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United Utilities

Water for the North West

United Utilities

North West Transfer Strategic Resource Option

Information to support an informal assessment of the NWT SRO against Regulation 63 of the *Conservation of Habitats and Species Regulations 2017*

Wood Group UK Limited – November 2022

Report for

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Contents

1. Introduction

1.1 The North-West Transfer SRO

1.1.1 The United Utilities Water (UU) North West Transfer (NWT) Strategic Resource Option (SRO) is one of 17 schemes promoted by Ofwat in the PR19 Final Determination to identify new strategic water resources to meet projected supply deficits as a consequence of population growth and climate change. The NWT SRO is a combination of the 'United Utilities Sources' (UUS) and 'United Utilities Vyrnwy Aqueduct' (UUVA) SROs and provides new sources to be brought online if water were to be transferred out of region, maintaining resilience for customers in the North West. The NWT SRO comprises two principal components:

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

1.1.2 The SROs are being brought forward through a 'gated' assessment process. Both the UUS and UUVA SROs have progressed through Gate 1 (July 2021) of the Regulators' Alliance for Progressing Infrastructure Development's (RAPID) gated process, and UU is now preparing its Gate 2 submission for a combined NWT SRO.

1.2 Habitats Regulations Assessment

1.2.1 The All Company Working Group (ACWG) guidance (October 2020[1]) sets out a requirement for an environmental assessment to be undertaken for each SRO, to include suitable assessment against the provisions of the *Conservation of Habitats and Species Regulations 2017* (as amended) (the 'Habitats Regulations')[2].

1.2.2 Regulations 63 and 64 transposed the provisions of Articles 6(3) and 6(4) of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') as they related to plans or projects in England and Wales.

[1] All Company Working Group (October 2020). Water Framework Directive: Consistent framework for undertaking no deterioration assessments

[2] The 2017 Regulations have been amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 to reflect the UK's exit from the EU, although these largely carried forward the provisions and terminology of the 2017 Regulations and do not fundamentally alter their interpretation. This report therefore primarily refers to the 2017 Regulations and (where appropriate for clarity) the relevant provisions of the Habitats Directive.

1.2.3 Regulation 63 states that if a plan or project is "*(a) is likely to have a significant effect on a European site*[3] *or a European offshore marine site*[4] *(either alone or in combination with other plans or projects); and (b) is not directly connected with or necessary to the management of the site*" then the competent authority must "*…make an appropriate assessment of the implications for the site in view of that site's conservation objectives*" before the giving consent or authorisation. The plan or project can only be given effect if it can be concluded (following an 'appropriate assessment') that it "*…will not adversely affect the integrity*" of a site, unless the provisions of Regulation 64 are met.

1.2.4 This assessment process is known as Habitats Regulations Assessment (HRA)[5]. An HRA determines whether there will be any 'likely significant effects' (LSE) on any European site as a result of a plan's implementation (either on its own or 'in combination' with other plans or projects)[6] and, if so, whether there will be any 'adverse effects on site integrity'[7].

1.3 This Report

1.3.1 RAPID's Gate 2 guidance (April 2022[8]) states that at Gate 2, all options must be informally assessed against the provisions of the Habitats Regulations. However, it is recognised that the gated submissions are not formally subject to the Regulations, and that not all evidence required to support the HRA (and other assessments) will necessarily be available at Gate 2.

1.3.2 This report will accompany the NWT SRO Gate 2 submission that will be determined by RAPID and summarises the current assessment of the SRO against the requirements of the Habitats Regulations, using the best available information at the time of the Gate 2

[3] As noted, the 2019 amendment to the Habitats Regulations largely carried forward the provisions and terminology of the 2017 Regulations, and so the term 'European site' is currently retained and for all practical purposes the definition is essentially unchanged. European sites are therefore: any Special Area of Conservation (SAC) from the point at which the European Commission and the UK Government agreed the site as a 'Site of Community Importance' (SCI) (if this was before 31 Jan 2020); any classified Special Protection Area (SPA); and any candidate SAC (cSAC). However, the term is also commonly used when referring to potential SPAs (pSPAs), to which the provisions of Article 4(4) of Directive 2009/147/EC (the 'new wild birds directive') are applied; and to possible SACs (pSACs) and listed Ramsar Sites, to which the provisions of the Habitats Regulations are applied a matter of Government policy (NPPF para. 181; TAN5 para. 5.1.3) when considering development proposals that may affect them. "European site" is therefore used in this document in its broadest sense, as an umbrella term for all of the above designated sites. Note, it is likely that this term will be supplanted at some point in the future although an appropriate UK-wide alternative has not yet been agreed (e.g. the NPPF in England has adopted the term 'Habitats sites' to refer collectively to those sites defined by Regulation 8, whereas the *Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019* uses the term 'National Site Network').

[4] 'European offshore marine sites' are defined by Regulation 18 of The Conservation of Offshore Marine Habitats and Species Regulations 2017; these regulations cover waters (and hence sites) over 12 nautical miles from the coast.

[5] The term 'Appropriate Assessment' has been historically used to describe the process of assessment; however, the process is more typically referred to as 'Habitats Regulations Assessment' (HRA), with the term 'Appropriate Assessment' limited to a specific stage within the process.

[6] Also referred to as the 'test of significance'.

[7] Also referred to as the 'integrity test'.

[8] Regulators' Alliance for Progressing Infrastructure Development (April 2022). *Strategic regional water resource solutions guidance for Gate 2*.

submission, and highlighting key areas for further evidence collection and assessment for Gate 3. The report is structured as follows:

- **Section 2** provides a brief summary of the NWT SRO and its component options;
- **Section 3** sets out the approach to the informal HRA of the SRO, including the key challenges and assumptions (**Section 3**);
- **Section 4** documents the 'screening' of the options;
- **Sections 5 – 9** provide 'appropriate assessments' for those European sites where significant effects could not be excluded, including 'inter-option' in combination assessments (i.e. effects of the options cumulatively) and in combination assessments with known non-SRO projects;
- **Section 10** summarises the plan-level 'in combination' assessment (i.e. the assessment of the NWT SRO with strategic plans such as UU's Water Resource Management Plan (WRMP)); and
- **Section 11** summarises the Gate 2 conclusions.

1.3.3 The report necessarily focuses on the options selected for the SRO; the iterative HRA-related processes used to inform the Gate 1 submissions are documented separately (Wood 2021a, 2021b).

1.3.4 Note that the HRA draws on the environmental data and assessments undertaken within other assessments, particularly in relation to operational effects and the hydrological zone of influence. These include:

- the Water Framework Directive (WFD) assessment (Wood 2022a)
- NWT SRO Gate 2: Assessment of options involving groundwater abstractions (Wood, 2022b)
- NWT SRO Gate 2: Assessment of options involving surface water abstractions (Wood, 2022c)

1.3.5 This HRA report should therefore be read in conjunction with these reports.

1.3.6 As noted, RAPID's Gate 2 guidance, which was drafted with input from Natural England (NE), states that at Gate 2 all options must be informally assessed against the provisions of the Habitats Regulations; this report therefore applies the techniques and terminology of HRA to the options.

1.3.7 However, it should be noted that the terminology of the HRA tests does not allow for equivocal conclusions, and so **all the assessments (both 'screening' and 'appropriate assessment') are necessarily preliminary and any conclusions indicative only, to guide the gated decision-making process**: they are not intended to be definitive Regulations-compliant statements. NE has indicated that it considers that reaching any conclusions at this point is premature and so the report will often refer to the risk of an option having adverse effects, which would not be acceptable terminology in a formal HRA, but which aims to preserve some of the value of the assessment to the gated decision-making process. All conclusions will be revisited and verified post-Gate 2.

2. The North-West Transfer SRO

2.1 SRO Summary

2.1.1 The NWT SRO is a combination of the United Utilities Sources (UUS) and Vyrnwy Aqueduct (UUVA) SROs. Both the UUS and UUVA SROs have progressed through Gate 1 (July 2021) of the Regulators' Alliance for Progressing Infrastructure Development's (RAPID) gated process.

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

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

2.1.3 As of June 2022, a total of 14 options are proposed for the NWT SRO (13 supply options and one enabling works option). The source options are geographically spread across UU's supply area, and include groundwater and river abstractions. Of the 13 source options, nine are included in the NWT Full Solution, with the remaining four held in reserve. The options are summarised in **Table 2.1**.

Table 2.1 Options included in the NWT SRO

Option ID	Option name	Description	Part of NWT Full Solution?
WR015	[✂]	[✂]	Yes
WR049d	[✂]	[✂]	Yes
WR076	[✂]	[✂]	Yes
WR102b	[✂]	[✂]	Yes
WR105a	[✂]	[✂]	No
WR106b	[✂]	[✂].	No
WR107a	[✂]	[✂]	Yes
WR107b	[✂]	[✂]	Yes
WR111	[✂]	[✂]	Yes

Option ID	Option name	Description	Part of NWT Full Solution?
WR113	[✂]	[✂]	Yes
WR144	[✂]	[✂]	No
WR149	[✂]	[✂]	Yes
STT041b	[✂]	[✂]	No
STTA4	[✂]	[✂]	Yes

2.1.4 It should be noted that the NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and so the NWT SRO options will therefore be included in the WRMP (which will precede the SRO submissions). Therefore, the NWT SRO reflects the WRMP and so cannot have 'in combination' effects with this plan.

3. Approach to HRA

3.1 Key Guidance

3.1.1 Although the SRO is not directly analogous to WRMPs, the key guidance document for HRA of WRMPs (**UKWIR (2021). *Environmental Assessment Guidance for Water Resources Management Plans and Drought Plans*. UK Water Industry Research Limited, London**) has some relevance.

3.1.2 Other relevant guidance and case-practice includes:

- Regulators' Alliance for Progressing Infrastructure Development (2022). Strategic regional water resource solutions guidance for Gate 2.
- Defra (2021). *Policy paper: Changes to the Habitats Regulations 2017* [online]. Available at: https://www.gov.uk/government/publications/changes-to-the-habitats-regulations-2017/changes-to-the-habitats-regulations-2017.
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- Defra (2012). *The Habitats and Wild Birds Directives in England and its seas: Core guidance for developers, regulators & land/marine managers* [online]. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/82706/habitats-simplify-guide-draft-20121211.pdf.
- PINS Note 05/2018: *Consideration of avoidance and reduction measures in Habitats Regulations Assessment: People over* Wind, Peter Sweetman v Coillte Teoranta. [withdrawn].

- SNH (2019). SNH Guidance Note: *The handling of mitigation in Habitats Regulations Appraisal – the People Over Wind CJEU judgement* [online]. Scottish Natural Heritage. Available at: https://www.nature.scot/sites/default/files/2019-08/Guidance%20Note%20-%20The%20handling%20of%20mitigation%20in%20Habitats%20Regulations%20Appraisal%20-%20the%20People%20Over%20Wind%20CJEU%20judgement.pdf.

3.2 Application of HRA of WRMPs

Process Overview

3.2.1 European Commission guidance[9] and established case-practice suggests a four-stage process for addressing Articles 6(3) and 6(4), and hence Regulations 63 and 64 (see **Box 1**), although not all stages will necessarily be required:

Box 1 – Stages of HRA

Stage 1 – Screening or 'Test of significance'

This stage identifies the likely effects of a project or plan on a European site, either alone or 'in combination' with other projects or plans, and considers whether these effects are likely to be significant. The 'screening' test or 'test of significance' is a low bar, intended as a trigger rather than a threshold test: a plan should be considered 'likely' to have an effect if the competent authority is unable (on the basis of objective information) to exclude the possibility that the plan or project could have significant effects on any European site, either alone or in combination with other plans or projects; an effect will be 'significant' simply if it could undermine the site's conservation objectives. Note that mitigation measures should not be considered at the 'screening' stage, in accordance with the **People over Wind** (Court of Justice of the European Union (ECJ) Case C-323/17); this reinforces the idea of screening as a 'low bar' and makes 'appropriate assessments' more common.

Stage 2 – Appropriate Assessment (including the 'Integrity test')

An 'appropriate assessment' (if required) involves a closer examination of the plan or project where the effects on relevant European sites are significant or uncertain, to determine whether any sites will be subject to 'adverse effects on integrity' if the plan or project is given effect. The scope of any 'appropriate assessment' stage is not set, and the assessments will not be extremely detailed in every case (particularly if mitigation is clearly available, achievable, and likely to be effective). The assessments must be 'appropriate' to the effects and proposal being considered, and sufficient to ensure that there is no reasonable doubt that adverse effects on site integrity will not occur (or sufficient for those effects to be appropriately quantified should Stages 3 and 4 be required).

Stage 3 – Assessment of Alternative Solutions

Where adverse effects remain after the inclusion of mitigation, Stage 3 examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of European sites. A plan or project that has adverse effects on the integrity of a European site cannot be permitted if alternative solutions are available, except for imperative reasons of overriding public interest (IROPI; see Stage 4).

Stage 4 – Assessment Where No Alternative Solutions Exist and Where Adverse Impacts Remain

This stage assesses compensatory measures where it is deemed that there are no alternatives that have no or lesser adverse effects on European sites, and the project or plan should proceed for imperative reasons of overriding public interest (IROPI). The EC guidance does not deal with the assessment of IROPI, although the IROPI need to be sufficient to override the adverse effects on European site integrity, taking into account the compensatory measures that can be secured (which must ensure the overall coherence of the 'national site network'.

[9] *Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (EC 2002).

3.2.2 The stages in Box 1 (if required) are used to ensure compliance with the Habitats Regulations and so principally reflect the stepwise legislative tests applied to the final, submitted project or plan; **there is no statutory requirement for HRA (or its specific stages) to be completed for draft plans or similar developmental stages**. This applies to the emerging NWT SRO.

3.2.3 Consequently there is flexibility for the HRA process to be run in a manner that provides maximum benefit for plan-development and sound decision-making, whilst still ultimately meeting the legislative tests.

3.2.4 Therefore, whilst the principles of HRA are applied to the emerging NWT SRO, **the specific tests associated with Regulation 63 will be applied to the SRO only at the Gate 3 submission** (in practice, to the planning applications and abstraction licence applications). The overarching HRA *process* for the SRO has therefore included the following key steps:

- An initial **'risk review'** of the possible SRO schemes for which information was available at Gate 1, to inform UU's development of the NWT SRO (i.e. 'HRA as a process'); for clarity, this review process is not documented in this report, but is available as part of the Gate 1 submission.
- The **Gate 2 assessment of the NWT SRO options** against the provisions of Regulation 63, comprising an informal 'screening' and 'appropriate assessment' designed guide further evidence gathering and indicate the likely conclusions of the HRA process (this report).
- **Gate 3 assessments of the NWT SRO** against the provisions of Regulation 63, comprising formal 'screening' and an 'appropriate assessment' of the planning and licence applications, designed to meet the legislative tests.

Key Challenges and Assumptions

3.2.5 The fundamental nature of the SRO presents a number of distinct challenges for a 'strategic' or high-level HRA and it is therefore important to understand how the SRO is developed, its objectives, and hence how it might consequently affect European sites.

Uncertainty and plan-level mitigation

3.2.6 HRAs of plans and strategies typically have to deal with a degree of uncertainty; very often, it is not possible to provide a detailed assessment of the effects of a proposal as many aspects simply cannot be fully defined at the strategy-level in the planning hierarchy. This is particularly true for options that will only be required over longer-term planning horizons, which are inevitably less defined than options that are required in the near term.

3.2.7 Where the available information is fundamentally insufficient to complete a meaningful appropriate assessment, then case-practice for strategic plans in general suggests some assessment may be deferred 'down the line' to a lower planning tier provided that certain criteria are met.

3.2.8 This is usually only appropriate where there is sufficient certainty that the proposal can (with the implementation of established scheme-level measures that are known to be effective) avoid adverse effects on the integrity of European sites; and/or if appropriate investigation schemes are identified to resolve the uncertainty and commitments are made within the plan to not pursue an option if adverse effects are identified through these investigations.

3.2.9 Case-practice in WRMP HRAs[10] has some relevance to the NWT SRO, since these are high-level plans that outline conceptual options at an early stage in their design and delivery process. With WRMPs it may be acceptable to include Preferred Programme options with residual uncertainties provided that:

- there is sufficient flexibility within the terms of the WRMP to ensure adverse effects can be avoided at the project level (e.g. the plan does not dictate specific pipeline routes or yields that cannot be deviated from); and/or
- the option is not required within the first five years of the plan period, so allowing time for additional investigations to be completed; and
- the uncertainty that this creates is mitigated at the plan-level by the inclusion of alternative options which:
  - will meet the required demand / deficit should the Preferred Programme option prove to have an unavoidable risk of adverse effects on the European sites in question; **and**
  - will not themselves have any adverse effect on any European sites.

3.2.10 Note, this is not intended to provide a mechanism for the inclusion of options where there appears to be no reasonable way of avoiding adverse effects. It should be noted that this flexibility is perhaps desirable in any case, since it is possible that a 'no adverse effect' option might be subsequently proven to have adverse effects when brought to the design stage. This approach allows for the WRMP to be compliant with the Habitats Regulations, since certainty over outcomes for the plan as a whole is provided.

3.2.11 However, it is important to note that some uncertainties will remain (particularly with regard to 'in combination' effects) and for some options it will only be possible to fully assess any potential effects at the pre-project planning stage, when certain specific details are known; for example: construction techniques; site specific survey information; the precise timing of implementation; or the status of other projects that may operate 'in combination'. In addition, it may be several years before an option is employed, during which time other factors may alter the baseline or the likely effects of the option.

WRMP development parameters and relevance to the SRO HRA

3.2.12 The modelling underpinning the WRMP development and option selection process incorporates several assumptions that are relevant to the SRO assessment and which influence the scope of the HRA:

[10] For example, in relation to UU's WRMP14.

- The WRMP development process takes account of the existing consents regime, and any known (or reasonably anticipated) amendments that are likely to be required (e.g. following Water Industry National Environment Programme (WINEP) investigations or similar) since there has to be a starting point / basis for the assessment (i.e. the modelling / optioneering process cannot start with the assumption that no current consents are reliable). Any required licence amendments are factored into the supply-deficit calculations, and the EA will have confirmed that these are valid for the planning period when the WRMP modelling is undertaken. The existing consents regime (taking into account any required sustainability reductions) is therefore 'the baseline'[11] and, by extension the HRA of the SRO necessarily focuses on the additional effects introduced by the SRO components and does not (and cannot) reassess or reconfirm the existing consents regime.
- In some instances, when considering water that may be available from existing sources, consultees have indicated that consideration of 'recent actual' abstraction is more appropriate than the currently licenced maximum, particularly for waterbodies that are considered 'over-licensed'; it is understood that these licences have been identified to UU during the plan-development process and factored into the supply-demand balance calculations.
- The modelling takes account of predicted local and regional growth when identifying risk areas and potential solutions, based (*inter alia*) on Local Plans and population growth models. 'In combination' effects with respect to land-use plans and specific options are therefore inherently considered and accounted for as part of the WRMP option development process (i.e. an option that does not account for local growth is not a solution) and this can be relied on by the HRA. Likewise, the modelling accounts for climate change.
- Unless otherwise stated by the EA during the options development process, it is assumed that the relevant Abstraction Licensing Strategy (ALS) documents are correct and reliable, and that the EA's assessments consider there to be 'water available' where this is stated in the ALS.

In combination effects with other SROs

3.2.13 With regard to schemes involving multiple water companies (particularly some SROs) the assessment will necessarily focus on those European sites directly exposed to the activities proposed and managed by UU, rather than sites that will only be affected by those scheme elements proposed and managed by other water companies; i.e. when undertaking the 'in combination' assessment of a scheme that appears in multiple plans the effects from source/donor will be considered distinct from supply/beneficiary.

[11] It is recognised that, occasionally, the sustainability reductions agreed through the RoC process have been subsequently shown to be insufficient to address the effects of PWS abstraction on some sites (the most notable example is the River Ehen in Cumbria); it is assumed that these will be identified to the water companies as part of the WRMP development process. The key point is that the HRA of the WRMPs is focused on the additional effects of the options, not the current effects of the consents regime.

3.2.14 For example, the source/donor plan will only consider the implications of the abstraction, etc on relevant European sites and water bodies within its catchment (and downstream catchments where relevant), and the supply/beneficiary plan would consider any implications on European sites / water bodies from the application of the supplied water within its catchment/s[12]. This approach is intended to ensure unnecessary duplication is avoided, and pragmatism will be applied to address indirect, downstream effects and effects on functional habitat.

3.3 HRA of the NWT SRO Options

Geographical Scope

3.3.1 'Arbitrary' buffers are not generally appropriate for HRA. However, as distance is a strong determinant of the scale and likelihood of effects, the application of a suitably precautionary study area (based on a thorough understanding of both the options and European site interest features) has some important advantages due to the number of options and the benefits of a consistent approach:

- using buffers allows the systematic identification of European sites using GIS, so minimising the risk of sites or features being overlooked;
- it ensures that sites for which there are no reasonable impact pathways can be quickly and transparently excluded from any further screening or assessment; and
- when assessing multiple options it provides a consistent point of reference for consultees following the assessment process, and the 'screening' can therefore focus on the assessment of effects, rather than on explaining why certain sites may or may not have been considered in relation to a particular option.

3.3.2 Professional experience and case-practice relating to typical water industry schemes demonstrates that environmental changes associated with construction in terrestrial environments are rarely notable more than 2 km from a source, and the UKWIR (2021) guidance includes accepted 'zones of influence' for certain aspects (for example, noise impacts would almost never be significant over 1km from the source). Operational effects can extend further, depending on the scale and nature of the option, and so an intentionally precautionary overarching assessment scope has been used as a starting point for the assessment; this includes:

- All European sites that are within 20km of any operational facilities or new infrastructure required to deliver each option (including temporary infrastructure)). This is an intentionally large buffer that can also reliably capture the vast majority of possible interactions with 'mobile species' in terrestrial environments.
- All European sites that are downstream of any operational facilities or new infrastructure required to deliver each option (including temporary infrastructure), or upstream sites that support migratory fish (no distance thresholds). This reflects the

[12] Note: for the Severn Thames transfer we would expect the in-combination assessment of impacts on the Severn to feature in both WRW and WRSEs plans. This is due to the complex interaction of releases and abstractions particular to this scheme.

potential for hydrological impacts to operate over greater distances, and to address the potential for catchment-scale in combination effects from operation.

3.3.3 These parameters are used as a starting point for identifying potentially exposed sites. It is not a 'hard buffer' and in some instances it may be appropriate to consider more distant sites[13]; however, unless otherwise noted, sites over 20km from the options that are not hydrologically linked and which do not support wide-ranging mobile species are typically considered sufficiently remote such that any environmental changes will be effectively nil, and so there will be 'no effects' on sites beyond this distance (and so no possibility of 'in combination' effects).

3.3.4 The European sites and interest features considered potentially exposed to the outcomes of the NWT SRO are listed in **Appendix A**.

Data Collection

European site data collection and conservation objectives

3.3.5 The screening and appropriate assessment stages take account of the baseline condition of the European sites and their interest features[14], including (where reported) data on

- the site boundaries and the boundaries of the component Sites of Special Scientific Interest (SSSIs);
- the conservation objectives;
- information on the attributes of the European sites that contribute to and define their integrity;
- the condition, vulnerabilities and sensitivities of the sites and their interest features, including known pressures and threats
- the approximate locations of the interest features within each site (if reported); and
- designated or non-designated 'functional habitats' (if identified).

3.3.6 These data were derived from:

- the most recent Joint Nature Conservancy Council (JNCC)-hosted GIS datasets;
- the Standard Data forms for SACs and SPAs and Information Sheets for Ramsar sites;
- Article 12 and 17 reporting;

[13] For example, where an option is likely to directly affect the marine environment (e.g. through desalination schemes) and hence have possible effects on wide-ranging marine species; however, wide-ranging marine / marine dependent species associated with marine sites that are not directly connected to the hydrological zone of influence are not typically considered to be both sensitive and exposed to the effects of the options.

[14] The interest features are taken to be the qualifying features; and other within-site features that may be relevant to site integrity, particularly 'typical species' (for SACs) and within-site supporting habitats for SPAs. 'Functional land' would not usually be considered an interest feature of the site (although it may be important to the integrity of some interest features).

- the published site Conservation Objectives;
- Supplementary Advice to the conservation objectives (SACO) where available[15];
- Site Improvement Plans (SIPs);
- Core Management Plans (Wales); and
- the supporting Site of Special Scientific Interest's favourable condition tables where relevant and where no SACOs applicable to the features are available.

3.3.7 Note:

- For SPAs, the qualifying features are taken as those identified on the most recent JNCC datasets and citations where these post-date the 2nd SPA Review (i.e. it will be assumed that any amendments suggested by the SPA review have been made) unless otherwise identified to us by Natural England (NE) or Natural Resources Wales (NRW); any site-specific issues relating to the SPA Review can be addressed in the screening and appropriate assessment of the individual SRO options (see below).
- The conservation objectives for Ramsar sites are taken to be the same as for the corresponding SACs / SPAs (where sites overlap); SSSI Definition of Favourable Condition Tables (FCTs) will be used for those qualifying features not covered by SAC/SPA designations.

3.3.8 Where possible the site data is used to identify other features that may be relevant to site integrity, particularly '**typical species**' (for SACs), within-site **supporting habitats**, and designated or non-designated '**functional habitats**'.

3.3.9 A '**typical species**' is broadly described by European Commission (EC) guidance as being any species (or community of species) which is particularly characteristic of, confined to, and/or dependent upon the qualifying Annex I habitat feature at a particular site. This may include those species which:

- are critical to the composition or structure of an Annex I habitat (e.g. constant species identified by the National Vegetation Classification (NVC) community classification);
- exert a critical positive influence on the Annex I habitat's structure or function (e.g. a bioturbator (mixer of soil/sediment), grazer, surface borer or predator);
- are consistently associated with, and dependent upon, the Annex I habitat feature for specific ecological needs (e.g. feeding, sheltering), completion of life-cycle stages (e.g. egg-laying) and/or during certain seasons/times; or
- are particularly distinctive or representative of the Annex I habitat feature at a particular site.

[15] NE has published '*Supplementary advice on conserving and restoring site features*' for most European sites in England which describe in more detail the range of ecological attributes which are most likely to contribute to a site's overall integrity, and the targets each qualifying feature needs to achieve in order for the site's conservation objectives to be met.

3.3.10 Within-site **supporting habitats** are those which support the population(s) of the qualifying species and which are therefore critical to the integrity of the feature.

3.3.11 '**Functional habitats**' are generally taken to be habitats or features outside a European site boundary that are important or critical to the functional integrity of the site habitats and / or its interest features. These might include, for example:

- 'buffer' areas around a site (e.g. dense scrub areas preventing public access; areas of land that reduce the effects of agricultural run-off; etc.);
- specific features or habitats relied on by mobile species during their lifecycle (e.g. high-tide roosts for waders; significant maternity colonies for bats known to hibernate within an SAC; areas that are critical for foraging or migration; etc).

3.3.12 **Conservation Objectives** benchmark Favourable Conservation Status (FCS) for each feature. Guidance from the UK Statutory Nature Conservation Bodies (SNCBs) provides a broad characterisation of FCS, stating that it "*relates to the long-term distribution and abundance of the populations of species in their natural range, and for habitats to the long-term natural distribution, structure and functions as well as the long-term survival of its typical species in their natural range. It describes a situation in which individual habitats and species are maintaining themselves at all relevant geographical scales and with good prospects to continue to do so in the future*" (JNCC 2018).

3.3.13 The conservation objectives for European sites in England have been revised by NE in recent years to improve the consistency of assessment and reporting. As a result, the high-level conservation objectives for all sites are effectively the same:

3.3.14 For SACs:

- *With regard to the SAC and the natural habitats and/or species for which the site has been designated (the 'Qualifying Features'...), 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* [as applicable to each site];
  - *The extent and distribution of the qualifying natural habitats;*
  - *The extent and distribution of the habitats of qualifying species;*
  - *The structure and function (including typical species) of the qualifying natural habitats;*
  - *The structure and function of the habitats of qualifying species;*
  - *The supporting processes on which the qualifying natural habitats rely;*
  - *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.*

3.3.15 For SPAs:

- *With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features'...), 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.*

3.3.16 The conservation objectives for Ramsar sites are taken to be the same as for the corresponding SACs / SPAs (where sites overlap). The conservation objectives are considered when assessing the potential effects of plans and policies on the sites; information on the sensitivities of the interest features also informs the assessment.

3.3.17 NE has published '*Supplementary advice on conserving and restoring site features*' for most sites, which describe in more detail the range of ecological attributes which are most likely to contribute to a site's overall integrity, and the minimum targets each qualifying feature needs to achieve in order to meet the site's conservation objectives. These are considered at the screening and appropriate assessment stages, as necessary.

