

South Lincolnshire Reservoir Strategic Regional Options - Strategic Environmental Assessment

RAPID Gate 1 Submission

July 2021

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Executive summary

The Strategic Environmental Assessment (SEA) supports the Environmental Assessment Report (EAR) that accompanies the Gate 1 submission report to Regulators' Alliance for Progressing Infrastructure Development (RAPID) for the South Lincolnshire Reservoir (SLR) Scheme. This report presents the findings of the SEA applied to the SLR options.

Based on the SEA outputs for residual effects (post mitigation), the three options are predicted to result in similar effects across all the SEA objectives.

A summary of the key potential benefits and adverse effects is provided below:

Topic	Benefits	Adverse effects
Biodiversity, flora and fauna	The reservoir does have the potential to create new habitat, with floating wetlands/ islands and planting considered within the wider benefits of the study and all options have an opportunity to protect and enhance biodiversity during operation.	All options are located within 200m of designated sites and would intersect with priority habitats. Negative residual effects identified due to a number of internationally protected sites having pathways to the reservoir.
Soil	No benefits identified.	All options intersect Grade 1 – 3 land and would lead to the permanent loss in the reservoir boundary. All options would be located within 500m of historic landfills.
Water	All options deliver reliable and resilient water supplies.	The majority of the routes for all options is located within Flood Zone 2 and 3. The abstraction and release of water has the potential to have an effect on water levels, flows and quality during the operational phase.
Air	No benefits identified.	All options are likely to generate short-term vehicle emissions and dust from construction activities.
Climatic factors	All options reduce vulnerability to climate change risks and hazards. All options have the opportunity to utilise greener and/or renewable energy.	All options will have negative carbon impacts due to construction and operation of the reservoir and pipeline transfers.
Landscape	Positive effects have also been identified given that the new reservoir provides a new valued landscape that is used by people. Measures such as planting on embankments, floating wetlands/ islands, embankment structuring/ landscape contouring and building a visitor centre/ public art space and creation of footpaths, cycle routes, nature trails and bridleways have all been considered within the wider benefits piece.	All options fall within national landscape character areas and there will be minor negative effects during the construction phase on these areas.
Historic environment	No benefits identified.	There are several listed buildings and several scheduled monuments within the area. There is potential for the setting of these historic assets to be affected during the construction phase. There is a potential

Topic	Benefits	Adverse effects
Population and human health	No benefits identified. Wider benefits piece being considered which could be a benefit for the population.	for unknown archaeology to be discovered during excavation of the reservoir. All options intersect a number of community facilities and are located within 500m of other community facilities.
Material assets	No benefits identified.	All options intersect minor roads.

1 Introduction

1.1 Overview

This report supports the Environmental Assessment Report that accompanies the Gate 1 submission report to the Regulators' Alliance for Progressing Infrastructure Development (RAPID) for the SLR Strategic Resource Option (SRO). This report presents the findings of the Strategic Environmental Assessment (SEA) applied to the three SLR options.

1.2 SLR Options

The three options described in this report have been selected for concept design, from a larger list of potential solutions in consultation with stakeholders. Following discussion with Affinity Water and Anglian Water, three exemplar sites within the Black Sluice catchment were selected for the Gate 1 submission. These options are shown in Table 1.1. Further details on the options are set out in Chapter 2.

Table 1.1: SLR Options

Option name	Description overview
Concept Design Option 1 (CDO1)	This option consists of the construction of a multi-purpose reservoir. Extraction points are assumed to be located on the River Witham and South Forty Foot Drain with transfers to the reservoir via pipeline. A third indirect intake provides for transfers from the River Trent to River Witham.
Concept Design Option 2 (CDO2)	This option consists of a single purpose public water supply reservoir. The transfer of water to the reservoir is achieved through diversions from the River Witham to the South Forty Foot Drain via open water transfer with flows then transferred through the South Forty Foot Drain to the reservoir.
Concept Design Option 3 (CDO3)	This option consists of a single purpose public water supply reservoir. Extraction from the River Witham is achieved through open water transfer to the reservoir via the South Forty Foot Drain. The Trent to Witham Transfer is also included within this option.

1.3 Methodology

1.3.1 Overview of assessment methodology

The group of water companies involved in developing SROs have been working together to increase consistency in approaches to SRO development across the country. To confirm the list of SEA criteria to be used in the SEA assessment for the SROs, a review of the SEA objectives of the water companies was undertaken to determine if a core set of scheme objectives could be developed. The draft WRMP 2019 guidance and its application to the SRO schemes was also considered. The recommended objectives were then reviewed against the Water Resources Planning Guidelines: Working Version for WRMP 2024. Further information on the process undertaken to develop the SEA objectives is available in the *Strategic Environmental Assessment: Core Objective Identification document*¹.

An option-level assessment has been undertaken to assess concept design options against the SEA objectives. The SEA assessment was undertaken on 14 SEA objectives based on nine topics (biodiversity, flora and fauna; soil; water; air; climatic factors; landscape; historic environment; population and human health; material assets). For each option, an assessment of the potential impact of construction and operation on each SEA criteria was undertaken. The

¹ All Companies Working Group: Core Objective Identification. Revision 01C. October 2020.

SEA assessment also considered the assessment of residual effects from construction and operation following the identification of potential mitigation.

For the options previously assessed as part of WRMP19, the existing assessment information was used as a basis for the SEA assessment work for the Gate 1 submission.

While SLR is a Water Resources East (WRE) scheme, the initial assessments to support the Gate 1 submission were undertaken using the method developed for use on the Water Resources South East (WRSE) regional programme. The WRE environmental assessment approach is currently being finalised following completion of the Integrated Environmental Assessment scoping consultation exercise. It is expected that the WRE methodology will be used to support the work for Gate 2 submission. As the WRSE and WRE methodologies are similar, this will not invalidate the Gate 1 assessments undertaken for the SLR SRO.

2 Scheme Description

2.1 Overview

As part of the Water Resource Management Plan 2019 (WRMP19), Anglian Water (AW) and Affinity Water (AFW) projected an increasing deficit between water supply and demand in several Water Resource Zones (WRZs) over the coming decades. The development of South Lincolnshire Reservoir (SLR), a winter storage reservoir in South Lincolnshire, was identified in AW WRMP19 as the preferred supply side option to meet their long-term demand for water.

