SRO**

Minworth Wastewater Treatment Works (WwTW), located to the east of Birmingham and south-east of Sutton Coldfield, is Severn Trent Water's largest sewage treatment works serving an equivalent population of 1.75 million people from Birmingham. The plant treats sludge from an equivalent population of 2.5 million. The WwTW discharges treated effluent, according to consented discharge permit, to the River Tame at two outfall locations, approximately SP 1741 9144 (downstream of Water Orton Lane) and SP 2002 9137 (upstream of Edison Road).

Minworth SRO is investigating the potential to provide water to the STT SRO by diverting some of the Minworth WwTW final effluent to the River Avon which is a tributary of the River Severn as well as to the GUC via the Coventry Canal. Additional treatment at Minworth WwTW – the Advanced Water Treatment Plant (AWTP) would be provided to ensure water quality is appropriate for discharge to the River Avon and the Coventry Canal allowing water to be diverted from the final effluent flow at Minworth and transferred to a combination of the River Avon and Coventry Canal.

The HRA undertaken for this Scheme by AECOM has identified potential effects to the following sites:

- The Humber Estuary SAC (UK0030170)
- The Humber Estuary Ramsar Site (UK11031)

Given the separation between the WwTW outfall locations and the Humber Estuary Designated sites (200km) the only potential impact pathway is whether the Minworth SRO would result in a reduction in water levels in the Humber Estuary SAC or Ramsar Site, or upstream of the site, sufficient to disrupt the ability of sea lamprey and river lamprey to travel to and from the SAC/Ramsar Site, given that the Humber Estuary SAC and Ramsar Site includes approximately 15 km of the River Trent in its tidal reaches between Keadby and the Humber Estuary itself. Upstream dispersion of river and sea lamprey in the River Trent is considered to be severely limited by 2.6m high, 100m broad Cromwell Weir (located on the main River Trent at grid reference SK 80931 61141), which is impassable to both species. However, there is a consented proposal to install two eel passes which would also be passable to lamprey.

The potential in-combination effects from SLR, FR and Minworth SROs are presented in Table 3.4.

**Table 3.4: FR, Minworth and SLR in-combination effects**

<b>Designated Sites/Qualifying Feature</b>	<b>FR adverse effects</b>	<b>Minworth adverse effects</b>	<b>SLR adverse effects</b>	<b>In-combination effects</b>
The Wash SPA and Ramsar bird assemblages	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	NA	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Potential – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Although effects are not anticipated to be significant in-combination due to the scale of the Wash and distance between the two affected estuaries further modelling would reduce uncertainty in this assessment.
The Wash SAC Common seals	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	N/A	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Potential – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Although effects are not anticipated to be significant in-combination due to the scale of the Wash and distance between the two affected estuaries further modelling would reduce uncertainty in this assessment.
The Wash SAC Otters	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	N/A	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Potential – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Although effects are not anticipated to be significant in-combination due to the scale of the Wash and distance between the two affected estuaries further modelling would reduce uncertainty in this assessment.
The Wash and North Norfolk Coast SAC and The Wash Ramsar saltmarsh vegetation	Yes – uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	N/A	Yes– uncertainty around potential effects from changes in flows and water quality and indirect effects on estuarine habitats	Potential – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Although effects are not anticipated to be significant in-combination due to the scale of the Wash and distance between the two affected estuaries further modelling would reduce uncertainty in this assessment.
The Humber Estuary SAC and Ramsar Site sea lamprey and river lamprey	N/A	Yes – uncertainty around potential effects from changes in flows and water quality affecting functionally linked habitat and indirect effects on estuarine habitats	Yes – uncertainty around potential effects from changes in flows and water quality affecting functionally linked habitat and indirect effects on estuarine habitats	Potential – further modelling should aim to look at the potential effects from water quality changes and changes in flows. Although effects are not anticipated to be significant in-combination due to the scale of the Humber Estuary and distance between the site and the estuary further modelling would reduce uncertainty in this assessment

### 3.4.9 Stage 2 outcomes for SLR Scheme

Following this informal HRA Appropriate Assessment, it is considered that no adverse effects to the sites' remain for the construction phase of the proposed Scheme at The Wash SPA/Ramsar Site, The Wash and Norfolk Coast SAC, the Humber Estuary SPA/SAC and Ramsar Site and Baston Fen SAC assuming that best practice and proposed mitigation measures are implemented.

No operation effects were identified for Baston Fen SAC. At this stage, however, it is not possible to rule out adverse effects for the operational phase the Wash and the Humber Estuary Designated Sites, as the potential adverse effects of increased sedimentation and changes in water levels and flows are currently unknown. These effects have the potential to change the extent and distribution of qualifying species, the structure and function of the habitats that support qualifying species, and the supporting processes on which habitats of qualifying species rely due to the physical loss, physical damage and biological disturbances identified.

Studies and modelling of the water demand from the River Trent and the inter-catchment transfer into the River Witham are needed to identify whether the changes in the water levels and flows as a result of the operation of the SLR would have an impact on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction is also required, to determine the potential effect of nutrient loading into the estuary. In addition, an assessment of the potential changes in sediment transport is required to estimate potential changes to qualifying habitats and the species they support.

Additional information about the Scheme, including a further assessment and modelling of the effects of the abstraction on the River Trent and the inter-catchment water transfer to the River Witham are also needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended.

Finally, the adverse effects identified through this informal HRA may be compounded through the more frequent and intense effects of climate change including heat waves, droughts, floods and rising sea levels. Therefore, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for these mid and long-term effects on the Designated Sites and the functional linked land located downstream of the Scheme.

It should be noted that the conclusions contained in this document are based on preliminary, indicative design assumptions available at this time, commensurate with the stage of Scheme development the project is at and are primarily informed by available, appropriate desktop information. As the Scheme development progresses to inform a future application for development consent, further survey work and assessments would be undertaken to inform and fulfil the regulatory requirements applicable at the time.

## 4 Conclusions and Recommendations

The HRA Stage 1 Screening concluded that the Scheme as proposed by Anglian Water is likely to result in Likely Significant Effects on the following Designated Sites:

- The Wash SPA (UK9008021) (approximately 23 km east of the Scheme)
- The Wash Ramsar (UK11072) (approximately 23 km east of the Scheme)
- The Wash and North Norfolk Coast SAC (UK0017075) (approximately 23 km east of the Scheme)
- Humber Estuary SPA (UK9006111) (approximately 52.5 km north of the Scheme)
- Humber Estuary SAC (UK0030170) (approximately 52.5 km north of the Scheme)
- Humber Estuary Ramsar Site (UK11031) (approximately 52.5 km north of the Scheme)
- Baston Fen SAC (UK UK0030085) (approximately 2 km south west of the Scheme)

Consequently, the Scheme has progressed to Stage 2 AA as several pathways and potential effects were identified at screening.

This informal HRA AA considered that the Scheme is located sufficiently distant from the Designated Sites at the Wash and Humber Estuary to exclude significant adverse effects as a result of noise, light, dust or other human disturbances during the construction phase assuming that best practices and proposed mitigation measures are implemented. This AA also considered that with appropriate mitigation measures in place the Scheme is not expected to have an adverse effect on the integrity of Baston Fen SAC for the construction and the operation phase.

During the operation phase, however, the Scheme has the potential to adversely affect the integrity of The Wash and the Humber Estuary Designated Sites and functionally linked habitats used by their qualifying species through the following pathways:

- Changes to water levels and flows due to the new abstraction from the River Trent and inter-catchment transfer into the River Witham, water storage and emergency discharge drawdown flows leading to fluctuations in water temperature regimes and salinity levels downstream.
- Physical damage as a result of changes in flow velocity and sediment fluxes leading to changes in natural coastal/estuarine processes; functionally linked habitat degradation as a result of water quality changes.
- Toxic contamination leading to biomass reduction and food web disruptions that may affect the life cycle of qualifying species. Sediments can transport pollutants and microplastics to estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.
- Non-toxic contamination as a result of changes in water turbidity, sediment loading and silt deposition altering ecosystem processes and food webs; as well as dust effects smothering habitats, affecting photosynthesis and reducing productivity. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying species.
- Biological disturbance including changes to habitat availability including functional linked habitat used by qualifying species; changes in species abundance or distribution; potential for populations to be displaced from current foraging/spawning areas; direct mortality of fish species as a result of entrainment in intake infrastructure; changes in natural succession; introduction of new pathways for spread of non-native invasive species as a result of inter-catchment water transfers.

These effects may lead to changes to:

- The extent and distribution of qualifying habitats
- The structure and function of the qualifying habitats
- The supporting processes on which habitats of qualifying species rely

Additionally, the identified effects have the potential to reduce the extent and quality of functional linked habitats supporting qualifying species' populations.

The recommended mitigation measures detailed within this document assume a worst-case scenario at this stage, in the absence of detailed survey data or local records. Mitigation measures have been proposed for both construction and operation phases at all sites.

In addition to best practice measure for construction, the mitigation measures proposed to avoid effects during the construction phase include sensitive timings of works to avoid key periods for overwintering bird populations. It is also recommended that a Construction Environmental Management Plan (CEMP) be put in place that would include the proposed mitigation measures in this AA as well as any other specific measures identified following an HRA undertaken at project level.

