Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 12C: Drainage Strategy

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended) ("APFP")

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1 Introduction

1.1 This Document

1.1.1 This document is the Drainage Strategy for the proposed Great Yarmouth Third River Crossing (hereafter referred to as "the Scheme"). It supports an application by Norfolk County Council (the Applicant) for a Development Consent Order (DCO) for the Scheme.

1.1.2 This document is an appendix to Chapter 12 of the Environmental Statement (document reference 6.1).

1.2 Structure of the Drainage Strategy

1.2.1 The chapters of this Drainage Strategy comprise:

- Chapter 1 - Introduction
- Chapter 2 - Drainage Strategy
- Chapter 3 - Summary

1.3 Scheme Description

1.3.1 Chapter 2 of Volume I of the Environmental Statement (ES) (DCO Document 6.1) provides a full description of the Scheme, and is accompanied by the General Arrangement Plan (DCO Document 2.2). Both documents should be read alongside the Drainage Strategy, as a detailed project description is not provided in this document to prevent unnecessary duplication.

1.4 Purpose of the Drainage Strategy

1.4.1 This document sets out the drainage strategy to be adopted for the Scheme. The Contractor will develop the detailed drainage design for the Scheme in accordance with this Drainage Strategy.

1.5 Proposed Design Parameters

1.5.1 The following design parameters must be adopted in the Contractor's detailed design:

1.5.2 Design return periods:

- 1 in 1 year return period, critical storm duration – to be accommodated without surcharge;
- 1 in 30 year return period, critical storm duration – to be accommodated without surcharge above chamber cover level – i.e. no flooding to the highway;
- 1 in 100 year return period, 6 hour duration storm – to be accommodated within storage structures; and
- An allowance for climate change will also be applied to the drainage design by increasing the rainfall intensity by 40%.

1.5.3 The design principles to be taken forward are:

- All runoff to be adequately treated before entering receiving waterbodies/systems;
- The inclusion of SuDS within the design;
- Existing surface water flooding to be considered as part of the proposed design to ensure that all existing flow routes are drained, surface water flood risk is not increased and enhancement is provided where reasonably practicable and appropriate.
- All drainage features to be designed and construction with consideration of shallow groundwater. Features to be lined where necessary to prevent surface and groundwaters coming into direct contact; and
- Future access for maintenance of drainage systems to be considered in the detailed design.

1.6 Design Standards to be Adopted

1.6.1 The following Design Standards (or equivalent latest guidance) will be used in developing the drainage strategy into a detailed design:

- Design Manual for Roads and Bridges – Volume 4 Section 2 based on HD33/16, HA 107/04 and HD45/09;
- CIRIA C753 – The SuDS Manual;
- Sewers for Adoption 7th Edition 2012;
- Guidance on Norfolk County Councils Lead Local Flood Authority role as Statutory Consultee to Planning (located on Norfolk County Council's Information for Developers webpage); and
- DEFRA - Non-statutory technical standards for sustainable drainage systems.

2 Drainage Strategy

2.1 Existing Drainage Network

2.1.1 There are multiple existing drainage systems within the Principal Application Site, these include:

- Ordinary watercourse and culvert network which is the responsibility of the Waveney, Lower Yare & Lothingland Internal Drainage Board (IDB);
- River Yare, a main river which is the responsibility of the Environment Agency (EA);
- Combined sewer network which is the responsibility of Anglian Water (AW); and
- Highway drainage network which is the responsibility of Norfolk County Council (NCC).

2.1.2 A CCTV survey was undertaken within the area of the Scheme to identify how the existing highway, within the Principal Application Site, drains. It was found that the majority of the existing highway drains into the IDB ordinary watercourse network either directly or via a carrier system. The rest of the highway drains into the AW combined sewer network.

2.2 Proposed Drainage Design

2.2.1 This chapter is split into the following sections, with a brief description of the proposed drainage approach:

- The western side of the Scheme – the section of the Scheme due west of the bridge high-point (highest level on the bridge deck);
- The eastern side of the Scheme – the section of the Scheme due east of the bridge high-point (highest level on the bridge deck).

2.2.2 The drainage strategy identified in this document is depicted in Figure 12C.1 and Figure 12C.2 within Volume III of the Environmental Statement.

2.3 The Western Side of the Scheme

2.3.1 There are two potential discharge options for the western side of the Scheme:

- Discharge via gravity to the IDB ordinary watercourse network; or
- Discharge via pumped system to the River Yare (area would be drained via gravity to a pumping station and then pumped into the main river).

