The Lake Lothing (Lowestoft) Third Crossing Order 201[*]

Lake Lothing
THIRD
CROSSING

Document 6.7: Preliminary Navigation Risk Assessment

Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Foreword

This Preliminary Navigation Risk Assessment relates to an application ('the Application') submitted by Suffolk County Council ('the Council' / 'the Applicant') to the Secretary of State (through the Planning Inspectorate) for a Development Consent Order ('DCO') under the Planning Act 2008.

If made by the Secretary of State, the DCO would grant development consent for the Applicant to construct, operate and maintain a new bascule bridge highway crossing, which would link the areas north and south of Lake Lothing in Lowestoft, and which is referred to in the Application as the Lake Lothing Third Crossing (or 'the Scheme').

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Abbreviations

COLREGs	International Regulations for Prevention of Collision at Sea, 1972
DCO	Development Consent Order
DfT	Department for Transport
GLA	General Lighthouse Authority
IALA	The International Association of Marine Aids to Navigation and Lighthouse Authorities
LPS	Local Port Service
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MGN	Marine Guidance Note
NRA	Navigation Risk Assessment
SHA	Statutory Harbour Authority

1 Introduction

1.1 Scope of the Assessments

1.1.1 This report sets out the preliminary Navigation Risk Assessment (NRA) based on the reference design brought forward for DCO application. It covers both the construction and operational phases of the Scheme. Any subsequent changes to the bridge design or construction methodology will need to be considered and the Risk Assessment amended accordingly.

1.2 Objectives

1.2.1 The objectives of the preliminary NRA were to establish;

- The hazards to navigation created by the presence of the scheme bascule bridge
- The existing control and mitigation measures in place within the Port
- The risk levels associated with the identified hazards
- Any additional control or mitigation measures that are required to ensure the risks are "as low as reasonably practicable".

2 Project Description

2.1 Overview

2.1.1 Lowestoft is a port town on the east coast of England, in the county of Suffolk. The town is divided in two by a sea inlet, Lake Lothing, which forms Lowestoft Harbour and provides access via Oulton Broad and Oulton Dyke to the River Waveney and the Broads.

2.1.2 Lake Lothing is currently crossed by two road bridges, one carrying the A47 across the passage between the inner and outer harbours and a second carrying the A1117 at the Mutford Bridge, Oulton Broad. These bridges open to allow shipping to access the port, causing significant traffic disruption.

2.1.3 The scheme is a new road crossing over Lake Lothing, improving access to the lake area as well as relieving congestion in, and around, the town centre.

2.2 Location of Scheme

2.2.1 The proposed location for the new bridge is shown on Figure 2.1, below.

Figure 2.1 - New Bridge Location

2.3 Bridge Design

2.3.1 The bridge will comprise a single counterweighted, rolling-lift bascule leaf, actuated via below deck hydraulic cylinders, supported on 2 reinforced concrete piers. The bridge will be constructed to provide a clear navigational channel, central in the lake, of 32m between fenders and 35m between the pier faces. The bridge deck will have a clear height over water of at least 12m above highest astronomical tide when lowered and raise to provide infinite clearance across the whole of the navigation channel. The fixed over water sections of the bridge will be protected from navigation impacts by passage and approach fendering. The opening bridge will be connected to the existing road network by a series of fixed approach spans. An indicative section showing the bridge outline in both the “raised” and “lowered” position is shown in Figure 2.2, below.

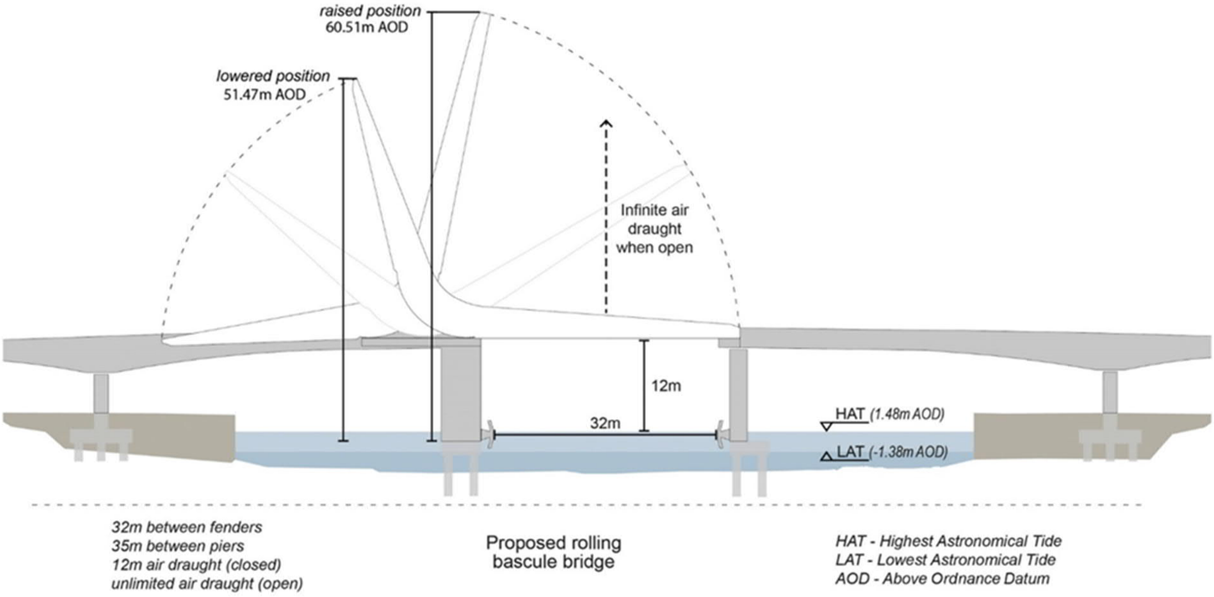

Figure 2.2 - Bridge outline (looking west)

2.4 Port Operations

2.4.1 The location of the Scheme crosses the navigation waterway within Lake Lothing. The Inner Harbour at the Port of Lowestoft has commercial quays both east and west of the Scheme bascule bridge location, along with a number of marina facilities located west of the bridge. Access to these berths will require an opening of the Scheme bascule bridge should the air draft of the vessel exceed the available headroom, including a suitable safety clearance, with the bridge in the lowered position.

3 Methodology

3.1 Assessment Process

3.1.1 The preliminary NRA has been prepared to assess the additional risks to vessel navigation that will arise during and following construction of the proposed bridge. It does not look to assess existing risks present during navigation or risks outside the areas of influence of the bridge and its operation.

3.1.2 The process adopted has followed the general principals of risk assessment as set out on page 30 of A Guide to Good Practice on Port Marine Operations, see paragraph 3.3.3, that being a 5 stage process comprising;

- Data Gathering
- Hazard Identification
- Risk Analysis
- Risk Assessment
- Risk Control

3.2 Consultation

3.2.1 In order to ensure a robust risk assessment process a Navigation Working Group has been established, consisting of the principal marine stakeholders and port users (both commercial and recreational). This working group has been convened on the following occasions;

- November 2017 – Project update and operational method workshop,
- May 2018 – Project update and risk assessment methodology workshop.

3.3 Guidance and References

3.3.1 This preliminary NRA has been prepared with reference to the following documents;

- Port Marine Safety Code, DfT/MCA Nov 2016
- A Guide to Good Practice on Port Marine Operations, DfT/MCA Feb 2017
- MGN 543 (M+F) – Safety of Navigation: Offshore Renewable Energy Installations (OREI's) – Guidance on UK Navigational Practice, Safety and Emergency Response, DfT/MCA Jan 2016
- The National Contingency Plan - A Strategic Overview for Responses to Marine Pollution from Shipping and Offshore Installations, DfT/MCA
- Methodology for Assessing the Marine Navigational Safety & Emergency Response of Risks of Offshore Renewable Energy Installations, DfT/MCA
- Lowestoft Harbour Bye-Laws 1993, ABP Ports; and
- Lowestoft Harbour Pilotage Directions, ABP Ports

3.4 Data Gathering

3.4.1 For the preparation of this preliminary NRA a variety of information sources have been reviewed and assessed for applicability, these included;

- Existing operational arrangements,
- Previous studies and assessments,
- Scheme studies and assessments, and
- Previous bridge incident reports.