At this stage some effects are still uncertain and therefore adverse effects on the Designated sites' integrity cannot be excluded. Further studies are recommended to address uncertainty and would include:

- Hydrodynamic modelling of flows and salinity into The Wash Designated Sites.
- Studies and modelling of the water demand from the River Trent and the River Witham are needed to identify whether the changes in the water levels and flows as a result of the operation of the South Lincolnshire Reservoir would have an impact on the Designated Sites and their qualifying features. Further modelling of the current nutrient level analysis due to the abstraction is also required to determine the effect of nutrient loading.
- Additional information about the Scheme, including a further assessment and modelling of the effects of the inter-catchment transfer from the River Trent to the River Witham are needed to reduce uncertainty and determine the effects on the Designated Sites located downstream. A detailed review of the baseline ecological data is also recommended.
- Finally, the adverse effects identified through this HRA may be compounded through the more frequent and intense effects of climate change, including heat waves, droughts, floods and rising sea levels. Therefore, climate change scenario analysis from simulations with Global Climate Models (GCMs) are also recommended to account for mid and long-term effects on the Designated Sites and functional linked land located downstream of the Scheme.

An in-combination assessment was undertaken with other plans or projects and identified potential effects in-combination with:

- Fenland Reservoir SRO – potential effects on The Wash SPA (bird qualifying species) and The Wash and North Norfolk Coast SAC / Ramsar Site (common seals, otters and saltmarsh vegetation).
- Viking Link electrical interconnector project extending from Revsing, Jutland, (Denmark) to Bicker Fen, Lincolnshire (UK) – potential effects include increased turbidity and site run off (pollution) into River Witham and Skerth Drain (tributary of South Forty-foot drain) hydrologically connected to The Wash Designated Sites.
- Minworth SRO – potential effects on The Humber Estuary SAC and Ramsar Site (sea lamprey and river lamprey).

It should be noted that the conclusions contained in this document are based on preliminary, indicative design assumptions available at this time, commensurate with the stage of Scheme development the project is at and are primarily informed by available, appropriate desktop information. As the Scheme development progresses to inform a future application for development consent, further survey work and assessments would be undertaken to inform and fulfil the regulatory requirements applicable at the time. Further design iterations would require revisions to this document and may result in changes to the current conclusion.

Ultimately, a strong and robust evidence base would be required to conclude that there would be no adverse effects on the integrity of any designated site, as a result of the construction or operation of the scheme. The level of detail available at this stage (which is considered proportionate) means that such effects cannot be ruled out at this stage. As a result, this would need further consideration and assessment as part of the next stages of design development to conclude what the effects (if any) of the SLR on designated sites would be, and any further work required by the HRA process. All of this would need to be undertaken in dialogue with key stakeholders, including Natural England and the Environment Agency.

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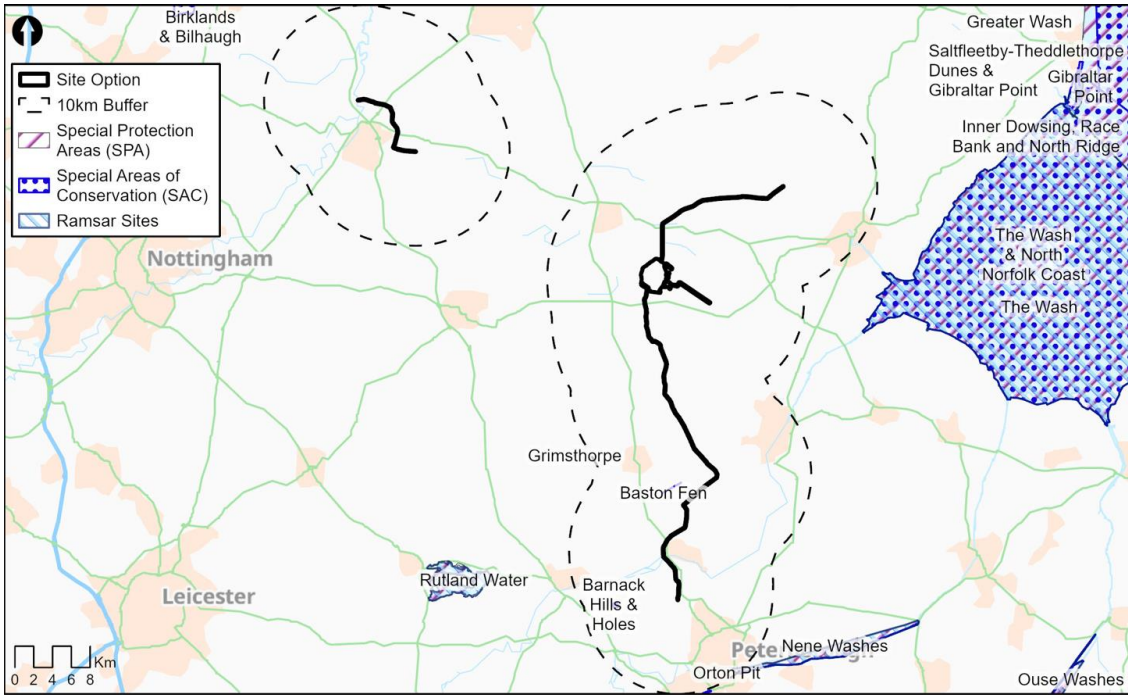
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# A. Preferred Scheme Map



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## B. HRA Screening Report

Designated Sites Assessed	Qualifying Features	Screening Result	Justification for Assessment
<p>The Wash SPA (UK9008021) (approximately 23km)</p>	<p><b>ARTICLE 4.1</b></p> <p>During the breeding season the area regularly supports:</p> <p><i>Sterna albifrons, Sterna hirundo</i></p> <p>Over winter the area regularly supports:</p> <p><i>Cygnus columbianus bewickii, Limosa lapponica</i></p> <p><b>ARTICLE 4.2</b></p> <p>Over winter the area regularly supports:</p> <p><i>Anas acuta, Anas Penelope, Anas strepera, Anser brachyrhynchus Arenaria interpres, Branta bernicla bernicla, Bucephala clangula, Calidris alba, Calidris alpina alpina, Calidris canutus, Haematopus ostralegus, Limosa limosa islandica, Melanitta nigra, Numenius arquata, Pluvialis squatarola, Tadorna tadorna, Tringa totanus</i></p> <p><b>ARTICLE 4.2 AN INTERNATIONALLY IMPORTANT ASSEMBLAGE OF BIRDS</b></p> <p>400367 waterfowl (5-year peak mean 1991/92-1995/96) Including: <i>Cygnus columbianus bewickii, Anser brachyrhynchus, Branta bernicla bernicla, Tadorna tadorna, Anas penelope, Anas strepera, Anas acuta, Melanitta nigra, Bucephala clangula, Haematopus ostralegus, Pluvialis squatarola, Calidris canutus, Calidris alba, Calidris alpina alpina, Limosa limosa islandica, Limosa lapponica, Numenius arquata, Tringa totanus, Arenaria interpres</i></p>	<p>Potential for likely significant effects</p>	<p>The Wash SPA is located sufficiently distant from the proposed option to exclude direct adverse effects like light and noise disturbance during the construction phase.</p> <p>This designated site is connected through small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash SPA, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this option is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying bird species.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance – Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on; creation on new pathways for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>
<p><b>The Wash Ramsar (UK11072) (approximately 23km)</b></p>	<p><b>Ramsar criterion 1</b></p> <p>The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water and deep channels.</p> <p><b>Ramsar criterion 3</b></p> <p>Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.</p> <p><b>Ramsar criterion 5</b></p> <p>Assemblages of international importance:</p> <p>Species with peak counts in winter:</p> <p>292541 waterfowl (5-year peak mean 1998/99-2002/2003)</p> <p><b>Ramsar criterion 6</b></p> <p>Species/populations occurring at levels of international importance.</p> <p>Species with peak counts in spring/autumn:</p> <p>Eurasian oystercatcher, <i>Haematopus ostralegus ostralegus</i>, Europe &amp; NW Africa - wintering; Grey plover, <i>Pluvialis squatarola</i>, E Atlantic/W Africa -wintering; Red knot,</p>	<p>Potential for likely significant effects</p>	<p>The Wash Ramsar Site is located sufficiently distant from the proposed option to exclude direct adverse effects like light and noise disturbance during the construction phase.</p> <p>This designated site is connected through small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to The Wash Ramsar Site, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p><b>During operation this option is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying bird species.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance – Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas; changes in natural succession. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on; creation on new pathways for spread of non-native invasive species as a result of the inter-catchment water transfer from the River Trent to the River Witham.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>

