Pell Frischmann

Redbourne Surface Water Flood Alleviation Scheme

Area 1 – Upstream Storage Area

Detailed Design Note

Date: October 2021
Report Ref: 104143-PEF-ZZ-AA-TN-C-0019

Revision Record					
Rev	**Description**	**Date**	**Originator**	**Checker**	**Approver**
A	Detailed Design Note	22-10-2021	TD	SM	JC
B	Amendment to section 2.4.3 and 2.4.4	19/06/2025	AB	TL	JC

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Pell Frischmann

Contents

1 Introduction

1.1 Scope of Report

Pell Frischmann has been appointed by North Lincolnshire Council (NLC) to undertake detailed design for the Redbourne Surface Water Flood Alleviation Scheme (SWFAS). This document will set out the detailed design scope of work for the upstream flood storage area and any associated water infrastructures in Area 1 of the Redbourne Village, North Lincolnshire.

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1.2 Background

Redbourne is a small rural village located 17km south east of Scunthorpe in North Lincolnshire and 4 km east of Kirkton in Lindsey, with sparsely populated rural village set in mature woodland. It is located in a landscape of large agricultural fields to the west, and flatter land to the east, subdivided with drainage ditches. The village is located approximately 800m east of the A15. The B1206 forms the main thoroughfare, through the village in a north-south direction. It is adjoined by numerous lanes spanning outwards from the east and west from the High Street and there is a wide green in the centre of Redbourne providing a centre point for the village.

A beck rises in the agricultural land located immediately west of the A15 and is culverted thorough the road embankment. The A15 highway drains discharge via a second pipe into a reed bed (known as the pollution pond), in the agricultural land immediately to the east of the A15. This was constructed to remove highway contaminants from the highway run-off. The pollution pond discharges the water into the beck at controlled rate via a discharge control structure and has an overflow weir for times of heavier flow. The penstock is currently seized and the reed bed heavily silted, reducing its effectiveness. No significant stormwater attenuation is provided by the pond.

The beck then flows through agricultural land, eastwards towards the village. In the village itself, the beck flows through a total of nineteen pipe bridges and culverts along Beck Lane, under the B1206, along School Lane and Park Lane.

At the end of School Lane, the beck turns northwards for approximately 50m in a heavily modified channel which includes an ornamental feature and overflow pipes in the grounds of Emmerson House. Ordnance Survey mapping from 1886 shows that the main channel follows the original route of the beck. At the north western corner of Emmerson House, the beck passes under the public footpath in the culvert the beck bends again by 80º to the east and flows along Park Lane in line with the public footpath. The watercourse continues to flow eastwards past Park Lane and continues eastwards into agricultural land where it forms Redbourne Old River prior to discharge into the New River Ancholme downstream.

NLC have indicated that previously the beck did not turn 90º to flow around the western side of Emmerson House. The original course of the beck continued its path eastwards along School Lane through the agricultural area to the south of the housing development. The beck then bent 90º to the north and used to flow northwards until it reached the eastern end of Park Lane. The beck then bent 90º to the east and flowed eastwards to form Redbourne Old River.

In June 2007 a series of properties within the village suffered from significant flooding. Redbourne was flooded again from minor flooding in January 2008.

NLC's Preliminary Flood Risk Assessments identified potential projects requiring a Flood Risk Management Plan. Following this process, the village of Redbourne has been identified as a high priority location warranting detailed investigation.

Pell Frischmann completed a Flood Evaluation Report (R50358T140Y001A) and an Options Report (R50385T141Y001A) in 2012. Following two further flood events in 2019, NLC has instructed Pell Frischmann to review the previous hydraulic model and update the findings of the reporting.

1.3 Revised Modelling

As part of the hydraulic model review undertaken in 2019 by Pell Frischmann, the original HEC-RAS watercourse model was converted into a ICM model to better model overland flows from the flooding watercourse.

A series of scenarios were tested:

Table 1 Modelled Scenarios

Scenario	Description
Base	Base model for comparison
100% Blocked	Blockage modelled at culvert trash screen located at the junction of High Street and School Lane.
Flow Control	Flow control located at the water inlet at the head of Beck Lane limited to 300 l/s.
Diversion Channel	Diversion/interception channel rear of properties of Park Lane

A 'rolling ball rainfall on to mesh' method was used to identify the low spots and overland flow paths in the village. This method also highlights areas where flooding maybe caused by pluvial flooding. The High Street and the head of School Lane seem to be areas where rainfall can become trapped and pool. Area rear of properties of Park Lane seem to be at risk from overland flows and similar can be seen at Carr Lane. Flooding occurs on the agricultural land south of the houses on Park Lane and historically a shallow furrow was used to convey water eastwards. However, in recent events a more substantial ditch has been cut to relieve flooding of the properties, and this has been found to be effective. For modelling result, see Redbourne Watercourse Modelling Results Technical Note.