4 Hazard Identification

4.1 General

4.1.1 The following section outlines the hazards resulting specifically from navigation in the vicinity of an opening bridge and the primary causational effect which lead to such hazards.

4.2 Collision

4.2.1 Collision is the uncontrolled coming together of two vessels underway. It is applicable to all sizes and types of vessels. Collision hazards are present during every vessel movement where other vessels are or could be present. The main factors affecting occurrence likelihood are vessel density, navigation constraints and vessel control.

4.3 Contact

4.3.1 Contact is the uncontrolled coming together of a vessel and either a fixed structure (such as a bridge) or a moored vessel. It is applicable to all sizes and types of vessels. Contact hazards are present whenever vessel movements occur in proximity to fixed structures and during berthing operations. The main factors affecting occurrence likelihood are navigation constraints and vessel control.

4.4 Grounding

4.4.1 Grounding is the unintentional coming together of a vessel and the bed of the river, sea or dock. While applicable to all types of vessel it is more likely for larger deeper draughted commercial vessels. Grounding hazards are more likely for vessels as draught increases. The main factors affecting occurrence likelihood are navigation chart accuracy, navigation planning and vessel control.

4.5 Major Cause of Hazards

4.5.1 *COLLISION*

Vessel Proximity

4.5.2 Restrictions on the width of navigable water inherently increases the proximity at which vessels will need to navigate.

Visibility

4.5.3 Reductions in visibility will increase the risks of Masters not seeing other vessels in sufficient time to navigate safely.

Equipment Failure

4.5.4 Failure of on-board equipment can render vessels adrift and unable to maintain navigational control thereby increasing the risks of collision. Failure of bridge operating equipment can result in vessels needing to perform evasive manoeuvres increasing the risks of collision.

4.5.5 *CONTACT*

Knowledge of Structure

4.5.6 A Masters lack of knowledge of the presence and nature of structures constraining navigation will increase the risk of contact between their vessel and a structure.

Current Pattern Changes

4.5.7 Familiarity with existing conditions and a failure to allow for potential changes caused by the presence of new structures will increase the risks of contact.

Wind Sheltering

4.5.8 Changes to the levels of wind exposure felt by a vessel navigating within the bridge passage can lead to an increased risk of contact, this risk increases as vessel dimensions increase.

Projections or Roll

4.5.9 Vessels with projecting cargo or flying bridges have greater potential to contact structures, similarly high vessels with a susceptibility to roll or traveling with a list produce a higher risk.

Equipment Failure

4.5.10 Failure of on-board equipment can render vessels adrift and unable to maintain navigational control thereby increasing the risks of contact. Failure of bridge operating equipment can result in vessels needing to perform evasive manoeuvres increasing the risks of contact.

Human Error

4.5.11 Human error and misjudgements are a contributory cause in a significant number of incidents and their potential requires consideration in all assessments.

4.5.12 *GROUNDING*

Changes in Sedimentation Patterns

4.5.13 Changes to the patterns of current flow during and following construction of new structures can lead to changes in sediment deposition areas and rates with a subsequent reduction in accuracy of available navigation chart data. This will tend to increase the risk of groundings particularly for deeper draughted vessels.

4.6 Incident Frequencies

4.6.1 A review of Marine Accident Investigation Branch (MAIB) incident reports during the period 1999 to 2018 has identified 10 events related to bridge structures. Of these 9 were contacts with the remaining one a collision.

4.6.2 Of the 10 recorded events, five were on the Thames in Central London, two each on the Ouse and Trent and the final one on the Mersey. No bridge related incidents have been recorded within the Port of Lowestoft.

4.6.3 An assessment of the traffic frequency for each class of vessel has been undertaken as part of the scheme preparation, the results of this assessment are presented in report 1069948-WSP-MAR-LL-RP-MA-0007, contained within Appendix B.

4.6.4 This assessment indicated that the anticipated annual number of vessel passages through the Scheme bridge could be around 10,000. This compares to 11,000 for the existing A47 bridge i.e. a 10% reduction. Of these movements around 25% will require the new bridge to open with the remaining 75% possible with the bridge closed. In total around 60% of recorded movements are commercial traffic with the remaining 40% recreational.

5 Existing Operational Measures

5.1 Navigation Control

5.1.1 Navigation within the Port is controlled by the local Harbour Master under the authority of the local Statutory Harbour Authority (SHA). Control of vessels is governed by Port Bye-Laws, general and special Directions and Notice to Mariners issued as required by the Harbour Master or Deputy as appropriate.

5.1.2 Navigation marks and lighting are used on the approach to the port and at the existing A47 bridge to control vessel movements, the current aids to navigation are in accordance with IALA system A.

Commercial Vessels

5.1.3 Commercial vessels are categorised as any vessel operating on a commercial basis; they are generally motor driven as opposed to sail and range from small to very large.

Piloted Vessels

5.1.4 Pilotage is required for the following vessels (with a few exemptions);

- All vessels or tows of 60.0 metres LOA or more.
- All vessels or tows of over 20.0 metres LOA carrying;
    - Dangerous or noxious liquid substances in bulk,
    - Explosives
- All vessels or tows of over 30.0 metres LOA carrying;
    - More than twelve passengers
- All vessels of less than 60 metres LOA, deemed to be a potential hazard to safe navigation.

Non-Piloted Vessels

5.1.5 Vessels falling outside these requirements and vessels whose Master holds a Pilot Exemption Certificate are not required to take a pilot although some may still choose to do so.

Recreational Vessels

5.1.6 Recreational vessels are those used by private individuals for personal or entertainment purposes; they are typically very small to small and can be either motor, sail or non-propelled (paddle). It is very rare for recreational vessels using the port to take pilots.

5.2 Vessel Control

5.2.1 Individual vessel movements for commercial traffic are controlled by the SHA through a Local Port Service (LPS); all vessels must notify a controller of any intended movements and are only permitted to proceed on receipt of confirmation.

5.2.2 All vessels are governed by the requirements of the Port Bye-Laws and directions along with the “International Regulations for Prevention of Collision at Sea” (COLREGs).

5.3 Bridge Control

5.3.1 The existing A47 Bridge is controlled from the main Port control room which overlooks the bridge. The bridge operates on an on-demand basis for all commercial vessels over 50t gross registered tonnage, with a restriction on operations during the hours of 8am to 9am, 12pm to 1pm and 5pm to 6pm, and on a pre-booked scheduled opening basis for recreational traffic.

5.4 Depth Control

5.4.1 Bed levels within the Port are monitored via biannual bathymetric surveys and maintained via dredging campaigns as required (currently biannually).

5.4.2 The SHA publishes depths for vessel passages and produces navigation charts detailing the actual bed levels for vessel Masters to plan movements.

6 Risk Assessment

6.1 Scope of the Assessments

6.1.1 The NRA has been conducted using a likelihood x severity matrix. The likelihood assessment considers the expected frequency of an event compared to the overall project design life. The severity assessment looks at both the worst case outcome and the most probable outcome for any given hazard. The assessment is made considering the potential effects on People, Property and Environment, as follows;

- Likelihood;
  - Remote – occurrence frequency greater than project design life,
  - Unlikely – occurrence frequency between 2 years and project life,
  - Possible – occurrence frequency less than biennial,
  - Likely – annual occurrence frequency,
  - Frequent – multiple occurrences expected annually.
- Severity;
  - Minor – no injuries or damage to property or environment,
  - Serious – injury not requiring hospitalization, damage not affecting operations, Tier 1 pollution incident,
  - Major – injury requiring hospital treatment, damage requiring repair, localised Tier 2 pollution,
  - Severe – single casualty, structural damage affecting operation, widespread Tier 2 pollution,
  - Catastrophic – multiple casualties, structural collapse/sinking or Tier 3 pollution.

(Pollution Tiers are as defined in "The National Contingency Plan - A Strategic Overview for Responses to Marine Pollution from Shipping and Offshore Installations").

6.1.2 The two values are used to form the Risk Matrix. Finally, the Risk Matrix score is assigned one of the five colour coded classifications, Slight, Low, Moderate, High and Intolerable, as shown below.

