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DISCLAIMER

This document has been prepared solely as a feasibility study of the restoration of the Louth Navigation canal for Groundwork Lincolnshire. Faber Maunsell accept no responsibility or liability for any use which is made of this document other than by the Client and their partners as listed in Section 1.0 of the report for the purposes for which it was originally commissioned and prepared.

Nomenclature

AINA	Association of Inland Navigation Authorities
AONB	Area of Outstanding Natural Beauty
BMIF	British Marine Industries Federation
BW	British Waterways
DETR	Department of Environment, Transport and the Regions
EMMLAC	East Midlands Museums, Libraries and Archive Council
FTE	Full Time Equivalent
HMYC	Humber Mouth Yacht Club
IWAAC	Inland Waterways Amenity Advisory Council
Km	Kilometres
LCC	Lincolnshire County Council
LNT	Louth Navigation Trust
m.	Metres
mAOD	Metres Above Ordnance Datum
MOD	Ministry of Defence
No.	Number
NNR	National Nature Reserve
RSPB	Royal Society for the Protection of Birds
RYA	Royal Yachting Association
SL	Soffit level
SW	Surface Water
WWTW	Waste Water Treatment Works

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Executive Summary

Introduction

- E.1 The Louth Navigation was constructed between 1765 and 1770. The Navigation extends a distance of 11.75miles (18.9km) from the Humber estuary at Tetney Haven to Riverhead in Louth. Extremely successful in its heyday, the Navigation quickly became Louth's economic engine. Like many rural canals, the Navigation gradually fell into decline and disrepair towards the end of the 19th century as roads and railways were developed. The Navigation eventually closed in 1924 when the locks, together with the Riverhead area, fell into dereliction and decay.
- E.2 In September 2004 Groundwork Lincolnshire on behalf of a group of public and private partners¹ commissioned Bullen Consultants (who became Faber Maunsell following a merger of the two companies on 1 April 2005) to carry out a study into the feasibility of restoring the Louth Navigation, generally known as the Louth Canal.

Scope of Study

- E.3 The scope of the study included the following elements:
- Investigate practical, economic and environmental options for restoring navigation along the Louth Canal.
 - Review river flows, both low flows and high flows.
 - Estimate the cost of restoring the Louth Navigation.
 - Undertake an environmental scoping study, to include a consultation exercise to obtain currently available baseline information and a review of the baseline information to determine constraints on restoration.
 - Undertake an economic impact assessment to assess the benefits of restoration in terms of additional income attracted to the area by user visits.

Technical Issues

- E.4 The proposed dimensions of the restored Navigation, as listed in the study brief, are based on the original Navigation dimensions and allow for the use of the Navigation by seagoing craft. The Navigation would be such that crafts with maximum dimensions of length 22m, beam 4.6m and draught 1.4m would be able to use the canal once navigation is restored.
- E.5 The restored Navigation would have a minimum bed width of 7.5m where practicable, with minimum headroom of 3.0m (measured to retained water level). The original eight locks (six currently remain) would be restored or reconstructed to provide a typical lock pen width of 4.65m, typical length of 27m and sill depth of 1.6m (below retained water level). One of the locks would bypass the Anglian Water tilting weir located downstream of Tetney Lock.

¹ The feasibility study was funded by a partnership between Louth Navigation Trust, Lincolnshire County Council, Louth Town Council, East Lindsey District Council, Anglian Water and Inland Waterways Association.

- E.6 Of the nine road bridges and six foot bridges along the canal, seven of the road bridges and three of the foot bridges would need to be raised to provide the required headroom for boats, based on the proposed retained water levels. In some locations swing bridges could be considered. A new sea lock though the sea defences at Tetney Haven would need to be constructed. The sea lock would require a small pumping station to pump saline water back to Tetney Haven.
- E.7 A new automated water level control sluice would be required adjacent to each lock so as not to increase flood risk. Increased retained water levels could increase the volume of pumping at adjacent land drainage pumping stations unless the Navigation is dredged deeper to retain existing water levels along the downstream length of the Canal. This could result in the requirement to lower some of the culverts which pass under the Canal.
- E.8 Due to increased water levels along the upper reach of the canal a land drainage pumping station and reinstatement of Alvingham lower culvert (inverted syphon) is required at Alvingham. A pumping station is also required at Louth Waste Water Treatment Works so final effluent flows can continue to discharge to the Navigation.
- E.9 A 36" crude oil transfer pipeline crosses the tidal channel at Tetney Haven and would need to be lowered below bed level to allow access by boats up the channel to the Louth Navigation.
- E.10 The River Lud flows into the head of the Louth Canal. Water from the river is currently used for a variety of purposes, including public water supply, spray irrigation and ecological compensation flows. Consideration of the water supply has determined that for the majority of the year, supply from the River Lud, which in the past has been diverted down the canal, would appear adequate for the foreseeable usage. However, at times of maximum summer usage the level of the pounds principally between Top Lock and Alvingham Lock could drop during the day due to usage of the locks when demand is higher than supply. The level of the pounds would replenish during the night when demand would be at a minimum.

Environmental Issues

- E.11 The key environmental constraints identified as part of the scoping study that are likely to require further consideration as part of any future Environmental Impact Assessment are outlined below:
- People, property, land or existing activities that are located or take place adjacent to or within the environs of the existing Navigation.
 - Any existing recreational or amenity activity that takes place within the immediate environs of the Navigation.
 - Flood risk management structures present along the navigation and the canal's ability to function as the primary drainage channel in this area.
 - Statutory designated and non-statutory designated sites associated with the Navigation.
 - The presence of protected species and habitats associated with the navigation e.g. bats, water vole.
 - The existing physical, chemical and biological status of the Navigation (e.g. habitats and wildlife diversity) that has been gradually reverting back to a more semi-natural ecosystem since the Navigation closed.
 - The nature of the existing rural environment e.g. quiet, low pollution levels etc that may be sensitive to development pressure.
 - Increased pressure on existing water resources within the catchment.
 - Existing infrastructure associated with the Navigation e.g. bridges, locks.
 - Existing services and utilities associated with the Navigation.
 - Designated assets with historical value associated with the Navigation e.g. lock structures.
 - Potential for contaminated land associated with the Navigation itself or its environs.

Key Environmental Opportunities

- E.12 The key environmental opportunities identified as part of the scoping study that are likely to require further consideration as part of any future Environmental Impact Assessment are outlined below:
- The potential to provide a major amenity asset and significantly improve access, recreation and amenity facilities along the navigation corridor and its associated environs.
 - The potential to increase the numbers of tourists who visit this part of Lincolnshire providing a boost to the local economy.
 - The potential to provide a significant number of permanent jobs within this area of Lincolnshire.
 - The potential for local businesses and farmers to diversify their activities and contribute towards the regeneration of this area.
 - There would be an opportunity to enhance and develop the canal and its environs as a wildlife corridor throughout its length including the restoration and / or creation of new habitats e.g. the adjacent channel of the River Lud, off-line wetlands, scrapes and ponds, fish passes etc with a view to maintaining and possibly increasing local biodiversity.
 - Restoration of the Navigation may provide opportunities to contribute to the overall restoration of a historic landscape e.g. enhance the character of district type landscapes.
 - Restoration of important historic structures such as the barrel shaped locks is likely to be incorporated into any restoration proposal for the Navigation.

Environmental Recommendations

- E.13 To ensure that the features of the existing environment of the Navigation and its environs are fully understood and that environmental impacts associated with the proposed restoration can be robustly appraised in the future, it is recommended that appropriate detailed surveys and desk based assessments are carried out at the start of the Environmental Impact Assessment.

Costs

- E.14 The outline budget cost for restoring the Navigation is estimated at £24.7million. The figure has been based on outline estimate of works and costs from recent tenders or price databases. The figure includes 15% for professional fees and a 20% contingency to cover potential risks.

Economics

- E.15 The study determined that the restored Navigation would provide a significant boost to tourism.
- E.16 The project would be a catalyst to attract new investment into the area, to regenerate the area and to boost the local economy.
- E.17 It is anticipated that as a result of the restoration of navigation on the Louth Canal and its development as a major recreational and tourism destination the current estimated annual spending associated with recreational and tourism use of the canal of around £1.1 million/annum would increase to more than £4.9 million/annum.
- E.18 While this estimate is a useful guide, the amount of the increase will perhaps depend upon the creativity and extent of the marketing. There are many opportunities that may be developed alongside both the key recreational activities and existing marketing strategies. For example:
- A heritage trail along the canal (especially between Louth and Alvingham – a reasonable day's walk) could incorporate the industrial heritage of the waterway, the heritage of Louth, the twin medieval churches at Alvingham and the remains of Louth Abbey.
 - Themed wildlife walks could attract visitors along the length of the canal, as well as to the Nature Reserve at Tetney.
 - The 'Louth Art Trail' might be extended along the canal.

- The on-going 'Taste of Lincolnshire' marketing campaign could be developed to incorporate pubs along the canal (e.g. at Louth and Tetney) and the shops in Louth. It maybe possible to create a series of 'gastronomic walks' along stretches of the canal from the pubs to the many shops in Louth already associated with the 'Taste of Lincolnshire' scheme.
- E.19 It should be noted that none of these environmentally and economically sustainable opportunities rely on the canal to be fully navigable from Louth to the coast. Such informal recreational use will account for much of the increased economic activity. Spending by boating and canoeing participants will amount to under £500,000 per annum, or around 4% of the total.
- E.20 It is important to note that this level of increased activity will only be achieved through the implementation of a well-resourced and targeted marketing campaign that sells the Louth Canal and its associated heritage assets, including the historic town of Louth and a new marina at Tetney Lock, as an attractive destination. The canal would need to be well integrated into current destination marketing strategies and this is not the case at present.
- E.21 The main benefits of increased investment in visitor facilities at Tetney Lock will be to raise the area's profile as a destination for leisure day trips. The existing appeal of the coastline and its importance as a location for bird watching (particularly of migrant passerines and for waders and wildfowl) will only be increased once the area receives improved tourist facilities.
- E.22 The following points provide a summary of the benefits that the proposed redevelopment of the Louth Canal would provide. Redevelopment will:
- Support more than 111 new jobs in the local area.
 - Support numerous local planning strategies and policy aims, including those related to recreation, the community, economy, housing and transport.
 - Attract more tourists to the area.
 - Provide new or improved opportunities for outdoor recreation, such as sailing, canoeing, walking and cycling, i.e. opportunities for 'healthy living'.
 - Boost the local economy and commercial opportunities at various points along the canal. Primarily, investment in sailing infrastructure and other businesses will provide new employment. Increased tourism will also support a wider range of existing businesses.
 - Provide an attractive area in Louth for new housing and improving the environment of existing houses.
 - Encourage the improvement and/or maintenance of the natural environment.
 - Encourage the conservation of the built heritage, including the canal and other sites along its route.
 - Provide numerous opportunities for the development of social inclusion agendas and community participation.

The Way Forward

- E.23 An outline master plan has been proposed which involves a variety of small and large projects over the short, medium and long term.
- E.24 Once implemented the plan should be monitored and updated as works progress.
- E.25 Major funding partners could include:
- East Midlands Regional Assembly.
 - The Lottery Heritage Fund.
 - Environment Agency/British Waterways.
 - Central Government.
 - European Union.

Conclusions

- E.26 The findings of this initial study demonstrate the viability of the restoration of the Louth Navigation. There are a number of identified technical and environmental issues which will need to be overcome in order to restore navigation. From the information known at this time overcoming these issues would appear feasible.
- E.27 The Navigation would increase leisure activities like walking and fishing. The study found that the restoration of the Louth Navigation could provide social, economic and environmental benefits to an area in need of diversification, creating up to 111 permanent jobs and bringing in an extra £3.8million/annum into the local economy each year.
- E.28 There is the potential for a range of adverse impacts, some of which may be significant. However, as many of these issues have been identified at this early stage it is likely that environmental risks associated with the restoration of the Navigation can either be avoided, mitigated, or compensated for during future design and implementation of improvement works. In addition to this there are a range of exciting opportunities to enhance the existing Canal and its environs as a wildlife corridor throughout its length.
- E.29 The estimated implementation capital cost is £24.7million.

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1 Introduction

Objectives of the Study

- 1.1 The objectives of Groundwork Lincolnshire's study brief dated 4 August 2004 were as follows:
- Review of the principal difficulties to be faced in restoring navigation along the Louth Canal from the Tetney Haven on the Humber Estuary to Louth.
 - Consider the best means and sequence of restoring or rebuilding the locks and bridges and of undertaking dredging and other works over the length of the Navigation.
 - Assess the benefits of restoration to the local community, as well as regionally and nationally.
 - Identify the potential economic and employment benefits accruing from restoration.
 - Investigate the environmental impacts of restoration.
 - Estimate the cost of the proposed engineering works.
 - Identify opportunities for increasing public access to, and engagement with, the canal and its associated heritage, e.g. the possibility of circular walkways, cycleways, access for small boats during restoration and the need to comply with the Disability Discrimination Act.

Scope of the Study

- 1.2 To achieve the study objectives the scope of the study was identified in the study brief as stated below:
- Investigate dredging the canal to its original profile and identify alternative practical, economic, environmental options, including maintenance of the existing water level between Outfen Lock and Tetney Lock.
 - Review of river flows, both low flows and high flows.
 - Estimate the cost of restoring the Louth Navigation.
 - Undertake an environmental scoping study to include a consultation exercise to obtain currently available baseline information and a review of the baseline information to determine constraints.
 - Undertake an economic impact assessment to assess the benefits of restoration in terms of additional income attracted to the area by user visits.

- 1.3 Following a tender submission in March 2003 Bullen Consultants Limited (who following a merger on the 1st April 2005 are now Faber Maunsell) were appointed on 20 September 2004 to undertake the Feasibility Study for the Restoration of the Louth Navigation. PLB Consulting Ltd was appointed to undertake the economic impact assessment.

Methodology

- 1.4 To achieve the study objectives Faber Maunsell together with PLB Consulting Ltd have undertaken the following activities:
- Review of historic documentation and plans.
 - Survey / inspection.
 - Definition of possible engineering works.
 - Estimation of costs.
 - Environmental scoping, including consultation.

- Economic Impact Assessment.

Feasibility Study Funding Partners

1.5

The following public and private organisation have funded the feasibility study for the restoration of the Louth Navigation:

Louth Navigation
Trust



Louth Town
Council

Louth Town Council

Lincolnshire
County Council

**LINCOLNSHIRE
COUNTY COUNCIL**

Inland Waterways
Association



East Lindsey
District Council



Anglian Water

anglianwater

2 Background

History of the Louth Navigation

- 2.1 The Louth Navigation was constructed between 1765 and 1770. The Navigation extends a distance of 11.75miles (18.9km) from the Humber estuary at Tetney Haven to Riverhead in Louth. Designed by John Grundy the Louth Navigation opened in 1770 as a means of promoting trade by moving goods by water instead of along primitive highway roads. Many of the highways, which were little better than tracks, became impassable during the winter months.
- 2.2 Extremely successful in its heyday, the Navigation quickly became Louth's economic engine. The Navigation was designed to take seagoing vessels capable of carrying cargoes of up to 120tons. These craft carried a diversity of goods, mainly involving the export of wool and corn and the import of coal and timber.
- 2.3 Various craft used the Navigation (generally known as the canal) including Humber keels and sloops that could carry cargoes of between 60 and 120tons. These craft traded on many inland navigable rivers and canals and also sailed to many east coast ports and London. Craft built in Louth were 15ft 0ins (4.57m) beam and 74ft 0ins (22.00m) length.
- 2.4 The canal channel was generally cut for two craft to pass side by side, i.e. 30ft 0ins (9.14m) width, with a minimum depth of 5ft 4ins (1.63m). Riverhead, the canal terminus, was constructed with a minimum depth of 6ft 6ins (1.98m) and 66ft 6ins (20.30m) width to allow boats to moor at the wharfs along each side of the canal basin at Riverhead.
- 2.5 Along the original canal there were eight locks used to overcome the approximate 50ft (15.2m)² differential in levels. Of these eight locks five were of an unusual design, having barrel shaped walls as opposed to straight sided walls. Currently, six locks remain in various stages of dilapidation, five of which are listed. The locks are generally 15ft 3ins (4.65m) minimum width, with length varying from 85ft 11ins (26.20m) at Willows Lock to 91ft 0ins (27.70m) at Tetney Lock. Rises at the original locks varied from 5ft 3ins (1.60m) at Salterfen Lock to 7ft 5ins (2.26m) at Outfen Lock².
- 2.6 The Navigation was originally supplied with water from the River Lud via a culvert at Riverhead (see Photograph 2.1). The Lud rises in the chalk of the Lincolnshire Wolds. Today the River Lud has been diverted down the Canal and most of the river flow passes along the canal channel. The original course of the river continues to run in parallel over part of the canal length and is supplied with a compensation flow from the Canal for ecological purposes.

² A description of the Locks & Bridges on the canal from Tetney to Louth, Padley, 1828



Photograph 2.1 - Inlet culvert from River Lud to Louth Canal at Riverhead (now abandoned)

- 2.7 Like many rural canals, the Navigation gradually fell into decline and disrepair towards the end of the 19th century as highways were improved and railways were developed. Its demise began when the Great Northern Railway took over the lease of the Navigation in 1846 and by increasing tolls, diverted goods onto the railway. The Navigation was seriously damaged in the 1920 flood and eventually closed in 1924 when the locks, together with the Riverhead area, fell into dereliction and decay.

Description of the Louth Navigation

- 2.8 This study covers the 18.9km of canal from the Riverhead (see Photograph 2.2) in Louth to Tetney Haven on the Humber Estuary and is situated in the heart of Lincolnshire. The extent and location of the canal is shown in Figure 1.



Photograph 2.2 - Louth Canal - Riverhead

- 2.9 The canal is a pleasant rural canal incorporating along its length historical structures, such as canal warehouses, in addition to the working canal structures, e.g. locks with their unusual barrel shaped wall design. Historic churches and other structures, e.g. watermills, are also located along the canal length.

- 2.10 The Louth Navigation is currently un-navigable. The lock gates have been removed. The canal is currently silted up, overgrown and in places obstructed by road crossings and other structures. The canal currently incorporates the following structures:
- 8 locks (6 locks remain in various stages of dilapidation).
 - 2 farm accommodation bridges.
 - 7 road bridges.
 - 6 footbridges.
 - 60 service crossings including a 36inch crude oil pipeline (14 are contained within bridge decks, 17 pass beneath the canal and 29 pass over the canal).
 - 2 tilting weir structures (one of which is on the site of an original lock).
 - 1 tidal outfall comprising two parallel sets of pointing doors (see Photograph 2.3).



Photograph 2.3 - Tidal outfall to Tetney Haven

- 2.11 As well as a recreational resource and land drainage flood relief channel the canal also serves a water resource function. Water originating from the River Lud, and the Waithe Beck, is pumped to Covenham Reservoir from the lower reaches of the canal near Fire Beacon Bridge. A tilting weir at Tetney Lock, downstream of the confluence of the Waithe Beck and the canal, minimises the risk of salt water entering the canal via the tidal outfall being drawn upstream to the reservoir. This is achieved by maintaining a differential head between upstream and downstream water levels. The weir operates automatically to maintain a level of 0.4 to 0.45m (assumed to be Above Ordnance Datum/ Newlyn) during the summer months and between 0.15 and 0.2m during the winter months.
- 2.12 Flows in the Louth Canal will not support peak summer abstraction at Covenham Reservoir during drought periods, hence the flows are augmented from the Great Eau via a pumping station at Cloves Bridge and a 11 km long 914mm diameter pipeline which discharges to the canal downstream of Outfen Lock.
- 2.13 The route of the canal passes through the parishes of Keddington, Alvingham, Covenham, Fulstow, North Cotes and Tetney Lock.

Louth Navigation Trust

- 2.14 The Louth Navigation Trust (LNT), a registered charity founded in 1986, has been involved with Groundwork Lincolnshire in the restoration of the Navigation Warehouse at the Riverhead where the Trust's office is now situated. The Trust is now concentrating on the restoration of the canal for navigation.

- 2.15 The Trust's main aims are as follows:
- Preserve, conserve and restore the canal and its associated buildings, including the locks.
 - Implement an economic, environmental and social study of the Riverhead area and canal corridor, as a preliminary to the phased restoration of the canal for navigation.
 - Promote the leisure and recreational use of the canal and towpath.
 - Promote the sustainable regeneration of the Riverhead area.
 - Provide and promote education for the community about the past history, heritage, and future plans, relative to the canal and its environs.
 - Identify, develop and implement environmental, social and economic projects along the canal corridor.
 - Maximise the use of the facilities at the Navigation Warehouse.

- 2.16 The Trust pursues a policy of actively involving the community and seeking to form partnerships with others, in the public and private sectors, to achieve its aims. The local community, East Lindsey District Council and Lincolnshire County Council and other interested organisations are supportive of the Trust's aims. The restoration of the Navigation features in the 'Lincolnshire Waterways Strategic Development Framework' July 2003. It is also included in the Action Plan of the Louth Market Town Initiative.

Restoration to Date

- 2.17 To date some local restoration work has been undertaken on the canal itself, largely using voluntary labour, to demonstrate the benefits of restoration to the community. Examples of this include:
- Replacement of the lock invert at Ticklepenny Lock.
 - Repointing of the walls at Ticklepenny Lock.
 - Maintenance of the towpath – clearance of vegetation.
 - Maintenance of the canal bed at Riverhead – clearance of litter.
 - Provision of signage along the route of the towpath.

Present Situation

- 2.18 The canal is currently used as a water resource, with water being abstracted from the canal into Covenham Reservoir (see Photograph 2.4), for use as agricultural spray irrigation and back into the River Lud as ecological compensation water, and as a drainage and flood relief channel. People use the towpath for walking. Members of the Witham & District Joint Anglers Federation fish the stretch between Austen Fen and Tetney Lock where existing water depths permit fishing.



Photograph 2.4 - Covenham Reservoir and intake channel from the Louth Canal

- 2.19 At the Riverhead in Louth the Navigation Warehouse, a Grade 2 listed building, built in the 1770's as a wool and corn store, was restored in 1998/9 to high environmental standards by a partnership between the LNT and Groundwork Lincolnshire.
- 2.20 The Navigation Warehouse (see Photograph 2.5) operates as an educational, social and meetings venue, with meeting rooms and Display Area on the ground floor. On the first and second floor there are offices currently occupied by a variety of public and private organisations.



Photograph 2.5 - Aerial View of Riverhead Louth and the Navigation Warehouse

- 2.21 The restored Navigation Warehouse has become, as planned, the catalyst for the regeneration of the Riverhead area. This has now led to the Louth Playgoers' building a £1.9 million theatre complex, some 250 metres from the warehouse. Developers have obtained Planning Permission for the erection of 66 housing units 300 metres from the warehouse. The Woolpack Public House, adjacent to the warehouse, has built a new extension to cope with increased trade. The 'sister' warehouse on the opposite bank of the canal has been converted into a prestigious dwelling (see Photograph 2.6) and two new blocks of flats have been erected 75 metres to the west of the warehouse.



**Photograph 2.6 - Warehouse converted to residential use
at Riverhead, Louth**

Landownership

- 2.22 The issue of landownership along the canal has become confused since the abandonment of the Navigation in 1924. It would appear that the Environment Agency own the canal from Keddington Lock to Tetney Haven. However, between Keddington and Riverhead the issue of landownership and the width of landownership remain unclear.
- 2.23 A developer who has been granted planning permission to develop land on the left bank at Riverhead for residential purposes confirmed during a recent public enquiry that the developer did not own the canal land.
- 2.24 The question of landownership is beyond the scope of this study. The Louth Navigation Trust is investigating this issue. This matter will have to be resolved before restoration can proceed.

3 The Canal Cut

Survey

- 3.1 The Environment Agency provided a copy of their September 2000 cross section survey drawings of the Louth Canal from Louth to Alvingham. The Environment Agency also supplied a copy of their August 2004 cross section survey drawings of the Louth Canal from Austen Fen Bridge to the Tetney Tilting Weir. The August 2004 survey did not include details of any of the structures located between Austen Fen Bridge and the Tetney Tilting Weir as the survey was only concerned with channel bed levels.
- 3.2 Lincolnshire County Council provided some levels on a few of the structures along the canal where as-constructed records were available.
- 3.3 To supplement the supplied cross section drawings a walkover inspection of the canal was undertaken between the 10th and 17th November 2004. The whole length of the canal was walked and notes made on obstructions, general condition of structures (locks, weirs, sluices, bridges, etc.), vegetation growth, inflow / outflows, and the condition of the channel, banks and boundary fences and stiles.
- 3.4 Once the extent of the existing survey data was established a survey team was employed to obtain levels at key locations where gaps existed in existing data. Survey benchmarks were established at key locations (i.e. structures). Details of this survey are included in Appendix A. The Ordnance Survey does not maintain benchmarks now. As the Surveys have been undertaken by various parties at different times potentially to different benchmarks or datums, it is recommended that a comprehensive survey of the whole canal using a Global Positioning System (GPS) is undertaken as part of any detailed design.

Description

- 3.5 Typically, the main channel is trapezoidal in shape. Although the channel has experienced some erosion and deposition, overall the channel is considered to be in a satisfactory condition with only a few minor slips noted during the walkover inspection (see Photograph 3.1).
- 3.6 The Canal is classified at a Main River.



Photograph 3.1 - Bank Slip downstream of Alvingham Canal Church Footbridge

- 3.7 Grass banks line the majority of the channel. Where wharfs existed, e.g. at Riverhead, the channel bank is lined by a brick retaining wall. The brickwork walls have been affected by tree roots and generally are in a poor state of repair. Some sections have recently been repaired. There are a number of walls which are leaning, e.g. Fire Beacon (see Photograph 3.2).



Photograph 3.2 - Leaning wall downstream of Fire Beacon Bridge

- 3.8 There are a number of trees within the canal banks, some of which overhang the main channel and would require cutting back as part of any restoration works (see Photograph 3.3). Principally, trees within the canal banks are located at the canal's upstream end around Riverhead & Keddington and upstream of Fire Beacon Bridge. Since the canal was abandoned the wharf running along the left bank between Riverhead and Top Lock has been partly infilled and planted over with trees. These would need to be removed as part of any restoration to provide a turning point and moorings.



Photograph 3.3 - Overhanging trees between Top Lock and Keddington Church Lock and erosion of bank toe

- 3.9 Within the Riverhead canal basin deposition of silt within the generally wider sections of the canal has led to the forming of mounds and reed beds within the channel bed.
- 3.10 During the walkover inspection, erosion of the channel bank toe, to various degrees, (see Photograph 3.4) was observed to have occurred at the following locations:

- Left bank between Keddington and Top Lock – affected length 100m.
- Right bank between Keddington and Top Lock – affected length 150m.
- Right bank upstream of Alvingham Lock Bridge – affected length 200m.
- Left bank upstream of Alvingham Church Canal Footbridge – affected length 100m.
- Right bank upstream of Alvingham Church Canal Footbridge – affected length 50m.
- Left bank downstream of Alvingham Church Canal Footbridge – affected length 10m.
- Right bank 370m downstream of Fulstow Bridge – affected length 10m.
- Left bank 380m downstream of Thoresby Bridge – affected length 50m.
- Left bank at New Delights – affected length 10m.
- Left bank upstream of Riverside Farm Access Bridge – affected length 30m.

3.11 A total length of 710m of toe erosion was noted during the walkover inspection. Some of the erosion has resulted in minor bank slippage.



Photograph 3.4 - Bank erosion downstream of Fulstow Footbridge

3.12 During the walkover inspection, erosion of the channel banks along a total length of 1,350m was observed to have occurred as a result of cattle drinking from the canal. This type of erosion had occurred at the following locations:

- Right bank New Delights – affected length 550m.
- Right bank from Tetney Lock Bridge to tidal outfall – affected length 800m.

3.13 During the walkover inspection a number of trees along the channel banks which had overhanging branches that could affect navigation and would require management/ pruning were noted at:

- Riverhead.
- Keddington.

3.14 A fish refuge is located downstream of Thoresby Bridge, adjacent to the main canal cut. It has not been confirmed if this is private or Environmental Agency controlled. The refuge consists of an offline lagoon approximately 0.33ha in plan area and is used by fish when the canal is in spate (see Photograph 3.5).



Photograph 3.5 - Fish Refuge area between Thoresby Bridge and New Delights

- 3.15 As well as the fish refuse there is an offline flood storage area between Thoresby Bridge and New Delights, which is used by the Environment Agency for flood risk management purposes.

Design Criteria

- 3.16 In developing proposals it is intended that the original appearance of the Navigation is retained or recreated, e.g. grassed banks with brick retaining walls for wharfs.
- 3.17 The channel should be dredged or desilted to provide the following standards (as stated in the study brief³):
- Maximum size of craft from tetney outfall to tetney lock - length 22m, beam 4.6m and draught 1.6m.
 - Maximum size of craft from tetney lock to Riverhead - length 22m, beam 4.6m and draught 1.4m.
 - Minimum bed width 7.5m (except at structures).
 - Width of locks as original or 4.65m.
 - Depth of lock as original or 1.68m.
 - Minimum depth of water over sills 1.6m (to allow use by boats with draught up to 1.4m).
 - Minimum depth of water over sea lock sill to be 1.9m (to allow the use by boats with draught up to 1.6m up to Tetney).
 - Headroom a minimum of 3.0m (above retained water level).
 - Access from Tetney Haven to the Navigation at high tide only.
- 3.18 Seepage from the navigation channel should be minimised.
- 3.19 The navigation channel should be stable in the long term and the design should take into account potential toe erosion.

³ Consultant's Brief for a Study of restoration of the Louth Navigation, Groundwork Lincolnshire, 21 July 2004.

Dredging

- 3.20 The Environment Agency dredges the lower reaches of the Louth Canal on a periodic basis, once every 10 years on average. Downstream of the tidal doors the tidal channel across the Haven is dredged by the Environment Agency, once every 5 years on average. The timing and amount of dredging depends on the level of deposition that has occurred within the intervening period. High summer flows assist in maintaining the channel with dredging tending to be needed as a result of low summer flows. Such work is currently undertaken when surveys show that the level of deposition could have a significant adverse affect on the level of flood risk along the canal. The dredging work is generally undertaken using draglines positioned on top of the channel banks.
- 3.21 Downstream of the tidal doors the channel across the Haven has in the past been dredged by the Environment Agency over a length of 1.5km, but the dredged reach length is normally only 600m. If the channel was continued to be maintained for low flows then the channel would have sufficient depth at high tide when access would be required for navigation purposes without the need for further dredging above the current levels of dredging.
- 3.22 In August 2004 the Environment Agency completed a survey of the bed between the Austen Fen Bridge and the Tetney Tilting Weir. Based on the results of this survey the Environment Agency has confirmed that it has no current plans to carry out any dredging works along the Louth Canal. The level of future dredging in Tetney Haven is currently being discussed between the Environment Agency and English Nature.
- 3.23 Disposal of excavated material can be problematic; some landowners adjacent to the canal maybe willing to accept the material for spreading on their land, with the appropriate recompense. In adjacent urban areas where space is limited and material cannot be disposed of on adjacent land or if the material is contaminated this may not be viable and material may need to be disposed of at a licensed tip.
- 3.24 From the available cross section drawings and using the indicative design retained water levels given in Table 4.1, the excavation volume upstream of the tidal doors at Tetney Lock to Riverhead to provide a navigation water depth of 1.6m is estimated as 135,000m³.
- 3.25 Details of dredging requirements to achieve the indicative design retained water levels given in Table 4.1 are given in Appendix B.
- 3.26 It should be noted that no channel survey is currently available for the reach between Alvingham and Austen Fen and so the above figures are based on an average of the volumes per metre run estimated upstream and downstream of the unsurveyed reach.
- 3.27 A significant 85% of the total excavation occurs between Fulstow Bridge and Outfen Lock due to the depth of dredging and the need to regrade adjacent channel banks (floodbanks) to achieve a design channel bed width of 7.5m. The installation of a lock between Fulstow Bridge and Outfen Lock could reduce the excavation volumes by raising the design retained water level. By raising water levels there could be significant impacts on land drainage outfalls and Anglian Water's Great Eau Water Transfer Pipeline which discharge to the Louth Canal along this reach. This option should be explored at detailed design stage.
- 3.28 Dredging/widening of the canal would tend to be on the left (west) bank of the Canal to avoid the high pressure Theddlethorpe – HOR Killingholme gas pipeline which runs parallel to the canal between Austen Fen and New Delights.
- 3.29 Tests will be required on the dredged material to ensure a suitable disposal route is identified in compliance with current waste regulations. This could have a significant impact on costs if material is classified as a waste and requires disposal at a tip licensed to accept such waste. In the costings (Section 10) it is assumed that 10% of material is disposed of at a local tip.
- 3.30 In widening the channel, adjacent floodbanks could need regrading to maintain their overall stability. This work could include the placement of material to the landward side of flood embankments. Adjacent drainage ditches may need to be relocated inland. Some land purchase maybe required for these works.

- 3.31 Increased retained water depths resulting from the restoration of the locks could reduce channel velocities and could result in an increase in deposition. Although this may not affect water levels, to maintain navigation depths there may be an increased need and cost of dredging along the Navigation.

Proposed Measures for Remedial Works to the Cut

- 3.32 The walkover inspection identified a number of areas where erosion has occurred. The erosion has probably occurred as a result of the current low water level and management arrangements. Once navigation is restored the location or extent of erosion could change. Navigational use by either moored boats or passing boats could increase the amount of erosion. Reduced channel velocities could lead to deposition as opposed to erosion. Works should be undertaken to control the risk of erosion. Once navigation is restored the location and extent of erosion should be monitored and remedial works undertaken where and when required. In addition to the identified lengths of current erosion, a contingency allowance of 500m of 'hard' and 500m of 'soft' erosion control measures is included within the scheme costings.
- 3.33 Appropriate strategies to control the rate of erosion should be implemented; e.g. boat speed limits imposed using canal bylaws and the provision of dedicated moorings at strategic locations along the route of the canal.
- 3.34 Any increase in retained water level could affect the rate of seepage to adjacent land. Discussions with representatives of Lindsey Marsh Drainage Board indicate that seepage is not a significant issue along the Louth Canal. This is borne out by the geology of the area that identifies mainly alluvium deposits and therefore seepage rates should be relatively low. Once navigation is restored the location and extent of any seepage should be monitored and remedial works undertaken where required. In this way resources can be targeted to locations where work is required.
- 3.35 Where remedial works are required three basic types of remedial work to the canal cut are proposed; complete relining, edge leakage control and erosion control. Within these categories there are a number of different methods. It is recognised that a hard edge to the canal gives little opportunity for environmental enhancement, so a number of soft edge protection details have also been provided.