1.4 Outline Design

Both solution scenarios in the revised model have merit to resolve the flooding in the location vicinity, but both solutions would be required to significantly reduce the flooding in the village. The diversion channel has the benefit of protecting properties at Park Lane from overland flows from either fluvial or pluvial flooding. Storage can be easily provided to attenuate the flows entering the village by utilising the adjacent fields as temporary storage basins.

Both solutions have been put forward for further development and subsequent outline design packages produced.

Various storage area locations and options have been considered during the outline design stage of the project. Initially a raised embankment immediately west of the farm track at the end of Beck Lane was considered but this would have entailed an earth structure which would disrupt the use of agricultural land. Further designs were investigated including earth embankments in

the field to the west of the original location but again the land usage and tree removal required made these unfeasible. The land immediately to the east of the A15 was investigated as North Lincolnshire Council already own the parcel of land which includes the pollution pond. The topography was found to be favourable: the shallow valley gradient and steeper slopes around the area gave sufficient water storage with a relatively short embankment. It was found that the embankment could be constructed without disrupting worked agricultural land, and a further advantage was the lower degree of tree cover upstream, with less potential for screen blockages in use. Access from the A15 already exists for construction and maintenance, and the scheme construction will have little impact on the village. This option was taken forward to landowner negotiation.

Following on from consultation with the client, parish council and the landowner, the existing model had been further revised and the result was included in the Redbourne Modelling: Revised Storage Location Technical Note, R103810N002-A in Appendix B.

2 Detailed Design Review

2.1 Overview

As part of the detailed design of the storage area and its associated water infrastructures, Pell Frischmann reviewed and assessed all existing data early in the programme, and any gaps on the data/information was highlighted to NLC.

Data that was reviewed were:

- Existing hydrological data;
- Existing flood risk data;
- Existing GI data;
- Existing topography survey data;
- Existing service search data; and
- Existing and revised models.

2.2 Design Standards and Other References

British Standards and Eurocodes have been used for the development of the design.

The standard Specification relating to technical aspects of all civil engineering works referred to in the specification documentation produced as part of the design, which is based on the

- Civil Engineering Specification for the Water Industry (CESWI) 7th edition; and
- Specification of Highway Works.

2.3 Design Basis

The design has been undertaken in accordance with the Redbourne Storage Area Detailed Design Scope 2.0 and on the basis of the following:

- Fluvial events: Provide a Standard of Protection (SoP) of 1 in 100 years (1%AEP) and adequate freeboard to the flood defences.
- Design life 100 years for the main civil elements of the works.

2.4 Design Review

Key parts of the design are:

- Embankment design;
- Storage area spillway;
- Reinforced concrete outlet headwall with flow control orifice; and
- Storage area energy dissipator.

All detailed design drawings are listed in the table below and can be found in Appendix A of this design note.

Drawing Number	Drawing title
104143-PEF-ZZ-AA-DR-C-0001	Upstream Storage Area Location Plan
104143-PEF-ZZ-AA-DR-C-0002	Upstream Storage Area General Arrangement
104143-PEF-ZZ-AA-DR-C-0003	Embankment Section A & B
104143-PEF-ZZ-AA-DR-C-0004	Embankment Crest Longitudinal Section Chainage 0 – 100m
104143-PEF-ZZ-AA-DR-C-0005	Embankment Crest Longitudinal Section Chainage 100 – 207m
104143-PEF-ZZ-AA-DR-C-0006	Details 1 & 2
104143-PEF-ZZ-AA-DR-C-0007	Upstream Storage Area Rock Mattress Basin Plan
104143-PEF-ZZ-AA-DR-C-0008	Energy Dissipator Sections
104143-PEF-ZZ-AA-DR-C-0009	Concrete Pipe Bedding
104143-PEF-ZZ-AA-DR-C-0010	Kerb Edge Plan
104143-PEF-ZZ-AA-DR-C-0011	Outlet Headwall Plan Elevation and Sections
104143-PEF-ZZ-AA-DR-C-0012	Outlet Headwall Proposed Concrete Outline and Benching Details
104143-PEF-ZZ-AA-DR-C-0013	Outlet Headwall Proposed Steel Work and Connection Details
104143-PEF-ZZ-AA-DR-C-0014	Outlet Headwall Base Reinforcement Details
104143-PEF-ZZ-AA-DR-C-0015	Outlet Headwall Wing Wall A Reinforcement Details
104143-PEF-ZZ-AA-DR-C-0016	Outlet Headwall Wing Wall B Reinforcement Details
104143-PEF-ZZ-AA-DR-C-0017	Outlet Headwall Stem Wall Reinforcement Details
104143-PEF-ZZ-AA-DR-C-0018	Outlet Headwall Weir Wall Reinforcement Details
104143-PEF-ZZ-AA-DR-GT-06001	Flood Storage Area Earthworks Notes
104143-PEF-ZZ-AA-DR-GT-06002	Flood Storage Area Earthworks Plan
104143-PEF-ZZ-AA-DR-GT-06003	Flood Storage Area Earthworks Sections

