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NORTH HYKEHAM RELIEF ROAD
HYDROMORPHOLOGY ASSESSMENT

TRANSPORT

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HYDROMORPHOLOGY ASSESSMENT

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Revision	Date	Prepared by	Checked by	Approved by	Description
C01	**01/08/23**	**AG**	**AG**	**AG**	**Updates following BB review**
P03	01/08/23	AG	AG	AG	Updates following BB review
P02	19/06/23	DM	TH	AV	updated for formatting
P01	12/06/23	DM	TH	AG	First Issue

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CONTENTS

1. INTRODUCTION

1.1 Introduction

This report summarises the hydromorphological assessment for the proposed scheme as required under the Design Manual for Roads and Bridges (DMRB) LA113 Road Drainage and the Water Environment, Revision 1 (Highways England, 2020). The objective is to provide an outline of the riverine characteristics for the watercourses within the study area, identify what impacts the introduction of the proposed scheme may have, and identify what mitigation may be required to manage these impacts.

The assessment supports and has informed the proposed scheme Environmental Statement (ES).

1.2 Methodology and Scope

The study has involved identifying fluvial features, including planforms, cross-sections, flow behaviours, bedforms, areas of erosion and accretion, and any pressures.

A walkover survey was undertaken in November 2022 and used alongside desktop information to inform the ES. This assessment can also be used to support the eventual detailed design where structures either interact with the watercourse channel, or cause changes in alignment, sediment entrainment and continuity, flow, and overall planform change. At this stage the report is intended to provide guidance to the project team, essentially corresponding with modern design best practices.

1.3 Site Walkover Survey

The observations made during the survey of the area to be impacted by the proposed scheme (November 2022) has been used as an evidence base for all assessment and analysis made within this report. No additional hydromorphology surveys have taken place, other than the assessment of desktop information, described above. Two principal watercourses were identified as being potentially impacted by the proposed scheme:

- The River Witham, and
- The Beck or 'South Hykeham Catchwater'.

A number of drainage ditches serving as agricultural field drains are intersected by the proposed alignment, and are to be culverted as part of the development. Some of these appear to be Internal Drainage Board (IDB) maintained, but the majority appear to be riparian landowner responsibility. These ditches ultimately are tributaries of either the Beck or the Witham. These drainage ditches have also been investigated as part of this assessment. The River Brant is located approximately 400m upstream of the proposed crossing, and is scoped out of the assessment.

The area of survey comprised a 1km reach of the River Witham that extends beyond the redline boundary of the proposed scheme both to the north and south (upstream and downstream). The survey assesses the overall channel geomorphology (cross-sectional character, planform, flow behaviour), geomorphological forms (erosion and deposition), sediment sources, artificial barriers and features, key habitats, and vegetation character.

The following sections provide a log of the observations recorded on site, and provide supporting photo images (see summary tables in Section 4). Tables summarising the findings are provided for the Witham and Beck individually, and collectively for the drainage ditches crossed by the proposed alignment.

1.4 Desk Study

The desk study included an analysis of satellite mapping, as well as of a number of geological and environmental GIS constraint layers to consider the broader, catchment scale characteristics of the planform.

Key data sources include:

- BGS Geology Viewer;
- Ordnance Survey mapping and aerial imagery (Ordnance Survey);
- Catchment Data Explorer (Environment Agency);
- Main Rivers (Environment Agency); and
- Historical mapping (National Library of Scotland).

2. DEVELOPMENT PROPOSALS

2.1 Overview

The following section of the report sets out in brief the development proposals, and the specific context in which they may have an impact on the hydromorphology of the watercourses, their respective riparian areas, and the associated catchments.

2.2 Summary of Scheme

The scheme consists of the construction of an approximately 8km stretch of 120kph Dual All-Purpose 2 Lane Carriageway between the A46 Hykeham Roundabout and the A15 Sleaford Roundabout at the west end of the Lincoln Eastern Bypass. The route also includes a segregated footway/cycleway at all new sections of the road and connections will be provided to existing footways.

The new road will pass around to the south side of South Hykeham and through Station Road near Waddington, before passing north around RAF Waddington. The proposed scheme alignment can be seen on Scheme General Arrangement Drawing, included in Appendix A.

It is understood the proposed NHRR will consist of a formed earth embankment for the majority of its route. The exception to this will be where the route crosses a watercourse. For the River Witham crossing, an approximately 90m clear span viaduct is proposed, which will be supported by two sets of 4no. bridge piers to provide support to the deck. The location of the piers is included on the Proposed Bridge General Arrangement, included in Appendix B.

2.3 Principal Impacts on Hydromorphology

An initial assessment of the route alignment against baseline catchment characteristics (see Chapter 4) indicates the following impacts could result due to the introduction of the NHRR:

- Loss of floodplain – the introduction of the earth embankment on which the road is to sit will result in localised impacts on out-of-bank flow during times of flooding. This could include increases in flow depths and velocities and subsequent increases in scour and deposition;
- Encroachment on channel – It is understood that the viaduct pier design will include 4no. piers situated on either riverbank (which also act as an Environment Agency flood defence). The presence of these piers will cause local impacts on river flow and scour, and subsequent downstream deposition;
- Impediment of flood flow – The presence of the earth embankment will impact on flood flows, by preventing the free dispersal of flood water across the Witham floodplain during a flood, as is the current situation;
- Introduction of surface water storage – the introduction of storage ponds to store surface water from the NHRR carriageway has the potential to impact on the local hydromorphology. This will include increased deposition, potential loss of floodplain storage and subsequent impacts on flood flows; and
- Introduction of surface water outfalls - along with the storage of surface water, it is understood a number of outfalls will also be introduced to provide a pathway for surface water to the Witham. The introduction of a headwall structure itself will impact river flow,

and the discharge of surface water (albeit attenuated and treated) could also impact hydromorphology.

The specific impacts of each of the separate NHRR elements and their respective impacts on hydromorphology are assessed in individual detail in Chapter 5.