A full scheme description can be found in the Environmental Assessment Report (EAR) of the Gate 1 submission, the *Concept Design Report*, however a summary of the main aspects of the options is included below.

2.2 Option descriptions

For Gate 1, there are three options for SLR as described in Table 2.1. Figures of the options are provided in Figure 2.1, Figure 2.2 and Figure 2.3 respectively.

Table 2.1: SLR Gate 1 options

Option name	Option description
Concept Design Option 1 (CDO1)	<p>This option consists of the construction of a multi-purpose reservoir. Extraction points are assumed to be located on the River Witham and South Forty Foot Drain with transfers to the reservoir via pipeline. A third indirect intake provides for transfers from the River Trent to River Witham and is sized to allow for the treatment and transfer of 150MI/d Deployable Output (DO), as required by AW and AFW.</p> <p>Benefits: Water resource (232MI/d), flood risk mitigation in the in the lower part of the South Forty Foot Drain and Irrigation supply of 2,500MI/year.</p> <p>Interdependencies: Anglian Water to Affinity Water Transfer Scheme.</p>
Concept Design Option 2 (CDO2)	<p>This option consists of a single purpose public water supply reservoir. The transfer of water to the reservoir is achieved through diversions from the River Witham to the South Forty Foot Drain via open water transfer with flows then transferred through the South Forty Foot Drain to the reservoir and is sized to allow for the treatment and transfer of 150MI/d Deployable Output (DO), as required by AW and AFW.</p> <p>Benefits: Water resource (189MI/d), Flood risk mitigation in the South Forty Foot Drain and in the high-level carriers, particularly in Swaton and Billingborough, Increased summer flows in the South Forty Flood Drain and improved water quality in the Black Sluice catchment.</p> <p>Interdependencies: Anglian Water to Affinity Water Transfer Scheme</p>
Concept Design Option 3 (CDO3)	<p>This option consists of a single purpose public water supply reservoir. Extraction from the River Witham is achieved through open water transfer to the reservoir via the South Forty Foot Drain. The Trent to Witham Transfer is also included within this option and is sized to allow for the treatment and transfer of 150MI/d Deployable Output (DO), as required by AW and AFW.</p> <p>Benefits: Water resource (189MI/d), flood risk mitigation in the River Glen downstream of Surfleet reservoir, irrigation supply of 2,500MI/year, increased summer flows in the South Forty Flood Drain, and improved water quality in the Black Sluice catchment.</p> <p>Interdependencies: Anglian Water to Affinity Water Transfer Scheme</p>