Table 6.1 - Risk Matrix

	Minor	Serious	Major	Severe	Catastrophic
Remote	1	2	3	4	5
Unlikely	2	4	6	8	10
Possible	3	6	9	12	15
Likely	4	8	12	16	20
Frequent	5	10	15	20	25

6.1.3 This Risk Classification indicates the magnitude and acceptability of the risk and guides whether additional mitigating control measures may be required to bring the risk to As Low As Reasonably Practicable (ALARP) principles.

6.1.4 The risks have been assessed for the following classification of vessel Traffic Type;

- Commercial (Large)
- Commercial (Small)
- Recreational (Motor)
- Recreational (Sail)

6.1.5 The outputs from the preliminary NRA are presented in Appendix A in the following format;

ID	Hazard	Cause	Phase	Traffic Type	Pre Mitigation				Existing Controls	New Mitigation	Post Mitigation			
					L	S	R	Rank			L	S	R	Rank

Where;

L – Likelihood, S – Severity, R – Risk.

7 Additional Mitigation Measures

7.1 Planning and Design Phase

Vessel Simulation

7.1.1 Vessel simulations have been undertaken to inform the preliminary design and following subsequent design developments. Various refinements to the design have been incorporated following the simulations to effectively reduce the risks created by its presence.

Hydrodynamic and Sediment Modelling

7.1.2 Hydrodynamic modelling has been undertaken to assess the extent of any changes to the flow patterns and sediment transport within the lake during both Construction and Operation Phases of the Scheme as envisaged in the preliminary design. This modelling should be used to inform the detailed design of the bridge along with the construction methodology to reduce the potential impact of changes to the flow patterns and sediment deposition locations.

Design Selection

7.1.3 Design decisions made during the Planning Phase have considered the potential impacts to navigation. All future design decisions should consider the effects on navigation and the preliminary Navigation Risk Assessment should be updated prior to construction, and prior to the Scheme of Operation for the new bridge required by the DCO (document reference 3.1) being put in place.

7.2 Construction Phase

Monitoring

7.2.1 Monitoring of potential changes in the level of risk to navigation caused by the construction of the new bridge should be undertaken, and early interventions to prevent risk to navigation becoming higher than As Low as Reasonably Practicable should be carried out should any potentially hazardous conditions be seen to be developing.

Notifications

7.2.2 During the Construction Phase a Notice to Mariners should be issued by the SHA to ensure that all users of Lowestoft Harbour are fully informed of the state of the works so far as affecting navigation, in accordance with the relevant provisions of the DCO.

Lights and Markings

7.2.3 During the Construction Phase all plant and works that could present a hazard to navigation should exhibit suitable marks and lights as may be required by the SHA. These should be notified to all local operators via a Notice to Mariners.

7.3 Operation Phase

Notifications

7.3.1 In preparation for the Operation Phase, an Admiralty Notice to Mariners should be prepared and distributed detailing the Scheme of Operation for the bridge. This should include all necessary details to ensure port users are adequately aware of the methods of communicating with the bridge operations and the meanings of the directions associated with the bridge. The relevant provisions of the DCO in respect of the Scheme of Operation must also be followed.

Surveys and Inspections

7.3.2 Monitoring of potential changes in the level of risk to navigation caused by the operation of the new bridge should be undertaken, and early interventions to prevent risk to navigation becoming higher than As Low as Reasonably Practicable should be carried out should any potentially hazardous conditions be seen to be developing.

Lights and Markings

7.3.3 During the Operation Phase the bridge should be identified with suitable marks and lights, as agreed with the SHA and (if necessary) the General Lighthouse Authority (GLA), Trinity House Lighthouse Service. The final lightings and markings scheme should be notified to all local operators via a Notice to Mariners issued by the SHA.

Maintenance

7.3.4 A suitable and sufficient maintenance regime should be established to ensure the mechanical reliability of the bridge. Suitable training should be given to operational staff to allow them to safely manage the operation of the bridge.

Risk Reviews

7.3.5 All navigational risk assessments are live documents and must be reviewed and revised in light of any changes in conditions to remain effective, as such the final bridge NRA should be incorporated into the wider SHA's Port Navigation Risk Assessment and revised and updated in line with the Ports Marine Safety Management System.

Appendix A – Preliminary NRA

Lake Lothing Third Crossing - Preliminary Navigation Risk Assessment

Suffolk County Council

Lake Lothing THIRD CROSSING

					Pre-Mitigation						Post-Mitigation			
Hazard ID	Hazard Type	Cause	Phase	Traffic Type	L	S	R	Rank	Existing Controls	Additional Mitigation	L	S	R	Rank
1	Collision	Increased traffic proximity due to construction	Construction	Commercial (Large)	3	4	12	4	LPS System, Navigation directions, Compulsory Pilotage	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	2	4	8	1
2	Collision	Increased traffic proximity due to construction	Construction	Commercial (Small)	4	4	16	1	LPS System, Navigation directions	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	2	4	8	1
3	Collision	Increased traffic proximity due to construction	Construction	Recreation (Sail)	4	3	12	4	LPS System, Navigation directions	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44
4	Collision	Increased traffic proximity due to construction	Construction	Recreation (Motor)	4	3	12	4	LPS System, Navigation directions	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44
5	Collision	Increased traffic proximity through bridge	Operation	Commercial (Large)	3	4	12	4	LPS System, Navigation directions, Compulsory Pilotage	Undertake simulations to assess the extent of potential changes to navigation, Traffic Control Signal lights	1	4	4	16
6	Collision	Increased traffic proximity through bridge	Operation	Commercial (Small)	4	4	16	1	LPS System, Navigation directions	Undertake simulations to assess the extent of potential changes to navigation, Traffic Control Signal lights	1	4	4	16
7	Collision	Increased traffic proximity through bridge	Operation	Recreation (Sail)	4	3	12	4	LPS System, Navigation directions	Traffic Control Signal lights	1	3	3	44
8	Collision	Increased traffic proximity through bridge	Operation	Recreation (Motor)	4	3	12	4	LPS System, Navigation directions	Traffic Control Signal lights	1	3	3	44
9	Collision	Obstruction to visibility	Operation	Commercial (Small)	3	4	12	4	LPS System, Navigation directions	IALA Signal lights	1	4	4	16
10	Collision	Obstruction to visibility	Operation	Commercial (Large)	2	4	8	40	LPS System, Navigation directions	IALA Signal lights	1	4	4	16
11	Collision	Obstruction to visibility	Operation	Recreation (Sail)	3	3	9	20	LPS System, Navigation directions	IALA Signal lights	1	3	3	44
12	Collision	Obstruction to visibility	Operation	Recreation (Motor)	3	3	9	20	LPS System, Navigation directions	IALA Signal lights	1	3	3	44
13	Collision	Proximity of waiting pontoon to turning area	Operation	Recreation (Sail)	2	3	6	52	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
14	Collision	Proximity of waiting pontoon to turning area	Operation	Recreation (Motor)	2	3	6	52	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
15	Collision	Proximity of waiting pontoon to turning area	Operation	Commercial (Large)	2	4	8	40	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
16	Collision	Proximity of waiting pontoon to turning area	Operation	Commercial (Small)	2	4	8	40	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
17	Collision	Requirement to hold awaiting bridge operations	Operation	Recreation (Sail)	3	2	6	52	LPS System, Navigation directions	Provision of waiting pontoon, scheduled bridge opening times.	1	2	2	74
18	Collision	Requirement to hold awaiting bridge operations	Operation	Recreation (Motor)	3	2	6	52	LPS System, Navigation directions	Provision of waiting pontoon, scheduled bridge opening times.	1	2	2	74
19	Contact	Equipment failure - bridge mechanism fails to open	Operation	Commercial (Large)	3	3	9	20	None	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols to be established	2	3	6	7
20	Contact	Equipment failure - bridge mechanism fails to open	Operation	Recreation (Sail)	3	3	9	20	None	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols to be established	2	3	6	7
21	Contact	Equipment failure - bridge mechanism fails to open	Operation	Commercial (Small)	3	3	9	20	None	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols to be established	2	3	6	7
22	Contact	Equipment failure - Failure of navigation lighting	Construction	Commercial (Large)	3	4	12	4	LPS System	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	4	4	16
23	Contact	Equipment failure - Failure of navigation lighting	Construction	Commercial (Small)	3	4	12	4	LPS System	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	4	4	16
24	Contact	Equipment failure - Failure of navigation lighting	Construction	Recreation (Sail)	3	3	9	20	LPS System	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44
25	Contact	Equipment failure - Failure of navigation lighting	Construction	Recreation (Motor)	3	3	9	20	LPS System	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