2.4.1 Embankment Design

The embankment is designed on 1 in 3 side slopes with a top width of 5m to a crest level of 23mAOD 600mm above the spillway crest level of 22.4mAOD. The embankment material consists of impermeable clay. A 3m wide cohesive shear key is also designed at the wet side of the embankment.

2.4.2 Storage Area Spillway

The 19.5m wide storage area spillway is designed on 1 in 3 side slopes with an average top width of 4m to a crest level of 22.4mAOD. The spillway is designed to operate on the full capacity of the A15 culverts with an expected mean hydraulic head of 100mm and a mean velocity of 0.56 m/s over the crest. The downstream spillway channel is designed on an average 1 in 17 longitudinal slope and a turf reinforcement mat will be used to protect the spillway crest and channel surface.

2.4.3 Reinforced Concrete Outlet Headwall with flow control orifice

The reinforced concrete outlet headwall is designed as a 10m long by 3.1m wide structure with an internal weir wall at 22.3mAOD. A 275mm orifice plate will be incorporated in the weir wall at 20.5mAOD and will limit the outflow to 300 l/s. A 900mm diameter concrete outfall pipe will

be incorporated to the headwall stem wall at 20.5m AOD and will limit the outlet velocity to 2.35 m/s.

2.4.4 Storage Area Energy Dissipator

A 6m long by 3.3m wide base with an invert level of 20.167mAOD, rock mattress energy dissipator basin is designed at the dry side of the embankment to limit the outlet velocity at 1.5 m/s to the downstream natural channel. The rock mattress basin is laid with a total nominal depth of 250mm below the finished sump level.

2.5 Environment

2.5.1 Trees and Vegetation

The works will require initial vegetation clearance within the working area. This will include removal of existing bushes/hedges and all vegetations. At the time of writing this note, all vegetations have been cleared on site with the consent from the landowner.

It is assumed the vegetation clearance was undertaken in accordance with the Environmental Action Plan (EAP) produced by the NLC environmental team.

2.5.2 Landscape

Minimal landscaping works will be required for the construction of the flood storage area. This was one of the key considerations during the outline design stage to minimise major cut and fill exercise to save cost and reduce H&S risk.

2.6 Service Clashes

Utility providers have been contacted and utility plans obtained. The following have been identified within 100m radius of the site:

- Gas Mains (Cadent Gas) – High and intermediate pressure gas main have been identified within the searched radius of the site. However, both the gas mains are located at the open field on the other side of A15. It is anticipated the impact on them from the construction of the flood storage area is negligible;
- Water Main (Anglian Water) – A pressurised water main has been identified on the other side of the highway verge of A15. It is anticipated that the construction works will have negligible impact on the water main;
- Sediment/Pollution Pond (NLC Highway) – A man-made sediment/pollution pond has been identified within the proposed site boundary immediately to the east of A15. This pond is constructed to remove highway contaminants from the highway run-off. The pollution pond discharges the water into the Redbourne beck running across the site at controlled rate via a discharge control structure and has an overflow weir for times of heavier flow. The penstock is currently seized and the bed of the pond heavily silted; and
- Underground Cable (BT) – underground BT cable has been identified running along the A15 on the nearside verge of the carriageway. The cable crosses the entrance of the site with unknown depth.

2.7 Operations and Maintenance Requirement

Access for NLC operations and maintenance staffs following completion of work has been considered in the design. It is envisaged the NLC staffs will access from the existing A15 access. It is possible that temporary widening may be required to accommodate construction vehicles.

3 Approvals

3.1 Planning

NLC deem planning permission is not required for the construction of the upstream storage area, inclusive of all the design elements such as the earth embankment, storage area spillway, outlet headwall structure and the energy dissipator. NLC to confirm with the council planning department.

3.2 Landowner Consent

All stakeholder engagement activities including liaison with the landowner is to be undertaken by NLC. It is assumed that an agreement in between the relevant landowner and NLC has been reached and consent granted.