3.3.18 In Wales, the Regulation 37 advice and Core Management Plans for the SACs and SPAs set out conservation objectives that benchmark Favourable Conservation Status (FCS) for each feature. For the Welsh European sites the conservation objectives comprise a 'vision' for the feature (the key component of the objective) and (where relevant) performance indicators by which the objectives may be measured. These are used and referred to as necessary within the assessment but are not generally reproduced in this report.

Water resources baseline data

3.3.19 Information on the water resources baseline in the region is drawn from other assessment reports, UU (e.g. groundwater (GW) and surface water (SW) abstraction locations, source operational parameters, WRZ operation, emergency or drought plan operations) and the EA (Public Water Supply (PWS) and other GW/ SW abstractions, Abstraction Licensing Strategy (ALS) documentation).

3.3.20 With regard to 'water available for use', the NWT SRO Surface Water Options Report (Wood, 2022a) and WFD Assessment (Wood, 2022b) provide details of the most up-to-date ALS position, based on previous ALS data and specific comments and notes from the EA, and this information is relied on in the HRA.

Option data

3.3.21 Information on the options has been provided by UU. This includes an outline of how the option will function, including the intended outcomes (design capacities and utilisation);

and the scheme delivery requirements, including the type and indicative location of any permanent or temporary infrastructure.

3.3.22 It should be noted that the location of some scheme aspects cannot always be established at the SRO level: whilst some elements are relatively clear (for example, new plant will often be located within or close to existing water company assets) Gate 2 is a conceptual design (rather than detailed design) stage. For pipelines an indicative design route is provided for option costing purposes, which has been informed by the Gate 1 assessments (i.e. in most instances direct impacts on designated sites identified at Gate 1 have been avoided through subsequent route amendments, where possible). However, it should be recognised that the options are not fixed proposals for delivery that cannot be deviated from, and there will be many aspects (particularly relating to construction) that cannot be defined at Gate 2 ahead of option specific investigations that will take place during Gate 3 (e.g. the location of any temporary enabling works; precise locations for materials storage; etc.).

Option Assessment

Overview

3.3.23 For each option (or group of options affecting a particular European site, as appropriate), the assessment comprises:

- a 'screening' to identify those options that cannot have significant effects due to the fundamental nature of the option (note, the options associated with the NWT scheme would not typically fall into this category);
- a 'screening' of European sites within the study area to identify those sites and features where there will self-evidently be 'no effect', 'no likely significant effects', or positive effects due to the option[16], and those where significant effects are likely or uncertain; and
- an 'appropriate assessment' of any European sites where significant effects cannot be excluded (this may include 'down-the-line' deferral of some options in accordance with established HRA practice, where appropriate).

3.3.24 The conservation objectives are taken into account at the screening and appropriate assessment stages as necessary.

General Assumptions

3.3.25 Most environmental changes associated with construction and operation will have an inherent range over which they naturally attenuate[17], and many interest features will have little or no sensitivity to the likely magnitude of the environmental changes. Broad or

[16] Note, for options with 'no effects' or positive effects there is no possibility of 'in combination' effects.

[17] For example, construction noise will almost invariably be indistinguishable from background levels over 600m from the source due to natural attenuation alone; several studies have demonstrated that visual disturbance of wading birds by construction plant or personnel is inconsequential over ~500m.

universal assumptions that can be robustly applied to the assessments of the individual options or interest features are set out in **Appendix B**.

3.3.26 In addition:

- It is assumed that all normal licensing, consenting and management procedures will be employed at option delivery and throughout operation. The HRA will not therefore assess speculative or hypothetical effects based on assumptions of non-compliance (e.g. accidental spillages of treatment chemicals from a new WTW).
- Guidance from the EA suggests that significant direct effects on groundwater dependent terrestrial ecosystems (GWDTEs) from drawdown associated with abstraction are unlikely for European sites over 5 km from the abstraction (*National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff*).

Screening

3.3.27 The screening identifies possible effects on European sites based on:

- the anticipated operation of each option and predicted hydrological zone of influence;
- the anticipated scope of any construction or enabling works required for each option;
- the European site interest features and their sensitivities; and
- the exposure of the site or features to the likely effects of the option (i.e. presence of reasonable impact pathways, taking into account species mobility and the likelihood of functional habitats being affected).

3.3.28 The screening therefore identifies:

- those European sites where significant effects are considered likely as the result of an option;
- those European sites where significant effects are considered uncertain as the result of an option;
- those European sites where significant effects were considered unlikely (alone) as the result of an option (but where in combination effects might still be possible); and
- those options that will have no effects on any European sites due to their nature or location (and hence no possibility of 'in combination' effects).

3.3.29 The 'low-bar' principle is used for the screening of the SRO component options[19]; in general, unless the possibility of significant effects can be simply and self-evidently excluded then an 'appropriate assessment' is completed (rather than a more detailed 'secondary screening' or similar). This applies to the options alone and in combination (i.e. unless it is evident that there will be 'no effects' from any options the possibility of 'in combination' effects is not excluded and these are taken forward to 'appropriate

[19] The low-bar nature of the screening test is characterised in case-law (*C-258/11 - Sweetman and Others*) as '*should we bother to check?*' – i.e. is a closer examination of possible effects required (i.e. appropriate assessment) or can effects self-evidently be excluded as nil or entirely nugatory?

assessment'). This approach simplifies the overall assessment and ensures procedural clarity.

3.3.30 The 'low bar' approach is consistent with the 'People Over Wind'[20] (PoW) case law, which requires that mitigation not be considered at screening. Historically, 'high-level' HRAs of strategic planning documents (or similar) typically assumed that established best-practice avoidance and mitigation measures (see **Appendix C**) would be employed at the project level to safeguard environmental receptors, including European site interest features, and accounted for this at the screening stage. However, it is arguable that an assumption such as this, albeit in relation to a lower-tier project that would itself be subject to HRA, might constitute an 'avoidance measure' that the SRO is effectively relying on to ensure that significant effects do not occur.

3.3.31 In this instance, therefore, mitigation measures (including the established best-practice avoidance and mitigation measures noted in **Appendix C**) are not taken into account at screening, but are instead introduced at the 'appropriate assessment' stage (if required).

Appropriate Assessments

3.3.32 The 'appropriate assessments' are an extension of the assessment processes undertaken at the screening stage, with significant effects examined to determine whether there will be any adverse effects on the integrity of any European sites taking into account the conservation objectives.

3.3.33 The presentation of the assessments depends on the nature of the options and European sites that might be exposed to effects; in this case the assessments are 'European site led' (i.e. each assessment section relates to a specific European site; this tends to simplify the 'in combination' assessment and minimises repetition of information relating to the interest features / sensitivities (etc.) of the sites).

3.3.34 Shared evidence applicable to multiple sites or features (for example, in relation to birds and construction noise) are provided in appendices to reduce repetition.

3.3.35 The appropriate assessments are 'appropriate' to the Gate 2 submission and nature of the SRO, the option under consideration, and the scale and likelihood of any effects; for example, exhaustive examination of feature sensitivities and possible effect pathways is not undertaken for options that would have previously been 'screened out with mitigation' if there is a high degree of confidence in the mitigation measures. The assessments include inter-option 'in combination' assessments.

3.3.36 As noted, the terminology of the HRA tests does not allow for equivocal conclusions, and so **all the assessments (both 'screening' and 'appropriate assessment') are necessarily preliminary and any conclusions indicative only, to guide the gated decision-making process**: they are not intended to be definitive Regulations-compliant statements. NE has indicated that it considers that reaching any conclusions at this point is premature and so the report will often refer to the risk of an option having adverse effects, which would not be acceptable terminology in a formal HRA, but which aims to

[20] Case *C 323/17 Court of Justice of the European Union: People Over Wind*

preserve some of the value of the assessment to the gated decision-making process. All conclusions will be revisited and verified post-Gate 2.

3.4 Plan-Level In Combination Assessments

3.4.1 HRA requires that the effects of other projects, plans or programmes be considered for effects on European sites 'in combination' with the SRO. There is limited guidance on the precise scope of 'in combination' assessments for strategies, particularly with respect to the levels within the planning hierarchy at which 'in combination' effects should be considered, although guidance is provided by the ACWG.

3.4.2 Broadly, it is considered that the NWT SRO could have the following in combination effects:

- Within-plan effects, i.e. separate options within the NWT SRO affecting the same European site(s); these are addressed as part of the option assessment process outlined above.
- Between-plan abstraction effects, i.e. effects with other abstractions, in association with or driven by other plans (for example, other water company WRMPs);
- Other between-plan effects, i.e. 'in combination' with non-abstraction activities promoted by other plans – for example, with flood risk management plans.
- Between-project effects, i.e. effects of a specific option with other specific projects and developments.

3.4.3 In undertaking the 'in combination' assessment it is important to note the following:

- The WRMP development process (which as noted has some relevance to the development of the NWT SRO options) explicitly accounts for land-use plans, growth forecasts and population projections when determining future demand and hence treatment and water management requirements, and this influences the SRO selection also.
- The detailed examination of non-water company consents for 'in combination' effects can only be undertaken by the EA or NRW through their permitting procedures.
- The water resource demands of known major projects are also taken into account during the development of the WRMPs (hence the NWT SRO).

3.4.4 Therefore:

- It is considered that (for the HRA) potential 'in combination' effects in respect of water-resource demands associated with known plans or projects will not occur since these demands are explicitly considered when developing the WRMP and its associated and related plans (including the SROs). The main exception to this is other water company WRMPs, which are developed concurrently.
- With regard to other strategic plans, the list of plans included within the SEA of the emerging UU WRMP is used as the basis for a high-level 'in combination' assessment. The SEA is used to provide information on the themes, policies and objectives of the 'in combination' plans, with the plans themselves examined in more detail as

necessary. Plans are obtained from the SEA datasets or internet sources where possible.

- With regard to projects:
  - The WRMP development process (which overlaps with the NWT SRO option development) explicitly accounts for the water-resource demands of known major projects (e.g. power station decommissioning; large-scale housing development) during its development, and so these 'in combination' effects are not considered in detail.
  - Potential 'in combination' effects between individual options and Nationally Significant Infrastructure Projects (NSIPs) identified by The Planning Inspectorate, and other known major projects, are assessed.
  - It is not possible to produce a definitive list of minor existing or anticipated planning applications within the zone of influence of each proposed option to review possible local 'in combination' effects. The nature of the NWT SRO and the timescales over which it operates ensure that generating a list of local planning applications at this stage would be of very little value, and this aspect can only be meaningfully undertaken at the scheme-level.

4. Options Screening

4.1 NWT SRO options

4.1.1 The 'screening' adopts a low-bar approach; in general, unless the possibility of significant effects can be simply and self-evidently excluded then an 'appropriate assessment' is completed (rather than a more detailed 'secondary screening' or similar). This applies to the options alone and in combination.

4.1.2 The initial 'alone' screening assessments for each option are set out in **Tables 4.2 – 4.15** below, and summarised by option in **Table 4.16**. In summary, the assessment aims to identify those European site features that are potentially vulnerable to a particular option – i.e. which have features that are both exposed and sensitive to the likely outcomes (see **Table 4.1**), taking into account the baseline for the site including the conservation objectives. Features that are both exposed and sensitive to an environmental change are assumed to be subject to 'likely significant effects' unless there is a clear over-riding reason why significant effects cannot occur.

Table 4.1 Summary of screening criteria for sites

Vulnerable?	Notes
0	Sites or features that are not exposed to the effects of an option via any reasonable impact pathways and so there will be 'no effect' (hence no risk of 'in combination' effects)
No (N)	Sites or features that are potentially exposed and sensitive to the predicted environmental changes, but where effects are not considered significant (alone) due to their scale, nature etc. based on the information on the options and other contextual assessment information. In combination effects may still be possible.
Uncertain (U)	Sites or features where a potential effect is clear and identifiable, which cannot be self-evidently excluded and which require additional consideration through 'appropriate assessment' (including options relying on mitigation to ensure significant effects do not occur).
Yes (Y)	Sites or features where significant effects are very likely or certain due to the scale/nature of the option proposals, or the vulnerability and distribution of the interest features on the European site. Adverse effects may be more likely and there is more certainty that (at project delivery) the option would have to rely on specific mitigation or compensation rather than general / simple environmental avoidance measures.

Table 4.2 Option screening summary – WR015 River Irwell to Heaton Park WTW

WR015			
River Irwell to Heaton Park WTW			
Option Summary			
[✂]			
General Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Rochdale Canal SAC	6.4	0	[✂]
Manchester Mosses SAC	9.5	0	[✂]
South Pennine Moors SAC	15.9	0	[✂]
South Pennine Moors Phase 2 SPA	16	0	[✂]
Rixton Clay Pits SAC	16.3	0	[✂]
Peak District Moors (South Pennine Moors Phase 1) SPA	19.1	0	[✂]
Rostherne Mere Ramsar	19.4	0	[✂]
Mersey Estuary Ramsar	DS	N	[✂]
Mersey Estuary SPA	DS	N	[✂]

European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Liverpool Bay SPA	DS	N	[✂]

Table 4.3 Option screening summary – WR049d River Ribble

WR049d			
River Ribble			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Ribble and Alt Estuaries Ramsar	11.9/DS	U	[✂]
Ribble and Alt Estuaries SPA	11.9/DS	U	[✂]
Bowland Fells SPA	14	0	[✂]
Manchester Mosses SAC	15.4	0	[✂]
Martin Mere Ramsar	18.1	0	[✂]
Martin Mere SPA	18.3	0	[✂]

European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Liverpool Bay SPA	DS	U	[✂]

*DS = Downstream

** Clewley *et al.* (2017). Assessing the habitat use of Lesser Black-backed Gulls (*Larus fuscus*) from the Bowland Fells SPA ANNEX 1 – 2017 update. *BTO Research Report No. 694A*. Report for Natural England, BTO, Thetford.

Table 4.4 Option screening summary – WR076 River Bollin

WR076			
River Bollin			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Rixton Clay Pits SAC	2	0	[✂]
Rostherne Mere Ramsar	2.7	0	[✂]
Manchester Mosses SAC	4.2	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	5.1	0	[✂]
Rochdale Canal SAC	19.2	0	[✂]
Mersey Estuary Ramsar	DS	U	[✂]
Mersey Estuary SPA	DS	U	[✂]
Liverpool Bay SPA	DS	N	[✂]

Table 4.5 Option screening summary – WR102b Widnes Boreholes

WR102b			
Widnes Boreholes			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Mersey Estuary SPA	3.0/DS	U	[✂]
Mersey Estuary Ramsar	3.5/DS	U	[✂]
Liverpool Bay / Bae Lerpwl SPA	6.9	0	[✂]
Mersey Narrows and North Wirral Foreshore Ramsar	9.7	N	[✂]
Mersey Narrows and North Wirral Foreshore SPA	9.7	N	[✂]
Dee Estuary/ Aber Dyfrdwy SAC	12.8	0	[✂]
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Ribble and Alt Estuaries Ramsar	14.6	0	[✂]
Sefton Coast SAC	14.6	0	[✂]
Ribble and Alt Estuaries SPA	14.7	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	16.6	0	[✂]
The Dee Estuary Ramsar	16.6	0	[✂]
The Dee Estuary SPA	16.6	0	[✂]
Midland Meres and Mosses Phase 2 Ramsar	17.9	0	[✂]

Manchester Mosses SAC	18.6	0	[✂]
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	19.5	0	[✂]
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.6 Option screening summary – WR105a Lymm Boreholes

WR105a			
Lymm Boreholes			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Rixton Clay Pits SAC	2.1	0	[✂]
Manchester Mosses SAC	3.9	N	[✂]
Rostherne Mere Ramsar	6.2	U	[✂]
Midland Meres and Mosses Phase 1 Ramsar	6.9	0	[✂]
Mersey Estuary Ramsar	17.6/DS	N	[✂]
Mersey Estuary SPA	17.8/DS	N	[✂]
Midland Meres and Mosses Phase 2 Ramsar	19.6	0	[✂]
West Midlands Mosses SAC	19.6	0	[✂]

European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.7 Option screening summary – WR106b Walton and Daresbury Boreholes

WR106b			
Walton and Daresbury Boreholes			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Mersey Estuary Ramsar	7.0/DS	N	[✂]
Mersey Estuary SPA	7.4/DS	N	[✂]
Manchester Mosses SAC	8.3	0	[✂]
Rixton Clay Pits SAC	8.8	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	9.8	0	[✂]
Midland Meres and Mosses Phase 2 Ramsar	11.5	0	[✂]
West Midlands Mosses SAC	12.5	0	[✂]
Rostherne Mere Ramsar	12.7	0	[✂]
Oak Mere SAC	13.5	0	[✂]

European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.8 Option screening summary – WR107a Aughton Park and Moss End Boreholes

WR107a			
Aughton Park and Moss End Boreholes			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Martin Mere Ramsar	7.7	0	[✂]
Martin Mere SPA	7.9	0	[✂]
Sefton Coast SAC	11.5/DS	N	[✂]
Mersey Narrows and North Wirral Foreshore Ramsar	12	N	[✂]
Ribble and Alt Estuaries Ramsar	12/DS	U	[✂]
Ribble and Alt Estuaries SPA	12.1/DS	U	[✂]
Mersey Narrows and North Wirral Foreshore SPA	12.3	N	[✂]
Liverpool Bay / Bae Lerpwl SPA	12.4/DS	N	[✂]
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Dee Estuary/ Aber Dyfrdwy SAC	14.2	0	[✂]
Mersey Estuary Ramsar	17.9	0	[✂]
Mersey Estuary SPA	17.9	0	[✂]

*DS = Downstream

Table 4.9 Option screening summary – WR107b Randles Bridge, Knowsley and Primrose Hill

WR107b			
Randles Bridge, Knowsley and Primrose Hill			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Martin Mere Ramsar	4.9	U	[✂]
Martin Mere SPA	4.9	U	[✂]
Sefton Coast SAC	7.2/DS	U	[✂]
Ribble and Alt Estuaries Ramsar	8.0/DS	U	[✂]
Liverpool Bay / Bae Lerpwl SPA	8.5/DS	N	[✂]

European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Mersey Narrows and North Wirral Foreshore Ramsar	9.1	N	[✂]
Mersey Narrows and North Wirral Foreshore SPA	9.3	N	[✂]
Ribble and Alt Estuaries SPA	9.4/DS	U	[✂]
Dee Estuary/ Aber Dyfrdwy SAC	10.1	0	[✂]
Mersey Estuary Ramsar	11.1	0	[✂]
Mersey Estuary SPA	11.1	0	[✂]

*DS = Downstream

Table 4.10 Option screening summary – WR111 Woodford Borehole

WR111			
Woodford Borehole			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
South Pennine Moors SAC	9.7	0	[✂]
Peak District Moors (South Pennine Moors Phase 1) SPA	10.2	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	12.8	0	[✂]
Rostherne Mere Ramsar	13.1	0	[✂]
Rochdale Canal SAC	15.7	0	[✂]
Peak District Dales SAC	18.5	0	[✂]
Mersey Estuary Ramsar	DS	N	[✂]
Mersey Estuary SPA	DS	N	[✂]
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.11 Option screening summary – WR113 Tytherington Borehole

WR113			
Tytherington Borehole			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Peak District Moors (South Pennine Moors Phase 1) SPA	5.3	0	[✂]
South Pennine Moors SAC	5.3	0	[✂]
Peak District Dales SAC	14.5	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	16.1	0	[✂]
Rostherne Mere Ramsar	18.1	0	[✂]
Mersey Estuary Ramsar	DS	N	[✂]
Mersey Estuary SPA	DS	0	[✂]
Liverpool Bay SPA	DS	0	[✂]

*DS = Downstream

Table 4.12 Option screening summary – WR144 Saddleworth

WR144
Saddleworth

Option Summary
[✂]

General Assessment Notes
[✂]

European sites in scope	Dist (km)*	LSE (alone?)	Notes
Peak District Moors (South Pennine Moors Phase 1) SPA	3	0	[✂]
South Pennine Moors SAC	3	0	[✂]
South Pennine Moors Phase 2 SPA	7.6	0	[✂]
Rochdale Canal SAC	7.7	0	[✂]
Mersey Estuary Ramsar	DS	N	[✂]
Mersey Estuary SPA	DS	N	[✂]

European sites in scope	Dist (km)*	LSE (alone?)	Notes
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.13 Option screening summary – WR149 Lightshaw

WR149			
Lightshaw			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Manchester Mosses SAC	3.3	U	[✂]
Rixton Clay Pits SAC	5.5	0	[✂]
Rostherne Mere Ramsar	13.6	0	[✂]
Midland Meres and Mosses Phase 1 Ramsar	15	0	[✂]
Mersey Estuary Ramsar	16.8/DS	N	[✂]
Mersey Estuary SPA	16.8/DS	N	[✂]
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.14 Option screening summary – STT041b Heaton Park (River Roch & River Irwell)

STT041b
Heaton Park (River Roch & River Irwell)
Option Summary
[✂]
General Assessment Notes

[✂]

European sites in scope	Dist (km)*	LSE (alone?)	Notes
Manchester Mosses SAC	9.5	0	[✂]
Rochdale Canal SAC	12	0	[✂]
South Pennine Moors SAC	15.1	0	[✂]
South Pennine Moors Phase 2 SPA	15.2	0	[✂]
Rixton Clay Pits SAC	16.3	0	[✂]
Peak District Moors (South Pennine Moors Phase 1) SPA	18.4	0	[✂]
Mersey Estuary Ramsar	DS	U	[✂]
Mersey Estuary SPA	DS	U	[✂]
Liverpool Bay SPA	DS	N	[✂]

*DS = Downstream

Table 4.15 Option screening summary – STTA4 NWT_Vyrnwy

STTA4			
NWT_Vyrnwy			
Option Summary			
[✂]			
General Assessment Notes			
[✂]			
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Midland Meres and Mosses Phase 1 Ramsar	0.1	U	[✂]

Midland Meres and Mosses Phase 2 Ramsar	0.7	U	[✂]
Oak Mere SAC	0.7	U	[✂]
West Midlands Mosses SAC	2.9	0	[✂]
Mersey Estuary Ramsar	5.0/DS	U	[✂]
European sites in scope	**Dist (km)***	**LSE (alone?)**	**Notes**
Mersey Estuary SPA	5.0/DS	U	[✂]
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	6.5/DS	U	[✂]
Fenn`s, Whixall, Bettisfield, Wem and Cadney Mosses SAC	9.3	0	[✂]
Brown Moss SAC	11.0	0	[✂]
Manchester Mosses SAC	14.8	0	[✂]
Rixton Clay Pits SAC	15.6	0	[✂]
Rostherne Mere Ramsar	18.6	0	[✂]
Dee Estuary/ Aber Dyfrdwy SAC	DS	0	[✂]
The Dee Estuary Ramsar	DS	0	[✂]
The Dee Estuary SPA	DS	0	[✂]

*DS = Downstream

Table 4.16 Screening summary by option (alone)

Option	European sites in scope	Summary
[✂]	Manchester Mosses SAC	No effects
	Mersey Estuary SPA	No LSE
	Mersey Estuary Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Peak District Moors (South Pennine Moors Phase 1) SPA	No effects
	Rixton Clay Pits SAC	No effects
	Rochdale Canal SAC	No effects
	Rostherne Mere Ramsar	No effects
	South Pennine Moors Phase 2 SPA	No effects
	South Pennine Moors SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Bowland Fells SPA	No effects
	Martin Mere Ramsar	No effects
	Martin Mere SPA	No effects
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Ribble and Alt Estuaries Ramsar	Uncertain
	Ribble and Alt Estuaries SPA	Uncertain
	Liverpool Bay SPA	No LSE
[✂]	Manchester Mosses SAC	No effects
	Mersey Estuary SPA	Uncertain
	Mersey Estuary Ramsar	Uncertain
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Rixton Clay Pits SAC	No effects
	Rochdale Canal SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Dee Estuary/ Aber Dyfrdwy SAC	No effects
	Liverpool Bay / Bae Lerpwl SPA	No effects
	Manchester Mosses SAC	No effects
	Mersey Estuary SPA	Uncertain
	Mersey Estuary Ramsar	Uncertain
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Midland Meres and Mosses Phase 2 Ramsar	No effects
	Ribble and Alt Estuaries Ramsar	No effects
	Ribble and Alt Estuaries SPA	No effects
	River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	No effects
	Sefton Coast SAC	No effects
	The Dee Estuary Ramsar	No effects
	The Dee Estuary SPA	No effects
	Liverpool Bay SPA	No LSE

Option	European sites in scope	Summary
[✂]	Manchester Mosses SAC	No effects
	Mersey Estuary SPA	No effects
	Mersey Estuary Ramsar	No effects
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Midland Meres and Mosses Phase 2 Ramsar	No effects
	Rixton Clay Pits SAC	No effects
	West Midlands Mosses SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Manchester Mosses SAC	No effects
	Mersey Estuary SPA	No LSE
	Mersey Estuary Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Midland Meres and Mosses Phase 2 Ramsar	No effects
	Oak Mere SAC	No effects
	Rixton Clay Pits SAC	No effect
	West Midlands Mosses SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Liverpool Bay / Bae Lerpwl SPA	No effects
	Martin Mere Ramsar	No LSE
	Martin Mere SPA	No LSE
	Mersey Estuary SPA	No effects
	Mersey Estuary Ramsar	No effects
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Ribble and Alt Estuaries Ramsar	Uncertain
	Ribble and Alt Estuaries SPA	Uncertain
	Sefton Coast SAC	No LSE
	Dee Estuary/ Aber Dyfrdwy SAC	No effects
	Liverpool Bay SPA	Uncertain
[✂]	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Dee Estuary/ Aber Dyfrdwy SAC	No effects
	Liverpool Bay / Bae Lerpwl SPA	No effects
	Martin Mere Ramsar	Uncertain
	Martin Mere SPA	Uncertain
	Mersey Estuary SPA	No effects
	Mersey Estuary Ramsar	No effects
	Ribble and Alt Estuaries Ramsar	Uncertain
	Ribble and Alt Estuaries SPA	Uncertain
	Sefton Coast SAC	Uncertain
	Liverpool Bay SPA	Uncertain

Option	European sites in scope	Summary
[✂]	Mersey Estuary SPA	No LSE
	Mersey Estuary Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Peak District Dales SAC	No effects
	Peak District Moors (South Pennine Moors Phase 1) SPA	No effects
	Rochdale Canal SAC	No effects
	South Pennine Moors SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Mersey Estuary SPA	No effects
	Mersey Estuary Ramsar	No effects
	Mersey Narrows and North Wirral Foreshore Ramsar	No effects
	Mersey Narrows and North Wirral Foreshore SPA	No effects
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Peak District Dales SAC	No effects
	Peak District Moors (South Pennine Moors Phase 1) SPA	No effects
	South Pennine Moors SAC	No effects
	Liverpool Bay SPA	No effects
[✂]	Mersey Estuary SPA	No LSE
	Mersey Estuary Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Peak District Moors (South Pennine Moors Phase 1) SPA	No effects
	Rochdale Canal SAC	No effect
	South Pennine Moors Phase 2 SPA	No effects
	South Pennine Moors SAC	No effects
	Liverpool Bay SPA	No LSE
[✂]	Manchester Mosses SAC	Uncertain
	Mersey Estuary SPA	No LSE
	Mersey Estuary Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Midland Meres and Mosses Phase 1 Ramsar	No effects
	Rixton Clay Pits SAC	No effect
	Liverpool Bay SPA	No LSE
[✂]	Manchester Mosses SAC	No effect
	Mersey Estuary SPA	Uncertain
	Mersey Estuary Ramsar	Uncertain
	Mersey Narrows and North Wirral Foreshore Ramsar	No LSE
	Mersey Narrows and North Wirral Foreshore SPA	No LSE
	Peak District Moors (South Pennine Moors Phase 1) SPA	No effects
	Rixton Clay Pits SAC	No effect
	Rochdale Canal SAC	No effect
	South Pennine Moors Phase 2 SPA	No effects
	South Pennine Moors SAC	No effects
	Liverpool Bay SPA	No LSE

Option	European sites in scope	Summary
[✂]	Midland Meres and Mosses Phase 1 Ramsar	Uncertain
	Midland Meres and Mosses Phase 2 Ramsar	Uncertain
	Oak Mere SAC	Uncertain
	West Midlands Mosses SAC	No effects
	Mersey Estuary Ramsar	Uncertain
	Mersey Estuary SPA	Uncertain
	River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	Uncertain
	Fenn`s, Whixall, Bettisfield, Wem and Cadney Mosses SAC	No effects
	Brown Moss SAC	No effects
	Manchester Mosses SAC	No effects
	Rixton Clay Pits SAC	No effects
	Rostherne Mere Ramsar	No effects
	Dee Estuary/ Aber Dyfrdwy SAC	No effects
	The Dee Estuary Ramsar	No effects
	The Dee Estuary SPA	No effects

4.2 Inter-option 'in combination' screening assessment

4.2.1 The inter-option in combination screening assessment is summarised in **Table 4.17**. This identifies all those European sites that could potentially be affected by two or more NWT SRO options, and then determines whether 'in combination' likely significant effects can be excluded.