2.3.2 The preferred option is to discharge via gravity to the IDB ordinary watercourse network.

2.3.3 If the River Yare discharge option is pursued the specific discharge location should be confirmed by the Contractor with the EA in accordance with the terms of the DCO and in accordance with any required environmental permit, prior to finalising the detailed drainage design.

2.3.4 The western drained area is illustrated in Figure 12C.1 within Volume III of the Environmental Statement and consists of:

- The moveable bridge deck - expected to drain via longfall and crossfalls directing surface run-off towards the kerbs, where drainage holes fabricated through the structure's deck will allow water to run down and into a closed pipe drainage system. Alternative options, such as installing a slot drain at the western extent of the bridge and draining the deck via longfall, are to be considered by the contractor during detailed design.
- The fixed bridge deck - expected to drain via kerb drainage units.
- The carriageway - to be typically drained via traditional pipe and gully system.
- The footway and cycleway - will either drain directly to the carriageway or into adjacent verges with swales constructed within them. The swales will then discharge into the wider drainage system comprised in this Drainage Strategy.
- Embankments - expected to be drained via filter drains located at the base which will outfall into the wider drainage system comprised in this Drainage Strategy.

2.3.5 The existing culverts beneath William Adams Way and Queen Anne's Road will be checked by the Contractor to determine whether they can accommodate a Q25 (return period of 1 in 25) to Q100 (return period of 1 in 100) design flow with no surcharge; depending on the implications of flooding (see HA 107/04, DMRB 4.2). Flow rates for the individual watercourses shall be calculated using Flood Estimation Handbook (FEH) methods, dependent on catchment size and characteristics. If it is found that either culvert is sufficient in size, extensions will be added. If undersized, a replacement will be put in place (whilst considering the wider network). Environmental enhancement such as culvert enlarging and natural beds should also be considered if replacement is necessary.

2.3.6 Discharge rates and volumes into receiving waterbodies/systems to be limited, as close as practical, to the greenfield runoff scenario for all events up to and including the 1 in 100 year return period event. Where this is not

achievable, the post development runoff rates and volumes should not exceed existing scenario values.

2.3.7 The proposed contributing area for the western side of the Scheme is 3.314ha.

2.3.8 The existing contributing area to the IDB watercourse within the extents of the proposed scheme consist of 1.314ha impermeable and 0.839ha permeable. These areas were defined using the outputs of the existing highway drainage CCTV survey.

2.3.9 The Greenfield QBar (return period of 2.3 years) runoff rate for the western side of the Scheme is 5l/s.

2.3.10 The Greenfield runoff rate for the 1 in 100 year return period for the western side of the Scheme is 17.9l/s.

2.3.11 The Greenfield runoff volume for the 1 in 100 year return period 6 hour event for the western side of the Scheme is 458m^3.

2.3.12 The existing scenario runoff rate and volume for the 1 in 100 year return period 6 hour event for the western side of the Scheme is 101.1l/s and 866m^3 respectively.

2.3.13 The MicroDrainage calculations provided in Annex A, Appendix 12C within Volume II of the Environmental Statement demonstrate the rates and volumes listed above.

2.3.14 The contributing area, impermeable/permeable divide, rates and volumes listed above are correct based on the General Arrangement Plans (Document 2.2). However due to variations permitted within the Limits of Deviation, the Contractor is required to confirm the above values and recalculate if necessary at detailed design.

2.3.15 The discharge hierarchy as outlined in Building Regulations Part H was followed when defining the drainage strategy for the western side of the scheme; it was concluded that discharge to watercourse was the preferred solution since infiltration is not viable due to the shallow groundwater table in the area.

2.3.16 The required attenuation storage options are to be developed by the Contractor but as a minimum will consist of the following:

- A storage feature located within the inner central area of the proposed roundabout;
- A storage feature located within the available verge area to the north-west of the proposed roundabout; and
- Swales located within verges (available space permitting).

2.3.17 The required pollution treatment/mitigation is to be developed by the Contractor but as a minimum will consist of the following:

- Natural treatment (SuDS) – e.g. wet pond/wetland feature, swales, filter drains;
- Proprietary treatment device(s) – vortex separator or similar approved treatment devices; and
- Spillage control penstocks - provided at the termination chamber of all mainline drainage runs and in advance of discharges to ponds, underground storage features, wet grasslands or watercourses.

2.3.18 Water quality discharge shall be assessed at detailed design stage by the Contractor using the Highways Agency Water Risk Assessment Tool (HAWRAT), with treatment measures assessed using indicative values provided in Table 8.1 of HD33/16 or equivalent latest guidance.

2.4 The Eastern Side of the Scheme

2.4.1 The discharge option for the eastern side of the Scheme is to discharge into the AW combined sewer network on South Denes Road at a rate acceptable to AW, pursuant to the provisions of the DCO.