	<p><i>Calidris canutus islandica</i>, W &amp; Southern Africa (wintering); Sanderling, <i>Calidris alba</i>, Eastern Eurasian curlew, <i>Numenius arquata arquata</i>, N. a. <i>arquata</i> Europe (breeding); Common redshank, <i>Tringa totanus totanus</i>, Ruddy turnstone, <i>Arenaria interpres interpres</i>, NE Canada, Greenland/W Europe &amp; NW Africa.</p> <p>Species with peak counts in winter:</p> <p>Pink-footed goose, <i>Anser brachyrhynchus</i>, Greenland, Iceland/UK; Dark-bellied brent goose, <i>Branta bernicla bernicla</i>, Common shelduck, <i>Tadorna tadorna</i>, NW Europe; Northern pintail, <i>Anas acuta</i>, NW Europe; Dunlin, <i>Calidris alpina alpina</i>, W Siberia/W Europe' Bar-tailed godwit, <i>Limosa lapponica lapponica</i>, W Palearctic.</p> <p>Species/populations identified subsequent to designation for possible future consideration under criterion 6.</p> <p>Species with peak counts in spring/autumn:</p> <p>Ringed plover, <i>Charadrius hiaticula</i>, Europe/Northwest Africa; Black-tailed godwit, <i>Limosa limosa islandica</i>, Iceland/W Europe;</p> <p>Species with peak counts in winter:</p> <p>European golden plover, <i>Pluvialis apricaria apricaria</i>, P. a. <i>altifrons</i> Iceland &amp; Faroes/E; Atlantic Northern lapwing, <i>Vanellus vanellus</i>, Europe - Black-headed gull, <i>Larus ridibundus</i>, N &amp; C Europe</p>		
<p><b>The Wash and North Norfolk Coast SAC (UK0017075) (approximately 23km)</b></p>	<p>1110 Sandbanks which are slightly covered by sea water all the time</p> <p>1140 Mudflats and sandflats not covered by seawater at low tide</p> <p>1160 Large shallow inlets and bays</p> <p>1170 Reefs</p> <p>1310 Salicornia and other annuals colonising mud and sand</p> <p>1330 Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>)</p> <p>1420 Mediterranean and thermo-Atlantic halophilous scrubs (<i>Sarcocornetea fruticosi</i>)</p> <p>1150 Coastal lagoons * Priority feature</p> <p>1365 Common seal <i>Phoca vitulina</i></p> <p>1355 Otter <i>Lutra lutra</i></p>	<p>Potential for likely significant effects</p>	<p>The Wash and North Norfolk Coast SAC is located sufficiently distant from the proposed option to exclude direct adverse effects during the construction phase.</p> <p>However, this designated site is connected through small, likely slow-flowing ditches to the South Forty-Foot Drain which is linked hydrologically to this SAC, approximately 23 km to the east. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p> <p>This site is designated for supporting the largest colony of common seals in the UK, with some 7% of the total UK population. The extensive intertidal flats at The Wash and on the North Norfolk Coast provide ideal conditions for breeding and hauling out. Changes in water quality and flows, including changes in turbidity as a result of increased sedimentation could potentially affect the intertidal banks of sand, mud and shallow water as well as functional linked land used by these qualifying species.</p> <p>Similarly, this site supports otters that can occupy very large ranges (around 32km for males and 20km for females) and the habitats close to the scheme may be used by these qualifying species when they are functionally linked to the designated site (linkage habitat). Therefore, otters can potentially be adversely affected by habitat degradation as a result of changes in water quality leading to a reduction in their food supply (e.g. as a result of fish mortality).</p> <p><b>During operation this option is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation of functional linked land used by seals and otters as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to The Wash estuarine environment, which can bioaccumulate in the prey of otters.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent and transfer into the River Witham.</li> <li>Biological disturbance– Changes to habitat availability including functional linked habitat used by otters; changes in species abundance or distribution; potential for populations to be displaced from current feeding areas. Seals and otters can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>
<p><b>Humber Estuary SPA (UK9006111) (approximately 52.5 km)</b></p>	<p>Article 4.1 During the breeding season the area regularly supports: <i>Botaurus stellaris</i>, <i>Circus aeruginosus</i> 6.3% of the population in Great Britain, <i>Recurvirostra avosetta</i>, <i>Sterna albifrons</i></p> <p>Over winter the area regularly supports:</p>	<p>Potential for likely significant effects</p>	<p>The Humber Estuary SPA is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like noise, light and human disturbance during the construction phase. However, this designated site is connected hydrologically via the River Trent that feeds directly into the estuary. Therefore, there is a potential pathway for adverse effects including changes in water quality and flows during the operation phase which cannot be ruled out at this stage.</p>

	<p><i>Botaurus stellaris</i>, <i>Circus cyaneus</i>, <i>Limosa lapponica</i>, <i>Pluvialis apricaria</i>, (North-western Europe - breeding), <i>Recurvirostra avosetta</i></p> <p>On passage the area regularly supports:</p> <p><i>Philomachus pugnax</i></p> <p>Article 4.2 Over winter the area regularly supports:</p> <p><i>Calidris alpina alpina</i>, <i>Calidris canutus</i>, <i>Limosa limosa islandica</i>, <i>Tadorna tadorna</i>, <i>Tringa totanus</i></p> <p>On passage the area regularly supports:</p> <p><i>Calidris alpina alpina</i>, <i>Calidris canutus</i>, <i>Limosa limosa islandica</i>, <i>Tringa totanus</i></p> <p>Article 4.2 – An internationally important assemblage of birds.</p> <p>In the non-breeding season, the area regularly supports:</p> <p><i>Anas crecca</i>, <i>Anas penelope</i>, <i>Anas platyrhynchos</i>, <i>Arenaria interpres</i>, <i>Aythya ferina</i>, <i>Aythya marila</i>, <i>Botaurus stellaris</i>, <i>Branta bernicla bernicla</i>, <i>Bucephala clangula</i>, <i>Calidris alba</i>, <i>Calidris alpina alpina</i>, <i>Calidris canutus</i>, <i>Charadrius hiaticula</i>, <i>Haematopus ostralegus</i>, <i>Limosa lapponica</i>, <i>Limosa limosa islandica</i>, <i>Numenius arquata</i>, <i>Numenius phaeopus</i>, <i>Philomachus pugnax</i>, <i>Pluvialis apricaria</i>, <i>Pluvialis squatarola</i>, <i>Recurvirostra avosetta</i>, <i>Tadorna tadorna</i>, <i>Tringa nebularia</i>, <i>Tringa totanus</i>, <i>Vanellus vanellus</i>.</p>		<p><b>During operation this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical-damage – Habitat loss and degradation as a result of water quality changes; modifications in flow velocity and sediment fluxes leading to changes in natural coastal-estuarine processes and thermal regime. Sediment deposition can smother the estuarine floor, reduce habitat complexity and cause anoxic conditions where dissolved oxygen is depleted by the overgrowth or change in bacterial diversity affecting food resources for qualifying bird species.</li> <li>Non-toxic contamination – Changes in turbidity, sedimentation/silting, salinity and nutrient levels.</li> <li>Toxic-contamination – Sediments can transport pollutants and microplastics to the Humber estuarine environment, which can bioaccumulate in the prey of seabirds and shorebirds.</li> <li>Water table/availability – Changes to water levels and flows due to direct intake from the River Trent.</li> <li>Biological disturbance– Changes to habitat availability including functional linked habitat used by qualifying bird species; changes in species abundance or distribution; potential for populations to be displaced from current foraging areas. Birds can be affected by increased sedimentation altering ecosystem processes and food webs that they or their prey rely on.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations. Disturbance to qualifying species may impact upon adult survival.</p>
<p><b>Humber Estuary SAC (UK0030170) (approximately 52.5 km)</b></p>	<p>H1110 Sandbanks which are slightly covered by sea water all the time</p> <p>H1130 Estuaries</p> <p>H1140 Mudflats and sandflats not covered by seawater at low tide</p> <p>H1150 Coastal lagoons</p> <p>H1310 Salicornia and other annuals colonising mud and sand</p> <p>H1330 Atlantic salt meadows (<i>Glauco-Puccinellietalia maritima</i>)</p> <p>H2110 Embryonic shifting dunes</p> <p>H2120 Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ('White dunes')</p> <p>H2130 Fixed dunes with herbaceous vegetation ('Grey dunes')</p> <p>H2160 Dunes with <i>Hippophae rhamnoides</i></p> <p>S1095 Sea lamprey (<i>Petromyzon marinus</i>)</p> <p>S1099 River lamprey, (<i>Lampetra fluviatilis</i>)</p> <p>S1364 Grey seal (<i>Halichoerus grypus</i>)</p>	<p>Potential for likely significant effects</p>	<p>The Humber Estuary SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like light, vibration and human disturbance during the construction phase. However, this designated site is hydrologically connected to the Scheme via the River Trent, that feeds directly into the estuary. This SAC is designated as an important migration route for both river lamprey and sea lamprey between coastal waters and their spawning areas. Any changes to water and/or habitat quality has the potential to disrupt migratory patterns of these designated species. Therefore, there is a pathway for potential adverse effects during construction and operation, including habitat loss and/or degradation of functionally linked habitat used by the designated fish species.</p> <p><b>During construction, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation as a result in changes in water quality affecting fish species.</li> <li>Toxic contamination - water quality degradation from potential pollution events affecting functionally linked habitat used by migratory fish species.</li> <li>Non-toxic contamination - changes in turbidity leading to changes in sediment loading and silt deposition affecting functional linked habitat used by the qualifying fish species.</li> <li>Biological disturbance –changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas; direct mortality as a result of fish getting caught or entrained at the abstraction point in the River Trent.</li> </ul> <p><b>During operation, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation, including functionally linked habitat as a result in changes in water quality affecting fish populations and grey seal populations.</li> <li>Toxic contamination - reduced dilution of pollutants due to water abstraction in the River Trent.</li> <li>Non-toxic contamination - changes in turbidity as a result of modification of flows leading to changes in sediment loading and silt deposition; changes in thermal regime due to increased water abstraction on the River Trent.</li> <li>Water table/ availability - change to water levels and flows due to new abstraction in the River Trent potentially affecting estuarine processes and environment affecting the life cycle of the sea lamprey and the river lamprey and grey seal populations.</li> <li>Biological Disturbances - changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations (particularly relevant for migratory fish species). Disturbance to qualifying species may impact upon adult survival.</p>
<p><b>Humber Estuary Ramsar Site (UK11031) (Approximately 52.5km)</b></p>	<p>Ramsar criterion 1</p>	<p>Potential for likely significant effects</p>	<p>The Humber Estuary Ramsar Site is located sufficiently distant from the proposed Scheme to exclude direct adverse effects like light, vibration and human disturbance during the construction phase. However, this designated site is hydrologically connected to the Scheme via the River Trent, that feeds directly into the estuary. This Ramsar Site is a</p>