Complete Re-lining

- 3.36 It is recommended that complete relining of the canal take place where there are principal canal structures at risk, e.g. major embankments. Although the use of complete relining techniques is not expected on the Louth Navigation due to the absence of any major embankments the techniques are listed below with brief comments for completeness.

Concrete Channel, Type R1

- 3.37 A concrete channel has the advantage of providing 95% leakage control; it has a long design life and has some flexibility of form. Care needs to be taken to ensure a good formation and this can require considerable excavation below the design formation level. Although concrete can be pumped for considerable distances, good access to the site is required. Maintenance is minimal and is generally confined to the joints between units. However, although some mitigation measures can be introduced, the finished appearance tends to be regular and stark. There is little possibility of introducing environmental enhancement.

Geomembrane Lining, Type R2

- 3.38 HDPE can be welded on site to provide a continuous, reasonably flexible, waterproof liner. As this is a specialised process, there is a requirement to employ only competent, proven firms for the works or invest in intensive training. The requirement for a firm formation is not as great as a concrete channel and this can reduce excavation. The access requirements to the site are also less onerous than for a concrete channel. The ability to cut and weld the liner to different shapes allows a more "natural" appearance to the finished canal and mitigation measures can be introduced for the edge details. This type of liner does require good protection from accidental damage.

Bentonite Lining, Type R3

- 3.39 Bentonite lining provides good leakage protection, although it is not as reliable as a Geomembrane. The skills required for its placement are not as great, as overlapping the material forms the joints. It is self-sealing to some extent, and small areas of incidental damage may self-seal. Consequently, the requirement for protection is not as great as with geomembranes.

Puddle Clay Lining, Type R4,

- 3.40 Puddle clay is the traditional method of waterproofing canals. The finished cut has a natural appearance but erosion control to the edges is required. There is considerable difficulty in obtaining suitable clay and it is probable that the material would have to be imported from considerable distances. Good site control of the methods used for placing the material is required, although there is no requirement for specialised machinery. This type of lining is useful for small areas and quick repairs.

Edge Leakage Control

- 3.41 Where seepage is a problem on one side of the canal, e.g. where the canal is built on sidelong ground or vermin damage has occurred, then leakage control could be required to one edge of the canal only.

Part Lining, Type L1

- 3.42 If the naturally occurring surface deposits under the canal are reasonably impermeable, then the side of the canal that has been built on embankment or is damaged could be lined. All the types R1 to R4 could be used, with modifications, provided that a good cut off can be provided in mid canal.

Sheet Piled Cut Off, Type L2

- 3.43 The intention of this method is to interrupt the drainage path by the driving of steel sheet piles. Detailed soils investigations would be required to ensure the suitability of the method.

Cut Off Trench, Type L3

- 3.44 This is a similar method to Type L2 but using a trench and filling with an impermeable material. Similar constraints operate for this method as Type L2. The impermeable material could be foamed concrete (unmodified), puddle clay, or some types of Geomembrane.

New Mass Retaining Wall, Type L4

- 3.45 A mass retaining wall would be made of concrete and would then be faced with brick to give a traditional appearance. It would be constructed in bays with the appropriate water bar between them. The depth of the wall would be dependent on the ground conditions. This type of construction would be considered in areas where there are numerous boat manoeuvres and a large frequency of mooring.

Erosion Protection

- 3.46 Where the canal is in cut and the natural ground is erodible, then erosion protection of the banks is required. This will reduce the amount of future dredging and maintain the line of the canal. If the type of protection is sloping, then the freeboard needs to be increased to give protection from the wash from the boats. Positive planting schemes will give additional protection and help break up the wash.

Sheet Piling on Canal Edge, Type E1

- 3.47 In the 1980s, this form of protection became widespread and British Waterways have invested in the required plant. It is an attractive method as their existing workforce is already skilled in this method of working and it can be carried out in remote areas from a workboat without draining the canal. However, it has little to recommend it as regards to appearance and stone gabions with coir roll should be considered to promote vegetation.

Sheet Piling on Canal Edge with Capping, Type E2

- 3.48 A concrete capping can be added to the sheet piles. This improves to the appearance of the piles but adds to the cost. Partial lowering of the water level is required during construction.

Coir Rolls, Type E3

- 3.49 Coir rolls provide an environmentally acceptable method of providing erosion control. However, their use previously is limited and the design life of the method is not known. This could have implications for future maintenance costs. The method is useful where the principal work proposed is dredging as any infilling can use the dredged material.

Gabion Mattress, Type E4

- 3.50 A gabion mattress is a wire mesh cage that is filled with a suitable sized stone. The voids between the stone allow for the dissipation of any waves. The voids below water level can be filled with soil and suitably planted.

Cattle Watering Areas, Type C1

- 3.51 Currently, erosion of the banks by cattle when gaining access to the canal for watering purposes is a problem, especially along the lower reaches of the canal. Dedicated watering areas should be identified to allow cattle access to the canal or cattle troughs.

Tidal Channel

- 3.52 For navigational safety purposes the tidal channel downstream of the tidal gates (see Photograph 3.6) would need to be periodically marked out. Currently, the Humber Yacht Club marks out the lower reach of the channel. Due to shifting sands the navigation channel is constantly in flux and the channel may need to be marked out a couple of times per year.



Photograph 3.6 - Tetney Haven tidal channel

- 3.53 Once navigation is restored, access to the canal from the Humber estuary would be limited to approximately 2 hours either side of high tide to ensure sufficient depth of water within the downstream tidal channel. This would also alleviate the requirement for additional dredging works above current levels to be undertaken along the downstream tidal channel.
- 3.54 It should be noted that as well as navigation, the canal also serves a drainage function. When unacceptable levels of silt accumulate in the tidal drainage channels it is normal operating practice to flush the channel. Tying back the tidal doors during a rising tide allows water upstream of the tidal doors, closing the gates at high tide retains the water. At low tide the water is released and the flush of water clears the channel of deposited silt. This practice should continue so long as navigation use is not affected or saline water is allowed to migrate upstream so as to affect the quality of water abstraction.

Moorings

- 3.55 Dedicated mooring opportunities need to be provided along the Navigation. Both short term and long-term moorings are required.
- 3.56 Photograph 3.7 shows an old navigation mooring which would require repair.



Photograph 3.7 - Derelict concrete landing stage/steps upstream of Austen Fen Bridge

- 3.57 Moorings should allow for flood flows. Boats should be allowed to rise and fall with the canal's fluctuating water levels.

Turning Heads

- 3.58 Dedicated turning heads need to be provided along the Navigation, notably at each end of the Navigation, e.g. at Tetney Lock and at Louth, and at intermediate locations.

Services

- 3.59 A pump washout, water point, toilets and shower block will need to be provided along the route of the Navigation. These services could be provided within a marina with associated boat maintenance facilities.

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4 Locks

History of the Locks

- 4.1 The original Navigation incorporated a total of eight locks. Six of the locks had distinctive barrel arch sided walls. The remaining two locks (Tetney Lock and Outfen Lock) had straight sided walls. It is presumed that James Grundy, the designer of the Louth Navigation, constructed the innovative barrel shaped locks to overcome the soil pressures encountered along the route of the Louth Navigation. The design appears to be unique to the Louth Navigation. Due to their unique design five of the Louth Navigation locks have been listed as Grade II structures. The listed locks are Keddington, Ticklepenny, Willows, Alvingham and Salterfen Locks.

Condition of the Locks

- 4.2 Of the original eight locks, two have now been demolished; three are in a very poor state of repair requiring total rebuild and three are in a reasonable state of repair and could be recoverable in part or in whole.
- 4.3 A description of each lock from the canal's downstream limit at Tetney Lock to the canal's upstream limit at Riverhead is given below:
- 4.4 **Tetney Lock** – This lock acted as the sea lock and allowed boat access from the Humber estuary to the Navigation and visa-versa. The original lock consisted of straight sided brick walls with stone copings. The lock has been totally demolished. The Tetney to North Cotes road bridge crosses the canal where the lock was once located. The modern road bridge of concrete construction replaced the original fixed timber bridge. The original lock had two sets of doors. One set for use by boats being raised by the lock and the other to protect against tidal inundation and to allow boats to enter the canal at high tide. When the tide came in the downstream doors were forced closed by the pressure of the rising tide. As the tide went out the doors would open due to the build up of water within the canal while the doors were tide-locked. Behind the sea doors were a set of draw doors, which controlled the level in the canal and could be raised to assist in scouring out the downstream tidal channel when silt had accumulated. A new sea lock is required at the tidal outfall sluice which ties into and maintains the tidal defences over the Navigation.
- 4.5 **Outfen Lock** – This lock consists of straight sided brick walls with stone copings (see Photograph 4.1). Currently, the lock is in a very poor condition. The left hand side of the downstream sill has completely collapsed, but the right hand side (towpath side) is the original structure though in rather a poor state of repair with signs of instability. This situation indicates that the existing bottom sill of the Outfen Lock is too high for present water levels, which with the removal of the Tetney Lock have reduced. A new lock should be constructed downstream of the existing lock thus allowing the original lock wall to be preserved as a mooring.



Photograph 4.1 - Outfen Lock – Note gates have been removed

- 4.6 **Alvingham Lock** – This lock consists of barrel arch sided brick walls with stone copings (see Photograph 4.2). The lock is in a reasonable condition. A modern fixed bridge of concrete construction has since replaced the original timber swing bridge located immediately upstream of the lock. Restoration of the existing chamber to navigation would require that road to be either raised, moved or a swing bridge installed. The Alvingham Mill Race is syphoned below the canal between the lock and the road bridge. This upper syphon is also a listed structure.



Photograph 4.2 - Alvingham Lock – Note gates have been removed

- 4.7 **Salterfen Lock** – This lock consists of barrel arch sided brick walls with stone copings (see Photograph 4.3). The lock is in a poor condition. A new lock is required.



Photograph 4.3 - Salterfen Lock – Note gates have been removed

4.8

Willows Lock – This lock, sometimes referred to as Carrotts Lock, consists of barrel arch sided brick walls with stone copings (see Photograph 4.4). The lock is in a reasonable condition except for the invert, which due to its timber beam construction has been subject to significant scour. The original invert timbers have decayed increasing the amount of scour. The walls are showing signs of leaning inwards. However, of all the locks along the Louth Canal, Willows Lock is the best remaining example of the unique barrel arch wall design and should be restored.



Photograph 4.4 - Willows Lock – Note gates have been removed

4.9

Ticklepenny Lock – This lock consists of barrel arch sided brick walls with stone copings (see Photograph 4.5) . The Louth Navigation Trust has previously replaced the timber floor of the lock to alleviate the on going deterioration of the lock that was threatening the stability of the lock walls. The lock is in a reasonable condition. A fairly well used local road crosses the centre of the lock chamber. A fixed concrete bridge has replaced the original timber swing bridge. Restoration of the existing chamber to navigation would require that road to be either raised or moved.



Photograph 4.5 - Ticklepenny Lock – Note gates have been removed

4.10

Keddington Church Lock – This lock consists of barrel arch sided brick walls with stone copings (see Photograph 4.6). The Environment Agency has placed stone filled gabions to support the lock's deteriorating brick walls. The lock is in a very poor condition and a new lock is required. A fairly well used local path crosses the centre of the lock chamber. A fixed metal footbridge has replaced the original timber swing bridge. Restoration of the existing chamber to navigation would require that bridge to be either raised or moved.



Photograph 4.6 - Keddington Church Lock – Note gates have been removed

4.11

Top Lock – The original barrel arch sided brick walls with stone coping lock has been totally demolished except for part of an abutment at the upstream end of the lock. A tilting gate sluice, operated by the Environment Agency for flood alleviation purposes is now located on the site of the Top Lock (see Photograph 4.7). The gate is lowered to alleviate the risk of flooding within Louth during periods of high flows. A new lock is required. The sluice structure would need to be relocated to the side of the new lock.



Photograph 4.7 - Environment Agency Louth Tilting Weir on site of old Top Lock

Principles of Repair

4.12 The guiding principle for the repairs is to leave serviceable structures fit for at least a further 25 years service without the need for any major works. In achieving this principle, the best use is to be made of existing structures and materials. Where new materials are required they should be of a common nature so that the finished structures are recognisable as locks from the Louth Navigation.

- 4.13 A completed lock will be expected to have:
- Fenders on both approaches.
 - Stop plank guides and sills in both approaches.
 - Structurally sound and stable walls.
 - Reasonably watertight and operable gates.
 - Common copings either from reclaimed stone copings or bull nosed bricks.
 - Paved quadrants to allow safe opening of the gates.
 - A serviceable by-wash (with an automated sluice for flood management purposes).
 - Fish pass (potentially).
 - Safety handrails, ladders, chains and signs.
 - Access ramps and stairs.
 - Bollards for mooring.

Methods of Repair

4.14 Due to the historic and listed nature of the locks, English Heritage will need to be fully consulted, and works agreed, prior to work proceeding. To date this consultation has not been undertaken.

- 4.15 A brief description of proposals is given below:
- The locks need to be de-watered from beyond the extent of the approach walls to allow detailed inspection and refurbishment works. This will require a fabric dam both upstream and downstream. The river flows would then need to be over-pumped or flumed through the lock. The work should be undertaken during summer low flow periods to minimise the risk of inundation.

- Inspection and repairs will be required to the approach walls, lock pen walls and inverts. From initial inspections it is likely that the upstream and downstream approaches will need to be substantially re-built.
- The lock chamber should be inspected and repair areas defined, including replacement of brickwork, timbers and ground anchors.
- Existing stone and bull nosed copings should not be disturbed unnecessarily, but where they are to be taken up for other repairs the opportunity should be taken to standardise their appearance at particular locks. This may mean removing part stone copings from one lock and replacing with bull nose bricks. The stone copings will then be stored to allow restoration of a full lock length at another lock. Deteriorated copings should be replaced.
- Quadrants should be replaced with brick pavements with upstands to provide heel grips.
- New lock doors and slackers will be required.
- The existing byweir and bywash channel should be fully inspected at the same time as the lock is de-watered. It is likely that the bywash channels will need to be completely re-built to cater for flood flows and in these instances pre-cast concrete units are cost effective and serviceable. In areas where repairs are possible the nature of the repair will be chosen to match the existing structure. The size of the bywashes may need to be increased for flood management purposes.
- New ladders, safety hand railing, chairs, paths and bollards will be required.

Access from the Coastline

- 4.16 Access to the Louth Navigation would be from the North Sea via the mouth of the Humber. A new sea lock would be required to allow access into the Navigation whilst also maintaining the tidal sea defences. The lock would be accessible during high tides. Typically there would be a 2 to 4 hour tidal window at high tide (i.e. 1 to 2 hours before and 1 to 2 hours after high tide). This period is similar to that available at Hull Marina located further up the Humber Estuary.

Proposed Locks

- 4.17 The following lock works are proposed:
- Sea Lock – new lock through existing sea defences.
 - Tetney Lock – new lock adjacent to Tilting Weir.
 - Outfen Lock – new lock downstream of existing.
 - Alvingham Lock – refurbished lock.
 - Salterfen Lock – new lock to replace existing.
 - Willows Lock – refurbished lock.
 - Ticklepenny Lock – refurbished lock.
 - Keddington Church Lock – new lock to replace existing.
 - Top Lock – new lock on site of existing tilting weir.
- 4.18 The impact of new locks at Salterfen and Keddington should be addressed with English Heritage and East Lindsey District Council (ELDC) to confirm the acceptability of the proposal.
- 4.19 The Sea Lock would be used at high tide and therefore would fill with tidal salt water. Discharge of this water or leakage through the tidal doors into the upstream Louth Navigation could increase the salinity of the upstream water. To overcome this issue the lock pen should incorporate pumps to allow salt water to be discharged back into the tidal estuary. An alternative solution could be a side pond that would be discharged by gravity to the Haven at low tide. In addition the Anglian Water tilting weir at Tetney Lock should be retained to minimise the risk of saline water being drawn further upstream. Some land purchase could be required to accommodate the works, e.g. new lock adjacent to tilting weir downstream of Tetney Lock.

- 4.20 The following issues in relation to the locks will affect the usage of the Navigation:
- The tidal window will restrict opening hours of the sea lock.
 - Access and egress to the Navigation will require a tidal passage that only experience users should attempt.
 - During flood conditions the locks may need to be closed for short periods from a safety point of view.

Indicative Proposed Sill Levels

- 4.21 Indicative proposed sill levels and hence pound levels at each proposed lock are given in Table 4.1. The levels are generally based on the surveyed sill level of the existing locks in order to retain the structure of the listed locks and to assist in restoring the character of the old Navigation. If changes to the sill levels of the listed locks were allowed then the sill levels could be changed to balance dredging works against the impacts of raised water levels and raised bridges.
- 4.22 The sill level of the proposed Tetney Lock should be set so as to maintain the existing water level at Tetney Lock of about 0.3m (assumed to be mAOD) provided by the Anglian Water tilting weir at Tetney Lock. This would prevent an impact of raised water levels on land drainage assets along the lower reaches of the canal and on the operation of Covenham Reservoir.
- 4.23 The sill level of the proposed Top Lock should be set so as to maintain the existing water level at Riverhead of about 15.27mAOD as provided by the Environment Agency tilting weir at Top Lock.

Table 4.1 - Proposed Indicative Sill and Retained Water Levels at Proposed Locks

Lock	Surveyed Upstream Sill Level (mAOD)	Proposed Indicative Sill Level (mAOD)	Indicative Retained Water Level (assuming 1.6m depth of water) (mAOD)
Sea Lock	n/a new lock	TBC	TBC [©]
Tetney Lock	n/a lock removed	-1.30	0.30
Outfen Lock	1.56 *	1.56	3.16
Alvingham Lock	3.50 #	3.50	5.10
Salterfen Lock	5.01 #	5.01	7.11
Willows Lock	7.20 #	7.20	8.80
Ticklepenny Lock	9.00 #	9.00	10.60
Keddington Church Lock	11.1 # (lowest upstream bed level)	11.10	12.70
Top Lock	15.21 # (EA weir level Oct 2000)	13.67	15.27

Source: Faber Maunsell Ltd

* Surveyline Topographical Survey 2005

Environment Agency Cross Section Survey 2000

© Sea lock to allow 1.9m depth of water

- 4.24 The proposed sill levels would also be the design bed levels in the pound upstream of the proposed lock.

- 4.25 In addition to the locks listed in Table 4.1 an additional lock between Tetney Lock and Outfen Lock could be considered to limit the amount of channel dredging required downstream of Outfen Lock. If provided, the lock should be located between Covenham Reservoir and Outfen Lock so as not to affect existing water levels downstream of Covenham Reservoir and hence abstraction from Waithe Beck.

5 Bridges

History of the Bridges

- 5.1 There are a total of 15 bridges along the length of the Louth Canal. The bridges are of various age and construction.
- 5.2 The bridges fall into the following categories:
- 1 Concrete/steel highway bridge.
 - 1 Concrete/steel access road bridge.
 - 6 Concrete highway bridges.
 - 1 Concrete access road bridge.
 - 3 Simply supported steel footbridges with concrete decks.
 - 3 Simply supported timber footbridge with steel girders.
- 5.3 Details of the bridges located along the Louth Canal, as supplied by Lincolnshire County Council (LCC), are listed in Table 5.1.
- 5.4 Responsibility for the individual bridges falls to a number of private landowners or public organisation, e.g. LCC or Lindsey Marsh Drainage Board (LMDB). Responsibilities for the individual bridges are listed in Table 5.1.
- 5.5 The existing soffit level of each bridge deck is also given in Table 5.1.

Table 5.1 - Bridges over the Louth Canal between Louth and Tetney Lock

LCC Bridge No	Location / name (Responsible organisation)	Bridge Description	Highest Deck Soffit Level (mAOD)
30/42/21	Main Lock Bridge at Tetney Lock (LCC)	21.35m span pre-cast concrete box beam	3.67 *
30/31/66	Riverside Farm Bailey Bridge (Private landowner)	20.6m span reinforced concrete deck and steel girder (Private)	2.48 *
39/39/57	Thoresby Bridge (LCC)	19.05m span steel beam/concrete slab	2.60 *
39/48/41	Fulstow Foot Bridge (LMDB)	24.1m span timber deck and steel girder	3.45 *
39/57/30	Fire Beacon Bridge (LCC)	7.58m span reinforced concrete	3.26 *
39/65/17	Biergate Foot Bridge (LMDB)	22.53 m span timber deck and steel girder	3.95 *
39/64/86A	Austen Fen Bridge (LCC)	3 span 4.27m/4.27m/4.88m reinforced concrete deck	2.84 *
39/74/10	Austen Fen Foot Bridge (LMDB)	3 span 10.2m/8.3m timber deck on steel girder	3.92 *
39/72/52	High Bridge (LCC)	4.57m reinforced concrete	4.87 *
39/61/82A	Alvingham Church Foot Bridge (LCC)	14.8m span steel beam with concrete slab	4.51 #
39/60/48A	Alvingham Lock Bridge (LCC)	9.5m span concrete box beam	6.45 #
38/59/37	River Farm Bridge (Private landowner)	3 span 4.4m/7.5m/4.4m reinforced concrete (Private)	8.33 #
38/58/09	Ticklepenny Lock Bridge (LCC)	3.96m span reinforced concrete	10.88 #
38/48/54B	Keddington Church Foot Bridge (Eastfield Foot Bridge) (LCC)	6.8m span reinforced concrete deck on steel girder	12.98 #
28/48/01A	Tilting Gate Foot Bridge at Louth (LCC)	4.9m span reinforced concrete slab	14.42 #

Source: Lincolnshire County Council and walkover inspection

* Surveyline Topographical Survey 2005

Environment Agency Cross Section Survey 2000

5.6

In addition to the access bridges there are several other structures that cross the canal, e.g. culverts (siphons) and pipe crossings. These structures are listed in Table 5.2. Further details of these services are given in Section 8.0.

Table 5.2 - Other Structures crossing the Louth Canal between Louth and Tetney Lock

Name / Location	Description	Soffit Level/Crown Level (mAOD)
Conoco Oil Pipeline, Tetney Haven	36inch Crude Oil Transfer Pipeline	SL = 3.07*
Thoresby Bridge Syphon	LMDB syphon to land drainage pumping station	Crown level unknown
Waterland Drain Syphon between Thoresby Bridge & Fulstow Bridge	LMDB syphon to land drainage pumping station	Crown level unknown
Fulstow Bridge Syphon	LMDB syphon to land drainage pumping station	Crown level unknown
Lawgate Sewer Branch Drain Syphon upstream of Fulstow Bridge	LMDB syphon to land drainage pumping station	Crown level unknown
Pipe at Fire Beacon	Water Pipe	SL = 3.31m *
Newcroft Drain Syphon downstream of Biergate Bridge	LMDB syphon to land drainage pumping station	Crown level unknown
Austen Fen Syphon at Austen Fen Footbridge	LMDB syphon to land drainage pumping station	Crown level unknown
Alvingham Syphon (upper)	Mill Race Syphon to Alvingham Mill	Crown level unknown
Alvingham Syphon (lower)	Tail Race Syphon on Westfield Drain from Alvingham Mill - currently blocked and abandoned	Crown level unknown

Source: Lindsey Marsh Drainage Board and walkover inspection

* Surveyline Topographical Survey 2005

- 5.7 After the old lock gates were removed and the retained water level within the canal lowered the Alvingham Lower Syphon was abandoned. Flow from Westfield Drain, into which the Tail Race of Alvingham Mill discharges, was diverted from the River Lud into the Louth Canal. When replacement gates are erected at the locks the retained water level will rise and the flow in Westfield Drain will probably need to be diverted back to the River Lud via a replacement syphon and/or pumped into the Louth Navigation, further details are given in Section 7.0.

Condition of the Bridges

- 5.8 In recent years LCC have replaced or improved a number of the bridges along the Louth Canal, e.g. Thoresby Bridge, such that in general the bridges are considered satisfactory by LCC for current needs.
- 5.9 Some minor defects, like small areas of spalling concrete at Ticklepenny Lock Bridge, were observed during the walkover inspection. However, other than for the needs of the navigation it is unlikely that any major works will be required on the bridges in the near future.

- 5.10 As part of the restoration works, bridges will be renewed and improved. As a result financial contributions from statutory authorities and owners could be available and should be sought. The level of any contributions could be affected by the different time-scales of improvements required by the various parties involved.

Proposed Engineering Works

- 5.11 Table 5.3 shows the indicative retained water level if navigation is restored and hence the potential amount of bridge raising that would be required to achieve the design headroom of 3m. The levels are based on the proposed indicative retained water levels shown in Table 4.1.

Table 5.3 - Potential Bridge Raising Works

Name / Location	Existing Deck Soffit Level (mAOD)	Indicative Water Level (mAOD)	Indicative Soffit Level with 3m Headroom (mAOD)	Indicative Bridge Raising (metres)
Main Lock Bridge (Tetney Lock)	3.67	0.30	3.30	0.00
Riverside Farm (Bailey Bridge)	2.48	0.30	3.30	0.82
Thoresby Bridge	2.60	0.30	3.30	0.70
Fulstow Foot Bridge	3.45	0.30	3.30	0.00
Fire Beacon Bridge	3.26	0.30	3.30	0.04
Biergate Foot Bridge	3.95	0.30	3.30	0.00
Austen Fen Bridge	2.84	0.30	3.30	0.46
Austen Fen Foot Bridge	3.92	0.30	3.30	0.00
High Bridge	4.87	3.16	6.16	1.29
Alvingham Canal Church Foot Bridge	4.51	3.16	6.16	1.65
Alvingham Lock Bridge	6.45	5.10	8.10	1.65
River Farm Bridge	8.33	7.11	10.11	1.78
Ticklepenny Lock Bridge (Lock and bridge in existing locations)	10.88	10.60	13.60	2.72
Ticklepenny Lock Bridge, (Lock relocated upstream of Bridge or Bridge located downstream of lock)	10.88	8.80	11.80	0.92
Eastfield Foot Bridge (Lock and bridge in existing locations)	12.98	12.70	15.70	2.72
Eastfield Foot Bridge (Bridge relocated downstream of Lock)	12.98	10.60	13.60	0.62
Tilting Gate Foot Bridge	14.42	12.70	15.70	1.28

Source: Faber Maunsell

- 5.12 With the proposed indicative pound levels shown in Table 4.1 a number of bridges currently do not have the design headroom of 3m above normal retained water level. If bridges were to be raised then to cater for design sight lines and road alignments the extent of the works are likely to extend beyond the confines of the existing road footprint and could require significant accommodation works, e.g. realignment of drainage ditches, adjacent property accesses, fences, walls and services.
- 5.13 An alternative to raising the bridges would be to provide swing bridges. Swing bridges could be manually operated or automated with traffic control lights and barriers. Considering the size and load requirements of the bridges then the swing bridges would probably need to be automated. Information obtained on electric services show services are located near to all the proposed bridge works. The availability of sufficient supply for the works has not been confirmed. General details of potential bridge works are provided in the following paragraphs.
- 5.14 **Main Lock Bridge at Tetney Lock** (see Photograph 5.1) – With sufficient water depth and headroom no work is proposed to this bridge.



Photograph 5.1 - Tetney Lock Main Bridge

- 5.15 **Bailey Bridge Riverside Farm** (see Photograph 5.2) – With sufficient water depth no dredging is required at this location but the existing deck level provides insufficient headroom. The existing bridge requires raising by 0.8m, it should be feasible to lift and reutilise the existing bailey bridge.



Photograph 5.2 - Riverside Farm Bailey Bridge

- 5.16 **Thoresby Road Bridge** (see Photograph 5.3) – Dredging of the channel by some 0.4m depth is required at this location. The clay bed at the bridge site would allow this dredging work to be undertaken. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 0.7m. The bridge carries a busy trunk road which would likely rule out a swing bridge option due to the significant disruption to traffic when the swing bridge is operated. There is potential for the existing deck to be raised in situ in one or two halves using sucking techniques. Details would need to be confirmed during detail design stage.



Photograph 5.3 - Thoresby Bridge

- 5.17 **Fulstow Foot Bridge** (see Photograph 5.4) – With insufficient water depth dredging of the channel by some 0.9m depth would be required at this location. The existing bridge deck provides sufficient headroom and would not need to be raised with the proposed pound levels. However, any increase in the proposed retained water level although reducing the required dredging depth would reduce the available headroom with the potential result that the level of the bridge would then require raising. To provide a bed width of 7.5m through the bridge could require its replacement or significant works to maintain its stability. However, a reduction in the required bed width at this location would mean that this bridge could be retained. A reduction in design bed width to 4.6m has been assumed in this study.



Photograph 5.4 - Fulstow footbridge and outfalls from LMDB Fulstow Pumping Station

- 5.18 **Fire Beacon Road Bridge** (see Photograph 5.5) – With insufficient water depth dredging of the channel by some 0.4m depth would be required at this location. The existing bridge deck nearly provides sufficient headroom, 2.96m as opposed to the required 3m. For the purposes of the study it is assumed that this bridge is not raised. However, any increase in the proposed retained water level although reducing the required dredging depth would reduce the available headroom with the result that the level of the bridge would then require raising. Due to the dredging, works to the foundations of the bridge would be required to maintain stability.



Photograph 5.5 - Fire Beacon Bridge and Pipebridge (water main)

- 5.19 **Biergate Foot Bridge** (see Photograph 5.6) – With insufficient water depth dredging of the channel by some 0.5m depth would be required at this location. The existing deck level provides sufficient headroom and would not need to be raised. However, any increase in the proposed retained water level although reducing the required dredging depth would reduce the available headroom with the potential result that the level of the bridge would then require raising. To provide a bed width of 7.5m through the bridge could require its replacement. However, a reduction in the required bed width at this location would mean that this bridge could be retained. A reduction in design bed width to 4.6m has been assumed in this study.



Photograph 5.6 - Biergate Foot Bridge and outfalls from LMDB Biergate Pumping Station

- 5.20 **Austen Fen Road Bridge** (see Photograph 5.7) – Dredging of the channel by some 1.2m depth is required at this location. The concrete invert of the bridge would need to be lowered as

part of the dredging works. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 0.5m. Due to these works the bridge would need replacing in its entirety.



Photograph 5.7 - Austen Fen Bridge

5.21

Austen Fen Foot Bridge (see Photograph 5.8) – With insufficient water depth dredging of the channel by some 0.9m depth would be required at this location. The existing deck level provides sufficient headroom and would not need to be raised. However, any increase in the proposed retained water level although reducing the required dredging depth would reduce the available headroom with the potential result that the level of the bridge would then require raising. To provide a bed width of 7.5m through the bridge could require its replacement or significant works to maintain stability. However, a reduction in the required bed width at this location would mean that this bridge could be retained. A reduction in design bed width to 4.6m has been assumed in this study.



Photograph 5.8 - Austen Fen Foot Bridge and outfalls from LMDB Austen Fen Pumping Station

5.22

High Bridge (see Photograph 5.9) – With sufficient water depth no dredging is required at this location. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 1.3m. A decrease in the proposed retained water level upstream of Outfen Lock although increasing the required dredging depth would increase the available headroom and reduce the amount that the bridge would need to be raised by.



Photograph 5.9 - High Bridge

5.23

Alvingham Church Foot Bridge (see Photograph 5.10) – With insufficient water depth dredging of the channel by some 0.2m depth would be required at this location. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 1.7m, such a rise would involve significant approach ramps. An alternative would be the installation of a swing bridge as with the original Navigation.



Photograph 5.10 - Alvingham Canal Church Foot Bridge viewed from upstream

5.24

Alvingham Lock Bridge (see Photograph 5.11) – With insufficient water depth dredging of the channel by some 0.2m depth would be required at this location. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 1.7m, such a rise would involve significant works on the approaches and on adjacent accesses. A swing bridge as with the original Navigation would overcome these impacts. If the lock at Alvingham were relocated upstream of the bridge to enable lower water level and hence road level then the listed Alvingham Upper Syphon would need to be lowered and the upstream sill of the listed lock removed. Due to the listed nature of the structures, a proposal of relocation might not be approved by the Planners of ELDC.



Photograph 5.11 - Alvingham Lock Bridge and Pipebridge (water main)

5.25

River Farm Bridge (see Photograph 5.12) – With sufficient water depth no dredging is required at this location but the existing deck level provides insufficient headroom. A swing bridge as with the original Navigation or new bridge raised by 1.8m is required.



Photograph 5.12 - River Farm Access Bridge

5.26

Ticklepenny Lock Bridge (see Photograph 5.13) – With insufficient water depth dredging of the channel by some 0.2m depth would be required at this location. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 2.7m; such a rise would involve significant works on the approaches and possibly on adjacent roads. A swing bridge as with the original Navigation would overcome these impacts. If the lock at Ticklepenny was relocated upstream of the bridge to enable lower water level and hence road level then the amount of bridge raising would be significantly lower at 0.9m. Alternatively it maybe feasible to relocate the bridge and approach roads downstream of the lock with the same benefits in reduced bridge raising but would require some land purchase.



Photograph 5.13 - Aerial view of Ticklepenny Lock and Bridge

5.27

Keddington Church Foot Bridge (Eastfield Foot Bridge) (see Photograph 5.14) – With insufficient water depth dredging of the channel by some 0.8m depth would be required at this location. The existing deck level provides insufficient headroom. The bridge requires raising by approximately 2.7m, such a rise would involve significant works on the approaches. A swing bridge as with the original Navigation would overcome these impacts. If the bridge and public footpath were relocated downstream of Keddington Lock to enable a lower water level and hence bridge level then the amount of bridge raising would be significantly lower at 0.6m.