Table 4.17 Summary of screening stage inter-option 'in combination' assessment

European site	Options affecting site	'Alone' screening summary?	In combination summary
Berwyn SPA	STTA4: NWT_Vyrnwy	No effect	[✂]
Bowland Fells SPA	WR049d: River Ribble	No effect	[✂]
Brown Moss SAC	STTA4: NWT_Vyrnwy	No effect	[✂]
Dee Estuary/ Aber Dyfrdwy SAC	WR102b: Widnes Boreholes WR107a: Aughton Pk. & Moss End b/h WR107b: Randles Br, Knowsley, Primrose H. STTA4: NWT_Vyrnwy	No effect No effect No effect No effect	[✂]
Fenn`s, Whixall, Bettisfield, Wem and Cadney Mosses SAC	STTA4: NWT_Vyrnwy	No effect	[✂]
Liverpool Bay / Bae Lerpwl SPA	WR015: River Irwell to new WTW WR049d: River Ribble WR076: River Bollin WR102b: Widnes Boreholes WR105a: Lymm Boreholes WR106b: Walton and Daresbury b/h WR107a: Aughton Park & Moss End b/h WR107b: Randles Br, Knowsley, Primrose H. WR111: Woodford Boreholes WR113: Tytherington Boreholes WR144: Saddleworth WR149: Lightshaw STT041b: Heaton Pk (R Roch & R Irwell)	No LSE Uncertain No LSE No LSE No LSE No LSE Uncertain Uncertain No LSE No effects No LSE No LSE No LSE	[✂]

European site	Options affecting site	'Alone' screening summary?	In combination summary
Manchester Mosses SAC	[✂]	No effect No effect No effect No effect No effect No effect Uncertain	[✂]
Martin Mere Ramsar	[✂]	No effect No LSE Uncertain	[✂]
Martin Mere SPA	[✂]	No effect No LSE Uncertain	[✂]
Mersey Estuary SPA	[✂]	No LSE Uncertain No LSE Uncertain Uncertain No effects No LSE No effects No effects No LSE No effects No LSE No LSE	[✂]

European site	Options affecting site	'Alone' screening summary?	In combination summary
Mersey Estuary Ramsar	[✂]	No LSE Uncertain No LSE Uncertain Uncertain No LSE No LSE No effects No effects No LSE No effects No LSE No LSE	[✂]
Mersey Narrows and North Wirral Foreshore Ramsar	[✂]	No LSE No LSE No LSE No LSE	[✂]
Mersey Narrows and North Wirral Foreshore SPA	[✂]	No LSE No LSE No LSE No LSE	[✂]
Midland Meres and Mosses Phase 1 Ramsar	[✂]	Uncertain No effects No effects Uncertain No effects No effects No effects No effects	[✂]

European site	Options affecting site	'Alone' screening summary?	In combination summary
Midland Meres and Mosses Phase 2 Ramsar	[✂]	Uncertain No effects No effects No effects	[✂]
Oak Mere SAC	[✂]	Uncertain No effects	[✂]
Peak District Dales SAC	[✂]	No effects No effects	[✂]
Peak District Moors (South Pennine Moors Phase 1) SPA	[✂]	No effects No effects No effects No effects No effects	[✂]
Ribble and Alt Estuaries Ramsar	[✂]	Uncertain No effects Uncertain Uncertain	[✂]
Ribble and Alt Estuaries SPA	[✂]	Uncertain No effects Uncertain Uncertain	[✂]
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	[✂]	Uncertain No effect	[✂]

European site	Options affecting site	'Alone' screening summary?	In combination summary
Rixton Clay Pits SAC	[✂]	No effect No effect No effect No effect No effect No effect	[✂]
Rochdale Canal SAC	[✂]	No effect No effect No effect No effect No effect	[✂]
Rostherne Mere Ramsar	[✂]	No effect No effect Uncertain No effect No effect No effect No effect	[✂]
Sefton Coast SAC	[✂]	No effect No LSE Uncertain	[✂]
South Pennine Moors Phase 2 SPA	[✂]	No effects No effects No effects	[✂]

European site	Options affecting site	'Alone' screening summary?	In combination summary
South Pennine Moors SAC	[✂]	No effects No effects No effects No effects No effects	[✂]
The Dee Estuary Ramsar	[✂]	No effects No effects	[✂]
The Dee Estuary SPA	[✂]	No effects No effects	[✂]
West Midlands Mosses SAC	[✂]	No effects No effects	[✂]

4.3 Screening Conclusions

4.3.1 The screening has concluded that significant effects are either likely or uncertain for the following sites and options (note, this includes options that may rely on mitigation measures to prevent significant effects occurring); these are therefore taken forward to an indicative appropriate assessment stage.

4.3.2 Note, the screening conclusions are based on the currently available data and accepted principles for determining the effects of PWS abstractions on water-resource sensitive sites and features (e.g. EA guidance); however, these conclusions will need to be revisited following Gate 2 to ensure that they remain robust as additional data is obtained from the groundwater model, consultation responses and other sources.

Table 4.18 Summary of options and sites requiring 'appropriate assessment'

European site	Options	Alone or IC*?
Liverpool Bay SPA	[✂]	IC IC IC IC IC IC IC IC IC IC IC IC
Manchester Mosses SAC	[✂]	Alone
Martin Mere Ramsar	[✂]	Alone / IC
Martin Mere SPA	[✂]	Alone / IC
Mersey Estuary Ramsar	[✂]	Alone / IC Alone / IC IC Alone / IC Alone / IC IC IC IC IC IC
Mersey Estuary SPA	[✂]	Alone / IC Alone / IC IC Alone / IC Alone / IC IC

European site	Options	Alone or IC*?
		IC IC IC IC
Mersey Narrows and North Wirral Foreshore Ramsar	[✂]	IC
Mersey Narrows and North Wirral Foreshore SPA	[✂]	IC
Midland Meres and Mosses Phase 1 Ramsar	[✂]	Alone Alone
Midland Meres and Mosses Phase 2 Ramsar	[✂]	Alone
Oak Mere SAC	[✂]	Alone
Ribble and Alt Estuaries Ramsar	[✂]	Alone / IC
Ribble and Alt Estuaries SPA	[✂]	Alone / IC
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	[✂]	Alone
Rostherne Mere Ramsar	[✂]	Alone
Sefton Coast SAC	[✂]	Alone / IC

*IC – 'In combination' with other WRMP options

4.3.3 Note that the following 'appropriate assessment' sections do not currently include detailed assessments of potential effects on Liverpool Bay SPA (principally risks associated with possible effects on the Alt (hence foraging areas for common terns offshore from the estuary) and to a lesser extent the Ribble (used by red-throated divers); or the associated effects on the tern interest features of the Mersey Narrows and North Wirral Foreshore SPA. These sites and pathways will be addressed in future workstreams, however the risks of adverse effects are considered low based on the assessments for the associated sites that are likely to have a greater exposure to the option effects (i.e. Mersey Estuary SPA/Ramsar; Ribble and Alt Estuary SPA/Ramsar).

5. Appropriate Assessment – Manchester Mosses SAC

5.1 Screening Summary

5.1.1 **Manchester Mosses SAC** comprises three areas of degraded raised bog in the Mersey floodplain that are remnants of a historically larger complex of lowland raised bogs lost to agriculture or development.

5.1.2 Seven options are located within 20km of the Manchester Mosses SAC, although all except WR149 (Lightshaw) and the 'reserve option' WR105a (Lymm boreholes) are located over 5km from the site and within separate surface water catchments; these options (i.e. all other than WR149 and, potentially, WR105a) will have 'no effect' on this SAC, and hence no 'in combination' effects.

5.1.3 [✂]

5.1.4 Raised bogs are predominantly ombrotrophic (fed by rainfall rather than surface or groundwater inputs) although areas adjacent to some of the SAC units support wetland habitats that (a) help maintain the SAC features and (b) may have linkages with surface- and/or groundwater. The proximity of the boreholes at Croft (3.0 – 5.5km from the SAC units) and Lymm (~4km) therefore ensures that a pathway for effects on this SAC from these options is identifiable.

5.1.5 Construction effects from the WR149 pipeline are not considered a likely outcome (irrespective of mitigation) due to distance and because none of the SAC units are hydrologically downstream from the likely construction areas.

5.2 European site summaries

Site overview

5.2.1 The three areas of degraded raised bog that make up the **Manchester Mosses SAC** are underpinned by parts of Astley and Bedford Mosses SSSI, Holcroft Moss SSSI, and Risley Moss SSSI.

5.2.2 All of the site units have been affected by peat cutting, and hence associated drainage and hydrological impacts, but they remain elevated above the surrounding areas with peat depth averaging 2.5m and so the core habitats of the site remain predominantly ombrotrophic. However, the margins of the site comprise shallower peats with wet woodland and fen, which are important to the integrity of the bog and which may be dependent on inputs from the local catchment or, possibly, groundwater from the sandstone aquifer if this is not confined by the till and sands and gravels underlying the site units.

Interest Features and Conservation Objectives

5.2.3 The SAC has the following **qualifying features**:

- Annex I habitats:
  - Degraded raised bogs still capable of natural regeneration (hereafter 'Degraded raised bogs').

5.2.4 The **Degraded raised bogs** feature is the primary reason for the selection of the site.

5.2.5 The 'supplementary advice' also provides guidance on the '**typical species**' considered to be associated with the site; these include the key species associated with raised bogs, referable to the relevant NVC types (M2 *Sphagnum cuspidatum/fallax* bog pool community; M3 *Eriophorum angustifolium* bog pool community; M20 *Eriophorum vaginatum* raised and blanket mire; M25 *Molinia caerulea – Potentilla erecta* mire; M18 *Erica tetralix – Sphagnum papillosum* raised and blanket mire).

5.2.6 With regard to '**functional land**', the supplementary advice notes that "*the structure and function of the qualifying habitat, including its typical species, may rely upon the continued presence of areas which surround and are outside of the designated site boundary*" and which are known to support areas of the **Degraded raised bogs** feature and the Annex I feature 'Active raised bogs', in addition to areas of fen. The supplementary advice notes that land adjacent to Bedford Moss and Astley Moss has been re-wetted, and restoration works at Cadishead and Little Woolden Moss LNR are considered critical to reducing the fragmentation of the SAC.

5.2.7 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3. Specific attributes and targets associated with the conservation objectives are provided in the 'Supplementary advice on conservation objectives'; these are not explicitly listed here but are available online[21] and are referred to as appropriate in the assessment sections below.

Condition, Pressures and Threats

5.2.8 The SSSIs underpinning the SAC that could potentially be sensitive to effects associated with options are all in 'favourable' or 'unfavourable recovering' condition due to the ongoing restoration of the bog habitats.

5.2.9 The SIP identifies 'hydrological changes' and 'air pollution: impact of atmospheric nitrogen deposition' as pressures affecting site integrity, although the hydrological pressures noted relate to local water-level management and the creation of wetland buffers rather than PWS abstraction.

[21] Available at: http://publications.naturalengland.org.uk/file/5279013610455040

5.3 Assessment of Effects

Option summary and effect pathways

5.3.1 **WR149** involves:

- [✂]
- [✂]
- [✂]
- [✂]

5.3.2 The option has a maximum capacity of 13.0Ml/d, however the anticipated utilisation of option WR149 would see the average year rate of abstraction peak in summer at 10.8Ml/d, with a minimum of approximately 1.6Ml/d in winter. For the '1 in 500 year drought' scenario, the option may be utilised at its maximum capacity for a number of months through the spring, summer and early autumn.

5.3.3 **WR105a** [✂].

5.3.4 The screening has determined that no sites (including Manchester Mosses SAC) will be exposed to likely significant effects as a result of **construction** due to the absence of pathways (sites in separate catchments) and/or distance, irrespective of mitigation (although standard project-level measures can be relied on to ensure that construction-related effects cannot occur).

5.3.5 With regard to **operation**, guidance from the EA (*National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff*) suggests that significant direct effects on groundwater dependent terrestrial ecosystems (GWDTEs) from drawdown associated with abstraction are unlikely for European sites over 5 km from the abstraction. [✂]

5.3.6 All the boreholes are in the Warrington and West Glaze GWMU. Regional sandstone groundwater levels suggest that Risley Moss SSSI, Holcroft Moss SSSI, and Astley and Bedford Mosses SSSIs could be supported to some extent by seepage from sandstone along with lateral interflow and runoff from the superficial cover; the extent of any hydraulic connection will depend on the local nature and thickness of superficial deposits and site groundwater levels however.

5.3.7 No other potential effect pathways (e.g. through changes in water quality or increases in air pollution) will be realised as a result of these options.

Option uncertainties

5.3.8 There are no key uncertainties over the intended operation of the options; however groundwater models for the aquifer are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects. In addition, none of the sites have been subject to field survey to determine the precise relationship / connectivity of the SAC and associated functional habitats with the sandstone aquifer body, although data from HS2 (HS2 2022a) investigations indicates that Holcroft Moss at least may have limited direct hydraulic connectivity with the aquifer due to confining sand/gravel and till

deposits (although there may be local patches of hydraulic continuity between the sands/gravels and the aquifer).

Assessment of effects

Interest feature exposure

5.3.9 The qualifying feature is found in all of the SAC units and so cannot be excluded based on location, although the exposure of the qualifying features and functional habitat associated with Astley and Bedford Mosses SSSI is likely to be low due to the distance of this SAC unit from the Croft borehole (5km), and probably nil in relation to Lymm.

Hydrological effects

5.3.10 The options are very unlikely to directly affect water levels within the **Degraded raised bogs** feature (irrespective of increased aquifer groundwater drawdown associated with the option). Raised bogs are predominantly ombrotrophic (fed by rainfall rather than surface or groundwater inputs) and the SACO suggests that this is the case for all of the SAC units; and borehole logs held by BGS typically show that the SSSI units are underlain by clays or glacial drift deposits. The elevation of the peat deposits above the surrounding areas also supports this, as does modelling data from HS2 (2022a). However, groundwater from the sandstone aquifer may play a role in preventing infiltration of water within the peat body into the underlying strata.

5.3.11 With regard to non-qualifying habitats of the SAC margins (e.g. wet woodland) and supporting areas of non-designated functional land outside the SAC boundary, there is a residual uncertainty over the extent to which groundwater from the sandstone aquifer contributes to the water supply to these (either directly due to localised continuity with the sands/gravels, or from seepages that contribute to surface water locally). Without development of the Lower Mersey Basin groundwater model it is not possible to estimate the likely contribution of groundwater to local surface waterbodies; however there is evidence from boreholes of clay layers and other superficial deposits that may partially confine the aquifer here.

5.3.12 It is nevertheless evident that the improving condition of these habitats, and hence the long-term maintenance of the SAC, is fundamentally linked to drainage management interventions within the local surface water catchments designed to increase the retention of water (from rainfall) in the bog areas, as various restoration and re-wetting schemes have demonstrated.

5.3.13 With regard to WR149, based on the WFD reporting and conceptual / water balance models undertaken in connection with HS2 (HS2, 2022), it is likely that the effects on groundwater levels of increasing abstraction above recent actuals (but within licence) will be small or negligible, and potentially of secondary importance in relation to water supply to the functional habitat areas from the local catchment and the effects of ongoing drainage management / water retention measures; similarly, reserve option WR105a is expected to have a little or no effect on the closest units (Risley Moss SSSI) and for this option the it is likely that the Ship Canal will moderate the effects (if employed) on aquifer

groundwater levels below the SAC due to the strong influence this has on local groundwater heads (ESI, 2009).

5.3.14 Adverse effects on integrity would not therefore be expected although this will require further evaluation beyond Gate 2 as part of the planned updates to the Lower Mersey Basin groundwater model.

Other projects 'in combination'

Options in other UU plans

5.3.15 With regard to other UU plans:

- The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; there cannot therefore be 'in combination' effects with this plan.
- The drought options identified in UU's revised draft Drought Plan 2021[22] do not affect this European site.
- The interaction of the NWT SRO options with specific schemes derived from the emerging Drainage and Wastewater Management Plan (DWMP) can only be assessed at the project level due to the generic nature of the DWMP options.

Minor projects

5.3.16 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence, and generating a list at this stage would be of little value. It is possible that there will be 'in combination' project-specific construction effects associated with future planning applications, although this can only be assessed at the time of any application. This is consistent with the ACWG guidance on cumulative/in combination assessments.

Major Projects

5.3.17 Reference has been made to the Planning Inspectorate's National Infrastructure Projects database[23] which includes major projects; no major projects are identified on this database that are likely to affect this site.

5.3.18 High-speed Rail 2 (HS2) involves construction close to the western boundary of Holcroft Moss SSSI and has been subject to an appropriate assessment, which concluded that construction and operation of the railway would not adversely affect this SSSI, hence the SAC (with the addition of mitigation measures to safeguard water levels in the superficial underlying strata); the scheme would not affect levels in the sandstone aquifer. In combination effects are therefore unlikely (particularly as Holcroft Moss SSSI is ~4km and

[22] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

[23] https://infrastructure.planninginspectorate.gov.uk/projects/

~6km from the Croft and Lymm boreholes respectively), although this would be addressed with data from the regional model.

Uncertainties and preliminary conclusion

5.3.19 The groundwater models for the aquifer are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects. In addition, none of the sites have been subject to field survey to determine the precise relationship / connectivity of the SAC and associated functional habitats with the sandstone aquifer at specific locations, which may be appropriate depending on the outputs of the model (i.e. the extent to which infiltration from the peat is prevented by high groundwater levels in the sandstone aquifer versus low-permeability strata, although the available evidence from borehole logs and similar suggest that the latter may be more common).

5.3.20 However, based on groundwater abstractions elsewhere, and the information and conceptual models of the site outlined in the WFD reports and HS2 (2022a), drawdown in the aquifer at the SAC is expected to be relatively small, and the potential effects on the habitats of the SAC are likely to be buffered to some extent by the influence of the superficial deposits and the local water level management practices. The preliminary conclusion is therefore that the risk of adverse effects on integrity, alone or in combination, is low although additional modelling / project-level data collection is required to confirm this.

6. Appropriate Assessment – Rostherne Mere Ramsar / Midland Meres and Mosses Phase I Ramsar

6.1 Screening Summary

6.1.1 **Rostherne Mere Ramsar** and two units of the **Midlands Meres and Mosses Phase I Ramsar** (The Mere, Mere SSSI and Tatton Meres SSSI) are within 20km of seven options (WR015: River Irwell to new WTW; WR076: River Bollin; WR105a: Lymm Boreholes (reserve option); WR106b: Walton and Daresbury b/h (reserve option); WR111: Woodford Boreholes; WR113: Tytherington Boreholes; and WR149: Lightshaw). These European sites are considered together due to their proximity and the similarity of the potential effect pathways.

6.1.2 Of the options, only options **WR105a** and **STTA4** have an element of uncertainty associated with the screening assessment. The surface water options (**WR015**, **WR076**) will not affect these Ramsar sites as they are in separate catchments or hydrologically downstream of the sites; of the groundwater options, **WR106b**, **WR111, WR113** and **WR149** are at least 12km from the Ramsar sites and located in separate surface water catchments (with their impacts ascribed to local watercourses by the EA), and so these will have no effects on water supply to these sites due to either direct drawdown of groundwater at the sites, or indirectly via effects on surface water inputs).

6.1.3 Construction associated with the options will have no effect on these sites due to distance and the absence of impact pathways (i.e. direct surface water connectivity, or mobile species likely to make significant use of habitats close to the construction areas). Note **STTA4** is assessed in **Section 10**.

6.2 European site summaries

Site overviews

6.2.1 **Rostherne Mere Ramsar** is described in the citation as "*the deepest, one of the largest and the most northerly of the meres of the Cheshire Plain*... [lying] ... *in a hollow surrounded by thick deposits of glacial drift overlying Triassic marls and saltbed*". The site is thought to be predominantly fed by surface water flows, some of which are derived from shallow springs within the catchment that originate in the superficial sands / gravel and glacial till deposits that overlie the sandstone aquifer (HS2, 2022b).

6.2.2 **The Mere, Mere SSSI** comprises two discrete waterbodies, The Mere and Little Mere, separated by a narrow spillway; the SSSI feeds the Rostherne Brook that flows into Rostherne Mere approximately 1.5km downstream. **Tatton Meres SSSI** also comprises two waterbodies. Both SSSIs are designated for their aquatic flora with associated marginal habitats including fen and reedswamp.

6.2.3 All of the meres are thought to have similar underlying geology (i.e. formed in natural depressions in the glacial drift, and considered to be essentially disconnected from the sandstone aquifer, although recent investigations (HS2, 2022b) have suggested some complexity at Rostherne due to its depth).

Interest Features and Conservation Objectives

6.2.4 **Rostherne Mere Ramsar** meets Criterion 1 for designation (sites containing representative, rare or unique wetland types) due to the open water (considered likely to correspond to the Annex I feature 'Standing open water habitat: natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation' and fringing fen, marsh and swamp habitat (edge component of the above standing open water). It is underpinned by Rostherne Mere SSSI.

6.2.5 The **Midland Meres and Mosses Phase 1 Ramsar** meets Criteria 1 and 2 (supports vulnerable, endangered, or critically endangered species or threatened ecological communities); the relevant component SSSIs support the following features (based on the FCT data from NE) that contribute to the meeting these criteria:

- The Mere, Mere SSSI:
  - S4 *Phragmites australis* reedbed / S6 *Carex riparia* swamp water-fringe vegetation.
  - Standing water on sedimentary rock, eutrophic pH >7: A8 *Nuphar lutea* community.
- Tatton Meres SSSI:
  - Mesotrophic standing open water;
  - Rush pasture, reedbed and swamp;
  - Wet woodland.

6.2.6 'Supplementary advice' or conservation objectives are not published for Ramsar sites; the conservation objectives are therefore taken from the FCT information for the underlying SSSIs; these are not explicitly listed here but are available online[24] and are referred to as appropriate in the assessment sections below.

Condition, Pressures and Threats

6.2.7 The SSSI units underpinning **Rostherne Mere Ramsar** are in 'unfavourable recovering' condition (the fringing terrestrial areas) or 'unfavourable no change' condition (the open water, due to high phosphate loading and consequent extremely low aquatic macrophyte diversity). The aquatic units of **The Mere, Mere SSSI** and **Tatton Meres SSSI** are also in 'unfavourable no change' condition due to eutrophication.

[24] Rostherne Mere SSSI, available at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/FCT/fct_1003353_f.pdf; The Mere, Mere SSSI, available at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/FCT/fct_1001818_d.pdf; Tatton Meres SSSI, available at: https://designatedsites.naturalengland.org.uk/PDFsForWeb/FCT/fct_1003604_d.pdf.

6.3 Assessment of Effects

Option summary and effect pathways

6.3.1 **WR105a** [✂]

6.3.2 The screening has determined that these Ramsar sites will not be exposed likely significant effects as a result of **construction** due to the absence of pathways, irrespective of mitigation (although standard project-level measures can be relied on to ensure that construction-related effects cannot occur).

6.3.3 With regard to **operation**, guidance from the EA (*National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff*) suggests that significant direct effects on groundwater dependent terrestrial ecosystems (GWDTEs) from drawdown associated with abstraction are unlikely for European sites over 5 km from the abstraction. [✂]. The meres are thought to be predominantly supplied by surface water from their catchments, some of which originates as springflow from the superficial deposits; the extent of any hydraulic connection with the sandstone aquifer will depend on the local nature and thickness of superficial deposits and site groundwater levels however.

6.3.4 No other potential effect pathways (e.g. through changes in water quality or increases in air pollution) will be realised as a result of this option.

Option uncertainties

6.3.5 There are no key uncertainties over the intended operation of the options; however groundwater models for the aquifers are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects. In addition, detailed hydrological assessments of Rostherne Mere are understood to be available but have not been provided at the point of reporting.

Assessment of effects

Interest feature exposure

6.3.6 The qualifying features are present in all of the meres so these cannot be excluded based on location.

Hydrological effects

6.3.7 Available evidence (including from studies undertaken by HS2) suggests that water supply to the meres is predominantly via surface water inputs from the catchment, some of which are supported by springs originating in the shallow sands/gravels and glacial till deposits that underlie the meres. The meres are not thought to be supported by direct or indirect inputs from the sandstone aquifer, although NE has suggested some residual uncertainty in relation to Rostherne Mere.

6.3.8 With regard to the Lymm boreholes specifically, the sandstone aquifer is confined to the south and east by the Mercia Mudstone Group (Tarporley Siltstone Formation and Bollin Mudstone Member) and the regional groundwater level contours suggest that the sandstone outcrop and subcrop in this catchment discharges groundwater north/northwest to the Mersey Estuary (and potentially to the Manchester Ship Canal and Bridgewater Canal, depending on the nature and thickness of the superficial cover). The WFD assessment notes that Rostherne Mere Ramsar and The Mere, Mere SSSI are disconnected from the aquifer.

6.3.9 Given this, and the distance of the Ramsar sites from the borehole, it is highly unlikely that the option (if employed) would result in adverse effects on integrity (alone) although this will require confirmation beyond Gate 2 as part of the planned updates to the regional groundwater models.

Other projects 'in combination'

Options in other UU plans

6.3.10 With regard to other UU plans:

- The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; there cannot therefore be 'in combination' effects with this plan.
- The drought options identified in UU's revised draft Drought Plan 2021[25] do not affect this European site.
- The interaction of the NWT SRO options with specific schemes derived from the emerging Drainage and Wastewater Management Plan (DWMP) can only be assessed at the project level due to the generic nature of the DWMP options.

Minor projects

6.3.11 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence, and generating a list at this stage would be of little value. This is consistent with the ACWG guidance on cumulative/in combination assessments. However, due to the distance of the Lymm borehole (and associated construction) from the Ramsar sites in combination effects with minor schemes close to the Ramsar sites are highly unlikely, although this can only be assessed at the time of any application.

[25] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

Major Projects

6.3.12 Reference has been made to the Planning Inspectorate's National Infrastructure Projects database[26] which includes major projects; no major projects are identified on this database that are likely to affect this site.

6.3.13 HS2 involves construction close to Rostherne Mere and has been subject to an appropriate assessment, which concluded that construction and operation of the railway would have very minor effects on water supply to the mere (hence effects on water levels) due to interception of some surface flows, although the magnitude of change was considered too small to adversely affect the integrity of the Ramsar site. The scheme would not affect groundwater levels in the sandstone aquifer. In combination effects are therefore unlikely (particularly given the distance to the Lymm boreholes and the confining mudstones), although this would be addressed with data from the regional model.

Uncertainties and preliminary conclusion

6.3.14 The groundwater models for the aquifer are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects. In addition, NE has indicated that additional assessment data of the hydrological functioning of Rostherne Mere may be available, which would require review.

6.3.15 However, based on groundwater abstractions elsewhere, and the information and conceptualisation of the aquifer and overlying geology outlined in the WFD reports and HS2 (2022b), any drawdown in the aquifer associated with operating the Lymm boreholes within the licenced capacity is not expected to affect water supply or levels within **Rostherne Mere Ramsar** or The Mere, Mere SSSI / Tatton Meres SSSI components of the **Midland Meres and Mosses Ramsar**. The preliminary conclusion is therefore that the is a low risk of adverse effects on integrity, alone or in combination, although additional modelling / project-level data collection is required to confirm this.

[26] https://infrastructure.planninginspectorate.gov.uk/projects/

7. Appropriate Assessment – Martin Mere SPA / Ramsar

7.1 Screening Summary

7.1.1 Martin Mere was an extensive marsh and lake complex that formed at the end of the last glacial period. It was drained for agriculture after the 17th century. **Martin Mere SPA** and **Martin Mere Ramsar** (hereafter SPA / Ramsar) are coincident sites covering a small part of the former mere, which support open water and seasonally flooded marsh; these are predominantly supplied by surface water from the local catchment of the mere, and water levels within the site are closely managed. The sites are designated for their wintering wildfowl populations.

7.1.2 Three options are located within 20km of these sites:

- [✂]
- [✂]

7.1.3 Water levels in Martin Mere SPA / Ramsar are closely managed, although theoretical pathways for effects exist through:

- effects on surface water flows that supply the sites; and
- effects on habitats of the Ribble or Alt estuaries, which are periodically used by birds from Martin Mere (note, this is primarily addressed in **Section 7**).