	<p>The site is a representative example of a near-natural estuary with the following component habitats:</p> <p>dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.</p> <p><b>Ramsar criterion 3</b></p> <p>The Humber Estuary Ramsar site supports a breeding colony of grey seals <i>Halichoerus grypus</i> at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.</p> <p>The dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad <i>Bufo calamita</i>.</p> <p><b>Ramsar criterion 5</b></p> <p>Assemblages of international importance: 153,934 waterfowl, non-breeding season (5 year peak mean 1996/97-2000/2001)</p> <p><b>Ramsar criterion 6</b> – species/populations occurring at levels of international importance.</p> <p>Species with peak counts in spring/autumn:</p> <p><i>Pluvialis apricaria apricaria</i>, <i>P. a. altifrons</i>, <i>Calidris canutus islandica</i>, W &amp; Southern Africa (wintering); Dunlin, <i>Calidris alpina alpina</i>, W Siberia/W Europe; <i>Limosa limosa islandica</i>, Iceland/W Europe; <i>Tringa totanus totanus</i>,</p> <p>Species with peak counts in winter:</p> <p><i>Tadorna tadorna</i>, NW Europe European <i>Pluvialis apricaria apricaria</i>, <i>P. a. altifrons</i> Iceland &amp; Faroes/E Atlantic <i>Calidris canutus islandica</i>, W &amp; Southern Africa; (wintering) Dunlin, <i>Calidris alpina alpina</i>, W Siberia/W Europe <i>Limosa limosa islandica</i>, Iceland/W Europe <i>Limosa lapponica lapponica</i>, W Palearctic.</p> <p><b>Ramsar criterion 8</b></p> <p>The Humber Estuary acts as an important migration route for both <i>Lampetra fluviatilis</i> and <i>Petromyzon marinus</i> between coastal waters and their spawning areas.</p>		<p>representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons. The area regularly supports internationally important numbers of various species of breeding and wintering waterbirds. Many passage birds, notably internationally important populations of ringed plover and sanderling stage in the area. The site supports Britain's most south-easterly breeding colony of grey seal (<i>Halichoerus grypus</i>) and the dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad (<i>Bufo calamita</i>). The Humber Estuary Ramsar Site also acts as an important migration route for both river lamprey (<i>Lampetra fluviatilis</i>) and sea lamprey (<i>Petromyzon marinus</i>) between coastal waters and their spawning areas. Any changes to water and/or habitat quality has the potential to disrupt migratory patterns of these designated species. Therefore, there is a pathway for potential adverse effects during construction and operation, including habitat loss and/or degradation of functionally linked habitat used by the designated fish species.</p> <p><b>During construction, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation as a result in changes in water quality affecting fish species.</li> <li>Toxic contamination - water quality degradation from potential pollution events affecting functionally linked habitat used by migratory fish species.</li> <li>Non-toxic contamination - changes in turbidity leading to changes in sediment loading and silt deposition affecting functional linked habitat used by the qualifying fish species.</li> <li>Biological disturbance –changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas; direct mortality as a result of fish getting caught or entrained at the abstraction point in the River Trent.</li> </ul> <p><b>During operation, this Scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage - habitat degradation, including functionally linkeed habitat as a result in changes in water quality affecting qualifying vegetation as well as bird, fish and grey seal populations.</li> <li>Toxic contamination - reduced dilution of pollutants due to water abstraction in the River Trent.</li> <li>Non-toxic contamination - changes in turbidity as a result of modification of flows leading to changes in sediment loading and silt deposition; changes in thermal regime due to increased water abstraction on the River Trent affecting qualifying bird, fish grey seal populations.</li> <li>Water table/ availability - change to water levels and flows due to new abstraction in the River Trent potentially affecting estuarine processes and environment affecting the life cycle of the qualifying bird, fish grey seal populations.</li> <li>Biological Disturbances - changes in functional linked habitat quality and availability for the river lamprey and sea lamprey, grey seals and qualifying bird species including disturbance to migratory journeys to spawning grounds and potential for populations to be displaced from current spawning grounds and feeding areas; natural succession.</li> </ul> <p>The identified effects have the potential to reduce the extent and distribution of functional habitat which supports the qualifying species' populations (particularly relevant for migratory fish species). Disturbance to qualifying species may impact upon adult survival.</p>
<p><b>Baston Fen SAC (UK UK0030085) (approximately 2 km south east of the Scheme)</b></p>	<p>S1149. <i>Cobitis taenia</i>; Spined loach</p>	<p>Potential for likely significant effects</p>	<p>The proposed transfer route from SLR to Eaton is situated approximately 2 km south west of Baston Fen SAC and it crosses the River Glen which is hydrologically connected to this Designated Site. Therefore, there is a pathway for potential effects due to construction, including eventual pollution events and biological disturbances of functionally linked habitat used by spined loach populations. The effects of non-toxic contamination and non-physical disturbance are considered to be temporary and localised.</p> <p><b>During construction, this scheme is likely to result in:</b></p> <ul style="list-style-type: none"> <li>Physical damage – Physical modification of river channels may remove habitat heterogeneity and the mosaic of microhabitats utilised by spined loach at different stages of their lifecycle; functionally linked habitat degradation as a result of water quality changes in case of pollution events may also adversely affect spined loach populations.</li> <li>Non-physical disturbance – vibration effects affecting functional linked habitat leading to changes in species distributions as a result of habitat avoidance. Due to their relatively sedentary nature, spined loach may be susceptible to direct entrainment into pumps in water abstractions.</li> <li>Biological disturbance – changes in functional linked habitat quality and availability; potential for populations to be displaced from current spawning grounds and feeding areas adversely affecting adult survival.</li> <li>Toxic contamination – water pollution / changes to water quality (degradation) affecting functional linked habitat used by Spined loach. Spined loach may be particularly vulnerable to deposited pollutants due to their burrowing and feeding habits. Pollutants may result in obvious lethal effects, however, a wide variety of sub-lethal effects, such as reduced fertility may affect the overall fitness of this qualifying species.</li> </ul>