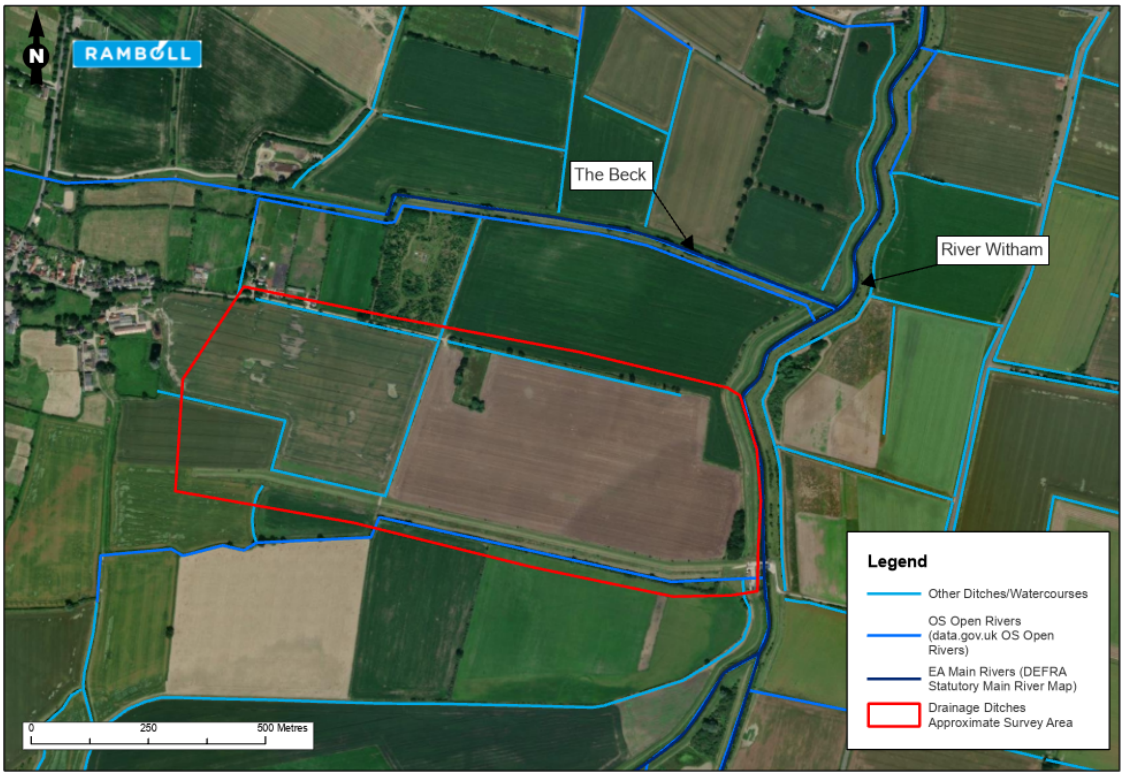
3. CHANNEL CHARACTERISTICS

The following section describes the catchments of each of the two watercourses that cross the study area, and the wider area feeding the collective drainage ditches. An individual watercourse plan has been prepared for each, which summarises the main features of each. These plans should be read in conjunction with this section of the report. The plans included are included in Appendix C, and include a separate plan for the River Witham, Beck and drainage ditches.

The catchment and channel characteristics for the Witham, Beck and Drainage Ditches are summarised in Tables 3.1-3.3 below.

Figure 3.1 presents the site location plan for the River Witham, The Beck, and the collective Drainage Ditches.

Figure 3.1: Site Location Plan



Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

Table 3.1: Catchment and Channel Characteristics of the Witham

River Witham	
Quantity and dynamics of water flow	Flow was uniform and smooth throughout the entirety of the surveyed reach.
Connection to groundwater bodies	None observed.
River/watercourse width variation	River width ranges from 19m at the southern end of the reach immediately north of the sluice gate to 11m at the northern end of the reach. Width is typically 11-12m throughout the surveyed reach. River was wider adjacent to the sluice gate.

Structure of the riparian zone	The riparian zone is dominated by short grasses with reedbeds occasionally present on the banks. Clusters of small trees were present on the east bank and were typically found at both the northern and southern ends of the surveyed reach.
Morphological pressures	Some evidence of minor erosion and deposition shown by gentle meandering and occasional reedbeds.

Table 3.2: Catchment and Channel Characteristics of the The Beck/South Hykeham Catchwater

The Beck/South Hykeham Catchwater	
Quantity and dynamics of water flow	Flow was typically uniform throughout the surveyed reach however areas where bed vegetation was dense saw restricted flow.
Connection to groundwater bodies	None observed.
River/watercourse width variation	Watercourse width ranges from 1-2m at the most upstream point of the surveyed reach to approximately 4m at the mouth. Width is typically around 2m throughout the surveyed reach. The channel was wider at the bridge/sluice gate.
Structure of the riparian zone	The riparian zone is dominated by grasses with reeds, denser vegetation and small trees present on the south bank, to the west of the bridge. Tracks were visible on the north bank but became less distinctive further upstream.
Morphological pressures	Minor deposition evidenced by occasional reedbeds.

Table 3.3: Catchment and Channel Characteristics of the Drainage Ditches

Drainage Ditches	
Quantity and dynamics of water flow	Flow was low to non-existent in observed ditches. Bed vegetation was observed to be dense.
Connection to groundwater bodies	None observed.
River/watercourse width variation	Watercourses were typically 1-2m in width and varied across the site.
Structure of the riparian zone	The riparian zone was dominated by short and long grasses with denser vegetation more common in less well-maintained ditches.
Morphological pressures	Little to no activity observed.

4. ASSESSMENT OF IMPACTS

4.1 Overview

An overview of the potential impacts the scheme may have on hydrogeomorphology are summarised in Section 2.3. The following chapter provides a more specific assessment of the likely impacts, based on what is known about the NHRR proposals and the characteristic of each watercourse as summarised in Chapter 3.

The assessment of impacts is split into the following:

- Temporary construction works;
- Earth embankment (permanent works);
- Bridge piers (permanent works);
- Outfalls and drainage structures (permanent works);
- Surface water storage (permanent works); and
- Culverts (permanent works).