3.3 Utility Providers

All stakeholder engagement activities including liaison with the affected utility providers is to be undertaken by NLC. It is assumed that discussion in between the relevant utility providers and NLC has started. Mitigation measures on any affected utilities are to be agreed at a later date.

3.4 Environmental

Anything related to the physical environment of the site is to be deal with by NLC in house environmental team, including the production of the Environmental Action Plan (EAP) if deem required.

4 Health & Safety

4.1 Designers Risk Assessment (DRA)

During outline and detailed design, several design hazards have been identified and designed out where possible. A Designers Risk Assessment (DRA) has been produced to record this process, which can be found in Appendix C. There are some residual risks that remain, and these have been identified and included within SHE boxes on the design drawings.

Appendix A – Technical Drawing

Appendix B – Revised Modelling Technical Note

Pell Frischmann

Project	103810 Redbourne
Document Title	Redbourne Modelling: Revised Storage Location Technical Note
Document Reference	R103810N002-A
Revision Reference	A
Prepared by	Johnathan Hubbard
Date	13th August 2021-

Technical Note

This report is a follow on from previous investigation and evaluation reports and is an assessment of a revised storage solution.

The topography around Redbourne is relatively flat with pockets of low spots across the village.

Max Elevation	15.8mAD
Min Elevation	9mAD
Elevation Range	6.8mAD
Average Elevation	12.4mAD

The concept solution was to provide a shallow detention area of 8,800m^2 to provide 4,400m^3 running parallel to The Beck as shown in Figure i.

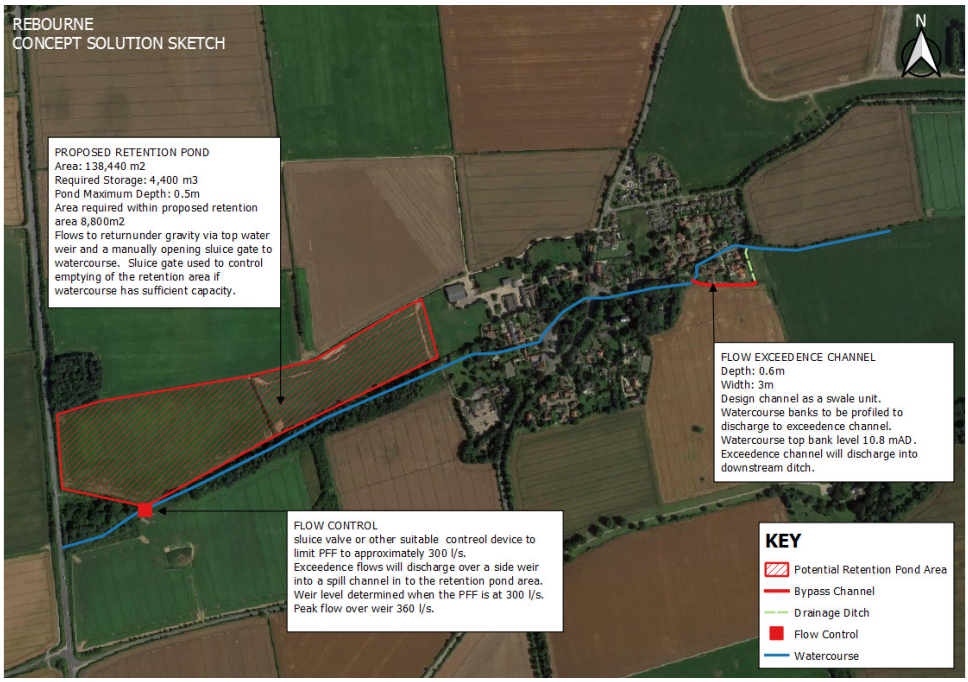

Figure i: Original Concept Solution

Following on from consultation with the client and parish council a new area was proposed for storm retention. This retention area is one of the A15 detention ponds that has recently been cleared of trees, see Figure ii with area outlined in yellow. The Beck runs through this detention area and the land is owned by the client.

Figure ii: Revised Detention Area

Unlike the original concept a retaining bank will have to be constructed across the Beck with a flow control. As the flow control is located at the same point of the original concept there should be no change to the required PFF of 300 l/s. A bypass weir will have to constructed in case of failure of the control device or storage being exceeded beyond the design requirement.

The model was re-run to assess the change in area. Unfortunately, the new area was outside of the original 2D mesh and Defra 1m LiDAR data did not cover this area. The area was covered by 5m resolution data and by merging the 1m and 5m resolution, a new mesh area was created.

For simplification purposes the storage area was modelled as two separate 2D meshes and connected to the Redbourne using a 1D open channel link based on a simplified channel dimensions of The Beck, see Figure iii. This approach was to stop double counting of flow generation from the modelled inflows and the rainfall runoff from the 2D mesh.