Figure 2.1: SLR Concept Design 1

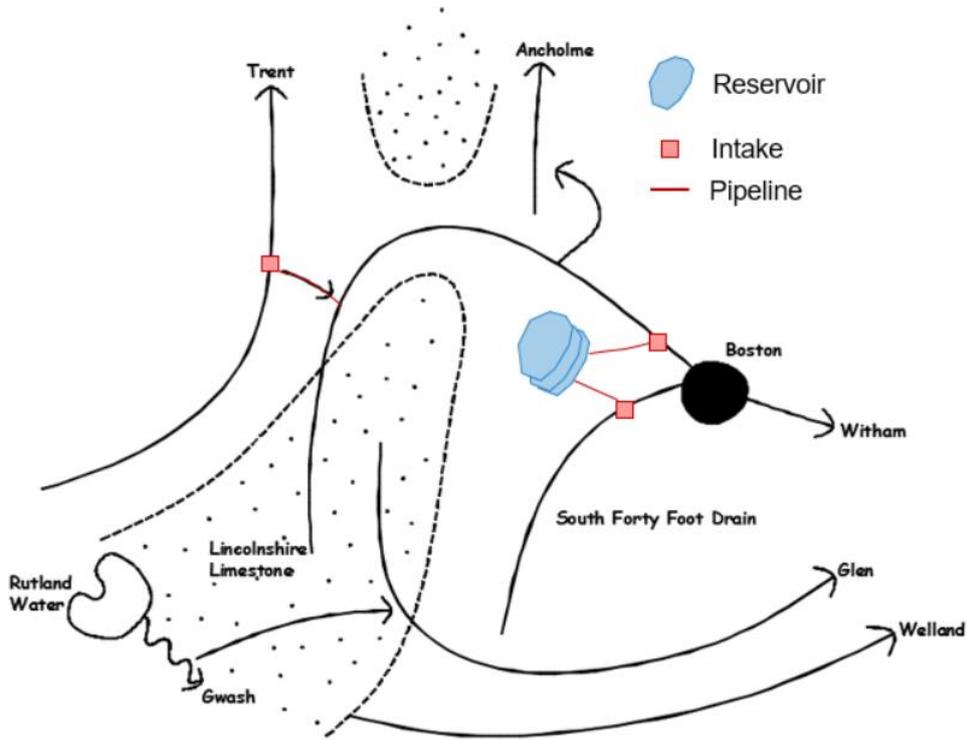


Figure 2.2: SLR Concept Design 2

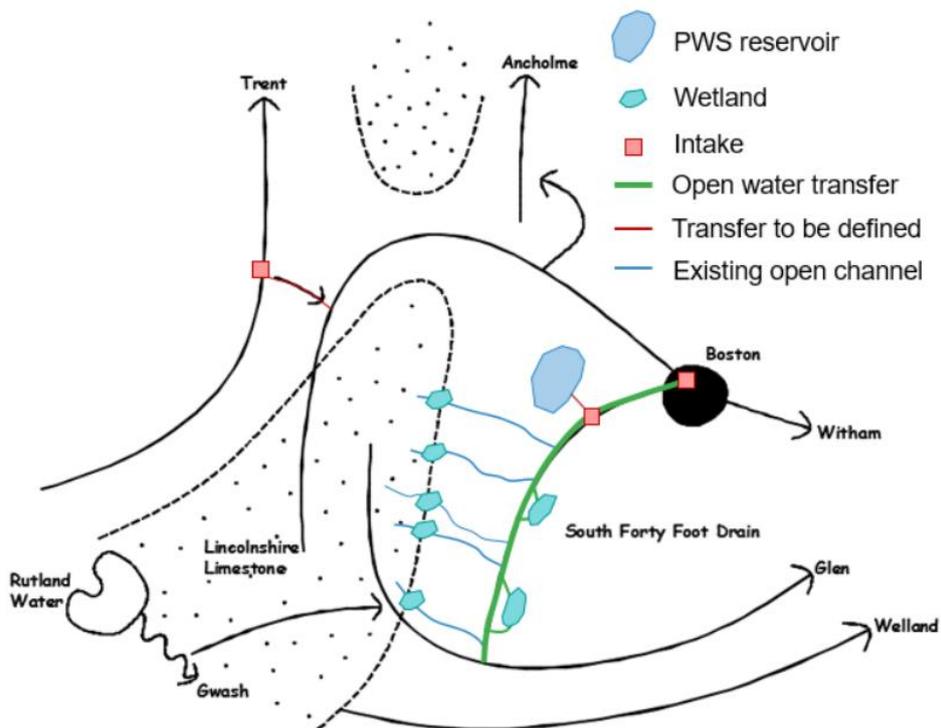
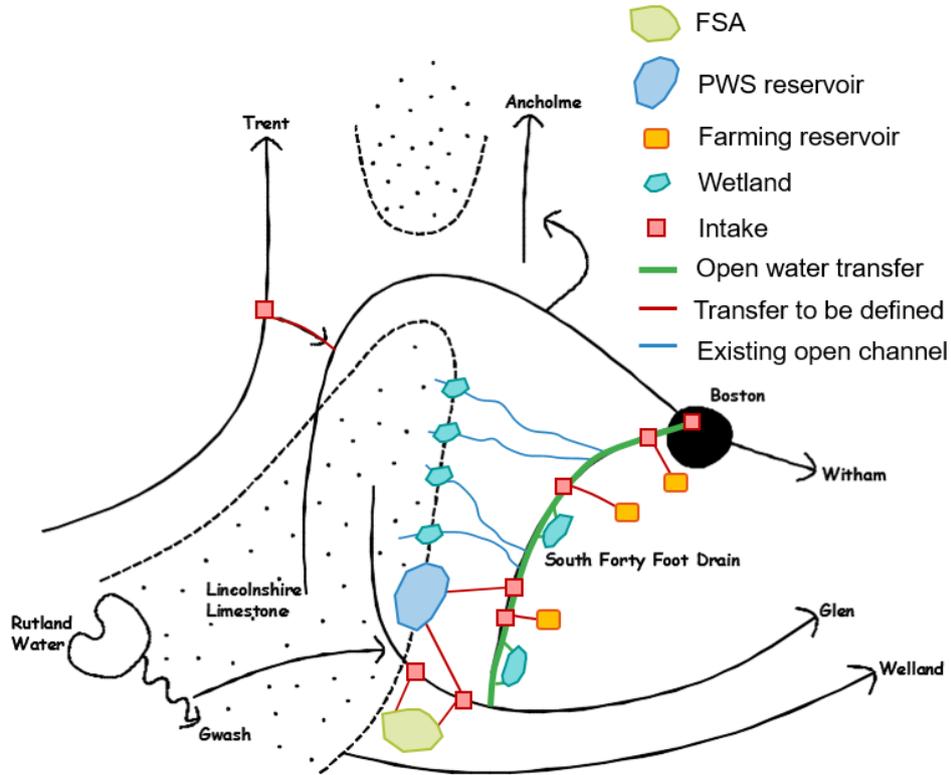


Figure 2.3: SLR Concept Design 3



3 Stage 1 Strategic Environmental Assessment Findings

3.1 Overview

The Stage 1 SEA outputs for each option are summarised in Table 3.1 and 3.2 and discussed in Sections 3.2, 3.3 and 3.4. The colour and score used in these tables to reflect the effects are as follows:

- White, (+): Construction/operation of the option would result in minor positive effects against the SEA objective;
- Yellow, (0): Construction/operation of the option would result in neutral effects against the SEA objective;
- Amber, (-): Construction/operation of the option would result in minor negative effects against the SEA objective;
- Orange, (--): Construction/operation of the option would result in moderate negative effects against the SEA objective; and
- Red, (---): Construction/operation of the option would result in major negative effects against the SEA objective.

For each option, the tables show ratings for construction and operation phases against each of the SEA objectives. Table 3.1 shows the ratings before any mitigation is applied and Table 3.2 shows the ratings after mitigation is applied. The applicable mitigation for each SEA objective is described in the following sections.

Table 3.1: Stage 1 SEA Outputs Pre-Mitigation

Pre mitigation

SEA Topic	SEA Objective	SLR 1				SLR 2				SLR3			
		Construction Effects		Operational Effects		Construction Effects		Operational Effects		Construction Effects		Operational Effects	
		+	-	+	-	+	-	+	-	+	-	+	-
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	0	--	+	---	0	--	+	---	0	--	+	---
Soil	Protect and enhance the functionality, quantity and quality of soils	0	---	0	0	0	---	0	0	0	---	0	0
Water	Increase resilience and reduce flood risk	0	--	0	--	0	--	0	--	0	--	0	--
	Protect and enhance the quality of the water environment and water resources	0	--	+	--	0	--	+	--	0	--	+	--
	Deliver reliable and resilient water supplies	0	0	+++	0	0	0	+++	0	0	0	+++	0
Air	Reduce and minimise air emissions	0	0	0	0	0	0	0	0	0	0	0	0
Climatic Factors	Reduce embodied and operational carbon emissions	0	-	0	-	0	-	0	-	0	-	0	-
	Reduce vulnerability to climate change risks and hazards	0	0	++	0	0	0	++	0	0	0	++	0
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	0	--	++	0	0	--	++	0	0	--	++	0
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	0	--	0	0	0	--	0	0	0	--	0	0
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	+	-	+++	0	+	-	+++	0	+	-	+++	0
	Maintain and enhance tourism and recreation	0	-	+++	0	0	-	+++	0	0	-	+++	0
Material Assets	Minimise resource use and waste production	0	--	0	-	0	--	0	-	0	--	0	-
	Avoid negative effects on built assets and infrastructure	0	--	0	0	0	--	0	0	0	--	0	0