4.2 Impact of Temporary Works

The temporary works will see a number of construction activities that could impact the hydromorphology of the watercourses, their respective riparian areas, and the associated catchments. These impacts are generally well understood and are likely to result mainly from the disturbance and dispersal of sediment resulting from excavations, the introduction of earth for the embankment fill, and the movement of construction traffic. This in turn could result in sediment entry into watercourses/ditches, consequential adverse impacts on hydraulic conditions, i.e., reductions in flow capacity, and impacts on flow velocities leading to increased propensity for scour/erosion.

As the temporary works access roads and vehicle movement diagram is not available, and there is no plan for the construction activities, it is considered that all three aspects of the water environment could be impacted, and will require mitigation.

4.3 Earth Embankment

The permanent introduction of the earth embankment will have a significant impact on the future overland flow of flood water. A review of the flood map for planning indicates that the River Witham floodplain is intersected by the proposed route alignment, and along with the displacement of flood water and impediment of flood flows, there are a number of secondary impacts that could result i.e. increased flooding to other receptors, greater duration of flooding etc.

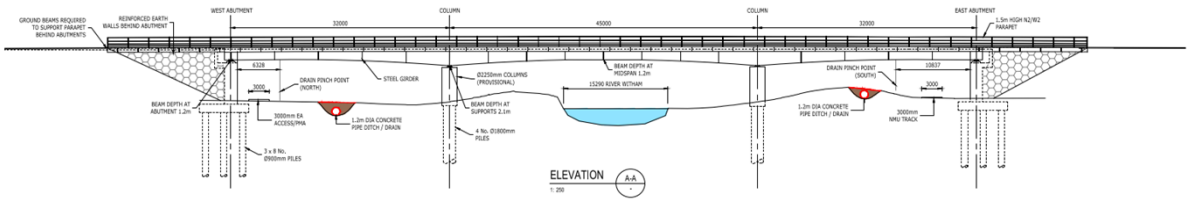
A review of the OS mapping indicates that the route only encroaches on the River Witham and the ditches, therefore these are the only two elements likely to be impacted.

4.4 Bridge Piers

The current design proposals are for a viaduct crossing is to be constructed across the River Witham. The crossing is to be clear span (i.e. the bridge soffit and abutments will be clear of the river channel) but is also set to contain two sets of supporting pier, each with 4no. individual

columns (see Bridge Plan included in Appendix B at the rear of the report and extract in Figure 4.1 below). The proposed pier locations indicate could cause the raised bank of the Witham to be at greater susceptibility of local scour, as the introduced piers will generate increased flow velocities in-front, to the side of, and behind the piers along the raised banks. A potential secondary impact would be the dispersal of eroded sediment downstream, and the increased likelihood of bank failure. It should also be noted that these raised banks act as Environment Agency flood defences.

Figure 4.1: Bridge Plan Extract



As the proposed piers are only situated adjacent to the Witham and do not interact with the ditches or Beck, the Witham is the only aspect of the water environment likely to be impacted.

4.5 Outfalls and Drainage Structures

The construction of the new carriageway will see the introduction of impermeable surfaces to what was previously greenfield land. There is therefore a requirement for a surface water drainage strategy to be developed alongside the scheme to ensure there is no adverse impact on water quality or quantity.

It is understood that the drainage strategy is currently under development, although broadly it will include the following:

- Introduction of a network of grassed surface water channels (GSWCs) adjacent to the carriageway and a concrete V-channel proposed in the central reservation with collected runoff ultimately conveyed to the Witham;
- Introduction of open ditches at the toe of the cutting adjacent to the carriageway with collected runoff ultimately conveyed to the Witham;
- Introduction of a series of outfalls located along the highway embankment to discharge surface water to the network of new drains; and
- Construction of outfalls along the bank of the Witham to provide a point of discharge for highway runoff to the wider water environment.

There are a number of potential impacts on the Witham and existing network of ditches, whilst the Beck is likely to be unaffected. The introduction of the new drainage as described above will be fundamentally changing the local hydrology, and the way in which the area drains. It is unlikely that this can be completely avoided, and as such the emphasis should be on ensuring that the introduction of the drainage is delivered in a way so that the impacts are not adverse, and providing enhancements where possible.

Separately, the introduction of the outfall structures to the Witham and existing ditches has the potential to disrupt flow conditions, and introduce an area which will have a naturally higher propensity to erosion and scour.

4.6 Surface Water Storage

Along with the introduction of a new network of ditches and outfalls, the drainage strategy will see the construction of a series of storage ponds, connecting to the new ditch network. The function of the ponds will be to provide storage and treatment of surface water, allowing it to be discharged at an attenuated rate and further to removal of pollutants.

A review of the preliminary drainage concept undertaken by Lincolnshire County Council indicates that given the proposed vertical alignment, surface water storage is likely to be required on both the east and west banks of the Witham, beyond the extent of the existing flood banks. The plan also indicates that there is the potential for at least one drain to discharge to an IDB drain, and as such both the Witham and existing drains could be impacted by the proposals.

With regard to specific impacts, the introduction of the ponds will impact existing floodplain conveyance and storage, and change the nature of the existing floodplain by introducing permanent water retaining structures.

4.7 Culverts

There are a number of IDB and landowner owned ditches which provide positive drainage of the existing agricultural fields through which the proposed NHRR alignment runs. As identified in Section 4.5, some of the drains will be re-aligned/incorporated into the proposed surface water drainage. Those which are not re-aligned/incorporated, and those which intersect with the proposed NHRR alignment will require culverting through the road embankment.

The culverting of existing ditches will have a number of impacts, ranging from disturbance of bed and bank material to loss of riparian vegetation. There will also be the associated operational issues associated with culverted drains, including scour, deposition, and poor hydraulic conditions.

As only culverting of the drainage ditches is proposed, these will be the only aspect of the water environment impacted.

5. PROPOSED MITIGATION MEASURES

5.1 Impact of Temporary Works

The mitigation for the temporary works will be the development of a detailed Construction and Environmental Management Plan (CEMP). Within the CEMP, the contractor should provide a method statement outlining how the construction activities will take place without causing pollution to the natural water environment resulting from sediment entry.

