Essex Highways

Boxted Bridge, Boxted
ECC BR 59

Option Study

October, 2018

RINGWAY JACOBS | Essex County Council

Essex Highways

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Purpose of this Report

Essex County Council has commissioned an Option Study to enable it to understand the options available to safely manage the current sub-standard Boxted Bridge and to investigate bridge strengthening and partial or full reconstruction options.

The Option Study is to take account of wider networks issues (other sub-standard bridges in the vicinity of Boxted Bridge and the general unsuitability of routes in the area for accommodating heavy goods vehicle or increased through route traffic).

Executive Summary

Boxted Bridge is located on the unclassified Wick Road, Boxted and crosses the River Stour on the Essex and Suffolk border (in the Dedham Vale and Stour Valley Area of Outstanding Natural Beauty).

The current bridge, which was built in 1903, was assessed in 1992. The assessment found the deck to have a live load capacity of 3 Tonnes but this rating was with reservations as assumptions were made regarding edge girder effective length/U-frame restraint. Although the assessment recommended the structure be restricted to 3 Tonnes Gross Vehicle Weight no weight restriction was implemented and none exists to date.

The bridge is narrow with no safety margins to separate the traffic from the half-through edge girders which are at risk of (and subject to) vehicle impact. The width between the traffic faces of the edge girders at the north abutment is insufficient to accommodate two traffic lanes. There is a significant hump in the vertical carriageway profile over the bridge which inhibits inter-visibility for oncoming traffic.

Maintenance of the structure has been deficient over a protracted period and elements of the bridge deck exhibit significant corrosion. There are cracks in the abutment walls which likely to have resulted from vehicle collisions with the east edge girder.

The road layout and bridge width are such that Heavy Goods Vehicles (HGVs) are unable to safely negotiate the Sky Hall Hill with Lower Farm Road junction, which is immediately southeast of the bridge. This has resulted in damage to the bridge edge girders (and pilasters) and the adjacent residential property boundary wall. The approaches to Boxted Bridge are narrow with multiple bends and are unsuitable routes for HGVs.

As a result of the bridge's low assessment rating and poor historical condition a study has been commissioned to consider management for the sub-standard asset and to identify strengthening, deck replacement and bridge reconstruction options.

The Options considered are:

Option 1 'Do nothing' – bridge structure, vehicle loading/type and network remain unchanged

Option 2 – Environmental weight and width restrictions on the existing bridge and highway network

Option 3 – Permanent weight restriction of 3 tonnes gross vehicle weight on the current structure

Option 4 – Permanent closure of the structure to motorised vehicles

Option 5 – Enhancing edge girder bending moment capacity by improved U-frame restraint

Option 6 – Constructing a new deck, with the same plan dimensions as the current superstructure, on the existing bridge foundations and abutments

Option 7 – Reconstruct the bridge either to the same plan dimensions as the current bridge or to greater width to enable HGVs to safely negotiate the bridge and make the Sky Hall Hill with Lower Farm Road junction maneuver

In undertaking this Option Study a number of local issues have been identified which affect the management of this asset;

- Mill House Bridge (ECC Bridge No. 371) and Island Bridge (ECC Bridge No. 372), which are on the approaches to Boxted Bridge (Lower Farm Road and Sky Hall Hill respectively) were assessed in 1992 and found to be 'weak' with assessment live load capacities of Fire Engine Group 2 in both cases. No weight restrictions are in place on these structures

- The wider road network (maintained by both Essex and Suffolk County councils) in the vicinity of Boxted Bridge is unsuitable for HGVs. Positive road signing to identify suitable routes for HGVs in the area are absent

In consideration of the poor condition and low assessment rating of the existing bridge together with the constraints at the bridge site and the wider network issues has led to the recommendations which may, from a highway authority's position, be regarded as compromised.

The recommendations from the Option Study are:

1. Essex County Council should liaise with Suffolk County Council for reinstatement of the 'Unsuitable for heavy goods vehicles' road sign at the junction of Wick Road with the B1068 Park Road
2. Essex and Suffolk County councils should reinstate/provide new road signs warning of bends, junctions and bridge hazards on both approaches to the structure
3. Essex County Council should replace the corroded steel posts which support the chevron warning sign (located in the garden of Island Cottage) at the junction of Sky Hall Hill and Lower Farm Road
4. A strategy for heavy goods vehicle movements in the Boxted/Langham parishes and Essex/Suffolk boundary areas should be developed and suitable routes identified and signed accordingly. This may necessitate the provision of turning areas to enable HGVs to access/exit the area using the same route
5. The current structure should be subject to a weight restriction of 3 tonnes gross vehicle weight (Option 3)
6. Essex County Council should commission a Feasibility Study to investigate the viability of constructing a replacement deck on the existing foundations/substructure (Option 6) or full reconstruction of the bridge on the current bridge footprint (Option 7A)

The difficulties of implementing and financing a number of the above are recognised but by the immediate implementation of recommendations 1, 2 and 3 this should afford a degree of protection to the current bridge, general public and Boxted Mill owner in the short term.

Recommendations 4, 5 and 6 are slightly longer term objectives but their commissioning and implementation should not be delayed due to the fragile condition (and historical low assessment rating) of the bridge, network issues and land owner concerns.

1. Introduction

Boxted Bridge is located on the unclassified Wick Road, Boxted and crosses the River Stour on the Essex and Suffolk border (in the Dedham Vale and Stour Valley Area of Outstanding Natural Beauty).

The current bridge, built in 1903, is a simply supported single span half-through steel deck on brick abutments but the foundation type is unknown. The form of the structure is believed to have been dictated by navigation clearance requirements.

Maintenance of the structure has been deficient over a protracted period and elements of the bridge deck exhibit significant corrosion. There are cracks in the abutment walls which are likely to have resulted from vehicle collisions with the east edge girder.

The structure was assessed in 1992 in accordance with BD 21/84. The assessment found the deck to have a live load capacity of 3 Tonnes but this rating was with reservations as assumptions were made regarding edge girder effective length/U-frame restraint. Although the assessment recommended the structure be restricted to 3 Tonnes Gross Vehicle Weight no weight restriction was implemented and none exists to date.

Due to the bridge's low assessment rating and the poor condition of a number of the elements Ringway Jacobs commissioned Jacobs to undertake an Option Study to investigate management of the sub-standard asset, strengthening, deck replacement and bridge reconstruction options.

2. Existing Structure and Site Description

2.1 Existing Structure Description:

Boxted Bridge is located on the 'Local Road' Wick Road, Boxted and crosses the River Stour on the Essex and Suffolk border.

The bridge, built in 1903, is a simply supported single span half-through steel deck on brick abutments but the foundation type is unknown. The form of the structure is believed to have been dictated by navigation clearance requirements; commercial river traffic operated on the River Stour to Sudbury until around the 1914-18 War.

The deck is trapezoidal in plan, being wider at the south abutment than the north, and has an effective square span of 12.50 m. It comprises riveted plate primary edge girder and transverse secondary beams, with tertiary longitudinal rolled I-beam/channel sections and hogging plates.

There are no safety margins to separate the traffic and the half-through edge girders which are at risk of (and subject to) vehicle impact. The width between the traffic faces of the edge girders at the north abutment is insufficient to accommodate two traffic lanes. There is a significant hump in the vertical carriageway profile over the bridge which inhibits inter-visibility for oncoming traffic. The hump conceals the Sky Hall Hill with Lower Farm Road junction and the bend in Lower Farm Road for drivers of cars heading south on Wick Road toward Boxted Bridge.

Maintenance of the structure has been deficient over a protracted period and elements of the bridge deck exhibit significant corrosion. There are cracks in the abutment walls which likely to have resulted from vehicle collisions with the east edge girder.

Brick retaining walls (with brick pilasters and stone copings) are located on the approaches to (and departures from) the bridge which support the highway above the level of the adjoining river banks. The retaining walls are generally in poor condition with extensive cracking and missing joint mortar.

Concrete post and steel tubular rail guardrails are provided on the southern approach/departure and timber post and wire fences are provided on the northern approach/departure.

2.2 Bridge assessment and inspection reports:

The structure was assessed in 1992 in accordance with BD 21/84. The assessment found the deck to have a live load capacity of 3 Tonnes but this rating was with reservations as assumptions were made regarding edge girder effective length/U-frame restraint. Although the assessment recommended the structure be restricted to 3 Tonnes Gross Vehicle Weight (GVW) no weight restriction was implemented and none exists to date.

A Principal Inspection of the bridge was carried out in March 2018 which found the structure to be in poor overall condition with **$BCI_{(Av)}$** and **$BCI_{(Crit)}$** scores of 54.84 and 35.78 respectively (Risk Ranking – High).

The Principal Inspection report identifies the present condition of the structure to be a cause for immediate concern; should deterioration continue closure of the bridge may well be necessary to ensure public safety.

2.3 Description of Existing Highway/Network:

The road layout and bridge width are such that heavy goods vehicles (HGVs) are unable to safely negotiate the Sky Hall Hill with Lower Farm Road junction (which is immediately southeast of the bridge)

without risking damage to the bridge edge girders or the adjacent residential property (Island Cottage) boundary wall. The approaches to Boxted Bridge, are narrow with multiple bends and are unsuitable routes for heavy goods vehicles. Wick Road which is the northern approach to the bridge was historically signed as unsuitable for HGVs but this sign is no longer extant.

The highway network in the north of Boxted Parish and the adjoining parishes of Langham, Stoke-by-Nayland (Suffolk), Higham (Suffolk) and Stratford St Mary (Suffolk) is generally unsuitable for HGVs and through traffic. Many routes in the area are signed 'unsuitable for HGVs'.

Diversion distances for cars and vans avoiding Boxted Bridge are between 5.9 miles and 7.1 miles. Advisory road signs indicate the area should be avoided by HGVs but 'authorised' diversion distances for lorries and HGVs could be around 11.2 miles and 12.4 miles.

Mill House Bridge (ECC Bridge No. 371) and Island Bridge (ECC Bridge No. 372), which are on the approaches to Boxted Bridge (Lower Farm Road and Sky Hall Hill respectively) were assessed in 1992 and found to have assessment live load capacities of Fire Engine Group 2. No weight restrictions are in place on these structures. General inspections of these structures in 2018 found Mill Bridge to have **$BCI_{(Av)}$** and **$BCI_{(Crit)}$** scores of 60.00 and 45.00 respectively and Island Bridge **$BCI_{(Av)}$** and **$BCI_{(Crit)}$** scores of 74.16 and 42.28 respectively.

2.4 Traffic Data:

A traffic count of vehicles at Boxted Bridge was carried out in November 2016 which recorded 5-day 12 hour total average flows of 271 vehicles comprising 232 cars/taxis, 26 light/medium goods vehicles, 3 HGVs and 10 motorcycles with an average speed of just under 25 mph (the signed speed limit is 60 mph).

2.5 Road Traffic Accidents:

There is one Personal Injury Accident recorded by Essex Police in the vicinity of Boxted Bridge.
A fatal road traffic accident occurred in the vicinity of Boxted Bridge in July 2012 and involved the rider of a quad-bike whom was travelling south along Wick Road (late at night in fine weather) toward the junction with Sky Hall Hill and Lower Farm Road. The vehicle crossed the bridge and failed to negotiate the right hand bend and collided with Island Cottage brick wall. The cause of the accident was recorded in the accident report as likely being alcohol with the road layout being a possible cause.

The owners of Island Cottage reported in September, 2016 that their garden wall facing the bridge had been knocked down by vehicles six times in nineteen years resulting in over £30,000 in insurance claims and excess.

The bridge edge girders and pilasters exhibit evidence of vehicle impact damage; the abutments exhibit cracks which are likely to be have developed as a result of girder impacts.

2.6 Description of Site:

Boxted Bridge is located in the Dedham Vale Area of Outstanding Natural Beauty and is adjacent to the Listed Grade II Boxted Mill property. The bridge site includes land within Colchester Borough and Babergh District councils.

The River Stour flows over a weir near Boxted Mill to the west of the bridge and forms a large pool before continuing under the bridge in an easterly direction.

Mature trees dominate the west bank of the northern side of Boxted Bridge. On the eastern side scrub extends for approximately 30m before mature crack willow dominates the river bank. On the southern side of Boxted Bridge the eastern bank is composed of an area of grass/garden. The western bank is

dominated by semi-mature trees some of which have recently been cut and cleared to allow access to the bridge and the resultant bare earth.

There are semi mature trees close to the bridge on either side of the southern bank both of which are covered in ivy.

The bridge is set in an area of high landscape value; the area was designated to ensure the natural beauty and special qualities of the area are conserved and enhanced for future generations.

The bridge is also adjacent to the Langham Water Works Local Wildlife Site.