			<ul style="list-style-type: none"> <li>Non-toxic contamination – changes in turbidity, sediment loading and silt deposition; Changes to thermal regime due to increased water abstraction, and reduced compensation flow releases into the River Great Ouse; reduced oxygen levels affecting functional linked habitat used by Spined loach.</li> </ul> <p>No operation effects are anticipated</p>
<p><b>Nene Washes SPA (approximately 9km south east of the Scheme)</b></p>	<p>A037 <i>Cygnus columbianus bewickii</i>; Bewick's swan (Non-breeding)</p> <p>A050 <i>Anas penelope</i>; Eurasian wigeon (Non-breeding)</p> <p>A051 <i>Anas strepera</i>; Gadwall (Breeding)</p> <p>A051 <i>Anas strepera</i>; Gadwall (Non-breeding)</p> <p>A052 <i>Anas crecca</i>; Eurasian teal (Non-breeding)</p> <p>A054 <i>Anas acuta</i>; Northern pintail (Non-breeding)</p> <p>A055 <i>Anas querquedula</i>; Garganey (Breeding)</p> <p>A056 <i>Anas clypeata</i>; Northern shoveler (Non-breeding)</p> <p>A056 <i>Anas clypeata</i>; Northern shoveler (Breeding)</p> <p>A156a <i>Limosa limosa limosa</i>; Black-tailed godwit (Breeding)</p>	<p>No likely significant effects</p>	<p>The Nene Washes SPA is located sufficiently distant from the proposed Scheme to exclude direct adverse effects such as light, vibration and human disturbance during the construction phase. The designated site is hydrologically connected to the Scheme however as the Scheme is located downstream of the designated site, there are no likely significant effects during either the construction or operation phase. No significant changes to water levels and flows within functionally linked land are anticipated as a result of the construction (or subsequent maintenance) of pipelines, intakes and associated infrastructure.</p>
<p><b>Nene Washes SAC (approximately 9km south east of the Scheme)</b></p>	<p>S1149. <i>Cobitis taenia</i>; Spined loach</p>	<p>No likely significant effects</p>	<p>The Nene Washes SAC is located sufficiently distant from the proposed Scheme to exclude direct adverse effects such as light, vibration and human disturbance during the construction phase. The designated site is hydrologically connected to the Scheme however as the Scheme is located downstream of the designated site, there are no likely significant effects during either the construction or operation phase of the scheme. No significant changes to water levels and flows within functionally linked land are anticipated as a result of the construction (or subsequent maintenance) of pipelines, intakes and associated infrastructure.</p>
<p><b>Nene Washes Ramsar (approximately 9km south east of the Scheme)</b></p>	<p><b>Ramsar criterion 2</b></p> <p>The site supports an important assemblage of nationally rare breeding birds. In addition, a wide range of raptors occur through the year. The site also supports several nationally scarce plants, and two vulnerable and two rare British Red Data Book invertebrate species have been recorded.</p> <p><b>Ramsar criterion 6 – species/populations occurring at levels of international importance.</b></p> <p>Qualifying Species/populations (as identified at designation)</p> <p>Species with peak counts in winter:</p> <p>Bewick's swan <i>Cygnus columbianus bewickii</i>.</p> <p>Species/populations identified subsequent to designation for possible future consideration under criterion 6.</p> <p>Species with peak counts in spring/autumn:</p> <p>Black-tailed godwit <i>Limosa limosa islandica</i></p> <p>Species with peak counts in winter:</p> <p>Northern pintail <i>Anas acuta</i></p>	<p>No likely significant effects</p>	<p>The Nene Washes Ramsar is located sufficiently distant from the proposed Scheme to exclude direct adverse effects such as light, vibration and human disturbance during the construction phase. The designated site is hydrologically connected to the Scheme however as the Scheme is located downstream of the designated site, there are no likely significant effects during either the construction or operation phase of the scheme. No significant changes to water levels and flows within functionally linked land are anticipated as a result of the construction (or subsequent maintenance) of pipelines, intakes and associated infrastructure.</p>

## C. Designated Sites

### C.1 The Wash and Norfolk Coast SAC

#### C.1.1 Conservation objectives

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;
- 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.

#### C.1.2 Qualifying features

- 1110 Sandbanks which are slightly covered by sea water all the time;
- 1140 Mudflats and sandflats not covered by seawater at low tide;
- 1160 Large shallow inlets and bays;
- 1170 Reefs;
- 1310 Salicornia and other annuals colonising mud and sand;
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*);
- 1420 Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*);
- 1150 Coastal lagoons \* Priority feature;
- 1365 Common seal (*Phoca vitulina*); and
- 1355 Otter (*Lutra lutra*).

#### C.1.3 Site description

The Wash and North Norfolk Coast is one of the most diverse coastal systems in Britain. This diversity is largely dependent on physical processes that dominate the natural system; consequently, the vulnerability of habitats is linked to changes in the physical environment. The intertidal zone is being threatened from coastal squeeze as a result of land-claim and coastal defence works as well as sea-level rise and storm-surges. Structures which control water along the North Norfolk Coast have fallen into disrepair, preventing appropriate water level controls for breeding birds. Therefore, a review of the water level management on the freshwater marshes of the sites is needed to make the site adaptable to future climate change.

Changes in the sediment budgets also threaten these habitats. At present activities which alter the sediment characteristics include dredging and coastal protection works. Current management is underway to address concerns over declines in shellfisheries. The area supports internationally important seal populations that are vulnerable to disturbance and disruption of the marine ecosystem upon which they depend. Such issues should be addressed through the Marine Scheme of Management.

### C.1.4 Pressures and threats

The Site Improvement Plan<sup>22</sup> has identified the following pressures and threats to this site and its qualifying species:

- **Public Access/ Disturbance**

The Wash is a very popular area for recreational activity and visitor numbers are likely to grow, for example as a result of the English Coastal Path and housing development. The range of recreational activities may have adverse impacts on the sites (Boating; motor boating; water skiing; jet skis; commercial and non-commercial wildlife tours; commercial shipping; kites (including surfers, boarders and buggy boarders); moorings; access to moorings; motorised vehicles; bikes, hovercraft; bird/wildlife watching; (dog) walking; Samphire collection, shellfish collection, bait digging, reed cutting, beachcombing, sea lavender gathering; beach barbecues; littering; wildfowling).

- **Siltation**

Sediment accretion is occurring in the Wash, and in such a dynamic system may be natural.

- **Fisheries: Recreational marine and estuarine**

Recreational sea fishing and shoreline angling is a large-scale activity with potential to impact on fish stocks as a resource for designated birds, but the size of the activity locally and its impact is not known.

- **Invasive Alien Species**

There is a risk of introduction and spread of non-native/invasive species (e.g. American Razor Clam *Ensis directus*; Slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite *Bonamia*) from future fisheries and mussel lay stocking. There is also a risk of translocation of invasive species through ballast water transfer and discharge.

- **Inappropriate coastal management**

Following the recent tidal event of December 2013 there may now be conflicts between flood risk management and the protection and provision of SPA/SAC habitats.

- **Fisheries: Commercial marine and estuarine**

A consent was granted to a private fishery tenant in 1984 for collection of shellfish, killing of starfish and application of lime to the seabed. No restriction on harvesting methodology or level were applied to the consent. Therefore, there is a risk to site features due to uncertainty of current management.

- **Predation**

Lack of predator control, where appropriate, is having an impact on the ability of sites to support breeding bird populations.

- **Coastal squeeze**

Coastal squeeze at this site may lead to a gradual loss of intertidal and coastal habitats due to sea level rise and the erection and maintenance of coastal defences. The Wash Shoreline Management Plan and the North Norfolk Coast Shoreline Management Plan are subject to

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<sup>22</sup> Site Improvement Plan: The Wash and North Norfolk Coast (SIP245). Available at: <http://publications.naturalengland.org.uk/publication/5327498292232192>



Habitats Regulations Assessment. Some areas of compensatory habitat still need to be designated.

- **Change in land management**

Grazing management. Areas of saltmarsh may be over and under-grazed throughout the site.

## C.2 The Wash SPA

### C.2.1 Conservation objectives

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The population of each of the qualifying features; and
- The distribution of the qualifying features within the site.

### C.2.2 Qualifying features

#### ARTICLE 4.1

- During the breeding season the area regularly supports:
- *Sterna albifrons*, (*Sterna hirundo*)
- Over winter the area regularly supports:
- *Cygnus columbianus bewickii*, *Limosa lapponica*

#### ARTICLE 4.2

- Over winter the area regularly supports:

*Anas acuta*, *Anas penelope*, *Anas strepera*, *Anser brachyrhynchus*, *Arenaria interpres*, *Branta bernicla bernicla*, *Bucephala clangula*, *Calidris alba*, *Calidris alpina alpina* *Calidris canutus*, *Haematopus ostralegus*, *Limosa limosa islandica*, *Melanitta nigra*, *Numenius arquata*, *Pluvialis squatarola*, *Tadorna tadorna*, *Tringa totanus*.

#### ARTICLE 4.2

- Over winter the area regularly supports:

*Cygnus columbianus bewickii*, *Anser brachyrhynchus*, *Branta bernicla bernicla*, *Tadorna tadorna*, *Anas penelope*, *Anas strepera*, *Anas acuta*, *Melanitta nigra*, *Bucephala clangula*, *Haematopus ostralegus*, *Pluvialis squatarola*, *Calidris canutus*, *Calidris alba*, *Calidris alpina alpina*, *Limosa limosa islandica*, *Limosa lapponica*, *Numenius arquata*, *Tringa totanus*, *Arenaria interpres*.

### C.2.3 Site description

The biological richness of the Wash is largely dependent on the physical processes that dominate the natural systems and consequently the ecological vulnerability is closely linked to the physical environment. The intertidal zone is vulnerable to coastal squeeze as a result of land-claim, coastal defence works, sea-level rise, and storm surges. Intertidal habitats are potentially affected by changes in sediment budget caused by dredging and coastal protection, construction of river training walls and flood defence works. The site is also potentially vulnerable to gas exploration. Activities affecting sediment budget and anthropogenic causes of

coastal squeeze would be addressed through the management Scheme being developed jointly for the SAC/SPA on this site. The estuary is fed by four large rivers which drain a substantial area of Eastern England. The volume and quality of water entering the Wash is dependent on the use made of these rivers for water abstraction and agricultural and domestic effluents. Discharge consents and abstraction licenses would be reviewed under the provisions of the Habitats Regulations.

There are two Air Weapons Ranges within the site; activities on these ranges are covered by a Memorandum of Understanding between the Ministry of Defence and Department of the Environment, a Declaration of Intent between the Ministry of Defence and Natural England and by Site Management Statements with Natural England. There is a Nature Conservation Management Plan and Management Committee for one of the ranges. These issues have been addressed in the Wash Estuary Management Plan and by Local Environment Agency Plans and would be extended through the Marine Scheme of Management which is now in progress. Vegetated shingle is a sensitive habitat. The site is managed to limit recreational pressures. Much of the interest is self-sustaining with little need for intervention. Natural coastal processes would lead to changes in the extent of lagoons at Shingle Street over time.