7.1.4 Construction effects from the pipeline are not considered a likely outcome (irrespective of mitigation) due to distance and because the site is not hydrologically downstream from the likely construction areas.

7.1.5 Note, the SPA / Ramsar sites are addressed together in the following sections as the site boundaries and interest features are fundamentally the same.

7.2 European site summaries

Site overview

7.2.1 **Martin Mere SPA / Ramsar** is a low-lying wetland complex of open-water, marsh and grassland habitats overlying deep peat that is actively managed by the Wildfowl and Wetlands Trust (WWT). It occupies a small part (~119 ha.) of the formerly substantial (~1300 ha.) Martin Mere lake and marsh, which was formed in a large depression in the drift deposits at the end of the last glacial period, and which was drained for agriculture post-1700 (with most drainage taking place from the mid-19th century with the introduction of steam pumps).

7.2.2 The wetlands of the SPA / Ramsar were effectively re-created from grazed pasture when the site was acquired by WWT in 1974.

7.2.3 The drainage and cultivation of the original mere has resulted in significant lowering of the ground levels around the SPA/Ramsar due to shrinkage of the peat, and so water levels within the site rely on active management through pumping and maintenance of flood embankments.

Interest Features and Conservation Objectives

7.2.4 The **SPA** has the following **qualifying features**:

- Tundra swan *Cygnus columbianus bewickii*
- Eurasian wigeon *Anas penelope*
- Pink-footed goose *Anser brachyrhynchus*
- Northern pintail *Anas acuta*
- Whooper swan *Cygnus cygnus*
- Waterbird assemblage

7.2.5 The site meets the following **Ramsar** criteria:

- Criterion 5: The site supports a waterfowl assemblage of international importance.
- Criterion 6: The site supports the following qualifying species:
  - Pink-footed goose *Anser brachyrhynchus* (spring/autumn)
  - Tundra swan *Cygnus columbianus bewickii* (winter)
  - Whooper swan *Cygnus cygnus* (winter)
  - Eurasian wigeon *Anas penelope* (winter)
  - Northern pintail *Anas acuta* (winter)

7.2.6 With regard to the **supporting habitats** for the SPA qualifying features, these are identified in the 'supplementary advice' as those that support the key behaviours of the nonbreeding/wintering period (moulting, roosting, loafing and feeding), i.e.

- Open standing water and other adjacent waterbodies
- Lowland damp Neutral grassland
- Swamp and tall herb fen

7.2.7 With regard to '**functional habitat'**, the supplementary advice also identifies 'arable land outside of the SPA' as a supporting habitat due to the feeding opportunities this provides (a target in the supplementary advice is to "*Maintain the availability of cereal grains, rape, potatoes and sugar beet, where these sources are locally important to feeding flocks*"), although specific areas of arable land are not identified. Other sites locally are also periodically used by birds associated with Martin Mere SPA/Ramsar (including Mere Sands Wood SSSI (approximately 2km to the north-east) and the nearby estuary sites (including the Ribble and Alt SPA/Ramsar and Mersey Estuary SPA / Ramsar).

7.2.8 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3. Specific attributes and targets associated with the conservation objectives are provided in the 'Supplementary advice on conservation objectives'; these are not explicitly listed here but are available online[27] and are referred to as appropriate in the assessment sections below.

Condition, Pressures and Threats

7.2.9 The SSSI underpinning the SPA / Ramsar is in 'favourable' condition due to the ongoing management of the site.

7.2.10 The SIP identifies 'hydrological changes', 'invasive species' and 'water pollution' as threats to site integrity. With regard to hydrological changes, the threat principally relates to the retention of water within the site (as the site is higher than the surrounding land) and the consequent need to maintain embankments around the site; the SIP identifies a goal to re-wet areas outside the site boundary to assist with this in the long-term.

7.3 Assessment of Effects

Option summary and effect pathways

7.3.1 **Option WR107a** involves:

- [✂]
- [✂]
- [✂]
- [✂]

7.3.2 The option has a maximum capacity of 10.0Ml/d, however the anticipated utilisation of option WR149 would see the average year rate of abstraction peak in summer at 4.9Ml/d, with a minimum of approximately 0.1Ml/d in winter. For the '1 in 500 year drought' scenario, the option may be utilised at its maximum capacity for a number of months through the summer and early autumn.

7.3.3 **Option WR107b** is dependent on the WTW upgrades proposed under WR107a and involves:

- [✂]
- [✂]
- [✂]

7.3.4 The option has a maximum capacity of 12.0Ml/d, however the anticipated utilisation would see the average year rate of abstraction peak in summer at 9.7Ml/d, with a minimum of approximately 1.2Ml/d in winter. For the '1 in 500 year drought' scenario, the option may be utilised at its maximum capacity for a number of months through the summer and early autumn.

[27] Available at: http://publications.naturalengland.org.uk/file/6661715513311232

7.3.5 The screening has determined that Martin Mere SPA / Ramsar will not be exposed to likely significant effects as a result of construction due to the absence of pathways (borehole sites and pipelines are within separate surface water catchments) and/or distance, irrespective of mitigation (although standard project-level measures can be relied on to ensure that construction-related effects cannot occur).

7.3.6 With regard to operation, guidance from the EA (*National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff*) suggests that significant direct effects on groundwater dependent terrestrial ecosystems (GWDTEs) from drawdown associated with abstraction are unlikely for European sites over 5 km from the abstraction. [✂].

7.3.7 All the boreholes are in the Kirkby Ormskirk GWMU. The WFD assessment suggests that interaction between groundwater in the Permo-Triassic sandstone aquifer and groundwater in the superficial deposits is uncertain, and so abstraction from Primrose Hill or (potentially) Aughton Park / Moss End may influence water supply to the SPA/Ramsar.

7.3.8 No other potential effect pathways (e.g. through changes in water quality or increases in air pollution) will be realised as a result of these options.

Option uncertainties

7.3.9 There are no key uncertainties over the intended operation of the option; however groundwater models for the aquifer are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects.

Assessment of effects

Interest feature exposure

7.3.10 The qualifying features and supporting habitats are found in all of the SPA / Ramsar units (plus in areas outside the site boundary) and so cannot be excluded based on location.

Water levels and supply

7.3.11 The supplementary advice notes that "*…meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will* [usually]*…be sufficient to support the SPA Conservation Objectives but in some cases more stringent standards may be needed to support the SPA feature*".

7.3.12 Water levels within the SPA/Ramsar are maintained through active management, although there is some uncertainty in the conceptualisation of the sandstone aquifer, and hence effects on water supply to the SPA/Ramsar from utilising the groundwater above recent actual abstraction rates. However, it should be noted that whilst the GWMU is categorised as 'over-licensed' the required volumes (10Ml/d for WR107a and 12Ml/d for WR107b) are considered available within recent actual surplus[28].

[28] Based on the Environment Agency water availability summary, provided to UU in March 2022.

7.3.13 Furthermore, it is understood that water supply to Martin Mere is principally from the local surface water catchment, which feeds Langley's Brook and Boat House Sluice (from which water may be pumped, [✂]. A surface water management plan produced for Burscough (Jacobs 2020) indicates that two watercourses that flow from the Burscough area towards the SPA/Ramsar are fed principally from local run-off, and the watercourses within this area are all generally perched above the regional water table in the sandstone aquifer and therefore hydraulically disconnected (although will receive runoff and shallow lateral interflow from the superficial deposits). Borehole data from BGS suggests that the superficial deposits are generally quite thick locally, and it is known that the mere was formed in a depression in the glacial drift.

7.3.14 Without development of the Lower Mersey Basin groundwater model it is not possible to estimate the likely contribution of groundwater to local surface waterbodies near the site; however there little to suggest that groundwater is a significant component of the water supply to the SPA/Ramsar, and impacts on this from the operation of (particularly) Primrose Hill are likely to be inconsequential in relation to (a) water supply from the local surface catchment and (b) the active water management measures undertaken at the site.

7.3.15 Although this will require further evaluation beyond Gate 2 as part of the planned updates to the Lower Mersey Basin groundwater model the available data suggest that the risk to Martin Mere from groundwater abstraction is low, and that adverse effects on integrity will not occur due to operation of WR107a and WR107b, alone or in combination.

Functionally-associated habitats

7.3.16 With regard to the non-designated supporting habitats in the surrounding agricultural fields, the value of these to the qualifying features is a function of the forage they provide (e.g. "*cereal grains, rape, potatoes and sugar beet*") rather than water-level associated habitat characteristics, and this aspect will not be affected by the operation of the options.

7.3.17 A future goal for the long-term management of the SPA/Ramsar is the creation of 'buffer zones' around the site to reduce nutrient inputs from the surrounding land and (potentially) the embankment maintenance requirements for the site itself; the options will not conflict with these goals for the same reasons noted above.

7.3.18 The habitats of the Ribble and Alt Estuaries SPA / Ramsar are also used by wintering birds associated with Martin Mere SPA/Ramsar; although there are some residual uncertainties regarding the effects of the options on the Ribble and Alt Estuaries SPA / Ramsar (see **Section 8**) based on the available data it is unlikely that any options will affect the value of these sites to wintering birds, and so adverse effects on the integrity of the Martin Mere SPA/Ramsar would not be expected through this mechanism (although this would require confirmation through additional investigation in relation to the Ribble).

Other projects 'in combination'

Options in other UU plans

7.3.19 With regard to other UU plans:

- The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; there cannot therefore be 'in combination' effects with this plan.
- The drought options identified in UU's revised draft Drought Plan 2021[29] do not affect these European sites.
- The interaction of the NWT SRO options with specific schemes derived from the emerging Drainage and Wastewater Management Plan (DWMP) can only be assessed at the project level due to the generic nature of the DWMP options.

Minor projects

7.3.20 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence, and generating a list at this stage would be of little value. It is possible that there will be 'in combination' project-specific construction effects associated with future planning applications, although this can only be assessed at the time of any application. This is consistent with the ACWG guidance on cumulative/in combination assessments.

Major Projects

7.3.21 Reference has been made to the Planning Inspectorate's National Infrastructure Projects database[30] which includes major projects; no major projects are identified that are likely to affect this site.

Uncertainties and preliminary conclusion

7.3.22 Groundwater models for the aquifer are still in development, and so there is uncertainty over the precise extent and magnitude of any drawdown effects, and the extent to which surface watercourses supplying the SPA/Ramsar will be affected (although incidental data and information suggests many of these are likely to be perched, with a limited contribution from groundwater). Based on the currently available evidence and site data, the integrity of Martin Mere SPA and Martin Mere Ramsar will not be adversely affected by the NWT options, alone or in combination, although this will need to be re-tested post Gate 2 and relationships with the other estuaries in the region explored.

[29] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

[30] https://infrastructure.planninginspectorate.gov.uk/projects/

8. Appropriate Assessment – Ribble and Alt Estuaries SPA / Ramsar and Sefton Coast SAC

8.1 Screening Summary

8.1.1 The **Ribble and Alt Estuaries SPA** and **Ribble and Alt Ramsar** are largely coincident sites covering the coastal and estuarine habitats from Lytham St. Anne's at the mouth of the Ribble estuary, south to Crosby near the Mersey Narrows. The sites are designated for their wintering wildfowl populations and (for the Ramsar only) the population of natterjack toad *Epidalea calamita*. The **Sefton Coast SAC** covers the dune systems between Crosby and Southport, and largely overlaps with the SPA and Ramsar sites in this area. These sites are considered together due to their close functional relationships and shared exposure to the environmental changes associated with the options.

8.1.2 Three options are located within 20km of these sites:

- [✂]
- [✂]

8.1.3 Theoretical pathways for effects exist through:

- potential construction-related impacts on the River Ribble associated with **WR049d** (principally from in-channel works and site-derived pollutants) hence the SPA / Ramsar downstream;
- reduced freshwater input to the Ribble estuary affecting the supporting habitats for the SPA / Ramsar qualifying features (**WR049d** and potentially **WR107b**);
- reduced freshwater input to the Alt estuary affecting the supporting habitats for the SPA / Ramsar qualifying features (potentially **WR107a** and **WR107b**); and
- operation of the Primrose Hill borehole (**WR107b**) potentially reducing groundwater inputs to the nearest dune habitats in the SAC [✂]

8.2 European site summaries

Site overviews

8.2.1 **Ribble and Alt Estuaries SPA** comprises an extensive area of intertidal mud and sandflats along the Irish Sea coast between Blackpool and Crosby, areas of salt- and grazing-marsh in the Ribble estuary, and parts of some dune systems. The **Ribble and Alt Ramsar** site covers the same areas, plus dune systems on the Sefton coast north and south of Formby; **Sefton Coast SAC** covers the dune systems between Crosby and Southport, and largely overlaps with the SPA and Ramsar sites in this area. The sites are underpinned by the Ribble Estuary SSSI and the Sefton Coast SSSI.

8.2.2 The dominant estuarine feature is the Ribble estuary (the Ribble Estuary SSSI covers ~9200 ha.), which has extensive intertidal sand-silt flats and saltmarshes that provide feeding areas and high-tide roosts for wintering wildfowl. South of Southport the habitats mainly comprise intertidal sands and the sand dune systems of the Sefton Coast SSSI that include all successional stages from embryonic to fixed dunes. These dune systems support several protected species of herpetofauna, including natterjack toad, great crested newt and sand lizard. The sands are crossed by the River Alt at Formby Bank, although this is a substantially smaller feature than the Ribble.

Interest Features and Conservation Objectives

Ribble and Alt Estuaries SPA

8.2.3 The **SPA** has the following **qualifying features**:

- Non-breeding:
  - Great cormorant *Phalacrocorax carbo*
  - Tundra swan *Cygnus columbianus bewickii*
  - Whooper swan *Cygnus cygnus*
  - Pink-footed goose *Anser brachyrhynchus*
  - Common shelduck *Tadorna tadorna*
  - Eurasian wigeon *Anas penelope*
  - Eurasian teal *Anas crecca*
  - Northern pintail *Anas acuta*
  - Greater scaup *Aythya marila*
  - Black (common) *scoter Melanitta nigra*
  - Eurasian oystercatcher *Haematopus ostralegus*
  - Ringed plover *Charadrius hiaticula*
  - European golden plover *Pluvialis apricaria*
  - Grey plover *Pluvialis squatarola*
  - Northern lapwing *Vanellus vanellus*
  - Red knot *Calidris canutus*
  - Sanderling *Calidris alba*
  - Bar-tailed godwit *Limosa lapponica*
  - Whimbrel *Numenius phaeopus*
  - Eurasian curlew *Numenius arquata*

- Common redshank *Tringa totanus*
- Black-tailed godwit *Limosa limosa islandica*
- Dunlin *Calidris alpina alpina*
- Waterbird assemblage

- Breeding
  - Ruff *Philomachus pugnax*
  - Black-headed gull *Larus ridibundus*
  - Lesser black-backed gull *Larus fuscus*
  - Common tern *Sterna hirundo*
  - Seabird assemblage

8.2.4 With regard to the within-site **supporting habitats** for the SPA qualifying features, these are taken to be those that support the key behaviours of the nonbreeding/wintering period (moulting, roosting, loafing and feeding), i.e.

- intertidal mud- and sandflats; and
- salt- and grazing marshes.

8.2.5 With regard to non-designated '**functional habitat'**, reporting by BTO (NE 2015) identifies several high-tide roost sites outside the boundaries of the designated sites. Arable land near the sites is periodically used by some species (this is particularly important for feeding and roosting pink-footed geese), although specific areas of non-designated farmland are not identified. More broadly, wintering birds associated with the site will frequently move between the other SPA and Ramsar sites around the north-west coast, including the Mersey Estuary SPA / Ramsar, the Mersey Narrows and North Wirral Foreshore SPA / Ramsar, the Dee Estuary SPA / Ramsar, Martin Mere SPA / Ramsar, Morecambe Bay and Duddon Estuary SPA, and Morecambe Bay Ramsar.

8.2.6 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3; no 'supplementary advice' for the SPA is provided however.

Sefton Coast SAC

8.2.7 The **SAC** has the following **qualifying features**:

- Annex I habitats
  - Embryonic shifting dunes
  - Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")
  - Fixed coastal dunes with herbaceous vegetation ("grey dunes")
  - Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)
  - Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)

- Humid dune slacks

- Annex II species:
  - Great crested newt *Triturus cristatus*
  - Petalwort *Petalophyllum ralfsii*

8.2.8 All of these features are primary reasons for site selection.

8.2.9 The 'supplementary advice' also provides guidance on the '**typical species**' considered to be associated with the site; these include the key species associated with the dune communities, referable to the relevant NVC types, and other species including Northern dune tiger-beetle *Cicindela hybrida*, Sand lizard *Lacerta agilis*, natterjack toad and Dune fescue *Vulpia fasciculate*.

8.2.10 With regard to non-designated **functional habitats** for the qualifying features, the importance of functional connectivity with the wider coastal sedimentary system is noted, particularly in relation to the current dredging regime in the Mersey Estuary and the availability of sediment to feed the dunes. No other specific areas of functionally associated land are identified.

8.2.11 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3. Specific attributes and targets associated with the conservation objectives are provided in the 'Supplementary advice on conservation objectives'; these are not explicitly listed here but are available online[31] and are referred to as appropriate in the assessment sections below.

Ribble and Alt Ramsar

8.2.12 The site meets the following **Ramsar** criteria:

- Criterion 2: the site supports up to 40% of the Great Britain population of natterjack toads.
- Criterion 5: The site supports a waterfowl assemblage of international importance.
- Criterion 6: The site supports the following qualifying species:
  - Lesser black-backed gull *Larus fuscus (breeding and on passage)*
  - Ringed plover *Charadrius hiaticula* (on passage)
  - Grey plover *Pluvialis squatarola* (on passage)
  - Red knot *Calidris canutus* (on passage)
  - Sanderling *Calidris alba* (on passage)
  - Common redshank *Tringa totanus* (on passage)
  - Black-tailed godwit *Limosa limosa islandica* (on passage)

[31] Available at: http://publications.naturalengland.org.uk/file/6735322931265536

- Dunlin *Calidris alpina alpina* (on passage)
- Tundra swan *Cygnus columbianus bewickii* (over winter)
- Whooper swan *Cygnus cygnus* (over winter)
- Pink-footed goose *Anser brachyrhynchus* (over winter)
- Common shelduck *Tadorna tadorna* (over winter)
- Eurasian wigeon *Anas penelope* (over winter)
- Eurasian teal *Anas crecca* (over winter)
- Northern pintail *Anas acuta* (over winter)
- Eurasian oystercatcher *Haematopus ostralegus* (over winter)
- Bar-tailed godwit *Limosa lapponica* (over winter)

8.2.13 With regard to the **supporting habitats** and **functional habitats** for the Ramsar qualifying features are taken to be the habitats for the equivalent SPA and SAC features.

8.2.14 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3; no 'supplementary advice' for the SPA (hence the coincident qualifying features of the Ramsar) is provided however.

Condition, Pressures and Threats

8.2.15 All of the units of the Ribble Estuary SSSI are in 'favourable' condition with the exception of one grassland unit in the upper estuary that is in 'unfavourable no change' condition due to the ongoing agricultural practices and management of the unit. In contrast, although approximately 92% of Sefton Coast SSSI is in 'favourable' or 'unfavourable recovering' condition, six of the 31 units are in 'unfavourable no change' or 'unfavourable declining' condition, invariably due to inappropriate management of the dune systems, particularly scrub management.

8.2.16 Accordingly the Sefton Ribble SIP (which covers the SPA and SAC) identifies the following as a pressures or threats on site integrity:

- Coastal squeeze (particularly erosion around Formby Point);
- Air pollution (nitrogen deposition);
- Inappropriate scrub control (principally of the dune systems);
- Invasive species (non-native scrub encroachment in the dunes; non-native marine species in Liverpool Docks);
- Hydrological changes (water availability in the dune systems, linked to local effects on the water table from scrub encroachment, woodland and interception of surface flows by adjacent urban drainage systems);
- Public Access/Disturbance (through disturbance of bird populations by terrestrial and marine recreation);

- Inappropriate coastal management (parking on beaches / dunes);
- Fisheries (commercial marine and estuarine);
- Change to site conditions (erosion of dune systems exposing industrial waste);
- Shooting / scaring;
- Feature location/ extent/ Pressure condition unknown (data gaps relating to bird populations, although work by the BTO has partially resolved this).

8.2.17 The options will not affect any of these pressures or threats, with the possible exception of 'hydrological changes'.

8.3 Assessment of Effects

8.3.1 The SPA / Ramsar sites are addressed together in the following sections as the site boundaries and interest features are largely coincident in the areas of the sites that are likely to be exposed to the outcomes of the options[32].

8.3.2 In addition, the SPA / Ramsar partly overlap with the **Sefton Coast SAC** (designated for its dune systems and associated species) between Crosby and Southport, and some Ramsar features (natterjack toad) are specifically associated with the habitats of the SAC.

8.3.3 The assessment therefore considers the sites and features according to the functional relationships and exposure to option outcomes.

Option summaries and effect pathways

8.3.4 **Option WR107a** involves:

- [✂]
- [✂]
- [✂]
- [✂]

8.3.5 The option has a maximum capacity of 10.0Ml/d, however the anticipated utilisation of would see the average year rate of abstraction peak in summer at 4.9Ml/d, with a minimum of approximately 0.1Ml/d in winter. For the '1 in 500 year drought' scenario, the option may be utilised at its maximum capacity for a number of months through the summer and early autumn.

8.3.6 **Option WR107b** is dependent on the WTW upgrades proposed under WR107a and involves:

- [✂]
- [✂]
- [✂]

[32] The Ramsar site is larger than the SPA, including inland dune systems between Formby and Southport.

8.3.7 The option has a maximum capacity of 12.0Ml/d, however the anticipated utilisation would see the average year rate of abstraction peak in summer at 9.7Ml/d, with a minimum of approximately 1.2Ml/d in winter. For the '1 in 500 year drought' scenario, the option may be utilised at its maximum capacity for a number of months through the summer and early autumn.

8.3.8 **Option WR049d** involves:

- [✂]
- [✂]
- [✂]

8.3.9 The option has a maximum capacity of 40Ml/d, however under an average abstraction scenario the rate of abstraction would peak in summer at 26Ml/d, with a minimum of 3Ml/d in winter. For the '1 in 500 year drought' abstraction scenario, use of the option would be sustained at a higher rate through the summer and early autumn, reaching the maximum rate in August.

Effect pathways (including inter-option 'in combination' pathways)

8.3.10 Environment Agency WRGIS data assign and distribute the abstraction impacts from the **WR107b** sources as follows:

- [✂]
- [✂]

8.3.11 The impacts from the boreholes at Aughton Park and Moss End (**WR107a**) are not yet assigned to a waterbody (new abstractions) although the boreholes are located within the Downholland (Lydiate/Cheshires Lines) Brook WFD river water body, which is drained by the Downholland Brook (which ultimately flows to the Alt).

8.3.12 Therefore, with regard to **operation**:

- Guidance from the EA (National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff) suggests that significant direct effects on groundwater dependent terrestrial ecosystems (GWDTEs) from drawdown associated with abstraction are unlikely for European sites over 5 km from the abstraction. [✂]. The remaining boreholes are all over 10km from the boundaries of the designated sites.
- All the boreholes associated with **WR107a** and **WR107b** are in the Kirkby Ormskirk GWMU. The WFD assessment suggests that interaction between groundwater in the Permo-Triassic sandstone aquifer and groundwater in the superficial deposits is uncertain; therefore
  - abstraction from Primrose Hill (**WR107b**) may directly influence water supply to the groundwater dependent ecosystems of the SAC and associated species of the Ramsar (this is recognised as a precautionary position given the distance to the boreholes);
  - abstraction from the options collectively may reduce freshwater inputs to the sites via surface water bodies (principally the main channels of the Ribble or Alt), which

may affect the physio-chemical characteristics of the estuary (e.g. salinity gradients, water quality) hence the supporting habitats for the SPA / Ramsar qualifying features.

- **WR049d** will reduce freshwater inputs to the Ribble estuary via the main channel of the Ribble; the Environment Agency has indicated, following a recent review of the Ribble ALS ledger, that there is water available for the abstraction; however significant effects on the SPA / Ramsar may occur through the changes in water volumes affecting the physio-chemical characteristics of the estuary hence the supporting habitats for the SPA / Ramsar qualifying features.

8.3.13 With regard to **construction**:

- The screening has determined that no sites will be exposed to construction-related environmental changes as a result of **WR107a** or **WR107b** due to the distance of these options from the closest sites and the absence of significant surface water connectivity to the likely construction areas (although standard project-level measures can be relied on to ensure that construction-related effects cannot occur).
- The River Ribble estuary (and hence the associated features of the SPA / Ramsar) may be exposed to construction-related environmental changes from **WR049d** (in channel and bankside construction will be required).

8.3.14 No other potential effect pathways (e.g. through direct changes in water quality or increases in air pollution) will be realised as a result of these options.

8.3.15 It is unlikely that spatially coincident 'in combination' effects from the options will be substantive due to the option characteristics:

- The Ribble Estuary SSSI units of the **Ribble and Alt Estuaries SPA / Ramsar** will be exposed to **WR049d** and (potentially) the Primrose Hill component of **WR107b** only.
- The dune habitats of the **Sefton Coast SAC** are potentially exposed to the Primrose Hill component of **WR107b** only.
- The Alt estuary units of the **Ribble and Alt Estuaries SPA / Ramsar** and **Sefton Coast SAC** may be exposed to **WR107a** and **WR017b.**

Assessment of effects - Water levels and supply to the dune systems of Sefton Coast SAC

8.3.16 The shallow hydrology of the Sefton Coast dune systems is relatively well-understood due to long-term monitoring since 1972 and the development of associated hydrological models (Stratford *et al*. 2013, EA 2010).

8.3.17 In summary, the dune systems typically comprise a layer of sand several metres thick, which is underlain by a poorly-permeable clay and silt layer that appears to largely isolate the dune systems from the underlying sandstone aquifer (Stratford *et al*. 2013; Environment Agency 2010). The sands overlying the clay layers therefore form a shallow sand aquifer for which the principal source of recharge is direct rainfall and perhaps shallow lateral flow and drainage from the immediate surrounding areas. Water levels

within the dune slacks are therefore "*a local expression of the water table developed within a dune sand aquifer*".

8.3.18 The essentially local and shallow nature of the water supply and balance is reinforced by models (Clarke & Sanitwong Na Ayutthaya, 2010) and monitoring (Clarke & Pegg, 1993) that have demonstrated the effects of land use on the water table (e.g. areas forested with pine trees have significantly lower water table levels than open dunes, and the controls on water levels from tree planting, golf course development and dewatering operations are recognised (Environment Agency 2010). It is noted that the hydrological threats noted in the SIP relate to colonisation of the dunes by scrub and woodland, and interception of local run-off by urban drainage networks.

8.3.19 Therefore, whilst some localised seepage of deep groundwater from the sandstone into the shallow sand aquifer associated with the dune systems cannot be categorically excluded, it is evident that any such input is an essentially inconsequential component of the water balance for the dune habitats. It should also be noted that the abstraction volumes proposed for Primrose Hill have been licenced, and that these were reviewed and confirmed through the Review of Consents.

Uncertainties and preliminary conclusion

8.3.20 Despite the residual uncertainty associated with the precise response of the sandstone aquifer to utilisation of the boreholes, there is a very high degree of confidence that the groundwater abstraction associated with **WR107a** and **WR107b** will not adversely affect the integrity of the interest features of the **Sefton Coast SAC** or the associated features of the **Ribble and Alt Estuaries Ramsar** (natterjack toad); and in reality the magnitude of any effects would almost certainly constitute a 'no likely significant effects' conclusion if the options were re-screened.

Assessment of effects - Flows in the Ribble Estuary and effects on qualifying bird species

Context

8.3.21 Several studies have suggested that the number and densities of wintering waterbirds around estuarine freshwater channels are consistently greater than across associated mudflats, and that several bird species show significant preferences for freshwater flow areas over mudflats (e.g. Ravenscroft *et al.* (1997), Ravenscroft (1998, 1999), Ravenscroft & Beardall (2002) & Ravenscroft & Emes (2004)), although other studies have indicated that deeply incised channels associated with large volume inflows (such as the Ribble) are less attractive to birds (Ravenscroft & Beardall, 2002).

8.3.22 There are a number of possible mechanisms for this. Correlations between freshwater flow and particle size (e.g. Ravenscroft & Emes (2004)), and substrate particle size distribution and invertebrate distribution have been recognised (e.g. Goss-Custard *et al.* (1991), Colwell and Landrum (1993), Yates *et al.* (1993)). Freshwater flow, salinity and invertebrate distribution have also been correlated (Kelly (2001)).