3. Constraints on Options

3.1 Ecology and Environment:

Boxted Bridge is located in the in the Dedham Vale and Stour Valley Area of Outstanding Natural Beauty and therefore its setting is of high landscape/ecology value.

The habitat types within the Boxted Bridge area (including immediate surrounds) include:

- Flowing watercourse (River Stour)
- Standing water (Boxted Mill weir pool)
- Mature and semi mature trees
- Broadleaved woodland
- Grazing pasture
- Amenity grass (surrounding)
- Arable
- Scrub
- Hardstanding (Boxted Bridge)

Preliminary ecological appraisal and protected species surveys of the site were carried out in 2016. No evidence of white clawed crayfish, water vole or otter were identified at Boxted Bridge. No bats were seen entering or emerging from Boxted Bridge; however, bats were recorded commuting and foraging under the bridge. The mature trees on the north side of the bridge have potential to support bats.

As there will be a time lapse between the initial wildlife surveys and any possible bridge works the surveys will need to be repeated.

Essex County Council Place Services has provided the following in respect of possible works at Boxted Bridge:

- ECC Landscape – Minimal disturbance shall be made to the existing trees beside the bridge to retain the landscape value around the bridge.
- ECC Ecology – the bridge scheme will involve modifications to the bridge and presumably the banks of the River Stour. This has the potential to impact protected species particularly water voles, reptiles and nesting birds given the location.

Dedham Vale AONB officer has commented:

- The site is within the nationally designated Dedham Vale Area of Outstanding Natural Beauty (AONB). Section 85 of the Countryside and Rights of Way Act, 2000 provides for a general duty of regard in relation to AONBs for all public bodies as follows: *'In exercising or performing any functions in relation to, or so as to affect, land in an area of outstanding natural beauty, a relevant authority shall have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty'*. The potential for any impacts during and after construction on the ecology of the river will need to be assessed. There may well be measures that can be incorporated into the design which would enhance the biodiversity of the river.

3.2 Environment Agency:

The Environment Agency has provided the following pre-application guidance in respect of possible works at Boxted Bridge:

- The Environment Agency would generally not be in favour of any loss of soffit height or reduction in the waterway cross section
- The Agency recommend that for a Road Bridge the soffit level is 600 mm or more above the 1 in 100 (1%) annual probability including climate change (design) flood level in order

to allow floating debris to pass freely through the structure. In this instance, the 1 in 100 (1%) including an allowance of 20% for climate change flood level is 9.144 m AOD. Furthermore, the soffit must be no lower than 300 mm above either of the upstream bank tops

- Environment Agency maps show the Boxted Bridge site to lie within Flood Zone 3, the high probability zone. Bridge works could require a site specific Flood Risk Assessment to demonstrate that the 'development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible, will reduce flood risk
- Essex County Council needs to take account the foreseeable increases in flow within a catchment due to further development and climate change
- River modelling should be undertaken for the Boxted Bridge site to accurately establish the risk to the proposed development in terms of potential depths and locations of flooding. The Environment Agency holds levels and flow data at Boxted Bridge under the River Stour river model and the information is available on request
- An environmental permit for flood risk activities is required to do work in, under, over or within 8 metres of the river. For road bridge works a Bespoke Permit is required
- Currently unpowered craft (i.e. those that are paddled, rowed or sailed) are permitted to travel the whole length of the Stour Navigation

3.3 Historic Environment:

Boxted Bridge is located in the Dedham Vale and Stour Valley Area of Outstanding Natural Beauty and is adjacent to the Grade II listed Boxted Mill.

Essex County Council Place Services has provided the following in respect of possible works at Boxted Bridge:

ECC Historic Environment – Depending on the level of ground works required there is the potential need for archaeological investigation, either in advance of construction or a programme during the construction phase. This depends on how much groundwork is required. If borehole assessment of the site takes place paleo-archaeological assessment of the resulting cores should take place. No development or preliminary groundworks of any kind shall take place until the applicant has secured and fully implemented a programme of archaeological work in accordance with a written scheme of investigation which has been submitted by the applicant and approved by the planning authority.

ECC Historic Buildings – Permanent restrictions (weight/width) on the existing bridge or constructing a new deck on the existing foundations/abutments options would not raise any concerns from a Historic Buildings perspective. Full bridge reconstruction on the footprint of the existing structure would need to be mindful of the views from the adjacent Grade II listed Mill and preserving the rural setting. Full bridge reconstruction on a widened footprint with highway alignment and junction improvements would be less desirable as it would seem to urbanise the rural setting of the listed building.

Babergh District Council has commented that the current bridge is not Listed and it is not in or adjacent to a conservation area. It is noted that the physical condition of the bridge is such that it is not fit for the traffic load placed upon it and therefore there is public benefit in transport terms from its replacement. The bridge is of limited value, if any, heritage significance based on its likely age and appearance and there would be no objection to its removal on heritage grounds.

3.4 Land:

Boxted Bridge crosses the River Stour and straddles the Essex and Suffolk county boundary.

Essex County Council owns and maintains the bridge and is responsible for maintaining the highway south of, and over, the River Stour. Suffolk County Council is responsible for maintaining the highway (Wick Road) north of the bridge.

Essex County Council Highway Records show the publicly maintainable highway is generally limited to the extent of the metalled carriageway; only at the southwest corner of the bridge does the maintainable highway include the verge.

Boxted Mill owns land southwest, northwest and southeast (including Island Cottage property and grounds) of the bridge. Boxted Mill land west of the bridge comprises mature and semi-mature trees and a large mill pond. Land southeast of the bridge is part of Island Cottage garden which is laid to lawn with a gravel drive leading to a garage.

Land northeast of the bridge is jointly owned by Messrs R. Barker and M. Wemyss and comprises hedged riverbank and low-lying grazing pasture.

Boxted Mill owners have been in communication with Essex County Council over many years in respect of heavy goods vehicles using Boxted Bridge (including Wick Road, Lower Farm Road and Sky Hall Hill) and resulting damage to Island Cottage boundary wall and the bridge. Boxted Mill owners have also raised concerns about the condition of (and absence of) warning signs on the approaches to the bridge and the junction of Sky Hall Hill with Lower Farm Road.

Essex County Council would need to negotiate with private landowners for the sale of land to facilitate bridge/highway upgrading (i.e. bridge widening and junction improvements).

3.5 Planning:

Works to Boxted Bridge would extend across the Essex and Suffolk border and includes land within Colchester Borough Council and Babergh District Council.

Essex County Planning was requested for Pre-Application Planning Advice in 2016 on a number of bridge options. The options identified were permanent restrictions (weight/width) on the existing bridge, constructing a new deck on the existing foundations/abutments, full bridge reconstruction on the current bridge footprint and full bridge reconstruction on widened footprint with highway and junction improvements.

Essex County Council Planning has provided the following based on ECC's Pre-Application Planning advice procedure:

- Proposals will need to comply with the generic policies within the Colchester Development Policies and Core Strategy in relation to design, sustainability, accessibility and the Area of Outstanding Natural Beauty
- The design of the bridge should be of a high quality and of logical configuration to comply with all planning policies
- Where a development straddles one or more local authority boundaries the applicant must submit identical applications to each authority. The planning fee is payable to the authority of whatever area contains the larger or largest part of the whole application site
- The need for the development should be clearly justified – this should take account of the reasons for the development and provide a robust evidence to support the justification
- The application lies within the Dedham Vale AONB and as such, any proposal shall have regard to the purpose of conserving and enhancing the natural beauty of the area of outstanding natural beauty

3.6 Network:

Boxted Bridge is set in a rural area with roads serving small settlements and providing access to individual properties and arable land. The roads are often only single lane width with numerous bends which and are unsuitable for HGVs and through traffic.

Boxted can be accessed from Colchester along Boxted Straight Road however a number of routes leading from the A12, A134 and B1068 are signed 'unsuitable for HGVs'.

Historically, there has been an 'unsuitable for heavy goods vehicles' Suffolk County Council road sign at the northern end of Wick Road (at the junction with the B1068 Park Road) but this sign is currently missing. Consequently, HGVs drivers could be using Wick Road and Boxted Bridge unknowing that the route is unsuitable for lorries.

Essex Highways Network Assurance was requested for its views on environmental and bridge weight restrictions, temporary diversions during bridge works and the strategic planning of HGVs movements. EH Network Assurance has provided the following:

- A further traffic survey should be undertaken and compared with that of 2016. Ownership of HGV's should be traced to establish origin and destination and enquire of the reason they are at Boxted Bridge
- The most reasonable solution in the long term is that the Bridge is subjected to a structural limit of 3 tonnes
- It is AONB and needs to be protected there does therefore need to be a complete assessment of the existing signing making sure that drivers are given the correct messages at the correct points to make informed directional changes

'Authorised' diversion routes required for permanent restrictions (weight and/or width) on the existing bridge or for road closure during deck replacement/bridge reconstruction works would require ECC to negotiate with Suffolk County Council and possibly Highways England to install signs on their respective networks. The diversion route lengths for cars and vans avoiding Boxted Bridge is at least 5.9 miles; diversion route distances for lorries and HGVs are 11.2 miles and 12.4 miles.

Suffolk County Council has advised it would not want Nayland (as it is a narrow road with overhanging buildings that have been struck in the past) and The Row between Stratford St Mary and Higham used as a diversion routes during Boxted Bridge works. There is an 18T weight restriction on the B1068 at Polstead Street, Stoke-by-Nayland.

Suffolk County Council has a management plan to ensure that HGVs and lorries use the most suitable routes, roads or villages in Suffolk and has produced a lorry route network map. The map identifies Stoke-by-Nayland and Nayland as historic villages where drivers should take extra care and where possible avoid.

3.7 Emergency Services:

Emergency service response times to incidents in the Boxted Bridge area could be affected as a result of the introduction of permanent measures to close the bridge to traffic, or weight restrict traffic using the bridge, or temporary closure/diversions during bridge works.

No discussions have been held with the emergency services concerning the above. However, it is considered that the risks posed to the relatively isolated residents, properties and businesses in the area could be mitigated by appropriate liaison between ECC and the emergency services during the planning stage for any option/options which are to be implemented.

3.8 Businesses:

The local area is populated by a selection of farms some with industrial use. It is expected that a number of the businesses are likely to use Boxted Bridge on a regular basis and possibly a number of times per day during harvest time.

Essex & Suffolk Water (E&SW) operates a water treatment works southeast of Boxted Bridge. However the company has confirmed heavy goods vehicle access to the treatment works is from the Stratford St Mary direction and therefore its vehicles do not use the bridge.

The number of local businesses using the Boxted Bridge is likely to be small but they could be significantly inconvenienced by permanent weight restriction on/closure of the bridge and certain other restrictions on the network.

To some extent businesses and hauliers operating in Boxted and Langham parishes and lorry drivers attempting to access the trunk road/distributor network are hampered by the lack of an Essex County Council strategic lorry route network for the area and the absence of appropriate and road signing.

3.9 Public Transport and Services:

Public transport services do not operate along routes which cross the bridge.

Primary schools are located in Boxted (Carter's Hill), Stoke-by-Nayland (School Street), Nayland (Bear Street) and Langham (School Road).

A GP's surgery is located in Bear Street, Nayland.

The number of local residents using the Boxted Bridge to access the above services on a daily basis is likely to be small but permanent closure of the bridge to motorised traffic and temporary diversions during bridge works would cause inconvenience to some residents/villagers.

However, it is considered that the inconvenience could be minimised by appropriate community consultation/involvement during the planning stage for any option/options which are to be implemented.

3.10 Road Safety:

Essex Highways' Road Safety provided the following road safety comments and recommendations in respect of current or possible arrangements at Boxted Bridge:

- The existing road marking centre line infers there is sufficient width for two way traffic flow. There is insufficient width and the centreline on the approach to and across the bridge should be removed
- There is no advanced warning in either direction for the bridge, there were signs (as visible on Google Street view 2009). Warning signs for the bridge and both approaches should be provided for the existing arrangements and possibly for an option which may be implemented
- There is an existing yellow backed chevron sign this is not visible on the approach to the bend. It is recommend that the single chevron sign is removed and replaced with 3 individual ones to guide motorists around the bend over the bridge
- It is anticipated that there may be bridge strikes to the parapets during the hours of darkness; it is recommended that bollards or reflective strips are considered and installed as part of the scheme
- There is significant roadside overgrowth narrowing the route further. This should be heavily cut back or removed as part of the scheme

Additionally it is noted that the existing road widths are very narrow, with multiple bends that help to negate traffic speeds, it was noted on site that there is very poor inter-visibility across the bridge for oncoming motorists. However this does help negate traffic speeds. It was found that when approaching the bridge from the Lower Farm Road traffic speeds are very low.