The CEMP should include measures such as:

- Installation of systems such as silt traps designed to trap silty water including adequate maintenance and monitoring of these to ensure effectiveness, particularly after adverse weather conditions;
- The cleaning of vehicle wheels prior to leaving site;
- Dust suppression (i.e., damping down); and
- Adherence to CIRIA guidance 'C532 – Control of Pollution from Construction Sites' 2001 (Ref. 12.24) for earthworks and construction activities.

5.2 Earth Embankment

Separate to the Hydromorphology Assessment, a Flood Risk Assessment (FRA) is being prepared for submission within the DSO. As part of the FRA, consultation was undertaken with the Environment Agency (EA), who confirmed that no compensatory storage will be required to offset that lost as a result of the embankment being introduced into the floodplain of the River Witham.

As such, no direct intervention is proposed to mitigate the impact of the embankment into the Witham floodplain.

5.3 Bridge Piers

As identified in Section 4.4, the introduction of the bridge may exacerbate local erosion of the river embankments, which also act as an Environment Agency flood defence. The mitigation measures to manage the impact of the introduction of the piers are two-fold; 1) the design of piers will need to be as passive as practicable, and 2) scour protection will be required at the embankments where they are located around the piers.

In relation to a passive design, this should include ensuring the piers are aligned in the direction of flow, are the minimum required structural width, and are cylindrical or oval in shape. A scour assessment is being undertaken separately by Ramboll and will include a calculation of the potential scour depth and extent, which in turn will form the design basis of a suitable scour protection apron to prevent erosion of the embankments.

5.4 Outfalls and Drainage Structures

The construction of outfall structures would align with good practice which can be found in the CIRIA guidance document, 'Culvert, screen and outfall manual' (C786) (CIRIA, 2019). The following are recommended:

- Outfall structures would be set back from the banks of the channel to avoid any significant disruption to natural processes and to avoid scour outflanking the structure;

- The apron of the outfall structure would include wing walls to appropriately tie the structure in with natural bank material;
- Pipes should not protrude into the channel and be submerged below the water line, to reduce the risk of scour;
- Outfalls and drainage channel confluences should be aligned downstream at a 45° angle to prevent flows along the watercourse from stilling; and
- Installation of green bank protection around the outfall structure to reduce the potential for bed and bank scour associated with increased flows.

5.5 Surface Water Storage

Due to the operational requirements of surface water storage being able to positively drain under gravity, there are certain constraints on the location of storage ponds. However, any surface water storage proposed as part of the scheme should be cognisant of the existing hydrology and flow paths, and seek to provide enhancements and promote good hydraulic conditions, and prevent occurrences like surface flooding and standing water.

5.6 Culverts

The construction of new culverts should follow good practice: 'Culvert, screen and outfall manual' (C786) (CIRIA, 2019). The following are recommended:

- New culverts to have internal diameters that match that of the natural channel;
- Limit the length of newly constructed culverts and extensions to prevent loss of the natural bed and banks;
- Bury the invert beneath the natural bed of the watercourses to allow for the continuation of sediment conveyance and reduce the impact on local flow dynamics;
- Tie in new and extended culverts with the banks to prevent the outflanking of the culverts by fluvial processes;
- Install baffles along the culvert beds to encourage flow variation, sedimentation and the restoration of the natural riverbed and sediment conveyance, and
- Where the inlets and outlets tie in with the channels, these tie in points should realign the channels to gently bend and should not tie into a perpendicular bend.

6. CONCLUSION

It is proposed to construct a new 8km stretch of 120kph Dual All-Purpose 2 Lane Carriageway between the A46 Hykeham Roundabout and the A15 Sleaford Roundabout at the west end of the Lincoln Eastern Bypass.

As part of the tranche of supporting environmental studies, a Hydromorphology Assessment has been undertaken. The purpose of the study is to assess what the potential impacts of the road could be on hydromorphology, and identify any measures that are required to mitigate these impacts. It is important to note that at this stage, the report is intended to provide guidance to the wider project design team in relation to the design of earthworks, drainage, and the proposed viaduct.

The study was based on a desktop study along with field observations which took place over an approximate 1km reach of the River Witham, and an approximate 400m reach of the Beck, a tributary of the Witham.

The character of the Witham and Beck is defined largely by flood control infrastructure, including raised river walls, dredged and partially straightened channels, and a system of overflows and sluice-gates upstream. Equally the ditches appear to form part of a wider network of land drainage, which historically and to the present day serve as land drainage for the local agricultural land.

The high-level assessment of potential impacts indicated that the proposed route could have a number of impacts on the local hydromorphology of the water environment. This includes those resulting from the introduction of an earth embankment into the floodplain, the introduction of piers within the banks of the River Witham, and the new surface water storage and outfalls. As such, a number of mitigation measures are to be included in the design of the proposed scheme to manage these impacts, these include:

- Passive design of bridge piers to minimise risk of scour to existing bank;
- Suitable design of all culverts to current standards, ensuring sufficient capacity is provided;
- Surface water drainage design which is cognisant to the existing environment, and seeks opportunities for enhancements; and
- A suitable CEMP to manage the environmental risks during construction.

Subject to a subsequent assessment to provide input to the detailed design process, ensuring inclusion of appropriate mitigation outlined above, the proposed NHRR can be delivered in a sustainable manner which will not adversely impact local hydrogeomorphology.

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ACRONYMS

Abbreviation	Term
BGS	British Geological Survey
DMRB	Design Manual for Road and Bridges
FRA	Flood Risk Assessment
CEMP	Construction and Environmental Management Plan

GLOSSARY

Term	Definition
Discharge	The volume of flow passing a point in a given time period.
Flow Dynamics	The manner in which flow behaves, i.e., turbulent flows, non-energetic and laminar flows.
Hydromorphology	The scientific study of the form and function of rivers and the interaction between streams and the landscape around them.
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
Meandering Channel	A single channel that follows a winding course, with a sinuosity ratio typically over 1.5.
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards. Note that Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
Outfall	Point of discharge into a waterbody.
Planform	The birds-eye view of the channel and the form of the channel from that perspective.
Reach	A length of river along which the channel controls are sufficiently uniform to allow a fairly consistent morphological structure to be maintained.
Riparian Zone	The corridor of land which runs along the banks of a river channel. If vegetated, it is known as the vegetated riparian zone.
Sinuosity	The degree in which a channel meanders, a sinuous channel generally has a sinuosity ratio between 0 and 1.5.

