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Environmental Statement Volume IV – Appendix 19-2: UXO Desk Based Assessment

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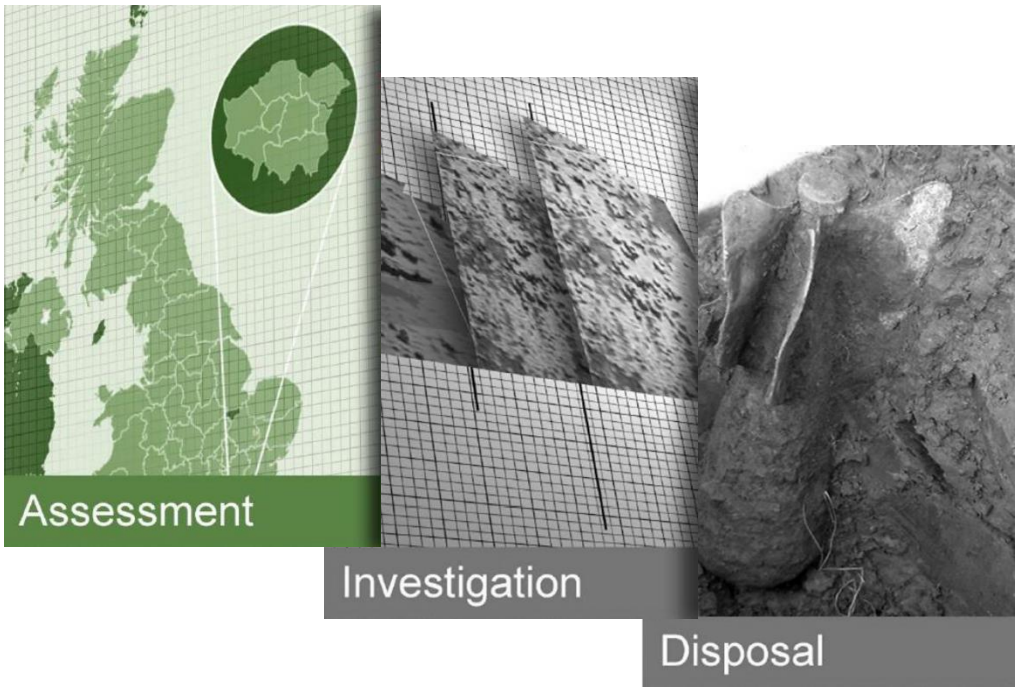

Immingham to Theddlethorpe - UXO Desk Study & Constraints Assessment

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UXO DESK STUDY & CONSTRAINTS ASSESSMENT

EXECUTIVE SUMMARY

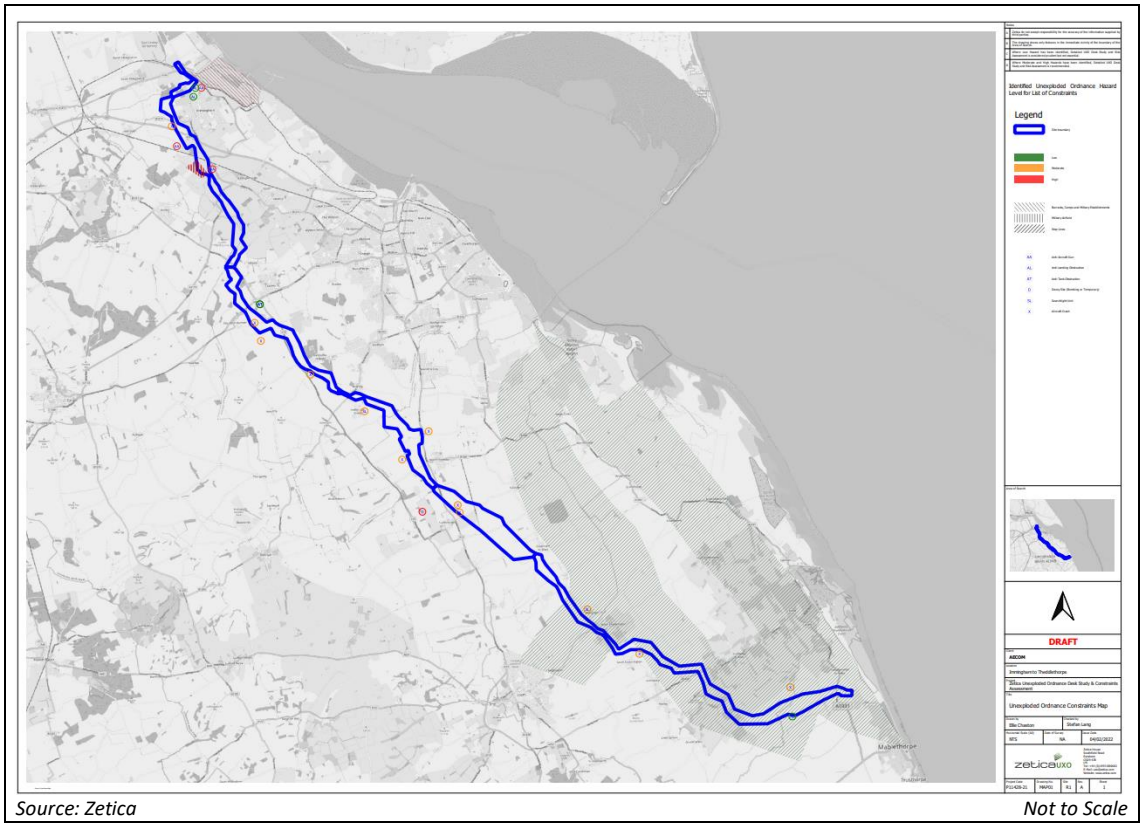
Zetica Ltd was commissioned by AECOM to carry out an Unexploded Ordnance (UXO) Desk Study and Constraints Assessment for an area of approximately 22km^2 between Immingham and Theddlethorpe in Lincolnshire ('the Area of Search').