3.11 Utilities:

NRSWA utility plant drawings have been obtained for the Boxted Bridge and the area in the vicinity of the bridge. Jacobs conducted a Ground Penetrating Radar (GPR) survey of the site in June 2016.

The NRSWA records do not record utility plant as crossing the bridge. However, the GPR survey was not fully conclusive in this respect and it is recommended that a slit trench is dug behind one of the abutments in order to confirm no utility apparatus is carried by the bridge before planning or undertaking major works to the structure.

A Suffolk County Council highway surface water drainage pipe is located in Wick Road with a manhole located just north of Boxted Bridge with an outfall through the bridge northeast retaining wall.

UKPN high voltage underground plant is located in the grazing pasture northeast of Boxted Bridge. UKPN overhead apparatus crosses Lower Farm Road adjacent to Boxted Mill.

A water main crosses Lower Farm Road between Island Cottage and Boxted Mill.

3.12 Geotechnical:

No geotechnical investigations have been undertaken as part of this Option Study.

However, a geotechnical desk study was undertaken which identifies the general stratigraphy expected at the Boxted Bridge site to consist of ‘a combination of Quaternary superficial deposits including Alluvium and River Terrace Deposits overlying undifferentiated bedrock of the Lambeth Group and Thanet Sand Formation overlying the White Chalk Subgroup’. The Geotechnical Desk Study identified limited existing information on the ground conditions expected at the bridge. A detailed geotechnical and contaminated land ground investigation is required therefore to provide confirmatory geological, geotechnical and land contamination information to enable detailed design.

The form (and founding level) of the current bridge foundations is unknown but intrusive investigations indicate the abutments to be mass brick construction with a uniform thickness of approximately 1.0 metre. The abutments appear ‘plumb’ and free of ‘in-plane’ differential settlement. Topographic survey levels seem to suggest no or only limited differential settlement between supports but as no as-built record drawings of the structure are available (and the deck being simply supported) this cannot be verified.

Constructing a new deck on the existing foundations (and abutments with some repairs undertaken) may be feasible providing there is no increase (or only a modest increase) in superstructure dead and superimposed dead loads.

3.13 CDM/Health and Safety:

The bridge in its current deteriorated condition and with an assessment rating of 3 tonnes (dating from 1992) may be considered to be a risk to road users.
CDM/health and safety issues associated with construction phase deck replacement or bridge reconstruction works at this location may include (but not be limited to) the following:

- Site access limitations
- Confined site
- Proximity of Environment Agency remotely controlled river control sluices to site

- Deep water
- Fast flowing and deep river during sustained wet weather/periods of heavy rain
- Water borne and livestock related pathogens
- Temporary instability of existing abutments during deck replacement/demolition
- Falls from height
- Deep excavations
- Proximity of works area to traffic at Skye Hall Hill/Lower Farm Road junction
- Crane/lifting operations
- Dense and mature tree growth around bridge

The River Stour flows over a weir at Boxted Mill to the west of the bridge and forms a large pool before continuing under the bridge in an easterly direction. The mill pool contains deep water even during times of low flow. The river depth at the bridge varies due to scour effects.

3.14 Miscellaneous:

Boxted Parish suffered damage from air raids during WW2.

It is recommended an Unexploded Ordnance (UXO) desk study be carried out to identify the risk of encountering UXO during ground investigation and construction phases.

4. Options Considered

The following options for management, strengthening, deck replacement and bridge reconstruction have been identified.

4.1 Option 1 – Do nothing:

This option would leave the existing bridge in its current state and subject to continued unrestricted vehicle loading. It can only be considered as a temporary measure as the bridge will continue to deteriorate and the need for a permanent solution (bridge closure, deck replacement or bridge reconstruction) will be necessary at an unknown future date.

This option places Essex County Council in a position of risk as failure of the bridge (either by element or global failure) due to deterioration, vehicle loading or vehicle impact cannot be predicted with accuracy. Further, it does not mitigate the current network issues or the risk of HGVs impact damage to the residential property boundary wall at the Skye Hall Hill with Lower Farm Road junction.

4.2 Option 2 – 3 Tonnes environmental weight and width restrictions on existing bridge and network:

This option would leave the existing bridge in its current state but would require advisory environmental weight and/or width restrictions to be signed on the approaches to the bridge. This would have the objective of discouraging the heavier and potentially more damaging vehicles from using the bridge and the local network. This should be considered a time limited measure as in the short to medium term a permanent solution for the bridge based on other options will need to be implemented.

This option would require a review and assessment of the impact on the wider network prior to being introduced. Physical width restrictions (i.e. bollards) could not be installed at the bridge due to the adverse effect on highway alignment. Neither would it be desirable to install physical barriers remote from the bridge due to the need for goods vehicles to access the area for everyday servicing and deliveries.

This option would cause inconvenience to certain categories of road users and businesses both local and further afield. It may be possible to define certain exemptions to the restrictions in favour of local businesses and farmers.

Option 2 would require HGVs previously accessing the Boxted and Langham via Wick Road, or that would use Boxted Bridge as part of a through route, to undertake lengthy detours that would need to be signed on both Essex County and Suffolk County council networks. This would require Essex County Council to liaise with Suffolk County Council for the installation of road signs on its network. Consultation with Highways England could also be required as installation of signs on its network may be necessary.

Signing environmental weight and width restrictions on the bridge approaches (Wick Road, Lower Farm Road and Sky Hall Hill) would, if obeyed by HGVs drivers/operators, limit the use of the bridge to cars, vans and light goods vehicles accessing the local area. It could have the effect of lessening the number of goods vehicles using the bridge as a through route and reduce the risk (and likely severity) of edge girder impacts and damage to the adjoining residential property boundary wall.

This option places Essex County Council in a position of continued risk as failure of bridge deck element/s due to corrosion/deterioration cannot be predicted with accuracy.

4.3 Option 3 – Introduce weight restriction of 3 tonnes Gross Vehicle Weight over the existing bridge:

This option would leave the existing bridge in its current state but limit its use to cars and vans. This should be considered a short term measure with a view to maintaining availability of the Lower Farm Road/Wick Road route to light traffic whilst the feasibility of a permanent solution for the bridge is investigated.

Imposing a structural weight restriction of 3 tonnes gross vehicle weight should protect the bridge from goods vehicle loading (potentially the most damaging traffic) and lower the risk and the potential severity of edge beam vehicle impact damage.

This measure could be considered to increase structural reliability/confidence based on the assessed load capacity incorporating appropriate factors of safety. It should also protect the local network from unsuitable vehicle types and reduce the risk of damage to the adjoining residential property boundary wall.

This option would require HGV's accessing the Boxted village area, or that would use Boxted Bridge as part of a through route, to undertake lengthy diversions that would need to be signed on both Essex County Council' and Suffolk County Council's network. Consultation with Highways England could also be required as installation of signs on its network may be necessary.

This option places Essex County Council in a position of continued risk as failure of bridge deck element/s due to corrosion/deterioration cannot be predicted with accuracy.

4.4 Option 4 – Permanent closure of the bridge to motorised traffic:

This option would leave the existing bridge in its current state but it would be relieved of all motorised traffic loading. However, it would be desirable for the bridge to remain open to pedestrians and cyclists given the structures isolated location and the absence of an alternative route (other than through private land and using private bridges).

This measure could be justified based on the relatively low number of vehicles using the bridge on a daily basis (271 vehicles per day, 2016 traffic count) and the high capital cost (and difficulties) associated with implementing a permanent bridge solution which is capable of accommodating unrestricted traffic. Closure of the bridge would however inconvenience farmers, businesses and a number of local residents.

This option reduces the risk to Essex County Council as, although the bridge will continue to deteriorate, it is likely to be some time before its condition poses a risk to non-motorised users. The bridge would however remain a maintenance liability for Essex County Council and the structure would still require periodic (and possibly monitoring) inspection.

This option would require a review and assessment of the impact on the wider network prior to being introduced and Essex County Council to liaise with Suffolk County Council for the installation of road closure and other road signs.

4.5 Option 5 – Enhance the capacity of the existing bridge to achieve 40 tonnes load capacity:

The aim of this option would be to enhance the load capacity of the deck elements which the 1992 assessment of the structure found to be sub-standard.

This could possibly be achieved by improving restraint of the existing edge girders and by replacing the heavily corroded longitudinal tertiary rolled steel channels.

Edge girder restraint could be improved by installing external U-frames adjacent to the abutments and at intermediate locations within the span. The external U-frames would comprise new cross beams (hung from existing edge girder bottom flanges) and braced vertical stiffeners (installed on the river side faces of the edge girders).

Installation of the new U-frame cross beams would result in a small reduction in total waterway cross-section at the structure and a reduction in navigation clearance.

The corroded longitudinal tertiary rolled steel channels would be replaced with new members which would require local break out and replacement of the deck concrete fill and hogging plates.

Maintenance painting of the remaining original steelwork would be carried out as part of this option.

The design life of this option would be limited by the residual life span of the original 1903 steel elements which could be limited based on their current condition.

Option 5 works would include repair/partial reconstruction of the bridge approach retaining walls.
A temporary full bridge/road closure would be required in order for these works to be undertaken with an estimated duration of 4 to 5 months.

4.6 Option 6 - Construct a replacement deck on the existing foundations/sub-structure:

The aim of this option would be to provide a new deck with the same, or similar, plan area as the existing structure but with a capacity sufficient for current design live loads. It would also have improved durability/lower maintenance liability.

As this option utilises the foundations of the 1903 structure it is desirable there should be no (or only minimal) increase in deck dead and superimposed dead loads applied to the substructure elements. The widths of the existing abutment walls are such that a replacement deck of marginally greater width, than that which is presently provided, could possibly be accommodated.

Option 6 works would include partial reconstruction of the abutments (or partial replacement by a reinforced concrete cill beams) and repair/partial reconstruction of the bridge approach retaining walls.

This option provides no, or little, scope for improving HGV turning at Sky Hall Hill with Lower Farm Road junction and the risk of damage to Island Cottage boundary wall would remain.

A temporary full bridge/road closure would be required in order for these works to be undertaken with an estimated duration of 4 to 5 months.

There are two sub-options for the form of the replacement deck that could be provided. These are:

Option 6A – Provide a replacement deck with a form and constructed in materials similar to the present structure:

For this sub-option the replacement deck would comprise a simply supported half-through steel deck with an appearance similar to that of the present structure. It would consist of welded plate edge girders with composite concrete and steel rolled I-section transverse secondary and longitudinal tertiary beams. It is likely the new edge girders would be fabricated in higher grade steel, with thicker flange plates and increased U-frame restraint.

The steelwork would be protected by a shop applied corrosion protection system with improved durability which may be expected to last for 25 years before requiring maintenance; the use of steel with improved atmospheric corrosion resistance (weathering steel) may be a possibility.

It is considered likely that a new deck of this form could be constructed with a similar carriageway vertical profile, construction thickness and soffit level as the existing structure. However, if acceptable to the Environment Agency, it could be constructed at a slightly lower soffit level to improve forward visibility over the bridge.

Although providing a replacement deck in this form would comply with current design standards in terms of load carrying capacity it would require a Departure from Standard as the edge girders would be vulnerable to vehicle impact as it is not possible, due to the limited width, to install a road restraint system to protect these elements.

Due to the access limitations and the restricted site it is considered likely that the deck elements would be craned into position and the deck assembled in-situ over the watercourse. Therefore temporary falsework is likely to be necessary during deck assembly. It is also likely that enclosed falsework access would be required to undertake future maintenance painting of the deck.

Option 6B – Provide a replacement deck with a 'slab' type construction form comprising either precast prestressed concrete or fibre reinforced polymer beams:

For this sub-option the replacement deck would comprise a simply supported 'slab' type deck formed from either precast prestressed concrete beams (with in-situ concrete between the webs and over the top flanges) or fibre reinforced polymer (FRP) beams. Decks constructed in either material can accommodate N1/N2 containment metal (steel or aluminium) post and three rail parapets.

The beam units would be individually craned into position over the watercourse to assemble the deck. Temporary edge protection is likely be required to protect the workforce when placing in-situ infill concrete around precast prestressed concrete beams.

It is considered likely a new deck of this form would require an increased construction thickness when compared to that of the existing structure. From a road user safety perspective it would be undesirable to raise the carriageway level to accommodate this, so a reduction in soffit level may be necessary. Initial guidance from the Environment Agency has indicated a modest reduction in soffit level (and therefore waterway cross-section) could be acceptable to them.

Well designed and constructed bridges of this form constructed in either precast concrete or FRP should only require minimum maintenance to keep them in good working condition.

The appearance of the deck would differ significantly from that of the existing structure which may not be acceptable to the planning authorities.

4.7 Option 7 – Reconstruct bridge:

This option would provide a structure with foundations, sub-structure and superstructure elements that have a design life of 100+ years with a low maintenance requirement.