Photograph 5.14 - Keddington Church Foot Bridge

5.28

Louth Tilting Weir Foot Bridge (see Photograph 5.15) – With sufficient water depth no dredging is required at this location but the existing deck level provides insufficient headroom. The bridge requires raising by approximately 1.3m, such a rise would involve significant works on the approaches. A swing bridge as with the original Navigation would overcome these impacts.



Photograph 5.15 - Environment Agency Louth Tilting Weir and foot bridge on site of Old Top Lock

- 5.29 The provision of fixed bridges could be preferable to the provision of swing bridges due to the lower maintenance costs of maintaining fixed bridges (e.g. mechanical works of swing bridges require regular greasing and servicing, traffic lights and barriers require maintenance). LCC has indicated a preference for fixed structure due to fixed structures having less maintenance requirements. Fixed bridges cannot be left open by accident or otherwise. In some instances fixed bridges may not be practical due to the works required to provide ramp accesses for vehicular or pedestrian access. Further consideration of the type of works will need to be made at detailed design stage in consultation with landowners and statutory authorities.
- 5.30 As well as the design headroom the bridges should have a navigable width of at least 4.7m to allow at least one craft to pass safely. If the bridge is on a bend allowances for the bend will need to be incorporated into the bridge design.
- 5.31 Some of the bridges have available headrooms only slightly less than would be preferred by the design criteria (e.g. Thorsby Bridge). There is considerable expense in raising bridges, consideration could be given to providing an 'intermediate' standard of restoration with headroom at the height restriction of the present Thorsby Bridge until a final standard with full headroom is achieved.

Management of Bridges

- 5.32 In improving bridges the following issues should be considered to promote safety along the canal and to provide a standard style for the whole Navigation in line with users' expectations:
- Ironwork – should be painted black and white in the traditional pattern.
 - Number Plates and Loading Signs – should be provided to all bridges.
 - Management – regular maintenance to remove any graffiti or rubbish and clear away weeds and vegetation from the walls of the bridges.
 - Moorings – temporary moorings should be provided upstream and downstream of swing bridges to allow boat users to step off and on when operating the bridges.

6 Towpath

Description of the Towpath

- 6.1 The Louth Navigation Trust currently mows approximately 12km of towpath three times a year. The mower creates a cleared path width of about 1.5m. The remaining lengths of the towpath are either grazed or have a hard surfacing. The hard surfacing is found in the urban areas between Louth and Keddington.

Principles of Reconstruction

- 6.2 The towpath can be divided into four basic categories:
- Urban.
 - Rural with heavy use.
 - Rural with light use.
 - Use by vehicles for operational reasons or access.
- 6.3 It is the intention of the Louth Navigation Trust to link the towpath with other public rights of way to create a series of circular walks for which leaflets are being produced by the Louth Navigation Trust.
- 6.4 It is suggested that for the urban areas, the towpath should be of robust construction, typically 1.2 metres wide and constructed with two layers of well graded crushed stone. The first layer is to give the path strength and the top layer is to ensure that the appearance and surface of the towpath is to a suitable standard.
- 6.5 In certain instances, the towpath should have a paved surface for safety reasons. These areas include narrow heavily trafficked lengths, areas under bridges and steep slopes such as at the bottom end of the locks.
- 6.6 Towpaths with heavy use in rural areas can be less formal with a slightly reduced width.
- 6.7 Rural towpaths with light use can be maintained in their current condition of grassed surface.
- 6.8 Where vehicular access is required then the surface could be 'Grasscrete', bituminous material or crushed stone.

Proposals for Towpath Reconstruction

- 6.9 The walkover inspection indicated that the towpath was generally well maintained. However, a number of locations where improvements could be undertaken have been identified:
- The towpath immediately downstream of Thoresby Bridge is narrow and should be widened. This could result in the narrowing of the Navigation.
 - 21 stiles situated along the length of the canal incorporate steps, which limits access for the less able users. These stiles could be improved by the provision of gates where stock control is required or preferably by their removal. Only one kissing gate was noted along the canal's 19km length.
 - The timber stile located downstream of Thoresby Bridge has a missing step. The stile should be repaired.
 - Overhanging trees should be trimmed or tied back where they affect access along the towpath. N.B. No works to trees were identified during the walkover inspection, although this should be review periodically.

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7 Water Issues

Introduction

- 7.1 Historically the Louth Navigation was served by flow diverted from the River Lud, which ran parallel to the Navigation as far as Alvingham. The flow entered at the top pound of the canal, via a culvert located between Riverhead and Top Lock. Today, the River Lud has been diverted down the canal in its entirety and the canal now forms the lower reaches of the river.
- 7.2 Along the canal's length there are control sluices that allow compensatory flows back into the River Lud for agricultural and ecological reasons (see Photograph 7.1). These sluices (or 'slackers') were installed in the banks of the canal to enable riparian landowners to release water from the canal into the adjacent ditches and dykes to maintain water levels in those ditches for stock watering, 'fencing' and subsoil irrigation purposes. Following the passing of the Water Resources Act in 1963 the use of the 'slackers' by the Internal Drainage Board was subject to an abstraction Licence.



Photograph 7.1 - Sluice for compensation flow to River Lud upstream Keddington Church Lock

- 7.3 Present water levels in the canal are governed by the need to abstract water at Covenham Reservoir and to intercept the flow of the Waithe Beck, causing it to flow up the canal to the Covenham intake. As well as the public water supply use the Louth Canal is also used to meet the demands of direct spray irrigation and to provide an environmental compensation flow in the canal.
- 7.4 Anglian Water operates a bulk water transfer scheme (the Great Eau Raw Water Transfer Scheme) to transfer additional water to the Louth Canal from the Great Eau. Water is pumped to the Louth Canal during drought periods when flows in the canal itself cannot support the peak summer abstraction at Covenham Reservoir. The water transfer pipeline from the Great Eau at Cloves Bridge discharges to the canal downstream of Outfen Lock.

Water Resources (Low Flows)

- 7.5 As well as meeting the demands of existing users, the restoration scheme will need to ensure a minimum navigational depth and provide water to allow a viable number of boat passages through the locks each day.

- 7.6 The historical records of the canal usage are relatively good. From the records there are no reported operational navigation problems due to low flows. The only known difficulty was as a result of a section of the canal silting up due to a lack of dredging which caused the tow horses significant difficulties. This suggests that there would be sufficient water for the needs of the restored Navigation as future usage is unlikely to exceed the usage in the Navigation's heyday when significant commercial traffic used the canal.
- 7.7 The Environment Agency have supplied average flow data from their gauging station at the top of the Louth Canal at Louth Tilting Weir (Station no. 029003) located slightly downstream of Riverhead at NGR TF33708790. Average daily flows from Jan 1968 to Aug 2004 were supplied by the Environment Agency.
- 7.8 From the 36 years of data supplied the 95% exceedence flow was determined as 0.12cumecs. The lowest daily flow was recorded as 0.07cumecs in Dec 1991.
- 7.9 There is a significant discharge to the Canal from Louth WWTW. which is located downstream of the Louth tilting weir and therefore is excluded from the current assessment of flows. The assessment of flow is therefore considered to be conservative.
- 7.10 An average daily flow of 0.12cumecs equates to a daily volume of 10,368m³. The lock with the largest fill volume is currently Keddington Church Lock. The Keddington Church Lock has a drop of 2.85m, a length of 26.7m and a width of 4.65m giving a volume between upstream and downstream pound levels of approximately 360m³. With a 95% exceedence daily volume of 10,368m³ there would be a sufficient supply for 28 separate lockages per day. Assuming that the lock is filled and emptied on each occasion (i.e. all traffic is one way) and that there are no losses through the lock between operations this would allow 28 boat movements.
- 7.11 The above analysis does not allow for any losses from the canal, e.g. seepage, evaporation, leakage through tidal sluice and paddles, etc. Any seepage that does occur could increase once the Navigation is restored due to increased water depths and therefore increased static heads causing leakage, so long as the groundwater level is below canal level.
- 7.12 It should be noted that no records of any seepage from the Louth Canal have been found during this study. At present there is insufficient data to accurately quantify the problem and information on the extent and potential for seepage needs to be gathered, possibly involving ground investigation. In the absence of any detailed information a conservative assumption on losses has been made. British Waterways suggested that a loss from a typical embanked canal (i.e. one where the retained level is above ground level) could be as high as 1.75megalitres/ kilometre/ week. The Environment Agency has confirmed that this rate is not excessive when compared to other lowland river systems. For the 18.9km of the Louth Canal this size of loss would equate to 4,750m³/day. Such a loss would halve the number of lockages that would be possible during periods of low flows to 15. Using the lowest recorded daily average flow of 0.07cumecs would allow just 4 lockages. It should be noted that not all the canal is embanked and so actual losses could be significantly lower than assumed above.
- 7.13 It should be noted that if seepage proves problematic relining the channel could improve the situation and reduce leakage losses. Alternatively a system to pump water back up the canal could be installed. A system of pumps could cost £80k at each lock. These estimates are budget allowances and further detailed study is required before any detailed design is undertaken. However, due to the costs of such work, such improvement works should only be considered once the extent of any problem has been fully determined, i.e. once the Navigation is restored and the problem, if any, can be accurately quantified.
- 7.14 Depending on the size of the losses assumed between 15 and 28 separate lockages could be accommodated each day. If the locks are used efficiently with the lock only filled and emptied when a boat travels up the canal or a boat travels down the canal respectively this would allow between 15 and 28 boats to traverse the canal daily in each direction (between 30 and 56 in total), based on the 95 percentile low flow.

- 7.15 With the anticipated 60 private boats along the Louth Navigation (see Paragraph 12.21) for the majority of the year the available water supply would appear to be adequate for the intended usage. At times of maximum summer usage the level within the smaller pounds i.e. those between Top Lock and Alvingham Lock could fall over the course of a day, as demand for the locks would be biased towards the hours of daylight. However, the pounds would replenish themselves during the night when demand would be at a minimum.
- 7.16 With regard to any requirement to maintain compensation flows along the canal it should be noted that water would pass down the canal either via the lock usage or through bywashes or via gate leakage, thereby maintaining a flow along the length of the canal (no flows would be abstracted from the canal as a result of the restoration of navigation). Increased water levels above restored locks would make abstraction more reliable by creating a volume of stored water between locks. This would create a large volume of water within the canal to act as an abstraction buffer. Flows down the canal will not be affected; however, navigation may increase the fluctuations slightly. The increased volume of storage available to abstractors would however, counter this.
- 7.17 The tidal gates and retained water level at Tetney Lock would be retained as existing to allow flows from the Louth Canal to the Tetney Haven to drain as currently.

Conclusions to Low Flow Assessment

- 7.18 From the records of the Navigation there is no recorded historical navigation operation problems associated with low flows.
- 7.19 The available flow records show that the 95% exceedence daily flow at the top end of the canal is 0.12cumecs. This equates to a daily volume of 10,368m³, which is sufficient to provide 28 separate lockages per day. With the lowest recorded daily flow of 0.07cumecs 17 separate lockages per day could be achieved.
- 7.20 The loss for seepage, evaporation, leakage through paddles, etc, could be as high as 1.75megalitres/kilometre/week or 4,750m³/day. Assuming this conservative loss the remaining water resource would be sufficient to provide 15 separate lockages per day based on the 95% exceedence daily flow at the top of the canal of 0.12cumecs. With the lowest recorded daily flow of 0.07cumecs 4 separate lockages per day could be achieved.
- 7.21 To date the current amount of abstraction has not been confirmed. Increased water levels above restored locks would make abstraction from the canal more reliable. Navigation would not abstract flow from the canal. Flows down the canal will not be affected; however, navigation may increase the fluctuations slightly. The increased volume of storage available to abstractors would however, counter this. The impact of navigation on protected rights to water would need to be determined in detail and agreed with the Environment Agency.
- 7.22 For the majority of the year the available water supply would appear to be adequate for navigation and abstraction. During periods of dry weather and maximum summer usage water levels could fluctuate during the day but would be replenished during the night.

High Flows

- 7.23 The Environment Agency have supplied maximum daily flow data obtained from their gauging station at Louth Tilting Weir (Station no. 029003) located downstream of Riverhead at NGR TF33708790. Maximum daily flows from Jan 1968 to Aug 2004 were supplied. The maximum peak flow recorded at the gauge during this period is 6.77cumecs (3/11/68).
- 7.24 The 1 in 100 years peak flow at the Louth Tilting Weir is estimated by the Environment Agency at 8.5cumecs, the November 1968 event is estimated by the Environment Agency as a 1 in 50 years return period event⁴.

⁴ The River Lud Catchment: A hydrological investigation into the possibility of installing an automatic siren system in Louth; A Adair Environment Agency March 2000.

- 7.25 The re-erection of lock gates and the potential raising of retained water levels along the canal could increase flood risk if works are not undertaken to offset the potential increase in flood risk. As part of the feasibility study to offset any adverse flood risk impacts it is proposed to install at each lock appropriately designed bywashes controlled by automated tilting gates or similar to allow flood flows to pass around the lock through side channels or culverts. The automated tilting gates would automatically lower to cater for any increase in flow and raise as flows abate in order to maintain water levels. The tilting gates would be similar to the Environment Agency's tilting gate at Louth Tilting Weir.
- 7.26 Due to the potential health and safety risks to boat users of flows discharging on to boats attempting to use the locks it is recommended that the lock pens not be used themselves to pass design flood flows except in an emergency situation.
- 7.27 The bypass weirs should include safety booms to alleviate the risk to boats being swept on to weirs in flood conditions.
- 7.28 The scope of this study does not include any detailed design and the exact sizes of the proposed tilting weirs cannot be given. However, it is anticipated that the gates would be similar in nature to the existing Louth Tilting Weir located downstream of Riverhead. The weirs may be slightly larger to cope with the higher flows anticipated further down the canal.
- 7.29 The Louth Tilting Weir is located on the position of the old Top Lock. To reinstate the lock the weir would require relocating to the side.
- 7.30 The Environment Agency has confirmed that the above flood management strategy is acceptable in principle subject to completion and approval of detailed design.
- 7.31 Details of electricity services received from Yorkshire Electricity shows power cables generally within 100m to 200m of the locations of each lock. The exception is at Outfen Lock where the nearest supply cable at High Bridge is 600m from the lock. It has been assumed that there is sufficient supply to meet the needs of the canal so that no uprating the distribution system is required. This will need to be confirmed with Yorkshire Electricity during the detailed design stage.
- 7.32 The level of the fixed concrete weir upstream of Riverhead Road, Louth, is 15.41mAOD. The level of the Louth Tilting Weir was surveyed at 15.21mAOD⁵. So long as the proposed top lock retained level is less than these levels then the proposals will not adversely affect upstream conditions.

Land Drainage

Gravity Outfalls

- 7.33 At present the retained water level in the canal allows gravity flow through flap valves from the adjacent dykes draining the farmland alongside the canal. Telemetrically controlled electric pumps are used to maintain drainage of adjacent land during periods of high river levels when the canal is tide locked and/or affected by high flows. The Lindsey Marsh Drainage Board operates these land drainage installations. Details of the drainage installations along the Louth Canal are given in Section 8.0.
- 7.34 Any increase in retained water level could reduce the volume of water that drains by gravity and thereby increase the amount of water that requires pumping. If this was the case Lindsey Marsh Drainage Board has indicated their requirement for a commuted sum to cover the additional costs of increased pumping. Additional costs would result from increased electricity usage, increased wear and tear of pumps, increased maintenance and uprating of the pumps/drainage assets including the provision of new pumping stations where required.

⁵ Environment Agency River Lud/Louth Canal Cross Section Survey dated Oct 2000

- 7.35 With the indicative proposed pound level of +0.3mAOD between Tetney Lock and Outfen Lock i.e. current retained water level (see Table 4.1), the retained water levels at the Board's existing gravity outfalls downstream of Outfen Lock, would not be affected by the works. An additional lock between Tetney Lock and Outfen Lock to limit the amount of channel dredging required downstream of Outfen Lock could be considered. If this lock was built then the Lindsey Marsh Drainage Board gravity outfall and pumping station at Austen Fen could be affected if the additional lock is located downstream of the Austen Fen Pumping Station.
- 7.36 It may be feasible to increase water levels within the canal and within Austen Fen thereby avoiding any additional pumping. During detailed design further consultation with LMDB would be required to determine the extent, if any, that retained water levels could be increased.

Drainage of Alvingham

- 7.37 The village of Alvingham and adjacent land drain by gravity into the Louth Canal via Westfield Drain. The Alvingham Mill Tail Race also discharges into Westfield Drain. Historically, Westfield Drain drained to the River Lud and when the Louth Navigation was constructed a brick culvert was built to convey flows in Westfield Drain below the canal (Alvingham Lower Syphon). A second brick culvert (Alvingham Upper Syphon) was also constructed to enable flows in the Alvingham Mill Race (Mill Stream) to be conveyed below the canal (see Photograph 7.2).



Photograph 7.2 - Alvingham Upper Syphon and Mill Stream (Upstream side)

- 7.38 With the abandonment of navigation along the Louth Canal Westfield Drain was diverted into the Louth Canal immediately downstream of Alvingham with a weir constructed to maintain water levels within Westfield Drain (see Photograph 7.3). Although the Upper Syphon is still used to supply Alvingham Mill the Lower syphon is now abandoned, blocked by silt and bricked up (see Photograph 7.4).



Photograph 7.3 - Lindsey Marsh Drainage Board Westfield Drain Weir



Photograph 7.4 - Abandoned and Bricked up Alvingham Lower Syphon (Upstream side)

- 7.39 Lindsey Marsh Drainage Board maintains Westfield Drain and the Mill Stream from the River Lud upstream of the Alvingham Upper Syphon. The Alvingham Upper Syphon and the Mill Race are maintained by the landowner.
- 7.40 With the abandonment of navigation along the Louth Canal the River Lud is able, when levels in the canal permit, to discharge under gravity direct to the Louth Canal. This is achieved via a 1.25m diameter flapped outfall at Alvingham. During period of high water levels in the Louth Canal water is passed down the old course of the River Lud to the South Dyke, via Grange Beck.
- 7.41 Both South Dyke and the River Lud are classed as Main Rivers and are maintained by the Environment Agency. Grange Beck is maintained by the Lindsey Marsh Drainage Board.
- 7.42 An increase in retained water level at Alvingham could reduce the volume of water that drains by gravity and thereby affect drainage of the area. At this stage three options are identified to maintain the current drainage standards in the area. Details are given in the following paragraphs.

- 7.43 The first option would be to reinstate the Lower Alvingham Syphon by the construction of a new culvert to replace the previously abandoned brick culvert. This would result in all of the flows from Westfield Drain being returned to the River Lud. The impacts of additional flows to the River Lud, Grange Beck and South Dyke system would need to be investigated; possibly resulting in the need for some drainage improvement works. The diversion of water back to the River Lud would result in the loss of a water resource from the Canal at low flows, which although small could be significant.
- 7.44 The second option would be to install a pumping station to pump all flows into the Navigation. There would be significant on going operating costs with this option, as all flows would need to be pumped into the Canal. To minimise flows, consideration could be given to minimising the flow along the Mill Stream to that required for ecological and Alvingham Mill operational interests (see Photograph 7.5). The Mill has been restored and is in use and therefore needs a reliable water supply.



Photograph 7.5 - Alvingham Mill and Mill Stream

- 7.45 The third option would be a combination of the previous two options and would involve the construction of a small pumping station and a culvert.
- 7.46 A detailed assessment of the land drainage at Alvingham is required to determine the preferred land drainage option for Alvingham. At this stage the third option (pumping station and culvert) is preferred as it would minimise the size and cost of the pumping station and would be more sustainable.

Water Table

- 7.47 General water table levels could rise as a result of increased retention levels within the Navigation. In an extreme this could result in some heave of adjacent land. However, the internal drainage system of adjacent land is generally pumped and could alleviate any potential increase in water table by increased pumping.
- 7.48 Property considered at risk should be monitored before and after restoration to determine the impact if any of any works. Remedial works to affected property may be required in the longer term. The extent of possible works has not been identified at this time. However, an overall contingency allowance to cover such eventualities is included in the scheme costings.

Water Quality

- 7.49 The proposed Sea Lock at Tetney Lock would be used at high tide and therefore would operate with tidal salt water. Discharge of this water or leakage through the tidal doors into the upstream Louth Navigation could increase the salinity of the water within the lower part of the

Louth Navigation. To alleviate this risk the lock pen should incorporate a pumping station to allow salt water to be discharged back into the tidal estuary. An alternative solution would be a side pond that would be discharged by gravity to the Haven at low tide.

7.50

The Anglian Water tilting weir (see Photograph 7.6) at Tetney Lock should be retained to minimise the risk of saline water being drawn further upstream.



Photograph 7.6 - Anglian Water Tilting Weir downstream of Tetney Lock

7.51

Increased motor powered boat traffic could pose a pollution risk to Covenham Reservoir. To alleviate this risk a floating boom at the mouth of the Covenham Reservoir intake should be provided.

8 Services

Location of Services

- 8.1 The following statutory utilities have supplied plans showing their services in the vicinity of the canal:
- Anglian Water (sewerage)
 - Anglian Water (water supply)
 - British Telecom (telephone)
 - ConocoPhillips (oil)
 - Lindsey Marsh Drainage Board (land drainage)
 - Transco (gas)
 - Yorkshire Electricity Distribution (electricity)
- 8.2 The following statutory utilities have indicated that they have no record of services within the vicinity of the canal:
- NTL (cable)
 - National Grid (electricity)
 - Total pipelines (oil)
 - British Petroleum Association (oil)
 - Esso Petroleum Company (oil)
 - Government Pipelines & Storage System (fuel)
 - Manchester Jetline (oil)
 - Mainline Pipeline (oil)
- 8.3 There are two private access bridges across the canal, one at River Farm and one just upstream of Tetney Lock (Riverside Farm). Services plans do not identify any services across these bridges but this should be confirmed with the relevant landowners during detailed design.

Anglian Water (sewerage)

- 8.4 Anglian Water has supplied plans showing sewers that cross the canal. These are:
- 75mm pumped foul sewer across Alvingham footbridge.
 - 7inch (180mm) pumped foul sewer under canal upstream of Salterfen Lock.
 - Unknown diameter pumped foul sewer under canal upstream of Salterfen Lock.
 - 375mm diameter foul sewer under canal 30m upstream of Louth Tilting Weir (Top Lock).
 - Two 850mm diameter foul sewers under canal 120m upstream of Louth Tilting Weir (Top Lock).

8.5 In addition to the sewers that cross the canal the following outfalls are operated by Anglian Water:

- Outfall from Louth Waste Water Treatment Works (WWTW) (see Photograph 8.1).
- 525mm diameter surface water outfall on right bank 170m downstream of Top Lock.
- 600mm diameter surface water outfall on right bank downstream of Top Lock.
- Overflow Sewer outfall on left bank downstream of Top Lock.
- Riverhead (downstream of Navigation Warehouse) two 750mm diameter surface water outfalls.
- Riverhead (upstream of Navigation Warehouse) 610mm diameter surface water outfall on left bank.
- Riverhead (upstream of Navigation Warehouse) 600mm diameter surface water outfall on right bank.



Photograph 8.1 - Louth WWTW Outfall

Anglian Water (water supply)

8.6 Anglian Water has supplied plans showing water mains that cross the canal. These are located at:

- Tetney Lock Bridge 100mm within bridge deck.
- Fulstow Bridge 180mm within bridge deck.
- Fire Beacon Bridge 75mm within bridge deck.
- Fire Beacon Bridge 150mm upstream of bridge.
- High Bridge 75mm downstream of bridge.
- 200m upstream of High Bridge 500mm main below canal invert.
- 200m upstream of High Bridge blanked off spare 500mm main below canal invert.
- Alvingham Lock Bridge 230mm upstream of bridge.
- Keddington Lock 100mm downstream of lock (see Photograph 8.2).



Photograph 8.2 - Water main downstream of Keddington Church Lock

8.7

In addition to the mains that cross the canal the following outfall is operated by Anglian Water:

- 550m downstream of High Bridge (914mm raw water transfer main from Great Eau) (see Photograph 8.3).



Photograph 8.3 - Outfall from Great Eau Raw Water Transfer Main

British Telecom (telephone)

8.8

British Telecom has supplied plans showing telephone cables that cross the canal. These are located at:

- Along sea defence crossing tidal gate structure, possible underground service.
- Confluence of Waithe Beck and Louth Canal (underground cable along left bank to Anglian Water Tilting Weir).
- Tetney Lock Bridge (underground cable within bridge deck).
- Thoresby Bridge (overhead cable downstream face).
- Thoresby Bridge (underground cable within bridge deck).

- Biergate Footbridge underground cables to pumping station on right bank possibly fed through duct to pumping station on left bank.
- Austen Fen Bridge (underground cables).
- Austen Fen Bridge (overhead cables upstream of bridge).
- High Bridge (overhead cables).
- Alvingham Lock Bridge (underground cable within bridge deck).
- Between Ticklepenny Lock and Keddington Lock (overhead cables).
- Top Lock (buried cable located immediately below the sluice).

ConocoPhillips (oil)

- 8.9 ConocoPhillips has confirmed that a 36" diameter crude oil transfer pipeline (see Photograph 8.4) crosses the Tetney Haven on the seaward side of the tidal lock gates (Tetney Lock). The pipeline in its current position would impede access for vessels into the Navigation at high tide.



Photograph 8.4 - Oil Transfer Pipeline across Tetney Haven

- 8.10 The Theddlethorpe - HOR Killingholme 150mm diameter high pressure (900psi) gas main is operated by ConocoPhillips. The pipeline is routed around the east of Thoresby Bridge away from the canal. Except for this short length the pipeline runs parallel to the canal between Austen Fen and New Delights possibly within the towpath. At New Delights the pipeline crosses beneath the canal.

Lindsey Marsh Drainage Board (land drainage)

- 8.11 Lindsey Marsh Drainage Board has supplied plans showing where the Board's drainage system crosses or discharges into the canal. These are located as follows. References to 'syphons' in the following list are culverts locally known as 'inverted syphons'.
- Gravity land drainage outfall upstream of the Tetney Lock tidal gates (right bank).
 - Gravity land drainage outfall upstream of the Tetney Lock tidal gates (left bank).
 - Gravity land drainage outfall between the Anglian Water Tilting Weir and the Tetney Lock tidal outfall (right bank).
 - A number of gravity land drainage outfalls to Waithe Beck.
 - Gravity land drainage outfall upstream of Tetney Lock (right bank).

- Thoresby Bridge Pumping Station. The pumping station has separate gravity (1 number) and pumped outfalls (2 number). There is also a syphon that passes under the canal (see Photograph 8.5).
- Waterland Drain Syphon which passes under the canal. There are also two gravity outfalls at this location.
- Fulstow Pumping Station. The pumping station has separate gravity (2 number) and pumped outfalls (3 number). There is also a 900mm diameter syphon that passes under the canal.
- Newcroft Drain Syphon which passes under the canal. There are also two gravity outfalls at this location.
- Biergate Pumping Station. The pumping station has two pumped outfalls.
- Austen Fen Pumping Station. The pumping station has separate gravity (2 number) and pumped outfalls (2 number). There is also a 650mm diameter syphon that passes under the canal.
- Westfield Drain discharges to the Louth Canal downstream of Alvingham. The drain conveys flows from Alvingham including from the Alvingham Mill tail race. A weir retains water levels within Westfield Drain.
- Outfall from the River Lud to the Louth Canal at Alvingham (right bank) maintained by the Environment Agency.
- Gravity Outfall from South Drain to the Louth Canal at Alvingham (see Photograph 8.6).



**Photograph 8.5 - Outfall from Lindsey Marsh Drainage Board
Thoresby Bridge Pumping Station**



Photograph 8.6 - LMDB South Drain Outfall, downstream of Alvingham Lock

Transco (gas)

- 8.12 Transco has supplied a plan showing gas supply pipes to the residential areas in the north east of Louth. The services are generally shown within the curtilage of roads. None of the services are shown to cross the canal or its towpath.

Yorkshire Electricity Distribution (electricity)

- 8.13 Yorkshire Electricity has supplied plans showing electric cables which cross the canal. These are located at:
- Downstream of Anglian Water Tilting Weir (high voltage overhead cables).
 - Confluence of Waithe Beck and Louth Canal (high voltage overhead cables).
 - Downstream of Tetney Lock Bridge (high voltage overhead cables – 2 sets).
 - Upstream of Tetney Lock Bridge (high voltage overhead cables).
 - Upstream of New Delights/Riverside Farm (high voltage overhead cables).
 - Thoresby Bridge (low voltage cable within bridge deck).
 - Fulstow Bridge (cable within bridge deck).
 - Fire Beacon Bridge (high voltage overhead cables).
 - Fire Beacon Bridge (low voltage overhead cables).
 - Between Fire Beacon Bridge and Biergate Bridge (high voltage overhead cables).
 - Biergate Footbridge (high voltage cables to pumping station on left bank, possibly fed through duct to pumping station on right bank).
 - Austen Fen Bridge (high voltage overhead cables).
 - Austen Fen Bridge (low voltage overhead cables downstream of bridge).
 - Between Austen Fen Bridge and Austen Fen Footbridge (high voltage overhead cables).
 - Austen Fen Footbridge (high voltage cables to pumping station on right bank, possibly fed through duct to pumping station on left bank).
 - High Bridge (low voltage overhead cables).
 - Field View between High Bridge and Alvingham (high voltage overhead cables).

- Alvingham Lock Bridge (2 no. low voltage cables and 1 no. high voltage in bridge deck).
- 100m upstream of River Farm Access Bridge (high voltage overhead cables).
- 350m upstream of River Farm Access Bridge (high voltage overhead cables).
- 500m upstream of River Farm Access Bridge (high voltage overhead cables).
- Upstream of Ticklepenny Lock (low voltage overhead cables to Abbey House).
- Between Ticklepenny Lock and Keddington Lock (high voltage overhead cables).
- Between Keddington Lock and Top Lock (high voltage buried cable possibly marked by low weir across canal) (see Photograph 8.7).
- Top Lock (high voltage buried cables located immediately below the sluice).



Photograph 8.7 - Weir (possible electricity cable) between Top Lock and Keddington Church Lock

Unknown Services

- 8.14 The following services were identified during the walkover inspection, but were not shown on the supplied utility plans. During the study it was not feasible to confirm what the services are and who owns them. Further investigation will be required prior to works proceeding to confirm whether they are currently used and whether they need to be retained:
- 2 pipes on downstream side of Fulstow Bridge.
 - Service duct on upstream side of Fulstow Bridge.
- 8.15 In addition to the mains that cross the canal the following outfalls were noted during the walkover inspection which are not noted on the record drawings obtained from the utilities:
- Downstream of Willows Lock on left bank (size and type unrecorded).
 - At Keddington Lock (size and type unrecorded).

Disclaimer by Utilities

- 8.16 All the utility companies have provided their standard disclaimer as to the presence and position of their services. Further site checks should be undertaken during the design and construction to check for the position of services and to check for the presence of additional uncharted services.

Impact of restoration on services

Anglian Water (sewerage)

- 8.17 The Anglian Water pumped foul sewer across Alvingham footbridge would need to be raised or relaid under the canal. As the pipeline is pumped this should be practicable but details would need to be agreed with Anglian Water.
- 8.18 Anglian Water has supplied details of five sewers that cross beneath the canal between Salterfen Lock and Riverhead. The crowns of these will need to be checked to confirm that any dredging works do not affect these services.
- 8.19 A number of sewers outfall to the canal between Salterfen Lock and Riverhead including the outfall from Louth WWTW, the impact of raised water levels on these outfalls will need to be confirmed.

Anglian Water (water supply)

- 8.20 The following water mains operated by Anglian Water would need to be diverted as part of the restoration proposals:
- High Bridge (3inch within bridge deck).
 - Alvingham Lock Bridge (9inch within bridge deck).
 - Keddington Lock (4inch main located above canal invert).
- 8.21 Anglian Water has supplied details of two water mains that cross beneath the canal upstream of High Bridge. The amount of dredging proposed at this location is low, approximately 0.15m. The crowns of these will need to be checked to confirm that any dredging works do not affect these services.
- 8.22 Anglian Water's 900mm raw water transfer main from the Great Eau outfalls to the canal downstream of Outfen Lock. If an additional lock is constructed downstream of Outfen Lock then the impact of raised water levels on this service will need to be confirmed. It is likely that the outfall will need to be diverted downstream of the reconstructed Outfen Lock.

British Telecom (telephone)

- 8.23 The following British Telecom services would need to be diverted as part of the restoration proposals.
- Thoresby Bridge (underground cable within bridge deck).
 - Austen Fen Bridge (underground cable).
- 8.24 There are a number of overhead cables that cross the canal. As the cables span from top of bank to top of bank restoration of navigation is not expected to impact on these services. However, the clearance should be checked prior to undertaking works.

ConocoPhillips (oil)

- 8.25 The ConocoPhillips pipeline is classified as of strategic importance and supplies crude oil for processing at ConocoPhillips Humber Refinery. The pipeline needs to be maintained available for discharging North Sea crude supplies transported by shuttle tankers. Methods for re-routing the pipeline would need to allow for the uninterrupted operation of the pipeline. ConocoPhillips have indicated that short duration shutdowns for critical works may be possible but durations would be limited and restricted to a few days. As the pipeline runs through Tetney Haven, an environmentally sensitive area, directional drilling underground from outside of the Tetney Haven SPA would probably be the preferred option on environmental grounds but at significant cost. This would enable the pipeline to be laid prior to connecting into the existing pipeline for the final tie-ins.

- 8.26 Any dredging/ channel widening in the vicinity of the high-pressure gas main should be undertaken with extreme care and in consultation with ConocoPhillips. It is likely that the majority of the works could be undertaken on the opposite bank.