Table 3.2: Stage 1 SEA Outputs Post-Mitigation

Post mitigation

SEA Topic	SEA Objective	SLR 1				SLR 2				SLR3			
		Construction Effects		Operational Effects		Construction Effects		Operational Effects		Construction Effects		Operational Effects	
		+	-	+	-	+	-	+	-	+	-	+	-
Biodiversity, flora and fauna	Protect and enhance biodiversity, priority species, vulnerable habitats and habitat connectivity (no loss and improve connectivity where possible)	0	--	++	--	0	--	++	--	0	--	++	--
Soil	Protect and enhance the functionality, quantity and quality of soils	0	--	0	0	0	--	0	0	0	--	0	0
Water	Increase resilience and reduce flood risk	0	--	0	--	0	--	0	--	0	--	0	--
	Protect and enhance the quality of the water environment and water resources	0	--	+	--	0	--	+	--	0	--	+	--
	Deliver reliable and resilient water supplies	0	0	+++	0	0	0	+++	0	0	0	+++	0
Air	Reduce and minimise air emissions	0	0	0	0	0	0	0	0	0	0	0	0
Climatic Factors	Reduce embodied and operational carbon emissions	0	-	0	-	0	-	0	-	0	-	0	-
	Reduce vulnerability to climate change risks and hazards	0	0	++	0	0	0	++	0	0	0	++	0
Landscape	Conserve, protect and enhance landscape, townscape and seascape character and visual amenity	0	--	++	0	0	--	++	0	0	--	++	0
Historic Environment	Conserve, protect and enhance the historic environment, including archaeology	0	-	0	0	0	-	0	0	0	-	0	0
Population and Human Health	Maintain and enhance the health and wellbeing of the local community, including economic and social wellbeing	+	-	+++	0	+	-	+++	0	+	-	+++	0
	Maintain and enhance tourism and recreation	0	-	+++	0	0	-	+++	0	0	-	+++	0
Material Assets	Minimise resource use and waste production	0	-	0	-	0	-	0	-	0	-	0	-
	Avoid negative effects on built assets and infrastructure	0	--	0	0	0	--	0	0	0	--	0	0

3.2 Concept Design 1

3.2.1 Biodiversity, Flora and Fauna

There are no statutory designated sites directly impacted by the scheme footprint, however there is one Site of Special Scientific Interest (SSSI) (Horbling Fen) within 500m and one Special Areas of Conservation (SAC) (Baston Fen) within 2000m. The SSSI is agricultural land and is designated due to its importance when studying Flandrian sea-level changes. No direct land take from these designated sites is required. Both of these sites are only within the boundary of the existing South Forty Foot Drain (SFFD) which is not anticipated to require modifying, so there shouldn't be any effects during construction. There are a number of Natura2000 (N2K) and internationally protected sites that have potential pathways to the reservoir that could result in negative impacts. There are the Wash and Norfolk Coast SAC, The Wash Special Protection Area (SPA), The Wash Ramsar, Humber Estuary SAC, Humber Estuary SPA and Humber Estuary Ramsar. There is Biodiversity Action Plan (BAP) and priority habitat within the footprint of the reservoir which will be permanently lost. However, the reservoir does have the potential to create new habitat, with floating wetlands/islands and planting considered within the wider benefits study. The option is at sufficient distance to the designated sites that construction effects are not a significant problem; however operationally the increased abstraction may lead to negative impacts and therefore Appropriate Assessment will be required. The site is also within 50m of several coastal and floodplain grazing marshes. The additional wetlands being created also have the opportunity to create new habitats that could be a positive enhancement.

Best practice methods are to be implemented to minimise disturbance effects. Reinstatement of priority habitats where possible, although there would still be permanent loss of BAP and priority habitat from the reservoir. Ecological surveys will be required. A Habitats Regulation Assessment (HRA) Appropriate Assessment is required to determine the effects on the SACs. Invasive Not-Native Species (INNS) mitigation could be achieved partially with an underground pipeline although holistic widespread management of INNS may reduce the spread of INNS further.

3.2.2 Soil

The reservoir footprint is within Grade 2 agricultural land which will be permanently lost. The pipeline is also within Grade 1 and Grade 2 agricultural land, so there will be negative effects resulting from the loss of topsoil during the construction phase. However, this could be reinstated following the works as the pipeline is buried. There are two historic landfills within 500m of the boundary.

Ground will be reinstated where possible, however the reservoir will lead to permanent loss of agricultural land.

3.2.3 Water

There are large areas of FZ2 and FZ3 within and within close proximity of the reservoir boundary. As such there is a potential risk of flooding during the construction and operational phases. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however potential residual flood risk is likely to remain.

The construction phase could result in negative effects on waterbodies within or adjacent to the reservoir boundary including the Black Sluice IDB draining to the South Forty Foot Drain. Embedded mitigation should be included such as agreement with the EA on watercourse diversions to ensure at least that no WFD status deterioration or effects on river environment

are caused, appropriate drainage for earthworks are planned, and fully bunded chemical / oil storage is incorporated into construction and operation plans. The abstraction and release of water has the potential to have an effect on water levels, flows and quality during the operational phase, however the WFD level 2 assessment recommends that abstraction and discharge conditions should be set to minimize changes to hydraulic regimes to manage associated risk. To minimise water quality effects, embedded mitigation measures such as regular water testing, treatment of drainage water, discharge permit application, amongst others should be implemented for the operational phase. There may be some minor negative effects during operation although embedded mitigation has been implemented. This option would create a sufficient surplus to facilitate a reduction in abstractions in other areas. Operationally, the scheme also aims to improve water quality within the area which would be a positive impact. Best practice construction measures will likely be implemented to mitigate effects but further level 2 WFD assessments are required for five waterbodies.

The proposed option is intended to increase capacity therefore improving resilience for supply. It is also intended to help reduce abstractions in more vulnerable areas whilst increasing the resilience of water supply during times of low flow.