#### C.2.4 Pressures and threats

The Site Improvement Plan<sup>23</sup> has identified the following pressures and threats to this site and its qualifying species:

- **Public Access/ Disturbance**

The Wash is a very popular area for recreational activity and visitor numbers are likely to grow, for example as a result of the English Coastal Path and housing development. The range of recreational activities may have adverse impacts on the sites (Boating; motor boating; water skiing; jet skis; commercial and non-commercial wildlife tours; commercial shipping; kites (including surfers, boarders and buggy boarders); moorings; access to moorings; motorised vehicles; bikes, hovercraft; bird/wildlife watching; (dog) walking; Samphire collection, shellfish collection, bait digging, reed cutting, beachcombing, sea lavender gathering; beach barbecues; littering; wildfowling).

- **Siltation**

Sediment accretion is occurring in the Wash, and in such a dynamic system may be natural.

- **Fisheries: Recreational marine and estuarine**

Recreational sea fishing and shoreline angling is a large-scale activity with potential to impact on fish stocks as a resource for designated birds, but the size of the activity locally and its impact is not known.

- **Invasive Alien Species**

There is a risk of introduction and spread of non-native/invasive species (e.g. American Razor Clam *Ensis directus*; Slipper limpet *Crepidula fornicata*; Pacific Oyster *Crassostrea giga*; oyster parasite *Bonamia*) from future fisheries and mussel lay stocking. There is also a risk of translocation of invasive species through ballast water transfer and discharge.

- **Inappropriate coastal management**

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<sup>23</sup> Site Improvement Plan: The Wash and North Norfolk Coast (SIP245). Available at: <http://publications.naturalengland.org.uk/publication/5327498292232192>

Following the recent tidal event of December 2013 there may now be conflicts between flood risk management and the protection and provision of SPA/SAC habitats.

- **Fisheries: Commercial marine and estuarine**

A consent was granted to a private fishery tenant in 1984 for collection of shellfish, killing of starfish and application of lime to the seabed. No restriction on harvesting methodology or level were applied to the consent. Therefore, there is a risk to site features due to uncertainty of current management.

- **Predation**

Lack of predator control, where appropriate, is having an impact on the ability of sites to support breeding bird populations

- **Coastal squeeze**

Coastal squeeze at this site may lead to a gradual loss of intertidal and coastal habitats due to sea level rise and the erection and maintenance of coastal defences. The Wash Shoreline Management Plan and the North Norfolk Coast Shoreline Management Plan are subject to Habitats Regulations Assessment. Some areas of compensatory habitat still need to be designated.

- **Change in land management**

Grazing management. Areas of saltmarsh may be over and under-grazed throughout the site.

### C.3 The Wash Ramsar Site

#### C.3.1 Conservation objectives

Ramsar sites themselves do not have the same defined conservation objectives as National Sites Network (NSN) sites in the UK. No further information is available on the conservation objectives of this site, although objectives relating to The Wash are available through The Wash SAC designation.

#### C.3.2 Qualifying features

- **Criterion 1**

The Wash is a large shallow bay comprising very extensive saltmarshes, major intertidal banks of sand and mud, shallow water, and deep channels.

- **Criterion 3**

Qualifies because of the inter-relationship between its various components including saltmarshes, intertidal sand and mud flats and the estuarine waters. The saltmarshes and the plankton in the estuarine water provide a primary source of organic material which, together with other organic matter, forms the basis for the high productivity of the estuary.

- **Criterion 5**

- Assemblages of international importance:

- Species with peak counts in winter:

- 292541 waterfowl (5-year peak mean 1998/99-2002/2003)

- **Criterion 6**

Species/populations occurring at levels of international importance.

- Species with peak counts in spring/autumn:

- Eurasian oystercatcher, *Haematopus ostralegus ostralegus*, Europe & NW Africa - wintering
- Grey plover, *Pluvialis squatarola*, E Atlantic/W Africa -wintering
- Red knot, *Calidris canutus islandica*, W & Southern Africa (wintering)
- Sanderling, *Calidris alba*, Eastern Eurasian curlew, *Numerius arquata arquata*, N. a. arquata Europe (breeding)
- Common redshank, *Tringa totanus totanus*,
- Ruddy turnstone, *Arenaria interpres interpres*, NE Canada, Greenland/W Europe & NW Africa
- Species with peak counts in winter:
  - Pink-footed goose, *Anser brachyrhynchus*, Greenland, Iceland/UK
  - Dark-bellied brent goose, *Branta bernicla bernicla*,
  - Common shelduck, *Tadorna tadorna*, NW Europe
  - Northern pintail, *Anas acuta*, NW Europe
  - Dunlin, *Calidris alpina alpina*, W Siberia/W Europe
  - Bar-tailed godwit, *Limosa lapponica lapponica*, W Palearctic

**Species/populations identified subsequent to designation for possible future consideration under criterion 6.**

- Species with peak counts in spring/autumn:
  - Ringed plover, *Charadrius hiaticula*, Europe/Northwest Africa
  - Black-tailed godwit, *Limosa limosa islandica*, Iceland/W Europe
- Species with peak counts in winter:
  - European golden plover, *Pluvialis apricaria apricaria*, P. a. altifrons Iceland & Faroes/E Atlantic
  - Northern lapwing, *Vanellus vanellus*, Europe
  - Black-headed gull, *Larus ridibundus*, N & C Europe

### C.3.3 Site description

The Wash is the largest estuarine system in Britain. It is fed by the rivers Witham, Welland, Nene and Great Ouse. There are extensive saltmarshes, intertidal banks of sand and mud, shallow waters and deep channels. It is the most important staging post and over-wintering site for migrant wildfowl and wading birds in eastern England. It supports a valuable commercial fishery for shellfish and also an important nursery area for flatfish. It holds one of the North Sea's largest breeding populations of common seal *Phoca vitulina* and some grey seals *Halichoerus grypus*. The sublittoral area supports a number of different marine communities including colonies of the reef-building polychaete worm *Sabellaria spinulosa*.

### C.3.4 Pressures and threats

None reported but the Ramsar Information Sheet (2008) needs updating. See SAC/SPA Pressures and Threats (Section C.1.4 & 2.4).

## C.4 The Humber Estuary SPA

### C.4.1 Conservation objectives

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- The extent and distribution of the habitats of the qualifying features;
- The structure and function of the habitats of the qualifying features;
- The supporting processes on which the habitats of the qualifying features rely;
- The population of each of the qualifying features, and,
- The distribution of the qualifying features within the site.

#### C.4.2 Qualifying features

- A021 *Botaurus stellaris*, Great bittern (Non-breeding)
- A021 *Botaurus stellaris*, great bittern (Breeding)
- A048 *Tadorna tadorna*, common shelduck (Non-breeding)
- A081 *Circus aeruginosus*, Eurasian marsh harrier (Breeding)
- A082 *Circus cyaneus*, hen harrier (Non-breeding)
- A132 *Recurvirostra avosetta*, pied avocet (Non-breeding)
- A132 *Recurvirostra avosetta*, pied avocet (Breeding)
- A140 *Pluvialis apricaria*, European golden plover (Non-breeding)
- A143 *Calidris canutus*, red knot (Non-breeding)
- A149 *Calidris alpina alpina*, dunlin (Non-breeding)
- A151 *Philomachus pugnax*, ruff (Non-breeding)
- A156 *Limosa limosa islandica*, black-tailed godwit (Non-breeding)
- A157 *Limosa lapponica*, bar-tailed godwit (Non-breeding)
- A162 *Tringa tetanus*, common redshank (Non-breeding)
- A195 *Sterna albifrons*, little tern (Breeding)
- Waterbird assemblage

#### C.4.3 Site description

The Humber Estuary is located on the east coast of England, and comprises extensive wetland and coastal habitats. The inner estuary supports extensive areas of reedbed, with areas of mature and developing saltmarsh backed by grazing marsh in the middle and outer estuary. On the north Lincolnshire coast, the saltmarsh is backed by low sand dunes with marshy slacks and brackish pools. Parts of the estuary are owned and managed by conservation organisations. The estuary supports important numbers of waterbirds (especially geese, ducks and waders) during the migration periods and in winter. In summer, it supports important breeding populations of bittern *Botaurus stellaris*, marsh harrier (*Circus aeruginosus*), avocet (*Recurvirostra avosetta*) and little tern (*Sterna albifrons*).