Lindsey Marsh Drainage Board (land drainage)

- 8.27 The impact of restoration on the Lindsey Marsh Drainage Board assets, e.g. pumping stations and gravity outfalls, are discussed in Section 7.0.

Transco (gas)

- 8.28 Information received from Transco indicates that proposed restoration works are unlikely to impact on services operated by Transco.

Yorkshire Electricity Distribution (electricity)

- 8.29 The following Yorkshire Electricity services would need to be diverted as part of the restoration proposals.

- Thoresby Bridge (low voltage cable within bridge deck).
- Alvingham Lock Bridge (2 no. low voltage cables and 1 no. high voltage in bridge deck).
- Between Keddington Lock and Top Lock (high voltage buried cable possibly marked by low weir across canal)

Unknown Services

- 8.30 The outfall at Keddington Lock should be diverted downstream of the lock.

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9 Summary of Engineering Work

Introduction

- 9.1 The principal engineering works that are required to restore the Navigation are summarised below. The proposed works take into account the extent and nature of all obstructions including highways and utility crossings, water level fluctuations, the need for dredging, structural condition of locks, weirs, etc., impacts on other water users and navigation criteria as laid down in the Study Brief.
- 9.2 The heritage value of some of the structures along the Louth Navigation and of the potential that exists for creating heritage trails, rambling routes and countryside access is high. In developing the options and considering potential engineering works, these factors have been taken into account.

Canal

- 9.3 To maintain the existing water resource function of the canal, i.e. bulk supply to Covenham Reservoir, a change in the canal section is recommended with existing water levels maintained between Tetney Lock and Outfen Lock.
- 9.4 The canal requires dredging and widening to regain the design navigation depth and widths.
- 9.5 Toe protection for eroded banks is required.
- 9.6 Seepage alleviation measures could be required to control possible seepage from the canal resulting from raised water levels.
- 9.7 Visitor moorings are required along the Navigation.
- 9.8 Facilities for boat users including pumped wash out, rubbish disposal, water point, toilets and showers are required.

Locks

- 9.9 1 new sea lock through the existing sea defences.
- 9.10 5 new locks are required.
- 9.11 3 locks require complete refurbishment.
- 9.12 Each lock requires a control sluice (tilting weir) for control of flood flows.

Bridges

- 9.13 4 number road bridges require raising.
- 9.14 3 number foot bridges require raising.
- 9.15 3 number fixed road bridges require replacement with swing bridges.

Towpath

- 9.16 Minor improvements to the towpath, stiles and signage are required.
- 9.17 Fishing decks, designed for disabled use, could be provided.

- 9.18 New car parking/ picnic area provision is required at selected locations along the canal to assist in facilitating access to the canal by non-boat users.

Services

- 9.19 13 services require diversion in terms of line and level. The two principal services are listed below:
- 36inch diameter crude oil pipeline.
 - 900mm diameter Great Eau water transfer pipeline outfall.

- 9.20 A number of culverts below the canal bed could be affected by proposed dredging works and require further investigation to find their crown levels.

Miscellaneous

- 9.21 A replacement culvert and new pumping station is required to deal with flows in Westfield Drain at Alvingham.
- 9.22 A new pumping station may be required for seawater disposal at the new sea lock at Tetney Lock.
- 9.23 A new pumping station may be required at Louth Waste Water Treatment Works. Consideration could be given to discharging instead to the Old River Lud.

10 Outline Costs

Outline Costs

- 10.1 In determining costs it has been assumed that competitive tenderers by commercial contractors will be obtained for the works. Industry standard cost databases (e.g. Wessex) and information from recent projects have been used to determine the capital and revenue costs of the studied options. Budget prices have been obtained from suppliers for key elements of work.
- 10.2 Liaison with Land and Water Group confirmed competitive rates for dredging and hauling up to 100m from source including disbursements to farmers for permission to spread material to agricultural land. This assumes that the dredged material once tested is suitable for disposal in this manner. If material were classed as a waste and required disposal at a licensed tip the rates would increase significantly.
- 10.3 Data from the Feasibility Study will be used as the basis for making financial bids to various funding bodies. A contingency figure of 20% has been applied to all costs. Estimates are sufficiently robust to enable funding to be sought with a high degree of confidence in the figures.
- 10.4 Table 10.1 shows outline construction costs for restoring the Navigation at £24.7million. The figure includes 15% for professional fees and a 20% contingency to cover potential risks, e.g. ground conditions.

Table 10.1 - Outline Cost of Restoration of the Louth Navigation

Item	Amount	Rate (£)	Total (*£)
Dredged in rural areas and tipped locally	121,500m ³	15/m ³	1,823k
Dredged in urban areas and taken to tip (less than 10km)	13,500m ³	30/m ³	405k
Toe protection (type E2 sheet pile)	710m	400/m	284k
Toe protection (type E2) contingency	500m	400/m	200k
Toe protection (type E3 coir roll)	1350m	60/m	81k
Toe protection (type E3) contingency	500m	60/m	30k
Cattle watering area	4no.	2.5k	10k
Turning Heads	4no.	25k	100k
Services for navigation users	2 no.	60k	120k
Seepage alleviation (type L2 pile) contingency	200m	500/m	100k
Floating boom to Covenham Reservoir intake	1no.	25k	25k
Visitor Moorings	10no.	75k	750k
Sea Lock	1no.	1500k	1,500k
New locks/refurbished locks	8no.	350k	2,800k
Tilting Weir Control Sluice for locks	8no.	100k	800k
Sub total			£9,028k

Table 10.1 - Outline Cost of Restoration of the Louth Navigation (continued)

Item	Amount	Rate (£)	Total (*£)
Carried forward / Sub total			9,028k
Raise Road Bridge – Thoresby Bridge	1no.	1,500k	1,500k
Underpinning works – Fire Beacon	1no.	125k	125k
Raise Road Bridge – Austen Fen Bridge	1no.	500k	500k
Raise Road Bridge – High Bridge	1no.	500k	500k
Raise Road Bridge – Ticklepenny Lock Bridge	1no.	500k	500k
Raise Foot bridge – Alvingham Church Canal Footbridge	1no.	200k	200k
Raise Foot bridge – Eastfield Footbridge	1no.	100k	100k
Raise Foot bridge – Tilting Gate Footbridge	1no.	100k	100k
Raise Existing Bailey Bridge – Riverside Farm	1no.	100k	100k
Provide Swing Bridge – Alvingham Lock Bridge	1no.	600k	600k
Provide Swing Bridge – River Farm Bridge	1no.	400k	400k
Towpath – Improve surfacing	1000m ²	10/m ²	10k
Towpath – Provide gates at stiles	10no.	0.5k	5k
Towpath – Provide improved signage	10no.	1k	10k
Towpath – Fishing decks	3No.	5k	15k
Carpark /picnic areas	3 no.	20k	60k
Services – support services during the works	11no.	10k	110k
Services – Divert 36inch oil pipeline	1no.	2,000k	2,000k
Services – Divert Great Eau Raw Water Transfer Pipeline	50m	500/m	25k
Services – Divert outfall at Keddington Lock	20m	250/m	5k
Pumping station for Alvingham drainage	1no.	250k	250k
Syphon for Alvingham drainage	1no.	150k	150k
Pumping station for sea lock saltwater	1no.	150k	150k
Pumping station for Louth WWTW	1no.	250k	250k
Committed sum for pumping station operation	3no.	150k	450k
Environmental Surveys	Sum	300k	300k
Land purchase/compensation	Sum		200k
Ground Investigation	Sum		200k
Topographical Survey	Sum		80k
Sub total			17,923k
Professional Fees (including EIA)	15%		2,688k
Sub total			20,611k
Contingency	20%		£4,122k
Budget Total			£24,733k

* Price base date December 2004

Source: Faber Maunsell

- 10.5 The above costs do not include the costs of any commercial developments, boat yard or marinas etc.

Voluntary Work

- 10.6 Volunteers could undertake some of the restoration work. A competent contractor would be required for significant amounts of the restoration due to the complexities and special skills involved. A well thought out design by professional engineers will also be required prior to undertaking works. The works will come under the Construction (Design and Management) Regulations, which would require the appointment of a Planning Supervisor and Principal Contractor.
- 10.7 A number of technical skills will be required to execute this project, the major requirements being listed in Table 10.2:

Table 10.2 - Skills Table

Skill	Canal Cut	Locks	Bridges	Culverts and Weirs
Traditional Brickwork	✓	✓	✓	✓
Concrete placing	✓	✓	✓	✓
Sheet Piling	✓			
Groundwork and Excavation	✓		✓	✓
Grouting		✓	✓	
Blacksmith		✓	✓	✓
Pipe laying				✓
Pipe lining				✓
Carpentry (including lock gates)		✓		
Surfacing	✓	✓	✓	
Fencing and Hedging	✓			
Mechanical and Electrical		✓	✓	✓

Source: Faber Maunsell

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11 Environment Scoping Study

Purpose and Objectives

- 11.1 The purpose of this Environmental Scoping Study is to determine, from the possible broad range of potential impacts associated with the restoration of the Louth Navigation, those that are the key significant ones that will require further detailed investigation as part of any future Environmental Impact Assessment. It will also contribute to identifying additional project options and provide direction towards a future preferred option.
- 11.2 To this end, the main objectives of this section are as follows:
- Through interpretation and analysis of information collated from consultation and desk based study, present baseline information with regard to the existing environment e.g. the sensitivity of the receiving environment, the receptors likely to be adversely impacted by the scheme and so forth.
 - Identify the key environmental constraints and opportunities associated with the restoration proposal.
 - Determine the potential impacts of constraints and opportunities (adverse and beneficial) and their significance.
 - Identify where possible, preliminary mitigation measures.
 - Highlight the key significant environmental issues that will need to be addressed in more detail at the next stage of the project.
- 11.3 A Scoping Opinion has not been sought at this stage of the project from the Local Planning Authority.

Approach and Methodology

- 11.4 In order to achieve the above objectives, to provide a robust and comprehensive environmental overview of the study area and to determine the potential impacts of the restoration proposal, an approach using the standard 'Scoping methodology' of an Environmental Impact Assessment (EIA) has been followed.
- 11.5 This involved both a broad consultation exercise and an initial desk based study looking across a wide range of potential environmental receptors.
- 11.6 The initial list of potential key significant issues has been determined by:
- Professional-led expert judgement based on information collated from desk based research, from experience and where possible, on sound scientific principles.
 - Issues raised by consultees.

Consultation and Desk Study

- 11.7 A preliminary consultation exercise was undertaken in October 2004 with a wide range of key stakeholders, both statutory and non-statutory and also included organisations that it was considered might have useful information with regard to the existing environment.
- 11.8 The objectives of this exercise were as follows:
- To inform stakeholders of the present study and the potential options with regard to restoration of the navigation.

- To invite comments from stakeholders on the proposed scheme with regard to potential environmental receptors and associated constraints and opportunities.
- To collate baseline information on the existing environment that may be relevant to the scheme / study area.
- To identify any potential future environmental surveys that may be required.
- To identify any other key stakeholders.

11.9

Stakeholders that were considered would have an interest in the proposed restoration of the Louth Navigation were identified. In total, 108 statutory and non-statutory organisations were consulted. The reason for such a broad-based consultation exercise at this stage was to ensure scoping was undertaken as thoroughly as possible to reduce the possibility of new issues being raised at a later date. The list of statutory and non-statutory consultees can be found in Table 11.1 below.

Table 11.1: Statutory and Non-Statutory Consultees

Statutory Consultees	Non-Statutory Consultees Continued
1. Environment Agency	32. Lincoln Canoe Club
2. English Nature	33. Covenham Sailing Club
3. Countryside Agency	34. Lindsey Marsh Internal Drainage Board
4. Lincolnshire County Council	35. Anglian Water Services Ltd.
5. East Lindsey District Council	36. British Horse Society
Non-Statutory Consultees	37. Ramblers Association (Lincolnshire)
6. Parish Councils	38. Lincolnshire Fieldpath Association
7. English Heritage	39. Louth Area Ramblers Association
8. Council for British Archaeology (East Midlands)	40. Sustrans
9. Heritage Trust of Lincolnshire	41. Lincolnshire Tourism
10. National Monuments Record Office	42. Witham and District Joint Anglers' Federation
11. The Society For Lincolnshire History and Archaeology	43. Anglers Conservation Association
12. Campaign to Protect Rural England	44. Lincolnshire Anglers Consultative Association
13. East Midlands Development Agency	45. National Federation of Anglers (East Midlands Region)
14. Government Office for the East Midlands (Rural Affairs Team)	46. Grimsby and District Amalgamated Society of Anglers
15. Rural Development Service	47. Boston and District Angling Club
16. Farming and Wildlife Advisory Group	48. Marine Conservation Society
17. National Farmers Union	49. Lincolnshire Wildlife Trust
18. Country Land and Business Association	50. British Ecological Society

Table 11.1: Statutory and Non-Statutory Consultees (continued)

19. Lincolnshire Wolds Countryside Service	51. Biological Records Centre
20. The British Association for Shooting and Conservation (Midlands)	52. Lincolnshire Bat Group
21. Groundwork Lincolnshire	53. The Royal Society for the Protection of Birds
22. Community Council for Lincolnshire	54. British Trust for Ornithology
23. Louth Civic Trust	55. National Trust (East Midlands)
24. Louth Navigation Trust	56. The Mammal Society (Lincolnshire)
25. Humber Mouth Boat Club	57. Lincolnshire Badger Group
26. Inland Waterways Association	58. Woodland Trust
27. British Canoe Union	59. Lincolnshire Bird Club
28. British Waterways	60. The Bat Conservation Trust
29. Defence Estates	61. The Lincolnshire Naturalists Union
30. Louth and District Canoe Club	62. Amphibian and Reptile Group (Lincolnshire)
31. Boston Canoe Club	63. British Trust for Conservation Volunteers
32. Lincoln Canoe Club	64. The National Biodiversity Network

- 11.10 The consultation pack (see Appendix D) was designed specifically for the broad spectrum of organisations being consulted at this stage of the project.
- 11.11 The results of the consultation exercise can be found in Appendix E and detail both comments from key stakeholders and also how comments have been addressed, or need to be addressed during future stages of the project.
- 11.12 In summary, a total of 108 individual consultation packs were sent to 80 organisations with 46 packs being completed and returned. This represents a very high return rate (42%) for this type of exercise. Of those who responded, 48% supported the scheme in principle.
- 11.13 Information and issues collated from the consultation exercise have been integrated where appropriate into both the 'Existing Environment' section and 'Identification of Environmental Impacts and Enhancement Opportunities' section.

Existing Environment

Human Beings – Residential and Commercial

Residential Properties

- 11.14 There are few concentrations of residential properties within the immediate vicinity of the Louth Navigation. The exceptions are some existing residential properties to the east of Louth within the Riverhead area, primarily on the right hand bank. This also includes an area on the north bank where planning consent has been given for a major new development to be set back from the navigation with up to 100 new houses and flats. The only other concentration of residential properties within the immediate vicinity of the navigation are those at Tetney Lock.
- 11.15 There are however, numerous individual properties (mostly farmhouses) adjacent to the navigation throughout its length. These are generally located near to bridge crossings.

11.16 Although not immediately adjacent to the navigation itself, Alvingham and North Cockerington are worthy of note as they lie approximately 0.5km either side of the existing navigation route.

Commercial Properties

11.17 The Riverhead area on the east side of Louth also has some commercial properties next to the navigation. The nature of the businesses here has not been identified as part of this study.

Commercial Fishing

11.18 Prior to June 2004 the Louth Navigation as with many other rivers in Lincolnshire, was open to licensed netmen to net eels. However, due to a national decline in eel numbers (poor recruitment, barriers to migration, commercial over-fishing and so forth), there has been a reduction in interest from licensed netmen over the past few years. For this reason, the Environment Agency has recently taken the decision not to lease the netting rights on Agency owned waters for the foreseeable future as a conservation measure. The Louth Navigation is included in this restriction.

Flood Defence and Drainage

11.19 The Louth Navigation and River Lud are both classified as Main Rivers. The navigation provides the primary drainage channel within this area with numerous smaller drains flowing perpendicular and into the canal that are either gravity fed, pumped or both. Small land drainage pumping stations can therefore be found throughout the study area. This system is designed to provide flood protection to the surrounding catchments.

Human Beings – Recreation and Amenity

Angling (also see section 12.0)

11.20 The Witham and District Joint Anglers' Federation control fishing rights on the Louth Navigation between Austen Fen and Tetney Lock. In addition, the Boston and District Angling Club and the Grimsby and District Amalgamated Society of Anglers also have joint rights to fish the Louth Navigation as members of Witham and District Joint Anglers' Federation. The navigation is a popular recreational fishery enjoyed by both local and visiting anglers. The area around Tetney is particularly popular. The overall extent of use by anglers' i.e. geographical preferences, general popularity and seasonal changes in use is largely unknown.

Public Rights of Way (also see Section 6)

11.21 Public footpath No. 343 runs along the right-hand bank of the Louth Navigation from Riverhead to Tetney Lock Bridge. Downstream of this bridge, footpath No. 18 joins the navigation and continues towards the coast and Northcoates Point. Access is also possible on the left-hand bank, footpath No. 12, from just upstream of Tetney Lock to the coast at Tetney Haven. In addition, very limited public access is also possible at two further locations on the left-hand bank; these are at Riverhead and immediately upstream of Thoresby Bridge.

Cycling (also see section 12.0)

11.22 The use of public access routes along the navigation corridor by cyclists is unknown. However, it is possible that those riding mountain bikes may use them.

11.23 It is noted that Sustrans are proposing a new cycle path (No 12) from Cleethorpes via Humberston and Tetney to Louth.

Walking (also see section 12.0)

11.24 There is good public access along the whole length of the right hand bank of the Louth Navigation that is used for walking, particularly close to the Riverhead area. The Trust has installed mileposts along the entire length of the navigation to encourage walkers to utilise the whole of this facility. The overall extent of use of this access route is not known.

Horseriding and Bridleways

11.25 There are no public bridleways along the length of the Louth Navigation. However, there is a short public bridleway that runs towards the navigation from Covenham Reservoir, although its use is likely to be limited by the fact that it does not continue along the navigation itself.

Parks and Open Space

11.26 Hubbards Hills and Westgate Fields are two areas of open green space on the outskirts of Louth that are popular with both local residents and visitors, particularly during the warmer months and are used for picnicking, walking and jogging. The River Lud also flows through these parks. A smaller area of open space within Louth that is planned for regeneration is Springfields.

Tourism (also see section 12.0)

11.27 Louth has a multitude of attractions to offer, many of which are historic in nature. There is a 16th Century Gothic Parish Church with a 300 foot spire, a nationally registered independent museum and a fully refurbished and restored Navigation Warehouse in the Riverhead area providing links to the 18th and 19th Century when Louth was a key trader with Hull, London and many other coastal ports via the Louth Navigation. In addition, there is the Lincolnshire Wolds immediately to the west of Louth that is designated as an Area of Outstanding Natural Beauty (AONB).

11.28 Along the length of the Louth Navigation itself, there are numerous holiday homes and Bed and Breakfast style accommodation that cater for tourists visiting this area.

Navigation

11.29 The Louth Navigation is not presently classified as a navigable watercourse and for most craft is not navigable, although it is used informally by people in canoes and kayaks. However, many of the original lock structures do still exist from 1770 when the navigation opened as a trade route. Since 1924 when the canal closed, all structures have been subject to decay and are presently in a state of disrepair.

Flora and Fauna**Statutory Designated Sites – Coastal**

11.30 The most prominent designated sites within the study area are the Humber Flats, Marshes and Coast (Phase 1) and the Humber Estuary. Both have international designations (Ramsar Site, Special Protection Area (SPA) and proposed Special Area for Conservation (pSAC)). These designations reflect a coastal / estuarine wetland habitat of international conservation importance that sustains rare and vulnerable birds, regular migratory species and a diverse range of flora and fauna.

11.31 The Humber Estuary has also recently been designated as a Site of Special Scientific Interest (SSSI), primarily because it supports many nationally important species.

11.32 There is also a National Nature Reserve (NNR), Donna Nook, which has been designated for its mosaic of important coastal habitats including dunes, slacks and inter-tidal areas.

11.33 The Louth Canal drains directly into the areas designated as Ramsar, SPA, cSAC and SSSI and approximately 5km up the coastline, north-west of the NNR.

11.34 All relevant sites are documented in Table 11.2.

Statutory Designated Sites – Inland

11.35 There is only one statutory designated site within the study area inland. This is Tetney Blow Wells, a series of four large artesian springs with associated flora and fauna.

11.36 It is located approximately 1.5km to the east of the Louth Navigation. Water arising from the Blow Wells drains via the Waithe Beck to the navigation.

11.37 The details of all statutory designated sites are listed in Table 11.3 below. For further information with regard to designations, please follow the internet citation links.

Table 11.2: Statutory designated sites

Designation and Site	Reason	Habitat Type, Location and Context	Citation Link
Ramsar Site: The Humber Flats, Marshes and Coast (Phase 1)	Wetland designated as internationally important.	Coastland. The Louth Navigation drains into the designated area.	www.wetlands.org.uk
Special Protected Area (SPA): The Humber Estuary	Rare and vulnerable birds listed in Annex 1 to the Birds Directive and for regularly occurring migratory species.	Coastland. The Louth Navigation drains into the designated area.	www.jncc.gov.uk
Proposed Special Area of Conservation (pSAC): The Humber Flats, Marshes and Coast	For various coastal habitats and species.	Coastland. The Louth Navigation drains into the designated area.	www.jncc.gov.uk
Site of Special Scientific Interest (SSSI): Humber Estuary	Supports many nationally important species.	Coastland. The Louth Navigation drains into the designated area.	www.english-nature.gov.uk
Site of Special Scientific Interest (SSSI): Tetney Blow Wells	Four large artesian springs plus associated flora and fauna.	Marsh / Wetland (NGR TA 320 007). The Louth Navigation is located approximately 1.5km to the east.	www.english-nature.gov.uk
National Nature Reserve: Donna Nook	Designated for biological or earth science interests. Dunes, slacks and inter-tidal areas.	Coastland. The Louth Navigation drains into the sea approximately 5km up the coastline, north-west of this designated area.	www.lincstrust.org.uk

Non-Statutory Designated Sites – Coastal

11.38 The Humber Flats, Marshes and Coast (Phase 1) is also designated as an Important Bird Area (IBA), again reflecting the species, numbers and significance of birds which inhabit this part of the coastline.

11.39 The Tetney to Mablethorpe Coastal Conservation Area (CCA1) is one of three such areas designated as part of the East Lindsey Local Plan. The aim of this designation is to protect the remaining landscape character and natural interest of the coast. The Louth Canal drains directly through CCA1.

Non-Statutory Designated Sites – Inland

11.40 There are two Lincolnshire Wildlife Trust (LWT) Nature Reserves within the study area. One is Tetney Blow Wells (see above) and the second is Covenham Reservoir, the south east corner of which is managed for wildlife.

11.41 Covenham Reservoir is located approximately 0.5km to the west of the Louth Navigation.

11.42 In addition, there are four wildlife sites adjacent to the navigation; namely Thoresby Bridge Ponds, Tetney Flood, New Delights and Barley's Pond at Tetney Lock.

11.43

The details of all non-statutory designated sites are listed below. For further information with regard to designations, please follow the citation links.

Table 11.3: Non - statutory designated sites

Designation and Site	Reason	Habitat Type, Location and Context	Citation Link
Important Bird Area (IBA): The Humber Flats, Marshes and Coast (Phase 1)	Hold significant numbers of one or more globally threatened species. Hold restricted range species. Hold exceptionally large numbers of migratory or congregatory species.	Coastland. The Louth Navigation drains into the designated area.	www.birdlife.net
Coastal Conservation Area (CCA1): Tetney to Mablethorpe	To protect the remaining landscape character and natural interest of the coast.	Coastland. The Louth Navigation drains into the designated area.	www.e-lindsey.gov.uk
LWT Nature Reserve: Tetney Blow Wells	Four large artesian springs plus associated flora and fauna.	Marsh / Wetland (NGR TA 320 007). The Louth Navigation is located approximately 1.5km to the east.	www.english-nature.gov.uk
LWT Nature Reserve: Covenham Reservoir	The south –east corner is managed for wildlife conservation.	Marsh / Wetland (NGR TF 349 955). The Louth Navigation is located approximately 0.5km to the west.	www.lincstrust.org.uk
County Wildlife Site: Thoresby Bridge Ponds	Two angling lakes with a diverse marginal wetland flora.	Standing Water (NGR TF 335998)	www.lincstrust.org.uk
County Wildlife Site: Tetney Flood	A swamp in a man made flat depression about 200m long by 5m wide. Nearly all the vegetation stands in 10-25cm of water.	Swamp, grassland (NGR TA 331001)	www.lincstrust.org.uk
County Wildlife Site: New Delights	Not surveyed since 1994 and no information available regarding this site.	(NGR TA 333008)	www.lincstrust.org.uk
County Wildlife Site: Barley's Pond, Tetney Lock.	One large fishing lake and one smaller lake with reasonably diverse flora of commoner species including Hairlike pondweed that is a Lincolnshire endangered species.	Standing water (NGR TA 340021)	www.lincstrust.org.uk

Protected Species

Great Crested Newt

11.44 No surveys for great crested newt have been undertaken as part of this Environmental Scoping Study. However, there is a record from north-east Lincolnshire, although its geographical association with the study area cannot be confirmed from the data available. It is very unlikely that great crested newts occur within the navigation itself; they are very fastidious in their habitat requirements. However, it is considered a possibility that they might inhabit certain ponds (and terrestrial habitat between such ponds) in the study area, some of which are in close proximity to the navigation.

11.45 *Legislation:* It is protected by Schedule 2 of the Conservation (Natural Habitats, etc.) Regulation, 1994 and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). The great crested newt is also a national priority Biodiversity Action Plan species.

Natterjack Toad

11.46 No surveys for natterjack toad have been undertaken as part of this Environmental Scoping Study. However, there are records for this species associated with the upper saltmarsh and sand dune habitats within the coastal area near Tetney.

11.47 *Legislation:* The natterjack toad is listed on Appendix II of the Bern Convention and Annex IVa of the EC Habitats Directive. It is protected by Schedule 2 of the Conservation (Natural Habitats, etc.) Regulation, 1994 and Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). The natterjack toad is also a national priority Biodiversity Action Plan species.

Water Vole

11.48 No water vole surveys have been undertaken as part of this Environmental Scoping Study. However, water voles are known to be present within the Louth Navigation although their geographical distribution and population density at this stage is not known.

11.49 *Legislation:* Water vole habitat (their place of shelter or protection) is protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). The water vole is also a national priority Biodiversity Action Plan species.

Bats

11.50 No bat surveys have been undertaken as part of this Environmental Scoping Study. However, it is possible that bats may utilise bridge structures, culverts and old lock structures as roosting habitat along the whole length of the navigation.

11.51 Species previously recorded along the navigation in flight include pipistrelle, daubenton, brown long eared, noctual's and natterer's.

11.52 Generally, the Louth Navigation is fairly under-recorded with regard to bats. There is a known colony of natterer's bats at Covenham. In addition, it is considered that there may be daubenton's roosting in a culvert through which the canal flows, approximately 50m upstream from the Navigation Warehouse. A recent survey found daubenton's migrating downstream from this area although no roost was located.

11.53 The canal basin adjacent to the Navigation Warehouse is a very important feeding area for daubenton bats, which have been observed feeding here in large numbers. The canal corridor itself provides an important feeding area for bats. A recent survey found both daubenton's and pipistrelle's feeding intermittently for a distance of approximately 1km downstream from Louth.

11.54 With regard to the Louth Navigation at Tetney Haven, very little work has been done on the coastal distribution of bats. However, there are enough coastal records to suggest that there is a lot of bat activity along the coast in this location with pipistrelle's (45mhz) and Noctual's recorded feeding in these open areas e.g. there is a record of pipistrelle's feeding at the outfall end of the Louth Canal along the strandline.

11.55 *Legislation:* All species of bat are listed on Annex IV of the EC 'Habitats and Species Directive'. The domestic legislation which implements this directive, combined with other UK legislation, ensures that individual bats and their breeding sites and resting places are protected. All bats are national priority BAP species.

Birds (Schedule 1 Species)

11.56 Only one schedule 1 species has been recorded within the vicinity of the navigation; the barn owl. These have been noted throughout the study area from Alvingham to Tetney Lock.

Badgers

11.57 No surveys for badger were undertaken as part of this Environmental Scoping Study. However, it is very likely that badgers are present within the study area.

11.58 *Legislation:* Badgers and their setts are protected under the Protection of Badgers Act 1992.

Spined Loach

11.59 No surveys for spined loach were undertaken as part of this Environmental Scoping Study. It is not known whether spined loach are present in the Louth Canal although the habitat available, slow flowing water with a fairly diverse vegetation over a silty substrate, does meet their requirements.

11.60 *Legislation:* This species is considered to be threatened within Europe and for this reason, is on Appendix 3 of the Bern Convention and Annex II of the EC Directive on the conservation of natural habitats and flora and fauna. It is also a local priority BAP species within Lincolnshire.

Non-Protected Species

Plants and Associated Habitat

11.61 The diversity of vegetation types along the banks of the Louth Navigation is presently unknown. However, it is likely at the very least to be made up of a range of common grasses and plants along its banks and margins including areas of taller vegetation such as shrubs and trees.

11.62 With regard to aquatic plants, a number of species are known to be present within the navigation and include moss, brooklime, water cress, Nuttalls' pondweed, various broad-leaved and narrow-leaved pondweeds, water mint, water forget-me-not, reed sweet grass and rigid hornwort (*source: Environment Agency pers. comm.*). Barley's Pond at Tetney Lock has records of Hairlike Pondweed (*Potamogeton trichoides*) that is considered to be an endangered species in Lincolnshire (*Source: LWT 2004*). Barley's Pond is immediately adjacent to the navigation and for this reason; it is possible that unrecorded species may be present in the navigation channel.

Terrestrial Invertebrates

11.63 No surveys for terrestrial invertebrates were undertaken and no data inventories have been identified. However, one particular species of note is the marsh moth that is only found at two nature reserves along the coastal belt of Lincolnshire. In Great Britain, this species is classified as 'Rare'. The marsh moth is also a national priority Biodiversity Action Plan species.

Aquatic Macroinvertebrates

11.64 The Louth Navigation has a diverse aquatic macroinvertebrate fauna, throughout most of its length and particularly in areas where a more natural habitat has developed since the closure of the navigation. The more diverse habitats have generally developed in and around old lock structures where debris such as brickwork has fallen into the watercourse creating a more heterogeneous habitat that is shallower and well oxygenated compared to a typical canal cross section. Typical fauna found at Ticklepenny Lock, Alvingham, High Bridge Alvingham, Fire Beacon and Tetney Lock includes a range of water snails, beetles, leeches, mayfly larvae, bugs, damselfly larvae, crustaceans and caddis fly larvae. Of particular note is *Riolus subviolaceus*, a water beetle of national significance, *Phryganea grandis*, a cased caddis fly larva of regional significance and *Ranatra linearis* (a water stick insect of local significance).

Fish

- 11.65 The character and nature of the Louth Navigation between Riverhead and the sea lock, predominantly slow flowing water over a silt substrate, is reflected by the fish species that inhabit most of this length of canal; namely lowland species (see Table 11.4).
- 11.66 The diversity of habitat for fish in the navigation is generally poor. However, the Environment Agency has previously noted the presence large numbers of fish associated with dense stands of common reed along the watercourse. Also of note is an off-line fish refuge at NGR TA 333003 that was constructed by the Environment Agency in 1996. The bank was cut out and a small lake built adjacent to the navigation. There is presently direct access for fish in and out off this area that has proved very successful as an additional habitat, particularly during periods of high flow.
- 11.67 The importance of existing features within the navigation that provide some degree of habitat diversity for fish species is essential in helping sustain the current stock levels.
- 11.68 The Louth Navigation in 2004 was recorded as a Class C fishery.

Table 11.4: Fish Species (2004)

High Bridge	Fire Beacon Bridge	Tetney Lock
Brown / sea trout	Common bream	Dace
Dace	Roach	Common bream
Gudgeon	Ruffe	Roach
European eel	Perch	Ruffe
Stone loach	Pike	Silver bream
-	-	Perch
-	-	Pike
-	-	Flounder
-	-	Roach x silver bream hybrid
-	-	Roach x common bream hybrid

Data source: Environment Agency (2004): Summary Report Fisheries Survey.

- 11.69 Just outside the study area and of importance is the River Lud (spring fed from the Lincolnshire Wolds chalk aquifer) upstream of Louth that flows into the Louth Navigation. The river here is characterised by a riffle and pool type habitat and fish species such as native brown trout, brook lamprey, stone loach and bullhead. Restoration of the navigation below Louth may provide important opportunities to enhance this more specialised and ecologically sensitive ecosystem e.g. removal of barriers for migratory salmonid species by incorporating fish passes into any new and existing structures.
- Amphibians**
- 11.70 No surveys for amphibians were undertaken and no data inventories have been identified. However, species very likely to be present within the study area include common frog, common toad and the smooth newt.
- Reptiles**
- 11.71 No surveys for reptiles were undertaken and no data inventories have been identified. However, species very likely to be present within the study area include common lizard and grass snake.

Birds – Coastal (Tetney Haven)

11.72 The Tetney Haven as described previously has a number of international designations. Of particular relevance are the Ramsar and SPA (Special Protection Area) designations that are directly related to the bird interests of this area. The Humber area (including the Tetney Haven) is an extremely important area for breeding, feeding, roosting and migrating birds. It has over 54,000 birds and is part of an important network of European sites for roosting birds, both migratory and resident. In addition, this area supports sites with over 20,000 overwintering wading birds of international importance.