2.4.2 The eastern drained area is illustrated in Figure 12C.2 within Volume III of the Environmental Statement and consists of:

- The moveable bridge deck - expected to drain via longfall and crossfalls directing surface run-off towards the kerbs, where drainage holes fabricated through the structure's deck will allow water to run down and into a closed pipe drainage system. Alternative options, such as installing a slot drain at the eastern extent of the bridge and draining the deck via longfall, are to be considered by the contractor during detailed design.
- The carriageway - to be typically drained via traditional pipe and gully system.
- The footway and cycleway - will drain directly to the carriageway.
- Embankments - expected to be drained via filter drains located at the base which will outfall into the wider drainage system comprised in this Drainage Strategy

2.4.3 Discharge rates and volumes into receiving combined sewer to be limited, as close as practical, to the greenfield runoff scenario for all events up to and including the 1 in 100 year return period event. Where this is not achievable, the post development runoff rate should not exceed 10l/s as defined by AW.

2.4.4 AW have undertaken modelling of the network and have concluded that a restricted rate of 10l/s into MH6006 is acceptable, although this rate and specific discharge location should be confirmed by the Contractor with AW in accordance with the terms of the DCO prior to finalising the detailed drainage design.

2.4.5 The outputs of the existing highway drainage CCTV survey indicate that South Denes Road and South Gates Road discharge to AW combined sewers.

2.4.6 The proposed contributing area for the eastern side of the Scheme is 0.782ha. This is the additional area which will discharge into the AW network.

2.4.7 The Greenfield QBar (return period of 2.3 years) runoff rate for the eastern side of the Scheme is 1.2l/s.

2.4.8 The Greenfield runoff rate for the 1 in 100 year return period for the eastern side of the Scheme is 4.2l/s.

2.4.9 The Greenfield runoff volume for the 1 in 100 year return period 6 hour event for the eastern side of the Scheme is 108m^3.

2.4.10 The MicroDrainage calculations illustrated in Annex A, Appendix 12C within Volume II of the Environmental Statement demonstrate the rates and volumes listed above.

2.4.11 The contributing area, impermeable/permeable divide, rates and volumes listed above are correct based on the General Arrangement Plans (Document 2.2). However, due to permitted variations within the Limits of Deviation, the Contractor is required to confirm the above values and recalculate if necessary at detailed design.

2.4.12 SuDS were explored as part of the drainage strategy for the eastern side of the scheme. Due to the existing urban area and restricted space, it is expected that opportunities for their inclusion will be limited.

2.4.13 The discharge hierarchy as outlined in Building Regulations Part H was followed when defining the drainage strategy for the eastern side of the scheme; it was concluded that discharge to combined sewer was the preferred solution since:

- Infiltration is not viable due to the shallow groundwater table in the area;
- Discharge via gravity to the River Yare is not viable due to unfavourable local levels, a reinforced quay wall and high tide levels; and
- There are no surface water sewers within close proximity to the Scheme.

2.4.14 Upon the sewerage undertaker's consent to the connection, the Contractor will be required to provide the evidence to confirm that alternative methods of surface water disposal (following the surface water management hierarchy as outlined in Building Regulations Part H) have been explored.

2.4.15 The required attenuation storage will be developed by the Contractor but as a minimum will consist of oversized pipes. Underground storage tanks should also be considered.

2.4.16 The required pollution treatment/mitigation is to be developed by the Contractor but as a minimum will consist of a proprietary device (vortex

separator or similar approved treatment devices) before discharge into the combined sewer.

2.5 Construction Details

2.5.1 Manholes, gullies and pipe networks used for the construction of the Scheme will be constructed in accordance with:

- Norfolk County Council's standard details;
- The MCHW Highway Construction details; or
- AW construction details (for works to the AW network). Contractor to confirm detail requirements with AW.

2.6 Maintenance Details

2.6.1 Long term maintenance, including access, to the proposed drainage features must be considered as part of the Contractor's detailed drainage design.

2.6.2 NCC will adopt the new gullies and systems within the highway.

2.6.3 Discussions are currently being undertaken with the Waveney, Lower Yare & Lothingland IDB for the stakeholder to adopt the watercourse/culvert network from the end of the current adoption (grid ref: 652162, 305871) to the point at which the IDB adopted system starts (grid ref: 651501, 306274) – subject to agreement. In the absence of agreement to adopt, the watercourse/culvert network would remain as riparian ownership.

2.6.4 Subject to further details being shared and agreed, it is proposed that the IDB will adopt the Scheme pumping station should this discharge option be selected. In the absence of agreement to adopt, the Applicant would maintain the pumping station.