#### C.4.4 Pressures and threats

The Site Improvement Plan<sup>24</sup> has identified the following pressures and threats to this site and its qualifying species:

##### **Water Pollution**

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<sup>24</sup> Natural England (2014) Site Improvement Plan: Humber Estuary (SIP108). Available at: <http://publications.naturalengland.org.uk/publication/5427891407945728>

There is an annual Dissolved Oxygen (DO) sag in the tidal River Ouse which has been present for many years, but has shown improvements more recently due to reductions in pollution. The DO sag means that at certain times of year, the water quality thresholds set out in the conservation objectives for the site are not being met. It is possible that the DO sag may cause a barrier to sea lamprey when they are migrating through the area during the summer months; however, there is currently not enough evidence available to draw accurate conclusions of the impact of the DO sag so further research is necessary. Due to the timing of the DO sag, it is unlikely that river lamprey is affected. There is concern around pollutants leaching from Capper Pass, a former aluminium smelting plant. Several of the Barton and Barrow clay pits on the south bank fail the total Phosphorus (P) target and need lake management plans and nutrient budgets. Many pits have not been tested for water quality but this may be an issue given the impoverished macrophyte communities. Further investigation is needed into the impacts. There is an issue with Tributyltin (TBT) in the sediment, which although possibly historical in origin, may need more investigation, as well as awareness campaigns to prevent the scale of this issue in the future.

### **Coastal squeeze**

The gradual and persistent loss of intertidal habitat due to sea level rise and presence of fixed defences affects every saltmarsh and mudflats where saltmarsh is absent. This is causing a loss of designated SAC features which needs to be addressed. A loss in mudflat can in turn affect SPA bird features that depend on these habitats.

### **Changes in species distributions**

There are declines in populations of SPA bird features due to unknown factors. Further investigation is needed to find the cause(s) of the declines and work to address the issues. River and sea lamprey spawn in freshwater sites many kilometres upstream of the designated site. Further investigations are needed to identify key spawning areas and raise awareness of these areas to prevent deterioration.

### **Undergrazing**

Lack of recent grazing by livestock has resulted in suitable habitat no longer being maintained for roosting/loafing SPA birds. Investigation is needed to ensure that any future introduction of grazing would be neutral or beneficial to the saltmarsh and dune SAC features.

### **Invasive species**

The presence of Azolla in the drains at Far Ings is currently being addressed. The presence of Himalayan Balsam is a catchment wide issue and there are localised patches of Giant Hogweed and Japanese Knotweed. Marine invasive species are also present with the slipper limpet and Chinese mitten crab being an issue, however the extent is unknown and more investigation is necessary.

### **Natural changes to site conditions**

Changes in the topography and habitats in the inner estuary may lead to a reduction of important habitats such as mudflats. There is evidence of changes including increased growth of Salicornia on mudflats. There are also increasing sediment loads within North Killingholm Haven Pits, which is affecting water levels and sluice functioning. The causes are unknown and need further investigation. Storm events in 2013 affected the structure of designated features. Due to climate change, these extreme weather events are more likely to occur and therefore it is important to gain an understanding of the effects of these events on protected habitats.

### **Public Access/Disturbance**

Recreational disturbance could be contributing to the declines in breeding and migratory bird populations at certain locations including East Halton Skitter, Barton Pits, Faxfleet and Welwick. The floodbank is adjacent to the river and there are many dog walkers, birders and other regularly occurring activities which may be causing disturbance to birds. Offroad vehicles can also cause disturbance to bird features.

### **Fisheries (Fish stocking)**

Several of the clay pits on the south bank of the estuary have active fisheries or have had fisheries in the past and still support non-native fish. The over-stocking of native and non-native fish is destructive to the clay pits freshwater habitat, having a negative impact on water quality and is implicated in the decline of macrophytes and in many of clay pits. The decline in macrophytes and water quality may both negatively impact SPA waterbirds.

### **Fisheries (commercial marine and estuarine)**

Dredges (inc. hydraulic), benthic trawls and seines and shore-based activities are categorised as 'Red' for the mudflats and sandflats not covered by seawater at low tide interest feature (and specifically the sub-feature: Eelgrass communities) as part of Defra's revised approach to commercial fisheries management in EMSs. Requisite mechanisms are being implemented by North Eastern IFCA and Eastern IFCA

### **Fisheries (commercial marine and estuarine)**

Commercial fishing activities categorised as 'amber or green' under Defra's revised approach to commercial fisheries in EMSs are being assessed by North Eastern IFCA and Eastern IFCA to determine whether management is required. For activities categorised as 'green', these assessments should take account of any relevant in-combination effects with other fishing activities.

### **Direct land take from development**

An illegal flood defence has been created on the Hesse forshore where material has been dumped.

### **Air Pollution**

Impact of atmospheric nitrogen deposition: Nitrogen deposition exceeds site relevant critical loads.

### **Shooting/ scaring**

There is unauthorised wildfowling and game bird management in areas such as Haverfield Quarries. Investigation is needed to understand the extent of the unauthorised wildfowling and the potential impacts on SPA features.

### **Direct impact from third party**

Commercial scale collection of *Salicornia* occurs near Saltfleetby. There was a proposal in 2013 regarding the harvesting of this species. There are management measures in place through 'Codes of Conduct' but these have had limited management success.

### **Inappropriate scrub control**

Successional scrub encroachment on grassland and reedbeds at Haverfield Quarries could reduce the likelihood of breeding by the marsh harrier.

## C.5 The Humber Estuary SAC

### C.5.1 Conservation objectives

With regard to the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

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;
- The supporting processes on which qualifying natural habitats and habitats of qualifying species rely;
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

### C.5.2 Qualifying features

- H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks
- H1130. Estuaries
- H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats
- H1150. Coastal lagoons\*
- H1310. Salicornia and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand
- H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- H2110. Embryonic shifting dunes
- H2120. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Shifting dunes with marram
- H2130. Fixed dunes with herbaceous vegetation ("grey dunes"); Dune grassland\*
- H2160. Dunes with *Hippophae rhamnoides*; Dunes with sea-buckthorn
- S1095. *Petromyzon marinus*; Sea lamprey
- S1099. *Lampetra fluviatilis*; River lamprey
- S1364. *Halichoerus grypus*; Grey seal

### C.5.3 Site description

The Humber is the second largest coastal plain Estuary in the UK, and the largest coastal plain estuary on the east coast of Britain. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion on the tidal rivers of the Ouse and Trent. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them; these include a breeding bird assemblage, winter and passage waterfowl, river and sea lamprey, grey seals, vascular plants and invertebrates.

The Humber is a muddy, macro-tidal estuary, fed by a number of rivers including the Rivers Ouse, Trent and Hull. Suspended sediment concentrations are high, and are derived from a variety of sources, including marine sediments and eroding boulder clay along the Holderness



coast. This is the northernmost of the English east coast estuaries whose structure and function is intimately linked with soft eroding shorelines. The extensive mud and sand flats support a range of benthic communities, which in turn are an important feeding resource for birds and fish. Wave exposed sandy shores are found in the outer/open coast areas of the estuary. These change to the more moderately exposed sandy shores and then to sheltered muddy shores within the main body of the estuary and up into the tidal rivers.

Habitats within the Humber Estuary include Atlantic salt meadows and a range of sand dune types in the outer estuary, together with Sandbanks which are slightly covered by sea water all the time, extensive intertidal mudflats, *Salicornia* and other annuals colonising mud and sand, and Coastal lagoons. As salinity declines upstream, reedbeds and brackish saltmarsh communities fringe the estuary. These are best-represented at the confluence of the Rivers Ouse and Trent at Blacktoft Sands.

Upstream from the Humber Bridge, the navigation channel undergoes major shifts from north to south banks, for reasons that have yet to be fully explained. This section of the estuary is also noteworthy for extensive mud and sand bars, which in places form semi-permanent islands. The sand dunes are features of the outer estuary on both the north and south banks particularly on Spurn peninsula and along the Lincolnshire coast south of Cleethorpes. Examples of both Fixed dunes with herbaceous vegetation (‘grey dunes’) and Shifting dunes along the shoreline with *Ammophila arenaria* (‘white dunes’) occur on both banks of the estuary and along the coast. Native sea buckthorn Dunes with *Hippophae rhamnoides* also occurs on both sides of the estuary. Significant fish species include river lamprey and sea lamprey *Petromyzon marinus* which breed in the River Derwent, a tributary of the River Ouse. Grey seals *Halichoerus grypus* come ashore in autumn to form breeding colonies on the sandy shores of the south bank at Donna Nook.

#### C.5.4 Pressures and threats

The Site Improvement Plan<sup>25</sup> has identified the following pressures and threats to this site and its qualifying species:

##### **Water Pollution**

There is an annual Dissolved Oxygen (DO) sag in the tidal River Ouse which has been present for many years, but has shown improvements more recently due to reductions in pollution. The DO sag means that at certain times of year, the water quality thresholds set out in the conservation objectives for the site are not being met. It is possible that the DO sag may cause a barrier to sea lamprey when they are migrating through the area during the summer months; however there is currently not enough evidence available to draw accurate conclusions of the impact of the DO sag so further research is necessary. Due to the timing of the DO sag, it is unlikely that river lamprey are affected. There is concern around pollutants leaching from Capper Pass, a former aluminium smelting plant. Several of the Barton and Barrow clay pits on the south bank fail the total Phosphorus (P) target and need lake management plans and nutrient budgets. Many pits have not been tested for water quality but this may be an issue given the impoverished macrophyte communities. Further investigation is needed into the impacts. There is an issue with Tributyltin (TBT) in the sediment, which although possibly historical in origin, may need more investigation, as well as awareness campaigns to prevent the scale of this issue in the future.