11.73 The birds within the Tetney Haven can be divided into two groups. There are breeding birds e.g. up to 80 redshank breed here and roosting birds (including those birds on migration routes) e.g. grey plovers use this area at low tide whilst shell duck and brent geese use this area at high tide in the winter months. The whaleback sandbank is a high tide roost for wading birds and is a particularly important feature in this area.

Birds – Inland (Louth Navigation and Associated Environment)

11.74 The route of the Louth Navigation is also provides important breeding, roosting and feeding habitat for birds.

11.75 Three Schedule 1 species (birds that are afforded special protection at all times) have been recorded within the study area; barn owls, kingfishers and little ringed plovers. Barn owls are common in both the Middle Marsh and Outmarsh and are very likely to breed within the study area. They have been recorded throughout the length of the navigation. Kingfishers have been recorded but usually outside the breeding season. Little ringed plovers nest at Covenham Reservoir but not along the canal itself.

11.76 Most of the common waterfowl breed along the system, primarily within the adjacent weedy drains. However, ducklings may be brought to the canal. The canal nearer to Louth runs through the Middle Marsh which has more bushes, trees, scrub, buildings and other structures and thus a more diverse breeding community comprising mainly common farmland and woodland species.

11.77 Sparrowhawks and kestrels have become more common and widespread throughout the county. Hobbies have also colonised within this area and have been regularly recorded hawking over Covenham Reservoir. Although they breed in this area, there are no records within 1km of the canal. Marsh Harriers have also been recorded in this area, but there are no records of breeding birds.

11.78 Hen harriers, peregrines, merlins and short eared owls have been recorded wintering in the Outmarsh area.

11.79 Grey wagtails are known to winter along the canal between Louth and Alvingham and nest upstream of Louth, one of their two or three breeding sites for the county.

11.80 The Outmarsh also has a good range of open country birds including skylark, yellow wagtail and both reed and corn bunting. However, the main importance of the Outmarsh is for wintering birds. Several hundred curlew feed, well dispersed between the canal and the coast and in some years there are good numbers of wintering lapwings, golden plover, grey geese and brent geese. Large numbers of mallard, wigeon and teal that roost by day at Covenham Reservoir or in the saltmarsh creeks on shore move to this area to feed at night.

Mammals

11.81 There are good population s of four species of wild deer in the County with roe and muntjac found adjacent to the canal.

Air

Air Quality

- 11.82 East Lindsey District Council (ELDC) undertakes air quality monitoring as part of the National Air Quality Strategy (NAQS). The most likely sources of air pollution likely to influence air quality as a result of local activity within the area are domestic fuel usage and motor vehicles.
- 11.83 A recent review has been completed and no areas within the county were identified as exceeding the national air quality standards. It can therefore be assumed that the air quality throughout the length of the navigation is currently satisfactory. No Air Quality Management Areas (AQMA) have been declared by ELDC.

Noise

- 11.84 No ambient noise monitoring has been undertaken as part of this study. However, a general assessment of existing noise sources has been undertaken. As the majority of the Louth Navigation flows through a largely rural landscape, ambient noise levels are expected to be relatively low compared to within market towns and villages. The general sources of ambient noise throughout the study area are most likely to be from traffic and farming practices.
- 11.85 There are key locations through the length of the navigation where noise levels may be intermittently raised. In most cases these are associated with existing road crossings and include the A1031 and a number of unclassified roads.
- 11.86 In addition, military aircraft use this area for training purposes.

Landscape and Visual Amenity

Landscape Designations

- 11.87 There is only one statutory designated landscape area within the study area. This is the Lincolnshire Wolds Area of Outstanding Natural Beauty (AONB). It lies immediately to the west of Louth and the Louth Navigation.

Landscape Character Areas

- 11.88 The Louth Navigation falls within the 'Lincolnshire Coast and Marshes' national Landscape Character Area (LCA). This Landscape Character Area has been further subdivided into five landscape types based on a district level Landscape Character Assessment. The Louth Navigation flows through three of these areas; namely Middle Marsh, Open Marsh and Naturalistic Coast. Each are described in turn below.

Lincolnshire Coast and Marshes (National Level LCA)

- 11.89 The Lincolnshire Coast and Marshes LCA is an open landscape with undulating land adjacent to the Wolds that gradually flattens eastwards toward the coastal plain. Agricultural activities have shaped much of this LCA with land being drained via numerous ditches and dykes amongst both mixed arable land (predominantly in the west) and pasture land (predominantly in the east). The Louth Navigation is the major drainage channel in this area. There are many small, dispersed farm units scattered amongst sparse settlements that become more concentrated along the coastline. Here the land is mostly devoid of woodland and hedgerows, features that do become more common towards the foot of the Wolds.

Middle Marsh (District Level LCA) Landscape Type 1

- 11.90 The Louth Navigation flows through the Middle Marsh landscape type between Louth and High Bridge (NGR TF 375922). The land here is undulating and typified by small to medium sized fields of pasture with some arable bounded by hedgerows with mature trees. There are nucleated / linear settlements with associated mature trees and churches, often forming dominant landscape features and linked by sinuous roads.

Open Outmarsh (District Level LCA) Landscape Type 2

- 11.91 From High Bridge to the sea lock, the navigation flows through the Open Outmarsh landscape type. Here, the land is predominantly flat and the landscape very open, typified by medium to large sized geometrically shaped arable fields and bounded by discontinuous hedges, usually without mature trees present. Settlements are linear in nature with interspersed isolated farmsteads linked by long straight roads. Long straight drainage ditches, sometimes with raised embankments also dissect this landscape.

Naturalistic Coast (District Level LCA) Landscape Type 5

- 11.92 Downstream of the sea lock the Louth Navigation channel enters the Naturalistic Coast landscape type. The land here is flat and made up of large, open areas of saltmarsh, mudflats and sandbanks dissected by winding creeks and drainage ditches. Embanked drainage ditches and sea defences are the only raised features within this landscape type.

Visual Amenity

- 11.93 The key visual features of the landscape associated with the Navigation are primarily, its openness and rural nature as described above. Such features will be particularly important to both residents living near to the navigation and those who enjoy the facilities the navigation has to offer such as its extensive footpaths.

Water**Water Quality**

- 11.94 The chemical water quality of the Louth Navigation upstream of Louth WWTW was recorded as very good (Grade A) in 2003. However, water quality does deteriorate immediately downstream (Grade D / E) of Louth WWTW due poor dilution i.e. a large volume of effluent discharging into a relatively small water body. There is some recovery further downstream where the overall quality is recorded as Grade C (fairly good).

- 11.95 The whole length of the Louth Navigation is situated in a designated Nitrate Vulnerable Zone (NVC). The primary reason for this designation is that surface waters in this area, including the Louth navigation, contain or could contain nitrate concentrations of greater than 50mg/l. The primary source of excess nitrates is from agricultural land. In addition, there is also a small zone within the vicinity of Covenham Reservoir where groundwater is also sensitive to increased nitrate levels.

- 11.96 Biological quality during 2003 was recorded as fairly good overall (Grade C).

Water Quantity

- 11.97 Please refer to Section 7.0 for details.

Land Use**Agriculture**

- 11.98 The study area associated with the Louth Navigation is predominantly used for agricultural purposes. Immediately east of Louth, the land is primarily used for cultivating cereals with some short-term pasture. As the navigation changes direction to the north, cereals along with sugar beet, potatoes and field vegetables dominate to where the canal discharges into the Tetney Haven. There is some summer grazing associated with the area of saltmarsh below the sea lock.

- 11.99 The land adjacent to the navigation is primarily classified as Grade 3. Towards Tetney Lock, the navigation flows through a limited area of Grade 2 and a slightly larger area of Grade 1 agricultural land.

Flood Defence and Drainage

- 11.100 There are various flood defence embankments throughout the length of the navigation that run adjacent to the canal.

11.101 The Louth Navigation and River Lud are both classified as Main Rivers. The navigation provides the primary drainage channel within this area with numerous smaller drains flowing perpendicular and into the canal that are either gravity fed, pumped or both. Small land drainage pumping stations can therefore be found throughout the study area. This system is designed to provide flood protection to the surrounding catchment.

Recreation and Amenity

11.102 See 'Human' for information regarding footpaths and other recreation facilities.

Habitats (man-made, semi-natural, natural)

11.103 There are numerous small ponds located throughout the study area, a number of which are situated very close to the navigation itself.

11.104 The canal corridor itself provides an extremely important longitudinal wildlife habitat incorporating flowing water of varying depths, aquatic margins and extensive grassed banks with scrub and trees.

11.105 Downstream of the sea lock, the navigation channel cuts through an area of intertidal mudflat and saltmarsh habitats.

Development

11.106 The market town of Louth is the largest urban area within the study area and is situated at the top end of the navigation. Towards the bottom end lies Tetney, the second largest settlement. Other smaller villages and hamlets situated along the length of the navigation include Keddington, Alvingham and North Cockerington, which lie closest to the watercourse and South Cockerington, Yarburgh, Covenham St. Mary, Covenham St Bartholomew, Fulstow, Grainthorpe, Marshchapel, North Cotes and Tetney Lock which lie some distance away.

11.107 The study area is also interspersed with small, scattered farmsteads and individual isolated properties, a number of which lie immediately adjacent to the navigation at bridge crossings.

11.108 Within Louth itself and adjacent to the canal is the Louth Navigation Warehouse that is used for educational and social purposes as well as a meetings venue, cafe and offices.

Services and Utilities

11.109 Please refer to Section 8.0 for detail.

Infrastructure

11.110 The study area encompasses a network of unclassified roads linking market towns, villages, hamlets and individual farmsteads. There is only one major route within the area, the A1031 that runs from the coast near North Somercotes and north-west towards Humberston. It crosses the Louth Navigation at Thoresby Bridge.

Cultural Heritage, Archaeology and Material Assets

General

11.111 The Louth Canal and its environs have a high archaeological potential, particularly with regard to areas where waterlogged conditions still exist and preserved deposits remain. It is likely that the construction of the canal may have destroyed any archaeological remains (pre 1760) within its immediate footprint. However, the following summary of important historical features reflects the nature and potential archaeological sensitivity of this environment.

11.112 For the purpose of this study, data was only collated from the National Monuments Records (NMR) Centre and the Lincolnshire Historic Environment Records (HER). The NMR and HER records highlighted 71 items of historic interest within the study area.

Designated Assets

Scheduled Ancient Monuments (SAM's)

- 11.113 There are three records of Scheduled Ancient Monuments within the study area. There is a deserted village at Brackenborough (approximately 2km west of the navigation), Louth Park Abbey remains (approximately 0.5km east of the navigation) and North Cockerington Hall Moated Site (approximately 0.5km east of the navigation).

Listed Buildings and Structures

- 11.114 There are a number of listed buildings and structures associated with the navigation and its environs. These are documented in Table 11.5 below. Further detail with regard to the locks can be found in section 4.0 of this report.

Table 11.5: Listed Building and Structures

Building or Structure	Details
Louth Park Abbey (TF 355885)	Listed building Grade I (also SAM).
Church of St Adelwold (TF 367913)	Listed building Grade I. 13 th Century and later.
St. Mary's Church, North Cockerington (TF 367 913)	Listed building Grade I. Norman and later.
Church of St Mary, Keddington	Listed building Grade II.
Alvingham Lock and Inverted Syphon (TF 533 907)	Listed building Grade II.
Keddington Lock (TF 345886)	Listed building Grade II and of unusual design with sidewalls consisting of four concave sections.
Tickle Penny Lock (TF 351889)	Listed building Grade II and of unusual design with sidewalls consisting of four concave sections.
Willows (Carrotts) Lock (TF 352895)	Listed building Grade II and of unusual design with sidewalls consisting of four concave sections.
St. Margaret's Church, Keddington (TF 344886)	Listed building Grade II. Medieval church with a Transitional south doorway and decorated detail.
Alvingham Water Mill (TF 366914)	Listed building Grade II. Watermill, built in 1782, machinery restored in 1972 and is used regularly. Site of a watermill in 1155. The site also houses a museum.
Crown Water Mill (TF 336877)	Listed building Grade II. Watermill (1716) with late 19 th Century buildings. Waterwheel and turbine are still present. Watermill at site mentioned in domesday book.
Brackenborough Hall, Brackenborough	Listed building Grade II.
Bridge Farmhouse, Austen Fen	Listed building Grade II.

Table 11.5: Listed Building and Structures (Continued)

Building or Structure	Details
Brick Navigation Warehouse (TF 369 946)	Listed building Grade II. Brick 19 th Century navigation Warehouse at Austen Fen where section of river navigation opened in 1767.
Stables at Keddington Corner Farmhouse (TF 354 896)	Listed building Grade II.
Ruins at the Priory (TF 333 876)	Listed building Grade II.
Mausoleum at the Priory (TF 334 876)	Listed building Grade II.
The Lincolnshire Poacher Hotel (TF 337 878)	Listed building Grade II.
The Woolpack Public House (TF 337 879)	Listed building Grade II.
Seymour and Castle Warehouse (TF 337 879)	Listed building Grade II.
Crown Mills (TF 335 878)	Listed building Grade II.
Baines Flour Mill (TF 338 880)	Listed building Grade II.
Warehouse at Thoresby Bridge (TF 335 997)	Listed building Grade II.

Parks, Gardens and Battlefields

11.115 There are no Registered Parks and Gardens or Registered Battlefields within the study area.

Conservation Areas

11.116 Part of the Louth Navigation falls within the Louth Conservation Area at the Riverhead end and within Louth itself.

Non-Designated Assets

11.117 The NMR and HER records also list a number of important features (non-designated) associated with the Louth Navigation and its environs that provide an important insight into the history of this area.

Prehistoric Sites (to c.AD 43)

11.118 A possible Bronze Age round barrow seen as cropmarks and a Prehistoric or Roman enclosure, also seen as cropmarks, are located near Keddington Corner.

Roman (AD64-c. AD410)

11.119 A group of 3rd and 4th century mainly Romano-British pottery are recorded from Tetney and some Roman coins (of Maxentius and Alexander Servus) are recorded from Keddington.

Medieval and Post Medieval (1066 – 1900)

- 11.120 There are various records from the Medieval or Post Medieval period including the remains of the Gilbertine Priory at Alvingham (includes precincts, moats, fish ponds and a building seen as earthworks), a settlement by the River Lud at Keddington Corner, a settlement associated with Alvingham village (including pond, enclosures, boundary bank and ridge and furrow), a linear settlement near North Cockerington (including a holloway, enclosures and ponds seen as cropmarks and earthworks), enclosures and boundaries at Tetney Haven and near Tetney Lock, saltern mounds at various locations, a pond, boundary banks, ridge and furrow and ditches near Keddington, a possible water channel immediately west of Louth WWTW and another water channel associated with the Medieval abbey at Louth.
- 11.121 The Louth Canal itself is listed, identified as a linear feature that was used for navigation purposes between 1761 and 1848. The navigation now serves as the primary drainage channel in this area.
- 11.122 There are also various shipwrecks listed within the Tetney Haven between the late 18th century and late 19th century.

Traffic and Transport

- 11.123 Due to the largely rural nature of the study area and the network of unclassified roads, it is very likely that traffic volume, journey delays and congestion are relatively low. However, no data is available at present to confirm this.
- 11.124 It has been noted that within Louth itself, congestion can be an issue during peak hours i.e. rush hour. This also includes the Riverhead area (*pers comm.*).

Geology, Soils and Contaminated Land

Geological and Soil Formation

- 11.125 From Louth east, the navigation cuts through Holderness Soil overlying a chalky till. These are slowly permeable, seasonally waterlogged fine loamy soils. As the navigation changes direction to the north, so does the type of soil, to Newchurch 2 Soil that overlies a marine alluvium. These are deep stoneless, mainly calcareous clayey soils. As the navigation turns east at Tetney Lock, the soil type changes again to Agney Soil, again overlying a marine alluvium. These are deep stoneless calcareous fine and coarse silty soils. Downstream of the sea lock, the soil is classified as Unripened Gley Soil. These are soils of various textures that are regularly inundated by high tides.

Designated Geological Sites

- 11.126 There are no known Geological Sites of Special Scientific Interest (SSSIs) or Regionally Important Geological Sites (RIGS) within the study area.

Contaminated Land

- 11.127 There are two sites close to the proposed navigation that may have contamination issues. These are at Riverhead Road, Louth (NGR TF 338881) and Eastfield Road, Louth (NGR TF 341880).

Identification of Environmental Constraints, Opportunities and Associated Potential Impacts

Overview

- 11.128 The primary objective of this section is to highlight the key environmental receptors that may be impacted upon, either adversely or beneficially, by the construction and / or operational phase as a result of the proposed restoration of the Louth Navigation. The nature and significance of the impact is also described. At this stage in the project, no mitigation measures have been identified and it is envisaged that such measures where necessary will be developed during any future detailed Environmental Impact Assessment (EIA).

Scoping Analysis

- 11.129 The initial results of the scoping analysis are set out in a scoping impact matrix in Appendix F. The results from detailed analysis are presented in Table F1 (Appendix F). Both documents are designed to be used concurrently. The latter of table highlights the potential environmental receptor and associated constraint or opportunity, a description of the type of impact and whether the impact is likely to occur during the construction or operational (end) phase, an assessment of impact significance (see significance criteria below) and recommendations for further survey work and / or further information required.

Summary and Next Steps

Key Environmental Constraints

- 11.130 The key environmental constraints identified as part of the scoping study that are likely to require further consideration as part of any future Environmental Impact Assessment are outlined below. For further detail, see Appendix F.

- People, property, land or existing activities that are located or take place adjacent to or within the environs of the existing navigation.
- Any existing recreational or amenity activity that takes place within the immediate environs of the navigation.
- Flood risk management structures present along the navigation and the canal's ability to function as the primary drainage channel in this area.
- Statutory designated and non-statutory designated sites associated with the navigation.
- The presence of protected species and habitats associated with the navigation e.g. bats, water vole.
- The existing physical, chemical and biological status of the navigation (e.g. habitats and wildlife diversity) that has been gradually reverting back to a more semi-natural ecosystem since the navigation closed.
- The nature of the existing rural environment e.g. quiet, low pollution levels etc that may be sensitive to development pressure.
- Increased pressure on existing water resources within the catchment.
- Existing infrastructure associated with the navigation e.g. bridges, locks.
- Existing services and utilities associated with the navigation.
- Designated assets with historical value associated with the navigation e.g. lock structures.
- Potential for contaminated land associated with the navigation itself or its environs.

Key Environmental Opportunities

- 11.131 The key environmental opportunities identified as part of the scoping study that are likely to require further consideration as part of any future Environmental Impact Assessment are outlined below. For further detail, see Appendix F.

- The potential to provide a major amenity asset and significantly improve access, recreation and amenity facilities along the navigation corridor and its associated environs.
- The potential to increase the numbers of tourists who visit this part of Lincolnshire providing a boost to the local economy.
- The potential to provide a significant number of permanent jobs within this area of Lincolnshire.
- The potential for local businesses and farmers to diversify their activities and contribute towards the regeneration of this area.

- There would be an opportunity to enhance and develop the canal and its environs as a wildlife corridor throughout its length including the restoration and / or creation of new habitats e.g. the adjacent channel of the River Lud, off-line wetlands, scrapes and ponds, fish passes etc with a view to maintaining and possibly increasing local biodiversity.
- Restoration of the navigation may provide opportunities to contribute to the overall restoration of an historic landscape e.g. enhance the character of district type landscapes.
- Restoration of important historic structures such as the barrel shaped locks is likely to be incorporated into any restoration proposal for the navigation.

Environmental Recommendations

- 11.132 To ensure that the features of the existing environment of the navigation and its environs are fully understood and that environmental impacts associated with the proposed restoration can be robustly appraised in the future, it is recommended that appropriate detailed surveys and desk based assessments are carried out at the start of the Environmental Impact Assessment.
- 11.133 The surveys and desk based assessments that have been identified as part of this environmental scoping study can be found in Table 11.7. It should be noted that the list is preliminary and at this stage, should not be considered in any way comprehensive.

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12 Economic Impact Assessment

Scope of Assessment

- 12.1 The study brief required that the economic benefits of restoration be assessed in terms of additional income attracted to the area by user visits. The assessment should also consider:
- a) The potential for agricultural diversification and other new business opportunities, including:
 - Boating facilities
 - Accommodation
 - Catering
 - Camping
 - Parking
 - Picnic areas
 - b) An estimate of the resultant enhanced property values.
 - c) Estimates of increased trade at tourism businesses within a 10 km radius.
 - d) Identification of 'honeypot' sites along the canal.
 - e) An estimate of increased employment resulting from increased economic activity in terms of permanent, part-time and temporary jobs.
 - f) The possibility of providing small boat moorings and portage during restoration.
 - g) The benefits of starting restoration from Tetney, if any.
 - h) A comparison of the benefits of restoration with those of other public investments in the area.

Economic Impact Model Methodology

- 12.2 The methodology used to estimate the economic and employment benefits associated with the proposed re-opening of navigation along the Louth Canal is based on guidance received from British Waterways and on the approaches used in other economic impact studies of waterway restoration projects made available to the project team (as listed in the Bibliography). In order to add value to the report, we have not just focused on the likely economic impacts of the project, but have also considered the other outputs and outcomes that might be generated over the course of the delivery process. This reflects current HM Treasury, ODPM and DTI thinking on impact assessment procedures.
- 12.3 The methodology for assessing the economic and employment benefits is based on the British Waterways tourism and leisure demand model, which has been developed over a number of years and has been tested on a number of different canals to test its validity. There are a number of key elements to the model:
- Estimates are made of the existing and potential number of canal users, broken down by type (e.g. boaters, anglers, walkers, etc). A base level of activity is identified and also a predicted level of activity once the canal has been re-opened for navigation.
 - Having calculated the number of additional canal users, it is necessary to establish the expenditure associated with this activity. Average spend per head is drawn from national and local surveys and applied to the visitor projections in order to obtain an overall expenditure figure.
 - Employment directly resulting from visitor expenditure is calculated using standard industry multipliers. Another multiplier is used to estimate indirect employment impacts.

Other Outputs and Outcomes Associated with the Restoration Project

- 12.4 As indicated in Paragraph 12.1, the study brief required the Consultants to investigate a number of other economic, employment and social impacts associated with the proposals. Our approach to identifying these benefits has been to review the impacts of other, similar initiatives across the UK and to draw guidance from these developments to identify the likely outcomes associated with the restoration of the Louth Navigation. A literature review and series of site visits has also informed this process, as have consultations with a number of key personnel familiar with this area.

Likely Economic and Employment Impacts

Current Usage and Future Demand for Outdoor Recreation

- 12.5 This section primarily addresses the economic and employment impacts of a renovated Louth Navigation associated with recreational and sporting uses. Boating, canoeing, walking, cycling and angling are all considered within this section.
- 12.6 In general, it should be noted from the outset that many facets of the regenerative process would support the wide range of strategies that have been implemented by East Lindsey District Council. These will be discussed in the following sections. In relation to the local economy and employment, the District Council aims to support new businesses and community initiatives, provide new business premises, promote diversification and reinvigorate the retail sector⁶. Furthermore, community and environmental sustainability are key general issues for development⁷. The canal regeneration has the potential to support all these strategies.

Boating

- 12.7 Currently there are no boats permanently moored on the canal. Restoration of the canal will allow motorboats and yachts of up to 22m length, 4.6m beam and drawing 1.6m to be moored on the canal. The air draught above Tetney Lock Bridge will be 3.0m, meaning that any sailing yachts moving up the canal to Louth will need to step their masts for the journey. Passing places will also be required for any but the smallest craft on the upper reaches of the canal, nearer Louth.
- 12.8 The main yacht club in the area is the Humber Mouth Yacht Club (HMYC) with around 300 members who own some 50 sailing yachts and dinghies⁸. The average craft length at the club is around 8 metres. There are also four or five fishing boats moored at the club's facilities but no motor-powered pleasure craft at present.
- 12.9 The Yacht Club, which is based at the southern end of the Humberston Fitties to the north of Tetney, has a Royal Yachting Association (RYA) Sailing School with 30 cadets, the maximum number allowed by the RYA. The Sailing School has a long waiting list, indicating considerable unsatisfied demand for sailing instruction in the area.
- 12.10 Apart from the HMYC there are two other yacht/ sailing clubs in the area:
- Grimsby and Cleethorpes Yacht Club.
 - Humber Cruising Association, Grimsby.
- 12.11 Sources at HMYC indicate that members of the three clubs have a combined total of some 1,000 boats in all.
- 12.12 Evidence of the growing demand for moorings in the area is provided by the increase in capacity at Grimsby marina which held some 90 boats two years ago but which can now accommodate around 250 craft with further developments planned.

⁶ East Lindsey District Council East Lindsey Economic Development Strategy

⁷ East Lindsey District Council (1999) East Lindsey Local Plan (Alteration 1999)

⁸ Mike Featherstone personal communication

- 12.13 We have been advised that the HMYC did look at moving to the seaward side of Tetney Lock in the 1960s when Covenham Reservoir was under construction, but that the move was rejected because the club would have become fragmented with motorboats and yachts moving to Tetney but the dinghies staying at the present site.
- 12.14 Sailing, and many other water sports, are also practised at Covenham Reservoir, which lies less than a kilometre from the canal. The sports available here include dinghy sailing, power boating / waterskiing, windsurfing and scuba diving⁹. While these facilities further emphasise the local demand for water sports and water-borne recreation, there is no direct access for boats from the reservoir to the Louth Canal.
- 12.15 The main demand for moorings on the restored Louth Navigation is likely to come from people keeping small pleasure craft on the Navigation for use on the main navigation. There may also be demand from owners of motor yachts, power cruisers and sailing yachts unable or not desiring to moor their boats in marinas and harbours in Hull and elsewhere on this stretch of the East Coast. It is possible that some sea-going craft may be moored at Riverhead if their owners feel that this is a more convenient location than the proposed marina at Tetney Lock (this is, of course, assuming that the restored Navigation is completed to the planned depth and width).
- 12.16 A key concern raised in consultations with local sailors is the fact that the canal stops several hundred metres short of the low water mark and that the access through the sandbanks to the canal entrance is via a creek whose course changes over time as a result of tidal activity. Dredging and on-going maintenance of the navigable channel will clearly be an important consideration in assessing the viability of a marina at Tetney. Nonetheless, we have been advised that should a deep water marina be developed at Tetney Lock, there would be considerable interest from existing sailors in the area and particularly from owners of larger boats.
- 12.17 Our projected demand for private moorings on the renovated Louth Navigation has been informed by the experience at a number of other canals across the UK. Table 12.1 below illustrates the average number of private boats per kilometre of navigable waterway on a number of other English canals.

Table 12.1 - Average Number of Private Boats per Kilometre of Navigable Waterway on English Canals

Canal	Number of Private Boats	Length (km)	Boats/ km
BW system, England & Wales	20,000	3,240	6.2
Monmouth & Brecon Canal	318	56	5.7
Lancaster Canal	800	68	11.8
Rochdale Canal	64	51	1.3
Average			6.2

*Sources: ASH Consulting Group with Coopers & Lybrand (1995) Millennium Link: Tourism Study. Report to British Waterways and Scottish Tourist Board
British Waterways (2004) The Economic Impact of Restoring the Huddersfield Narrow and Rochdale Canals*

⁹ Covenham Water Sports Association (www.cwsa.co.uk)

12.18 Taking the average of 6.2 private boats per kilometre of canal gives a projection of around **118 boats** for the entire length of the Louth canal. We would suggest that this is likely to be a considerable overestimate as the canal itself is relatively short with locks potentially every 2 km or so making it less attractive for even a day cruise. Whilst the Monmouth & Brecon Canal, for instance, also occupies a relatively rural area, it is still sufficiently long to be more appealing as a boating venue. Low figure on Rochdale Canal could be due to urban area and vandalism.

12.19 We thus propose to adopt a more modest estimate of around **60 private boats** permanently moored on the canal once the restoration of navigation is complete, or 50% of the figure predicted by using the British Waterways national average. This figure is in addition to any boats that might be displaced from the Humber Mouth Yacht Club site at Humberston Fitties.

12.20 We would expect around 50 of these additional boats to be moored at a marina at Tetney Lock and the remainder to be moored at the Riverhead if a small marina could be built there. It is expected that the majority of craft kept on the canal will be either small motor cruisers or sea-going yachts of sufficient size to be able to travel up and down the east coast and the Humber estuary.

12.21 Based on the experience of other UK inland waterways, it is anticipated that the 60 private boats moored on the Louth Navigation can be broken down as follows:

Table 12.2 - Type of Boat Anticipated on the Louth Navigation

Type of Boat	%	Number
GRP	87%	52
Wood	6%	4
Steel	4%	2
Other	3%	2
Total	100%	60

Source: Percentage figures based on BMIF 1991 study of inland motor craft in the UK

12.22 The importance of this data is that craft constructed from different materials have different servicing and maintenance needs, with associated costs varying according to the construction of the hull. This has implications both for the supporting infrastructure required to service the boating community that will arise as a result of the re-opening of navigation along the Louth Canal and also for the long-term economic impacts associated with recreational use of the system.

12.23 Of the 60 private boats that might be moored on the Louth Canal during the course of the year, not all will be based there all year round. British Marine Industries Federation research undertaken in the mid 1990s suggests that:

- 40% of craft are kept at home during the winter months.
- 20% require other winter storage.
- 40% are left on or by the water during the winter.

12.24 Thus winter storage and supporting services could be required for between 12 and 36 boats within the vicinity of the canal, although because boats based on sheltered waters such as canals are less likely to suffer from being kept in the water over the winter, then this may be an over-estimate of the eventual level of demand. Because of the commercial and residential value of land at the Riverhead, it is likely that the boatyard facilities required to service the private craft moored on the canal and to provide winter berthing would be located at Tetney Lock.

Trip Boats

12.25 It is assumed that once a suitable navigable channel has been restored along the whole length of the canal then a commercial operator will introduce a trip boat onto the system allowing both local residents and also visitors to the area to enjoy a trip on the canal. Given Louth's emerging position as a day visitor and tourism destination we assume that the boat will be moored at Riverhead and that two types of trip could be offered:

- Daytime sightseeing trips to Alvingham (including a stop so that visitors can take a trip to the mill and historic churches) or longer trips to Tetney Lock.
- Evening cruises including dining and entertainment.

12.26 Research by British Waterways¹⁰ indicates that the average trip boat attracts around **6,700 passengers per annum** and that approximately 75% of all customers to trip and restaurant boats live within 20 miles of the starting point. Thus Grimsby and its surroundings, as well as the resorts of Cleethorpes and Mablethorpe, could be expected to provide business for a trip boat. Lincoln is probably too far away and in any case has its own provision on the waterways in the area.

Canoeing

12.27 At present there is no data on the level of canoeing on the canal. Evidence from British Waterways¹¹ and recent academic research¹² is that nationally, canoeing is growing in popularity because it is inexpensive and easy to learn. Canoeing on canals is developing through canoe clubs, special events, touring and canoe hire. It is estimated that some 100,000 UK residents regularly participate in canoeing (0.17% of the UK population) and a further 1 million take part on an occasional basis (1.7% of the UK population).

12.28 Assuming a penetration rate for casual canoeing within the UK population of around 1.7% and a penetration rate for regular canoeists of 0.17%, then we would expect around **2,440 people** to be sufficiently interested in the sport in the East Lindsey district to use the canal for canoeing once navigation has been reopened and once the canal is actively being promoted for public access¹³. Of these, some 220 residents of East Lindsey would be regular participants and 2,220 occasional canoeists.

Walking

12.29 There is no information on current levels of walking and cycling along the public right of way that runs along the whole of the canal from Riverhead to Tetney. It was, however, observed that the canal banks were used extensively by people walking their dogs, even in mid-week in the winter. The canal-side paths were particularly well used in Louth (around the Riverhead area) and at Tetney. This suggests that in summer time and at weekends substantial numbers of people will use the route of the canal for recreational walking.

12.30 Nevertheless, to provide a proxy figure, we have examined participation data for outdoor recreation drawn from the recent Leisure Day Visits survey undertaken by the Countryside Agency and partners. We have used this to derive a possible level of activity based on the current population of Louth and the surrounding area.

12.31 Recent research¹⁴ indicates that 81% of adults in England made at least one leisure day trip in the two weeks prior to interview and that, of these trips, 16% included a walk, hill walk or ramble. The total adult population of East Lindsey is around 107,350¹⁵, which gives a potential market for leisure day trips every fortnight of around 87,000 people. Of the trips made over the course of a fortnight by these adult residents, some 13,900 will include a walk, hill walk or ramble. Multiplying this by 26 provides an *annual* estimate of around 361,400 walking, hill

¹⁰ Quoted in: ASH Consulting Group with Coopers & Lybrand (1995) Millennium Link: Tourism Study. Report to British Waterways and Scottish Tourist Board

¹¹ British Waterways (2003) The Economic Impact of the Restoration of the Kennet & Avon Canal

¹² School of the Environment, University of Brighton (2001) Water-based Sport and Recreation: The Facts

¹³ Population of East Lindsey estimated at 130,440, based on the 2001 census

¹⁴ TNS Travel & Tourism (2004) GB Leisure Day Visits. Report of the 2002-03 Great Britain Day Visits Survey

¹⁵ Source: 2001 census

walking and rambling excursions by adults resident in the district. Of course, not all of these will be made to the Louth Canal and for forecasting purposes we suggest that 10% of this figure is used, or around **36,000 visits per annum**.