8.3.23 These physical relationships between invertebrate distributions and freshwater flows are important since there are numerous studies detailing relationships between overwintering waterbirds and the densities or distributions of their invertebrate prey (e.g. Goss-Custard et al. (1991), Colwell (1993), Colwell and Landrum (1993), Yates *et al*. (1993), Dierschke *et al*. (1999), Ravenscroft *et al*. (2002, 2004). Associations between bird densities and particle size (Granadeiro *et al*. 2004) have also been recognised.

8.3.24 Possible relationships between birds and freshwater flows were investigated in detail through a series of studies in The Swale SPA/Ramsar and the Medway Estuary and Marshes SPA/Ramsar (RPS 2004a, 2004b, 2004c, 2005a; Humpheryes & Kellett 2003). These studies found few consistent patterns, however; for example:

- Whilst the general relationship of birds and creek corridors (rather than channels) was usually replicated between watercourses and embayments, the species assemblage was variable between creeks and years, suggesting that creek-specific variables may be less important for determining the community composition than environmental or community processes operating in the wider estuary or beyond. Most species (67%) displayed no, or a negative, association with creeks (70% when feeding behaviour only was considered).
- Latitudinal relationships between creeks and invertebrates were inconsistent, with only a slight tendency for invertebrate biomass to be higher within the creek corridor than the channel or surrounding mudflats.
- Significant decreases in invertebrate abundance and biomass down longitudinal gradients (potentially related to greater exposure to tidal processes) were recorded, although bird numbers showed the opposite (i.e. greater numbers towards the sea), perhaps reflecting greater foraging accessibility due to interstitial water, or less disturbance.
- Furthermore, no significant differences in the usage of creeks by birds were recorded between freshwater creeks and those that were predominantly saline.

8.3.25 A broad consensus position appears to be that it is not freshwater flow volumes *per se* that are critical to the bird / intertidal channel relationship, rather the presence of some flows within channels to maintain morphology, and that bird distributions are often influenced instead by regional factors (e.g. changes in disturbance levels, reductions in bird populations altering estuary usage, proximity of roost sites), local factors (e.g. the role of creek morphology or substrate penetrability) and small-scale interactions (e.g. inter and intra-specific bird relationships, or prey availability associated with behavioural or physiological responses to intertidal exposure).

8.3.26 It should be noted that this relationship relates to smaller freshwater channels, such as Crossens Pool; as noted, there is some evidence that incised channels associated with large volume inflows (such as the Ribble) are less attractive to birds (Ravenscroft & Beardall, 2002).

8.3.27 With regard to overall volume of freshwater input to the estuary as a whole, whilst this will be important for maintaining the productivity of the ecosystem hence attractiveness to overwintering birds, the effects of small changes in inputs are typically subtle. The daily mean flows from the Rivers Ribble, Darwen and Douglas (~46m^3/s, based on gauging

station data) are small compared to the average tidal inflow of 12,000m^3/s on a spring tide (Halcrow, 2013), and so the effects of freshwater input will be most noticeable in the upper estuary. It should also be noted that the Ribble and Alt Estuaries SPA/Ramsar have not been identified as sites that are in unfavourable condition due to excessive nutrients (such that 'nutrient neutrality'[33] is being deployed or considered as mitigation in recent NE advice to LPAs[34]).

8.3.28 The effects of flow reduction must be looked at in the context of the requirements of the qualifying features of the SPA/Ramsar. Site integrity (based on the conservation objectives) requires, subject to natural change, the maintenance or restoration of

- 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.

8.3.29 However, it must be recognised that estuaries are naturally dynamic environments and so none of these aspects (with the possible exception of the populations of the qualifying features) will necessarily have a fixed and specific target from which deviation would always constitute an adverse effect on integrity. For example, it is known that the Ribble is an accreting estuary (partly as a result of historical interventions, such as the canalisation of the main channel and construction of the North and South Training Walls).

Hydrological Effects

8.3.30 [✂]

8.3.31 Flow impact assessments have been developed for the WFD assessment of **WR049d**, based on gauged flow records at NRFA gauge 71001 (Ribble at Samlesbury). Appendix B of the WFD report shows that with average-year utilisation, the impacts on flow immediately downstream of the abstraction would be less than 5% for the majority of the time, only exceeding 10% for a very small number of low flow days (at flows less than Q99 – i.e. rare very low flow conditions). At higher utilisation (1 in 500-year utilisation profile), impacts would exceed 10% for a slightly greater proportion of the time (at flows less than Q95). Based on the HOF in the 2013 ALS, abstraction would be allowed for the vast majority of the time, but may be constrained at the lowest flows (gauged flows were below the HOF on 21 days between 1976-2020, increased to 37 days with average utilisation and 51 days with 1 in 500 year abstraction). Furthermore, it should be noted that two significant tributaries join the Ribble between the proposed abstraction and the

[33] Poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for European sites being in unfavourable condition, and substantial reductions are needed to achieve favourable conservation status. 'Nutrient neutrality' is a mitigation approach that potentially allows new developments to be approved provided that there is no net increase in nutrient loading within the catchments of the affected European site.

[34] Letter from NE to LPA Chief Executives and Heads of Planning, 16 March 2022; Re. Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites.

SPA / Ramsar (the River Darwen at Preston and the River Douglas at Naze Mount) and so the actual proportional reduction of freshwater inputs to the SPA / Ramsar as a result of **WR049d** will be notably less than that outlined above[35].

8.3.32 These data, and information from the Environment Agency, suggest that water is available to meet the requirements of this option (the Ribble, Douglas and Crossens ALS (Environment Agency, 2013) states that water is available in the Lower Ribble; more recent water availability information provided by the Environment Agency in March 2022 indicates that this is still the case, with approximately 150Ml/d available at Q95).

8.3.33 With regard to the borehole options (principally the Primrose Hill component of **WR107b** and the Aughton Park / Moss End components of **WR107a**), the available data suggests that the abstraction impacts of these will be ascribed to the Alt catchment; if they have any effects on streams flowing north[36] then flows to the SPA/Ramsar are only likely to be affected through impacts on the Three Pools Waterway and The Sluice (**WR107b**), which discharge across the Crossens Marsh foreshore at Fiddler's Ferry (in which case spatially coincident 'in combination' effects (i.e. cumulative at a single location) with the **WR049d** option will not occur) or minor streams that ultimately flow to the River Douglas, such as the Sefton Brook (**WR107a**). No flow data for Three Pools Waterway or The Sluice are available, and determining the precise effects of the borehole options requires development of the regional model, but the available data strongly suggests that the effects of borehole abstraction on flows in the Crossens Pool (the intertidal channel at Fiddler's Ferry) will be nil or too negligible to alter the characteristics of the habitats associated with Crossens Pool such that the integrity of the sites would be adversely affected.

Effects on the physio-chemical environment

8.3.34 **Water quality** assessments have been undertaken at relevant locations downstream of the proposed abstraction on the Ribble, including Environment Agency monitoring locations which also coincide with wastewater treatment works at Walton le Dale. This WwTW is in the tidal reach of the Ribble, and is therefore subject to tidal influences as well as freshwater flows (see Appendix D of the WFD report).

8.3.35 It should be noted that these assessments relate to the Ribble upstream of the SPA/Ramsar, but have some relevance for the estuary.

8.3.36 Assessments calculating the impact of the predicted changes to flows on dilution suggest that there would be only a very small change in concentrations of determinands, and comparison of the baseline and predicted concentrations demonstrates that the abstraction would not result in a change in WFD status at any of the sample points. Available data for specific pollutants and Priority Substances have been reviewed,

[35] Based on flow monitoring data from the Ribble at Samlesbury, the Douglas at Wanes Blades Bridge, Yarrow at Croston Mill, Lostock at Littlewood Bridge and Darwen at Blue Bridge, the Douglas and Darwen contribute ~25% of the flows into the Ribble estuary (although other minor sources will also contribute).

[36] The watercourses that flow from the Ormskirk area towards the SPA/Ramsar are thought to be generally perched above the regional water table in the sandstone aquifer and therefore hydraulically disconnected (although they will receive runoff and shallow lateral interflow from the superficial deposits), and so effects on freshwater flow volumes to the Ribble SSSI component of the SPA/Ramsar will be negligible (particularly for the River Douglas).

recognising the chemical failures in the Ribble (conf. Calder to tidal) relating to polybrominated diphenyl ethers (PBDEs) and mercury. For almost all locations and parameters only one of the samples exceeds either the mean EQS or reaches 75% of the EQS. The low proportion of samples exceeding 75% of the EQS, coupled with the low predicted reduction in flow, suggests that there is a very low risk of EQS exceedance occurring as a result of the proposed abstraction.

8.3.37 The risk to water quality (in the context of the WFD) is shown from this assessment to be very low. However, the Environment Agency have expressed concerns about option **WR049d** from a river water quality perspective, which may require further investigation. Comments from the Environment Agency[37] suggest this is related to Combined Sewer Overflows rather than a continuous discharge; however, the reasons for the concerns are not immediately evident in the available monitoring data and it is noted that the Ribble and Alt Estuaries SPA/Ramsar have not been identified as sites that are in unfavourable condition due to excessive nutrients (such that 'nutrient neutrality'[38] is being deployed or considered as mitigation in recent NE advice to LPAs[39]). This would suggest that the marginal reduction in freshwater input to the estuary will not have potentially notable effects on estuarine water quality.

8.3.38 With regard to geomorphology, the main channel of the Ribble has been canalised in the past and is still constrained to some extent by the North and South Training Walls, and so flows at low tide are essentially confined to the relatively incised main channel. As a result, substantial changes in flow are likely to be needed to alter the degree of wetted/exposed channel (which will not occur as a result of these options). Minor changes to sediment deposition may occur as this is related to salinity, but this will be within the range of natural variation for the estuary.

Exposure of features

8.3.39 As noted, the daily mean flows from the Rivers Ribble, Darwen and Douglas are small compared to the average tidal inflow of 12,000m^3/s on a spring tide, and so the effects of freshwater input will be most noticeable in the upper estuary and along the immediate margins of the Ribble main channel.

8.3.40 NE (2015) provides data on the typical distributions of wintering birds at low tide within the Ribble Estuary SSSI[40]; in summary, the species most obviously associated with the Ribble channel within the estuary are widgeon and teal (principally in the upper estuary, where they utilise the adjacent salt- and grazing-marsh) and shelduck (typically associated

[37] Comments received from the Environment Agency in April 2022 on the Evidence and Assessment Scoping Report (Wood, 2022)

[38] Poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for European sites being in unfavourable condition, and substantial reductions are needed to achieve favourable conservation status. 'Nutrient neutrality' is a mitigation approach that potentially allows new developments to be approved provided that there is no net increase in nutrient loading within the catchments of the affected European site.

[39] Letter from NE to LPA Chief Executives and Heads of Planning, 16 March 2022; Re. Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites.

[40] See Appendix 4 of NE (2015); available at http://publications.naturalengland.org.uk/file/4869603618455552

with Salter's Bank adjacent to the river channel, south of Lytham St. Anne's)[41]. However, the habitats of these species will not be particularly sensitive to the anticipated magnitude of change associated with the options, which are likely to be largely restricted to the main channel. For example, the saltmarshes will only be periodically inundated by the highest tides and the principal sources of freshwater to these areas will be local run-off and rainfall rather than water from the Ribble main channel; similarly, the areas preferred by shelduck have a strong marine influence due to the proximity to the sea and hence tidal coverage, irrespective of the effects of freshwater flow within the Ribble main channel.

Uncertainties and Preliminary Conclusion

8.3.41 Based on the available data, it is considered that the risk of adverse effects on the integrity of the Ribble estuary component of the Ribble and Alt Estuaries SPA/Ramsar, alone or in combination through changes in freshwater input is low. This is based principally on the small magnitude of change for the flows into the estuary, in proportion to freshwater flows from the Ribble and other sources, and in relation to the tidal volumes; and on the low sensitivity of the interest features (specifically the habitats used by the qualifying features) to changes in freshwater inputs of this magnitude. Any changes will be small and within the range of natural variation for the estuary.

8.3.42 This conclusion is necessarily preliminary, subject to development of the regional groundwater model and additional investigations to understand any residual concerns relating to water quality (if required); however, it is likely to be robust based on assessments of similar magnitude impacts from other sites in the UK (e.g. from estuaries in the south and east of England, in connection with the Review of Consents investigations).

Assessment of Effects – Construction on the Ribble

8.3.43 Option **WR049d** will require construction of [✂] from the SPA/Ramsar, and associated works immediately adjacent to the river. Pipeline construction will be required within the catchment and will require crossings of tributaries of the Ribble.

8.3.44 The precise scope of the construction (including location, timing, materials, extent, duration, etc.) cannot be defined at this point, although it is likely that in-channel works will be scheduled for the summer to facilitate water management.

8.3.45 The SPA / Ramsar features may be exposed to construction-related effects through:

- site-derived pollutants (principally oils and other contaminants) entering the Ribble hence affecting their supporting habitats (the estuarine will be less sensitive to sediments);
- noise or visual disturbance of SPA/Ramsar qualifying features using functionally associated habitats outside the SPA/Ramsar (direct effects on birds within the sites will not occur due to the distance).

[41] This distribution reflects dietary preferences; wigeon are predominantly grazers, particularly of the saltmarsh grass *Puccinellia maritima*; teal typically feed on plant seeds and some invertebrates (e.g. chironomid larvae and small snails) in shallow pools in the mudflats, creeks and saltmarshes; shelduck typically forage on mud-snails and tubifex worms found in the open flats (Brown & Grice 2005).

8.3.46 With regard to **disturbance**, the abstraction is likely to be located close to the Brockholes Nature Reserve; this supports species associated with the SPA/Ramsar and may be considered 'functionally associated'; for example:

- small numbers of common tern breed within the site and utilise the estuary for foraging;
- wintering birds, particularly geese and ducks, move between the site and the estuary.

8.3.47 Visual disturbance from construction is unlikely to affect SPA/Ramsar birds using the site due to the distance to the core areas[42] and the presence of screening vegetation (trees) along the reserve margins and the banks of the Ribble.

8.3.48 The magnitude and potential effects of construction noise cannot be accurately determined without details of the construction (including plant and time of year). However, without any barriers, the sound power level of the loudest equipment typically used in construction schemes of this type would attenuate to around 55dB(A) within 300m, and to 50 dB(A)[43] within 600m due to distance alone. Cutts *et al*. (2013) note that "*a 70dB noise threshold* [for disturbance] *has…been developed over a period of years, based on published data as well as findings from primary observations*", and noise from typical construction works would likely attenuate below this threshold in less than 100m. In addition, the baseline noise environment will be relatively loud due to the presence of the M6 viaduct overflying the site, which may provide a moderating effect for some construction noise (noise does not operate additively), and the screening vegetation around the site margins will also impede noise transfer to the site. Additional mitigation measures (e.g. use of acoustic screens, timing of works to avoid key periods for sensitive species, good construction practices such as 'soft starts' on equipment) can also be employed to reliably minimise or eliminate potential noise impacts.

8.3.49 Furthermore, any disturbance will be relatively short term and temporary, and potentially notable proportions of the bird species associated with with SPA/Ramsar are unlikely to be exposed at Brockholes Nature Reserve (the vast majority of the qualifying species' populations will spend most of their time in or close to the estuary, and low-disturbance areas are always likely to be available). As a result, adverse effects on the integrity of the SPA/Ramsar due to disturbance at the will not occur.

8.3.50 With regard to **site-derived pollutants**; again it is not possible to quantify the likely effects without details of the construction (including intended approaches and time of year). However, it is clear that construction within watercourses is not a rare occurrence, and that there are numerous established measures that can be employed to reliably avoid impact pathways being realised (e.g. the use of silt curtains or coffers within rivers to

[42] Evidence suggests that 'flush distances' for wintering waterbirds (the distances at which birds typically move when approached by people) are less than 350m, and substantially less than this for most species (Laursen *et al*. 2005) – e.g. the longest distance recorded by Laursen *et al*. (2005) was ~320m (for brent geese), whereas the distances for dunlin were less than 70m.

[43] As a guide, 60dB(A) is approximately equivalent to a conversation; 50dB(A) is approximately equivalent to the level associated with a quiet suburb or light traffic. The road noise from the M48 crossing is probably around 50 db(A) at 1km from the bridge (based on very simple attenuation calculations using noise data from other motorways).

minimise sediment release). As a result, there is a high-degree of confidence that the SPA/Ramsar will not be adversely affected through this mechanism.

Uncertainties and Preliminary Conclusion

8.3.51 Based on the available data, it is considered that **WR049d** will have no adverse effects on the integrity of the Ribble estuary component of the Ribble and Alt Estuaries SPA/Ramsar, alone or in combination through construction related impacts. This conclusion is necessarily preliminary, subject to the identification of construction approaches and additional investigations to understand any residual concerns relating to the Brockholes Nature Reserve (if required); however, it is considered robust given the likely scale and location of construction works and the availability of mitigation measures.

Assessment of effects - Flows in the Alt at Crosby and effects on qualifying bird species

Context

8.3.52 The context for potential effects on the Alt is largely as per the Ribble (see above) – i.e. reductions in freshwater flows may affect the supporting habitats for the qualifying bird species, although evidence suggests that any relationship between birds and freshwater inputs is subtle and probably not related to flow volumes *per se*; and is probably secondary to a range of other regional and local variations in estuary characteristics that change over the short- and long-term.

8.3.53 With regard to the Alt specifically, this is a substantially smaller watercourse than the Ribble, with substantially different characteristics in the intertidal area. Its channel cuts through the dunes and sandbanks of Formby Bank and is not associated with extensive area of typical estuarine habitats (e.g. intertidal mud and silts; saltmarsh; etc.).

Hydrological Effects

8.3.54 Flows in the Alt may be affected by the borehole abstractions associated with **WR107a** and **WR107b**. All of the boreholes except Primrose Hill are located with WFD river water bodies that ultimately flow to the Alt (Downholland (Lydiate/ Cheshires Lines) Brook for Aughton Park and Moss End, Croxteth/Knowsley Brook for Randles Bridge and Knowsley).

8.3.55 Regional groundwater flows west and north to discharge at the coast and to the lower River Alt. The watercourses in this area are all generally perched above the regional water table in the sandstone aquifer and therefore hydraulically disconnected, although will receive runoff and shallow lateral interflow from the superficial deposits (especially where the Shirdley Hill Sand Formation is found), depending on the nature and thickness of the superficial deposits.

8.3.56 As the Croxteth/Knowsley Brook flows past Randles Bridge and joins the Alt, regional sandstone groundwater levels are close to or above ground level such that there is the potential for the Alt to gain groundwater baseflow from the aquifer, with upward hydraulic gradients. Here the sandstone is overlain by the superficial Shirdley Hill Sand Formation and may have a good hydraulic connection with the river. In its bottom reaches, where

the Superficial Deposits are underlain by the Mercia Mudstone, the Alt is very low lying and highly engineered with an extensive pumped drainage system to protect farmland from flooding.

8.3.57 However, there is some uncertainty over the precise impact of the options on flows in the Alt due to:

- the need to develop the Lower Mersey Basin groundwater model to determine aquifer behaviour; and
- the absence of gauged flow data from low in the Alt catchment to provide a reasonable indication of current inputs to the intertidal areas from the Alt (hence comparison against the likely abstraction volumes from the boreholes).

8.3.58 Nevertheless, it is expected that the effects will be small based on available data from the EA and the WFD assessment; and it is noted that the boreholes associated with **WR107b** are already licensed for the required volumes and that these were considered as part of the Review of Consents.

Exposure of features

8.3.59 NE (2015) provides data on the typical distributions of wintering birds at low tide near the Alt estuary and Formby Bank[44]; in summary, the species most obviously associated with this sector are those commonly found on open sand- and mudflats which exploit the tidal edge (e.g. knot, sanderling, dunlin) and there is a general tendency for birds in this area to be loosely associated with the Alt as it crosses the sandflats at Formby Bank. However, as noted, based on other studies it is unlikely that the volumes of freshwater *per se* are a key factor or critical factor in any relationship that might exist with the intertidal sections of the Alt.

Uncertainties and Preliminary Conclusion

8.3.60 Based on the available data, it is considered that the options will have a low risk of adverse effects on the integrity of the Alt estuary component of the Ribble and Alt Estuaries SPA/Ramsar, alone or in combination. This is based principally on the anticipated small magnitude of change for the flows into the estuary, in proportion to freshwater flows from other sources, and in relation to the tidal volumes and high exposure of Formby Bank to marine influence; and on the low sensitivity of the interest features (specifically the habitats used by the qualifying features) to changes in freshwater inputs of this magnitude. It is likely that any changes will be small and within the range of natural variation for the estuary.

8.3.61 This conclusion is necessarily preliminary, subject to development of the regional groundwater model.

[44] See Appendix 4 of NE (2015); available at http://publications.naturalengland.org.uk/file/4869603618455552

Other projects 'in combination'

Options in other UU plans

8.3.62 With regard to other UU plans:

- The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; there cannot therefore be 'in combination' effects with this plan.
- The drought options identified in UU's revised draft Drought Plan 2021[45] do not affect these European sites.
- The interaction of the NWT SRO options with specific schemes derived from the emerging Drainage and Wastewater Management Plan (DWMP) can only be assessed at the project level due to the generic nature of the DWMP options.

Minor projects

8.3.63 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence, and generating a list at this stage would be of little value. It is possible that there will be 'in combination' project-specific construction effects associated with future planning applications, although this can only be assessed at the time of any application. This is consistent with the ACWG guidance on cumulative/in combination assessments.

Major Projects

8.3.64 Reference has been made to the Planning Inspectorate's National Infrastructure Projects database[46] which includes major projects; no major projects are identified that are likely to affect this site.

8.4 Assessment Summary

8.4.1 There are some residual uncertainties regarding the behaviour of the sandstone aquifer and options **WR107a** and **WR107b** (which will be resolved by the development of the Lower Mersey Basin groundwater model); however, the initial conclusions of the assessment are as follows:

- [✂]
- [✂]
- [✂]
- [✂]

[45] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

[46] https://infrastructure.planninginspectorate.gov.uk/projects/

- [✂]

9. Appropriate Assessment – Mersey Estuary SPA / Ramsar

9.1 Screening Summary

9.1.1 The **Mersey Estuary SPA** and **Mersey Estuary Ramsar** are largely coincident sites covering the coastal and estuarine habitats of the Mersey Estuary from Runcorn Bridge in the east to Devil's Bank near St. Michael's in the west. The sites are designated for their wintering wildfowl populations.

9.1.2 Twelve options are located within 20km of these sites, or within their catchment:

- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]
- [✂]

9.1.3 Theoretical pathways for effects exist through:

- potential construction-related impacts on the estuary associated with some options that will rely on project-level mitigation (and so cannot be 'screened out');
- reduced freshwater input to the Mersey estuary from the options cumulatively, affecting the supporting habitats for the SPA / Ramsar qualifying features;

9.2 European site summaries

Site overviews

9.2.1 The Mersey Estuary SPA / Ramsar is a large sheltered estuary with a narrow mouth and wide shallow basin. It is composed of extensive intertidal mud and sandflats on the northern and southern shores of the estuary, distinct areas of rocky shore and areas of saltmarsh which are constantly eroding and accreting. The site also includes an area of reclaimed marshland, salt-marshes, brackish marshes and boulder clay cliffs with freshwater seepages. The Manchester Ship Canal forms part of the southern boundary of

the site and separates a series of pools from the main estuary. These pools together with Hale Marsh are important roosting sites for wildfowl and waders at high tide. The sites are underpinned by the Mersey Estuary SSSI and New Ferry SSSI.

Interest Features and Conservation Objectives

Mersey Estuary SPA

9.2.2 The **SPA** has the following **qualifying features**:

- Non-breeding:
  - Common shelduck *Tadorna tadorna*
  - Eurasian teal *Anas crecca*
  - Northern pintail *Anas acuta*
  - European golden plover *Pluvialis apricaria*
  - Common redshank *Tringa totanus*
  - Black-tailed godwit *Limosa limosa islandica*
  - Dunlin *Calidris alpina alpina*
- Waterbird assemblage, including the above species plus Ringed plover *Charadrius hiaticula*, Northern lapwing *Vanellus vanellus*, Eurasian curlew *Numenius arquata*, Eurasian wigeon *Anas penelope*, Grey plover *Pluvialis squatarola*, Great crested grebe *Podiceps cristatus*

9.2.3 With regard to the within-site **supporting habitats** for the SPA qualifying features, these are taken to be those that support the key behaviours of the nonbreeding/wintering period (moulting, roosting, loafing and feeding), i.e.

- intertidal mud- and sandflats;
- salt- and grazing marshes; and
- associated high-tide roosting sites.

9.2.4 With regard to non-designated '**functional habitat'**, reporting by BTO (NE 2015) identifies several high-tide roost sites outside the boundaries of the designated sites, including at Frodsham Marsh. More broadly, wintering birds associated with the site will frequently move between the other SPA and Ramsar sites around the north-west coast, including the Mersey Estuary SPA / Ramsar, the Mersey Narrows and North Wirral Foreshore SPA / Ramsar, the Dee Estuary SPA / Ramsar, Martin Mere SPA / Ramsar, Morecambe Bay and Duddon Estuary SPA, and Morecambe Bay Ramsar.

9.2.5 The overarching **conservation objectives** for the site are essentially as per those outlined in **Section 3.3**; no 'supplementary advice' for the SPA is provided however.

Mersey Estuary Ramsar

9.2.6 The site meets the following **Ramsar** criteria:

- Criterion 5: The site supports a waterfowl assemblage of international importance.
- Criterion 6: The site supports the following qualifying species/populations:
  - Common shelduck *Tadorna tadorna*
  - Eurasian teal *Anas crecca*
  - Northern pintail *Anas acuta*
  - Common redshank *Tringa totanus*
  - Black-tailed godwit *Limosa limosa islandica*
  - Dunlin *Calidris alpina alpina*

9.2.7 With regard to the **supporting habitats** and **functional habitats** for the Ramsar qualifying features are taken to be the habitats for the equivalent SPA features.

9.2.8 The overarching **conservation objectives** for the site are essentially as per those outlined in Section 3.3; no 'supplementary advice' for the SPA (hence the coincident qualifying features of the Ramsar) is provided however.

Condition, Pressures and Threats

9.2.9 Most of the units of the Mersey Estuary SSSI are in 'favourable' or 'unfavourable recovering' condition (8 of 12; approximately 55% of the SSSI). Four of the units (~45% of the SSSI) are in 'unfavourable no change' or 'unfavourable declining' condition, invariably due to inappropriate management of the saltmarsh (grazing) or due to overall declines in some species (notably pintail) across the estuary (although the reasons for this decline are unclear).

9.2.10 Accordingly the Mersey Estuary SIP identifies the following as a pressures or threats on site integrity:

- Changes in species distributions (there have been large decreases in bird numbers on this SPA compared to local SPAs and regional trends);
- Invasive species (significant increase in population of Canada geese; non-native marine species in Liverpool Docks);
- Public Access/Disturbance (through disturbance of bird populations by terrestrial and marine recreation).

9.2.11 The options will not affect any of these pressures or threats, with the possible exception of the 'changes in species distributions' through hydrological changes.

9.3 Assessment of Effects

9.3.1 The SPA / Ramsar sites are addressed together in the following sections as the site boundaries and interest features are coincident. The assessment therefore considers the

sites and features according to the functional relationships and exposure to option outcomes.

Option summaries and effect pathways

9.3.2 There are a number of options within the Mersey catchment, several of which are a substantial distance from the SPA/Ramsar (such that significant effects alone would not be anticipated through either construction or operation). The distribution of the options and their relationship with the surface waterbodies within the catchment are set out in **Figure 9.1**. The options and effect pathways are described in **Table 9.1**.