APPENDIX A – SCHEME PROPOSALS

N

0 250 500 m

Legend

Site Boundary

Proposed Alignment

Figure Title
Appendix A - Scheme Proposals

Project Name
North Hykeham Relief Road

Project No./Filery ID
1620013942/NHRR-RAM-EWE-HYKE-RP-LE-22004

Date	Figure No.	Prepared By
August 2023	A	DM

Scale	Issue
1:25,000 @A3	1

Client
Balfour Beatty & Lincolnshire County Council

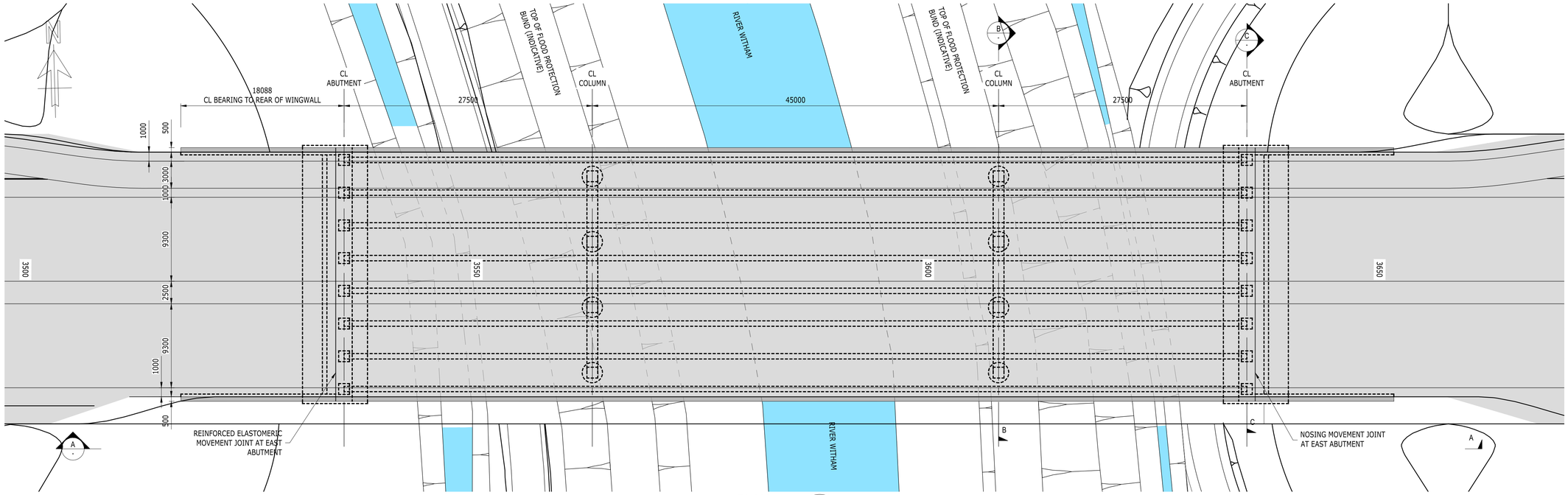
RAMBOLL

Appendix A - Scheme Proposals.pagx

PASTE FROM BELOW

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

APPENDIX B – PROPOSED BRIDGE PLAN



PLAN

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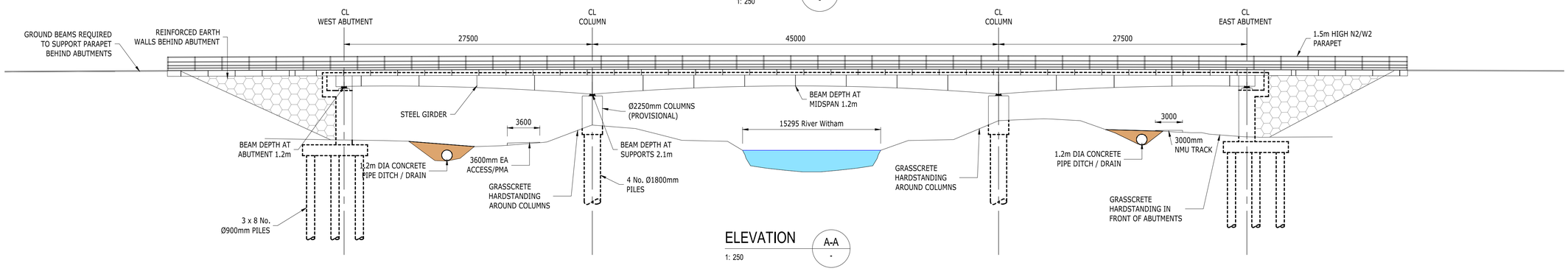