##### **Coastal squeeze**

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<sup>25</sup> Natural England (2014) Site Improvement Plan: Humber Estuary (SIP108). Available at: <http://publications.naturalengland.org.uk/publication/5427891407945728>

The gradual and persistent loss of intertidal habitat due to sea level rise and presence of fixed defences affects every saltmarsh and mudflats where saltmarsh is absent. This is causing a loss of designated SAC features which needs to be addressed.

### **Changes in species distributions**

River and sea lamprey spawn in freshwater sites many kilometres upstream of the designated site. Further investigations are needed to identify key spawning areas and raise awareness of these areas to prevent deterioration.

### **Undergrazing**

Investigation is needed to ensure that any future introduction of grazing would be neutral or beneficial to the saltmarsh and dune SAC features.

### **Invasive species**

The presence of Azolla in the drains at Far Ings is currently being addressed. The presence of Himalayan Balsam is a catchment wide issue and there are localised patches of Giant Hogweed and Japanese Knotweed. Marine invasive species are also present with the slipper limpet and Chinese mitten crab being an issue, however the extent is unknown and more investigation is necessary.

### **Natural changes to site conditions**

Changes in the topography and habitats in the inner estuary may lead to a reduction of important habitats such as mudflats. There is evidence of changes including increased growth of Salicornia on mudflats. There are also increasing sediment loads within North Killingholm Haven Pits, which is affecting water levels and sluice functioning. The causes are unknown and need further investigation. Storm events in 2013 affected the structure of designated features. Due to climate change, these extreme weather events are more likely to occur and therefore it is important to gain an understanding of the effects of these events on protected habitats.

### **Public Access/Disturbance**

Recreational disturbance could be contributing to the declines in breeding and migratory bird populations at certain locations including East Halton Skitter, Barton Pits, Faxfleet and Welwick. The floodbank is adjacent to the river and there are many dog walkers, birders and other regularly occurring activities which may be causing disturbance to birds.

### **Fisheries (Fish stocking)**

Several of the clay pits on the south bank of the estuary have active fisheries or have had fisheries in the past and still support non-native fish. The over-stocking of native and non-native fish is destructive to the clay pits freshwater habitat, having a negative impact on water quality and is implicated in the decline of macrophytes and in many of clay pits.

### **Fisheries (Commercial marine and estuarine)**

Dredges (inc. hydraulic), benthic trawls and seines and shore-based activities are categorised as 'Red' for the mudflats and sandflats not covered by seawater at low tide interest feature (and specifically the sub-feature: Eelgrass communities) as part of Defra's revised approach to commercial fisheries management in EMSs. Requisite mechanisms are being implemented by North Eastern IFCA and Eastern IFCA

**Fisheries (Commercial marine and estuarine):** Commercial fishing activities categorised as 'amber or green' under Defra's revised approach to commercial fisheries in EMSs are being assessed by North Eastern IFCA and Eastern IFCA to determine whether management is

required. For activities categorised as 'green', these assessments should take account of any relevant in-combination effects with other fishing activities.

### **Direct land take from development**

An illegal flood defence has been created on the Hesse forshore where material has been dumped.

### **Air Pollution (impact of atmospheric nitrogen deposition)**

Nitrogen deposition exceeds site relevant critical loads.

### **Shooting/ scaring**

There is unauthorised wildfowling and game bird management in areas such as Haverfield Quarries.

### **Direct impact from third party**

Commercial scale collection of *Salicornia* occurs near Saltfleetby. There was a proposal in 2013 regarding the harvesting of this species. There are management measures in place through 'Codes of Conduct' but these have had limited management success.

### **Inappropriate scrub control**

Successional scrub encroachment on grassland and reedbeds at Haverfield Quarries could reduce the likelihood of breeding by the marsh harrier.

## **C.6 The Humber Estuary Ramsar Site**

### **C.6.1 Conservation objectives**

Ramsar sites themselves do not have the same defined conservation objectives as National Sites Network (NSN) sites in the UK. No further information is available on the conservation objectives of this site, although objectives relating to The Humber Estuary are available through The Humber Estuary SPA and SAC designation.

### **C.6.2 Qualifying features**

#### **Ramsar criterion 1**

The site is a representative example of a near-natural estuary with the following component habitats:

dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.

#### **Ramsar criterion 3**

The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.

The dune slacks at Saltfleetby-Theddlethorpe on the southern extremity of the Ramsar site are the most north-easterly breeding site in Great Britain of the natterjack toad *Bufo calamita*.

#### **Ramsar criterion 5**

Assemblages of international importance: 153,934 waterfowl, non-breeding season (5 year peak mean 1996/97-2000/2001)

## **Ramsar criterion 6 – species/populations occurring at levels of international importance.**

Species with peak counts in spring/autumn:

Pluvialis apricaria apricaria, P. a. altifrons, Calidris canutus islandica, W & Southern Africa (wintering); Dunlin, Calidris alpina alpina, W Siberia/W Europe; Limosa limosa islandica, Iceland/W Europe; Tringa totanus totanus,

Species with peak counts in winter:

Tadorna tadorna, NW Europe European Pluvialis apricaria apricaria, P. a. altifrons Iceland & Faroes/E Atlantic Calidris canutus islandica, W & Southern Africa; (wintering) Dunlin, Calidris alpina alpina, W Siberia/W Europe Limosa limosa islandica, Iceland/W Europe Limosa lapponica lapponica, W Palearctic.

## **Ramsar criterion 8**

The Humber Estuary acts as an important migration route for both Lampetra fluviatilis and Petromyzon marinus between coastal waters and their spawning areas.

### **C.6.3 Site description**

The Humber Estuary is the largest macro-tidal estuary on the British North Sea coast. It drains a catchment of some 24,240 square kilometres and is the site of the largest single input of freshwater from Britain into the North Sea. It has the second-highest tidal range in Britain (max 7.4 m) and approximately one-third of the estuary is exposed as mud or sand flats at low tide. The inner estuary supports extensive areas of reedbed with areas of mature and developing saltmarsh backed in places by limited areas of grazing marsh in the middle and outer estuary. On the north Lincolnshire coast the saltmarsh is backed by low sand dunes with marshy slacks and brackish pools. The Estuary regularly supports internationally important numbers of waterfowl in winter and nationally important breeding populations in summer.

### **C.6.4 Pressures and threats**

#### **Disturbance to vegetation through cutting / clearing**

Reedbeds being cut and cleared on margins of pits associated with angling. Management agreements and enforcement to address.

#### **Vegetation succession**

Lack of reedbed management leading to scrub encroachment. Management agreement to address.

#### **Water diversion for irrigation/domestic/industrial use**

Abstraction causes reduced freshwater input. Review of consents well advanced but not yet implemented.

#### **Overfishing**

Substantial lamprey by-catch in eel nets in River Ouse.

#### **Pollution – domestic sewage**

Reduced dissolved oxygen in River Ouse is a barrier to fish migration. Review of consents well advanced but not yet implemented.

#### **Pollution – agricultural fertilisers**

Reduced dissolved oxygen in River Ouse is a barrier to fish migration. To be addressed through Catchment Sensitive Farming Initiatives and implementation of Water Framework Directive.

### **Recreational/tourism disturbance (unspecified)**

Particularly illegal access by motorised recreational vehicles and craft. Control through management scheme.

### **Other factor**

Coastal squeeze causing loss of intertidal habitats and saltmarsh due to sea level rise and fixed defences. The Humber Flood Risk Management Strategy has been developed and is being implemented.

## **C.7 Baston Fen SAC**

### **C.7.1 Conservation objectives**

With regard to the natural habitats and/or species for which the site has been designated (the 'Qualifying Features' listed below), and subject to natural change;

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 the habitats of qualifying species
- The structure and function of the habitats of qualifying species
- The supporting processes on which the habitats of qualifying species rely
- The populations of qualifying species, and,
- The distribution of qualifying species within the site.

### **C.7.2 Qualifying features**

- S1149. *Cobitis taenia*; Spined loach

### **C.7.3 Site description**

Baston Fen SAC comprises long strips of permanent pasture which are subject to regular winter flooding, interspersed with a series of old flooded borrow-pits with associated swamp and fen plant communities.

Amongst the variety of fish which have been recorded from the site is the spine loach *Cobitis taenia*, significant populations of which occur in the Counter

Drain and, to a lesser extent, in the River Glen. This site represents a key stronghold for this species within the Welland catchment.

### **C.7.4 Pressures and threats**

The Site Improvement Plan<sup>26</sup> has identified the following pressures and threats to this site and its qualifying species:

#### **Siltation**

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<sup>26</sup> Natural England (2014) Site Improvement Plan: Baston Fen SAC (SIP010). Available at: <http://publications.naturalengland.org.uk/publication/6625046869049344>

There has been no desilting of the ditch since SAC notification because of the concerns over what this could do to the Spined loach population. There is currently more silt than is considered ideal for the species, and a management programme is necessary for both the health of the Spined loach population and for the macrophyte community. It would need careful planning and monitoring.

### **Changes in species distributions**

The Spined loach population is not monitored with sufficient frequency to determine population fluctuations.