12.32

An alternative methodology is to derive estimates of current usage using an average density of use per kilometre per annum. This approach is frequently used by British Waterways when assessing the economic benefits of canal regeneration projects¹⁶. Recent work on the Rochdale Canal in Lancashire found an average of 70,000 visits per kilometre per annum¹⁷. The original economic impact study for the Millennium Link project in Central Scotland used two multipliers – one for rural stretches of canal and one for urban stretches. Both multipliers were based on survey work carried out on different stretches of the Forth & Clyde Canal in and around Glasgow. The findings are summarised below:

Table 12.3 - Informal Visitor Numbers on Forth & Clyde Canal

	Informal Visitors per km per Day	Informal Visitors per mile per Day	Total Informal Visitors per year / per km
Rural stretches	10	16	3,650
Urban stretches	160	256	58,400

Source: ASH Consulting Group with Coopers & Lybrand (1995) *Millennium Link: Tourism Study. Report to British Waterways and Scottish Tourist Board*

12.33

Applying these multipliers to the Louth Navigation gives the following results:

Table 12.4 - Current Informal Visitor Numbers on Louth Navigation

	Visits per Year per km	km of Canal	Total Visits per Year
Rural stretches	3,650	18	65,700
Urban stretches	58,400	1	58,400
Total		19	124,100

Source: PLB Consulting Ltd

12.34

This figure is far in excess of the estimate derived from the GB day visit survey data because that study covers only leisure activities, whilst the above analysis will include people using canal-side footpaths / towpaths for other purposes such as walking to and from school or work, or to and from shopping and other non-leisure trips. In many urban areas of the UK this level of activity is quite considerable.

12.35

For modelling purposes we have used the higher estimate of around **124,100 walking trips** as the current level of activity.

12.36

Experience from a number of canal regeneration projects around the UK provides some guidance on what levels of activity might be expected post-implementation of the regeneration project.

¹⁶ See for example: British Waterways (2003) *The Economic Impact of the Restoration of the Kennet & Avon Canal*; British Waterways (2004) *The Economic Impact of Restoring the Huddersfield Narrow and Rochdale Canals*

¹⁷ British Waterways (2004) *The Economic Impact of Restoring the Huddersfield Narrow and Rochdale Canals* p34

Table 12.5 - Visits per Annum Before and After Regeneration Projects for a Number of Canals

Site	Visits per Annum		% Change
	Before Improvement	After Improvement	
Walsall (West Midlands)	71,500 (1999)	154,500 (2001)	+110%
Stourbridge (West Midlands)	41,500 (1999)	87,500 (2001)	+111%
Ratho (Scotland)	18,000 (1998)	75,000 (2001)	+317%
Linlithgow (Scotland)	17,000 (1997)	163,000 (2001)	+859%
Edinburgh (Scotland)	94,000 (1997)	145,000 (2001)	+54%
Kennet & Avon Canal	6.67 million (1995)	7.7 million (2002)	+15%

Source: British Waterways (2003) *The Economic Impact of the Restoration of the Kennet & Avon Canal*

- 12.37 Of the above examples, we would suggest that Ratho has much in common with the more rural parts of the Louth Canal area, as it is a small village set in attractive countryside on the edge of Edinburgh with a canal-side pub the main attraction, perhaps akin to Tetney or Alvingham. Linlithgow we would suggest has something in common with the Riverhead area of Louth as it developed as a small market town serving the surrounding area and the canal is some hundreds of yards from the town centre. However, both settlements are less than 30 minutes from central Edinburgh and are thus able to call on a large day visitor population. Louth is less well served in this respect although it is close enough to Grimsby and other towns on the Humber estuary to act as a day visit location. It will also attract holidaymakers from Cleethorpes, Mablethorpe, Skegness as well as the Lincolnshire Wolds Area of Outstanding Natural Beauty (AONB).
- 12.38 For forecasting purposes, we propose to use a figure somewhere between the Ratho and Linlithgow findings, or around a **550% uplift** in informal recreation visitors. Once the regeneration of the canal is complete, therefore, we anticipate that the overall level of informal recreational usage of the canal to increase from 124,100 to **806,650** visits per annum.
- 12.39 **It is important to note that this level of increase activity will only be achieved through the implementation of a well-resourced and targeted marketing campaign that sells the Louth Canal and its associated heritage assets, including the historic town of Louth and the new marina at Tetney Lock, as an attractive destination. The canal would need to be well integrated into current destination marketing strategies and this is not the case at present.**
- Cycling**
- 12.40 Cycling is one of the most popular forms of outdoor recreation and canal towpaths often provide scenic, traffic-free cycle routes. There is no primary data on levels of cycling activity across the area at present and thus we have had to derive estimated data from other waterways.
- 12.41 A recent survey of activity at a number of canals in West Yorkshire and East Lancashire found the following levels of activity per kilometre per annum:

Table 12.6 - Regional Waterways Density Estimates: Visits per km per Year by Activity

Canal	Informal Users per km per Year	Anglers per km per Year	Cyclists per km per Year
Leeds & Liverpool Canal	119,000	850	5,000
Ashton Canal	99,000	1,000	5,500
Peak Forest Canal	96,000	450	5,250
Huddersfield Narrow Canal	69,000	400	3,000
Calder & Hebble	52,000	750	4,000
Average, all 5 canals	87,000	690	4,550
% of informal users	100%	1%	5%

Source: British Waterways (2004) *The Economic Impact of Restoring the Huddersfield Narrow and Rochdale Canals*

- 12.42 Given that the current footpaths along the Louth Canal are not designated as towpaths (or bridleways), and thus cannot legally be used for cycling, it is assumed that this activity is currently negligible. Assuming that one aspect of the restoration project will be to provide cycling access along the whole length of the canal from Riverhead to Tetney Lock, and taking on board evidence from other canals (see above) then we are assuming a total of around 5,000 cycling visits per km per annum, or **95,000** cycling visits a year along the whole length of the canal.
- Angling***
- 12.43 Data suggest that the market for angling has been static for some time and the National Federation of Anglers advises that recent years have seen a reduction in the number of affiliated clubs and the number of members. This suggests that there may have been a decline in angling as an organised activity.
- 12.44 Recent research indicates that there are some 1.5 million members of angling clubs in the UK, of whom 300,000 take part in the sport on a regular basis¹⁸. This represents penetration rates of around 2.5% and 0.5% respectively. Translating this to the population of East Lindsey gives a potential market of around 3,260 angling club members and 650 regular anglers.
- 12.45 Most of the canal (from Alvingham Fen to Tetney Lock) is administered for angling purposes by the Witham and District Joint Anglers Federation. They rent the fishing rights from the Environment Agency on an annual basis. The president of that local federation relates that the canal is extremely popular with local anglers due to the quality of the river and countryside and because there are few other freshwater rivers in the area. The river at Tetney – especially the stretch opposite the Public house was reported to be particularly popular¹⁹.
- 12.46 Surveys at other canals suggest that for every angler there are 100 informal canal visitors (see Table 12.6). The information put forward in Paragraph 12.35 on participation in walking leads us to assume that the canal will attract around **2,000 angling visits per annum at present**. Experience from elsewhere suggests that canal regeneration projects have little impact on participation in angling and thus this level of activity is projected to remain stable.

¹⁸ School of the Environment, University of Brighton (2001) *Water-based Sport and Recreation: The Facts*

¹⁹ Mr Stewart Oxborough, President of the Witham and District Joint Anglers Federation – pers. comm.

Direct Economic Impacts of Current and Future Activity

Boating

Introduction

12.47 Owners of private boats moored on the Louth Navigation will incur expenditure in the following ways:

- Annual berthing & storage costs.
- Annual maintenance and running costs.
- Spending per outing or trip.

Berthing, maintenance and running costs

12.48 Annual running costs associated with different types of boat are summarised below with the 1991 price levels updated to 2004 levels to take account of inflation (BMIF has not been able to provide updated data within the study timescale).

Table 12.7 - Annual Running Costs Associated With Different Types of Boat

	Berthing Storage Cost	Maintenance & Running Costs	Annual Cost (1991 Prices)	Annual Cost (2004 Prices)
Power/ motor cruiser	£ 1,063	£ 1,530	£ 2,593	£ 4,330
Motor sailor	£ 1,196	£ 890	£ 2,086	£ 3,484
Sailing yacht	£ 957	£ 1,023	£ 1,980	£ 3,307
Narrow boat	£ 595	£ 980	£ 1,575	£ 2,630
Fishing boat	£ 278	£ 680	£ 958	£ 1,600
Sailing dinghy	£ 180	£ 230	£ 410	£ 685

Source: BMIF 1991 Survey of Boat Owners

12.49 For forecasting purposes we have assumed the following split of boats moored on the Louth Canal:

	%	Number
■ Power/ motor cruiser	20%	12
■ Motor sailor	40%	24
■ Sailing yacht *	30%	18
■ Fishing boat *	10%	6
Total	100%	60

* Only using canal as a haven from the Humber.

12.50 Total spending on berthing, repairs and maintenance is thus estimated at some **£205,000** per annum.

Table 12.8 - Estimated Annual Spending on Berthing, Repairs and Maintenance

Type of craft	Spend per Boat per Year	Number of Boats	Total Spend per Year
Power/ motor cruiser	£4,330	12	£ 51,964
Motor sailor	£3,484	24	£ 83,607
Sailing yacht	£3,307	18	£ 59,519
Fishing boat	£1,600	6	£ 9,599
Total		60	£ 204,689

Source: PLB Consulting Ltd

Spending on trips

12.51

British Waterways (BW) data indicates that private boats are used on average for 42 days a year and that an additional six non-cruising days are spent by boat owners at a designated mooring on general cleaning, maintenance and other related tasks. Figures on average spend per head are as follows:

Table 12.9 - Average Spend per Head (boating)

Item	Average Spend per Head/ Day (1995 Prices)	Average Spend per Head/ Day (2004 Prices)
Mooring/ berths	£ 1.17	£ 1.66
Fuel	£ 2.30	£ 3.27
Provisions	£ 3.50	£ 4.97
Eating & drinking ashore	£ 5.70	£ 8.09
Shopping for boating items	£ 1.80	£ 2.56
Other boat-related spending	£ 0.50	£ 0.71
Total spend/ head/ day	£ 14.97	£ 21.26

Source: ASH Consulting Group with Coopers & Lybrand (1995) Millennium Link: Tourism Study. Report to British Waterways and Scottish Tourist Board. Information updated by PLB Consulting Ltd

12.52

Total spending by boat users is estimated at **£176,000**, based on the BW assumption that an average of three people are engaged in every private boat trip and 2 people make a maintenance visit.

- Boat trips: (60 boats x 42 days/ year) x (3 people spending £21.26/head/day) = **£160,706**
- Maintenance visits: (60 boats x 6 days/ year) x (2 people spending £21.26/head/day) = **£15,305**

12.53

It should be noted that this excludes any financial activity associated with the maintenance and operation of private boats moored on the canal or in the new marina that have been moved from Humberston Fitties, as this spending is merely being diverted from elsewhere in the local economy.

Trip Boats

12.54 As indicated earlier, it is anticipated that one trip boat will be located on the canal post-restoration and that it will attract approximately 6,700 passengers per annum. Average expenditure profiles for passengers on British Waterway's canals in 1994 were as follows:

- £2.84 per head on tickets per trip.
- £3.94 per head on catering and retail items per trip.

12.55 The figure below uprates these figures by an inflationary amount of 4% per annum to give a 2004 equivalent of around £4.20 and £5.80 respectively, or a total income for the trip boat of **£67,250 per annum**.

Table 12.10 - Updated Boat Trip Tickets and Catering Spend

Year	Tickets	Catering & Retail	Total
1994	£2.84	£3.94	£6.78
2004	£4.20	£5.83	£10.04

Source: PLB Consulting Ltd, based on data reported in ASH Consulting Group with Coopers & Lybrand (1995) Millennium Link: Tourism Study. Report to British Waterways and Scottish Tourist Board

Canoeing

12.56 We have previously estimated that there are some 220 regular canoeists and 2,220 participants in the District who might use the canal at least on an occasional basis. Assuming an average spend per head on a countryside day trip of £8.94²⁰ (2004 prices), and assuming that regular canoeists visit once a month and occasional participants once a year (at come-and-try it sessions etc), then canoeists using the canal could be expected to generate around **£25,600²¹** in the local economy once canoeing is established on the Louth Canal.

Walking

12.57 Our current estimate is of around 124,100 informal visits at £8.94/ per annum to the Louth Canal. Taking the same average spend per head on a leisure day visit gives a possible spend in the local economy of around **£1,109,500**. Assuming that the regenerated canal is marketed as an attractive destination for informal recreation of all kinds, then it is predicted that the level of visitor activity could rise to around 806,000 visits per annum, which would generate a spend of around **£7,211,000**.

12.58 However, some sources argue only 50% of towpath users are leisure walkers and that many are just walking to work or on other personal business. Thus a more modest projection could be achieved by reducing the predicted level of spending by 50% to reflect that many towpath users in and around Louth will not spend any money within the local economy, making the projected spend around **£3,605,500**.

Cycling

12.59 Potential conflict with anglers, walkers and disabled users would need to be ameliorated. This could be undertaken by the provision of a widened shared footpath, say 3m wide or by segregated paths. Such a shared width would be difficult to provide along some lengths of the canal and therefore a cycleway should only be encouraged if a safe segregated route can be established taking advantage of side paths. To allow the use of the towpath by cycles and wheelchairs all the stiles along its length would need to be replaced by gates or preferably removed (if stock control is not required). Assuming that cycling is both permitted but also actively encouraged along the canal side footpath / towpath then we estimate that up to 95,000 trips might be made per annum, generating around **£850,000** per annum for the local economy.

²⁰ GB Leisure Day Visit Survey indicates that the 2002/03 level was £8.60 and this has been increased by 4% to reflect inflation

²¹ $((220 \times 12) + (2,220 \times 1)) \times £8.94 = £25,580$

Angling

12.60 It is estimated that there are around 2,000 angling visits to the canal each year at present and that this figure will not change following regeneration, giving a stable level of spending (at 2004 prices) of around **£17,900** per annum.

Summary

12.61 Table 12.11 overleaf summarises the anticipated direct economic benefits that will arise as a result of the restoration of navigation on the Louth Canal and its development as a major recreational and tourism destination. It is anticipated that the current estimated spending associated with recreational and tourism use of the canal of around £1.1 million/annum will increase to more than £4.9 million/annum.

12.62 While this estimate is a useful guide, the amount of the increase will perhaps depend upon the creativity and extent of the marketing. There are many opportunities that maybe developed alongside both the key recreational activities and existing marketing strategies. For example:

- A heritage trail along the canal (especially between Louth and Alvingham – a reasonable day's walk) could incorporate the industrial heritage of the waterway, the heritage of Louth, the churches at Alvingham and the remains of Louth Abbey.
- Themed wildlife walks could attract visitors along the length of the canal, as well as to the Nature Reserve at Tetney.
- The 'Louth Art Trail' might be extended along the canal.
- The on-going 'Taste of Lincolnshire' marketing campaign could be developed to incorporate pubs along the canal (e.g. at Louth, Alvingham and Tetney) and the shops in Louth. It maybe possible to create a series of 'gastronomic walks' along stretches of the canal from the pubs to the many shops in Louth already associated with the 'Taste of Lincolnshire' scheme.

12.63 It should be noted that none of these environmentally and economically sustainable opportunities rely on the canal to be fully navigable from Louth to the coast. Indeed, as can be seen from the table below, such informal recreational use will account for much of the increased economic activity. Spending by boating and canoeing participants will amount to under £500,000 per annum, or around 4% of the total.

Table 12.11 - Estimated Pre-development and Post-development Spend

Activity	Pre-development (2004 prices)	Post-development (2004 prices)
Boats (annual berthing, repairs & maintenance costs)	£ -	£205,000
Boats (spending during trips & excursions)	£ -	£176,000
Trip boat - total spending by guests	£ -	£ 67,250
Spending by canoeists	£ -	£25,600
Spending by informal users	£1,109,500	£3,605,500
Spending by cyclists*	£ -	£850,000
Spending by anglers	£17,900	£17,900
Total	£1,127,400	£4,947,250.00

* Assuming a safe segregated cycle route can be established (see paragraph 13.6)

Source: PLB Consulting Ltd

Employment Impacts of Current and Future Activity

- 12.64 We have not been able to secure employment multipliers that are derived for the East Lindsey tourism economy and thus have adopted a figure of £34,435 per Full Time Equivalent (FTE) taken from the recent East Midlands Museum, Libraries and Archive Council sponsored study of the economic impact of festivals on the region's economy²².
- 12.65 Applying this multiplier to the estimated total spending figures presented in Table 12.11 indicates that current levels of spending by visitors and canal users to the Louth Canal area support around **32.7 FTE jobs**, with almost all of these supported by people walking along the towpath/ canal-side footpaths. Once the developments are completed, this will increase to around **143.7 FTE jobs**, an increase of 111 FTE jobs.

Other Benefits

Introduction

- 12.66 As has already been noted in Paragraph 12.1, there are several ways in which the regeneration of the Louth Canal could bring significant economic benefits to the Louth area and could also support the local economic and employment strategies of East Lindsey District Council. In this section, additional benefits will be highlighted, and these can also be seen to support a wide range of other local planning policies²³. These include:
- Protecting and conserving of the natural environment, the landscape, and archaeological remains – encouraging development that does not harm these resources and improves the environment where possible.
 - Locating developments such that they will reduce the need to travel (e.g. the Riverhead development is very close to the centre of Louth).
 - Encouraging tourism development in areas that will benefit from such investment and in ways that will not harm the environment.
 - Providing a range of housing for the local residents as part of canal enabling works that adds to the character of the local area, is on re-used land if possible and is sited such that the need for car journeys is reduced.
 - Improving the viability and vitality of town centres and the shopping environment.
 - Improving the provision of sport and recreation facilities for all – encouraging the public to be involved in formal and informal recreation and allowing greater access to the countryside and open spaces.
 - Maintaining and supporting community facilities for all.
- 12.67 In addition, the Inland Waterways Amenity Advisory Council (IWAAC) has identified a wide range of benefits that waterways can bring to national and local government policy agendas²⁴:

Policy Objective	Value of Waterways
-------------------------	---------------------------

- | | |
|--------------|---|
| Regeneration | <ul style="list-style-type: none"> ■ Act as catalyst for economic and social renewal ■ Increase development value and the opportunity for investment ■ Focus and link regeneration initiatives ■ Generate long term economic activity and opportunities for employment ■ Promote inclusion and quality of life |
|--------------|---|

²² Arts Council England (2003) Festivals and the Creative Region: The economic and social benefits of cultural festivals in the East Midlands. Key findings from a study by De Montfort University, Leicester

²³ East Lindsey District Council (1999) East Lindsey Local Plan 1999

²⁴ Inland Waterways Amenity Advisory Council (2001) Planning a Future for the Inland Waterways: A Good Practice Guide

- | | |
|---|--|
| Sport and Recreation | <ul style="list-style-type: none"> ■ Provide an important sport and recreation resource ■ Contribute to the health and well-being of society ■ Form corridors linking urban areas to the countryside ■ Promote accessibility to all members of society ■ Add value as a national fishery |
| Tourism | <ul style="list-style-type: none"> ■ Act as a tourism asset in their own right ■ Provide a link between existing and new attractions ■ Support the holiday industry through water-based activities ■ Provide world-renowned destinations such as the Thames and the Broads ■ Enhance the environment and attract increased visitor activity |
| Heritage, Culture and the Natural Environment | <ul style="list-style-type: none"> ■ Form a unique heritage, cultural, educational landscape and environmental asset ■ Host a wide array of important historic buildings and structures ■ Contribute to the diversity of the natural environment by sustaining habitats and hosting rare species ■ Contribute to open space provision ■ Provide a resource for water supply and land drainage |
| Transport | <ul style="list-style-type: none"> ■ Contribute to integrated transport objectives ■ Provide transport routes on a local and national scale ■ Act as a waterborne transport corridor for people and freight ■ Form important cycling, walking and public access corridors |

12.68 The Association of Inland Navigation Authorities (AINA) has also prepared guidance notes on how waterway restoration and regeneration projects can deliver real benefits to local communities and economies, and on how these benefits can be assessed²⁵.

Development Impacts

12.69 ***Ancillary Facilities Required to Service Canal Users and Visitors***
 Visitors using all or part of the Louth Canal can be expected to make use of a range of support facilities. Table 12.12 overleaf identifies the main user groups and the range of services required to support their chosen activity, with each facility type discussed in more detail below.

²⁵ Association of Inland Navigation Authorities (2003) Demonstrating the value of waterways: A good practice guide to the appraisal of restoration and regeneration projects

Table 12.12 - Ancillary Facilities Required to Service Canal Users and Visitors

Service/ facility	Private Boats	Trip Boats	Informal Recreation Users (locals)	Tourists & Day Visitors
Permanent moorings	X	X		
Temporary moorings	X	X		
Boatyard services	X	X		
Winter storage	X	X		
Catering	X		X	X
Overnight accommodation				X
Retailing	X		X	X
Car parking	X	X	X	X
Orientation and Interpretation Panels			X	X

Source: PLB Consulting Ltd

- 12.70 It is anticipated that the permanent moorings will be in two locations – Riverhead in Louth and at Tetney Lock. Temporary moorings will also be provided at Riverhead, Alvingham, Tetney Lock (either side of the sea lock) and possibly also at Covenham Cut and at Oxford House. The most appropriate location for a boatyard and chandlery is at Tetney Lock. Orientation and interpretation panels would be located along the length of the canal. All other facilities (catering, accommodation, retailing, car parking) will be focused on Riverhead and Tetney Lock. All facilities will be market-driven. Enhanced parking will also be provided at Alvingham especially the main ‘honeypot’ sites since parking to access the canal away from towns and villages is currently very limited.
- 12.71 In short, the proposals are likely to create three ‘honeypot’ areas:
- Riverhead, Louth.
 - Alvingham.
 - Tetney Lock.
- 12.72 The opportunities at each location are explored in more detail below, along with an indication of the likely impacts and outcomes.
- Riverhead, Louth***
Impact on Leisure and Tourism
- 12.73 The regeneration of the canal could significantly enhance the leisure and tourism provision of Louth. Photograph 12.1 shows an aerial view of Louth Riverhead. As has already been outlined (see Paragraph 12.62), there are several ways in which the canal could be integrated with the existing provision, especially in terms of recreational routes. This, in turn, would have economic and employment benefits.

- 12.74 With regard to the Riverhead area specifically, the area could become a centre for tourism and recreation. The Louth Play-goers Riverhead Theatre is already close by and there are opportunities for engaging with visitors about the heritage of the area and for retail in the already renovated warehouses. There is also a public house adjacent to the canal. Redevelopment could lead to this being an attractive visitor destination and a start-point for walks, cycle rides or boat trips along the canal to Alvingham or Tetney Lock.



Photograph 12.1 - Aerial view of Riverhead Louth with Navigation Warehouse

- 12.75 *Impact on Residential and Commercial Development Opportunities*
There are two main areas where the restoration of the canal around the Riverhead will create benefits to the local economy:
- Providing an attractive environment around which new housing can be built and sold on at a premium.
 - Creating an environment where new and restored office space and leisure facilities such as a hotel, restaurants and shops can be provided.
- 12.76 In terms of **housing**, experience from elsewhere, such as the Milton Keynes Canal Basins²⁶, indicates that residential properties that benefit from a waterside location achieve sale prices of up to 25% to 30% more than for other, similar homes in the area without such facilities.
- 12.77 At present there are approximately 30 residential properties in the area immediately adjacent to the canal, as well as several blocks of flats opposite Riverhead. The average price of a standard three-bedroom, semi-detached house in Louth is currently £135,000 to £140,000²⁷. Following a successful redevelopment of the Riverhead area, it might thus be expected that the value of similar houses in the Riverhead area might increase to over £180,000. Similar percentage rises could be experienced by smaller and larger properties in the area.
- 12.78 In addition, there is an area of derelict land at the end of Riverhead Terrace. This may be partly developed into a small marina, but if this option were found not to be viable, it would be possible to build perhaps 30 houses on this area. This could be an attractive canal-side development where the houses would again sell at a premium because of the riverside location.
- 12.79 As for the other **commercial opportunities**, it is likely that attractiveness of the existing industrial sites to the south east of the Riverhead will increase during and following the restoration of the canal.

²⁶ see IWAAC (2001) Planning a Future for the Inland Waterways: A Good Practice Guide

²⁷ Based on a survey of five estate agents in Louth.

- 12.80 Guidance from OffPAT, the government's advisor on programme evaluation, gives the following employment densities in terms of Full Time Equivalent (FTE) job per area of floorspace²⁸:
- Small business units: one FTE job per 32 m².
 - Offices: one FTE job per 19 m².
 - Retail: one FTE per 20 m².
 - Restaurants: one FTE per 13 m².
 - General (3*) hotels: 1 employee per 2 bedrooms.
- 12.81 Whilst there are already some small businesses, pub and theatre operations in and around the Riverhead, the preparation of a masterplan for the area that seeks to exploit its increased desirability as an investment location should lead to an increase in existing property values of between 10% and 20%, based on experience elsewhere²⁹.
- 12.82 At this stage, however, it is difficult to be more specific as to the likely employment and commercial impacts of redevelopment in the Riverhead area using the above formulae. The main area with development potential is in the historic buildings along Thames Street. However, these buildings (and others) currently house several small industrial units that detract from the built environment of that area. Obviously, any long-term strategy for redevelopment would need to address changing the use of these buildings in order to make the area attractive for tourism, leisure, informal recreation, and investment in new housing and other associated support businesses and facilities. Relocating existing 'bad neighbour' businesses away from Riverhead would possibly require Compulsory Purchase Orders by the District Council which would incur costs and also displace jobs thus changing local employment patterns. Tackling the potentially negative local reactions to this will require careful thought by the Council.
- 12.83 Investments in general improvements to the historic environment around the Riverhead would establish a continuous, high quality environment between the end of the canal and the town centre. As an indication of the level of investment that might be required in the area, we have examined the history of investment in Buxton's conservation area between 1980 and 2005. During this period some £2.6 million has been spent on 260 properties, an average of £10,000 per property³⁰. We estimate that there are a total of around 30 historic properties in the surrounding area that would benefit from some additional investment in conservation and maintenance, at a **value of around £300,000**.

Alvingham

Impact on Leisure and Tourism

- 12.84 Alvingham has the principal non-industrial heritage assets in the area of the canal, namely two 12th-century churches (one of which is owned by the Churches Conservation Trust) and a 17th century mill (privately owned and open to the public on an occasional basis). A pottery and café closed down some years ago. Access to the churches can be gained on public footpaths through a farmyard and across fields. A small, informal parking area exists close to both churches and mill. The village itself is unremarkable in terms of heritage interest and we would anticipate that the main development opportunities will be associated with increasing access provision at the mill and churches, and to provide better footpath links to the towpath / canalside path. Photograph 12.2 shows an aerial view of Alvingham.

²⁸ OffPAT (undated) Using Employment Densities to Forecast Job Outputs. Appraisal Advice Note No. 1

²⁹ see AINA (2003) p24

³⁰ English Historic Towns Forum (2004) Investing in Heritage: Financing Small Town Regeneration



Photograph 12.2 - Aerial view of Alvingham

- 12.85 Key areas for investment are likely to be:
- Creation of a surfaced car park to serve canal, mill and churches.
 - Provision of orientation panels at the car park.
 - Provision of interpretation panels for the canal, mill and churches.
 - Signposting to the mill and churches and to the canal-side walks.
- 12.86 We would expect the main leisure and tourism impacts to be:
- Increased footfall from day visitors and tourists using the informal recreation infrastructure.
 - Increased visits to the churches and mills, eventually requiring the employment on a part-time basis of a heritage site co-ordinator for the village who can manage access to these locations on behalf of the owners.
 - An increase in demand for catering provision leading to the re-opening of a café in the village.
- 12.87 The likely economic impacts of increased tourism development have been addressed previously.
- Impact on Residential and Commercial Development Opportunities*
- 12.88 Land tenure patterns and existing land uses, plus planning considerations, mean that there is unlikely to be any significant impact on housing or commercial development opportunities in Alvingham. There may, however, be relatively small-scale economic impacts if a café were to open, and on the existing farm shop and blacksmith's businesses near Alvingham (although these are some distance from the main centre of the village, towards Yarburgh).
- Tetney Lock**
- Impact on Leisure and Tourism*
- 12.89 Tetney Lock has few facilities, apart from a public house. Nevertheless, it is important as the settlement at the seaward end of the Louth Canal and as an access point for the nearby Nature Reserve. As with Alvingham, the redevelopment of the canal could significantly increase the value of the village as a visitor centre or 'honey-pot' site – especially if a marina were to be developed there. There would be opportunities for increasing visitors interested in sailing, wildlife and walking, perhaps along a long-distance route to Louth. Photograph 12.3 shows an aerial view of Tetney Lock.



Photograph 12.3 - Aerial view of Tetney Lock

- 12.90 Key areas for investment are likely to be:
- Creation of a surfaced car park and more parking spaces in general.
 - Provision of orientation panels relating to wildlife, walks and heritage.
 - Provision of interpretation panels for the canal.
 - Signposting to the canal-side walks and nature reserve.
 - Infrastructure to support the sailing / water sport participants of the area.
- 12.91 We would expect the main leisure and tourism impacts to be:
- Increased footfall from day visitors and tourists using the informal recreation infrastructure.
 - Increased visits by those engaged in sailing or water sports.
 - An increase in demand for catering provision, leading to greater use of the public house and perhaps opportunities for other catering establishments.
- 12.92 *Impact on Residential and Commercial Development Opportunities*
 There is likely to be little impact on the residential pattern of Tetney due to planning considerations. However, as is suggested above, there are likely to be significant commercial opportunities servicing the sailing / water sport community, and those who may visit the area for general informal recreation, wildlife watching and walking along the canal (either in-land or towards the coast). Catering and retail are likely to be the commercial sectors most able to benefit from the proposed developments.
- Increasing Access***
- Introduction***
- 12.93 Social inclusion is an important element of public policy and must be considered in relation to all public development projects. In other words, what moves can be taken to increase engagement with the Louth Canal by many of the social groups identified as being under-represented in the audience for built heritage and outdoor recreation. These groups include the unemployed, disabled people and people from ethnic minorities.
- 12.94 The proposed regeneration of the Louth Canal certainly provides numerous opportunities for inclusion, such that the facilities could be used by all sections of the population, be they residents of East Lindsey or visitors to the area.

Built Heritage

- 12.95 As previously indicated, restoration of the Canal, including its five unique barrel-shaped locks, will draw in new audiences for the built heritage. This will not only include people interested in the industrial heritage of the canal, but also people interested in ecclesiastical heritage (there are two important 12th century churches at Alvingham and the ruins of Louth Abbey lie near the canal) and in the historic built environment of Louth itself.
- 12.96 Market research undertaken in the last decade or so has provided some useful data on the profile of those most likely to visit historic buildings and monuments³¹. This research indicates that visitors are most likely to be:
- Adults aged between 35 and 44, and between 54 and 59.
 - From socio-economic groups ABC1, particularly AB.
 - Owners of, or those who have access to, a car.
 - In full-time employment, particularly those working in managerial positions.
 - From wealthier families.
 - Of white ethnic origin.
- 12.97 Research carried out for the Heritage Lottery Fund³² identifies the following audiences were as being particularly *under-represented* in visits to the built heritage:
- Teenagers / young adults.
 - Some older people.
 - People without cars.
 - The unemployed and those on low incomes.
 - Disabled people.
 - Ethnic minorities.
- 12.98 With regard to the tourism market in East Lindsey, the District Council's latest strategy³³ has determined that the following socio-economic groups are the key markets – or main potential customers – for different groups of attraction and products across the area:
- Coastal markets (traditional resorts): socio-economic groups C2, D, E.
 - Inland markets (market towns, the Wolds): socio-economic groups B, C1, C2.
 - Coastal heritage and specialist markets: socio-economic groups B, C1, C2.
- 12.99 The strategy also identifies some potential for targeting socio-economic groups A and B for specialist short breaks to coastal or inland areas.
- 12.100 A national survey of the audiences for different types of heritage site carried out on behalf of the Heritage Lottery Fund found that socio-economic groups A, B and C1 are the most likely to visit industrial heritage sites, a definition which includes canals³⁴.

³¹ See for example: BJM Research and Consultancy Ltd (2000): 1999 Visitor Monitor (prepared for English Heritage); Historic Scotland (1999): Visitor Profile at Historic Scotland Properties; Mintel (1998): Survey of Days Out; Casey et al (1996): Culture as Commodity

³² PLB Consulting Ltd (2001) Developing New Audiences for the Heritage: A Report for the Heritage Lottery Fund. Available at www.hlf.org.uk

³³ East Lindsey District Council (2001) Tourism Strategy 2001 – 2005: A Tourism Approach to Developing Sustainable Communities, pp18-19.

³⁴ PLB Consulting (2001) Developing New Audiences for Heritage: A Research Study for the Heritage Lottery Fund

- 12.101 It can, therefore, be concluded that the key tourism markets in East Lindsey for inland attractions, coastal heritage and specialist attractions (but not for the coastal resorts such as Mablethorpe) do broadly coincide with the nationally identified market for industrial heritage and thus the redevelopment and regeneration of the Louth Canal will support the development of the area's tourism sector.

Inland Waterways

- 12.102 Inland Waterways Amenity Advisory Council (IWAAC) has prepared guidance on how inland waterways can be used to encourage greater social inclusion³⁵. Key recommendations from the IWAAC work of relevance to the proposed restoration of the Louth Canal include:

- The development of partnerships between British Waterways, the Environment Agency, local authorities, voluntary waterway organisations and community groups to prepare strategies for promoting and sustaining community use of waterways.
- Liaison with the Department of Environment, Transport and the Regions (DETR) to ensure the inclusion of waterways in the Community Strategies that are being prepared by local authorities.
- DETR to provide guidance, via the Home Office, to Crime & Disorder Partnerships to raise awareness of the impacts of concerns for personal security on use of the waterways and how this can best be tackled, including bringing them into the remit of neighbourhood wardens.
- Ensuring that access to all parts of the waterway is possible for the physically disabled.
- Navigation authorities to share resources with and provide practical support to voluntary waterway organisations that are targeting particularly vulnerable groups in the community.

- 12.103 Of the above recommendations, the development of a partnership for promoting sustained community use of the waterway and the need to ensure that access is possible for the physically disabled to all parts of the waterway are the two that are of most relevance in the first instance to the Louth Canal.