The structure would be fully compliant with current design standards in terms of load carrying capacity and durability but not necessarily in terms of highway alignment, road safety or without the need of Departures from Standard.

N1/N2 containment metal (steel or aluminium) post and three rail parapets would be provided over the bridge.

Option 7A - Full bridge reconstruction on current bridge footprint

The bridge is likely to comprise an integral type structure with a 'slab' type deck (formed of precast prestressed/FRP beams (as Option 6) or in-situ reinforced concrete) and reinforced concrete abutments faced in brick to suit (expected) planning requirements. The form of the foundations has not been

established at this time as it is dependent on the findings from detailed geotechnical investigations which have not yet been undertaken.

Although the new bridge would be no wider than the original structure it would be structurally better suited to accommodate HGV traffic as main superstructure elements would no longer be at risk from direct vehicle impact.

Although the scale of the new bridge would be commensurate with the current structure its appearance would present views from the adjacent Grade II listed Mill which may not be acceptable on planning grounds.

An increase in deck construction thickness with a corresponding reduction in deck soffit level is likely to be necessary for this option. Initial guidance from the Environment Agency has indicated a modest reduction in soffit level (and therefore waterway cross-section) could be acceptable to them.

This option provides no, or little, scope for improving HGV turning at Sky Hall Hill with Lower Farm Road junction and the risk of damage to Island Cottage boundary wall would remain.

Option 7B - Full bridge reconstruction on widened footprint incorporating highway alignment and junction 'improvements'

The new bridge would be significantly wider than the existing structure to accommodate HGVs crossing the bridge and HGV turning movements at the Sky Hall Hill with Lower Farm Road junction. This would require Essex County Council to purchase adjoining private land as a significant section of the new bridge would be constructed outside the current publicly maintainable highway.

Due to the desirability of limiting the environmental impact of the scheme, minimising private land acquisition and the likely difficulty in being able to realign and widen Wick Road (due to it being part of Suffolk County Council's highway network) the new bridge would still be trapezoidal in plan but being much wider at the southern end than the existing structure.

The fairly extreme trapezoidal plan form dictated for the new structure would probably require the deck to be constructed using in-situ reinforced concrete. Due to the form of deck construction and the relatively long skew span along the east side of the structure the depth of an in-situ concrete deck may need to be significantly greater than that of the existing structure and require a lower soffit to accommodate this.

The scale and appearance of the reconstructed bridge would differ significantly from that of the existing structure and therefore may not be acceptable to the planning authorities.

This option would reduce the risk of lorry impact damage to Island Cottage boundary wall.

This option could be considered to 'urbanise' a section of the AONB and is likely to require planning permission. Based on the traffic flow (i.e. need) and the setting it is considered unlikely that such development would receive planning consent.

5. Conclusions

Options advantages/ disadvantages.

5.1 Option 1 – Do nothing:

Advantages

- Essex County Council incur no immediate capital cost
- Despite the bridge being subject to occasional vehicle loads greater than it's historically low assessment rating the deck elements show no apparent signs of loading related failure
- No reduction in availability of Essex County Council network
- Do-nothing option has no, or little, adverse effect on Suffolk County Council network/villages

Disadvantages

- Edge girders will continue to be at risk from HGV impacts
- Present condition (and continuing deterioration) of bridge exposes Essex County Council and the general public to ongoing, and potentially increasing, risk
- Essex County Council network (bridge structures and routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- Island Cottage boundary wall at risk of further damage from HGVs

Option 1 is not recommended.

5.2 Option 2 - Environmental weight and width restrictions on existing bridge and network:

Advantages

- Environmental restrictions should reduce the number of HGVs using the sub-standard bridge and local network
- Essex County Council incur limited initial capital cost in implementing environmental restrictions
- Island Cottage boundary wall at reduced risk of damage from HGVs
- Could be welcomed by some local residents
- Immediate implementation may be considered to provide some short-term reduction in risk to Essex County Council while it explores a permanent solution

Disadvantages

- Edge girders will continue to be at some risk from HGV impacts
- Present condition (and continuing deterioration) of bridge exposes Essex County Council and the general public to ongoing, and potentially increasing, risk
- Traffic Orders would be advisory only
- Essex County Council network (bridge structures and routes) could continue to be subject to HGV through traffic
- It could inconvenience local farmers and businesses
- May not be favoured by Suffolk County Council as it could increase HGVs using Stoke-by-Nayland and Nayland villages

Option 2 is viable in the short-term only; not recommended as permanent solution.

5.3 Option 3 – Introduce weight restriction of 3 tonnes Gross Vehicle Weight over the existing bridge:

Advantages

- Weight restriction would reduce the number of HGVs using the sub-standard bridge and local network
- Traffic Order would be enforceable
- Present condition (and continuing deterioration) of bridge exposes Essex County Council and the general public less risk in the short term
- Essex County Council incur limited initial capital cost in implementing weight restriction
- Island Cottage boundary wall at reduced risk of damage from HGVs
- Likely to be welcomed by some residents
- Immediate implementation may be considered to provide greater short-term reduction in risk to Essex County Council while it explores a permanent solution

Disadvantages

- Present condition (and continuing deterioration) of bridge exposes Essex County Council and the general public to some risk
- Likely to inconvenience local farmers and businesses
- Unlikely to be favoured by Suffolk County Council as it could increase HGVs using Stoke-by-Nayland and Nayland villages
- Could increase emergency service response times to some areas

Option 3 is viable in the short-term as a load mitigation interim measure; not recommended as permanent solution.

5.4 Option 4 – Permanent closure of the bridge to motorised traffic:

Advantages

- Bridge not subject traffic loading or impact damage
- Present condition (and continuing deterioration) of bridge exposes Essex County Council and the general public to less risk in the medium term
- Essex County Council incur limited initial capital cost in implementing closure
- Immediate implementation provides greatest reduction in risk to Essex County Council while it considers/develops a permanent solution
- Due to the high capital cost/difficulties in implementing a permanent solution and the relatively low daily traffic flow using the bridge permanent closure could be considered acceptable to Essex County Council on a cost/benefit basis
- Island Cottage boundary wall at reduced risk of damage from HGVs

Disadvantages

- Local section of Essex County Council network would be unavailable to all classes of motorised traffic
- It would inconvenience local farmers, businesses and a number of residents
- Traffic is likely to be displaced onto other sections of the Essex County Council local network which are unsuitable (i.e. sub-standard structures and single lane carriageways) for HGVs and increased traffic
- Unlikely to be welcomed by Suffolk County Council as it could increase traffic using Stoke-by-Nayland and Nayland villages
- Could increase emergency service response times to some areas
- Bridge remains a maintenance liability to Essex County Council and would require periodic general inspection

Option 4 is viable in the medium term; not recommended as permanent solution (unless justified on a cost/benefit basis).

5.5 Option 5 – Enhance the capacity of the existing bridge:

Advantages

- Upgrading would provide deck with 40 tonnes assessment live load capacity
- Limited change to bridge aesthetics likely to be acceptable to planning authorities
- Likely to be favoured by Suffolk County Council as it would have no, or little, adverse effect on effect on Suffolk County Council network/villages in the long term
- Option likely to require the shortest duration road closure period for implementation when compared to other permanent solutions
- Option would be less costly to implement than other permanent solutions considered
- Construction activities undertaken above normal river levels

Disadvantages

- Edge girders would continue to be at risk from HGV impact
- Structure is already 115 years old and is considered to have a limited residual lifespan; cost of enhancing works compared to the residual lifespan could be considered to represent poor value
- It is not considered viable/cost effective to improve the general condition of the deck sufficiently to regard this option as a permanent solution
- Difficult to carry out effective abutment repairs due to deck remaining in place
- Bridge deck elements, through deterioration, exposes Essex County Council and the general public to ongoing, and potentially increasing, risk
- Essex County Council network (other sub-standard structures in area and local routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- Upgrading works could compromise bridge waterway cross-section which could be rejected by Environment Agency
- Island Cottage boundary wall would be continued risk of damage from HGVs

Option 5 is not recommended.

5.6 <u>Option 6 - Construct a replacement deck on the existing foundations/sub-structure:</u>

5.6.1 Option 6A – Provide a replacement deck with a form and constructed in materials similar to the present structure

Advantages

- Deck would be designed to accommodate current design live loads and would have improved durability/lower maintenance requirements
- Construction activities undertaken above normal river levels
- Appearance of the replacement deck would be similar to the present structure and could therefore be acceptable to planning authorities
- Replacement deck would be within the current highway boundary and could be considered as permitted development
- May provide some scope to improve inter-visibility for traffic approaching the bridge
- No, or only, limited effect on waterway cross-section

Disadvantages

- Half-through edge girders would be at risk from HGV impact (unless the bridge is weight restricted to exclude HGV traffic)

- Structure would incorporate foundations and sections of original abutments which are already 115 years old and are of unknown form/quality and unknown residual lifespan
- Abutment walls would require partial reconstruction to repair vertical cracks or to accommodate reinforced concrete cill beams
- Steelwork maintenance painting would be required at 25-30 year intervals
- Essex County Council network (other sub-standard structures in area and local routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- Island Cottage boundary wall would be at continued risk of damage by HGVs

Option 6A should be investigated at feasibility stage.

5.6.2 Option 6B – Provide a replacement deck with a 'slab' type construction form

Advantages

- Deck would be designed to accommodate current design live loads and would have improved durability (100+ years)/lower maintenance requirements
- Main superstructure elements would not be at direct risk from vehicle impact
- Replacement deck would be within the current highway boundary and could be considered permitted development, however due to the altered appearance of the bridge this should be confirmed by the planning authorities.
- Replacement deck would be provided with vehicle road restraint parapets
- Construction activities undertaken above normal river levels

Disadvantages

- Appearance of the replacement deck will be significantly different from the present structure
- Structure would incorporate foundations and sections of original abutments which are already 115 years old and are of unknown form/quality and of unknown residual lifespan
- Abutment walls would require partial reconstruction to repair vertical cracks or to accommodate reinforced concrete cill beams
- Essex County Council network (other sub-standard structures in area and local routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- Some reduction in waterway cross-section which may not be acceptable to Environment Agency
- Island Cottage boundary wall would be at continued risk of damage by HGVs

Option 6B should be investigated at feasibility stage.

5.7 Option 7 - Reconstruct bridge:

5.7.1 Option 7A - Full bridge reconstruction on current bridge footprint

Advantages

- New structure would be designed to accommodate current design live loads and would have improved durability (100+ years)/low maintenance requirements
- Deck would be provided with vehicle road restraint parapets
- No or little requirement for land outside of the current highway boundary
- New structure would be within the current highway boundary and could be considered permitted development, however due to the altered appearance of the bridge this should be confirmed by the planning authorities

Disadvantages

- New structure would not be compliant with current design standards in terms of carriageway cross-section
- Appearance of new structure will be significantly different form the present structure
- Requires construction activities to be undertaken below river/river bed level (need for cofferdams, de-watering etc.)
- Existing bridge foundation details are unknown; their form and extent could adversely affect new bridge foundation design/construction
- Essex County Council network (other sub-standard structures in area and local routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- Some reduction in waterway cross-section which may not be acceptable to Environment Agency
- Island Cottage boundary wall would be at continued risk of damage by HGVs

Option 7A should be investigated at feasibility stage.

5.7.2 Option 7B – Full bridge reconstruction on widened footprint incorporating highway alignment and junction 'improvements

Advantages

- New structure would be designed to accommodate current design live loads and would have improved durability (100+ years)/low maintenance requirements
- New structure would be an improvement in terms of carriageway cross-section (however, it is unlikely that current cross-section/junction layout requirements could be fully achieved)
- Bridge widening and junction improvement likely to favoured by local farmers and businesses
- Island Cottage boundary wall would be at significantly less risk of damage by HGVs

Disadvantages

- Implementation of this option would require purchase of private land outside the current highway boundary
- Scheme could be considered to 'urbanise' a section of the AONB
- This option would require planning approval; based on the traffic flow (i.e. need) and the setting it is considered unlikely that the development would receive planning permission
- Bridge widening and junction improvement would not be favoured by some local residents
- Essex County Council network (other sub-standard structures in area and local routes) will continue to be subject to vehicle loadings and types which are incompatible with bridge assessment ratings and single lane carriageways
- It is possible Essex County Council would need to carry out carriageway widening/ improvements on Wick Road (part of Suffolk County Council's network) to tie-into the new bridge
- Requires construction activities to be undertaken below river/river bed level (need for cofferdams, de-watering etc.)
- Existing bridge foundation details are unknown; their form and extent could adversely affect new bridge foundation design/construction
- Some reduction in waterway cross-section which may not be acceptable to Environment Agency

Option 7B is not recommended.