ELEVATION A-A

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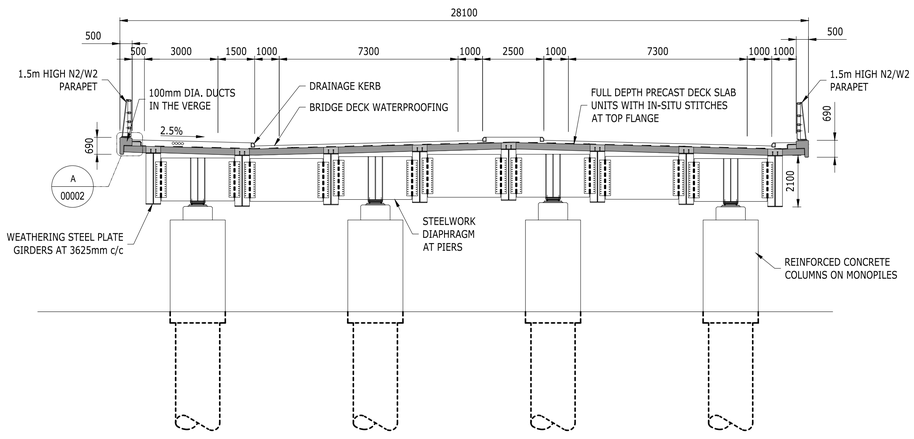
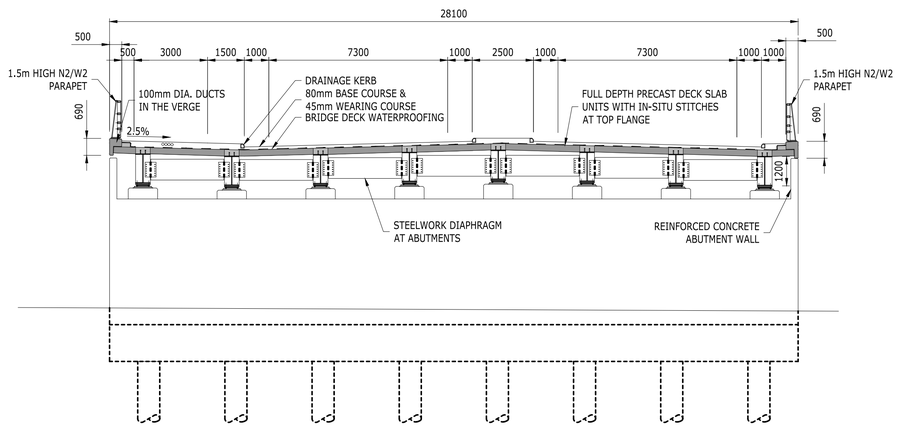


SECTION B-B

1: 125



SECTION C-C

1: 125

Notes

1. THIS DRAWING SHALL ONLY BE USED FOR THE DESIGN ELEMENT STATED IN THE DRAWING TITLE.
2. ONLY WRITTEN DIMENSIONS SHALL BE USED.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
4. ALL LEVELS ARE IN METRES RELATED TO ORDNANCE DATUM.
5. ALL CHAINAGES ARE IN METRES UNLESS NOTED OTHERWISE.
6. STEELWORK GRADE TO BE S355 J2W UNLESS OTHERWISE NOTED
7. CONCRETE GRADES TO BE AS FOLLOWS:
   IN-SITU/PRECAST DECK SLAB: C40/50
   PRECAST STRINGCOURSE: C40/50
   ABUTMENT AND PIERS: C40/50
   WINGWALLS: C40/50
   PILECAPS: C40/50
   PILES: C32/40
8. CONCRETE FINISHES:
   PRECAST STRINGCOURSE: F3, U3
   EXPOSED IN-SITU FACES: F4, U3
   BURIED IN-SITU FACES: F1, U1
   SURFACES TO BE WATERPROOFED: F2, U4
   EXPOSED PRECAST DESK SURFACES: F4
   EXPOSED IN-SITU DECK SURFACES: F4
9. THE FLOOD PROTECTION BUNDS ARE SHOWN INDICATIVELY. FURTHER TOPOGRAPHICAL SURVEY IS REQUIRED TO CONFIRM LOCATION PRIOR TO DETAILED DESIGN.

Rev	Description	Drawn	Checked	Approved	Date
P01	09/05/23	HR	2023/05/09	GW	09/05/23
P02	08/08/23	SP	GW	SC	08/08/23
P03	Approved and Accepted	SP	HW	AM	07/09/23
C01	Approved and Accepted	SP	HW	AM	07/09/23
P04	Fourth Issue	DB	LF	AM	27/10/23

Suitability: S5

Drawing Status: Suitable for Review & Acceptance

Project Name: North Hykeham Relief Road

Project Client: Lincolnshire County Council – Working for a better future

Project Contractor: Balfour Beatty

Project Designer: Ramboll

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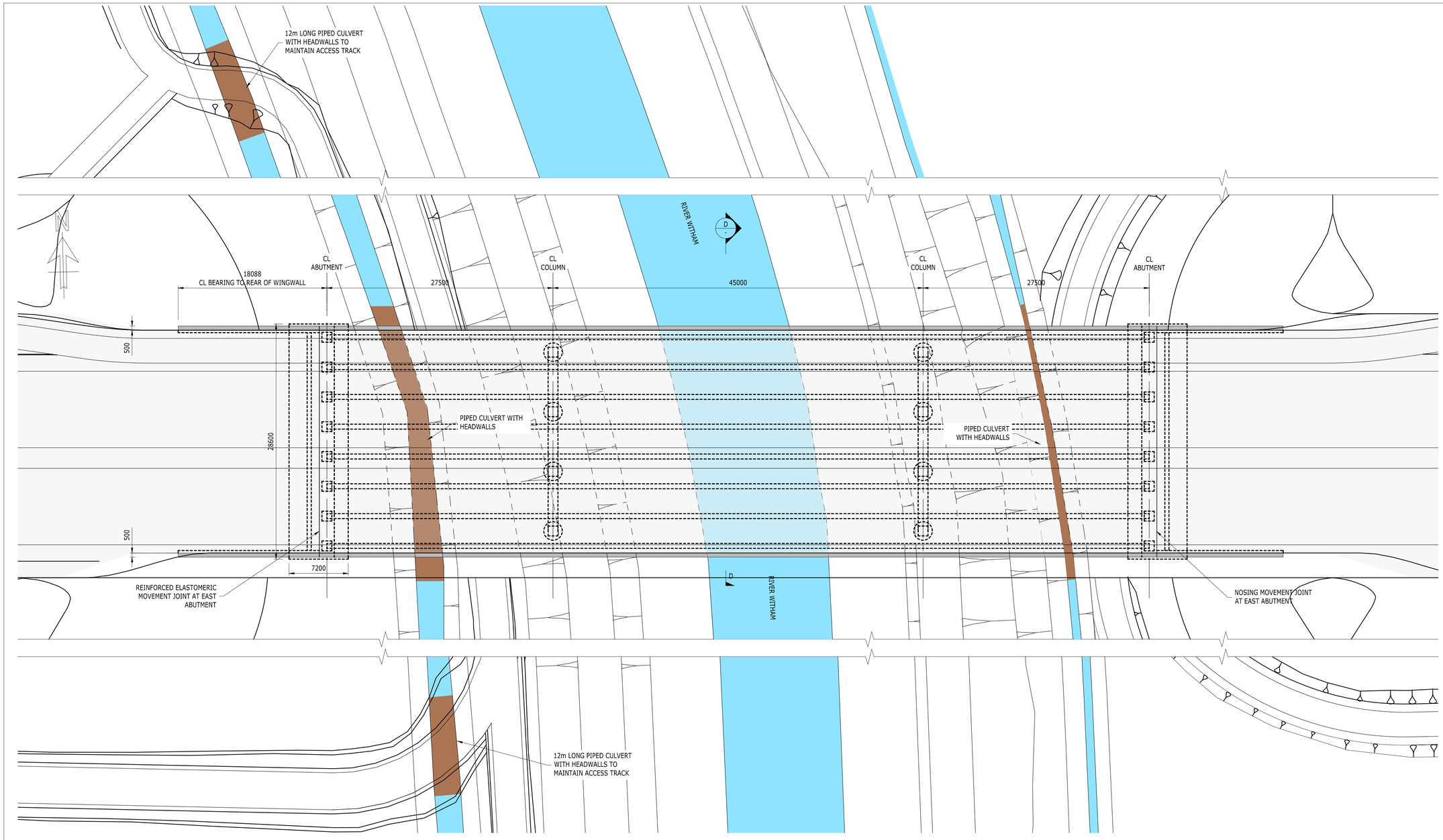
www.ramboll.co.uk