Figure 9.1 Options within the Mersey Estuary catchment

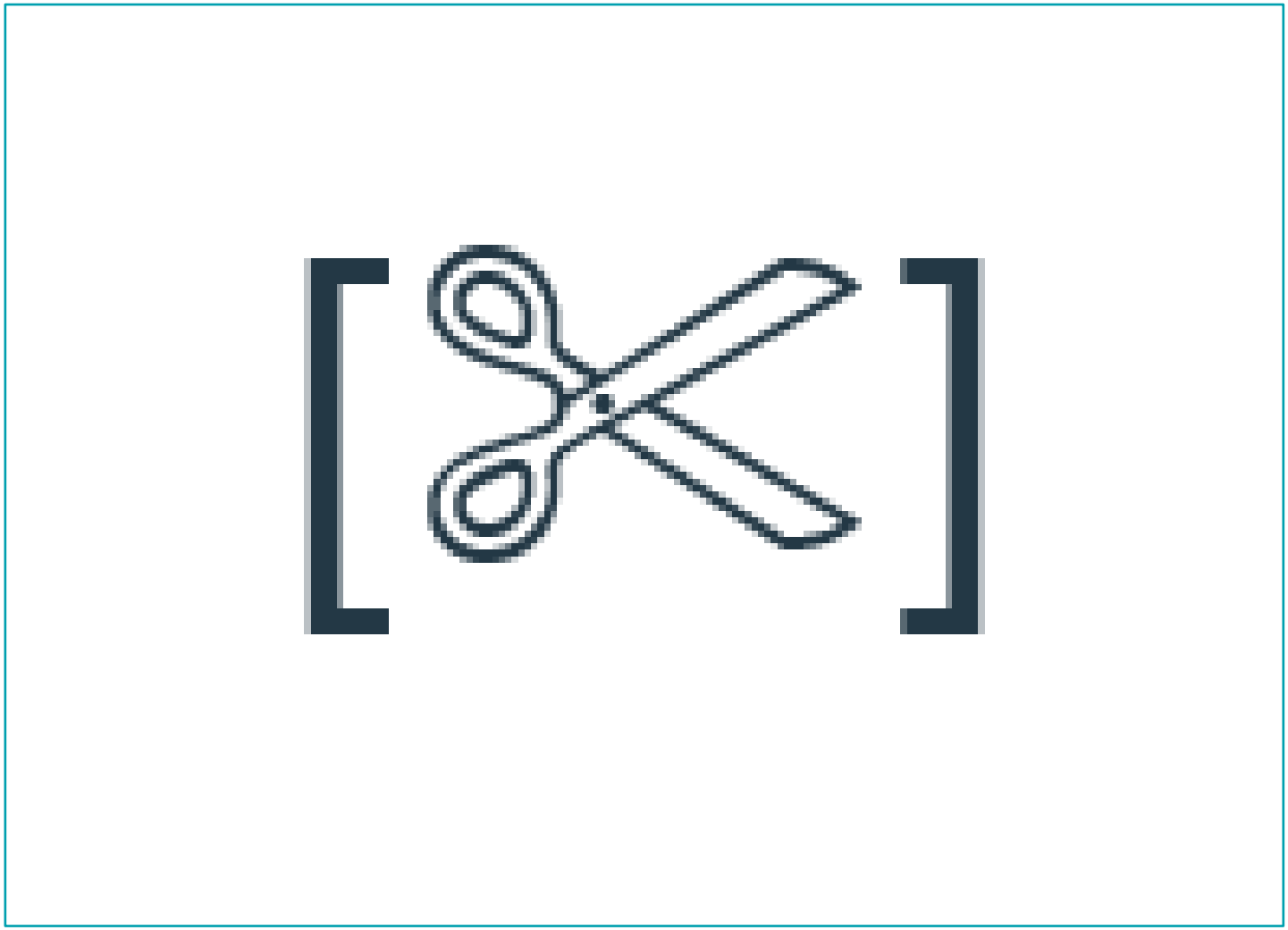

Table 9.1 Summary of NWT Full Solution options and potential pathways for effects on the Mersey Estuary SPA / Ramsar

Option	Distance from SPA / Ramsar	Option summary and yield profile	Potential pathways for effects on the Mersey Estuary SPA / Ramsar
WR015: River Irwell to new WTW	50km	[✂]	[✂]
WR076: River Bollin		[✂]	[✂]
WR102b: Widnes Boreholes	5km	[✂]	[✂]
WR107a: Aughton Park & Moss End b/h2	17.9km	[✂]	[✂]
WR107b: Randles Br, Knowsley, Primrose H.	11.1km	[✂]	[✂]
WR111: Woodford Boreholes	35km	[✂]	[✂]
WR113: Tytherington Boreholes	42km	[✂]	[✂]

Option	Distance from SPA / Ramsar	Option summary and yield profile	Potential pathways for effects on the Mersey Estuary SPA / Ramsar
WR149: Lightshaw	17.6km	[✂]	[✂]
STTA4	4.6km	[✂]	[✂]

Table 9.2 Summary of NWT 'reserve' options and potential pathways for effects on the Mersey Estuary SPA / Ramsar

Option	Distance from SPA / Ramsar	Option summary and yield profile	Potential pathways for effects on the Mersey Estuary SPA / Ramsar
STT041b: Heaton Pk (R Roch & R Irwell)	38.6km	[✂]	[✂]
WR105a: Lymm Boreholes	17.6km	[✂]	[✂]
WR106b: Walton and Daresbury b/h	7km	[✂]	[✂]
WR144: Saddleworth	44km	[✂]	[✂]

9.3.3 No other potential effect pathways (e.g. through direct changes in water quality or increases in air pollution) will be realised as a result of these options.

9.3.4 In terms of spatially coincident 'in combination' effects from the options, Figure 8.1 provides a conceptual model of the options in relation to the Mersey Estuary. There are some complexities associated with the Ship Canal and the River Mersey[47] but broadly:

- The following options are likely to impact flows entering the estuary via the River Mersey and the Ship Canal:
  - WR015
  - WR076
  - WR111
  - WR144
  - WR149
  - ST041b (reserve option)
  - WR105a (reserve option)
  - WR106b (reserve option)
- The following options are likely to affect flows entering the estuary via other watercourses:
  - WR102b

9.3.5 In addition, some of the borehole options closer to the estuary (e.g. WR102b, WR105a, WR106b), may have a limited impact on surface water flows due to local confinement, but reduce direct inputs to the estuary from the aquifer.

Assessment of effects - Flows in the Mersey Estuary and effects on qualifying bird species

Context

9.3.6 The broad context for this impact is as per that outlined in Section 7.3.

9.3.7 The effects of flow reduction must be looked at in the context of the requirements of the qualifying features of the SPA/Ramsar. Site integrity (based on the conservation objectives) requires, subject to natural change, the maintenance or restoration of

- the extent and distribution of the habitats of the qualifying features;
- the structure and function of the habitats of the qualifying features;

[47] Water in the MSC flows in a south-easterly direction towards the River Weaver; most of the flow enters the Mersey estuary at this point (along with flows from the Weaver) via the Weaver Sluices. A relatively small proportion of the flow enters the inner Mersey Estuary further downstream at Eastham Lock (at the western end of the SPA / Ramsar).

- 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.

9.3.8 However, it must be recognised that estuaries are naturally dynamic environments and so none of these aspects (with the possible exception of the populations of the qualifying features) will necessarily have a fixed and specific target from which deviation would always constitute an adverse effect on integrity.

Hydrological Effects

9.3.9 The cumulative flow impacts for all the options in the NWT Full Solution have been calculated to determine the potential impact on freshwater volumes entering the Mersey Estuary compared to gauged flows (see **Table 9.3**). This is a very conservative worst-case assessment scenario, and assumes that:

- all options are used at full capacity 100% of the time; and
- that all impact from the groundwater abstractions will ultimately impact on the lower reaches of the Mersey/estuary (either via impacts on flow upstream, or reduced accretion to the lower reaches).

9.3.10 The total flow is calculated for a location downstream of the confluence of the Mersey, Bollin and the Ship Canal (MSC), based on the furthest downstream gauges on the principal tributaries, i.e.:

- Irwell at Adelphi Weir;
- Irk at Collyhurst Weir;
- Medlock at London Road;
- Worsley Brook at Eccles;
- Mersey at Ashton Weir;
- Glaze Brook at Little Woolden Hall;
- Sinderland Brook at Partington;
- Bollin at Bollington Mill.

9.3.11 Note this does not include the effects of WR102b on the Ditton Brook (ungauged) although these will be small in relation to the inputs from the River Mersey.

Table 9.3 Maximum cumulative impact of all Full Solution options at different flows

Aspect	Q95	Q70	Q50
Total flow at D/S terminus of Mersey/MSC at conf. with Bollin (Ml/d)	1070	1702	2401
Total abstraction (Ml/d)	91	91	91
Total Q95 flow minus total abstraction (Ml/d)	979	1611	2310
Flow change %	8.5%	5.3%	3.8%

9.3.12 As noted, this assessment is conservative; however it shows that the maximum cumulative impacts on freshwater inputs into the estuary from the Mersey catchment (note, there will be additional inputs from the catchment local to the estuary, from the Wirral and Liverpool) are relatively small at all except the lowest flows. With regard to the availability of water, some of the options (particularly the groundwater options) suggest that limited water is available for licensing or abstraction; however, this is not understood to be based on identified or potential impacts on the Mersey Estuary SPA / Ramsar.

Effects on the physico-chemical environment

9.3.13 The effect of reduced freshwater input to the estuary on key physio-chemical parameters cannot be precisely quantified without the development or adaptation of bespoke models of the tidal flows and mixing in the estuary.

9.3.14 The freshwater flow into the Mersey estuary is relatively small for the estuary's size (Ridgeway *et al.* 2012), with estimates of typical freshwater input being around 66m^3/s compared to the tidal influx into the Narrows of 2000m^3/s during a spring tide (Pye *et al.* 2002). The UK's National Tidal and Sea Level Facility[48] estimates that river flow in the Mersey is ~1% of the tidal flow. The Mersey is therefore considered a well-mixed estuary due to high tidal current velocities, relatively low freshwater input and high degree of turbulent mixing. The small reductions in freshwater input due to the options (in relation to inputs from the River Mersey catchment, and to the estuary catchment as a whole) are therefore likely to have very limited effects that are unlikely to be measurable outside the upper estuary.

9.3.15 Monitoring (RPS 2011) indicates that salinities within the Inner Mersey Estuary range from 16.9 Practical Salinity Units (PSU) to 32.9 PSU, depending on the tidal cycle and seasonal inputs from freshwater sources. The invertebrate fauna of the estuary are therefore adapted to wide variations in salinity, and the small reductions in freshwater input associated with the NWT SRO will not result in salinity changes that are outside of this normal range.

9.3.16 With regard to water quality, it is noted that the Mersey Estuary SPA/Ramsar have not been identified as sites that are in unfavourable condition due to excessive nutrients (such

[48] https://ntslf.org/

that 'nutrient neutrality'[49] is being deployed or considered as mitigation in recent NE advice to LPAs[50]). This would suggest that the marginal reduction in freshwater input to the estuary will not have potentially notable effects on this aspect of estuarine water quality, particularly recognising that there will be no increase in total loading of nutrients to the estuary associated with any of the options. Initial assessments undertaken for the WFD assessment (see Appendix D of the WFD report) suggest that the abstractions would not result in deterioration in status on either the source river or the downstream Mersey, including for toxic chemicals, although additional investigation may required for the estuary waterbody given the history of toxic contamination in the sediments (although, as before, the influence of the freshwater input on this aspect versus the tidal influx volume would be logically small).

9.3.17 However, the WFD assessment also recognises that there is an ongoing programme of water quality improvements in the Irwell catchment, including to waste water treatment works and combined sewer overflows. The primary purpose of these works is to improve water quality (particularly dissolved oxygen) in the heavily managed reaches of the downstream Mersey and Manchester Ship Canal. There is a risk that reduced dilution as a result of the proposed abstractions could reduce the effectiveness of those planned improvements. More detailed water quality modelling is planned, using existing SAGIS-SIMCAT and ICM models, to assess the impact of the proposed abstractions on water quality in the Irwell and (potentially) the Bollin.

9.3.18 It should be noted that these improvements and concerns relate to the freshwater environment and are driven by the protection of the Ship Canal for cyprinid fish under the WFD (previously under the Freshwater Fish Directive). The effects of this on the supporting habitats of the SPA / Ramsar is likely to be negligible for most areas of these sites due to the size and influence of the tidal influx relative to the freshwater inputs from the Irwell. However, some minor effects on DO in the immediate vicinity of the River Mersey or Ship Canal where they enter the estuary are possible, compared to a predicted future baseline without the NWT SRO abstractions; however, the abstractions would not offset the benefits of the WwTW and discharge improvements entirely, such that the quality of water entering the estuary would decline relative to the current baseline[51]. Adverse effects via this mechanism would not therefore be expected, although this may require additional analysis following the planned water quality modelling.

[49] Poor water quality due to nutrient enrichment from elevated nitrogen and phosphorus levels is one of the primary reasons for European sites being in unfavourable condition, and substantial reductions are needed to achieve favourable conservation status. 'Nutrient neutrality' is a mitigation approach that potentially allows new developments to be approved provided that there is no net increase in nutrient loading within the catchments of the affected European site.

[50] Letter from NE to LPA Chief Executives and Heads of Planning, 16 March 2022; Re. Advice for development proposals with the potential to affect water quality resulting in adverse nutrient impacts on habitats sites.

[51] This is relevant as minor negative impacts are often interpreted in the context of longer-term indirectly related improvements for which there is sufficient surety over delivery. It should be noted that this is consistent with the 'Dutch Nitrogen' case; this essentially concluded (*inter alia*) that an appropriate assessment could not take into account conservation measures, preventive measures, or measures that are not part of the proposal if the expected benefits of those measures are not certain at the time of that assessment. This is not the case for the improvements to the Ship Canal, which are backed by an agreed strategy and included in UU's Business Plan. A similar example is found in air quality assessments that are consistent with IAQM guidance (IAQM 2020), where (for example) minor impacts on NOx are set in the context of the predicted long-term decline that will result from the transition to electric vehicles.

9.3.19 With regard to geomorphology, the fluvial supply of sediment to the Estuary is small compared to the supply of sediment from offshore sources (C2HMHill 2013), and the Ship Canal acts as a notable sediment trap for fluvial sediments from the catchment. The estuary as whole is accreting, although the channels within the upper estuary are highly dynamic, frequently undergoing substantive re-orientation in response to both river flows and (more usually) tidal processes on decadal timescales. The small change in freshwater volumes will not substantially alter this; minor changes to sediment deposition may occur as this is related to salinity, but this will be within the range of natural variation for the estuary.

Exposure of features

9.3.20 NE (2015) provides data on the typical distributions of wintering birds at low tide within the Mersey Estuary[52]; in summary, the vast majority of the wintering birds in the estuary are associated with the mudflats and saltmarsh on the southern side of the main channel, near Ince Banks, particularly teal, dunlin and black-tailed godwit. However, these areas will not be particularly sensitive to the anticipated magnitude of change associated with the options, which are likely to be largely restricted to the main channel of the Mersey. For example, the saltmarshes will only be periodically inundated by the highest tides and the principal sources of freshwater to these areas will be local run-off and rainfall rather than water from the Mersey. It is therefore unlikely that the minor changes in freshwater input will alter the supporting habitats for the qualifying features, such that the integrity of the species' population may be undermined.

Uncertainties and Preliminary Conclusion

9.3.21 Based on the available data, it is considered that the options will have no adverse effects on the integrity of the Mersey Estuary SPA/Ramsar, alone or in combination. This is based principally on the small magnitude of change for the flows into the estuary, in proportion to freshwater flows from the River Mersey catchment and other flows into the estuary, and in relation to the tidal volumes; and on the low sensitivity of the interest features (specifically the habitats used by the qualifying features) to changes in freshwater inputs of this magnitude. Any changes will be small and within the range of natural variation for the estuary.

9.3.22 This conclusion is necessarily preliminary, subject to development of the regional groundwater model; however, it is considered robust.

Assessment of Effects – Construction in the catchment

9.3.23 The precise scope of the construction requirements for each option (including location, timing, materials, extent, duration, etc.) cannot be precisely defined at this point, although none of the options will require construction activity particularly close to the estuary.

9.3.24 The SPA / Ramsar features may be exposed to construction-related effects through:

[52] See Appendix 4 of NE (2015); available at http://publications.naturalengland.org.uk/file/4869603618455552

- site-derived pollutants (principally oils and other contaminants) entering tributaries of the Mersey estuary, hence affecting their supporting habitats;
- noise or visual disturbance of SPA/Ramsar qualifying features using functionally associated habitats outside the SPA/Ramsar (direct effects on birds within the sites will not occur due to the distance).

9.3.25 With regard to **disturbance**, none of the options are located near to any areas of land identified by NE (2015) that may be considered 'functionally associated' such as high tide roosts, and in practice such effects can only be identified through project-level survey. However, mitigation measures (e.g. use of acoustic screens, timing of works to avoid key periods for sensitive species, good construction practices such as 'soft starts' on equipment) can be employed to reliably minimise or eliminate potential noise impacts. As a result, adverse effects on the integrity of the SPA/Ramsar due to disturbance at the option delivery locations will not occur.

9.3.26 With regard to **site-derived pollutants**; again it is not possible to quantify the likely effects without details of the construction (including intended approaches and time of year). However, it is clear that the construction requirements of these options are unexceptional, and that there are numerous established measures that can be employed to reliable avoid impact pathways being realised. As a result, there is a high-degree of confidence that the SPA/Ramsar will not be adversely affected through this mechanism.

Other projects 'in combination'

Options in other UU plans

9.3.27 With regard to other UU plans:

- The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; there cannot therefore be 'in combination' effects with this plan.
- The drought options identified in UU's revised draft Drought Plan 2021[53] do not affect these European sites.
- The interaction of the NWT SRO options with specific schemes derived from the emerging Drainage and Wastewater Management Plan (DWMP) can only be assessed at the project level due to the generic nature of the DWMP options.

Minor projects

9.3.28 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence and, generating a list at this stage would be of little value. It is possible that there will be 'in combination' project-specific construction effects associated with future planning applications, although this can only

[53] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

be assessed at the time of any application. This is consistent with the ACWG guidance on cumulative/in combination assessments.

Major Projects

9.3.29 The Planning Inspectorate's National Infrastructure Projects database[54] identifies three major projects with the potential to affect the Mersey Estuary sites; in addition, HS2 is a major construction scheme within the catchment:

Table 9.4 National Infrastructure Projects that may affect the Mersey estuary

Project	Summary	Status	Effect pathways / HRA conclusions
Hydrodec Oil Re-Refinery Eastham	[✂]	Not submitted (due 2015)	Not yet submitted; no assessment possible
Hynet North West Hydrogen Pipeline	[✂]	Not submitted (expected 2023)	Not yet submitted; no assessment possible but in combination effects only likely in relation to construction, and these will be avoidable at the scheme level with mitigation that can be employed for the NWT SRO schemes.
Keuper Gas Storage Project	[✂]	Approved; pre-commencement.	Scheme will discharge brine to the estuary at Runcorn; HRA concluded 'no LSE'
HS2	[✂]	Approved; under construction.	Scheme will involve construction within the Mersey estuary catchment; appears to have been screened out of the HRA process, and in practice there are no potential i/c effects on the Mersey estuary.
Protos	[✂]	Approved; under construction.	This collection of developments received outline planning permission in 2009; the HRA for that concluded 'no LSE' and areas of the site have been built out; in combination effects only likely in relation to

[54] https://infrastructure.planninginspectorate.gov.uk/projects/

Project	Summary	Status	Effect pathways / HRA conclusions
			future development plots (since existing will form part of the baseline) and potential effects from these can only be determined at the project stage; there are few mechanisms for in combination effects assuming that the individual projects meet any consenting requirements for discharges etc to the estuary.

9.3.30 There is a potential interaction with the Keuper Gas Storage Project, as this will discharge brine to the Ship Canal and hence the Mersey estuary at Runcorn. The effects of this brine discharge were modelled by RPS (2011)[55] as part of the EIA for the scheme; the HRA of the scheme (ERM 2015)[56] notes the following:

9.3.31 "*The RPS Environmental Appraisal is based on a simulated mixing zone and salinity resulting from an additional discharge of saturated brine (310 g/l) to the Mersey Estuary via the MSC under low flow (Q75) conditions with a maximum discharge rate of 0.22 m3/s (19,000 m3/day). Modelling of the salinity change during low flow (Q75) conditions indicates the salinity of MSC water discharging to the Mersey at the Weaver Sluices will increase from 4-6 PSU to 11-12 PSU. This is below the natural range of salinity (16.9- 32.9 PSU) recorded in the inner Mersey Estuary*".

9.3.32 The HRA therefore concluded that this would not significantly affect the sites as the habitat communities and species living in estuaries are habituated to a range salinities and temperatures and are highly tolerant to fluctuating environmental conditions; and the scheme would not be outside the natural range of salinity. It should also be noted that:

- this assessment assumed the implementation of conditions on operation that would require that brine discharges be reduced to maintain salinities in the normal range when flows at the Weaver Sluices were below Q75;
- the brine discharges will occur for six years only during the solution mining phase.

9.3.33 In theory, the NWT SRO options may marginally reduce flows in the Ship Canal which may affect brine dilution; however, the reduction (and the corresponding effects on salinity) will be negligible; furthermore, the conditions relating to the brine discharge below Q75 will

[55] Available at: www.kgsp.co.uk/wp-content/uploads/2015/12/6.2-KGSP-ES-Technical-Appendices.pdf]
[56] Available at: http://www.kgsp.co.uk/wp-content/uploads/2015/12/5.4-KGSP-HRA.pdf

ensure that salinities remain within the predicted range. Adverse in combination effects will not therefore occur with this scheme.

9.4 Assessment Summary

9.4.1 [✂]

9.4.2 Note, if no adverse effects alone or in combination occur for the Mersey Estuary SPA / Ramsar, other European sites in the area will not be indirectly affected if / when their qualifying feature populations utilise the Mersey Estuary SPA / Ramsar (i.e. Ribble and Alt Estuaries SPA / Ramsar, the Mersey Narrows and North Wirral Foreshore SPA / Ramsar, the Dee Estuary SPA / Ramsar, Martin Mere SPA / Ramsar, Morecambe Bay and Duddon Estuary SPA, and Morecambe Bay Ramsar).

10. Appropriate Assessment – STTA4

10.1 Screening Summary

10.1.1 This section focuses on the potential effects of STTA4 on those European sites that are not subject to site-led assessments in Sections 5 – 9; this is for clarity and simplicity, as the potential environmental changes associated with the option will be small-scale and the effect pathways largely the same; and the European sites considered in this section will only be exposed to potential effects from this option. This section therefore assesses the effects of STTA4 on the following sites:

- Midland Meres and Mosses Phase 1 Ramsar (principally in relation to the Hatch Mere SSSI and Flaxmere Moss SSSI components of this site);
- Midland Meres and Mosses Phase 2 Ramsar (principally in relation to the Oak Mere SSSI and Linmer Moss SSSI components of this site);
- Oak Mere SAC;
- River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC.

10.1.2 Effects on the Mersey Estuary SPA / Ramsar are considered in Section 8.

10.1.3 In summary, the scheme will require small temporary working compounds at intervals along the aqueduct to allow for modifications to existing valve chambers, valve houses, bulk supply points and break pressure tanks. These works will be at discrete locations on the existing pipeline route, some of which are relatively close to the above designated sites, and so construction impacts are possible in the absence of mitigation.

10.1.4 Due to the limited scope of the effects the assessment structure has been simplified relative to Sections 5 – 8 to ensure it remains appropriate to the scale and complexity of the potential effects.

10.2 Assessment of Effects

Midland Meres and Mosses Phase 1 Ramsar

10.2.1 Midlands Meres and Mosses Phase 1 Ramsar meets the following criteria:

- Criterion 1 (sites containing representative, rare or unique wetland types); a diverse range of habitats from open water to raised bog formed in natural depressions in the glacial drift.
- Criterion 2 (supports vulnerable, endangered, or critically endangered species or threatened ecological communities); supports a number of rare species of plants associated with wetlands including five nationally scarce species together with an assemblage of rare wetland invertebrates.

10.2.2 The only units of this site potentially exposed to effects from STTA4 are Hatch Mere SSSI and Flaxmere Moss SSSI, which are approximately 120m from a location identified for valve chamber works; the remaining site units are all over 5km from the aqueduct and not linked by surface watercourses.

10.2.3 Hatch Mere SSSI is essentially an open-water site, whereas Flaxmere Moss SSSI is primarily an infilled basin mire. There are no direct surface water connections between the likely construction area and these sites, based on OS mapping.

10.2.4 Based on the location and likely scale of the works, the only potential pathway for effects is via site-derived pollutants (run-off, emissions to air) affecting the site habitats; there is no risk of the works affecting habitat that might be functionally critical to the integrity of the mobile species of the site (wetland invertebrates) based on aerial photos of the locations likely to be affected.

10.2.5 With regard to site-derived pollutants:

- it is self-evident that emissions to air from plant required for these minor works will be negligible and short-term, with the distance to the site ensuring that there is no risk of any relevant threshold exceedances; and
- there are no direct surface water connections between the likely construction area and these sites, based on OS mapping surface run-off and other pathways for site.

10.2.6 These potential pathways can be reliably prevented using established project-level measures (see Appendix C); application of these measures will ensure that the scheme has 'no effect' on this site or its interest features (hence no risk of 'in combination' effects with other plans or projects).

Midland Meres and Mosses Phase 2 Ramsar

10.2.7 Midlands Meres and Mosses Phase 2 Ramsar meets the following criteria:

- Criterion 1 (sites containing representative, rare or unique wetland types); a diverse range of habitats from open water to raised bog formed in natural depressions in the glacial drift.
- Criterion 2 (supports vulnerable, endangered, or critically endangered species or threatened ecological communities); supports a number of rare species of plants and invertebrates associated with wetlands.

10.2.8 The only units of this site potentially exposed to effects from STTA4 are Oak Mere SSSI and Linmer Moss SSSI which are approximately 800m and 1km respectively from the nearest locations identified for valve chamber works; the remaining site units are all over 2km from the aqueduct and not linked by surface watercourses.

10.2.9 Oak Mere is a shallow acidic mesotrophic lake with a relatively complex hydrology related to both ground- and surface-water input. Linmer Moss SSSI is a small steep-sided waterbody with fen vegetation. There are no direct surface water connections between the likely construction area and these sites, based on OS mapping.

10.2.10 Based on the location and likely scale of the works, the only potential pathway for effects is via site-derived pollutants (run-off, emissions to air) affecting the site habitats; there is no risk of the works affecting habitat that might be functionally critical to the integrity of the mobile species of the site (wetland invertebrates) based on aerial photos of the locations likely to be affected.

10.2.11 With regard to site-derived pollutants:

- it is self-evident that emissions to air from plant required for these minor works will be negligible and short-term, with the distance to the site ensuring that there is no risk of any relevant threshold exceedances; and
- there are no direct surface water connections between the likely construction area and these sites, based on OS mapping surface run-off and other pathways for site.

10.2.12 These potential pathways can be reliably prevented using established project-level measures (see Appendix C); application of these measures will ensure that the scheme has 'no effect' on this site or its interest features (hence no risk of 'in combination' effects with other plans or projects).

Oak Mere SAC

10.2.13 The qualifying features of this site are:

- Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
- Transition mires and quaking bogs

10.2.14 The effects of the option on this site will be as per the Oak Mere SSSI component of the Midlands Meres and Mosses Phase 2 Ramsar (above); in summary, all potential effect pathways can be reliably prevented using established project-level measures (see Appendix C); application of these measures will ensure that the scheme has 'no effect' on this site or its interest features (hence no risk of 'in combination' effects with other plans or projects).

River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC.

10.2.15 The qualifying features of this site are:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- Sea lamprey *Petromyzon marinus*
- Brook lamprey *Lampetra planeri*
- River lamprey *Lampetra fluviatilis*
- Atlantic *salmon Salmo salar*
- Bullhead *Cottus gobio*

- Otter *Lutra lutra*
- Floating water-plantain *Luronium natans*

10.2.16 The site is located over 6km from the nearest locations identified for valve chamber works, although is a downstream receptor for multiple construction locations.

10.2.17 Based on the location and likely scale of the works, the only potential pathway for effects is via site-derived pollutants (run-off) affecting the site itself; there is no risk of the works affecting non-designated habitat that might be functionally critical to the integrity of the mobile species of the site (fish species, otter) based on aerial photos of the locations likely to be affected. Note, the Floating water-plantain feature is located in Bala Lake and will not be exposed to any effects irrespective of mitigation.

10.2.18 With regard to site-derived pollutants, potential pathways can be reliably prevented using established project-level measures (see Appendix C); application of these measures will ensure that the scheme has 'no effect' on this site or its interest features (hence no risk of 'in combination' effects with other plans or projects).

10.3 Conclusion

10.3.1 STTA4 involves minor, small-scale localised works to existing valve chambers, valve houses, bulk supply points and break pressure tanks on the aqueduct. These works will be at discrete locations on the existing pipeline route, some of which are relatively close to European sites. However, it is certain that potential pathways for effects can be reliably prevented using established project-level measures (see Appendix C), and so the option will have **no adverse effects, alone or in combination**, on any European sites.

11. Strategic In Combination Assessment

11.1 Between-option 'in combination' effects

11.1.1 The effects of the NWT SRO options operating 'in combination' have been explored through the screening and appropriate assessment phases (see **Sections 5 – 10**). These assessments have concluded that there is no or low risk of unavoidable adverse 'in combination' effects for any European sites or features based on the currently available information, although this will require review with the development of the groundwater model and future assessment stages.