Note.
Providing for pedestrian and cycle traffic during Option 5, 6 and 7 bridge works may be difficult as it could require:

a) Boxted Mill owner permission to divert through the Mill grounds, over Environment Agency river control structures and a padlocked gate

or

b) Boxted Mill and other landowner agreement to the installation of pedestrian temporary footbridge over the River Stour and footway diversion through private grounds

Approvals for the above may not be forthcoming if Boxted Mill owner feels 'disadvantaged' by Essex County Council's preferred option.

6. Options Estimated Works Durations and Costs

Option	Description	Estimated works duration (months)	Estimated works cost (£)
1	Do nothing	Not applicable	Nil
2	Environmental weight and width restrictions on existing bridge and network	Negligible	Negligible
3	Introduce weight restriction of 3 tonnes Gross Vehicle Weight over the existing bridge	Negligible	Negligible
4	Permanent closure of the bridge to motorised traffic	Negligible	Negligible
5	Enhance the capacity of the existing bridge	4 to 5	400,000 – 450,000
6A	Provide a replacement deck with a form and constructed in materials similar to the present structure	4 to 5	400,000 – 500,000
6B	Provide a replacement deck with a 'slab' type construction form	4 to 5	400,000 – 500,000
7A	Full bridge reconstruction on current bridge footprint	8-9	700,000 - 800,000
7B	Full bridge reconstruction on widened footprint incorporating highway alignment and junction 'improvements'	10-12	900,000 - 1,000,000

7. Recommendations

The recommendations from the Option Study are:

1. Essex County Council should liaise with Suffolk County Council for reinstating of the 'Unsuitable for heavy goods vehicles' road sign at the junction of Wick Road with the B1068 Park Road
2. Essex and Suffolk County councils should reinstate/provide new road signs warning of bends, junctions and bridge hazards on both approaches to the structure
3. The corroded steel posts which support the chevron warning sign (located in the garden of Island Cottage) at the junction of Sky Hall Hill and Lower Farm Road should be renewed by Essex County Council
4. A strategy for heavy goods vehicle movements in the Boxted/Langham parishes and Essex/Suffolk boundary areas should be developed and suitable routes identified and signed accordingly. This may necessitate the provision of turning areas to enable HGVS to access/exit the area using the same route
5. The current structure should be subject to a weight restriction of 3 tonnes gross vehicle weight (Option 3)
6. Essex County Council should commission a Feasibility Study to investigate the viability of constructing a replacement deck on the existing foundations/substructure (Option 6A/6B) or full reconstruction of the bridge on the current bridge footprint (Option 7A)

The difficulties of implementing and financing a number of the above are recognised but by the immediate implementation of recommendations 1, 2 and 3 this should afford a degree of protection to the current bridge, general public and Boxted Mill owner in the short term.

Recommendations 4, 5 and 6 are slightly longer term objectives but their commissioning and implementation should not be delayed due to the fragile condition (and historical low assessment rating) of the bridge, network issues and land owner concerns.

Appendix A. Location Plan

Appendix B. Photographs

Photo. 1 Bridge east (downstream) elevation – plate girder edge beam

Photo. 2	Looking toward bridge from North (Wick Road)

Photo. 3	Looking toward bridge from South (Lower Farm Road)

Photo. 4 View along Sky Hall Hill looking toward Boxted Bridge/Lower Farm Road

Photo. 5	Edge girder top flange HGV scrape

Photo. 6	Edge girder bearing stiffener - vehicle impact damage

Photo. 7 Edge girder top flange cover plate distortion and failing corrosion protection

Photo. 8	Edge girder bottom flange section loss

Photo. 9	General view of deck soffit

Photo. 10 Typical distortion of transverse beam bottom flange plates

Photo. 11	Longitudinal RSC bottom flange loss/edge girder corrosion

Photo. 12	Longitudinal RSC bottom flange loss/hogging plate pitting (holes)

Photo. 13 North abutment crack

Photo. 14	Bridge northeast approach retaining wall cracks

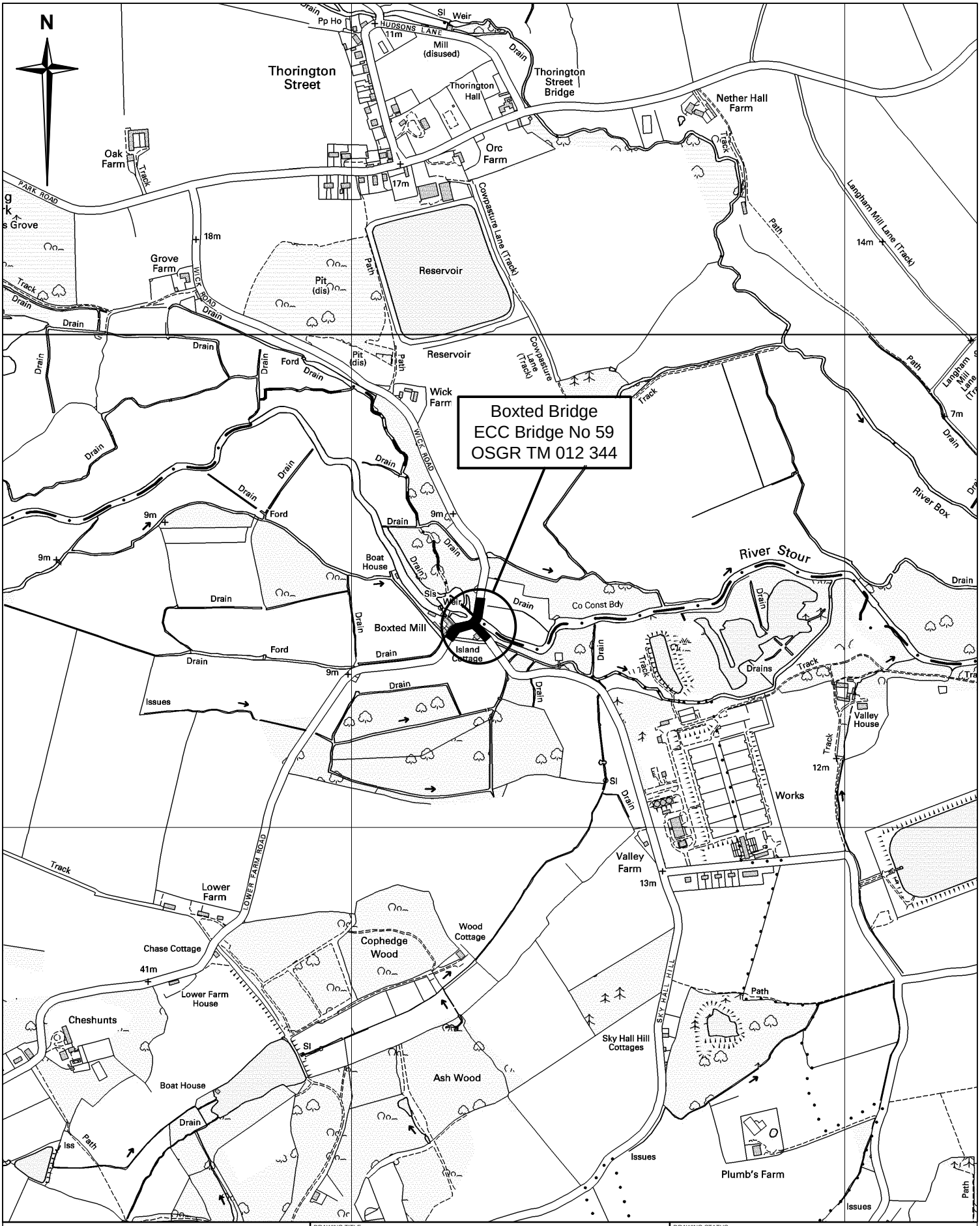
Photo. 15	Bridge northwest approach retaining wall

Photo. 16 Bridge southwest retaining wall

Photo. 17	Island Cottage boundary wall HGV impact damage (representative image 1)

Photo. 18	Island Cottage boundary wall HGV impact damage (representative image 2)

Appendix C. Drawings



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DRAWING TITLE

BOXTED BRIDGE
BOXTED
ECC BRIDGE No. 59
LOCATION PLAN

DRAWING STATUS

INFORMATION

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
DATE	DATE JUN 16	DATE	DATE	DATE

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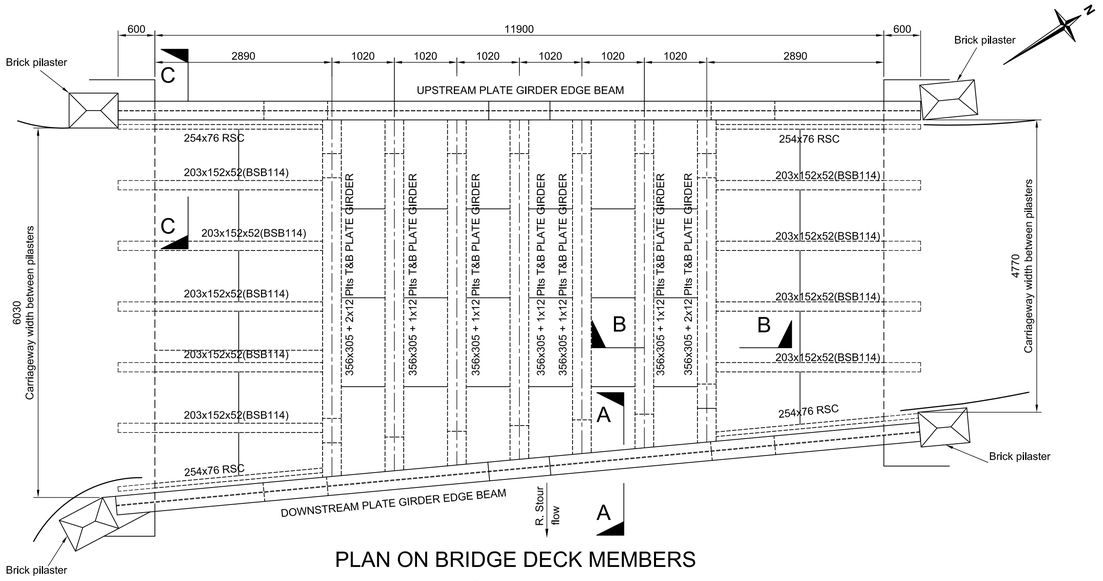

PLAN ON BRIDGE DECK MEMBERS

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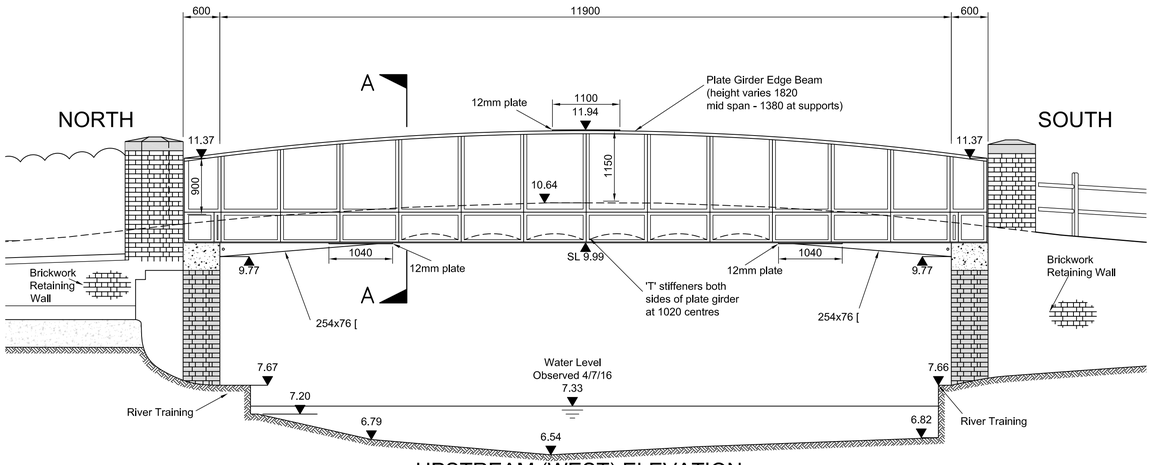