Drawing Title: North Hykeham Relief Road
River Witham Bridge
General Arrangement
Sheet 1 of 2

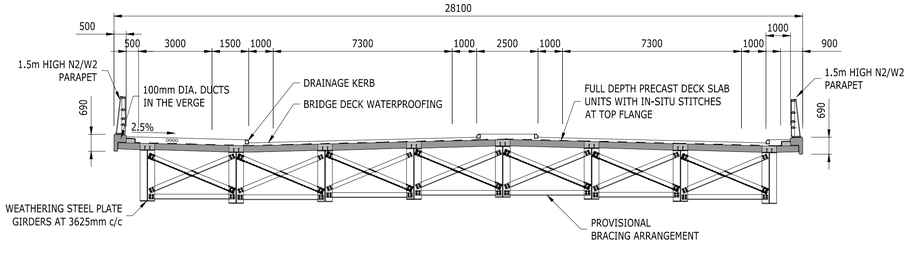
Project No:	Scale (@A1):	Drawn:	Date:
1620013942	AS SHOWN	DB	27/10/23

Drawing No: NHRR-RAM-SBR-BR03-DR-CB-00001

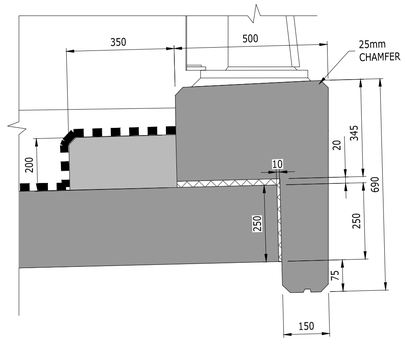
Rev: P04



PLAN - 1: 250



SECTION D-D - 1: 125



DETAIL A - 1: 10

EDGE OF DECK

Notes

1. THIS DRAWING SHALL ONLY BE USED FOR THE DESIGN ELEMENT STATED IN THE DRAWING TITLE.
2. ONLY WRITTEN DIMENSIONS SHALL BE USED.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
4. ALL LEVELS ARE IN METRES RELATED TO ORDNANCE DATUM.
5. ALL CHAINAGES ARE IN METRES UNLESS NOTED OTHERWISE.
6. STEELWORK GRADE TO BE S355 J2W UNLESS OTHERWISE NOTED
7. CONCRETE GRADES TO BE AS FOLLOWS:
   IN-SITU/PRECAST DECK SLAB: C40/50
   PRECAST STRINGCOURSE: C40/50
   ABUTMENT AND PIERS: C40/50
   WINGWALLS: C40/50
   PILECAPS: C40/50
   PILES: C32/40
8. CONCRETE FINISHES:
   PRECAST STRINGCOURSE: F3, U3
   EXPOSED IN-SITU FACES: F4, U3
   BURIED IN-SITU FACES: F1, U1
   SURFACES TO BE WATERPROOFED: F2, U4
   EXPOSED PRECAST DESK SURFACES: F4
   EXPOSED IN-SITU DECK SURFACES: F4

Rev	Description	Drawn	Checked	Approved	Date
P01	09/05/23	HR	2023/05/09	GW	09/05/23
P02	08/08/23	SP	GW	SC	08/08/23
P03	Approved and Accepted	SP	HW	AM	07/09/23
C01	Approved and Accepted	SP	HW	AM	07/09/23
P04	Fourth Issue	DB	LF	AM	27/10/23

Suitability: S5
Drawing Status: Suitable for Review & Acceptance

Project Name: North Hykeham Relief Road

Project Client: Lincolnshire County Council – Working for a better future

Project Contractor: Balfour Beatty

Project Designer: RAMBOLL

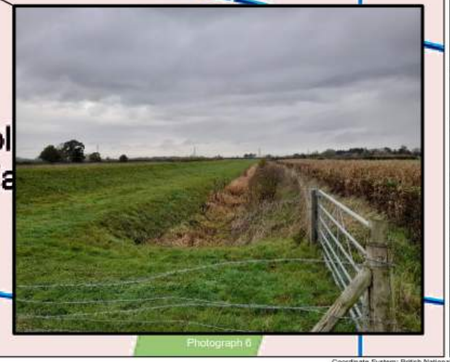
tel 01244 311855 chester@ramboll.co.uk
www.ramboll.co.uk

Drawing Title: North Hykeham Relief Road
River Witham Bridge
General Arrangement
Sheet 2 of 2

Project No:	Scale (@A1):	Drawn:	Date:
1620013942	AS SHOWN	DB	27/10/23

Drawing No: NHRR-RAM-SBR-BR03-DE-CB-00002
Rev: P04

APPENDIX C – BASELINE WATERCOURSE PLANS



Grange Farm

The Beck

Meadow Lane

River Witham

The Beck/South Hykeham Catchwater

Proposed storage ponds for highway runoff

New roundabout proposed as part of NHRR scheme

Environment Agency Flood Embankment

Environment Agency Flood Control Sluice Gates

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6

Photographs	
Photograph 1	An unnamed ditch approximately 270m west of the River Witham and approximately 320m south of the Beck.
Photograph 2	Overgrown channel of an unnamed ditch approximately 1km west of the River Witham and approximately 600m south of the Beck.
Photograph 3	Culverted section of an unnamed ditch approximately 650m west of the River Witham and approximately 270m south of the Beck.
Photograph 4	An unnamed ditch approximately 650m west of the River Witham and approximately 270m south of the Beck.
Photograph 5	An unnamed ditch approximately 800m west of the River Witham and approximately 600m south of the Beck, taken from above a culverted section.
Photograph 6	An unnamed ditch approximately 800m west of the River Witham and approximately 600m south of the Beck, taken from above a culverted section.