					Pre-Mitigation						Post-Mitigation			
Hazard ID	Hazard Type	Cause	Phase	Traffic Type	L	S	R	Rank	Existing Controls	Additional Mitigation	L	S	R	Rank
26	Contact	Equipment failure - Failure of navigation lighting	Operation	Commercial (Large)	3	3	9	20	LPS System	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact proteciton fendering.	2	2	4	16
27	Contact	Equipment failure - Failure of navigation lighting	Operation	Recreation (Sail)	3	3	9	20	LPS System	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact proteciton fendering.	2	2	4	16
28	Contact	Equipment failure - Failure of navigation lighting	Operation	Recreation (Motor)	3	3	9	20	LPS System	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact proteciton fendering.	2	2	4	16
29	Contact	Equipment failure - Failure of navigation lighting	Operation	Commercial (Small)	3	3	9	20	LPS System	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact proteciton fendering.	2	2	4	16
30	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operation	Commercial (Large)	2	4	8	40	LPS System	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV.	1	4	4	16
31	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operation	Commercial (Small)	2	4	8	40	LPS System	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV.	1	4	4	16
32	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operation	Recreation (Sail)	2	3	6	52	LPS System	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV.	1	3	3	44
33	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operation	Recreation (Motor)	2	3	6	52	LPS System	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV.	1	3	3	44
34	Contact	Lack of knowledge of presence of structure	Construction	Commercial (Large)	3	3	9	20	Compulsory Pilotage and Pilot Exemption Certification	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44
35	Contact	Lack of knowledge of presence of structure	Construction	Recreation (Sail)	4	2	8	40	None	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	2	2	4	16
36	Contact	Lack of knowledge of presence of structure	Construction	Recreation (Motor)	4	2	8	40	None	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	2	2	4	16
37	Contact	Lack of knowledge of presence of structure	Construction	Commercial (Small)	2	3	6	52	None	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks	1	3	3	44
38	Contact	Lack of knowledge of presence of structure	Operation	Commercial (Large)	3	3	9	20	Compulsory Pilotage and Pilot Exemption Certification	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	2	2	4	16
39	Contact	Lack of knowledge of presence of structure	Operation	Recreation (Sail)	4	2	8	40	None	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	3	1	3	44
40	Contact	Lack of knowledge of presence of structure	Operation	Recreation (Motor)	4	2	8	40	None	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	3	1	3	44
41	Contact	Lack of knowledge of presence of structure	Operation	Commercial (Small)	2	3	6	52	None	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	2	2	4	16
42	Contact	Loss of control due to changes in current patterns	Construction	Commercial (Large)	3	4	12	4	Compulsory Pilotage and Pilot Exemption Certification	Undertake modelling to assess the extent of potential changes to current patterns, Issue Notice to Mariners	1	3	3	44
43	Contact	Loss of control due to changes in current patterns	Construction	Recreation (Sail)	4	3	12	4	None	Undertake modelling to assess the extent of potential changes to current patterns, Issue Notice to Mariners	2	2	4	16
44	Contact	Loss of control due to changes in current patterns	Construction	Recreation (Motor)	3	3	9	20	None	Undertake modelling to assess the extent of potential changes to current patterns, Issue Notice to Mariners	2	2	4	16

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Hazard ID	Hazard Type	Cause	Phase	Traffic Type	Pre-Mitigation L	S	R	Rank	Existing Controls	Additional Mitigation	Post-Mitigation L	S	R	Rank
45	Contact	Loss of control due to changes in current patterns	Construction	Commercial (Small)	2	4	8	40	None	Undertake modelling to assess the extent of potential changes to current patterns, Issue Notice to Mariners	1	3	3	44
46	Contact	Loss of control due to changes in current patterns	Operation	Commercial (Large)	3	3	9	20	Compulsory Pilotage and Pilot Exemption Certification	Undertake simulations to assess the extent of potential changes to navigation, Issue Notice to Mariners, impact protection fendering	2	2	4	16
47	Contact	Loss of control due to changes in current patterns	Operation	Recreation (Sail)	4	3	12	4	None	Issue Notice to Mariners, impact protection fendering	3	1	3	44
48	Contact	Loss of control due to changes in current patterns	Operation	Recreation (Motor)	3	2	6	52	None	Issue Notice to Mariners, impact protection fendering	2	1	2	74
49	Contact	Loss of control due to changes in current patterns	Operation	Commercial (Small)	2	3	6	52	None	Undertake simulations to assess the extent of potential changes to navigation, Issue Notice to Mariners, impact protection fendering	2	2	4	16
50	Contact	Loss of control due to wind sheltering	Operation	Commercial (Large)	3	3	9	20	Compulsory Pilotage and Pilot Exemption Certification	Undertake simulations to assess the extent of potential changes to navigation, Issue Notice to Mariners, impact protection fendering	2	2	4	16
51	Contact	Loss of control due to wind sheltering	Operation	Recreation (Motor)	3	2	6	52	None	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge	2	1	2	74
52	Contact	Loss of control due to wind sheltering	Operation	Recreation (Sail)	4	2	8	40	None	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge	3	1	3	44
53	Contact	Loss of control due to wind sheltering	Operation	Commercial (Small)	2	3	6	52	None	Undertake simulations to assess the extent of potential changes to navigation, Issue Notice to Mariners, impact protection fendering	2	2	4	16
54	Contact	Proximity of waiting pontoon to turning area	Operation	Commercial (Large)	2	3	6	52	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
55	Contact	Proximity of waiting pontoon to turning area	Operation	Commercial (Small)	2	3	6	52	None	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks.	1	3	3	44
56	Contact	Vessel contact with bridge attempting to proceed without an opening	Operation	Commercial (Large)	1	4	4	78	Compulsory Pilotage and Pilot Exemption Certification	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Real-time air draft indicator.	1	4	4	16
57	Contact	Vessel contact with bridge attempting to proceed without an opening	Operation	Commercial (Small)	3	3	9	20	None	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Real-time air draft indicator.	1	3	3	44
58	Contact	Vessel contact with bridge attempting to proceed without an opening	Operation	Recreation (Sail)	3	2	6	52	None	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Real-time air draft indicator.	1	2	2	74
59	Contact	Vessel projections or roll causes contact with bridge superstructure	Operation	Commercial (Large)	4	3	12	4	Compulsory Pilotage and Pilot Exemption Certification	Bridge designed with no oversailing when open, impact protection fendering	2	3	6	7
60	Contact	Vessel projections or roll causes contact with bridge superstructure	Operation	Recreation (Sail)	3	2	6	52	None	Bridge designed with no oversailing when open, impact protection fendering	2	2	4	16
61	Contact	Vessel projections or roll causes contact with bridge superstructure	Operation	Commercial (Small)	2	2	4	78	None	Bridge designed with no oversailing when open, impact protection fendering	1	2	2	74
62	Grounding	Change in sediment regime leads to shoaling	Construction	Commercial (Large)	3	4	12	4	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design, additional surveying and control dredging (if required)	2	4	8	1
63	Grounding	Change in sediment regime leads to shoaling	Construction	Commercial (Small)	2	3	6	52	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design, additional surveying and control dredging (if required)	1	3	3	44
64	Grounding	Change in sediment regime leads to shoaling	Construction	Recreation (Sail)	2	2	4	78	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design	1	2	2	74

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Preliminary Navigation Risk Assessment