UPSTREAM (WEST) ELEVATION
WATERWAY AREA= 37.70 m²

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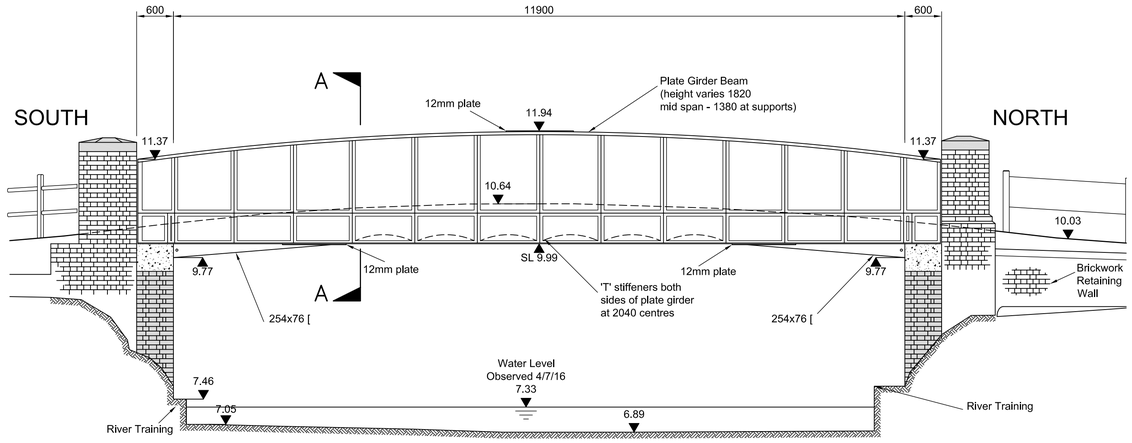

DOWNSTREAM (EAST) ELEVATION
WATERWAY AREA= 36.15 m²

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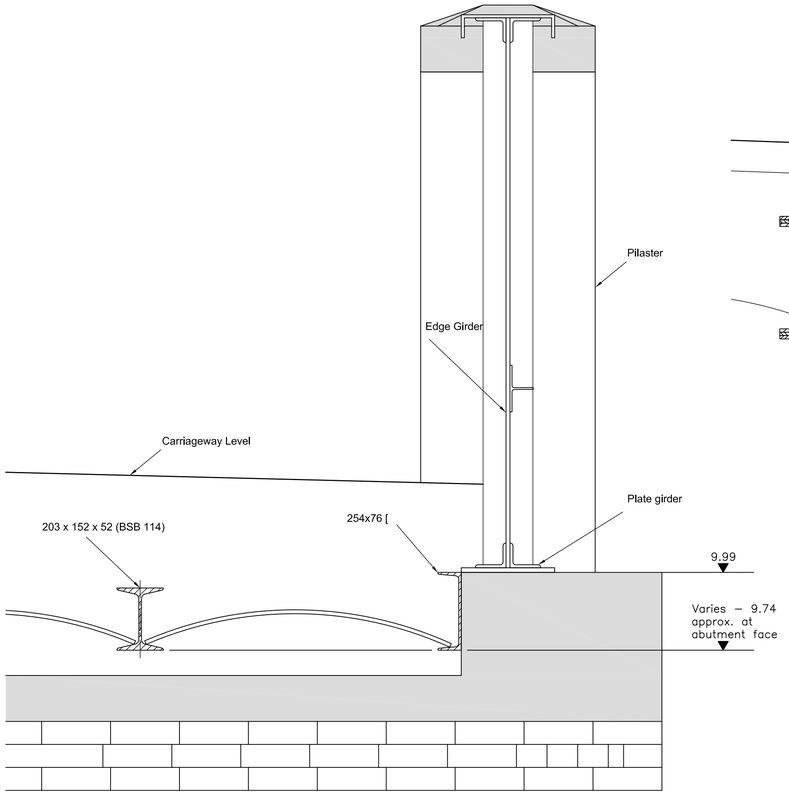

SECTION C-C

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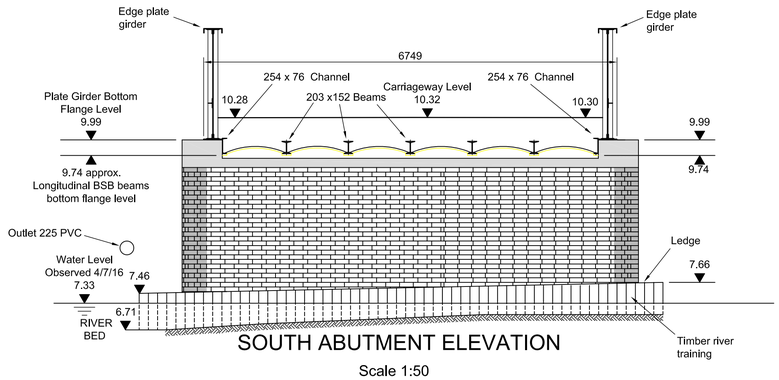

SOUTH ABUTMENT ELEVATION

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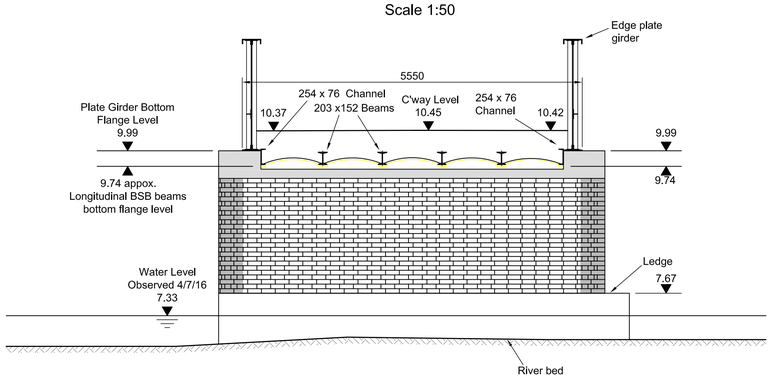

NORTH ABUTMENT ELEVATION

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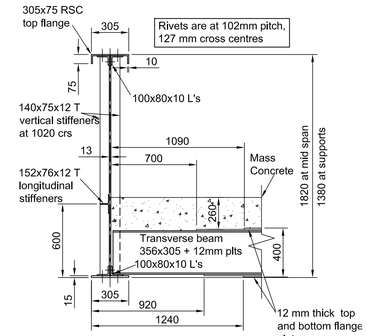

SECTION A-A

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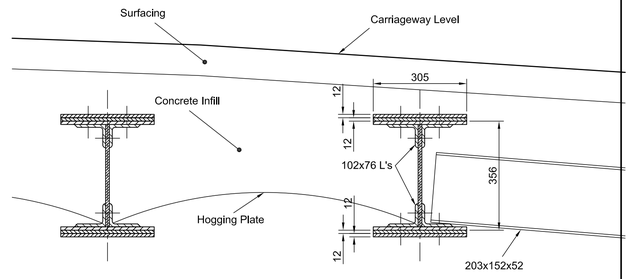


SECTION B-B

Scale 1:10

NOTES

1. All dimensions are in millimetres unless noted otherwise.
2. All levels are in metres above Ordnance Datum unless noted otherwise.

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
A	08/18	River bed profile amended and other minor amendments	ST			

DRAWING STATUS

INFORMATION

RINGWAY JACOBS integrated expertise

Essex County Council

Mark Rowe, Service Director, Highways
Seax House, 2nd Floor, Victoria Road South,
Chelmsford, CM1 1QH - Tel: 0345 6037631

SCHEME TITLE

BOXTED BRIDGE
ECC BRIDGE No. 059

DRAWING TITLE

EXISTING BRIDGE
GENERAL ARRANGEMENT

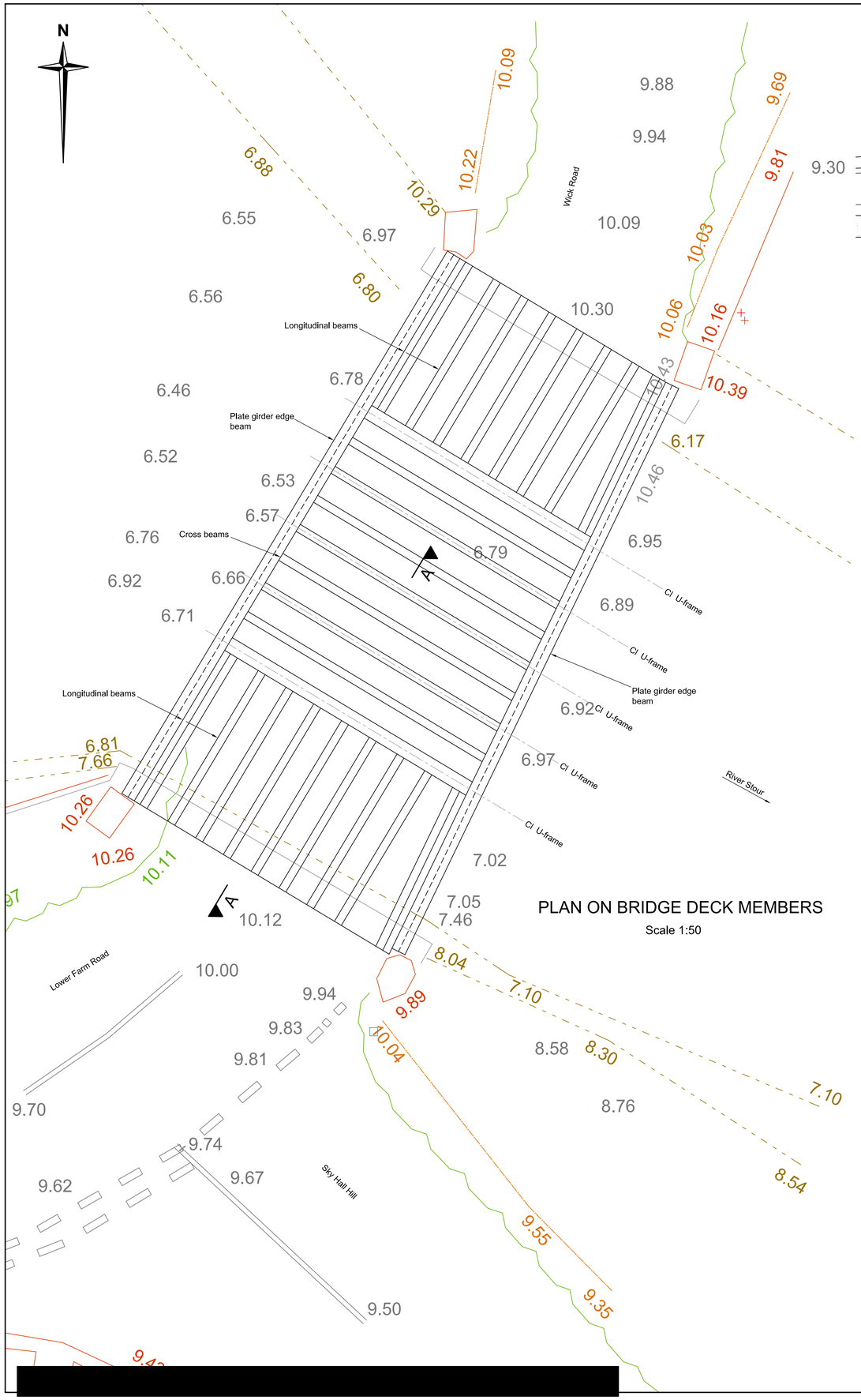
DESIGNED	[redacted]			
DATE	DATE JUN14	DATE AUG 16	DATE AUG 16	DATE SEP 16

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841X594mm)
As Shown

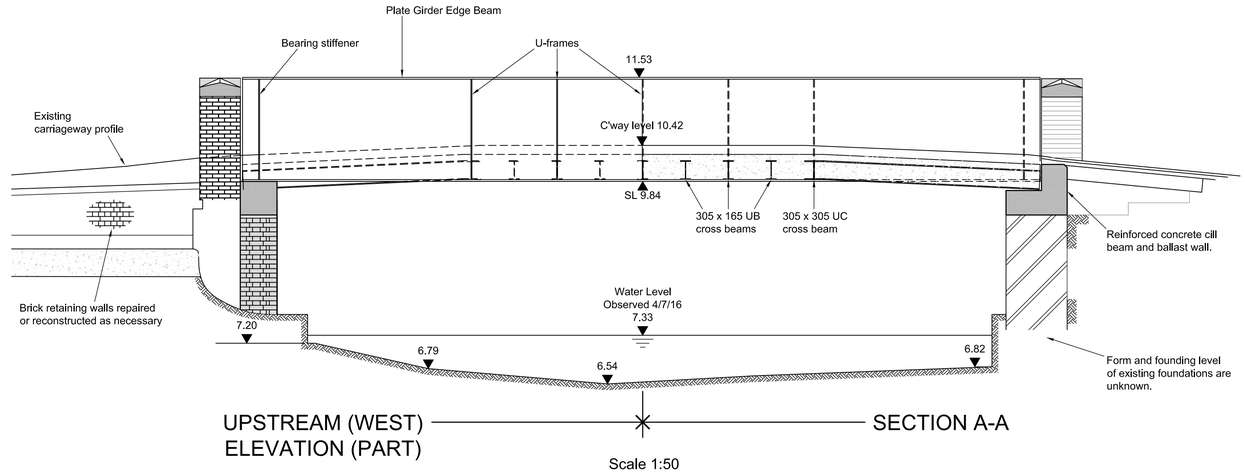
DRAWING No.
BR0059-01-1101

REV.
A



PLAN ON BRIDGE DECK MEMBERS

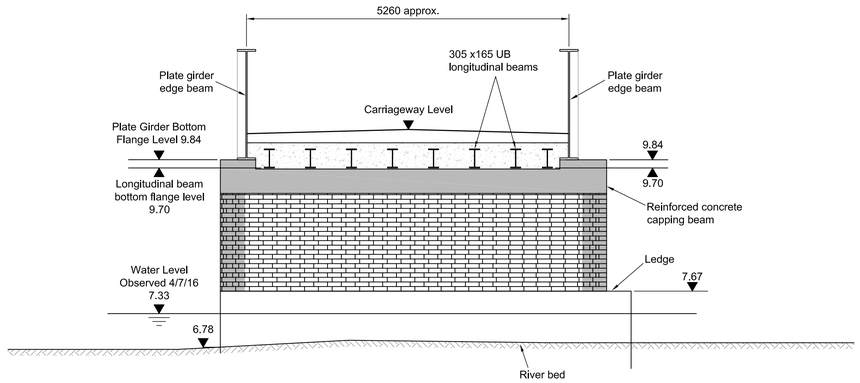
Scale 1:50



UPSTREAM (WEST) ELEVATION (PART)