The aim of this report is to gain a fair and representative view of the UXO hazard for the Area of Search in accordance with the Construction Industry Research and Information Association (CIRIA) C681, 'Unexploded Ordnance (UXO), a Guide for the Construction Industry'.

The Area of Search has a history of military activity. The main potential UXO hazard constraints within the Area of Search are shown on the accompanying P11428-21-R1-MAP01-A.

The Figure below, reproduced as Figure 3 in the main report, illustrates the main UXO hazard constraints identified.

UXO hazard constraints within the Area of Search



Source: Zetica *Not to Scale*

A number of potential sources of UXO hazards offering constraints within the Area of Search have been identified. These are shown on P11428-21-R1-MAP01-A.

Wartime Bombing

- World War Two (WWII) bombing densities within the Area of Search were generally low. The Area of Search was predominantly rural in nature, with few strategic targets in the immediate vicinity.
- No records of any significant air raid incidents within the Area of Search have been found.

Military Airfields & Aircraft Crashes

- Military airfields offer the potential for significant UXO hazards due to the use, storage and disposal of ordnance.
- 1No. World War One (WWI)-era airfield was identified within the Area of Search.
- No records have been found to indicate that any airfields were located on or in close proximity to the Area of Search during WWII.
- There were 9No. bomber aircraft crashes on or in close proximity to the Area of Search during WWII, some of which may provide a constraint to development.
- Airfields and aircraft crashes in the Area of Search are indicated on the accompanying P11428-21-R1-MAP01-A.

Military Defences

- During WWII air and anti-invasion defences were constructed on and in the vicinity of the Area of Search to counter bombing raids and the threat of invasion. These included Anti-Aircraft (AA) batteries, lines of defences (Stop Lines), anti-landing and anti-tank obstacles.
- Those defences identified in the Area of Search are indicated on the accompanying P11428-21-R1-MAP01-A.

Other Military Establishments

- During WWI and WWII Immingham Docks, adjacent to the Area of Search, were used as a naval base.
- Identified military establishments in the Area of Search are indicated on the accompanying P11428-21-R1-MAP01-A.

RECOMMENDATIONS

Avoidance

Where possible, the proposed route corridor options should be diverted around the identified UXO hazard constraints.

UXO Desk Study and Risk Assessment

Once a preferred route option or options have been selected it is recommended that a detailed UXO desk study and risk assessment is commissioned to confirm the UXO hazard level along the route.

Risk Mitigation Plan

Where a potential UXO hazard is identified by the desk study and risk assessment, a document will be provided that summarises the UXO risk mitigation measures recommended for the intended types of development and common working practices.

Non-intrusive geophysical surveys can be undertaken to further delineate the potential UXO hazard along the preferred route options, whilst also identifying other buried hazards and features such as archaeology, changes in ground conditions, buried obstructions and utilities.