					Pre-Mitigation						Post-Mitigation			
Hazard ID	Hazard Type	Cause	Phase	Traffic Type	L	S	R	Rank	Existing Controls	Additional Mitigation	L	S	R	Rank
65	Grounding	Change in sediment regime leads to shoaling	Operation	Commercial (Large)	3	4	12	4	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design	1	4	4	16
66	Grounding	Change in sediment regime leads to shoaling	Operation	Commercial (Small)	2	3	6	52	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design	1	3	3	44
67	Grounding	Change in sediment regime leads to shoaling	Operation	Recreation (Sail)	2	2	4	78	Bathymetric surveys and navigational charts, Maintenance dredging	Modelling during design	1	2	2	74
68	Grounding	Objects dropped into navigation channel during construction	Construction	Commercial (Large)	3	3	9	20	Statutes and Bye-laws preventing deposition of objects in water	Anti-pollution contract requirments and notificaiton procedures	1	3	3	44
69	Grounding	Objects dropped into navigation channel during construction	Construction	Commercial (Small)	2	3	6	52	Statutes and Bye-laws preventing deposition of objects in water	Anti-pollution contract requirments and notificaiton procedures	1	3	3	44
70	Grounding	Objects dropped into navigation channel during construction	Construction	Recreation (Sail)	3	2	6	52	Statutes and Bye-laws preventing deposition of objects in water	Anti-pollution contract requirments and notificaiton procedures	1	2	2	74
71	Contact	Vessel equipment failure	Operation	Commercial (Large)	1	4	4	78	None	impact protection fenders	1	3	3	44
72	Contact	Vessel equipment failure	Operation	Commercial (Small)	2	3	6	52	None	impact protection fenders	2	2	4	16
73	Contact	Vessel equipment failure	Operation	Recreation (Sail)	2	3	6	52	None	impact protection fenders	2	2	4	16
74	Contact	Vessel equipment failure	Operation	Recreation (Motor)	2	3	6	52	None	impact protection fenders	2	2	4	16
75	Contact	Human error - Vessel operator	Construction	Commercial (Large)	2	4	8	40	None	TBC by Contractor	2	4	8	1
76	Contact	Human error - Vessel operator	Construction	Commercial (Small)	2	3	6	52	None	TBC by Contractor	2	3	6	7
77	Contact	Human error - Vessel operator	Construction	Recreation (Sail)	2	3	6	52	None	TBC by Contractor	2	3	6	7
78	Contact	Human error - Vessel operator	Construction	Recreation (Motor)	2	3	6	52	None	TBC by Contractor	2	3	6	7
79	Contact	Human error - Vessel operator	Operation	Commercial (Large)	4	4	16	1	Pilot/PEC	impact protection fenders	4	2	8	1
80	Contact	Human error - Vessel operator	Operation	Commercial (Small)	4	3	12	4	None	impact protection fenders	4	2	8	1
81	Contact	Human error - Vessel operator	Operation	Recreation (Sail)	3	3	9	20	None	impact protection fenders	3	2	6	7
82	Contact	Human error - Vessel operator	Operation	Recreation (Motor)	3	3	9	20	None	impact protection fenders	3	2	6	7

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Appendix B – Vessel Survey Report

Suffolk County Council

LAKE LOTHING THIRD CROSSING

Vessel Survey Report

1069948-WSP-MAR-LL-RP-MA-0007
MAY 2018

CONFIDENTIAL

Suffolk County Council

LAKE LOTHING THIRD CROSSING

Vessel Survey Report

TYPE OF DOCUMENT (DRAFT) CONFIDENTIAL

PROJECT NO. 62240712
OUR REF. NO. 1069948-WSP-MAR-LL-RP-MA-0007

DATE: MAY 2018

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3	
Remarks	Draft	Draft	Final	Final	
Date	November 2017	December 2017	January 2018	May 2018	
Prepared by	Stephen Horne	Stephen Horne	Stephen Horne	Stephen Horne	
Signature					
Checked by	Bernard Jones	Bernard Jones	Bernard Jones	Bernard Jones	
Signature				B. Jones	
Authorised by	Joanna Lyon	Joanna Lyon	Joanna Lyon	Joanna Lyon	
Signature					
Project number	62240712	62240712	62240712	62240712	
Report number	1069948-WSP-MAR-LL-RP-MA-0007	1069948-WSP-MAR-LL-RP-MA-0007	1069948-WSP-MAR-LL-RP-MA-0007	1069948-WSP-MAR-LL-RP-MA-0007	
File reference					

CONTENTS

FIGURES

TABLES

1 INTRODUCTION

1.1 GENERAL

WSP Limited have been commissioned to progress approvals, designs and agreements for a third crossing at Lake Lothing, Lowestoft.

1.2 SCOPE OF REPORT

This report details the commissioning, progression and outcome of a vessel survey within the Port of Lowestoft conducted to confirm the number and timings of openings of the existing bascule bridge and to assess the likely opening frequency of the third crossing.

1.3 OBJECTIVES

The objectives of the vessel survey were to establish;

- The typical opening frequency of the existing bascule bridge
- The range of numbers of openings over a 24 hour period
- The size and distribution of vessels navigating within the Port
- The ratio of commercial to recreational vessels
- From this information, derive an estimated frequency of openings for the Scheme bridge

Following analysis, the outputs of the survey were to be used to inform a potential operating regime that would integrate with the existing bridge’s regime and provide the best operational balance between water and road traffic.

The outputs were also used to inform the Preliminary Navigation Risk Assessment in terms of the number and frequency of vessel movements and therefore the likelihood of incidents.

2 PROJECT DESCRIPTION

2.1 OVERVIEW

Lowestoft is a port town on the east coast of England, in the county of Suffolk. The town is divided in two by a sea inlet, Lake Lothing, which forms Lowestoft Harbour and provides access via Oulton Broad and Oulton Dyke to the River Waveney and the Broads.

Lake Lothing is currently crossed by two road bridges, one carrying the A47 across the passage between the inner and outer harbours and a second carrying the A1117 at the Mutford Bridge, Oulton Broad. These bridges open to allow shipping to access the port, causing significant traffic disruption.

The Scheme is a new road crossing over Lake Lothing, improving access to the lake area as well as relieving congestion in, and around, the town centre.

2.2 LOCATION OF SCHEME

The proposed location for the new bridge is shown on Figure 1, below.

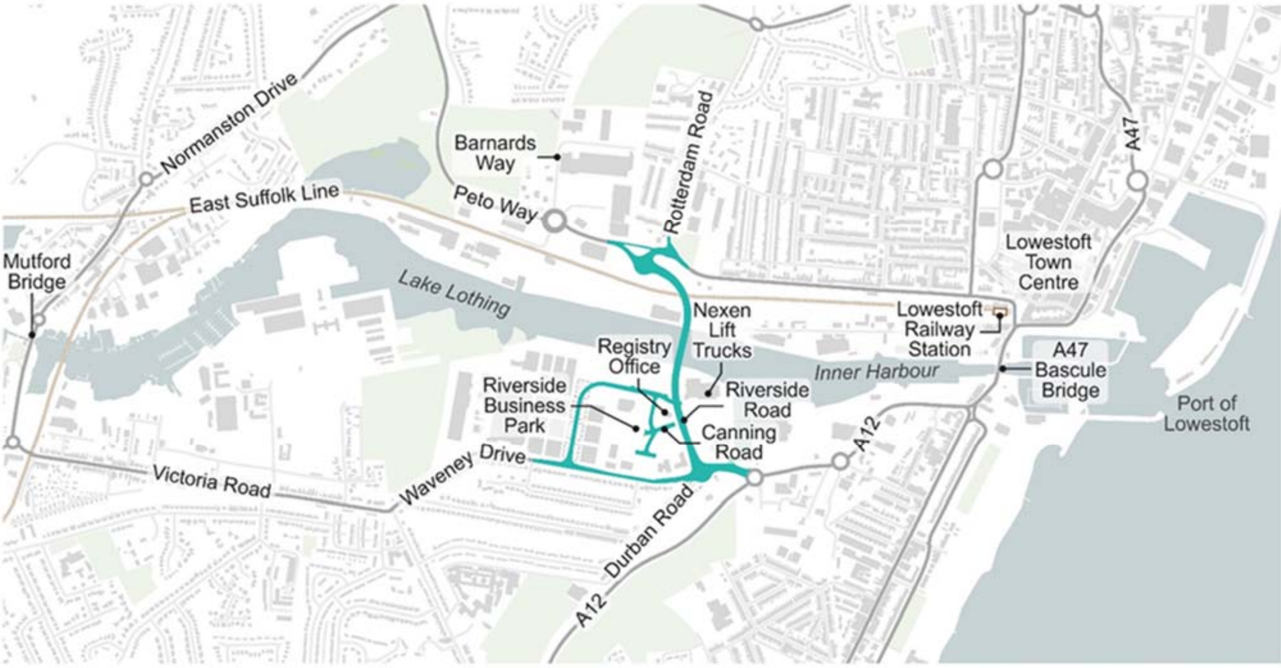

Figure 1 – New bridge location

2.3 BRIDGE DESIGN

The bridge will comprise a single counterweighted, rolling-lift bascule leaf, actuated via below deck hydraulic cylinders, supported on 2 reinforced concrete piers. The bridge will be constructed to provide a clear navigational channel, central in the lake, of 32m between fenders and 35m between the pier faces. The bridge deck will have a clear height over water of at least 12m above highest astronomical tide when lowered and raise to provide infinite clearance across the whole of the navigation channel. The fixed over water sections of the bridge will be protected from navigation impacts by passage and approach fendering. The opening bridge will be connected to the existing road network by a series of fixed approach spans. An indicative section showing the bridge outline in both the “raised” and “lowered” position is shown in Figure 2, overleaf.