Natural Heritage

- 12.104 The Lincolnshire coast in general is of international importance for birdlife. The marshes at Tetney Lock are one of the many nature reserves and the marshes there are designated as a SSSI. In addition, Covenham Reservoir also lies close to the route of the canal and is a haven for birdlife. It is certain that greater promotion of this part of North East Lincolnshire for tourism and day visitor activity will increase opportunities for public engagement with the natural heritage at Tetney Lock and along the Louth Canal.

- 12.105 Nearby areas of coastline already attract large numbers of visitors:

- Saltfleetby – Theddlethorpe Dunes National Nature Reserve (NNR) are estimated by English Nature to receive around 300,000 visitors a year.
- Donna Nook National Nature Reserve (MoD and Lincolnshire Wildlife Trust) attracts 60,000 visitors per annum including 30,000 between October and December to view the seals.
- Tetney RSPB reserve, one of Britain's largest Little Tern colonies, receives 50,000 visitors per annum including around 2,000 walking out to the shoreline to visit the reserve itself.
- Gibraltar Point NNR attracts 190,000 visitors per annum.

- 12.106 Recognition of the area's significance for ornithology and nature study is reflected in the current proposals by English Nature to increase public access to its reserves along this stretch of the Lincolnshire coast. A study was commissioned in late 2004 to investigate opportunities for increasing interpretation and access to their reserves and its findings, once available in June 2005, should be used to inform similar, future activity along the Louth Canal.

³⁵ IWAAC (2001) The Inland Waterways: towards greater social inclusion

12.107 At a national level, countryside visitors are most likely to be from socio-economic groups A, B and C1³⁶, thus mirroring the inland tourism market for East Lindsey (see Paragraph 12.100). We would anticipate, therefore, that the regeneration of the Louth Canal will attract those markets most likely to engage in countryside recreation thus strengthening the markets for the existing English Nature and RSPB reserves in the area.

12.108 The main benefits of increased investment in visitor facilities at Tetney Lock will be to raise the area's profile as a destination for leisure day trips. The existing appeal of the coastline and its importance as a location for bird watching (particularly of migrant passerines and for waders and wildfowl) will only be increased once the area receives improved tourist facilities.

Image Building

12.109 AINA guidance on assessing the impacts of waterway regeneration and restoration projects confirms their value in raising general awareness of an area as an attractive destination for leisure and tourism and as a desirable investment location. We anticipate that the restoration of the Louth Canal and its corridor will certainly contribute to the wider public awareness of Lincolnshire's waterways (perhaps in conjunction with the existing Lincolnshire Waterways Project). Moreover, as the only navigable waterway close to the Lincolnshire Wolds AONB, it will be able to offer visitors to the Wolds an alternative attractive landscape to visit.

12.110 Louth is the principal service centre for the eastern part of the Lincolnshire Wolds AONB and most Wolds visitors are likely to come into the town at some point. Promotion of the Riverhead area could emphasise the town's historical links with the agricultural communities of the Wolds and the fenlands towards the coast. Indeed, the tourism department of East Lindsey District Council plans to promote links between the coastal and inland attractions of the district in its future marketing campaigns³⁷. This in turn, through appropriate interpretation, will add value to visitor's appreciation and understanding of this part of the county.

Summary of Benefits

12.111 The following points provide a summary of the benefits that the proposed redevelopment of the Louth Canal would provide. Redevelopment will:

- Support more than 111 new jobs in the local area.
- Support numerous local planning strategies and policy aims, including those related to recreation, the community, economy, housing and transport.
- Attract more tourists to the area.
- Provide new or improved opportunities for outdoor recreation, such as sailing, canoeing, walking and cycling, i.e. opportunities for 'healthy living'.
- Boost the local economy and commercial opportunities at various points along the canal. Primarily, investment in sailing infrastructure and other businesses will provide new employment. Increased tourism will also support a wider range of existing businesses.
- Provide an attractive area in Louth for new housing and improving the environment of existing houses.
- Encourage the improvement and/or maintenance of the natural environment.
- Encourage the conservation of built heritage, including the canal and other sites along its route.
- Provide numerous opportunities for the development of social inclusion agendas and community participation.

³⁶ TNS Travel & Tourism (2004) GB Leisure Day Visits. Report of the 2002-03 Great Britain Day Visits Survey

³⁷ Simone Pitzal, East Lindsey District Council, pers. comm.

13 Access

Existing Access to the Towpath

- 13.1 The canal is currently a valuable linear recreational and drainage asset and it has the potential to absorb greater use without adverse affect. Paragraphs 12.93 to 12.108 identified the beneficial impact that restoration works could have on social inclusion. This section of the report considers access from public highways to the towpath for all potential users of the canal.
- 13.2 At present access to the canal can be obtained at the following locations (locations in **bold** indicate where public main roads cross the canal):
- **Tetney Lock** (Main Lock Bridge) off the Tetney to North Cotes road (no off road parking available except at adjacent Public House)
 - Riverside Farm (public footpath to left bank only)
 - **Thoresby Bridge** (no off road parking available)
 - Fulstow Bridge (footbridge at end of public highway, and un-maintained public road from Marsh chapel)
 - **Fire Beacon** (no off road parking available)
 - Biergate Farm (footbridge at end of un-maintained public road and bridleway from Covenham)
 - **Austen Fen Bridge** (no off road parking available)
 - **High Bridge** (no off road parking available)
 - Alvingham Church Canal Footbridge (public footpath)
 - **Alvingham Lock Bridge** (no off road parking available)
 - River Farm (private, no public right of way)
 - **Ticklepenny Lock Bridge** (off road parking available)
 - Keddington Church/Eastfield (footbridge via public footpath)
 - Top Lock/Tilting Weir (footbridge via public footpath)
 - **Riverhead** (off road parking available at Navigation Warehouse)
- 13.3 Access to the canal towpath can be difficult especially as at the majority of access points there is usually poor provision for car parking and poor sight lines along connecting roads and bridges.
- 13.4 The towpath surface varies along its length with natural worn grass in the more rural area with sealed paths in the urban area of Louth between Riverhead and Keddington (i.e. up to the first stile). The general width of the made footpath is approximately 1m. There are 21 artificial barriers (i.e. stiles) on the actual route. There is some way-marking (fingerposts) along the canal length. Facilities are generally concentrated in Louth with a public house located at Tetney Lock. There are few benches provided along the canal (Ticklepenny Lock being one).

Users

- 13.5 Much of the existing towpath is designated public footpath and the Louth Canal does provide an 18.9km walkable route along its length. However, the whole route is not passable for wheelchairs or the less able bodied, mainly due to the presence of a number of stiles. In recent years the Louth Navigation Trust has improved some of the towpath and manages the vegetation growth to maintain general access along the length of the canal.

- 13.6 Cycle access along the canal is currently fairly limited due to the nature and legal status of the towpath and stiles. The towpath surface would need to be upgraded to improve cycle provision. Potential conflict with anglers, walkers and disabled users would need to be ameliorated. This could be undertaken by the provision of a widened shared footpath, say 3m wide or by segregated paths. Such a shared width would be difficult to provide along some lengths of the canal and therefore a cycleway should only be encouraged if a safe segregated route can be established taking advantage of side paths. To allow the use of the towpath by cycles and wheelchairs all the stiles along its length would need to be replaced by gates or preferably removed (if stock control is not required).
- 13.7 Some bridleways cross the canal or run parallel to it but none of the towpath is classified as a bridleway. It is not recommended that the towpath be managed to allow horse riding as horse riding would be significantly restricted by the narrowness of the path and could cause potential conflict with anglers, walkers and disabled users.
- 13.8 With the restoration of navigation the use by boaters would be enhanced. Boats can provide excellent opportunities for people with disabilities to access waterways. To this end provision of disabled access to moorings should be encouraged.
- 13.9 The canal can be used for canoeing. Disabled people can canoe and consideration should be given to their needs as regards access to launching points.
- 13.10 There is an angling club on the canal. Dedicated access for disabled anglers should be provided at the most suitable locations (e.g. near to car parking).

Circular Walks

- 13.11 There are several links to the right of way network and therefore there is potential to create circular walks. Louth Navigation Trust has produced brochure of walks in conjunction with Lincolnshire Wolds Countryside Agency. The brochure is currently being updated.

Disability Discrimination Act

- 13.12 The Disability Discrimination Act (DDA) 1995 is based on the principle that disabled people should not, for a reason related to their disability, be treated less favourably than others. Since October 2004 service providers will be expected to take reasonable steps to remove, alter or provide reasonable means of avoiding physical features that make it impossible or unreasonably difficult for a disabled person to make use of a service.
- 13.13 A code of practice established by the Disability Discrimination Act elaborates upon the duties placed by the Act on those providing access to goods, facilities, services and premises. Although not a legal document it can be used as evidence in legal proceedings under the Act and so it is in the interest of the service provider to ensure that their practice, policy and procedures are wherever possible in accordance with the code.

Suggested Improvements

- 13.14 Where possible, the Disability Discrimination Act requires access to the towpath to be improved to a standard that also allows wheelchair access. It is therefore proposed that to improve access:
- At a number of Bridges it could be possible to construct a car park or off road parking.
 - The majority of the towpath is grass and in relatively good condition. To maintain the condition careful management is essential especially if usage is increased. There is a general need to level the path where it is significantly uneven and to reduce significant cross falls where practicable. In some sections a stone 'hoggin' type path maybe more sustainable.
 - The footpath should be widened to at least 1m or passing places provided at approximately 150m intervals.

- A walking clearance of at least 1.5m should be maintained by cutting or tying back overhanging trees and bushes.
- Surface steps should be removed throughout the length.
- A self closing type of gate should replace stiles and gates where they exist and are necessary for agricultural purposes (life stock control) or to prevent access by motor vehicles (see Photograph 13.1).



Photograph 13.1 - Timber Stile between Keddington Church Lock and Ticklepenny Lock

- There is a significant pinch point at Thoresby Bridge where the towpath is narrow due to adjacent buildings creating an obstruction to wheelchair users. If the canal cannot be narrowed to provide additional towpath width it maybe possible to negotiate access through adjacent private land (see Photograph 13.2).



Photograph 13.2 - Narrow towpath at Thoresby Bridge

- Signing should be a suitable height, colour and contrast, to be legible to the majority of users (see nib.org.uk for guidance and standards).

- Picnic tables with provision for wheelchairs could be provided at key points along the Navigation. Consideration should be given to the maintenance of such areas including collection and removal of rubbish.

14 Construction Access

Introduction

- 14.1 Road access to the area is principally via the A16 (Boston – Grimsby) and the A157 (Lincoln – Louth). The A1031 coast road (Grimsby - Skegness) crosses the canal at Thoresby Bridge.
- 14.2 Concern has been expressed that forming access for the works to the canal will have a significant adverse effect on the local environment. Access to the canal is difficult and there are few access points from main roads. Many of the public highways adjacent to the canal are unsuitable for substantial construction traffic and could cause a significant nuisance to the local residents if used for such.
- 14.3 Apart from the A1031 the surrounding roads giving access to the canal are minor roads and are not designed to cope with large amounts of traffic. They facilitate access to the canal at:
- Tetney Lock
 - Fire Beacon Bridge
 - Austen Fen
 - High Bridge
 - Alvingham
 - Ticklepenny
 - Riverhead
- 14.4 Within Louth access would mainly have to be negotiated through adjacent industrial land.

Proposals for Construction Access

- 14.5 For each length of canal, the proposed construction access will be:

Between Tetney Haven and Riverside Farm

- 14.6 For major and minor works access would be from Tetney Lock off the Tetney to North Cotes Road.

Between Riverside Farm and Fulstow Bridge

- 14.7 For major works access would be from the A1031 coast road (Grimsby - Skegness) which crosses the canal at Thoresby Bridge. For minor works access to both banks from Fulstow Bridge (footbridge) could also be obtained.

Between Fulstow Bridge and Biergate Farm

- 14.8 For major works access would be from Fire Beacon Bridge. For minor works access to the east bank from Biergate Farm (footbridge) could also be obtained.

Between Biergate Farm and Austen Fen Footbridge

- 14.9 For major and minor works access would be from Austen Fen Bridge.

Between Austen Fen Footbridge and Alvingham

- 14.10 For major works access would be from High Bridge. For minor works not involving vehicle access from Alvingham (footbridge) could also be obtained.

Between Alvingham Lock Bridge and River Farm

- 14.11 For major works access would be from Alvingham. For minor works access from River Farm could also be negotiated.

Between River Farm and Keddington

- 14.12 For major works access would be from Ticklepenny Lock Bridge. For minor works access from Keddington could also be obtained.

Between Keddington and Riverhead

- 14.13 For major works access would be negotiated though industrial land which bounds the canal at Riverhead.

Mitigation Measures

- 14.14 The following mitigation measures are suggested to minimise the potential impact of accessing the works on residents:
- Designated areas should be defined for deliveries and access.
 - Designated access routes should be agreed with the County Council.
 - Orders must be obtained from the County Council regarding the temporary closure of any footpaths or roads.
 - The timings of deliveries, especially large items, should be such as to minimise the impact on local traffic.
 - Access points should be signed, securely fenced and gated.
 - Regular discussion of the works with landowners, before, during and after, should be instigated to enable issues to be identified and resolved.
 - To maintain easy access for emergency services the County Council and Emergency Services should be informed of any works that may block road access.
 - All plant and machinery used during the construction should comply with current exhaust gas emissions and noise suppression standards at all time. Plant should not be revved or left to idle unnecessarily.
 - Measures will be required to keep the access roads clean and to cover materials during transportation.

15 Master Plan

Development of a Master Plan

- 15.1 The feasibility study has identified that restoration of the Navigation could be technically, economically and environmentally feasible. However, further work is required before the restoration of the Navigation becomes a reality. The Master Plan defines a realistic, achievable programme for implementation of the findings of the feasibility study and suggests how to progress the restoration works.
- 15.2 The Master Plan defines potential costs and benefits arising at various stages of the project and it specifies anticipated constraints, landownership issues or technical factors, which need to be resolved. It also covers issues such as detailed design, gaining of required approvals, planning permissions, potential partnerships and phasing of the works.

Management of the Restoration Project

- 15.3 Currently, the Partners to the project have created a Steering Group, which has directed the feasibility study. Following on from the feasibility study the steering group (or similar management team) should continue to push the scheme forward, to provide direction and to oversee the work as the project is implemented.
- 15.4 To allow efficient and effective delivery of the project a Project Manager should be appointed by the Steering Group. The Project Manager would report to the Steering Group.

Communication Plan

- 15.5 A communication plan should be developed and implemented to formalise the consultation and the promotion of the project. The plan would be used to keep the local community and landowners informed of progress.
- 15.6 The plan could include face-to-face meetings, seminars/presentations, newsletters or other publicity such as a website or press releases.

Funding

- 15.7 Project Partners have previously allocated funds for the initial feasibility study of the project. Following on from the feasibility study funding for further more detailed investigation and ultimately for construction will need to be sought from the various grant aiding bodies, local authorities, developers and other interested organisations. Funding streams to cover the on-going costs of maintaining and operating the Navigation should also be investigated.
- 15.8 Major funding partners could include:
- East Midlands Development Agency.
 - The Lottery (Heritage Fund).
 - Environment Agency/British Waterways.
 - Central Government.
 - European Union.
 - County and District Councils.
- 15.9 Commitment of public funding could be the catalyst to increase investment from the private sector, e.g. property developers or user groups in the public private or voluntary sectors. Such avenues of funding should be explored and may involve the use of Section 106 agreements under the Town and Country Planning Act 1990.

- 15.10 The Planners at East Lindsey District Council have indicated that proposed works would need to be in accordance with local plan policies. This limits potential extended development to existing urban areas and therefore limits the potential for enabling works to fund the restoration outside of Louth, unless amendments to the local plan could be obtained. Developers have indicated an interest in undertaking developments on or adjacent to the restored Navigation.

Landownership/Navigation Rights

- 15.11 The issue of landownership has become confused since the abandonment of the Navigation in 1924. It is believed that the Environment Agency now owns the canal from Keddington Lock to Tetney Haven. However between Keddington and Riverhead the issue of landownership is unclear. The question of landownership is beyond the scope of this study. The Louth Navigation Trust is progressing this issue further.
- 15.12 New waterways require an Act of Parliament to allow the right of navigation and derive an income. Such Acts are obtained through a sponsor or through the use of a Transport and Works Order. It is believed that the original Act of Parliament dated 24 March 1763 allowing the opening of the canal has not been annulled. This being the case there could still be a right of navigation along the Navigation. It should be noted that a right of navigation does not imply a right to moor to the banks or a right to undertake works to improve the Navigation. The legal question of the right of navigation is beyond the scope of this report and the Louth Navigation Trust is progressing this issue further.

Consents

- 15.13 Agreements from landowners will be required.
- 15.14 Planning permission from East Lindsey District Council will be required for the restoration works.
- 15.15 Land Drainage Consent from the Environment Agency will be required for the restoration works. Consent from Lindsey Marsh Drainage Board will also be required.
- 15.16 Consent of Lincolnshire County Council for works to highways/bridges will be required.
- 15.17 Agreement of English Heritage for works to listed structures will be required.
- 15.18 Agreement of English Nature for works at Tetney Haven will be required.
- 15.19 The works will need to be undertaken with due regard to the Construction (Design and Management) Regulations.

Future Management

- 15.20 Responsibility for future management of the Navigation, its maintenance and a viable exit strategy should be explored.
- 15.21 Licence arrangements for boat users of the Navigation should be explored.

Programme/Phasing of the Works

Study Packages

- 15.22 Further work is required before major construction can commence. Work packages for the next stage of the project should build on the work undertaken as part of the feasibility study. Suggested packages are:
- Detailed study to allow flood risk issues to be fully addressed. This will include the development of a computer model of the whole Louth Canal to determine existing and post restoration water levels, and hence the size of bywashes or control sluices, so as not to adversely affect flood risk.

- Detailed study to determine the impact of navigation on protected rights to water, including assessment of leakage rates and potential fluctuations in flow along the Navigation.
- Liaison with Anglian Water to confirm details for the proposed pumping station at Louth WWTW and relocation of the outfall for the Great Eau water transfer pipeline.
- Detailed appraisal of the drainage at Alvingham to identify a preferred land drainage option.
- Detailed appraisals and designs for all the new or refurbished structures that have been identified in the feasibility study, including liaison with English Heritage on works to the listed locks.
- Further liaison with utilities regarding detailed design, costing and phasing of diversion of services and the supply of services for Navigation use.
- Environmental Impact Appraisal to build upon the environmental scoping work undertaken to date to ensure that issues are satisfactorily resolved and objections to the works avoided. This would include a comprehensive assessment of the Tetney Haven SPA. The Output should include an environmental action plan.
- Channel and topographical survey - detailed survey of whole canal to obtain data all to the same datum using global positioning system (GPS).

Construction Packages

15.23 Until significant amounts of the above study packages are completed, restoration of navigation may not be confirmed as feasible. However, the following works could be undertaken subject to funding prior to restoration of navigation. Indicative costs are given which allow 15% for Professional Fees and a 20% contingency allowance.

- Improvements to access – towpath/stiles. (£21k)
- Improvements to access – car parking. (£28k each)
- Improvements to fishing – disabled fishing decks. (£7k each)
- Improvements to access – signage. (£14k)
- Restoration of locks without installation of the lock gates to safeguard the remaining parts of the listed locks. (£455k each)
- Erosion protection measures. (£504k)

15.24 If works are undertaken by third parties on structures along the canal, opportunities to facilitate restoration of navigation should be sought.

15.25 Improvements together with the implementation of a well-resourced and targeted marketing campaign that sells the Louth Canal and its associated heritage assets as an attractive destination which could increase visitor numbers and spend significantly prior to full restoration of navigation.

Programme

15.26 An anticipated programme of restoration prepared by the Louth Navigation Trust and the steering group members is given overleaf with potential benefits and constraints.

Table 15.1 - Outline Master Plan Programme

Item	Activity	Start	Finish	Benefits	Constraints
Access Improvement Projects					
1	Four Navigation Walks Brochures.	2005	2006	Access improvements, promote walking and tourism. Note: Walk 1 two churches & A Canal successfully completed 2005.	-
2	Bailey Bridge Project - Raise low bridge.	2005	2007	Access improvements resulting in improved headroom along a significant length of the lower reach of the Louth Canal. Act as a catalyst to start Louth Navigation Boat Club.	Funding required. Consents required. Final Landowner agreement required. Involvement of Waterway Restoration Group required to minimise costs.
3	Tetney Lock Slipway Project.	2005	2007	Access improvements allowing safe access/egress for small boats/canoes. Improved car parking allowing access to coastal areas.	Funding required. Consents required. Final Landowner agreement required. Operational/maintenance responsibility to be addressed.
4	Covenham Reservoir Project - Create an area of outdoor activity involving boating, walking, cycling combining the resources of Covenham and the Canal.	2005	2007	Access improvements, promote boating, walking, cycling and tourism.	Funding required. Consents required.
Restoration of Navigation					
5	ELDC Waterways Strategy	2005	2006	Promotion of waterway and navigation in North Lincolnshire to balance Lincolnshire Waterways Strategy.	
6	Formalisation of Navigation Company/Trust	2006	2009	Resolve maintenance, legal & revenue issues.	
7	Restoration of Locks (without lock gates)	2006	2009	Historical asset preservation.	Funding required. Consents required. Final Landowner agreement required.

Table 15.1 - Outline Master Plan Programme (continued)

Item	Activity	Start	Finish	Benefits	Constraints
8	Development of Louth Riverhead	2010	2020	Regeneration benefits.	Developer involvement
9	Development of Tetney Lock Marina	2010	2020	Regeneration benefits.	Developer involvement
10	New locks and Install gates on existing locks	2010	2020	Full restoration with economic, environmental, & historical benefits	Funding required. Completion of studies, flood risk assessment, environmental impact assessment Consents required.
11	Navigability of the canal – remaining construction	2010	2020	Full restoration with previously defined economic, environmental, & historical benefits	Funding required. Consents required.

Source Based on Louth Navigation Trust Master Plan (July 2005)

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16 Conclusions

- 16.1 The findings of this initial study demonstrate the viability of the restoration of the Louth Navigation. There are a number of identified technical and environmental issues which will need to be overcome in order to restore navigation. From the information known at this time overcoming these issues would appear feasible.
- 16.2 The Navigation would increase leisure activities like walking and fishing. The study found that the restoration of the Louth Navigation could provide social, economic and environmental benefits to an area in need of diversification, creating up to 111 permanent jobs and bringing in an extra £3.8million/annum into the local economy each year.
- 16.3 There is the potential for a range of adverse impacts, some of which may be significant. However, as many of these issues have been identified at this early stage it is likely that environmental risks associated with the restoration of the Navigation can either be avoided, mitigated, or compensated for during future design and implementation of improvement works. In addition to this there are a range of exciting opportunities to enhance the existing Canal and its environs as a wildlife corridor throughout its length.
- 16.4 The estimated implementation capital cost is £24.7million.
- 16.5 The Master Plan defines a realistic, achievable programme for implementation of the findings of the feasibility study and suggests how to progress the restoration works.

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Figures

Figure 1 – Location Plan

Figure 2 – Key Plan

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Appendix A – Survey Data

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Appendix B – Dredging Requirements

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Appendix C – Section Details and Proposed Works

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Appendix D – Consultation Pack

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Appendix E – Consultation Responses

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Appendix F – Significant Criteria and Impact Matrix

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Human

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- Direct impact on residents / proprietors resulting in a significant and permanent changes to way of life or business OR residents / proprietors having to permanently relocate.
- Direct impact on residential / commercial properties with the potential for significant permanent changes to property OR significant change in the value of property / business.
- Direct impact on landowners with the potential for significant permanent changes to land use OR significant change in the value of land.
- Direct impact to all or a significant part of a recreational asset including permanent changes to asset.
- Direct impact on the integrity of the navigation to function efficiently during periods of flooding or high flows throughout the year over significant reaches OR a significant increase in the risk of flooding.
- A significant increase in permanent employment opportunities OR a sustainable net gain to the local economy.
- Direct impact on existing agricultural practices resulting in permanent major changes to farm holding or farm operation.
- Permanent impacts on daily MOD operations in the area.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- Direct impact on residents / proprietors resulting in limited permanent changes or temporary major changes (< one year) to way of life or business OR residents / proprietors having to temporarily relocate.
- Direct impact on residential / commercial properties with the potential for limited permanent changes to property OR limited change in the value of property / business.
- Direct impact on landowners with the potential for limited permanent changes to land use OR limited change in the value of land.
- A direct impact to a large area of a recreational asset (between 5% and 50%), whilst leaving the majority of the asset undisturbed.
- Direct impact on the integrity of the navigation to function efficiently during periods of flooding or high flows throughout the year over medium length reaches OR a limited increase in the risk of flooding.
- A significant increase in seasonal employment opportunities and / or a limited increase in permanent employment opportunities OR a seasonal net gain to the local economy.
- Direct impact on existing agricultural practices resulting in permanent moderate changes to farm holding or farm operation.
- Temporary impacts on daily MOD operations in the area

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- Direct / indirect impact on residents / proprietors resulting in limited temporary changes to way of life or business and no relocation.
- Direct / indirect impact on residential / commercial properties resulting in temporary disruption (< one year).
- Direct / indirect impact on landowners resulting in temporary disruption (< one year).
- A direct impact to a limited area of a recreational asset (< 5%).

- Direct impact on the integrity of the navigation to function efficiently during periods of flooding or high flows throughout the summer months and only over short reaches with no increase in the risk of flooding.
- Limited seasonal or temporary employment opportunities OR and limited net gain to the local economy.
- Direct impact on existing agricultural practices resulting in permanent minor or temporary (< one year) moderate changes to farm holding or farm operation.
- Negligible impacts on daily MOD operations in the area.

No Impact: No detectable change to the environment i.e. no impact on any of the above receptors.

Flora and Fauna

Major: A permanent change, sometimes extensive, to habitats, flora or fauna (sometimes of national importance) that in this context is interpreted specifically as:

- A permanent effect on a statutory designated site of nature conservation importance that impacts on the integrity of the site and / or the reason for which the site was originally designated.
- A permanent change in the diversity of flora and / or fauna present over a significant length of continuous watercourse OR multiple limited lengths of continuous watercourse.
- A permanent effect on the population of a rare or endangered species of flora or fauna or a substantial effect on its environment at one or more locations.
- A permanent loss or gain of a nationally rare or declining natural or semi-natural habitat regardless of extent OR a permanent change in the quality of such a habitat.
- A lack of compliance with legislation associated with an internationally designated site.

Moderate: Sometimes a permanent change, usually spatially limited, to habitats, flora or fauna (sometimes of regional importance) that in this context is interpreted specifically as:

- A permanent effect on a non-statutory designated site of nature conservation value that impacts on the integrity of the site and / or the reason for which the site was originally designated.
- A permanent change in the diversity of flora or fauna present over a limited length of continuous watercourse OR a localised change at multiple sites.
- A material effect on the population of a protected or regionally notable plant or animal species OR regular disturbance of such species at one or more locations.
- The temporary disturbance (< one year) of a protected species where impacts can be appropriately mitigated.
- A permanent loss or gain of a regionally notable or locally restricted semi-natural habitat regardless of extent OR a permanent change in the quality of such a habitat OR regular disturbance to this type of habitat.
- A lack of compliance with legislation associated with a nationally designated site.

Minor: Usually a temporary change, always localised, to habitats, flora or fauna (sometimes of local importance) that in this context is interpreted specifically as:

- A temporary and limited effect on a non-statutory designated site of nature conservation value that does not impact on the integrity of the site and / or the reason for which the site was originally designated.
- A localised change in the diversity of flora or fauna present at an individual or very limited number of sites.
- A limited effect on the population of a non-protected or locally notable plant or animal species OR regular disturbance of such species at one or more locations.

- The limited reduction or improvement of the nature conservation value of a modified habitat type, community or population.
- The temporary (< one year) disturbance of a non-protected habitat or species that cannot be mitigated.
- A permanent loss or gain to an existing and ubiquitous habitat that has been heavily modified from its natural or semi-natural state OR periodic disturbance to this type of habitat OR a reduction in the quality of this type of habitat.

No Impact: No detectable change to the environment i.e. no impact on the site or its setting.

Air

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A change in air quality at a county scale with potential for impacts in other counties resulting from large-scale emissions.
- A permanent and significant change in noise levels compared to existing ambient noise levels over a broad geographic area in relation to the noise source.
- A permanent and significant change in the number and sources of vibration compared to the existing situation over a broad geographic area in relation to the vibration source with the potential for significant damage to buildings or structures OR limited damage to listed buildings or structures.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A change in air quality at a local scale with potential for impacts within the county resulting from medium-scale emissions.
- A temporary but significant change in noise levels compared to existing ambient noise levels over a limited geographic area in relation to the noise source.
- A temporary but significant change in the number and sources of vibration compared to the existing situation over a limited geographic area in relation to the vibration source with the potential for limited damage with the potential for limited damage to non-listed buildings or structures.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- A change in air quality at a specific location and only within the immediate vicinity of the emission source resulting from small-scale emissions.
- A permanent or temporary non-significant change in noise levels compared to ambient noise levels immediately adjacent to the noise source.
- A permanent or temporary non-significant change in the number and sources of vibration compared to the existing situation immediately adjacent to the vibration source with damage to buildings or structures very unlikely.

No Impact: No detectable change to the environment i.e. no impact on the site or its setting.

Landscape and Visual Amenity

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A substantial physical change to all or a significant part of the landscape that has a major effect on its existing character.
- Various aspects of the proposed restoration are viewed as a dominant feature in the landscape when considering the view towards them.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A moderate physical change to a limited part of the landscape that has a moderate effect on its existing character.
- Various aspects of the proposed restoration are viewed as an important element in the landscape when considering the view towards them.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- A change to the landscape that has a minor impact on its existing character.
- Various aspects of the proposed restoration are viewed as being one of a number of components that make up the view, but not a dominant or particularly evident feature, when considering the view towards it.

No Impact: No detectable change to the environment i.e. no impact on the landscape or its character.

Water

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A direct impact resulting in the degradation of the chemical and / or biological status of water quality (> 3 months) over a significant length of watercourse as a result of the proposed restoration works.
- A direct and permanent impact on the existing water resource over a significant length of the navigation.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A direct impact resulting in the degradation of the chemical and / or biological status of water quality (up to 3 months) over a limited length of watercourse as a result of the proposed restoration works.
- A direct and permanent impact on the existing water resource over a limited length of the navigation.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- A direct impact resulting in the degradation of the chemical and / or biological status of water quality (< 1 week) within the immediate vicinity of restoration works.
- A direct and temporary (< one year) impact on the existing water resource over a limited length of the navigation.

No Impact: No detectable change to the environment i.e. no impact on the existing quality of chemical and biological water quality.

Land Use

Major: A fundamental change to the environment i.e. direct and / or indirect impact to all or a significant part of land associated with various aspects of the proposed restoration that have a major impact on its existing use.

Moderate: A material but non-fundamental change to the environment i.e. direct and / or indirect impact to a limited part of land associated with various aspects of the proposed restoration that have a moderate impact its existing use.

Minor: A detectable but non-material change to the environment i.e. direct and / or indirect impact to a limited part of land associated with various aspects of the proposed restoration that has a minor impact its existing use.

No Impact: No detectable change to the environment i.e. no impact on the existing land use.

Cultural Heritage, Material Assets and Archaeology

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A major direct impact on nationally significant or regionally significant heritage assets i.e. they are lost or their integrity is severely damaged OR there is potential for very significant or extensive restoration or enhancement of characteristic features or their setting.
- A moderate direct impact on or compromise to the wider setting of multiple nationally or regionally significant heritage assets, such that the cumulative impact would seriously compromise the integrity of a related group or historic landscape/townscape.
- An impact that is highly intrusive and would seriously damage the setting of the heritage resource, such that its context is seriously compromised and can no longer be appreciated or understood OR removal or successful mitigation of an existing visual intrusion, such that the integrity, understanding and sense of place of a highly valued area, a group of sites or features of national or regional significance is re-established
- An impact that is in serious conflict with government policy for the protection of the heritage, as set out in PPG 15 and PPG 16 OR one that has the potential to make a major contribution to government policies for the protection or enhancement of the heritage.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A major direct impact on regionally or locally significant heritage, resulting in loss of features such that their integrity is substantially compromised, but adequate mitigation can be specified OR provide potential for significant restoration of characteristic features or their settings.
- Impacts that are damaging to nationally significant heritage assets, resulting in loss of features such that their integrity is compromised, but not destroyed, and adequate mitigation has been specified OR provide potential for significant restoration of characteristic features or their settings.
- A proposal that is out of scale with, or at odds with the scale, pattern or form of the heritage resource OR intrusive in the setting (context), and will adversely affect the appreciation and understanding of the characteristic heritage resource OR will enhance the existing historic landscape / townscape character through beneficial landscaping / mitigation and good design.
- An impact that is in conflict with local or regional policies for the protection of the heritage OR contribute to Regional or Local policies for the protection or enhancement of the heritage.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- Damage to locally significant heritage features for which adequate mitigation can be specified OR restore or enhance the form, scale, pattern or sense of place of the heritage resource through good design and mitigation.
- A detrimental impact on the context of regionally or locally significant assets, such that their integrity is compromised and appreciation and understanding of them is diminished OR restore or enhance the form, scale, pattern or sense of place of the heritage resource through good design and mitigation.
- not fit well with the form, scale, pattern and character of a historic landscape / townscape / area OR remove or mitigate visual intrusion (or other indirect impacts) into the context of

locally or regionally significant heritage features, such that appreciation and understanding of them is improved.

- Impacts that are in conflict with local policies for the protection of the local character of the heritage OR are not in conflict with national, regional or local policies for the protection of the heritage.

No Impact / Neutral Impact: No detectable change to the environment i.e. no impact or neutral impact on any historical asset or its setting.

- No appreciable impacts, either positive or negative, on any known or potential heritage assets.
- A combination of slight positive and negative impacts, on locally significant aspects of the heritage.
- Do not result in severance or loss of integrity, context or understanding within a historic landscape.
- Maintenance of existing historic character in a landscape / townscape.