3.2.4 Air

The option does not fall within an Air Quality Management Area (AQMA) and there are none within 2000m of the option location. Construction is likely to have a minor and temporary impact on air quality. Whilst best practice mitigation measures are likely to be implemented during the construction phase, minor and temporary impacts on air quality are likely to still occur.

3.2.5 Climatic Factors

Carbon will be generated from materials used to construct the reservoir (embodied carbon), construction activities and from operation of the reservoir. Investigation into the use of renewables during construction and operation for energy supply and use of materials with lower embodied carbon should be considered in future design stages. A carbon footprint study could help identify areas for carbon savings or alternative materials. However, it is noted that, as the electricity grid is decarbonised, it is anticipated that greener energy will be available.

Further abstraction may have a negative effect on the environment if not properly monitored and licenced. However, the option will increase resilience of the environment by having the capacity to release water into river during low flow and drought conditions and reducing abstraction in more vulnerable areas that would be exacerbated by drought conditions. Monitoring to reduce the risk of negative effects on the environment due to abstraction post construction should be undertaken at the next stage.

3.2.6 Landscape

The option falls within four National landscape character areas; Kesteven Uplands (0.02%); Southern Lincolnshire Edge (0.25%); The Fens (0.18%); Trent and Belvoir Vales (0.01%). Based on this there could be minor negative effects during the construction phase on these areas. Embedded mitigation could include tree surveys, tree retention, minimising hedgerow removal, maintain existing views where possible and avoiding disturbance to key landscape features. However, minor effects will likely remain. The new reservoir will result in a significant and permanent change to landscape, and therefore, although embedded mitigation such as extensive landscaping around reservoir footprint, limiting embankment heights and slope steepness, will be implemented, effects will remain.

Positive effects have also been identified given the new reservoir provides a new valued landscape that is used by people. Measures such as planting on embankments, floating wetlands/ islands, embankment structuring/ landscape contouring and building a visitor centre/

public art space and creation of footpaths, cycle routes, nature trails and bridleways have all been considered within the wider benefits piece. These will likely contribute to an overall improvement in the landscape surrounding the reservoir. The site does not fall within any Green Belt land or any Areas of Outstanding Natural Beauty (AONB). Measures to reduce the visual impact of the reservoir implemented, however residual effects remain.

3.2.7 Historic Environment

The Trent to Witham pipeline is on the boundary line of a conservation area. There could be construction impacts to the conservation area including disturbance and visual impacts. There are numerous listed buildings and scheduled monuments within 500m of the option. This includes three scheduled monuments that border the boundary of the reservoir. Embedded mitigation to minimise these effects should be considered, such as consideration to the siting of temporary works. However, there will still be a permanent visual impact on these monuments. There is a potential for unknown archaeology to be discovered when excavating for the works.

Best practice mitigation measures will likely be implemented to minimise setting effects during construction. A full investigation will be required for planning, as well as an Archaeological Watching Brief which may be required during the construction phase, however residual effects are likely to remain if removal is permanent. Further work is required to confirm significance.

3.2.8 Population and Human Health

The option is within 500m of play spaces, registered common land, religious buildings and religious grounds but does not directly impact any of these. There is also one noise action important area within the Scheme boundary. There is likely to be minor and temporary effects to the local community and users of these facilities during the construction phase. Construction of the reservoir may bring employment opportunities for people in the local area with the potential for longer term job opportunities once the reservoir is operational. The wider benefits piece suggests the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops as well as a community hub would be beneficial. These proposals will help provide new revenue streams to the local economy and opportunities for the Lincolnshire region as a whole. Other elements to boost recreation on the site have also been identified and include viewing platforms for birdwatching, water sports and new picnic areas. Moderate positive effects have therefore been identified given these facilities could contribute to improved health and wellbeing from recreation, access to new greenspace, as well as opportunities for community cohesion. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur during the construction phase.

There would need to be minor road diversions to accommodate the reservoir pipeline which may lead to a disruption to recreation. However, the wider benefits would compensate and go beyond what is existing, including the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops and serve as a community hub as outlined above.

Best practice mitigation measures will likely be implemented to minimise effects during construction, however some disruption likely to remain during the construction phase.

3.2.9 Material Assets

New reservoir and associated infrastructure required for the option will involve materials and resource use. Excavated material will be generated, which could be reused on site. Opportunities to implement sustainable design measures to reduce the impact should be considered, however it is likely that minor negative effects will remain.

There would need to be minor road diversions to accommodate the reservoir. There is likely to be moderate and temporary impacts during the construction phase from disruption for users (e.g. road closures, diversions). Embedded mitigation measures could include creating new road diversions and haul roads at the start of the construction, importing main construction materials (drainage stone, rip rap, fuel) by train, and determining access routes and operational hours to minimise traffic through villages avoiding peak road traffic hours. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur.

3.3 Concept Design 2

3.3.1 Biodiversity, Flora and Fauna

There are no statutory designated sites directly impacted, however there is one SSSI (Cross Drain) within 500m and one SAC (Baston Fen) within 2000m. The SSSI (Horbling Fen) is agricultural land and is designated due to its importance when studying Flandrian sea-level changes. No direct land take from these designated sites is required. Both of these sites are only within the boundary of the existing SFFD which will be widened as part of this option. Therefore, there could be impacts during construction and operation which will need to be considered. There are a number of N2K and internationally protected sites that have potential pathways to the reservoir that could result in negative impacts. These are The Wash and North Norfolk Coast SAC, The Wash SPA, The Wash Ramsar, Humber Estuary SAC, Humber Estuary SPA and Humber Estuary Ramsar. There is BAP and priority habitat within the footprint of the reservoir which will be permanently lost. However, the reservoir does have the potential to create new habitat, with floating wetlands/islands and planting considered within the wider benefits study. The option is at sufficient distance to the designated sites that construction effects are not a significant problem however operationally the increased abstraction may lead to negative impacts therefore an Appropriate Assessment will be required. The site is also within 50m of several coastal and floodplain grazing marshes. The nature of the transfer has a significant impact on INNS risk. The greatest risk is presented by the Witham to SLR transfer being designed as a fully open channel. The additional wetlands being created also have the opportunity to create new habitats that could be a positive enhancement.