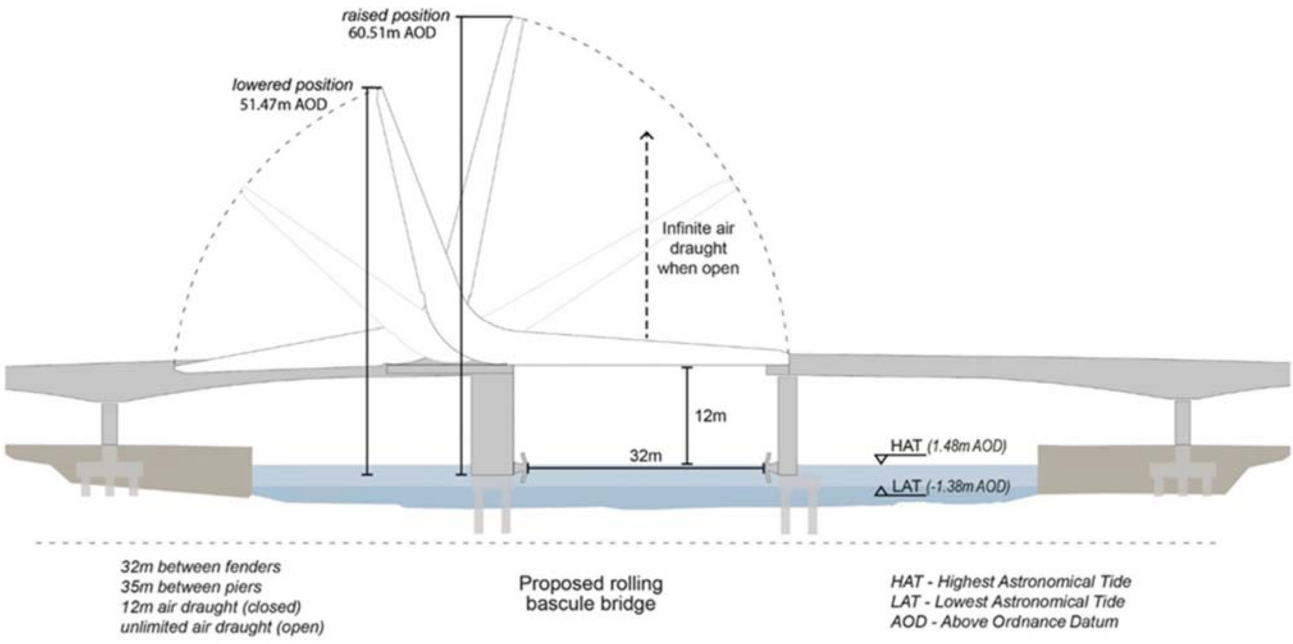

Figure 2 – Bridge outline (looking west)

2.4 PORT OPERATIONS

The location of the Scheme crosses the navigation waterway within Lake Lothing. The Inner Harbour at the Port of Lowestoft has commercial quays both east and west of the Scheme bascule bridge location, along with a number of marina facilities located west of the bridge. Access to these berths will require an opening of the Scheme bascule bridge should the air draft of the vessel exceed the available headroom, including a suitable safety clearance, with the bridge in the lowered position.

3 SURVEY METHODOLOGY

3.1 SURVEY SET-UP

In order to capture details of all vessel movements within the Port, high definition wide angle time lapse cameras were installed at two locations, one capturing images of vessels passing through the existing bridge passage, the second observing those that proceeded past the location of the new bridge. The cameras were of sufficient resolution to allow positive identification of 95% of commercial vessels passing and determination of air draft for all vessels either by identification of the vessel by name or by use of fixed reference points on the captured images.

Figure 3 – Camera locations

The cameras were combined with a local hard drive for data recording, a Wi-Fi router for network connectivity, a 4G M2M aerial for remote connections and a power supply for each unit, all housed in an externally rated box. These boxes were mounted on street lighting columns at suitable locations to ensure sufficient coverage of the areas under inspection.

The cameras were set up to capture an image every 10 seconds. This timeframe was established considering field of vision of the cameras and the anticipated transit time for a vessel travelling at the Port maximum speed of 4 knots through that field. This 10 second frame rate ensured that at least 3 images of every vessel transiting the passage would be recorded.

Initially the method of data recovery was to be via local Wi-Fi network connectivity between the cameras and a laptop taken to site, however after an initial attempt it was found that this method would take too long to complete due to poor signal quality and low transfer rates. Following this it was decided to leave the cameras in position for approximately 3 months, periodically checking that they were continuing to record, and then remove the whole assemblies and recover all of the data via direct connection to the hard drives.

The cameras were initially erected on 13th July 2017 and taken down on 3rd October 2017, this initial recorded data was then collected and analysed. The cameras were then refurbished and re-erected on 2nd January 2018 to continue collecting data for a second period being removed on 13th April 2018 with the second data set subsequently analysed.

3.2 DATA PROCESSING

Following recovery of the captured images, a manual review of the photos was undertaken to identify bridge openings. This information was recorded within a spreadsheet, noting the start and finish of each bridge operation, the numbers and, where possible, names of vessels, whether the vessels were of a size that would require an opening of the new bridge and whether the vessel would progress past the location of the new bridge. A note on openings required solely for recreational vessels was also made.

No allowance for potential berth reassignments within the port post construction of the new bridge has been made within the analysis.

The survey data was compared with a small sample data set obtained from ABP, comprising bridge operation records for 3 weeks from 27th May 2017.

4 INITIAL SURVEY DATA ANALYSIS

4.1 EXISTING A47 BASCULE BRIDGE

A total of 1242 openings of the bridge were recorded during the initial 80 days surveyed; this equates to an average of 15.5 openings per day. The numbers of openings per day ranged from 1 to 23, with the most frequent number of openings being 16 and 17.

In total 2443 vessel movements were recorded during the initial survey period. The highest number of vessel movements during a single day was 62, the lowest being 1. The largest vessel entering the port during this period was the Arklow Raven at 89.99m in length.

The maximum number of vessel movements during a single bridge lift was 14 although over 55% of all lifts were for a single vessel and, on one occasion, the road was closed with no associated vessel movement.

The average durations, from road traffic stop to restart, for recorded bridge operations by number of vessels is shown in Figure 4 below, the overall average duration being just under 5 minutes.