Drainage Ditches	
Quantity and dynamics of water flow	Flow was low to non-existent in observed ditches. Bed vegetation was observed to be dense.
Connection to groundwater bodies	None observed.
River/watercourse width variation	Watercourses were typically 1-2m in width and varied across the site.
Structure of the riparian zone	The riparian zone was dominated by short and long grasses with denser vegetation more common in less well-maintained ditches.
Morphological pressures	Little to no activity observed.

0 1 2 Kilometres

Legend

- Drainage Ditches Approximate Survey Area
- Proposed Alignment
- EA Main Rivers (DEFRA Statutory Main River Map)
- OS Open Rivers (data.gov.uk OS Open Rivers)
- Other Ditches/Watercourses

Figure Title
Drainage Ditches Hydromorphology Plan

Project Name
North Hykeham Relief Road

Project Number	Figure No.
1620013942	N/A
Date	Prepared By
May 2023	DM
Scale	Issue
1:4,000 @A1	1

Client
Balfour Beatty Construction

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

Other Watercourses v2.pagx

Photographs	
Photograph 1	Mouth of the Beck, looking east from east side of bridge/sluice gate approximately 30m upstream of confluence with the Witham.
Photograph 2	View from north bank looking east toward bridge/sluice gate approximately 70m upstream of bridge/sluice gate.
Photograph 3	View from north bank looking east toward bridge/sluice gate approximately 220m upstream of bridge/sluice gate.
Photograph 4	View from north bank looking west (upstream) approximately 360m upstream of bridge/sluice gate.

The Beck/South Hykeham Catchwater

Proposed storage ponds for highway runoff

River Witham

New roundabout proposed as part of NHRR scheme

Environment Agency Flood Embankment

Environment Agency Flood Control Sluice Gates

The Beck/South Hykeham Catchwater	
Quantity and dynamics of water flow	Flow was typically uniform throughout the surveyed reach however areas where bed vegetation was dense saw restricted flow.
Connection to groundwater bodies	None observed.
River/watercourse width variation	Watercourse width ranges from 1-2m at the most upstream point of the surveyed reach to approximately 4m at the mouth. Width is typically around 2m throughout the surveyed reach. The channel was wider at the bridge/sluice gate.
Structure of the riparian zone	The riparian zone is dominated by grasses with reeds, denser vegetation and small trees present on the south bank, to the west of the bridge. Tracks were visible on the north bank but became less distinctive further upstream.
Morphological pressures	Minor deposition evidenced by occasional reedbeds.

0 1 2 Kilometres

Legend

- Beck Approximate Survey Area
- Proposed Alignment
- EA Main Rivers (DEFRA Statutory Main River Map)
- OS Open Rivers (data.gov.uk OS Open Rivers)
- Other Ditches/Watercourses

Figure Title: The Beck Hydromorphology Plan

Project Name: North Hykeham Relief Road

Project Number	Figure No.
1620013942	N/A
Date: May 2023	Prepared By: DM
Scale: 1:3,000 @A1	Issue: 1

Client: **Balfour Beatty Construction**

RAMBOLL

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.

Beck v2.mxpr

Photographs	
Photograph 1	Sluice gate located at the southern end of the surveyed reach.
Photograph 2	View from western bank looking toward cluster of trees on eastern bank approximately 100m downstream of sluice gate.
Photograph 3	View from western embankment looking toward tree cluster on eastern bank at proposed crossing point.
Photograph 4	View of meander looking north approximately 130m north of the proposed crossing point.
Photograph 5	View of River Witham at the confluence with the Beck.
Photograph 6	View of River Witham in the northern part of the site looking south approximately 200m north-east of the Witham confluence with the Beck.

River Witham	
Quantity and dynamics of water flow	Flow was uniform and smooth throughout the entirety of the surveyed reach.
Connection to groundwater bodies	None observed.
River/watercourse width variation	River width ranges from 19m at the southern end of the reach immediately north of the sluice gate to 11m at the northern end of the reach. Width is typically 11-12m throughout the surveyed reach. River was wider adjacent to the sluice gate.
Structure of the riparian zone	The riparian zone is dominated by short grasses with reedbeds occasionally present on the banks. Clusters of small trees were present on the east bank and were typically found at both the northern and southern ends of the surveyed reach.
Morphological pressures	Some evidence of minor erosion and deposition shown by gentle meandering and occasional reedbeds.

adow Lane

River Witham

The Beck/South Hykeham Catchwater

Proposed storage ponds for highway runoff

Waddington Low Fields

Somerton G

Bram Road

New roundabout proposed as part of NHRR scheme

Lowfields Farm

Environment Agency Flood Embankment

Environment Agency Flood Control Sluice Gates

0 1 2 Kilometres

Legend

- Witham Approximate Survey Area
- Proposed Alignment
- EA Main Rivers (DEFRA Statutory Main River Map)
- OS Open Rivers (data.gov.uk OS Open Rivers)
- Other Ditches/Watercourses

Figure Title: River Witham Hydromorphology Plan

Project Name: North Hykeham Relief Road

Project Number	Figure No.
1620013942	N/A
Date: May 2023	Prepared By: DM
Scale: 1:3,500 @A1	Issue: 1

Client: **Balfour Beatty Construction**

RAMBOLL

Witham v2.pagx

Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.