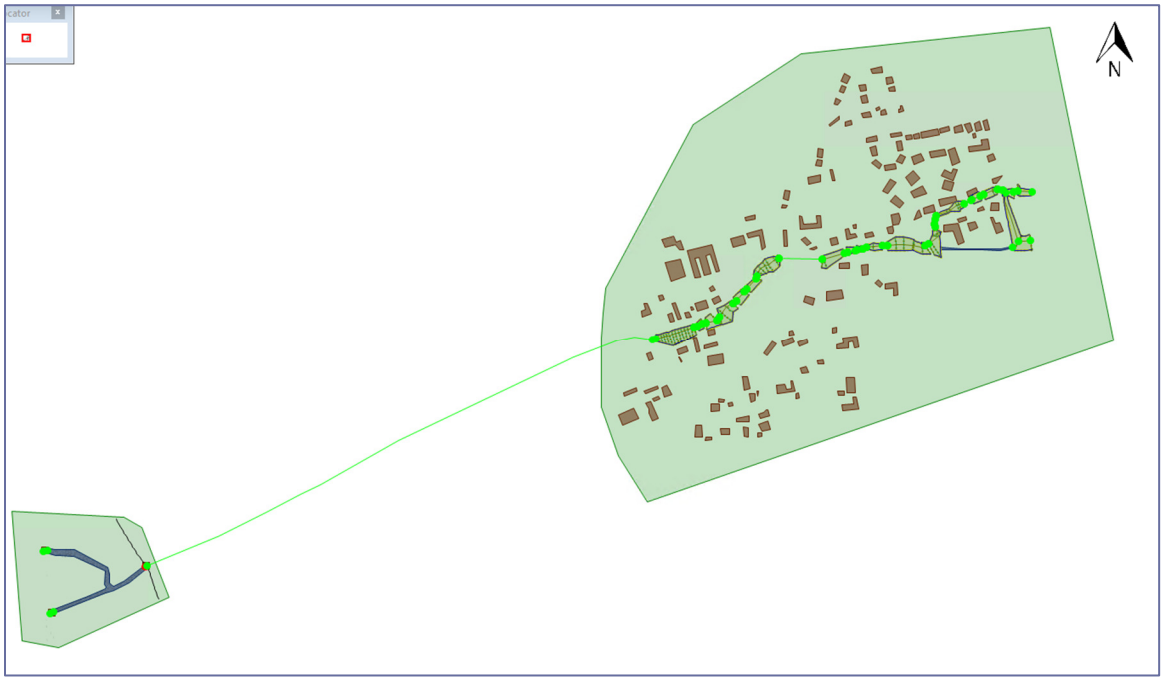

Figure iii: Modelled Revised Storage

A simple flow restricted orifice link of 300 l/s was used to simulate the flow control with a 600mm weir link to represent the bypass weir. A porous wall object was created on the 2D mesh to represent the retention bank. The porous wall's porosity was set to 0 and the crest level set to infinite.

To represent the flow in the beck the original generated flows were split between the flows from the A15 (Highway_Inlet:100 l/s) and the upstream flows of The Beck (Beck_Inlet: 360 l/s). These flows represent a constant 1 in 100 year flow rate. These flows then discharge on to the 2D mesh of the storage and run down a lowered mesh zone, which represents the channels in the retention area, to the flow control link.

Results shown in Figure iv displays the predicted flood depths for a 1 in 100, 120 minute design rainfall event. There is still some localised flooding caused by low spots on the mesh due to unmodelled surface water network.