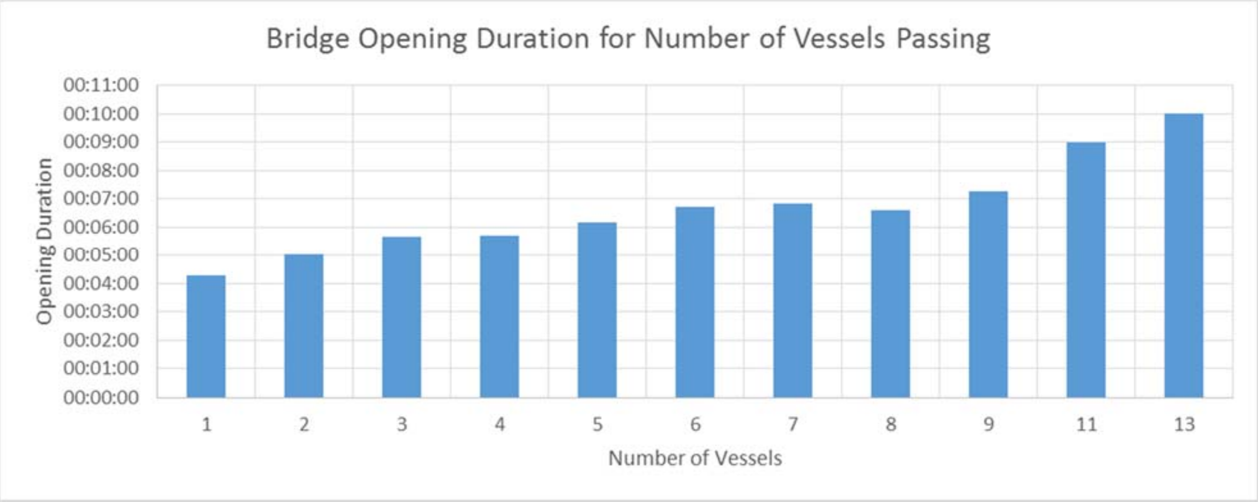

Figure 4 – Bridge opening durations

4.2 NEW BRIDGE

Any vessel with an apparent air draft over 11.5m travelling to or from west of the new bridge location within the survey has been identified as requiring a lift of the new bridge, the figure of 11.5m was chosen to provide a working safety margin below the structure of the new bridge for vessels transiting without a bridge lift. A total of 450 movements including such vessels were observed during the initial 80 days recorded; this equates to an average of 5.6 openings per day. The range of numbers of projected openings per day was 0 to 17, although the figure of 17 occurred on a single day only with the next highest figure being 11. The most common count for projected openings per day was 7.

These figures are likely to be an over estimation as the assessment of whether a vessel would require a lift of the new bridge has not taken account of tide level but has been based on the lowest available clearance, which is at highest astronomical tide, therefore some vessels with air drafts between 11.5 and 13.5m may be able to transit without an opening at lower tidal levels.

Assessing the potential opening durations associated with movements past the Scheme bridge from the vessel survey data is not straightforward as currently the vessels are uninhibited in their passage through this location and therefore likely travel at a higher speed than they would through the new bridge passage once constructed. They also do not have to make allowances for the potential for having to wait for the bridge to open thus potentially maintain a higher speed for longer, these factors will affect the approach time to the Scheme bridge. While the presence of the bridge would act to slow vessels on approach the fact that the Scheme bridge is significantly wider than the existing A47 bridge passage suggests that vessels will transit the Scheme bridge faster than they do the existing bridge, this will affect the transit time. The principal factor affecting opening durations is the time taken to raise and lower the Scheme bridge which is greater than that of the existing, combined with the time taken to clear the bridge of traffic (both vehicular and pedestrian). Making allowances for each of these factors we believe an equivalent duration ratio of 125% for a single vessel transit reducing to 105% for 4 vessels or more would be applicable. Table 1, below, shows the basic build-up of the comparative durations for typical vessel transit configurations for the A47 bridge and the Scheme.

Table 1 – Typical bridge transit comparisons (durations in seconds)

Number of Vessels	1		2		3		>4	
Operation	A47	Scheme	A47	Scheme	A47	Scheme	A47	Scheme
Wig-Wags	20	20	20	20	20	20	20	20
Barriers	10	10	10	10	10	10	10	10
Clear Bridge	35	35	35	35	35	35	35	35
Raise	60	106	60	106	60	106	60	106
Transit	80	60	125	90	170	120	220	150
Lower	60	106	60	106	60	106	60	106
Barriers	10	10	10	10	10	10	10	10
Total (Mins)	4:35	5:47	5:20	6:17	6:04	6:47	6:55	7:17
Ratio	126.2%		117.8%		111.8%		105.3%	

Applying these ratios to the movements identified within the survey would give an overall average opening duration of around 6 minutes and a longest observed opening of 11.5 minutes.

4.3 OVERALL OPENING FREQUENCY

Comparing the frequency of openings required for the Scheme and A47 Bascule Bridge we can see a significant reduction in the number of openings likely to be required. Figure 5, below, shows the number of days out of the 80 day survey period on which a given number of openings occurred, for example the A47 (existing) Bridge opened 15 times on 8 days.

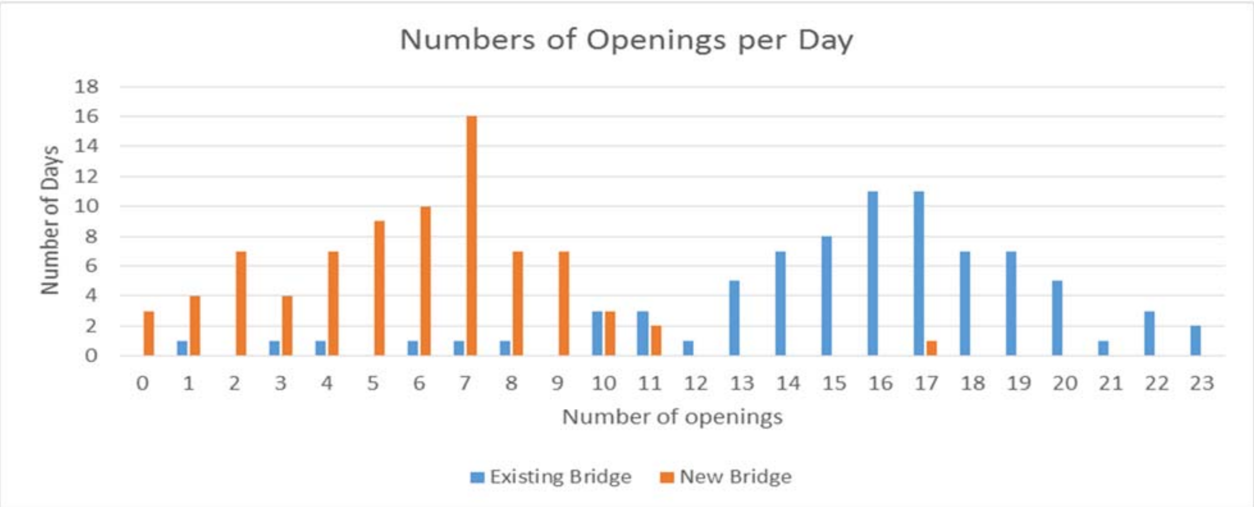

Figure 5 – Distribution of number of openings

These results are consistent with the small sample data set supplied by ABP from their operational records and indicates that the survey accurately reflects the current navigational frequency within the Port, a comparison between the frequency of openings of the A47 Bascule Bridge during the initial survey period and ABP's sample data is shown in Figure 6, below.

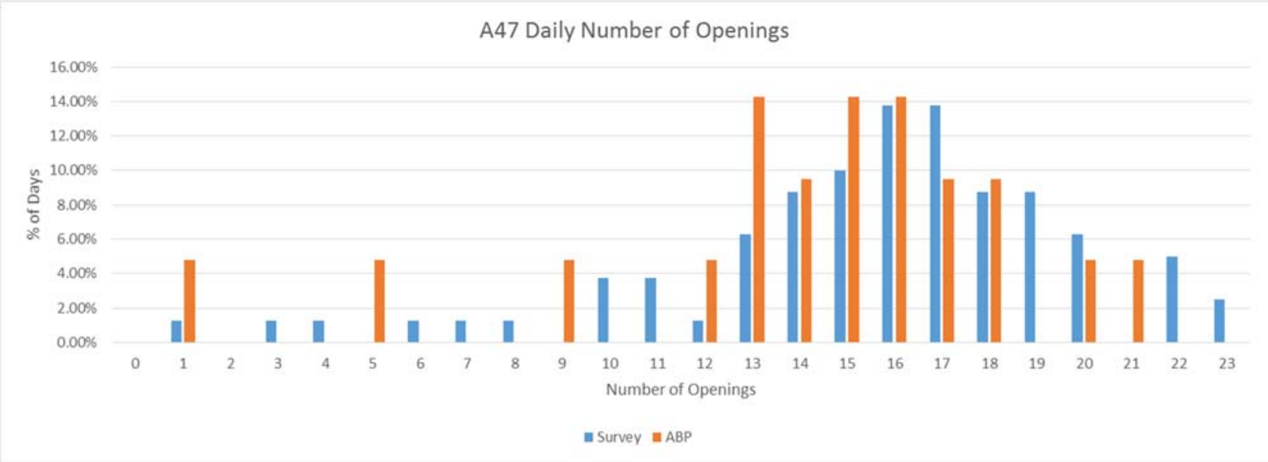

Figure 6 – Distribution of A47 openings during survey and sample set

4.4 AIR DRAFT VARIANCE

A comparison of opening frequencies for different vertical clearances for the Scheme bridge, including the safety margin outlined in Section 4.2 in all cases taken as 0.5m, and vessel air drafts was undertaken, as shown in Figure 7 below.