2.7 Stakeholder Involvement

2.7.1 The following stakeholders were consulted as part of the development of this Drainage Strategy:

- Anglian Water (AW);
- The Waveney, Lower Yare & Lothingland Internal Drainage Board (IDB);
- The Environment Agency (EA); and
- NCC Lead Local Flood Authority (LLFA).

3 Summary

3.1.1 The Contractor will develop the detailed drainage design for the Scheme in accordance with this Drainage Strategy, specifically the design parameters detailed in Section 1.5.

3.1.2 For the western side of the Scheme, discharge rates and volumes into receiving waterbodies/systems to be limited, as close as practical, to the greenfield runoff scenario for all events up to and including the 1 in 100 year return period event. Where this is not achievable, the post development runoff rates and volumes should not exceed existing scenario values.

3.1.3 The preferred discharge option for the western side of the Scheme is to the IDB ordinary watercourse, however an alternate discharge into the River Yare via pumped system is also considered.

3.1.4 For the eastern side of the Scheme, discharge rates and volumes into receiving waterbodies/systems to be limited, as close as practical, to the greenfield runoff scenario for all events up to and including the 1 in 100 year return period event. Where this is not achievable, the post development runoff rates should not exceed 10l/s as defined by AW.

3.1.5 An adequate inclusion of attenuation, pollution treatment and SuDS is to be included within the Contractor's detailed drainage design.

Great Yarmouth Third River Crossing

Application for Development Consent Order

Document 6.2: Environmental Statement Volume II: Technical Appendix 12C, Annex A: MicroDrainage Calculations

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ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	3.314	Urban	0.000
SAAR (mm)	598	Region Number	Region 5

Results l/s

QBAR Rural	5.0
QBAR Urban	5.0
Q100 years	17.9
Q1 year	4.4
Q30 years	12.1
Q100 years	17.9

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
Site Location	
C(1km)	-0.023
D1(1km)	0.309
D2(1km)	0.346
D3(1km)	0.224
E(1km)	0.318
F(1km)	2.477
Areal Reduction Factor	1.00
Area (ha)	3.314
SAAR (mm)	598
CWI	86.560
SPR Host	22.990
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	18.69
Greenfield Runoff Volume (m^3)	458.301

Area Summary for Existing

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.365	0.365	0.365
	User	-	100	0.775	0.775	1.140
	Classification	grass	10	0.015	0.002	1.142
	User	-	100	0.067	0.067	1.208
	User	-	100	0.027	0.027	1.235
	Classification	grass	10	0.270	0.027	1.262
	Classification	grass	10	0.327	0.033	1.295
	Classification	grass	10	0.227	0.023	1.317
	User	-	100	0.080	0.080	1.397
1.001	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				2.152	1.397	1.397

Summary Wizard of 360 minute 100 year Winter I+0% for Existing

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.309	E (1km)	0.318
Site Location		D2 (1km)	0.346	F (1km)	2.477
C (1km)	-0.023	D3 (1km)	0.224	Cv (Summer)	0.750
Cv (Winter)	0.840				

Margin for Flood Risk Warning (mm)	0.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Winter
Duration(s) (mins)	360
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Event	Duration (mins)	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
E1.000	E1	360 minute 100 year Winter I+0%	360	100.000	98.340	-0.860	0.000
E1.001	E2	360 minute 100 year Winter I+0%	360	100.000	98.313	-0.887	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Infil. Flow (l/s)	Infil. Vol (m³)	Maximum Vol (m³)	Discharge Vol (m³)	Maximum Velocity (m/s)	Pipe Flow (l/s)	Status
E1.000	E1	0.15				0.378	866.692	0.4	101.1	OK
E1.001	E2	0.15				1.466	868.172	0.4	101.1	OK

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.782	Urban	0.000
SAAR (mm)	598	Region Number	Region 5

Results l/s

QBAR Rural	1.2
QBAR Urban	1.2
Q100 years	4.2
Q1 year	1.0
Q30 years	2.8
Q100 years	4.2

Greenfield Runoff Volume

FEH Data

Return Period (years)	100
Storm Duration (mins)	360
Site Location	
C(1km)	-0.023
D1(1km)	0.309
D2(1km)	0.346
D3(1km)	0.224
E(1km)	0.318
F(1km)	2.477
Areal Reduction Factor	1.00
Area (ha)	0.782
SAAR (mm)	598
CWI	86.560
SPR Host	22.990
URBEXT (1990)	0.0000

Results

Percentage Runoff (%)	18.69
Greenfield Runoff Volume (m^3)	108.145