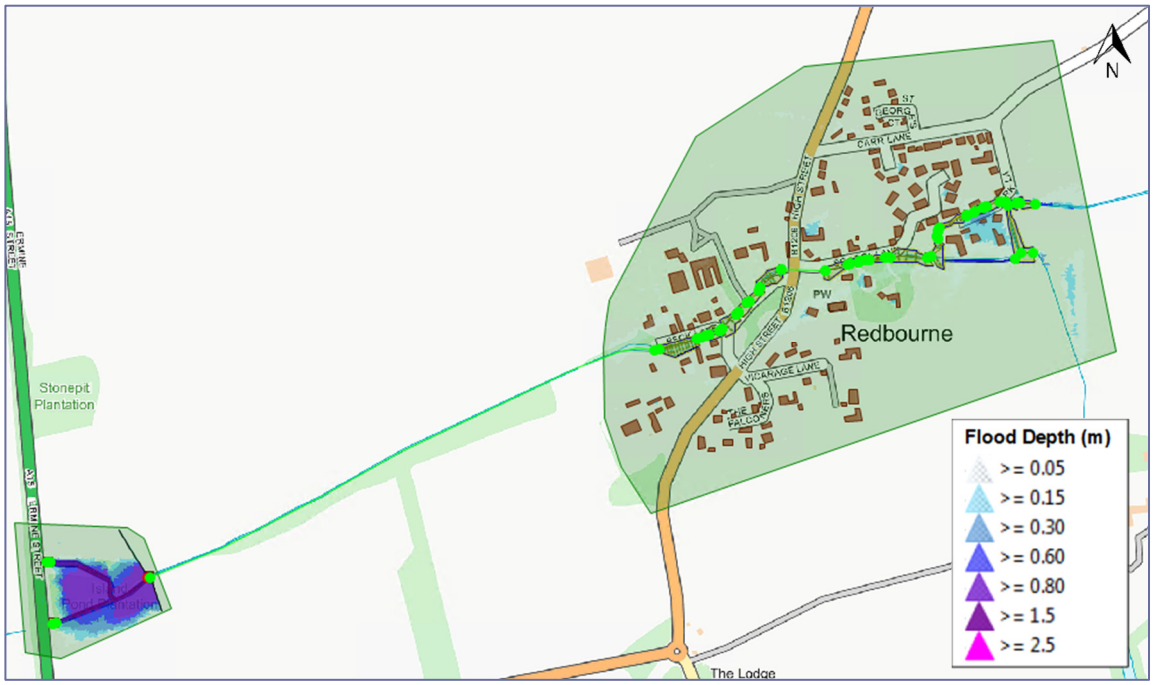

Figure iv: Results 1 in 100 120 minute Event

Restriction of the model:

- As previous mention the surface water network in Redbourne has not been modelled and flows have reached the watercourse overland.
- This is still a high-level evaluation model and therefore other factors such as road, fence/walls and other drainage networks are not represented in the model.
- It is assumed that the drainage dykes in field network will be maintained to a good standard and not become overgrown or clogged with debris.
- There is no allowance in the model for future development.
- The modelled beck is as of when the watercourse survey was undertaken in 2015 and assumes a relatively clear channel.
- No downstream boundaries have been applied to the network.

Report Ref.	**Document1**
File Path	Document1

Rev	Suit	Description	Date	Originator	Checker	Approver
A		Issue	13-08-2021	J. Hubbard	S. Maxwell	J. Chen

Ref. reference. Rev revision. Suit suitability.

Appendix C – Designers Risk Assessment

DESIGN RISK ASSESSMENT

Project Nr:	104143	**Project Title:**	Redbourne Flood Alleviation Scheme – Upstream Storage Area
Principal Designer & Representative:	Pell Frischmann	**Client & Representative:**	North Lincolnshire Council Mike Brown
Scope of Design:	Flood storage area with earth embankment, RC headwall, spillway and energy dissipator.	**DRA Nr:**	

METHODOLOGY

The degree of **RISK** is defined as **PROBABILITY** times **SEVERITY** for identified hazards and qualified as **HIGH**, **MEDIUM** or **LOW.**		**SEVERITY** of the Consequences		
		Fatality, major injury or illness causing long-term disability	Injury or illness causing short-term disability	Other injury or illness
PROBABILITY of Hazard arising		**High**	**Medium**	**Low**
Certain or near certain to occur	High	High	High	Medium
Reasonably likely to occur	Medium	High	Medium	Low
Very seldom or never occurs	Low	Medium	Low	Low

COMMON HAZARDS DEFINED AS:

1	Fall of person from height
2	Being struck by mobile plant
3	Fall of person on same level (tripping)
4	Collapse of structure
5	Manual handling
6	Striking by moving objects
7	Electricity
8	Contact with moving parts of machinery
9	Fire
10	Hazardous substances including dust
11	Noise and vibration
12	Hot working (welding, plumbing, etc)
13	Being struck by falling items
14	Confined spaces
15	Other

DESIGN RISK ASSESSMENT

Activity:	**Phase 1 Construction**					**Design Stage:**		**Tender issue.**	
Element	**Location**	**Hazard**	**Prob**	**Sev**	**Risk**	**Available Control Measures**	**Residual Risk**	**Action by**	**Procedure**
Existing Services	Whole work site	Service Strike - Damage to existing services during excavation or by plant movement; injury to site personnel and general publics	M	H	H	Underground BT cable is identified in the east verge of Ermine street (A15). Statutory undertakers search to be reviewed by Contractor prior to undertaking works. Area to be CAT scanned by trained and competent operator. Contractor to locate all services using hand tools before mechanical excavation can commence. Contractor to liaise with service providers to locate all services prior to excavation works. Pre-construction information and utility plans to be made available to the Contractor by the Designer.	M	Contractor/Designer	Pre-construction survey. Method Statement / Site Induction.
Working adjacent to water – drowning.	Whole work site, especially Redbourne Beck and existing sediment/pollution pond	Falling into water – Injury to site personnel or drown	L	H	M	All watercourses and open water contain shallow water under normal conditions but may become deep in flood conditions. Safe system of work to be identified for works in watercourse, taking account of varying conditions. Sediment/pollution pond to be temporarily fenced off during the construction period.	L	Contractor	Method Statement / Site Induction.