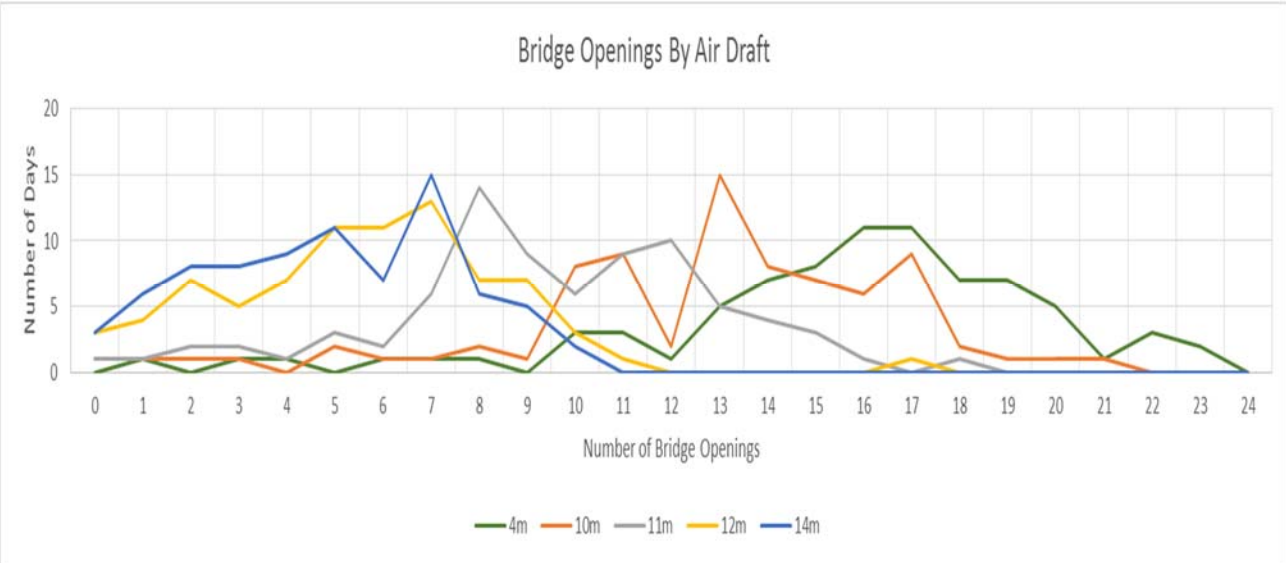

Figure 7 – Bridge openings for different clearances

This comparison shows that a small increase in bridge clearance would produce only minimal improvement on number of openings while a small decrease would result in a substantial increase in opening requirements. This indicates that the Scheme bridge design is set at the optimal height considering road and vessel traffic constraints.

4.5 HOURLY DISTRIBUTION

An analysis of bridge openings per hour was performed to assess the profile of anticipated demand for openings during the day. The results of this are shown on Figure 8.

For the existing bridge pronounced dips occur for the hours 8:00-9:00, coinciding with the am peak road traffic period and also 12:00-13:00. A lesser reduction in operations is observed in the pm peak period of 17:00-18:00. These result from ABP's policy of restricting openings unless requested during these periods to assist with traffic flow.

For the new bridge the pm peak period reduction is more evident with a similar reduction present during the am peak.

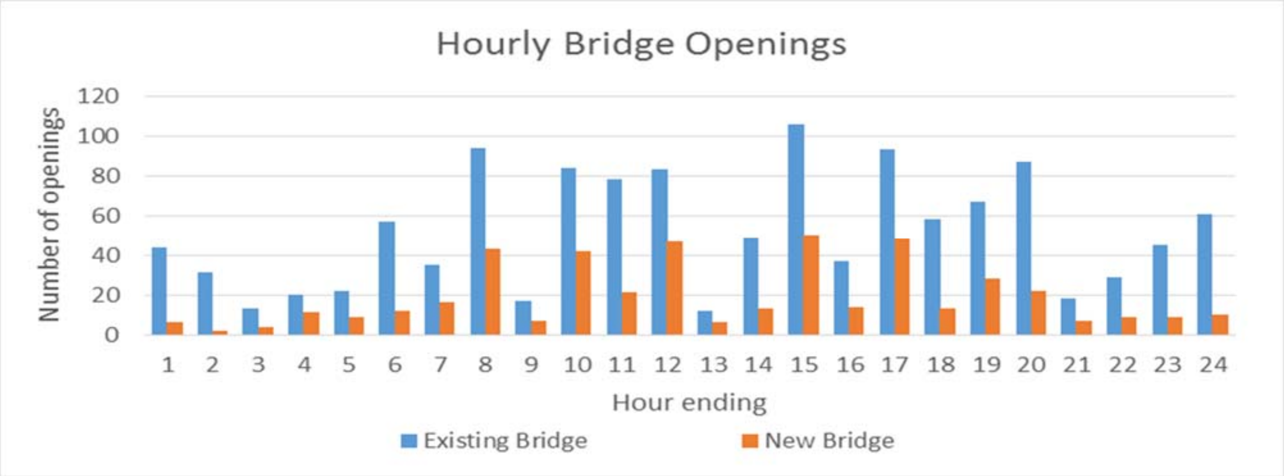

Figure 8 – Hourly openings

4.6 COMMERCIAL AND RECREATIONAL TRAFFIC

An assessment of the number of openings of the new bridge that would have been required by commercial and recreational traffic shows that, of the 450 anticipated openings, 217 would be attributable to commercial vessels, while 233 would have been solely from movements of recreational craft.

Of the recreational movements, approximately 75% occurred during the scheduled A47 bridge operation periods, with the remaining 25% occurring simultaneously with a commercial vessel bridge opening.

4.7 TWO WAY MOVEMENTS

An analysis of the number of operations involving simultaneous two way vessel movements has shown this occurred in 196 of the 1242 operations recorded; however only 13 of these involved vessels of sufficient air draft to require an opening of the new bridge travelling in both directions. Vessels will not be permitted to transit the Scheme bridge while it is in motion, this is similar to the directions for the A47 bridge. For movements involving vessels above and below the clearance limit, it has been assumed that the vessels able to transit the bridge without a lift would proceed with the bridge closed the bridge would then lift to allow the larger vessel to pass (or vice versa depending on the Harbour Masters instruction).

5 SECOND SURVEY DATA ANALYSIS

The data obtained from the second survey period was evaluated in a similar manner to the initial data.

During this period the total number of recorded movements was considerably lower than during the initial survey, predominantly due to a large reduction in recreational vessels (as may be expected by the seasonal difference).

The following table details the principal differences in the two survey data sets;

Table 2 – Comparison between initial survey and second survey results

	Initial Data (80 Days)	Second Data (89 Days)	% Difference
Total Vessel Movements	2443	1114	-54%
Commercial Vessels	1509	1075	-28%
Recreational Vessels	934	39	-95%
A47 Bridge Openings	1242	841	-32%
Scheme Bridge Openings	450	170	-62%
A47 Recreational Openings	416	33	-92%
Scheme Recreational Openings	233	9	-96%
A47 Commercial Openings	1208	808	-33%
Scheme Commercial Openings	214	161	-25%
Maximum A47 Daily Openings	23	18	-21%
Maximum Scheme Daily Openings	17	6	-64%
Average A47 Daily Openings	15.5	9.5	-38%
Average Scheme Daily Openings	5.6	1.9	-66%

There are a number of potential contributory factors to differences in the data sets namely seasonal variation and maintenance operations undertaken on the A47 Bridge during the second period.

Considering the differences observed it is reasonably conservative to use the results from the initial survey in the Scheme assessments to replicate a worst case scenario as that data represents more vessel movements in a shorter duration.

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