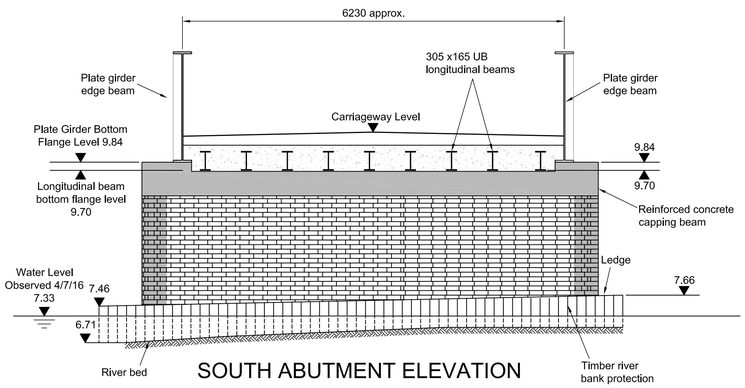
SECTION A-A

Scale 1:50



NORTH ABUTMENT ELEVATION

Scale 1:50



SOUTH ABUTMENT ELEVATION

Scale 1:50

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
A	08/18	River bed profile amended and other minor amendments	ST			

DRAWING STATUS

PRELIMINARY FOR INFORMATION

RINGWAY JACOBS integrated expertise

Essex County Council

Mark Rowe, Service Director, Highways
Seax House, 2nd Floor, Victoria Road South,
Chelmsford, CM1 1QH - Tel: 0345 6037631

SCHEME TITLE

BOXTED BRIDGE
ECC BRIDGE No. 59
OPTION STUDY

DRAWING TITLE

Option 6A - Replacement Half-through Deck on Existing Foundations and Substructure

DESIGNED	[redacted]	REVIEWED	APPROVED
DATE	DATE DEC 16	DATE DEC 16	DATE / DATE

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

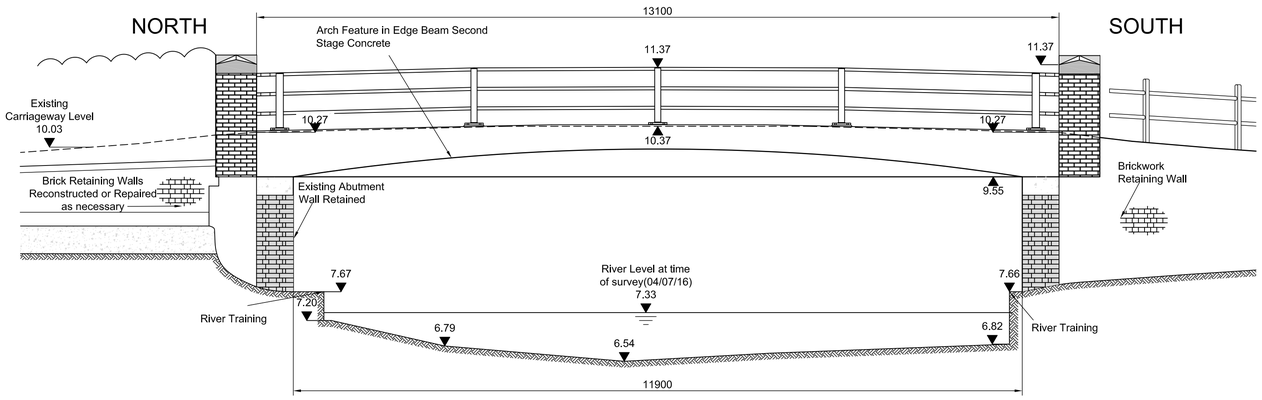
SCALE AT A1 (841X594mm)
As Shown

DRAWING No.
BR0059-01-1206

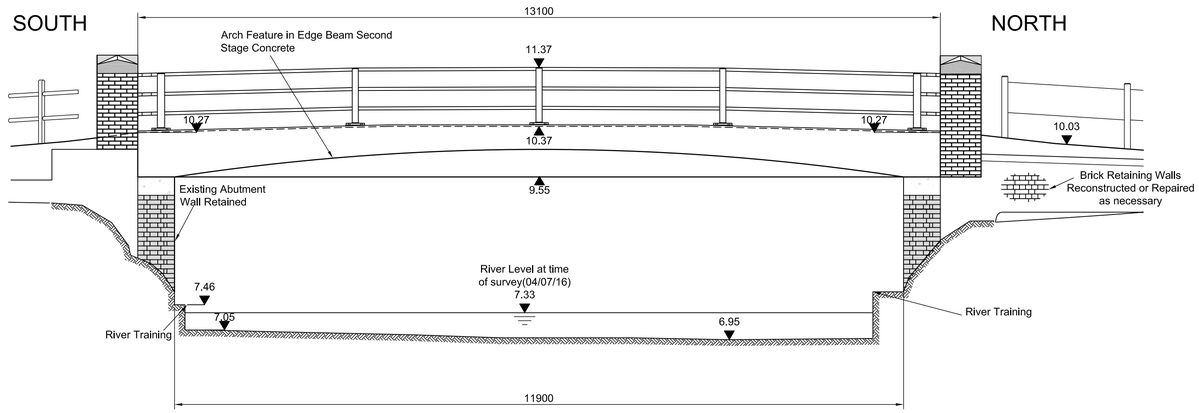
REV.
A

NOTES

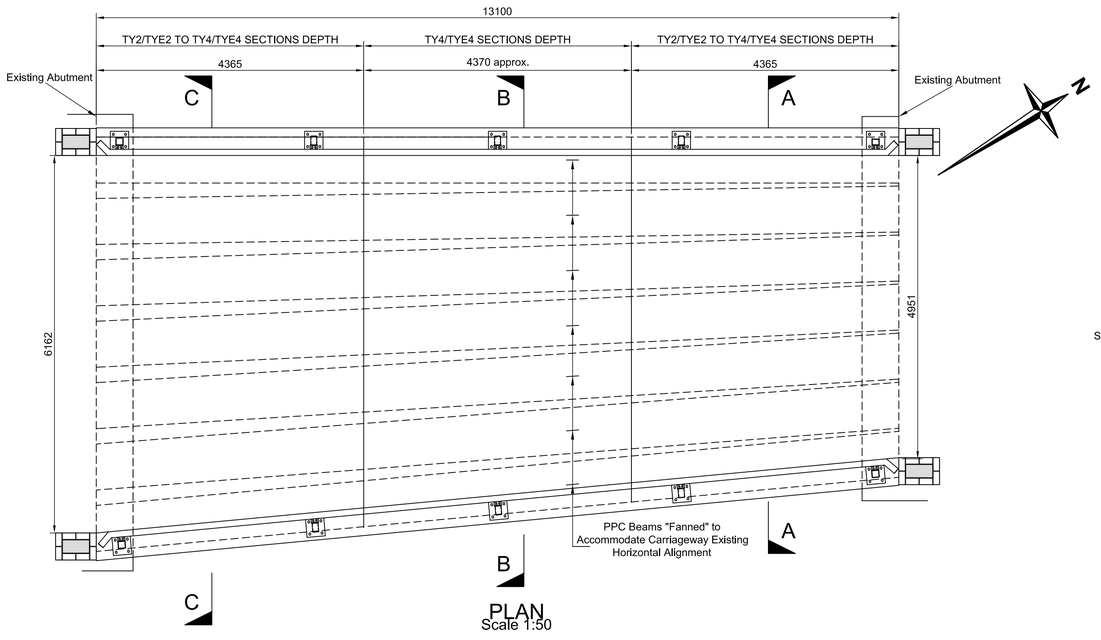
1. All dimensions are in millimetres unless noted otherwise.
2. All levels are in metres above Ordnance Datum.



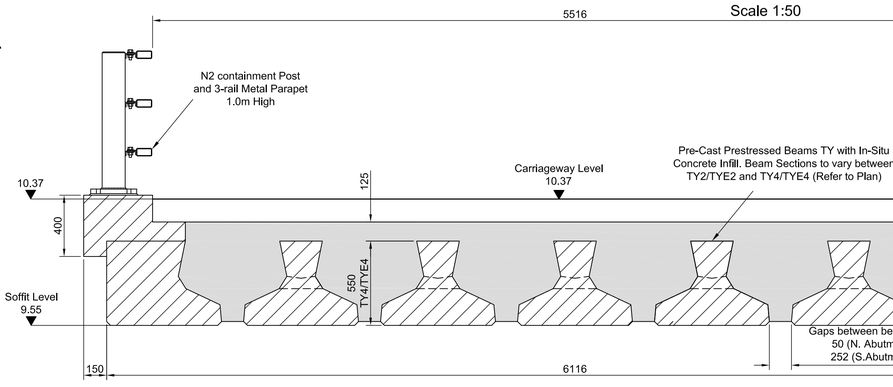
UPSTREAM (WEST) ELEVATION
WATERWAY AREA= 32.76 m²
Scale 1:50



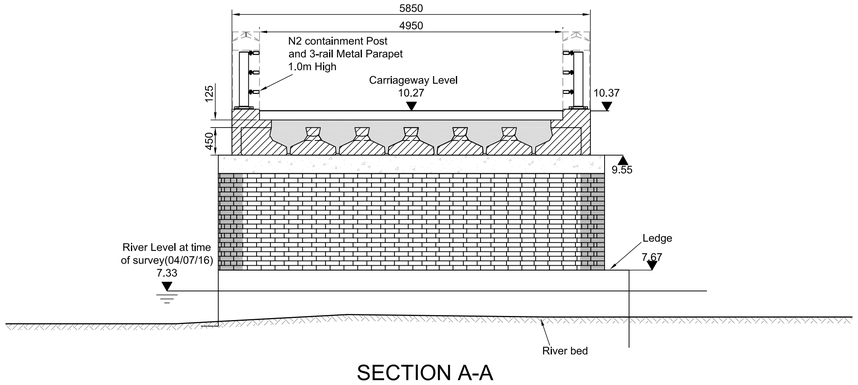
DOWNSTREAM (EAST) ELEVATION
WATERWAY AREA= 31.23 m²
Scale 1:50



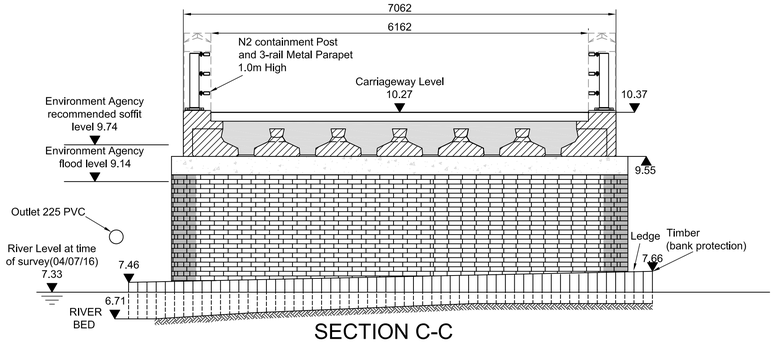
PLAN
Scale 1:50



SECTION B-B
Scale 1:20



SECTION A-A
Scale 1:50



SECTION C-C
Scale 1:50

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
A	08/18	River bed profile amended and other minor amendments	ST			

DRAWING STATUS

PRELIMNARY FOR INFORMATION

RINGWAY JACOBS integrated expertise

Essex County Council

Mark Rowe, Service Director, Highways
County Hall A2 Annexe, Chelmsford, CM1 1QH
Tel: 0845 6037631

SCHEME TITLE

BOXTED BRIDGE
ECC BRIDGE No. 059
OPTION STUDY

DRAWING TITLE

Option 6B - Replacement 'Slab' Type Deck on Existing Foundations and Substructure

DESIGNED	[redacted]			
DATE	DATE DEC 15	DATE SEP 16	DATE SEP 16	DATE SEP 16

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841X594mm)
As Shown

DRAWING No.
BR0059-01-1203

REV.
A

[redacted]

N

Mill Pond

Wick Road

BOXTED BRIDGE
ECC No. 59

SUFFOLK

Boxted Mill

River Stour

THL
+ 9.29

THL
+ 9.22

Island
Cottage

Island Cottage
Garage

ESSEX

Lower Farm Road

Mill House Bridge
ECC No. 371

Island Bridge
ECC No. 372

Sky Hall Hill

SITE PLAN

NOTES

1. This drawing is to be read in conjunction with drawing BR0059-01-1208.
2. This drawing is indicative only and subject to detailed design, safety, audit/review, planning etc.