DESIGN RISK ASSESSMENT

Activity:	Phase 1 Construction					Design Stage:		Tender issue.	
Element	**Location**	**Hazard**	**Prob**	**Sev**	**Risk**	**Available Control Measures**	**Residual Risk**	**Action by**	**Procedure**
Working adjacent to water – disease.	Whole work site	Contact Waterborne diseases such as leptospirosis, hepatitis and E-coli – Illness or dead to personnel who contact with the disease	L	H	M	Avoid contact with water in ditches and drains where possible. Cover skin cuts and abrasions. After contact with water, never handle food or touch mouth/nose until hands have been washed.	L	Contractor	Method statement / site induction. Contractor to provide adequate cleansing facilities, handwipes etc.
Working adjacent to water – pollution.	Whole work site	Escape of fuels, oils, cement materials etc – Pollution to watercourses and open wate.	M	M	M	Avoid recycled materials for site compounds and haul roads adjacent to watercourses. Refuelling should be carried out in designated areas only. Shut down or remove leaking machines immediately and prevent spread of fluids. Stored materials and liquids should be kept in bunded containers and away from any watercourses and open water.	L	Contractor	All works to be carried out under an approved Construction Environmental Management Plan (CEMP). Method statements and site inductions inform operatives.
Site access adjacent to A15	Site access entrance	Restricted site access with acute turning angle – Accident and damage to site and public vehicle	M	H	H	Contractor to check suitability of access road/track and implementing appropriate traffic management system. Widening of site access.	M	Contractor	Method statement detailing what kind of site vehicle to be used for the work and considering appropriate traffic management system.
General working	Whole work site	Manual Handling – both long and short terms injury.	M	M	M	Avoid manual handling where possible. Make a suitable and sufficient assessment of the risk of injury from any hazardous manual handling operations that	L	Contractor	Method statements and site induction. Staff training.

DESIGN RISK ASSESSMENT

Activity:	Phase 1 Construction					Design Stage:		Tender issue.	
Element	**Location**	**Hazard**	**Prob**	**Sev**	**Risk**	**Available Control Measures**	**Residual Risk**	**Action by**	**Procedure**
						cannot be avoided. Where possible, provide mechanical assistance, for example, a sack trolley or hoist. Where this is not reasonably practicable then explore changes to the task, the load and the working environment. Follow HSE guidance on Manual Handling.			
General working	Whole work site	Harmful substances – Both short and long terms injury	M	H	H	All substances used on site, including cement - based products, are to be stored and used in accordance with the manufacturer's instruction and recorded on a COSHH data sheet.	L	Contractor	Method statements and COSHH assessments.
Excavation – collapse	Whole site	Trenches Collapse – Injury or dead to site personnel and general publics	M	H	H	Consider excavation depths, batter back excavation and minimise requirement to excavate. Ensure all excavations are planned and designed by competent temporary works contractor. Excavations are to be fenced off with vehicle stop blocks if necessary.	M	Contractor; temporary works designer.	Method statements; temporary works design.
Site plant movements	Whole work site.	Plant and traffic movements within the site area – Accident that may cause injury or dead to site personnel and general publics	H	H	H	Site delivery traffic and staff vehicles to be segregated from construction plant. One-way systems to be used where possible. Pedestrian barriers and designated walkways to be set out. All plant movements should be	M	Contractor	Traffic management plan and site set-up plan. Method statements and pass down through site inductions.