As such it is recommended that best practice methods are implemented to minimise disturbance effects. In particular, reinstatement of priority habitats should be undertaken where possible, however permanent loss of BAP and priority habitat from the reservoir will remain. It is noted that ecological surveys are required and a HRA Appropriate Assessment will be required to determine effects on SAC. INNS mitigation could be achieved partially with an underground pipeline although holistic widespread management of INNS may reduce the spread of INNS further.

3.3.2 Soil

The reservoir footprint is within Grade 3 agricultural land which will be permanently lost. The pipeline/ open water transfer is also within Grade 1 and Grade 2 agricultural land, so there will be negative effects resulting from the loss of topsoil during the construction phase. This will be permanently lost where the open water transfer is constructed, however, this could be reinstated following the works in areas where the pipeline is considered as this can be buried. There are five historic landfills within 500m of the boundary.

Ground will be reinstated where possible, however the reservoir will lead to permanent loss of agricultural land.

3.3.3 Water

There are large areas of FZ2 and FZ3 within and in close proximity to the reservoir boundary. As such there is a potential risk of flooding during the construction and operational phases. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however a potential residual flood risk is likely to remain.

It is noted that the construction phase could result in negative effects on waterbodies within or adjacent to the reservoir boundary including the Black Sluice IDB draining to the South Forty Foot Drain. Embedded mitigation should be included such as agreement with the EA on issues such as watercourse diversions to ensure no WFD status deterioration occurs or that effects on river environment are minimised as well as ensure that appropriate drainage for earthworks is provided and that fully bunded chemical / oil storage is considered within the construction and operational plans. The abstraction and release of water has the potential to have an effect on water levels, flows and quality during the operational phase, however the WFD level 2 assessment recommends that abstraction and discharge conditions should be set to minimize changes to hydraulic regimes to manage to risk. To minimise water quality effects, embedded mitigation measures such as regular water testing, treatment of drainage water, discharge permit application, amongst others should be implemented during the operational phase. There may be some minor negative effects during operation although embedded mitigation has been implemented. This option would create a sufficient surplus of water to facilitate a reduction in abstractions in other areas. Operationally, the scheme also aims to improve water quality within the area which would be a positive impact.

Best practice construction measures will likely be implemented to mitigate effects but further level 2 WFD assessments are required for seven waterbodies.

The proposed option is intended to increase capacity therefore improving resilience for supply. It is also intended to help reduce abstractions in more vulnerable areas whilst increasing the resilience of water supply during times of low flow.

3.3.4 Air

The option does not fall within an AQMA and there are none within 2000m of the option location. Construction is likely to have minor and temporary impact on air quality. Whilst best practice mitigation measures are likely to be implemented during construction phase, local minor and temporary impacts on air quality are still likely to occur.

3.3.5 Climatic Factors

Carbon will be generated from materials used to construct the reservoir (embodied carbon), construction activities and from operation of the reservoir. It will be necessary to investigate the use of renewables during construction and operation for energy supply as well as the use of materials with lower embodied carbon. A carbon footprint study could help identify areas for carbon savings or alternative materials. As the electricity grid is decarbonised, it is anticipated that greener energy will be available.

It is noted that further abstraction may have a negative effect on the environment if not properly monitored and licenced. However, the option will increase resilience of the environment by having the capacity to release water into river during low flow and drought conditions and reducing abstraction in more vulnerable areas that would be exacerbated by drought conditions. Monitoring to reduce the risk of negative effects on the environment due to abstraction post construction should be undertaken at the next stage.

3.3.6 Landscape

The option falls within four National landscape character areas; Kesteven Uplands (0.02%); Southern Lincolnshire Edge (0.25%); The Fens (0.18%); Trent and Belvoir Vales (0.01%). As such there could be minor negative effects during the construction phase on these areas. Embedded mitigation could include tree surveys, tree retention, minimising hedgerow removal, maintain existing views where possible and avoiding disturbance of key landscape features. However, minor effects will likely remain. In particular the new reservoir will result in the significant and permanent change to landscape, and although embedded mitigation such as extensive landscaping around reservoir footprint, limiting embankment heights and slope steepness, will be implemented, effects will remain.

Positive effects have also been identified given the new reservoir provides a new valued landscape that is used by people. Measures such as planting on embankments, floating wetlands/ islands, embankment structuring/ landscape contouring and building a visitor centre/ public art space and creation of footpaths, cycle routes, nature trails and bridleways have all been considered within the wider benefits piece. These will likely contribute to an overall improvement in the landscape surrounding the reservoir. The site does not fall within any Green Belt land or any Areas of Outstanding Natural Beauty (AONB). Measures to reduce the visual impact of the reservoir should be implemented, however residual effects remain.

3.3.7 Historic Environment

The Trent to Witham pipeline is on the boundary line of a conservation area. There could be construction impacts to the conservation area including disturbance and visual impacts. There are numerous listed buildings and scheduled monuments within 500m of the option. There is one scheduled monument (Car Dyke, Roman canal at Helpringham) immediately adjacent to the proposed pipeline required for the Scheme. Embedded mitigation to minimise these effects should be considered, such as consideration to the siting of temporary works. However, there will still be potential for a permanent visual impact on these monuments. There is a potential for unknown archaeology to be discovered when excavating for the works.

Best practice mitigation measures will likely be implemented to minimise setting effects during construction. A full investigation will be required for planning, as well as an Archaeological Watching Brief, however residual effects are likely to remain if removal is permanent. Further work is required to confirm significance.

3.3.8 Population and Human Health

The option is within 500m of several play spaces, an allotment, registered common land, schools, religious buildings and religious grounds but does not directly impact any of these. There is likely to be minor and temporary effects to the local community and users of these facilities during the construction phase. Construction of the reservoir may bring employment opportunities for people in the local area with the potential for longer term job opportunities once the reservoir is operational. The wider benefits piece suggests the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops and serve as a community hub. These proposals will help provide new revenue streams to the local economy and opportunities for the Lincolnshire region as a whole. Other elements to boost recreation on the site have also been identified and include viewing platforms for birdwatching, water sports and new picnic areas. Moderate positive effects have therefore been identified given these facilities could contribute to improved health and wellbeing from recreation, access to new greenspace, as well as opportunities for community cohesion. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur during the construction phase.