Traffic and Transport

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A permanent effect resulting in an increase of traffic flow of more than 100% above existing flows OR permanent loss of access.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A material effect resulting in an increase of traffic flow of > 10 and <100% above existing flows OR temporary loss of access.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- A limited but detectable change resulting in an increase of traffic flow of < 10% and no loss of access.

No Impact: No detectable change to the environment i.e. no impact on the site or its setting.

Soil

Major: A fundamental change to the environment i.e. a direct impact on agricultural soils resulting in permanent changes to fertility, compaction or quality over significant areas of land.

Moderate: A material but non-fundamental change to the environment i.e. a direct impact on agricultural soils resulting in permanent changes to fertility, compaction or quality over limited areas of land.

Minor: A detectable but non-material change to the environment i.e. a direct impact on agricultural soils resulting in temporary changes to fertility, compaction or quality over limited areas of land such as access routes.

No Impact: No detectable change to the environment i.e. no impact on the existing quality of soil.

Geology

Major: A fundamental change to the environment that in this context is interpreted specifically as:

- A permanent effect on a statutory / non-statutory site of geological conservation value.

Moderate: A material but non-fundamental change to the environment that in this context is interpreted specifically as:

- A material effect on a non-statutory designated site of geological conservation value. A lack of compliance with legislation.

Minor: A detectable but non-material change to the environment that in this context is interpreted specifically as:

- The limited reduction or improvement of the geological conservation value of a non-designated site.

No Impact: No detectable change to the environment i.e. no impact on the site or its setting.

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Table F1: Scoping Analysis Matrix

Broad environmental resources affected	Constraint or opportunity	Impact summaries: Construction (C) or End-state (E)	Associated construction or operation activity	Potential significance of impacts (indicate ✓ or X)	Future surveys and information required
Human:					
	Development:	(E): <ul style="list-style-type: none"> Restoration of the navigation could bring about an increased pressure for development in the open countryside. 	(20)	Significance of impact not known	
	Residential Properties:	(C) (E): <ul style="list-style-type: none"> Potential for permanent changes to properties e.g. damage, access as a result of proposed works, impacts associated with raising water levels. 	(4) (19) (5) (6) (7) (9) (10) (11) (18)	*** ** *	Need to quantify number of residential properties that may be impacted by the scheme and the degree of impact for each property.
	Commercial Properties:	(C) (E): <ul style="list-style-type: none"> Potential for permanent changes to properties e.g. damage, access as a result of proposed works, impacts should there be a need to raise water levels. 	(4) (10) (18)	*** *	Need to quantify number of commercial properties that may be impacted by the scheme and the degree of impact for each property.
	Commercial Activities:	(C): <ul style="list-style-type: none"> Potential for disruption to commercial activities. 	(4)	***	Identification of commercial properties where disruption to activities during construction is likely.
	Landowners:	(C) (E): <ul style="list-style-type: none"> Potential for permanent loss of land primarily associated with widening the canal and bridge works. 	(4) (9) (20)	***	Need to identify all landowners likely to be impacted by the works.
	Landowners:	(E): <ul style="list-style-type: none"> Potential for increase in value of land associated with restoration and 	(4) (9) (20)	✓✓✓	

		development projects e.g. marinas.			
	MOD Property and Activities:	(E): <ul style="list-style-type: none"> Potential for increased bird strike risk within the statutory safeguarding area at the northern section of the Louth navigation between Thoresby Bridge and Tetney High Sands should environmental enhancements such as wetlands be created within this location. 	(23)	Significance of impact not known	Continued liaison with the MOD bird strike team is essential should the restoration proposal include creating offline wetland areas.
	Angling:	(C) (E): <ul style="list-style-type: none"> Potential for disruption to anglers parking at bridges to gain access to canal during bridge works. 	(4) (9)	**	Angling clubs should be consulted regarding any future work program.
		<ul style="list-style-type: none"> Disturbance to anglers during dredging or lock refurbishment or replacement Boats using navigation. 	(5) (6) (7) (10) (11) (20) (22)	*	
	Angling:	(E): <ul style="list-style-type: none"> Potential to improve access for anglers at strategic locations such as steps, fishing platforms, disabled access and safe parking areas. 	(23)	✓	Consult with angling club re types of amenity enhancements that would be most beneficial as part of this restoration project.
	Access:	(C) (E): <ul style="list-style-type: none"> Disruption to users of the footpath along the navigation during various work activities that may result in either temporary footpath closures or diversions e.g. bridge works. 	(4) (5) (6) (7) (8) (10)(11) (20) (22)	**	
		<ul style="list-style-type: none"> As above but during dredging and maintenance works. 	(9) (22)	*	
	Access:	(E): <ul style="list-style-type: none"> Opportunity to increase recreational 	(23)	✓✓✓	Liaison with LCC re Rights of Way Improvement Plan.

		<p>access along the canal towpaths and links with nearby rural settlements and Open Access Land in the area e.g. circular routes for walkers, cyclists etc.</p> <ul style="list-style-type: none"> • Enhancement of the existing footpath e.g. footpath upgrade to a bridleway. • Opportunity to provide signage and interpretation along the canal corridor. This would enhance any new links re access and could also provide historical, natural history and other educational information with regard to the canal and its environs. • Opportunities to extend and link to national cycle routes. • Creation of heritage trails, wildlife walks and extension of Louth Art Trail. • Incorporation of pubs and shops along the canal as part of the on going 'Taste of Lincolnshire' marketing campaign. 			<p>Investigate opportunities to link with new Open Access Land in area (maps are at the provisional stage). Making connections improves opportunities for sources of funding.</p> <p>Investigate opportunities to link objectives with those of the Wolds.</p> <p>Cycling maps are being produced by ELDC, LCC, Wolds CS and Mablethorpe Town Council.</p>
	Tourism:	<p>(E):</p> <ul style="list-style-type: none"> • Potential to attract more visitors and contribute to the regeneration of the area and local economy e.g. use of the navigation, diversification from farming to guesthouses and rural trades. • Opportunity to provide boat trips along the canal to various destinations e.g. Alvingham Pottery and local pubs. 	(18) (19) (20) (21)	✓✓	Investigate links with Environmental Tourism Study of North Lincolnshire (presently ongoing).
	Navigation:	<p>(E):</p> <ul style="list-style-type: none"> • This would be a major recreational asset to the area, likely to attract both local use and visitors. Opportunity to restore the navigation allowing both barges, small motorised craft and sailing boats to traverse the canal (including various facilities such as moorings). • There is also the potential to provide for 	(13) (14) (15) (16) (17) (18) (19) (20) (21) (22)	✓✓✓	

		<p>sports such as canoeing and kayaking with access and egress points and canoe portages at strategic locations.</p>			
	Flood Defence and Drainage Capacity:	<p>(C) (E):</p> <ul style="list-style-type: none"> • Potential for the efficiency and integrity of the drainage channel to be compromised during construction works associated with bridges and lock structures. • Potential for efficiency of gravity fed pumps to be compromised should there be a need to raise water levels. • Potential of increased flooding resulting from raised water levels and hence a raised water table throughout the catchment. • Potential impacts on existing flood embankments due to channel widening. • Potential for increased rates of erosion at the toe of the canal due to boat wash. 	<p>(4) (5) (6) (7) (8) (10) (11) (20)</p>	<p>***</p>	<p>Detailed information needs collating re existing extent of flood defence structures and how these might be impacted upon as a result of the restoration proposals.</p>
	Flooding:	<p>(C) (E):</p> <ul style="list-style-type: none"> • Potential for increased flooding due to dredging of the bed which could lead to existing banks being undermined. • Potential for increased deposition of sediment due to increased water depth resulting in reduction in drainage efficiency. 	<p>(9)</p>	<p>***</p>	<p>Flood risk assessment associated with the restoration project needs to be undertaken.</p>
	Flood Defence and Drainage Capacity:	<p>(E):</p> <ul style="list-style-type: none"> • Potential for the drainage channel capacity and efficiency to be enhanced by raised bridges, increased water depth with regular channel maintenance. 	<p>(13) (17) (22)</p>	<p>✓</p>	

	Employment:	(C): <ul style="list-style-type: none"> Potential for locally skilled personnel to gain temporary employment during the construction phase. 	(4) (5) (6) (7) (8) (9) (10) (11) (12)	✓	
		(E) <ul style="list-style-type: none"> Redevelopment will provide more than 270 new jobs in the local area. 	(18) (19) (20) (21)	✓✓✓	
	Local Economy:	(E): <ul style="list-style-type: none"> There is the potential to boost the local economy and commercial opportunities at various points along the canal. 	(18) (19) (20) (21)	✓✓	
	Farm Holdings and Agricultural Practices:	(C): <ul style="list-style-type: none"> Potential loss of land associated with farm holdings due to expansion of bridge footprints, construction of new locks and the proposed marina near Tetney Lock. There is also the possibility of minor disruption to farm practices during construction works. 	(4) (6) (11)	*	The extent of land that may be permanently lost as a result of restoration works needs quantifying.
	Farm Holdings and Agricultural Practices:	(C): <ul style="list-style-type: none"> Opportunities to diversify e.g. B&B's, guesthouses, rural trades. 	(20)	✓	Links to the ELDC Local Plan and current policies and real opportunities for diversification need identifying.
Flora and Fauna:					
	Statutory Designated Sites:	(C) (E): <ul style="list-style-type: none"> Regular disturbance to breeding and roosting birds within the Tetney Haven due to presence of boats and dredging of sea channel. Adverse impacts on other species and habitats of interest i.e. the biological features for which this area was designated. Potential for excessive sediment (and 	(4) (6) (7) (8) (9) (11) (12) (21) (22)	***	Maybe necessary to undertake an Appropriate Assessment during the appraisal stage (EIA) if impacts are considered to be significant. Continued liaison with English Nature and RSPB essential.

		<p>contaminated sediment if present) to be washed into the estuary during construction works.</p> <ul style="list-style-type: none"> Potential changes to freshwater flows (quality and quantity) entering the Tetney Haven (pSAC, SPA, Ramsar, SSSI) via the navigation sea lock. 			An in depth study to address the potential impact on birds associated with this area is necessary and has been requested by the RSPB.
	Non-Statutory Designated Sites:	<p>(C) (E):</p> <ul style="list-style-type: none"> Adverse impacts on sites immediately adjacent to the navigation e.g. potential loss of area of site due to expansion of bridge footprints, disturbance to breeding birds and other wildlife. 	(4)	**	<p>Non-statutory designated sites will need to be appropriately surveyed where they will potentially be impacted upon by the restoration works.</p> <p>Environmental surveys to be undertaken need identifying.</p>
	Watercourses and Ponds:	<p>(C) (E):</p> <ul style="list-style-type: none"> A permanent and extensive change in the diversity of flora and fauna within the navigation due to dredging, multiple in channel construction sites (lock works) and ultimately boat use resulting in a reduction in the quality of habitat. Loss of habitats and therefore diversity of habitats throughout the navigation that have been slowly reverting to a more semi-natural state since the navigation closed. Loss of adjacent flowing water and pond habitats due to excessive pressure on water resources. 	(5) (6) (7) (8) (9) (10) (11) (12) (20) (22)	***	Habitats present within the navigation should be surveyed as part of the full EIA.
		<ul style="list-style-type: none"> Temporary disturbance of habitats associated with all bridge works. 	(4) (13)	*	
	Watercourses and Ponds:	<p>(E):</p> <ul style="list-style-type: none"> Canal could be enhanced along its whole length as a wildlife corridor with the creation of habitats appropriate to the landscape type. 	(23)	✓✓✓	Restoration of lengths of the old River Lud channel as mitigation for impacts on existing biodiversity associated with restoring the

		<ul style="list-style-type: none"> Potential to restore lengths of the adjacent channel of the River Lud and enhance habitats. 			navigation needs investigating.
	Wetland Habitats:	<p>(C) (E):</p> <ul style="list-style-type: none"> Adverse impacts on habitats of interest i.e. saltmarsh, mudflats, sandbanks within the Tetney Haven. 	<p>(4) (6) (7) (8) (9) (11) (12) (21)</p>	***	This should be addressed as part of any study undertaken to assess impacts on birds using this area.
	Wetland Habitats:	<p>(E):</p> <ul style="list-style-type: none"> Potential to create large areas of wetland habitat adjacent to the navigation that are appropriate to this area such a coastal and floodplain grazing marsh and reedbed as part of the restoration project. These may benefit local biodiversity in the area and contribute to national and local BAP targets. 	(23)	✓✓✓	Investigate links with the Lincolnshire Coastal and Floodplain Grazing Marsh Feasibility Study (Rick Keemer, English Nature) and agri-environment schemes.
		<ul style="list-style-type: none"> Potential to create ponds and shallow scrapes adjacent to the canal. These may benefit local biodiversity in the area and contribute to national and local BAP targets. 	<p>(23) Strategic locations throughout the length of the canal.</p>	✓✓	
	Lower Plants (Aquatic):	<p>(C) (E):</p> <ul style="list-style-type: none"> Potential loss of existing lock structures that may provide substrata for a variety of aquatic mosses and liverworts and associated invertebrates. 	<p>(5) (7) (14) (16)</p>	**	Survey of flora of old lock structures.
	Higher Plants (Aquatic):	<p>(C) (E):</p> <ul style="list-style-type: none"> Major and permanent changes in floral diversity and species as a result of extensive dredging. Loss of submerged plant communities due to increased water turbidity resulting from boats using the 	<p>(4) (5) (6) (7) (9) (10) (11) (20) (22)</p>	***	Survey of flora of associated watercourses, especially the old River Lud.

		<p>navigation.</p> <ul style="list-style-type: none"> Boat wash leading to erosion of banks and loss of plants. 			
	Higher Plants (Aquatic):	<p>(E):</p> <ul style="list-style-type: none"> Opportunity to re-establish diverse and dense aquatic marginal vegetation along the length of the navigation providing an enhanced habitat for a variety of wildlife. 	(23) Along the length of the navigation.	✓✓✓	
	Lower Plants (Terrestrial):	<p>(C) (E):</p> <ul style="list-style-type: none"> Potential loss of existing lock structures and bridges that may provide substrata for a variety of terrestrial mosses and liverworts and associated invertebrates. 	(4) (5) (7) (14) (16)	**	Survey of flora of old lock structures.
	Higher Plants (Terrestrial):	<p>(C) (E):</p> <ul style="list-style-type: none"> Permanent loss of a limited area of common species associated with restoration. 	(4) (6) (11) (13) (15) (19)	*	Phase 1 habitat survey of length of navigation (both banks) would be required.
B	Grassland and Scrub Habitat:	<p>(C) (E):</p> <ul style="list-style-type: none"> Permanent loss of a limited area of habitat associated with restoration e.g. new locks. 	(4) (6) (11) (13) (15) (19)	*	
	Arable Land and Pasture Habitat:	<p>(C) (E):</p> <ul style="list-style-type: none"> Permanent loss of a limited area of farmland associated with restoration e.g. new locks. 	(4) (6) (11) (13) (15) (19)	*	
	Hedgerow:	<p>(C) (E):</p> <ul style="list-style-type: none"> Location of hedgerows (if present) and relationship with proposed sites for construction are as yet unknown. 	(4) (6) (11) (13) (15) (19)	Significance of impact not known	Area of hedgerow that may be lost needs to be quantified.
	Hedgerow:	<p>(E):</p> <ul style="list-style-type: none"> Opportunities to plant new lengths of native hedgerow (if appropriate with 	(23) Strategic locations	✓ to ✓✓✓ (dependent on scale of	

		landscape character) that may be strategically located to link existing habitats.	throughout the length of the canal.	planting)	
	Trees and Woodland:	(C) (E): <ul style="list-style-type: none"> Location of individual trees, copse and small areas of woodland and relationship with proposed sites for construction are as yet unknown. 	(4) (6) (11) (13) (15) (19)	Significance of impact not known	Area of number of trees that may be impacted upon by the works needs to be quantified.
	Trees and Woodland:	(E): <ul style="list-style-type: none"> Opportunities to plant new trees of copse of trees (if appropriate with landscape character) such as pollarded willows along the canal. 	(23) Strategic locations throughout the length of the canal.	✓ to ✓✓✓ (dependent on scale of planting)	
	Otter:	(C) (E): <ul style="list-style-type: none"> Potential disturbance to otters (if present) during bridge works. Otters are known to utilise area beneath bridges and can often have holts or hovers nearby. Increased activity along the canal due to boat traffic. Otters are likely to adapt but initial intrusion of a presently quiet wildlife corridor maybe significant. 	(4) (20)	**	Comprehensive survey / information search for the presence of otters along the navigation.
		<ul style="list-style-type: none"> There maybe an impact on otters associated with the construction of a marina near Tetney Lock (if present). This depends very much on the marina's exact location. 	(11)	Significance of impact not known	
	Otter:	(E): <ul style="list-style-type: none"> Opportunities (if appropriate to provide artificial otter holts along the rout of the navigation. Scrub planting adjacent to existing otter holts (if present and necessary) plus new areas of scrub near new holts to 	(23) Strategic locations throughout the length of the canal.	✓ to ✓✓✓ (dependent on perceived benefits)	

		provide otters with safe areas rest.			
	Water Vole:	<p>(C) (E):</p> <ul style="list-style-type: none"> Loss of habitat and disturbance associated with various construction activities. Loss of habitat and disturbance should there be any permanent raising of water levels. Habitat fragmentation. Regular disturbance resulting from increased activity along the canal due to boat traffic. 	<p>(4) (5) (6) (7) (9) (20) (22)</p>	**	Comprehensive survey / information search for the presence of water vole along the navigation.
		<ul style="list-style-type: none"> There maybe an impact on water vole associated with the construction of a marina near Tetney Lock (if present). This depends very much on the marina's exact location. 	(11)	Significance of impact not known	
	Water Vole:	<p>(E):</p> <ul style="list-style-type: none"> Opportunities to create new areas of habitat off the main navigation channel such as connected backwaters. Opportunity to re-establish diverse and dense aquatic marginal vegetation along the length of the navigation providing an enhanced habitat for water vole. 	<p>(23) Backwaters at strategic locations throughout the length of the canal. Planting along the length of the navigation.</p>	✓✓ to ✓✓✓ (dependent on extent of enhancement)	
	Great Crested Newt:	<p>(C):</p> <ul style="list-style-type: none"> Potential for disturbance to GCN (if present) at ponds adjacent to the canal associated with construction works e.g. Thoresby Bridge. 	(4)	**	Comprehensive survey / information search for the presence of great crested newt within ponds adjacent to the navigation.

		<ul style="list-style-type: none"> • There maybe an impact on GCN associated with the construction of a marina near Tetney Lock (if present). This depends very much on the marina's exact location. 	(11)	Significance of impact not known	
	Great Crested Newt:	(E): <ul style="list-style-type: none"> • Potential to create ponds and shallow scrapes adjacent to the canal with appropriate terrestrial habitat favourable to sustain breeding populations of GCN. 	Strategic locations throughout the length of the canal.	✓✓	
	Bat:	(C): <ul style="list-style-type: none"> • Potential direct impacts on roosting sites (if present) e.g. bridges, lock structures, mature trees etc. 	(4) (5) (7) (10)	***	Comprehensive survey / information search for the presence of bats along the navigation and any associated buildings / structures.
		<ul style="list-style-type: none"> • Potential indirect impacts on roosting sites (if present) during construction of new locks. 	(6)	✓✓	
	Bat:	(E): <ul style="list-style-type: none"> • Opportunity to incorporate bat boxes or roosting habitat into new bridges and lock structures. 	(13) (14) (15) (16)	✓	
	Badger:	(C) (E): <ul style="list-style-type: none"> • Presence unknown in relation to construction activities. 	-	Significance of impact not known	Comprehensive survey / information search for the presence of badgers along the navigation.
	Spined Loach:	(C) (E): <ul style="list-style-type: none"> • Loss of habitat: mud, silts and aquatic plants due to extensive dredging and maintenance work. 	(9)	***	Comprehensive survey / information search for the presence of spined loach within the navigation.

		<ul style="list-style-type: none"> Increased suspended sediments and reduced water quality / clarity due to boat use. 	(20)	Significance of impact not known	
	Terrestrial Invertebrates:	<p>(C) (E):</p> <ul style="list-style-type: none"> Many species of terrestrial invertebrates will be present at different times of year throughout the length of the navigation. Most are likely to be common and ubiquitous. 	-	No perceived impact	Survey of fauna of old lock structures.
	Aquatic Invertebrates:	<p>(C) (E):</p> <ul style="list-style-type: none"> Loss of habitat diversity due to dredging and deepening of navigation. There are many areas of the system that has reverted back to a more semi-natural state since the close of the navigation. Reduction in the diversity of macroinvertebrates due to the above. Reduction in the clarity of water and increased suspension of particles due to boats using navigation resulting in a reduction in water quality and diversity of macroinvertebrates. 	(5) (7) (9) (20)	***	Survey of fauna of old lock structures and associated watercourses, especially the old River Lud.
		<ul style="list-style-type: none"> Potential for very minor, spatially limited and temporary disturbance to macroinvertebrates. 	(8) (10) (11) (12) (22)	*	
	Fish:	<p>(C) (E):</p> <ul style="list-style-type: none"> Loss of overall diversity of habitat (including spawning habitat) due to dredging, deepening and boat use e.g. areas of shallower water, stony substratum and aquatic macrophytes. Increase in suspended sediment loads and reduction in water quality during dredging. 	(5) (7) (9) (22)	***	Survey information available from the EA. However, further more detailed surveys may be required to understand full impact on existing fish populations.

		<ul style="list-style-type: none"> • Temporary disturbance to fish species during construction phases. • Intermittent but regular disturbance to species during operation e.g. boat traffic. 	(4) (10) (11) (20)	*	
	Fish:	<p>(E):</p> <ul style="list-style-type: none"> • Opportunity to remove existing barriers preventing fish migration e.g. locks through construction of fish ladders / passes associated with all new or refurbished structures. This could potentially have a major positive impact on fish populations within the 21km navigation and by opening up and connecting the navigation to its source. 	(14) (15) (16)	***	<p>Investigate type of structures that can be incorporated into new and refurbished locks to enable fish passage and migration throughout the navigation.</p> <p>Investigate other habitat creation opportunities that could be incorporated within the restoration proposal.</p>
		<p>(E):</p> <ul style="list-style-type: none"> • Opportunity to create backwaters and quiet off-line spawning and nursery areas. 	(23)	**	
	Amphibians:	<p>(C) (E):</p> <ul style="list-style-type: none"> • There may be impacts associated with these construction activities. However, the specific presence of amphibians (although likely) is unknown at this stage. • Loss of habitat for amphibians. 	(4) (6) (11) (13) (15) (19)	Significance of impact not known	Comprehensive survey / information search for the presence of amphibians within the navigation corridor.
	Reptiles:	<p>(C) (E):</p> <ul style="list-style-type: none"> • There may be impacts associated with these construction activities. However, the specific presence of reptiles is unknown at this stage. 	(4) (6) (11) (13) (15) (19)	Significance of impact not known	Comprehensive survey / information search for the presence of reptiles within the navigation corridor.

	Roosting Birds:	<p>(C) (E):</p> <ul style="list-style-type: none"> Disturbance to roosting birds within the Tetney Haven, part of an internationally designated site. Changes to the current areas important for roosting birds as a result of channel dredging within the Tetney Haven. 	(8) (12) (21)	***	Comprehensive survey / information search for the presence of birds within the navigation corridor.
		<ul style="list-style-type: none"> Potential impacts on roosting birds within the Tetney Haven during the construction of a marina near Tetney Lock. 	(11)	*	
	Breeding Birds:	<p>(C) (E):</p> <ul style="list-style-type: none"> Disturbance to breeding birds during construction within the Tetney Haven. Disturbance of breeding birds within the Tetney Haven due to boat traffic. 	(8) (12) (21)	***	Comprehensive survey / information search for the presence of breeding birds within the navigation corridor.
		<ul style="list-style-type: none"> Disturbance to breeding birds during construction within the navigation. Loss of marginal vegetation and therefore bird breeding habitat within the navigation resulting from boat wash and bank erosion. Disturbance of breeding birds due to boat traffic. 	(4) (5) (6) (7) (9) (10) (11) (20)	**	
	Mammals:	<p>(C) (E):</p> <ul style="list-style-type: none"> There may be impacts associated with these construction activities. Roe and muntjac deer are known to be adjacent to the canal. They may become trapped in a steeper sided watercourse. Other mammals have not yet been specifically identified. 	(4) (6) (7) (13) (15) (16)	Significance of impact not known	<p>Comprehensive survey / information search for the presence of mammals within the navigation corridor.</p> <p>Identification of mammal species to be targeted other than those already covered would need to be undertaken.</p>
Air & Climate:					
	Air Quality:	(C) (E):	(4) (5) (6) (7) (8)	*	There may be a need to

		<ul style="list-style-type: none"> Emissions from construction vehicles. Emissions from boat traffic. 	(9) (10) (11) (12) (20) (21)		carry out a localised air quality assessment to determine the estimated air pollution concentrations at selected locations prior to and post restoration.
	Noise:	<p>(C) (E):</p> <ul style="list-style-type: none"> Disturbance to birds and other wildlife within the Tetney Haven. Disturbance to residents located immediately adjacent to bridges or within Louth at Riverhead. 	(4) (8) (10) (11) (12)	**	There may be a need to carry out a localised noise assessment to determine the ambient noise levels prior to construction and estimate those during construction and post restoration at selected locations.
		<ul style="list-style-type: none"> Disturbance to residents located near to locks. Disturbance to birds and other wildlife within the Tetney Haven due to boat traffic and maintenance activities. 	(5) (6) (7) (9) (20) (21) (22)	*	
	Vibration:	<p>(C) (E):</p> <ul style="list-style-type: none"> Potential damage to listed buildings or structures. 	(5) (6) (10)	*** (if buildings or structures are not listed then X applies)	
		<ul style="list-style-type: none"> Potential damage to non-listed buildings or structures. 	(4) (8) (9) (11) (12)	**	
		<ul style="list-style-type: none"> Disturbance to birds and other wildlife due to boat traffic and maintenance activities. 	(20) (21) (22)	*	
Landscape & Visual Amenity:					
	Statutory Designated Landscape:	<p>(C) (E):</p> <ul style="list-style-type: none"> Impacts on Lincolnshire Wolds AONB 	-	No perceived impact	

	Landscape Character:	(C) (E): <ul style="list-style-type: none"> Bridges at present are approximately at a level with the surrounding landscape. Raising bridges may result in them becoming more prominent features within the landscape. 	(4) (13)	**	A detailed landscape impact assessment will need to be undertaken as part of any future EIA.
		<ul style="list-style-type: none"> Indeterminate impacts 	(6) (8) (10) (11) (18) (19)	Significance of impact not known	
	Landscape Character:	(C) (E): <ul style="list-style-type: none"> Restoration of the navigation (an important dominant feature) will also contribute to the overall restoration of an historic landscape. 	(20)	✓✓✓	
		<ul style="list-style-type: none"> Potential to enhance the character of district scale landscape types as part of the restoration. Middle Marsh and Outmarsh landscape types have lost trees historically. Appropriate tree planting can replace historic context of navigation e.g. pollarded trees along the canal. The opportunity to bury the oil pipeline. 	(12) (23)	✓	
	Visual Amenity:	(C) (E): <ul style="list-style-type: none"> Bridges at present are approximately at a level with the surrounding landscape. Raising bridges may impact on views from residential properties adjacent to the canal. 	(4) (13)	***	Se above.
		<ul style="list-style-type: none"> Visual intrusion for users of the public footpath during construction works. 	(5) (6) (7) (9)	*	
		<ul style="list-style-type: none"> Indeterminate impacts 	(8) (10) (11) (18) (19)	Significance of impact not known	
Water:					

	Surface Water Quality:	(C) (E): <ul style="list-style-type: none"> Increased water turbidity with time and therefore a reduction in water quality due to boat traffic (the magnitude of impact will be directly related to intensity of boat use). 	(20)	***	Future predictions for water quality will need to be made taking into account the perceived level of use of the navigation by boats etc. Studies associated with other navigations e.g. the Broads may be useful here.
		<ul style="list-style-type: none"> Increased water turbidity and theretofore a reduction in water quality due to re-suspension of sediments during construction and maintenance works. Potential impact from a reduction in water quality from Louth WWTW downstream due to flows potentially being held up by new lock structures (Louth WWTW is a major works for the area and also receives light industrial wastewater. It is a major volume of flow into a low volume system. Possible impact of saline intrusion resulting from work carried out on the sea locks at Tetney. 	(4) (5) (6) (7) (8) (9) (10) (11) (12) (22)	**	
	Surface Water Quantity:	<ul style="list-style-type: none"> Potential for differing patterns of freshwater discharge into the Tetney Haven. There are likely to be multiple issues associated with restoration and impacts on water resources. However, at present these have not been fully identified. 	-	Significance of impact not known	Water resources investigation needed including impacts of restoration on existing water resource and how this might effect environmental receptors dependant on this resource.
	Ground Water Quality:	(C) (E): <ul style="list-style-type: none"> No impacts identified. 	-	No perceived impacts	
	Ground Water Quantity:	(C) (E): <ul style="list-style-type: none"> No impacts identified. 	-	No perceived impacts	
	Flow dynamics:	(C) (E):	-	No perceived	

		• No impacts identified.		impacts	
Land use:					
	Services and Utilities:	(E): • .Potential impact on crude oil transfer pipe that crosses the Tetney Haven on the Seaward side of the tidal lock gate.	(20)	***	Continued liaison with service and utility companies.
	Utilities:	(E): • Raised water levels or deepening may decrease the efficiency and stability of surface water and combined sewer outfall aprons and final effluent and storm discharges from Louth and Newton Marsh WWTW. • Covenham Water Treatment Works may also be impacted by raised water levels. The treatment process involves wastewater being returned back to the works intake. Raised water levels may submerge the flap valves and reduce the effectiveness of discharge points. • Increased motorised traffic may pose a pollution risk with regard to the water treatment process, where abstraction from the canal occurs via an open cut.	(20)	***	
	Land Use:	(C) (E): • Loss of small area of internationally designated sites due to new sea lock.	(8) (11) (19)	***	The extent of land that may be permanently lost as a result of restoration works needs quantifying.
		• Loss of agricultural land due to increased footprint of raised bridges, channel widening etc.	(11) (19)	**	
		• Permanent changes in land use associated with restoration.	(4) (6) (10) (13) (15) (19)	*	
Cultural Heritage, Archaeology &					

Material Assets:					
	<p>Designated Assets:</p>	<p>(C) (E):</p> <ul style="list-style-type: none"> Up to 7 bridges will require raising by at least 1m to allow for the passage of craft. Potential damage to Alvingham Mill and Austen Fen Mill associated with works to nearby bridges. Direct impacts on listed locks during construction i.e. Alvingham Lock, Willow Lock, Ticklepenny Lock, Salter Fen Lock and Keddington Lock. Potential loss of original locks or lock features and complete removal of the historic fabric during lock replacement or refurbishment. Potential impact on the Navigation Warehouse and also a nearby private dwelling. 	<p>(4) (5) (7) (10) (16)</p>	<p>***</p>	<p>Any direct works or works that may indirectly affect listed buildings or structures will require listed buildings consent and consultation with English Heritage and the LPA.</p> <p>Replacement of locks may require the recording of the fabric and its context to be undertaken as the lock is dismantled.</p> <p>A fully detailed desk-based assessment is required to identify all historic assets along, and within the vicinity</p>

		<ul style="list-style-type: none"> In-direct impacts on listed locks during construction i.e. Alvingham Lock, Willow Lock, Ticklepenny Lock, Salter Fen Lock and Keddington Lock. 	(6)	**	of, the canal (a corridor of 150m either side of the canal). This should look at all the existing information available in the sources quoted in the Lincolnshire Archaeological Handbook, along with an assessment of the historical and archaeological background to the area and specifically the canal. Emphasis should be given to the need to identify and assess the condition and significance of specific structures associated with the canal in order to inform the restoration process. The use of cartographic information and field reconnaissance will also form important elements in the DBA.
	Designated Assets:	<p>(E):</p> <ul style="list-style-type: none"> Opportunity to restore original lock structures as part of restoration. 	(14)	✓✓✓	
	Unknown Archaeology:	<p>(C):</p> <ul style="list-style-type: none"> Potential to unearth and disturb archaeological artefacts during excavation works associated with construction. 	(4) (5) (6) (7) (8) (9) (10) (11) (12)	Significance of impact not known	Works associated with the restoration may require archaeological prospection to identify any archaeological remains and suitable mitigation.
Traffic & Transport:					
	Traffic Congestion:	<p>(C):</p> <ul style="list-style-type: none"> Potential for congestion and congested routes associated with temporary closure of bridges during works. 	(4)	**	

	Traffic Volume:	<p>(E):</p> <ul style="list-style-type: none"> Increased numbers of visitors to Louth as a direct result of the restoration of the navigation. Louth is already a congested market town and these problems could be exacerbated, particularly with regard to accessing the Riverhead area. 	(20)	*	
Geology, Soil and Contaminated Land					
	Waste:	<p>(C) (E):</p> <ul style="list-style-type: none"> Waste material associated with dredging / channel widening will need to be disposed of. 	(12)	* to *** (dependent on extent of event)	A detailed study may be required re waste disposal for this project.
	Land Quality:	<p>(C) (E):</p> <ul style="list-style-type: none"> Potential for pollution and contamination of land from crude oil pipeline during construction works. 	(12)	* to *** (dependent on extent of event)	
	Designated Geological Sites:	<p>(C) (E):</p> <ul style="list-style-type: none"> No impacts identified. 	-	No perceived impacts	
	Contaminated Land:	<p>(C):</p> <ul style="list-style-type: none"> The potential for impacts associated with contaminated land and restoration of the navigation has been identified but actual impacts are presently unknown. 	(10)	Impacts and there significance not yet known	Site investigations re contaminated land would be required to establish whether contaminated land is present and the impacts (if any) that might be associated with the restoration.