DESIGN RISK ASSESSMENT

Activity:	Phase 1 Construction					Design Stage:		Tender issue.	
Element	**Location**	**Hazard**	**Prob**	**Sev**	**Risk**	**Available Control Measures**	**Residual Risk**	**Action by**	**Procedure**
						controlled by a banksman.			
Soil and materials movements	Whole work site and surrounding public roads.	Import and export of soils, delivery of construction materials and plant - Accident that may cause injury or dead to site personnel, general publics and road users on Ermine Street (A15)	H	H	H	All traffic movements on public highways are to be carried out under an approved traffic management plan. This should consider noise, dust, peak times, school hours, route congestion etc.	M	Contractor	Method statement and traffic management plan to be approved before commencement on site.
Lifting Operations	General site	Lifting of heavy items – Injury or dead to site personnel if hit by swinging of lifting plants or items drop from height	M	H	H	Crane platform to be designed by competent temporary works contractor. All lifting to be planned in accordance with LOLER and managed by trained and competent banksman.	M	Contractor	Method statement and temporary works plan. Works in accordance with LOLER.
Interface with public	Whole work site	Use of space, road or area that the general public have access to - Harm or injury to members of the public.	M	H	H	All work areas are to be securely fenced off to prevent access by the public, accidental or otherwise. Where works encroach on the public highway, fenced footways are to be provided to segregate pedestrians from the public highway.	L	Contractor	Method statements and traffic management plan to be approved before commencement on site.
Confined space	Redbourne Storage Area Outlet Headwall	Confined space and Low headroom clearance following the	H	M	H	Contractor to ensure a safe working environment for access and egress during construction.	M	Contractor	Contractor to implement suitable scheme. Method statement to be produced and approved for working in confined space.

DESIGN RISK ASSESSMENT

Activity:	Phase 1 Construction					Design Stage:		Tender issue.	
Element	**Location**	**Hazard**	**Prob**	**Sev**	**Risk**	**Available Control Measures**	**Residual Risk**	**Action by**	**Procedure**
		installation of trash screens in front of the weir wall – Injury or dead to site personnel while working within the restricted environment							
Prepared By:	T Dimitriadis		**Checked By:**			S Maxwell	**Approved By:**		J Chen
Signature:	TD		**Signature:**				**Signature:**		
Date:	19/08/21		Date:			19/08/21	**Date:**		19/08/2021

SCHEDULE OF SIGNIFICANT RESIDUAL RISKS

Project Nr:	104143	**Project Title:**	Redbourne Flood Alleviation Scheme – Upstream Storage Area
Principal Designer & Representative:	Pell Frischmann	**Client & Representative:**	North Lincolnshire Council Mike Brown
Scope of Design:	Flood storage area with earth embankment, RC headwall, spillway and energy dissipator.	**DRA Nr:**	
Activity:	**Construction of flood storage area**	**Design Stage:**	**Tender issue**

Element	Location	Hazard	Available Control Measures	Residual Risk	Action by
Existing Services	Whole work site	Service Strike - Damage to existing services during excavation or by plant movement; injury to site personnel and general publics	Underground BT cable is identified in the east verge of Ermine street (A15). Statutory undertakers search to be reviewed by Contractor prior to undertaking works. Area to be CAT scanned by trained and competent operator. Contractor to locate all services using hand tools before mechanical excavation can commence. Contractor to liaise with service providers to locate all services prior to excavation works. Pre-construction information and utility plans to be made available to the Contractor by the Designer.	M	Contractor/Designer
Site access adjacent to A15	Site access entrance	Restricted site access with acute turning angle – Accident and damage to site and public vehicle	Contractor to check suitability of access road/track and implementing appropriate traffic management system. Widening of site access.	M	Contractor
Excavation – collapse	Whole site	Trenches Collapse – Injury or dead to site personnel and general publics	Consider excavation depths, batter back excavation and minimise requirement to excavate. Ensure all excavations are planned and designed by competent temporary works contractor. Excavations are to be fenced off with vehicle stop blocks if necessary.	M	Contractor; temporary works designer.
Site plant movements	Whole work site.	Plant and traffic movements within the site area – Accident that may cause injury or dead to site personnel and general publics	Site delivery traffic and staff vehicles to be segregated from construction plant. One-way systems to be used where possible. Pedestrian barriers and designated walkways to be set out. All plant movements should be controlled by a banksman.	M	Contractor

Soil and materials movements	Whole work site and surrounding public roads.	Import and export of soils, delivery of construction materials and plant - Accident that may cause injury or dead to site personnel, general publics and road users on Ermine Street (A15)	All traffic movements on public highways are to be carried out under an approved traffic management plan. This should consider noise, dust, peak times, school hours, route congestion etc.	M	Contractor
Lifting Operations	General site	Lifting of heavy items – Injury or dead to site personnel if hit by swinging of lifting plants or items drop from height	Crane platform to be designed by competent temporary works contractor. All lifting to be planned in accordance with LOLER and managed by trained and competent banksman.	M	Contractor
Confined space	Redbourne Storage Area Outlet Headwall	Confined space and Low headroom clearance following the installation of trash screens in front of the weir wall – Injury or dead to site personnel while working within the restricted environment	Contractor to ensure a safe working environment for access and egress during construction.	M	Contractor
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Date:	19/08/21	**Date:**	19/08/21	**Date:**	19/08/21