LEGEND

- Existing Bridge
- New Widened Bridge
- Swept Vehicle Path Envelope
- Private Land Required to Accommodate Highway and Junction 'Improvements'

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd

DRAWING STATUS

PRELIMINARY FOR INFORMATION

Essex Highways

Essex Highways,
Seax House, 2nd Floor, Victoria Road South,
Chelmsford, CM1 1QH - Tel: 0345 6037631

SCHEME TITLE

BOXTED BRIDGE
ECC BRIDGE No. 059
OTPION STUDY

DRAWING TITLE

OPTION 7B - FULL BRIDGE RECONSTRUCTION ON WIDENED FOOTPRINT INCORPORATING HIGHWAY ALIGNMENT AND JUNCTION 'IMPROVEMENTS' - SITE PLAN

DESIGNED	DRAWN	CHECKED	REVIEWED	APPROVED
[redacted]				
DATE	DATE	DATE	DATE	DATE
Sep 18	Sep 18			

DRAWING UNITS U.N.O.

SCALE AT A1 (841X594mm)
1:200

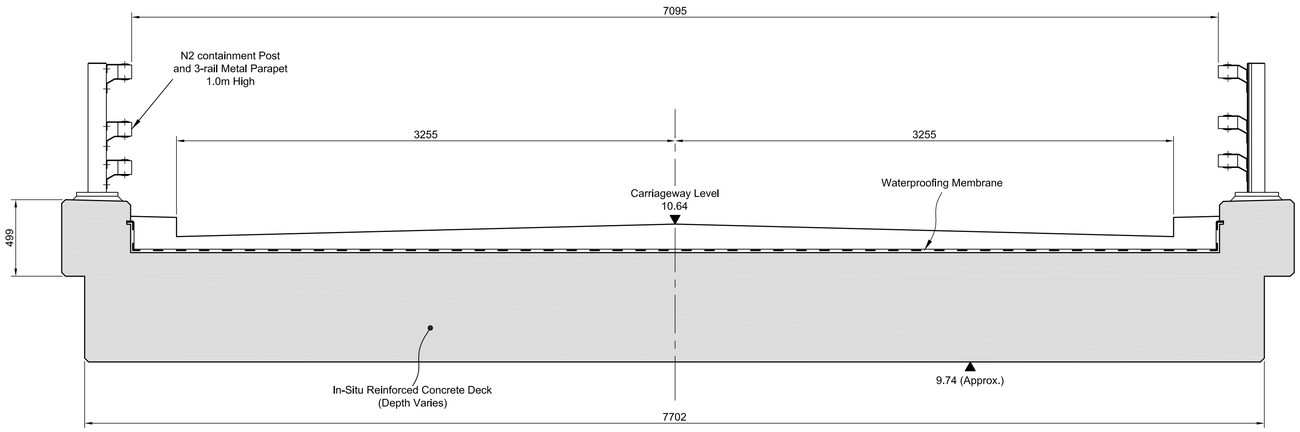
DRAWING No.
BR0059-01-1207

REV.
-

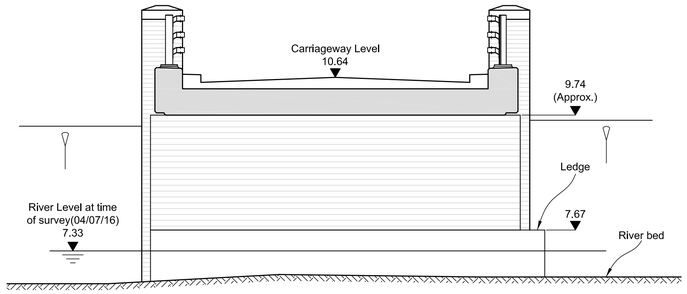
RINGWAY JACOBS
integrated expertise

Essex County Council

[redacted]



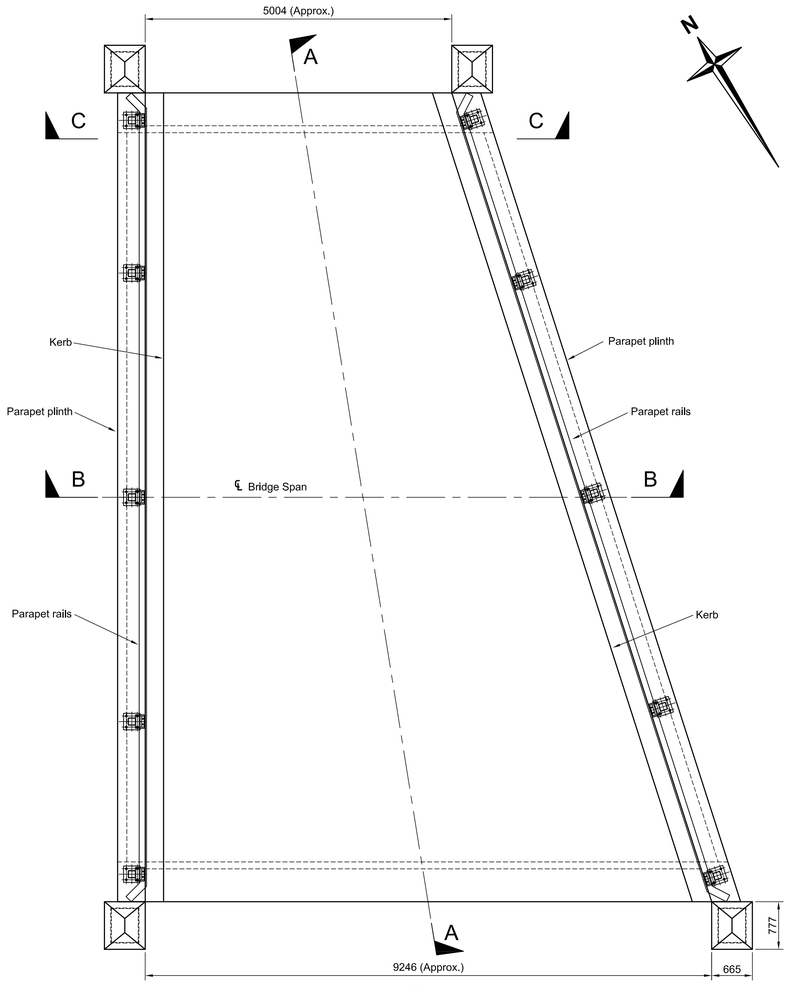
SECTION B-B
Scale 1:20



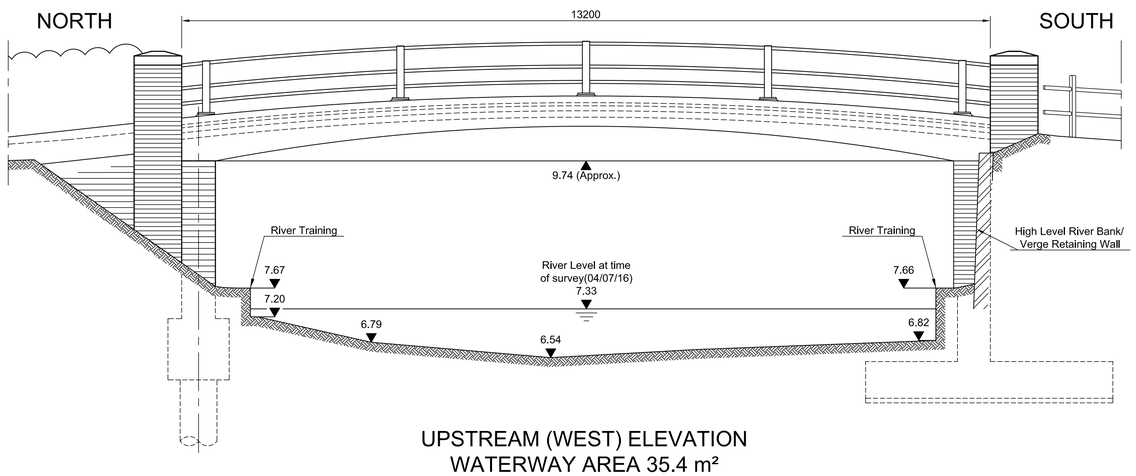
SECTION C-C
Scale 1:50

NOTES

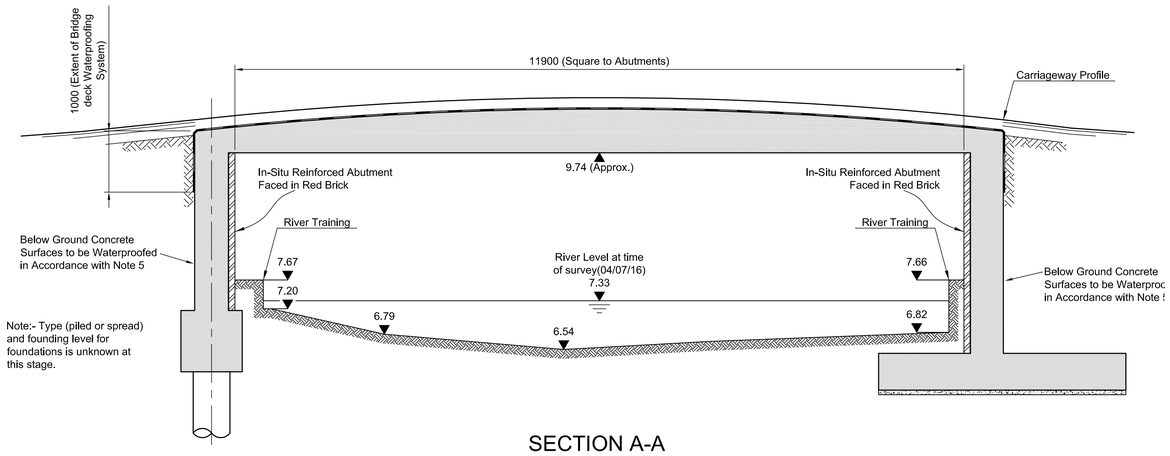
1. All dimensions are in millimetres unless otherwise stated.
2. All levels are in metres above Ordnance Survey Datum.
3. This drawing is to be read in conjunction with drawing BR0059-01-1207.
4. Brick-tie channels (self anchoring or plain back with welded anchors) in Grade 1.4301 stainless steel of nominal with 28mm and 100mm long to be cast in at 900mm centres horizontally and 300mm verticaly and staggered. Brick ties to be Grade 1.4031 stainless steel x 2.0mm thick with a projection of 75mm.
5. All buried concrete surfaces, unless protected by the deck waterproofing system, shall be painted with a primer and two coats rubberised bitumen emulsion.
6. Form of Foundations and Founding Levels are Dependent on Geotechnical Investigation/Testing and any Existing Obstructions.



Plan
Scale 1:50



UPSTREAM (WEST) ELEVATION
WATERWAY AREA 35.4 m²
Scale 1:50



SECTION A-A
Scale 1:50

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd

DRAWING STATUS

PRELIMINARY FOR INFORMATION

Essex Highways

Essex Highways,
Seax House, 2nd Floor, Victoria Road South,
Chelmsford, CM1 1QH - Tel: 0345 6037631

SCHEME TITLE

BOXTED BRIDGE
ECC BRIDGE No. 059
OTPION STUDY

DRAWING TITLE

OPTION 7B - FULL BRIDGE RECONSTRUCTION on WIDENED FOOTPRINT INCORPORATING HIGHWAY ALIGNMENT and JUNCTION 'IMPROVEMENTS' - BRIDGE PLAN and SECTIONS

[redacted]		CHECKED	REVIEWED	APPROVED
DATE	DATE	DATE	DATE	DATE
Sep 18	Sep 18			

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841X594mm)
As Shown

DRAWING No.
BR0059-01-1208

REV.
-

RINGWAY JACOBS integrated expertise

Essex County Council