There would need to be minor road diversions to accommodate the reservoir pipeline which may lead to a disruption to recreation. However, the wider benefits would compensate and go beyond what is existing, including the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops and serve as a community hub as outlined above.

Best practice mitigation measures will likely be implemented to minimise effects during construction, however some disruption likely to remain during the construction phase.

3.3.9 Material Assets

New reservoir and associated infrastructure required for the option will involve materials and resource use. Excavated material will be generated, which could be reused on site. Opportunities to implement sustainable design measures to reduce the impact should be considered, however it is likely that minor negative effects will remain.

There would need to be minor road diversions to accommodate the reservoir pipeline. There is likely to be moderate and temporary impacts during the construction phase from disruption for users (e.g. road closures, diversions). Embedded mitigation measures could include creating new road diversions and haul roads at the start of the construction, importing main construction materials (drainage stone, rip rap, fuel) by train, and determining access routes and operational hours to minimise traffic through villages avoiding peak road traffic hours. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur.

3.4 Concept Design 3

3.4.1 Biodiversity, Flora and Fauna

There are two SSSIs (Baston and Thurlby Fens, Cross Drain) within 200m of the site, as well as priority habitats of deciduous woodland and lowland fens. There is one Special Area of Conservation (SAC) within 2000m (Baston Fen). There are no Ramsar Sites within 2000m of the site. However, the site is within 2000m of three Woodland Priority Habitat Networks, which are deemed to be of low spatial priority. There are a number of N2K and internationally protected sites that have potential pathways to the reservoir that could result in negative impacts. These are The Wash and North Norfolk Coast SAC, The Wash Ramsar, The Wash SPA, Humber Estuary SAC, The Humber Estuary SAC and the Humber Estuary Ramsar. There is BAP and priority habitat within the footprint of the reservoir which will be permanently lost. However, the reservoir does have the potential to create new habitat, with floating wetlands/islands and planting considered within the wider benefits study. The option is at sufficient distance to the designated sites that construction effects are not a significant problem however operationally the increased abstraction may lead to negative impacts therefore an Appropriate Assessment will be required. The site is also within 50m of several coastal and floodplain grazing marshes. The nature of the transfer has a significant impact on INNS risk. The greatest risk is presented by the Witham to SLR transfer being designed as a fully open channel. The additional wetlands being created also have the opportunity to create new habitats that could be a positive enhancement.

Best practice methods are to be implemented to minimise disturbance effects, however the potential for residual effects on SSSIs / Groundwater Dependent Terrestrial Ecosystems (GWDTEs) is likely. Reinstatement of priority habitats should be considered where possible, however the permanent loss of priority habitat and woodland from reservoir is likely. As such ecological surveys will be required to confirm likely impacts. INNS mitigation could be achieved partially with an underground pipeline although holistic widespread management of INNS may reduce the spread of INNS further.

3.4.2 Soil

The reservoir footprint is within Grade 2 agricultural land which will be permanently lost. The pipeline is also within Grade 1, 2 and 3 agricultural land, so there will be negative effects resulting from the loss of topsoil during the construction phase. However, this could be reinstated following the works as the pipeline is buried. There are two historic landfills within 500m of the boundary. Ground will be reinstated where possible, however the reservoir will lead to permanent loss of agricultural land.

3.4.3 Water

There are large areas of FZ2 and FZ3 within the reservoir boundary and within close proximity. As such there is a potential risk of flooding during the construction and operational phases. Measures to reduce the impact of flooding during the construction phase are likely to be implemented, however potential residual flood risk is likely to remain.

The construction phase could result in negative effects on waterbodies within or adjacent to the reservoir boundary including: the Black Sluice IDB draining to the South Forty Foot Drain, Trent from Soar to Beck, River Witham, Brook Drain. Embedded mitigation should be included such as agreement with the EA on watercourse diversions to ensure at least that no WFD status deterioration or effects on river environment are caused, appropriate drainage for earthworks are planned, and fully bunded chemical / oil storage is incorporated into construction and operation plans. The abstraction and release of water has the potential to have an effect on water levels, flows and quality during the operational phase, however the WFD level 2 assessment recommends that abstraction and discharge conditions should be set to minimize changes to hydraulic regimes in order to manage the risk. To minimise water quality effects, embedded mitigation measures such as regular water testing, treatment of drainage water, discharge permit application, amongst others should be implemented for the operational phase. There may be some minor negative effects during operation although embedded mitigation has been implemented. Operationally, the scheme also aims to improve water quality within the area which would be a positive impact. Best practice construction measures will likely be implemented to mitigate effects but further level 2 WFD assessments are required for eight waterbodies.

The proposed option is intended to increase capacity therefore improving resilience for supply. It is also intended to help reduce abstractions in more vulnerable areas whilst increasing the resilience of water supply during times of low flow.

3.4.4 Air

The option does not fall within an AQMA and there are no impacts within 2000m of the option location. Construction is likely to have minor and temporary impact on air quality. Whilst best practice mitigation measures are likely to be implemented during construction phase, minor and temporary impacts on air quality are likely to still occur.

3.4.5 Climatic Factors

Carbon will be generated from materials used to construct the reservoir (embodied carbon), construction activities and from operation of the reservoir. It will be necessary to investigate the use of renewables during construction and operation for energy supply as well as the use of materials with lower embodied carbon. A carbon footprint study could help identify areas for carbon savings or alternative materials. As the electricity grid is decarbonised, greener energy will be available.

Further abstraction may have a negative effect on the environment if not properly monitored and licenced. However, the option will increase resilience of the environment by having the capacity

to release water into river during low flow and drought conditions whilst reducing abstraction in more vulnerable areas that would be exacerbated by drought conditions. Monitoring to reduce the risk of negative effects on the environment due to abstraction post construction should be undertaken at the next stage.

3.4.6 Landscape

The option falls within three National landscape character areas; Kesteven Uplands (0.02%); The Fens (0.23%); Trent and Belvoir Vales (0.01%). There could be minor negative effects during the construction phase on these areas. Embedded mitigation could include tree surveys, tree retention, minimising hedgerow removal, maintain existing views where possible and avoiding disturbance to key landscape features. However, minor effects will likely remain. The new reservoir will result in a significant and permanent change to landscape and although embedded mitigation such as extensive landscaping around the reservoir footprint, limiting embankment heights and slope steepness will be implemented, effects will remain.