11.2 'In combination' effects with other UU Plans

WRMP

11.2.1 The NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and so the NWT SRO options will therefore be included in the WRMP (which will precede the SRO submissions). There will be other options in the WRMP that could operate 'in combination' with the NWT SRO options, although this 'in combination' has been undertaken as part of the HRA for the emerging WRMP, and will be completed prior to the Gate 2 submission. Therefore, the NWT SRO will be essentially part of the WRMP and so cannot have 'in combination' effects with this plan.

Drought Plan

11.2.2 As with the WRMP, the NWT SRO is developed in the context of UU's WRMP (the options are feasible options developed for the WRMP) and the options will therefore be included in the WRMP and assessed 'in combination' as part of the HRA of that plan; the requirements of UU's current Drought Plan are accounted for within the WRMP calculations and the HRA of this plan, and so there cannot be additional 'in combination' effects between the NWT SRO and the Drought Plan.

11.2.3 In addition, the drought options identified in the revised draft Drought Plan 2021[57] do not affect any of the European sites potentially affected by the NWT SRO, and the revised draft Drought Plan 2021 HRA[58] confirms that there will be 'no LSE' alone or in combination as a result of the Drought Plan.

[57] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/draft-final-drought-plan-2022.pdf

[58] https://www.unitedutilities.com/globalassets/z_corporate-site/about-us-pdfs/water-resources/uu-revised-draft-dp-hra-_300721.pdf

Drainage and Wastewater Management Plan (DWMP)

11.2.4 UU's draft DWMP has identified a total of 403 options for 22 Tactical Planning Units (TPUs)[59]. For each of the 22 TPU catchments a legal obligation to 'increase treatment capacity' option has been identified for the relevant wastewater treatment works; however, the options are largely generic (e.g. 'enhanced operational maintenance'; 'sludge centre rationalisation'; 'surface water source control measures') that do not identify specific locations for interventions below the TPU level.

11.2.5 The DWMP HRA concludes that there is insufficient information available in the DWMP to enable potential effects on European sites within, near or downstream of TPUs to be meaningfully assessed, and so assessment is necessarily deferred 'down the line'. However:

- The options will involve minor and/or unexceptional construction works, and construction effects can clearly be avoided with normal best-practice measures.
- Implementation of the options must be consistent with the DWMP objectives and these include meeting all permitting requirements (now, or in the future) and protecting, restoring or improving the environment by reducing spills from storm overflows and delivering WINEP-driven schemes. Operational effects on water quality would therefore be neutral or positive both collectively and for individual schemes. Other operational effects are conceivable (for example, new pumping stations may introduce noise and vibration effects), but these will be scheme-specific, not systematically driven by the options in the DWMP, and avoidable with best-practice design measures.

11.2.6 Consequently, the interaction of the NWT SRO options with specific schemes derived from the DWMP can only be assessed at the project level (although there is nothing to suggest that adverse effects will be unavoidable); and overall water quality within the receiving waterbodies (including European sites potentially affected by the NWT SRO) will be positive as a result of the DWMP (so adverse in combination effects would not occur).

11.3 Between-company 'in combination' effects

WRMPs

11.3.1 Other water company plans are currently in preparation, and so an 'in combination' assessment cannot be completed at this stage; however, the SRO options will not affect any European sites that are likely to also be exposed to effects associated with options from other WRMPs, and so in combination effects with other WRMPs would not be expected.

[59] TPUs are essentially units within wastewater drainage catchments, typically associated with a treatment works.

Drought Plans

11.3.2 As with the WRMPs, the drought options within other water company Drought Plans will not affect any European sites that are likely to also be exposed to effects associated with the SRO options, and so in combination effects with other WRMPs would not be expected.

11.4 In combination effects with other plans and programmes

Effects with other strategic plans and water resource demand

11.4.1 The NWT SRO is developed in the context of UU's WRMP. The WRMP explicitly accounts for growth forecasts when calculating future water demand (and hence areas with potential deficits). This means that 'in combination' water-resource effects with growth promoted by other plans or projects are considered and accounted for during the WRMP development process and its deficit calculations.

11.4.2 Potential 'in combination' effects in respect of water-resource demands due to other plans or projects are therefore unlikely since these demands are explicitly modelled when determining deficit zones and hence developing Feasible Options. As a result (in respect of water resources) the WRMP is not likely to make non-significant effects in other plans significant (indeed, other plans are arguably the 'source' of any potential effects in respect of water demand, with the WRMP having to manage potential effects that are not generated by the WRMP itself).

11.4.3 Local plans are not all consistent with regard to planned growth and this arguably introduces some uncertainty. However, with regard to water resources and planning uncertainty it is important to note the following:

- The WRMP safeguards against uncertainty in option yield and timing through 'Target Headroom'; this is an allowance provided in the planning process (i.e. designed-in spare capacity) that ensures that any supply-demand deficit will still be met if there is an underperforming demand management measure or growth exceeds predicted levels. It is therefore extremely unlikely that additional demand or a poorly-performing option would 'suddenly' result in a deficit that might affect a European site; and (in any case);
- The WRMP is revised on a five-yearly cycle, which allows any changes in demand forecasts (e.g. as new plans come forward) to be accounted for, and for timely intervention should a measure not be performing as expected. Delivery is also formally reviewed on an annual basis.

11.4.4 It is therefore considered that the Final WRMP options will not have significant 'in combination' effects with local plans in respect of water resources; this applies to the NWT SRO options also, since they are derived from the WRMP planning and optioneering process.

Effects with major projects

11.4.5 Known major projects that are likely to increase demand have been taken into account during the development of UU's WRMP and determination of future deficits.

11.4.6 With regard to individual projects interacting with specific options to affect particular sites, this is addressed in **Sections 5 – 9**.

11.4.7 In summary, reference has been made to the Planning Inspectorates National Infrastructure Projects database[60] which includes major projects, subject to the requirements of the Planning Act 2008. It includes projects:

- where the developer has advised the Planning Inspectorate in writing that they intend to submit an application in the future;
- where an application has already been made to the Planning Inspectorate and is undergoing the development consent process;
- where a Development Consent Order (DCO) application has been determined.

11.4.8 This exercise did not identify any major projects likely to adversely affect the integrity of any sites in combination with the NWT SRO.

Minor projects

11.4.9 It has not been possible to produce a definitive list of existing (minor) planning applications near each option's zone of influence and, generating a list at this stage would be of little value. It is possible that there will be 'in combination' project-specific construction effects associated with future planning applications, although this can only be assessed at the time of any application. This is consistent with the ACWG guidance on cumulative/in combination assessments.

Effects with strategic development pressure

11.4.10 Regional and local plans have been reviewed at a high level to determine whether there are any likely significant 'in combination' effects, with allocation sites identified where possible. This review has not indicated any potential or likely 'in combination' effects that could occur as a result of cumulative development pressure, and in reality the timescales involved in the implementation of the options and the absence of detail on allocation proposals makes any 'in combination' assessment difficult and potentially meaningless. However, the construction works required for the options are temporary and not of a scale or type that would make 'in combination' effects likely.

[60] https://infrastructure.planninginspectorate.gov.uk/projects/

12. Gate 2 Conclusions

12.1 Overview

12.1.1 UU has identified 14 options to maintain supplies to customers in the north-west and make water available for the Severn Thames Transfer SRO; ten of these are included in the NWT Full Solution, with the remaining four held in reserve.

12.1.2 RAPID's Gate 2 guidance (February 2022[61]) states that at Gate 2 all options must be assessed against the provisions of the Habitats Regulations. However, it is recognised that the gated submissions are not plans or projects that are formally subject to the Regulations, and that not all evidence required to support the HRA (and other assessments) of the SRO options (collectively, or individually) will necessarily be available at Gate 2.

12.1.3 However, it should be noted that the terminology of the HRA tests does not allow for equivocal conclusions, and so **all the assessments (both 'screening' and 'appropriate assessment') are necessarily preliminary and any conclusions indicative only, to guide the gated decision-making process**: they are not intended to be definitive Regulations-compliant statements. NE has indicated that it considers that reaching any conclusions at this point is premature and so the report has referred to risk of an option having adverse effects, which would not be acceptable terminology in a formal HRA, but which aims to preserve some of the value of the assessment to the gated decision-making process. All conclusions will be revisited and verified post-Gate 2.

12.1.4 This report accompanies the NWT SRO Gate 2 submission and summarises the current assessment of the SRO against the requirements of the Habitats Regulations, using the best available information at the time of the Gate 2 submission, and highlighting key areas for further evidence collection and assessment for Gate 3.

12.1.5 For each option (or group of options, as appropriate), the assessment has comprised:

- an initial 'screening' of European sites within the study area to identify those sites and features where there will self-evidently be 'no effect', 'no likely significant effects', or positive effects due to the option[62], and those where significant effects are likely or uncertain; and
- an outline 'appropriate assessment' of any European sites where significant effects cannot be excluded.

12.1.6 The conservation objectives are taken into account at the screening and appropriate assessment stages as necessary.

[61] Regulators' Alliance for Progressing Infrastructure Development (February 2022). Strategic regional water resource solutions guidance for gate 2.

[62] Note, for options with 'no effects' or positive effects there is no possibility of 'in combination' effects.

12.2 Screening

12.2.1 The screening has concluded that significant effects are either likely or uncertain for the following sites and options (note, this includes options that may rely on mitigation measures to prevent significant effects occurring); these are therefore taken forward to an appropriate assessment stage.

Table 12.1 Summary of options and sites requiring 'appropriate assessment'

European site	Options	Alone or IC*?
Liverpool Bay SPA	STT041b: Heaton Pk (R Roch & R Irwell) WR015: River Irwell to new WTW WR076: River Bollin WR102b: Widnes Boreholes WR105a: Lymm Boreholes WR106b: Walton and Daresbury b/h WR111: Woodford Boreholes WR113: Tytherington Boreholes WR144: Saddleworth WR149: Lightshaw WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill WR049d: River Ribble	IC IC IC IC IC IC IC IC IC IC IC IC IC
Manchester Mosses SAC	WR149: Lightshaw	Alone
Martin Mere Ramsar	WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill	Alone / IC
Martin Mere SPA	WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill	Alone / IC
Mersey Estuary Ramsar	STTA4: NWT_Vyrnwy STT041b: Heaton Pk (R Roch & R Irwell) WR015: River Irwell to new WTW WR076: River Bollin WR102b: Widnes Boreholes WR105a: Lymm Boreholes WR106b: Walton and Daresbury b/h WR111: Woodford Boreholes WR113: Tytherington Boreholes WR144: Saddleworth WR149: Lightshaw	Alone / IC Alone / IC IC Alone / IC Alone / IC IC IC IC IC IC IC
Mersey Estuary SPA	STTA4: NWT_Vyrnwy STT041b: Heaton Pk (R Roch & R Irwell) WR015: River Irwell to new WTW WR076: River Bollin WR102b: Widnes Boreholes WR105a: WR106b: Walton and Daresbury b/h WR111: Woodford Boreholes WR113: Tytherington Boreholes	Alone / IC Alone / IC IC Alone / IC Alone / IC IC IC IC IC

European site	Options	Alone or IC*?
	WR144: Saddleworth WR149: Lightshaw	IC IC
Mersey Narrows and North Wirral Foreshore Ramsar	(Indirect effects on interest features via impacts on Ribble and Alt SPA/Ramsar or Mersey Estuary SPA / Ramsar)	IC
Mersey Narrows and North Wirral Foreshore SPA	(Indirect effects on interest features via impacts on Ribble and Alt SPA/Ramsar or Mersey Estuary SPA / Ramsar)	IC
Midland Meres and Mosses Phase 1 Ramsar	STTA4: NWT_Vyrnwy WR105a: Lymm Boreholes	Alone Alone
Midland Meres and Mosses Phase 2 Ramsar	STTA4: NWT_Vyrnwy	Alone
Oak Mere SAC	STTA4: NWT_Vyrnwy	Alone
Ribble and Alt Estuaries Ramsar	WR049d: River Ribble WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill	Alone / IC
Ribble and Alt Estuaries SPA	WR049d: River Ribble WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill	Alone / IC
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	STTA4: NWT_Vyrnwy	Alone
Rostherne Mere Ramsar	WR105a: Lymm Boreholes	Alone
Sefton Coast SAC	WR107a: Aughton Park & Moss End boreholes WR107b: Randles Bridge, Knowsley and Primrose Hill	Alone / IC

*IC – 'In combination' with other NWT options

12.2.2 Note that the 'appropriate assessment' sections do not currently include detailed assessments of potential effects on Liverpool Bay SPA (principally risks associated with possible effects on the Alt (hence foraging areas for common terns offshore from the estuary) and to a lesser extent the Ribble (used by red-throated divers); or the associated effects on the tern interest features of the Mersey Narrows and North Wirral Foreshore SPA. These sites and pathways will be addressed in future workstreams, however the risks of adverse effects are considered low based on the assessments for the associated sites that are likely to have a greater exposure to the option effects (i.e. Mersey Estuary SPA/Ramsar; Ribble and Alt Estuary SPA/Ramsar).

12.3 Appropriate Assessments

12.3.1 Informal appropriate assessments were undertaken for those European sites that may be significantly affected by NWT SRO schemes (or where there was uncertainty at the screening stage), alone or in combination.

12.3.2 The preliminary results of the assessments are summarised in **Table 12.2**.

12.3.3 In conclusion, whilst there are some residual uncertainties at the Gate 2 stage (principally associated with aquifer response that will be resolved with the development of the groundwater models), the currently available data indicate that the risk of the options adversely affecting the integrity of any European sites, alone or in combination, is low – and so progression of the options beyond Gate 2 would be reasonable.

12.3.4 It should also be noted that several of the options are not required until late in the planning cycle (2040 or 2060) and so there is therefore substantial time for any residual uncertainties associated with these options to be resolved (or alternative options identified is adverse effects prove to be unavoidable).

Table 12.2 Summary of preliminary assessment conclusions, key uncertainties and additional investigations that may be required

Site(s)	Assessment summary	Key uncertainties	Additional investigations
Liverpool Bay SPA	[✂]	• Groundwater models for the aquifer are still in development (precise impact of groundwater exploitation on freshwater input to the Alt not certain, although the current assessment is conservative (assumes all of the abstraction from groundwater is felt at the estuary). • EA water quality concerns on the Ribble	• Groundwater model completion. • Models of tidal mixing may be appropriate depending on groundwater model outputs. • More detailed water quality modelling is planned using existing SAGIS-SIMCAT and ICM models, to assess the impact of the proposed abstractions on water quality in the Irwell and (potentially) the Bollin. • Additional information on the operation of the Ship Canal and typical apportionment of flows with the River Mersey, plus potential effects on dredging frequency. • Groundwater model completion • Determine nature of EA water quality concerns for the River Ribble.
Manchester Mosses SAC	[✂]	• Groundwater models for the aquifer are still in development (precise extent and magnitude of any drawdown effects uncertain). • Site units have not been subject to field survey (may be required to determine the precise relationship / connectivity of the SAC and associated functional habitats with the groundwater body).	• Groundwater model completion • Hydrological surveys of SAC margins to develop conceptual model of local connectivity (may be appropriate depending on groundwater model outputs).
Rostherne Mere Ramsar / Midland	[✂]	• Groundwater models for the aquifer are still in development (precise extent and	• Groundwater model completion

Site(s)	Assessment summary	Key uncertainties	Additional investigations
Meres and Mosses Phase 1 Ramsar		magnitude of any drawdown effects uncertain). • NE has suggested that there are some complexities at Rostherne Mere that may not be reflected by the current geological models for the site.	• Review additional hydrological assessment data that NE may hold relating to Rostherne Mere.
Martin Mere SPA / Martin Mere Ramsar	[✂]	• Groundwater models for the aquifer are still in development (precise extent and magnitude of any drawdown effects uncertain).	• Groundwater model completion • Review of site water level management plan (may be appropriate depending on groundwater model outputs).
Mersey Estuary SPA / Mersey Estuary Ramsar	[✂]	• Groundwater models for the aquifer are still in development (precise impact of groundwater exploitation on freshwater input to the estuary not certain, although the current assessment is conservative (assumes all of the abstraction from groundwater is felt at the estuary). • Water quality within the Ship Canal and lower Mersey is being explored as part of the WFD assessment.	• Groundwater model completion. • Models of tidal mixing may be appropriate depending on groundwater model outputs. • More detailed water quality modelling is planned using existing SAGIS-SIMCAT and ICM models, to assess the impact of the proposed abstractions on water quality in the Irwell and (potentially) the Bollin. • Additional information on the operation of the Ship Canal and typical apportionment of flows with the River Mersey, plus potential effects on dredging frequency.
Ribble and Alt Estuaries Ramsar / Sefton Coast SAC	[✂]	• Groundwater models for the aquifer are still in development (precise extent and	• Groundwater model completion.

Site(s)	Assessment summary	Key uncertainties	Additional investigations
		magnitude of any drawdown effects uncertain).	
Ribble and Alt Estuaries SPA / Ribble and Alt Estuaries Ramsar	[✂]	• Groundwater models for the aquifer are still in development (precise extent and magnitude of any effects on flows in the Alt uncertain). • EA water quality concerns on the Ribble. • Usage of Brockholes Nature Reserve.	• Groundwater model completion • Determine nature of EA water quality concerns for the River Ribble. • Data on usage of Brockholes by (particularly) tern species (hence disturbance risk).
The Dee Estuary Ramsar / The Dee Estuary SPA **Mersey Narrows and North Wirral Foreshore Ramsar / Mersey Narrows and North Wirral Foreshore SPA** **Morecambe Bay and Duddon Estuary SPA / Morecambe Bay Ramsar**	[✂]	• Residual uncertainties as per estuarine sites noted above.	• As per estuarine sites noted above.

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Appendix A
European sites considered by the HRA process

The table below lists the European sites and their features considered for the NWT SRO HRA (i.e. sites within 20km of an option, or downstream, or upstream sites supporting fish that may use affected reaches of rivers). Hyperlinks to site documentation are provided to simplify presentation.

Berwyn SPA	
A074	Red kite *Milvus milvus*
A098	Merlin *Falco columbarius*
A082	Hen harrier *Circus cyaneus*
A103	Peregrine *falcon Falco peregrinus*
Bowland Fells SPA	
A183	Lesser black-backed gull *Larus fuscus*
A082	Hen harrier *Circus cyaneus*
A098	Merlin *Falco columbarius*
Brown Moss SAC	
S1831	Floating water-plantain *Luronium natans*
Dee Estuary/ Aber Dyfrdwy SAC	
H1130	Estuaries
H1140	Mudflats and sandflats not covered by seawater at low tide
H1210	Annual vegetation of drift lines
H1230	Vegetated sea cliffs of the Atlantic and Baltic Coasts
H1310	*Salicornia* and other annuals colonizing 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")
H2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes")
H2190	Humid dune slacks
S1095	Sea lamprey *Petromyzon marinus*
S1099	River lamprey *Lampetra fluviatilis*
S1395	Petalwort *Petalophyllum ralfsii*
Fenn`s, Whixall, Bettisfield, Wem and Cadney Mosses SAC	
H7110	Active raised bogs
H7120	Degraded raised bogs still capable of natural regeneration
Liverpool Bay / Bae Lerpwl SPA	
A001	Red-throated diver *Gavia stellata*
A065	Black (common) *scoter Melanitta nigra*
A195	Little tern *Sterna albifrons*
A193	Common tern *Sterna hirundo*
A177	Little gull *Larus minutus*
WATR	Waterbird assemblage
Manchester Mosses SAC	
H7120	Degraded raised bogs still capable of natural regeneration

Martin Mere Ramsar	
Crit. 5	Crit. 5 - regularly supports 20,000 or more waterbirds
Crit. 6	Crit. 6 - regularly supports 1% of the individuals in a population of one species/subspecies of waterbirds
Martin Mere SPA	
A037	Tundra swan *Cygnus columbianus bewickii*
A050	Eurasian wigeon *Anas penelope*
A040	Pink-footed goose *Anser brachyrhynchus*
A054	Northern pintail *Anas acuta*
A038	Whooper swan *Cygnus cygnus*
WATR	Waterbird assemblage
Mersey Estuary Ramsar	
Crit. 5	Crit. 5 - regularly supports 20,000 or more waterbirds
Crit. 6	Crit. 6 - regularly supports 1% of the individuals in a population of one species/subspecies of waterbirds
Mersey Estuary SPA	
A162	Common redshank *Tringa totanus*
A052	Eurasian teal *Anas crecca*
A162	Common redshank *Tringa totanus*
A137	Ringed plover *Charadrius hiaticula*
A142	Northern lapwing *Vanellus vanellus*
A140	European golden plover *Pluvialis apricaria*
A054	Northern pintail *Anas acuta*
A160	Eurasian curlew *Numenius arquata*
A050	Eurasian wigeon *Anas penelope*
A048	Common shelduck *Tadorna tadorna*
A672	Dunlin *Calidris alpina alpina*
A141	Grey plover *Pluvialis squatarola*
A616	Black-tailed godwit *Limosa limosa islandica*
A005	Great crested grebe *Podiceps cristatus*
Mersey Narrows and North Wirral Foreshore Ramsar	
Crit. 4	Crit. 4 - supports plant/animal species at a critical stage in their life cycles, or provides refuge
Crit. 5	Crit. 5 - regularly supports 20,000 or more waterbirds
Crit. 6	Crit. 6 - regularly supports 1% of the individuals in a population of one species/subspecies of waterbirds
Mersey Narrows and North Wirral Foreshore SPA	
A672	Dunlin *Calidris alpina alpina*
A193	Common tern *Sterna hirundo*
A130	Eurasian oystercatcher *Haematopus ostralegus*
A162	Common redshank *Tringa totanus*
A177	Little gull *Larus minutus*
A671	Red knot *Calidris canutus islandica*
A193	Common tern *Sterna hirundo*
A017	Great cormorant *Phalacrocorax carbo*
A141	Grey plover *Pluvialis squatarola*
A144	Sanderling *Calidris alba*
A157	Bar-tailed godwit *Limosa lapponica*
WATR	Waterbird assemblage
Midland Meres and Mosses Phase 1 Ramsar	
Crit. 1	Crit. 1 - sites containing representative, rare or unique wetland types
Midland Meres and Mosses Phase 2 Ramsar	
Crit. 1	Crit. 1 - sites containing representative, rare or unique wetland types
Crit. 2	Crit. 2 - supports vulnerable, endangered, or critically endangered species or threatened eco. communities

Oak Mere SAC	
H3110	Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)
H7140	Transition mires and quaking bogs
Peak District Dales SAC	
H4030	European dry heaths
H6130	Calaminarian grasslands of the *Violetalia calaminariae*
H6210	Semi-natural dry grasslands and scrubland facies on c*alca*reous substrates (*Festuco-Brometalia*) (* important orchid sites)
H7230	Alkaline fens
H8120	C*alca*reous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)
H8210	C*alca*reous rocky slopes with chasmophytic vegetation
H9180	*Tilio-Acerion* forests of slopes, screes and ravines
S1096	Brook lamprey *Lampetra planeri*
S1163	Bullhead *Cottus gobio*
S1092	White-clawed (or Atlantic stream) crayfish *Austropotamobius pallipes*
Peak District Moors (South Pennine Moors Phase 1) SPA	
A098	Merlin *Falco columbarius*
A140	European golden plover *Pluvialis apricaria*
A222	Short-eared owl *Asio flammeus*
Ribble and Alt Estuaries Ramsar	
Crit. 2	Crit. 2 - supports vulnerable, endangered, or critically endangered species or threatened eco. communities
Crit. 5	Crit. 5 - regularly supports 20,000 or more waterbirds
Crit. 6	Crit. 6 - regularly supports 1% of the individuals in a population of one species/subspecies of waterbirds
Ribble and Alt Estuaries SPA	
A017	Great cormorant *Phalacrocorax carbo*
A616	Black-tailed godwit *Limosa limosa islandica*
A038	Whooper swan *Cygnus cygnus*
A179	Black-headed gull *Larus ridibundus*
A160	Eurasian curlew *Numenius arquata*
A062	Greater scaup *Aythya marila*
A144	Sanderling *Calidris alba*
A158	Whimbrel *Numenius phaeopus*
A183	Lesser black-backed gull *Larus fuscus*
A672	Dunlin *Calidris alpina alpina*
A162	Common redshank *Tringa totanus*
A048	Common shelduck *Tadorna tadorna*
A137	Ringed plover *Charadrius hiaticula*
A141	Grey plover *Pluvialis squatarola*
A065	Black (common) scoter *Melanitta nigra*
A193	Common tern *Sterna hirundo*
A162	Common redshank *Tringa totanus*
A142	Northern lapwing *Vanellus vanellus*
A144	Sanderling *Calidris alba*
A130	Eurasian oystercatcher *Haematopus ostralegus*
A143	Red knot *Calidris canutus*
A157	Bar-tailed godwit *Limosa lapponica*
A151	Ruff *Philomachus pugnax*
A037	Tundra swan *Cygnus columbianus bewickii*
A052	Eurasian teal *Anas crecca*
A050	Eurasian wigeon *Anas penelope*
A040	Pink-footed goose *Anser brachyrhynchus*

A140	European golden plover *Pluvialis apricaria*
A054	Northern pintail *Anas acuta*
SBA	Seabird assemblage
WATR	Waterbird assemblage
SBA	Seabird assemblage
River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC	
H3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
S1095	Sea lamprey *Petromyzon marinus*
S1096	Brook lamprey *Lampetra planeri*
S1099	River lamprey *Lampetra fluviatilis*
S1106	Atlantic *salmon Salmo salar*
S1163	Bullhead *Cottus gobio*
S1355	Otter *Lutra lutra*
S1831	Floating water-plantain *Luronium natans*
Rixton Clay Pits SAC	
S1166	Great crested newt *Triturus cristatus*
Rochdale Canal SAC	
S1831	Floating water-plantain *Luronium natans*
Rostherne Mere Ramsar	
Crit. 1	Crit. 1 - sites containing representative, rare or unique wetland types
Sefton Coast SAC	
H2110	Embryonic shifting dunes
H2120	Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes")
H2130	Fixed coastal dunes with herbaceous vegetation ("grey dunes")
H2150	Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)
H2170	Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)
H2190	Humid dune slacks
S1166	Great crested newt *Triturus cristatus*
S1395	Petalwort *Petalophyllum ralfsii*
South Pennine Moors Phase 2 SPA	
A098	Merlin *Falco columbarius*
A140	European golden plover *Pluvialis apricaria*
A222	Short-eared owl *Asio flammeus*
BBA	Breeding bird assemblage
BBA	Breeding bird assemblage
South Pennine Moors SAC	
H4010	Northern Atlantic wet heaths with *Erica tetralix*
H4030	European dry heaths
H7130	Blanket bogs (* if active bog)
H7140	Transition mires and quaking bogs
H91A0	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
The Dee Estuary Ramsar	
Crit. 6	Crit. 6 - regularly supports 1% of the individuals in a population of one species/subspecies of waterbirds
Crit. 2	Crit. 2 - supports vulnerable, endangered, or critically endangered species or threatened eco. communities
Crit. 5	Crit. 5 - regularly supports 20,000 or more waterbirds
Crit. 1	Crit. 1 - sites containing representative, rare or unique wetland types

The Dee Estuary SPA	
A162	Common redshank *Tringa totanus*
A143	Red knot *Calidris canutus*
A193	Common tern *Sterna hirundo*
A054	Northern pintail *Anas acuta*
A162	Common redshank *Tringa totanus*
A672	Dunlin *Calidris alpina alpina*
A195	Little tern *Sterna albifrons*
A052	Eurasian teal *Anas crecca*
A130	Eurasian oystercatcher *Haematopus ostralegus*
A141	Grey plover *Pluvialis squatarola*
A048	Common shelduck *Tadorna tadorna*
A616	Black-tailed godwit *Limosa limosa islandica*
A191	Sandwich tern *Sterna sandvicensis*
A160	Eurasian curlew *Numenius arquata*
A157	Bar-tailed godwit *Limosa lapponica*
WATR	Waterbird assemblage
West Midlands Mosses SAC	
H3160	Natural dystrophic lakes and ponds

Appendix B
Effect Pathway Assumptions

Table B1 (from UKWIR 2021) and the following paragraphs outline some of the general assumptions that are typically (and reliably) applied to plan-level assessments where effect pathways are imaginable but not quantifiable at the plan level. These are applied cautiously, recognising that there is always a risk of atypical scenarios, but have been proved to be generally robust across a wide range of scenarios.