Positive effects have also been identified given the new reservoir provides a new valued landscape that is used by people. Measures such as planting on embankments, floating wetlands/ islands, embankment structuring/ landscape contouring and building a visitor centre/ public art space and creation of footpaths, cycle routes, nature trails and bridleways have all been considered within the wider benefits piece. These will likely contribute to an overall improvement in the landscape surrounding the reservoir. The site does not fall within any Green Belt land or any Areas of Outstanding Natural Beauty (AONB). Measures to reduce the visual impact of the reservoir implemented, however residual effects remain.

3.4.7 Historic Environment

There are several listed buildings and several scheduled monuments within 500m of the reservoir and one conservation area within 2000m. One of the Scheduled Monuments is deemed to be heritage at risk, which means it has been identified by Historic England as being in poor condition/ dilapidated. There is potential for the setting of these historic assets to be affected during the construction phase. There is a potential for unknown archaeology to be discovered during excavation of the reservoir. There are several listed buildings and several scheduled monuments within 500m of the reservoir and one conservation area within 2000m. One of the Scheduled Monuments is deemed to be heritage at risk, which means it has been identified by Historic England as being in poor condition/ dilapidated. There is potential for the setting of these historic assets to be affected during the construction phase. There is a potential for unknown archaeology to be discovered during the excavation of the reservoir.

Best practice mitigation measures will likely be implemented to minimise setting effects during construction. A full investigation will be required for planning, as well as an Archaeological Watching Brief, however residual effects likely to remain if removal is permanent. Further work is required to confirm significance.

3.4.8 Population and Human Health

The option is within 500m of golf courses, greenspace, registered common land and religious buildings but does not directly impact any of these. There is likely to be minor and temporary effects to the local community and users of these facilities during the construction phase. Construction of the reservoir may bring employment opportunities for people in the local area with the potential for longer term job opportunities once the reservoir is operational. The wider benefits piece suggests the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve on-site recreational activities, school visits, corporate workshops as well as serve as a community hub. These proposals will help provide new revenue streams to the local economy and opportunities for the Lincolnshire region

as a whole. Other elements to boost recreation on the site have also been identified and include viewing platforms for birdwatching, water sports and new picnic areas. Moderate positive effects have therefore been identified given these facilities could contribute to improved health and wellbeing from recreation, access to new greenspace, as well as opportunities for community cohesion. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur during the construction phase.

The reservoir is adjacent to an A Road and there are major roads within the pipeline boundaries which are directly affected, therefore there may be disruption to recreation. However, the wider benefits would compensate and go beyond what is existing, including the creation of new footpaths and cycle ways as well as outdoor activities and a new multi-use venue that can both serve as on-site recreational activities, school visits, corporate workshops and as well as a community hub as outlined above. Best practice mitigation measures will likely be implemented to minimise effects during construction, however some disruption likely to remain during the construction phase.

3.4.9 Material Assets

New reservoir and associated infrastructure that are required for the option will involve materials and resource use. Excavated material will be generated, which could be reused on site. Opportunities to implement sustainable design measures to reduce the impact should be considered, however it is likely that minor negative effects will remain.

There would need to be minor road diversions to accommodate the reservoir pipeline. There are likely to be moderate and temporary impacts during the construction phase from disruption for users (e.g. road closures, diversions). Embedded mitigation measures could include creating new road diversions and haul roads at the start of the construction, importing main construction materials (drainage stone, rip rap, fuel) by train, and determining access routes and operational hours to minimise traffic through villages avoiding peak road traffic hours. Best practice mitigation measures will likely be implemented to minimise effects during construction. However, minor and temporary effects are likely to still occur.

4 Conclusions

A Strategic Environmental Assessment was undertaken using the Water Resources South East methodology on the SLR options. The SEA should be updated with new information gathered at Gate 2.

A summary of the key potential benefits and adverse effects of the Scheme is presented in Table 4.1:

Table 4.1: Summary of the Potential Benefits and Adverse Effects of the Scheme

Topic	Benefits	Adverse effects
Biodiversity, flora and fauna	The reservoir does have the potential to create new habitat, with floating wetlands/ islands and planting considered within the wider benefits of the study and all options have an opportunity to protect and enhance biodiversity during operation. Negative residual effects identified due to a number of internationally protected sites having pathways to the reservoir.	All options are located within 200m of designated sites and would intersect with priority habitats.
Soil	No benefits identified.	All options intersect Grade 1 – 3 land. All options would be located within 500m of historic landfills.
Water	All options deliver reliable and resilient water supplies.	The majority of the routes for all options is located within Flood Zone 2 and 3. The abstraction and release of water has the potential to have an effect on water levels, flows and quality during the operational phase.
Air	No benefits identified.	All options are likely to generate short-term vehicle emissions and dust from construction activities.
Climatic factors	All options reduce vulnerability to climate change risks and hazards. All options have the opportunity to utilise greener and/or renewable energy.	All options will have negative carbon impacts due to construction and operation of the reservoir.
Landscape	Positive effects have been identified given the new reservoir provides a new valued landscape that can be used by people. Measures such as planting on embankments, floating wetlands/ islands, embankment structuring/ landscape contouring and building a visitor centre/ public art space and creation of footpaths, cycle routes, nature trails and bridleways have all been considered within the wider benefits piece.	All options fall within national landscape character areas and there will be minor negative effects during the construction phase on these areas.
Historic environment	No benefits identified.	There are several listed buildings and several scheduled monuments within the area. There is potential for the setting of these historic assets to be affected during the construction phase. There is a potential

Topic	Benefits	Adverse effects
Population and human health	No benefits identified. Wider benefits piece being considered which could be a benefit for the population.	for unknown archaeology to be discovered during excavation of the reservoir. All options intersect a number of community facilities and are located within 500m of other community facilities.
Material assets	No benefits identified.	All options intersect minor roads.

A. Stage 1 SEA output tables

The outputs can be provided upon request.