Table B1 Potential Impacts of Plan Options (from UKWIR 2021)

Broad categories of potential impacts on European sites, with examples	**Examples of operations responsible for impacts (distance assumptions in italics)**
Physical loss: • Removal (including offsite effects, e.g. foraging habitat, and removal of supporting habitat within boundary of a SPA) • Smothering	Development of infrastructure associated with scheme, e.g. new or temporary pipelines, transport infrastructure, temporary weirs. Indirect effects from a reduction in flows e.g. drying out marginal habitat. Physical loss is most likely to be significant where the boundary of the scheme extends within the boundary of the European site, or within an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated).
Physical damage: • Sedimentation / silting • Prevention of natural processes including coastal and fluvial bank stabilisation, prevention of long-shore drift etc. • Habitat degradation • Erosion • Fragmentation • Severance/barrier effect • Edge effects	Reduction in river flow leading to permanent and/or temporary loss of available habitat, sedimentation/siltation, fragmentation, etc. Physical damage is likely to be significant where the boundary of the scheme extends within or is directly adjacent to the boundary of the European site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated, or where natural processes link the scheme to the site, such as through hydrological connectivity downstream of a scheme, long shore drift along the coast, or the scheme impacts the linking habitat).

Broad categories of potential impacts on European sites, with examples	Examples of operations responsible for impacts (distance assumptions in italics)
Non-physical disturbance: • Noise (incl. underwater) • Visual presence • Human presence • Light pollution • Vibration (incl. underwater).	Noise from temporary construction or temporary pumping activities. Taking into consideration the noise level generated from general building activity (c. 122dB(A)) and considering the lowest noise level identified in appropriate guidance as likely to cause disturbance to bird species, it is concluded that noise impacts could be significant up to 1km from the boundary of the European site[63]. Noise from vehicular traffic during operation of a scheme. Noise from construction traffic is only likely to be significant where the transport route to and from the scheme is within 3-5km of the boundary of the European site. Plant and personnel involved in in operation of the scheme. These effects (noise, visual/human presence) are only likely to be significant where the boundary of the scheme extends within or is directly adjacent to the boundary of the European site, or within/adjacent to an offsite area of known foraging, roosting, breeding habitat (that supports species for which a European site is designated). Schemes which might include artificial lighting, e.g. for security around a temporary pumping station. Effects from light pollution are only likely to be significant where the boundary of the scheme is within 500m of the boundary of the European site. Vibration from temporary construction From a review of Environment Agency internal guidance on HRA and various websites/sources[64, 65, 66] it is considered that effects of vibration are more likely to be significant if development is within 500m of a European site.

[63] British Standards Institute (BSI) (2009) BS5228 - Noise and Vibration Control on Construction and Open Sites. BSI, London.

[64] Institute of Lighting Professionals (2011) Guidance Notes for the Reduction of Obtrusive Light GN01:2011

[65] Environment Agency (2013 Bird Disturbance from Flood and Coastal Risk Management Construction Activities. Overarching Interpretive Summary Report. Prepared by Cascade Consulting and Institute of Estuarine and Coastal Studies.

[66] Cutts N, Hemingway K and Spencer J (2013) The Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning and Construction Projects. Produced by the Institute of Estuarine and Coastal Studies (IECS). Version 3.2.

Broad categories of potential impacts on European sites, with examples	Examples of operations responsible for impacts (distance assumptions in italics)
Water table/availability: • Drying • Flooding / stormwater • Changes to surface water levels and flows including both increases and reductions. • Changes in groundwater levels and flows • Changes to coastal water movement	Changes to water levels and flows due to increased water abstraction, reduced storage or reduced flow releases from reservoirs to river systems. 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 European site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site.
Toxic contamination: • Water pollution • Soil contamination • Air Pollution	Reduced dilution in downstream or receiving waterbodies due to changes in abstraction or reduced compensation flow releases to river systems. 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 European site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site. Air emissions associated with plant and vehicular traffic during construction and operation of schemes. The effect of dust is only likely to be significant where site is within or in proximity to the boundary of the European site[67, 68]. Without mitigation, dust and dirt from the construction site may be transported onto the public road network and then deposited/spread by vehicles on roads up to 500m from large sites, 200m from medium sites, and 50m from small sites as measured from the site exit. Effects of road traffic emissions from the transport route to be taken by the project traffic are only likely to be significant where the protected site falls within 200 metres of the edge of a road affected[69].

[67] Highways Agency (2003) Design Manual for Roads and Bridges (DMRB), Volume 11.

[68] Institute of Air Quality Management (2014) Guidance on the assessment of dust from demolition and construction v1.1.

[69] NE Internal Guidance – Approach to Advising Competent Authorities on Road Traffic Emissions and HRAs V1.4 Final - June 2018

Broad categories of potential impacts on European sites, with examples	Examples of operations responsible for impacts (distance assumptions in italics)
Non-toxic contamination: • Nutrient enrichment (e.g. of soils and water) • Algal blooms • Changes in salinity • Changes in water chemistry (e.g. pH, calcium balance etc) • Changes in thermal regime • Changes in turbidity • Changes in sedimentation/silting	Changes to water salinity, nutrient levels, turbidity, thermal regime due to increased water abstraction, storage, or reduced compensation flow releases to river systems. 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 European Site. However, these effects are dependent on hydrological continuity between the scheme and the European site, and sometimes, whether the scheme is up or down stream from the European site.
Biological disturbance: • Direct mortality • Changes to habitat availability • Out-competition by non-native species • Selective extraction of species • Introduction of disease • Rapid population fluctuations • Natural succession	Potential for changes to habitat availability, for example reductions in wetted width of rivers leading to desiccation of macrophyte beds due to changes in abstraction or reduced compensation flow releases to river systems. In addition, via removal of vegetation (including hedgerows and trees) used by based as foraging, roosting and hibernation sites and birds as roosting and nesting sites. Creation of new pathway of non-native invasive species. This effect is only likely to be significant where the scheme is situated within the European site or an upstream tributary of the European site (or affects groundwater levels supporting these sites or tributaries) Entrapment during in-river or terrestrial construction works causing injury and/or mortality of mobile species Likely to be a risk of entrapment, injury and/or mortality where the boundary of the option extends within or is directly adjacent to the boundary of a European site or within/adjacent to offsite functionally linked habitat. Mobile species could include fish, bats and European otters for example. Potential for changes to habitat availability via removal of vegetation (including hedgerows and trees) to facilitate construction activities and potential entrapment, injury and/or mortality of breeding birds and roosting/hibernating bats. This effect is dependent on the requirement to remove vegetation (if it cannot be avoided), ecological surveys to determine species presence and timing of removal based on species specific ecological considerations.

In addition:

Water resource sensitive features

The EA has previously published advice on qualifying species and habitats that it considers to be water-resource dependent (National EA guidance: Habitats Directive Stage 2 Review: Water Resources Authorisations – Practical Advice for Agency Water Resources Staff). This is not

reproduced here, but as a general rule most species are not considered water resource dependent with the exception of wildfowl and waders associated with estuarine and wetland sites. Wide-ranging marine / marine dependent species associated with marine sites that are not directly connected to the hydrological zone of influence are not typically considered to be both sensitive and exposed to the effects of the options (except in certain relatively unique circumstances, such as some desalination schemes).

Estuarine birds and freshwater flows

Several studies have suggested that the number and densities of wintering waterbirds around estuarine freshwater channels are consistently greater than across associated mudflats, and that several bird species show significant preferences for freshwater flow areas over mudflats (e.g. Ravenscroft et al. (1997), Ravenscroft (1998, 1999), Ravenscroft & Beardall (2002) & Ravenscroft & Emes (2004)), although other studies have indicated that deeply incised channels associated with large volume inflows are less attractive to birds (Ravenscroft & Beardall, 2002).

There are a number of possible mechanisms for this. Correlations between freshwater flow and particle size (e.g. Ravenscroft & Emes (2004)), and substrate particle size distribution and invertebrate distribution have been recognised (e.g. Goss-Custard et al. (1991), Colwell and Landrum (1993), Yates et al. (1993)). Freshwater flow, salinity and invertebrate distribution have also been correlated (Kelly (2001)).

These physical relationships between invertebrate distributions and freshwater flows are important since there are numerous studies detailing relationships between overwintering waterbirds and the densities or distributions of their invertebrate prey (e.g. Goss-Custard et al. (1991), Colwell (1993), Colwell and Landrum (1993), Yates et al. (1993), Dierschke et al. (1999), Ravenscroft et al. (2002, 2004). Associations between bird densities and particle size (Granadeiro et al. 2004) have also been recognised.

Possible relationships between birds and freshwater flows were investigated in detail through a series of studies in The Swale SPA/Ramsar and the Medway Estuary and Marshes SPA/Ramsar (RPS 2004a, 2004b, 2004c, 2005a; Humpheryes & Kellett 2003). These studies found few consistent patterns, however; for example:

- Whilst the general relationship of birds and creek corridors (rather than channels) was usually replicated between watercourses and embayments, the species assemblage was variable between creeks and years, suggesting that creek-specific variables may be less important for determining the community composition than environmental or community processes operating in the wider estuary or beyond. Most species (67%) displayed no, or a negative, association with creeks (70% when feeding behaviour only was considered).

- Latitudinal relationships between creeks and invertebrates were inconsistent, with only a slight tendency for invertebrate biomass to be higher within the creek corridor than the channel or surrounding mudflats.
- Significant decreases in invertebrate abundance and biomass down longitudinal gradients (potentially related to greater exposure to tidal processes) were recorded, although bird numbers showed the opposite (i.e. greater numbers towards the sea), perhaps reflecting greater foraging accessibility due to interstitial water, or less disturbance.

Furthermore, no significant differences in the usage of creeks by birds were recorded between freshwater creeks and those that were predominantly saline.

A broad consensus position appears to be that it is not freshwater flow volumes *per se* that are critical to the bird / intertidal channel relationship, rather the presence of some flows within channels to maintain morphology, and that bird distributions are often influenced instead by estuary-wide factors (e.g. changes in disturbance levels, reductions in bird populations altering estuary usage, proximity of roost sites), local factors (e.g. the role of creek morphology or substrate penetrability) and small-scale interactions (e.g. inter and intra-specific bird relationships, or prey availability associated with behavioural or physiological responses to intertidal exposure).

Bat species and functional land

Bat species associated with UK SACs are not considered 'water resource sensitive' and so (in the absence of substantial habitat changes caused by operational aspects (e.g. draining of a wetland or replacement of extensive foraging habitat with a reservoir; or introduction of light etc. sources that may disrupt commuting or seasonal movements), their exposure to the outcomes of the WRMP will be limited to incidental effects from construction. In most instances potential effects will not be specifically identifiable or quantifiable (as the locations of works are not necessarily defined, and field surveys would not typically be undertaken at plan level).

UK bat species do not typically travel substantial distances (i.e. tens of kilometres) when foraging and the Bat Conservation Trust has therefore identified Core Sustenance Zones (CSZs)[70] – defined as "*the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the resilience and conservation status of the roost*" – for UK bat species; the CSZs for all UK species have a radius of 4km or less, with the exception of the CSZ for barbastelle (6km). This can be cautiously applied to bat SACs, although it is recognised that many roosts used by SAC bat populations will not be within the boundaries of the SAC. In general, therefore, unavoidable adverse effects would not be expected unless significant permanent land-take within those zones is likely; virtually all other potential effects are avoidable with normal good practice in planning and design, and with established mitigation measures that are known to be effective – although these inevitably cannot be defined above the project level.

[70] https://cdn.bats.org.uk/uploads/pdf/Resources/Core_Sustenance_Zones_Explained_04.02.16.pdf?v=1550597495

Birds and construction noise / visual disturbance

The **exposure** of any birds using the reservoir to **noise** and **visual disturbance** associated with the development will depend on several factors, including:

- the sound power level of the machinery;
- the principal habitats and locations used by the birds species (and hence the distance from the source of any disturbance);
- attenuating factors (such as screening by topography, buildings or vegetation);
- the seasonal timing of the works;
- background noise levels in this area[71].

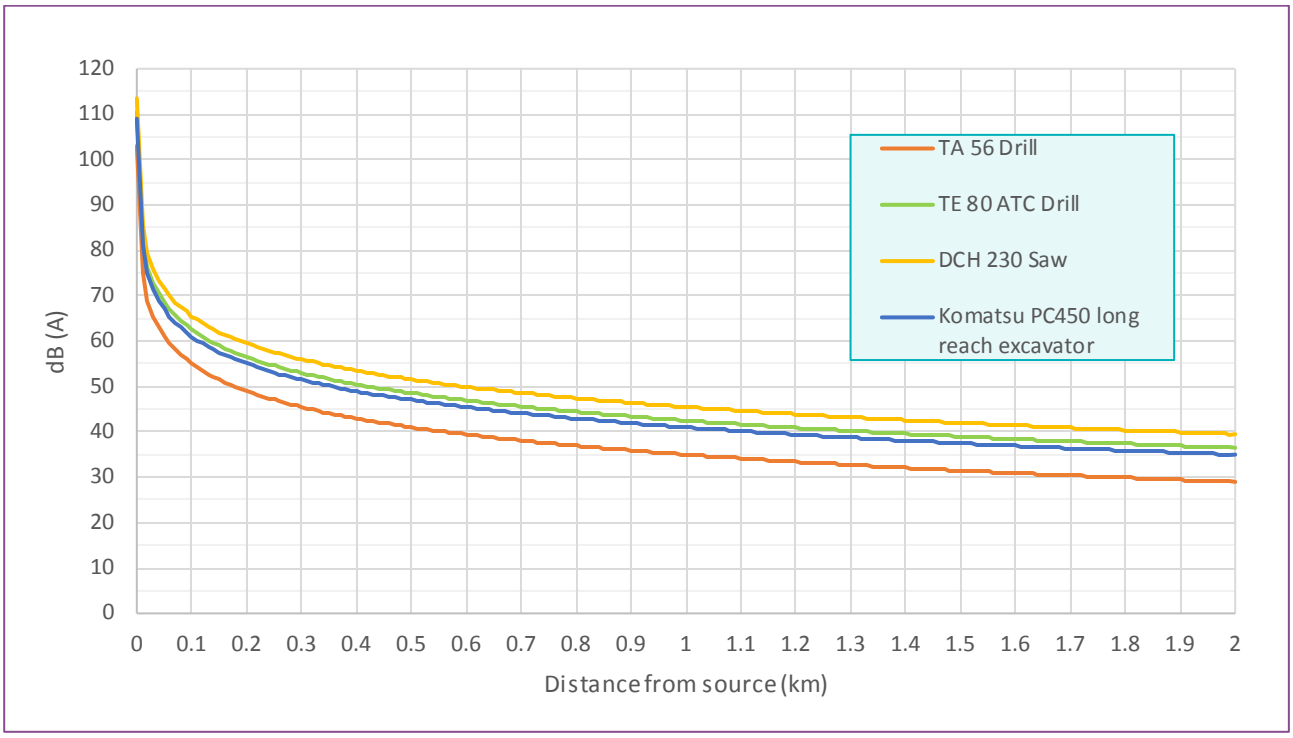
The sensitivity of the interest features will depend on their behavioural characteristics, their general tolerance / habituation to existing or new activities at a site, and the extent to which avoidance behaviours are achievable. This may also vary during the year (for example, most bird species will be more sensitive when nesting as avoidance behaviours are more constrained).

With regard to noise, a typical long-reach excavator has sound power level of ~109 dB(A); drills and saws have sound power level between 103 dB(A) and 114 dB(A). Without any barriers, the noise level of the loudest equipment used would attenuate to around 55dB(A) within 300m, and to 50 dB(A)[72] within 600m due to distance alone (see Figure B1).

[71] Noise levels do not operate additively, so the dB levels in an area are not the sum of the component sources.

[72] As a guide, 60dB(A) is approximately equivalent to a conversation; 50dB(A) is approximately equivalent to the level associated with a quiet suburb or light traffic (which is unlikely to be reached except at night in this area).

Figure B1 Approximate attenuation of equipment noise with no barriers



With regard to visual disturbance, sensitivity may be broadly correlated with size, with larger species typically having greater 'flush distances' (the distances at which birds typically move when approached by people). Laursen *et al.* (2005) determined that the mean flush distance for shelduck was 225 m; 319 m for brent geese; but only 70 m for dunlin (a much smaller species).

Cutts *et al.* (2009)[73] provide a useful review of available data on bird disturbance. It makes particular reference to noise and disturbance investigations studies undertaken during sea defence works, which included piling works. These studies identified disturbance levels for various activities associated with construction, based on observations of bird responses, which are summarised in **Table B2** below.

Table B2 Observed disturbance associated with sea wall construction activities (after Cutts *et al.* 2009) and the need for similar activities at site

Activity	Observed Disturbance Level	Equivalent activity required for substation works
Personnel and plant on mudflat	High	No
Personnel and plant on seaward toe and face	High to Moderate	No
Intermittent plant and personnel on crest	High to Moderate	No

[73] Cutts N., Phelps A. & Burdon D. (2009) *Construction and waterfowl: defining sensitivity, response, impacts and guidance.* Report to Humber INCA by the Institute of Estuarine and Coastal Studies, University of Hull

Activity	Observed Disturbance Level	Equivalent activity required for substation works
Irregular piling noise (above 70 dB)	High to Moderate	No
Long term plant and personnel on crest	Moderate	No
Regular piling noise (below 70dB)	Moderate	No
Irregular noise (50-70 dB)	Moderate	Yes
Regular noise (50-70dB)	Moderate to low	Yes
Occ*asio*nal movement of the crane jib and load above sight-line	Moderate to low	No
Noise below 50 dB	Low	Yes
Long-term plant only on crest	Low	No
Activity behind flood bank (inland)	Low	Yes

Key:

High	Maximum response; preparing to fly away and flying away, may leave area altogether
Moderate-high, Moderate, Moderate-low	Head turning, scanning behaviour, reduced feeding, movement to other areas close by (decreasing response)
Low	No effect

The study also records the following observations from other construction schemes on the Humber:

- Piling activity on the landward side of the sea wall at Pyewipe (southern shore), associated with construction of a pumping station, had no disturbance effect on birds in January, February and March; the numbers and distributions of birds were similar during periods with and without piling. Disturbance only occurred when construction was moved to the seaward-side of the sea wall in April.
- Six years of bird monitoring associated with the construction of the Humber International Terminal (HIT) concluded that most disturbance only caused birds to move over a small area, and that the HIT development did not have a significant effect on usage of the area by birds.

In general, therefore, effects from noise and visual disturbance during construction typically have a limited range and duration, are reversible, and do not result in long-term adjustments in bird behaviours (such that they might constitute an adverse effect).

Air Quality Effects from Construction Schemes

A number of pollutants have a negative effect on air quality; however, the most significant and relevant to habitats and species (particularly plant species) are the primary pollutants sulphur dioxide (SO_2, typically from combustion of coal and heavy fuel oils although this has declined substantially), nitrogen oxides (NOx, mainly from vehicles) and ammonia (NH_3, principally from

agriculture), which (together with secondary aerosol pollutants[74]) are deposited as wet or dry deposits. These pollutants affect habitats and species mainly through acidification and eutrophication.

Acidification increases the acidity of soils, which can directly affect some organisms and which also promotes leaching of some important base chemicals (e.g. calcium), and mobilisation and uptake by plants of toxins (especially metals such as aluminium).

Air pollution contributes to eutrophication within ecosystems by increasing the amounts of available nitrogen (N)[75]. This is a particular problem in low-nutrient habitats, where available nitrogen is frequently the limiting factor on plant growth, and results in slow-growing low-nutrient species being out-competed by faster growing species that can take advantage of the increased amounts of available N.

Overall in the UK, there has been a significant decline in SOx and NOx emissions in recent years and a consequential decrease in acid deposition. In England, SO_x and NO_x have declined by 97% and 72% respectively since 1970 (Defra, 2018) which is the result of a switch from coal to gas, nuclear and renewables for energy generation, and increased efficiency and emissions standards for cars. These emissions are expected to decline further in future years with the transition to electric vehicles. In contrast, emissions of ammonia have remained largely unchanged; they have declined by 10% in England since 1980 (Defra, 2018), but since 2008 have started to increase slightly.

The effect of SO_x and NO_x decreases on ecosystems has been marked, particularly in respect of acidification; the key contributor to acidification is now thought to be deposited nitrogen, for which the major source (ammonia emissions) has not decreased significantly. Indeed, eutrophication from N-deposition (again, primarily from ammonia) is now considered the most significant air quality issue for many habitats.

In terms of the exposure of designated sites to air quality changes associated with construction, this tends to be considered on a case-by-case basis. However, the Department of Transport's *Transport Analysis Guidance*[76] states that "***beyond 200m, the contribution of vehicle emissions from the roadside to local pollution levels is not significant***" and this distance is typically applied to construction schemes also when considering the potential for European sites to be exposed to any local effects associated with emissions to air. However, it should be noted that concentrations and deposition of traffic-generated pollutants do not decline linearly with distance from the road; typically, air pollution levels fall sharply within the first 20 – 30m before declining more slowly with increased distance[77]. Concentrations and deposition will also be affected by physical parameters, such as local topography or vegetation structure.

[74] Secondary pollutants are not emitted, but are formed following further reactions in the atmosphere; for example, SO_2 and NO_x are oxidised to form SO_4^{2-} and NO_2^- compounds; ozone is formed by the reaction of other pollutants (e.g. NOx or volatile organic compounds) with UV light; ammonia reacts with SO_4^{2-} and NO_2^- to form ammonium (NH_4^+).

[75] Nitrogen that is in a form that can be absorbed and used by plants.

[76] See http://www.dft.gov.uk/webtag/documents/expert/unit3.3.3.php#013; accessed 15/06/14.

[77] For example, recent air quality modelling by Wood of a new link road at an MoD establishment in the UK found that an Average Annual Daily Traffic (AADT) increase of ~7,000 increased nitrogen deposition by 0.21 kg N/ha/yr at the worst receptor point (at the immediate kerbside), and that by 25m from the road the increase in N-deposition was zero.

Highways England's *Design Manual for Roads and Bridges* (DMRB) sets out an approach for assessing the effect of emissions from specific road schemes on designated sites; this suggests that a quantitative air quality assessment may be required if a European site is within 200m of an affected road and the predicted change in annual average daily traffic (AADT) is over 1000. It should be noted that this is 'in combination' with other projects (etc.), but this is a relatively large increase which

- would not be met by the vast majority of construction schemes when considering either vehicle access to the site / deliveries, or the equivalent movement / use of construction plant); and
- is assumed to be permanent (which is not the case for most construction).

Although it is not simple to apply 'rule of thumb' estimates to relationships between traffic volumes and N-deposition (as this is influenced by a number of factors), it is worth noting that the DMRB guidance regarding air quality thresholds is based on the assumption that 1,000 extra vehicles is equivalent to ~0.01 kg N/ha/yr (this is obviously a coarse figure and there are other factors that come into play such as the emissions factors used for opening year/ wind direction / number of HGVs / speed etc.). The EA-accepted threshold for 'significant effects' on habitats to be possible is an increase of >1% of the minimum critical load[78].

Air quality modelling and assessment is unlikely to be achievable at the WRMP level due to the absence of information on scheme design and construction approaches; and arguably not proportionate. However, it is clear that in the vast majority of cases emissions associated with construction schemes are of a magnitude that (a) will not exceed the thresholds for significant or significant adverse effects (even if relatively close to a site), and which (b) can be reliably managed or avoided using standard and unexceptional avoidance and mitigation measures, if required.

[78] The 1% threshold is used as it is accepted that levels below this are difficult to measure and not typically distinguishable from background fluctuations. An exceedance of 1% of the critical load should be seen as a 'starting point' for assessing the significance of any effects; the Institute of Air Quality Management (IAQM) position statement on air quality effects notes that "*it is the position of the IAQM that the use of a criterion of 1% of an assessment level in the context of habitats should be used only to screen out impacts that will have an insignificant effect. It should not be used as a threshold above which damage is implied and is therefore used to conclude that a significant effect is likely.*"

Appendix C
Standard Mitigation and Avoidance Measures

Overview

The 'avoidance measures' that may be applied to the options are detailed below, and are grouped as follows:

- General Measures (established construction best-practice, etc.) which will be applied to all options;
- Option-specific Measures (established and reliable measures identified to avoid specific potential effects on European sites, such as in relation to mobile species from the sites).

These measures will be applied unless project-level HRAs or project-specific environmental studies demonstrate that they are not required (i.e. the anticipated effect will not occur), not appropriate, or that alternative or additional measures are necessary or more appropriate.

Note that these measures are not exhaustive or exclusive and must be reviewed at the project stage, taking into account any changes in best-practice as well as scheme-specific survey information or studies.

General Measures and Principles

Scheme Design and Planning

All options will be subject to project-level environmental assessment as they are brought forward, which will include assessments of their potential to affect European sites during their construction or operation. These assessments will consider or identify (inter alia):

- opportunities for avoiding potential effects on European sites through design (e.g. alternative pipeline routes; micro siting; etc);
- construction measures that need to be incorporated into scheme design and/or planning to avoid or mitigate potential effects - for example, ensuring that sufficient working area is available for pollution prevention measures to be installed, such as sediment traps;
- operational designs required to ensure no adverse effects occur (e.g. screening, additional treatment, etc.) – although note that these measures can only be identified through detailed investigation schemes and agreed through the project-level HRA process.

Pollution Prevention

The habitats of European sites are most likely to be affected indirectly, through site-derived pollutants, rather than through direct encroachment. There is a substantial body of general construction good-practice which is likely to be applicable to all of the proposed options and can be relied on (at this level) to prevent significant or adverse effects on a European site occurring as a result of construction site-derived pollutants. The following guidance documents detail the industry best-practices in construction that are likely to be relevant to the proposed schemes:

- Environment Agency Pollution Prevention Guidance Notes[79], including:
  - PPG1: General guide to the prevention of pollution (May 2001);
  - 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 spillages on highways (June 2002);
- Environment Agency (2001) Preventing pollution from major pipelines [online]. Available at www.environment-agency.gov.uk/static/documents/Business/pipes.pdf. [Accessed 1 March 2011];
- Venables R. et al. (2000) Environmental Handbook for Building and Civil Engineering Projects. 2nd Edition. Construction Industry Research and Information Association (CIRIA), London.

The best-practice procedures and measures detailed in these documents will be followed for all construction works derived from the DWMP as a minimum standard, unless scheme-specific investigations identify additional measures and/or more appropriate non-standard approaches for dealing with potential site-derived pollutants.

General measures for species

Most species-specific avoidance or mitigation measures can only be determined at the scheme level, following scheme-specific surveys, and 'best-practice' mitigation for a species will vary according to a range of factors that cannot be determined at the strategic (DP) level. In addition, some general 'best-practice' measures may not be relevant or appropriate to the interest features of the European sites concerned (for example, clearing vegetation over winter is usually advocated to avoid impacts on nesting birds; however, this is unlikely to be necessary to avoid effects on some SPA species (such as overwintering estuarine birds) and the winter removal of vegetation might actually have a negative effect on these species through disturbance). However, the following general measures will be followed to minimise the potential for impacts on species that are European site interest features unless project level environmental studies or HRA indicate that

[79] Note, the Environment Agency Pollution Prevention Guidance Notes have been withdrawn by the Government, although the principles within them are sound and form a reasonable basis for pollution prevention measures.

they are not required or not appropriate, or that alternative or additional measures are more appropriate/necessary:

- Scheme design will aim to minimise the environmental effects by 'designing to avoid' potential habitat features that may be used by species that are European site interest features when outside the site boundary (e.g. linear features such as hedges or stream corridors; large areas of scrub or woodland; mature trees; etc.) through scheme-specific routing studies.
- The works programme and requirements for each option will be determined at the earliest opportunity to allow investigation schemes, surveys and mitigation to be appropriately scheduled and to provide sufficient time for consultations with NRW/NE.
- Night-time working, or working around dusk/dawn, should be avoided to reduce the likelihood of negative effects on nocturnal species.
- Any lighting required (either temporary or permanent) will be designed with an ecologist to ensure that potential 'displacement' effects on nocturnal animals, particularly SAC bat species, are avoided.
- All compounds/pipe stores etc. will be sited, fenced or otherwise arranged to prevent vulnerable SAC species (notably otters) from accessing them.
- All materials will be stored away from commuting routes/foraging areas that may be used by species that are European site interest features.
- All excavations will have ramps or battered ends to prevent species becoming trapped.
- Pipe-caps must be installed overnight to prevent species entering and becoming trapped in any laid pipe-work.

Option-specific measures

Currently, no adverse effects are anticipated for the options and so no option-specific mitigation measures have been identified.

However, European sites and their interest features will be considered throughout future investigations, and any required measures will be identified and refined during the scheme design and employed during construction / operation as appropriate. Agreement on appropriate measures will be made with NRW / NE where potential adverse effects are identified.

wood.

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