CONTENTS

Figures, Plates & Tables

Accompanying GIS Data

P11428-21-R1-MAP01-A (UXO Constraints Study)

ABBREVIATIONS

AA	Anti-Aircraft
ALARP	As Low As Reasonably Practicable
ARP	Air Raid Precaution
AT	Anti-Tank
AXO	Abandoned Explosive Ordnance
BD	Bomb Disposal
BDO	Bomb Disposal Officer
BDU	Bomb Disposal Unit
CMD	Conventional Munitions Disposal
DCLG	Department of Communities and Local Government
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOR	Explosive Ordnance Reconnaissance
ERW	Explosive Remnants of War
ESA	Explosive Substances and Articles
FFE	Free From Explosives
GCR	Great Central Railway
HAA	Heavy Anti-Aircraft
HE	High Explosive
HMS	His/Her Majesty's Ship
HQ	Headquarters
HSE	Health and Safety Executive
IB	Incendiary Bomb
IED	Improvised Explosive Device
IEDD	Improvised Explosive Device Disposal
JSEODOC	Joint Services EOD Operations Centre
LAA	Light Anti-Aircraft
MoD	Ministry of Defence
OB	Oil Bomb
PM	Parachute Mine
PUCA	Pick Up and Carry Away
RA	Royal Artillery
RAF	Royal Air Force
RN	Royal Navy
SAA	Small Arms Ammunition
TEP	Time Expired Pyrotechnics
UXAA	Unexploded Anti-Aircraft
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
WWI	World War One
WWII	World War Two

UXO DESK STUDY & CONSTRAINTS ASSESSMENT

Please read: Zetica has colour coded each paragraph. Paragraphs with black text on a white background are paragraphs that provide site-specific information or information specifically researched as part of this project.

Boxed paragraphs in a dark green text with a green background are paragraphs providing general information and, where appropriate, links to online resources giving further detail. These are all available at [redacted]. If you cannot gain access to these resources, Zetica can forward them on request.

1 INTRODUCTION

1.1 Project Outline

Zetica Ltd was commissioned by AECOM to carry out a detailed Unexploded Ordnance (UXO) Desk Study and Constraints Assessment for a route of approximately 22km^2 between Immingham and Theddlethorpe in Lincolnshire ('the Area of Search').

The aim of this report is to gain a fair and representative view of the UXO hazard for the Area of Search and its immediate surrounding area in accordance with the Construction Industry Research and Information Association (CIRIA) C681 'Unexploded Ordnance (UXO), a Guide for the Construction Industry'.

This Desk Study is intended to provide 'high level' information of potential UXO hazards as a result of military activity within the defined Area of Search. The UXO hazards identified within the defined Area of Search and described in this report are based on the experience of Zetica Ltd for other military establishments elsewhere in the UK.

The actual activities on any establishment will vary and further, more detailed study will be required during the subsequent stages of the proposed route design and construction process where the proposed route options actually impacts on these hazards. This may result in the UXO hazard ranking being reassessed as lower or higher.

Where appropriate, this hazard assessment includes:

- Likelihood of ordnance being present.
- Type of ordnance (size, filling, fuze mechanisms).
- Quantity of ordnance.
- Potential for live ordnance.
- Probable location.
- Ordnance condition.

It should be noted that some military activity providing a source of UXO hazard may not be recorded and therefore there cannot be any guarantee that all UXO hazards affecting the Area of Search have been identified in this report.

1.2 The Area of Search

The Area of Search comprises approximately 22km^2 in Lincolnshire, as defined by the following Ordnance Survey National Grid References (OSNGRs):

North: TA 168170

Centre: TF 227994

South: TF 483874

The areas referred to in this report are shown on P11428-21-R1-MAP01-A. Specific locations within the Area of Search are referred to by geographical local names and by approximate OSNGRs where appropriate.

Figure 1 is a location map of the Area of Search and Plate 1 is a recent satellite image of the Area of Search.

Figure 1 Map of the Area of Search

Source: OpenStreetMap *Not to Scale*

Legend	Area of Search

Plate 1 Recent satellite image of the Area of Search

Source: Google Earth *Not to Scale*

Legend	Area of Search

1.3 Scope of Work

This study is produced to assist in the planning process of a pipeline corridor selection scheme within the Area of Search, as defined above and on the constraints plan given in P11428-21-R1-MAP01-A.

The main emphasis of the report is to address constraints from UXO hazards across the entire Area of Search to help inform the selection of proposed pipeline routes.

Further detailed research will then be required in the form of a Desk Study and Risk Assessment for the chosen routes to determine what (if any) risk mitigation measures need to be put in place before intrusive works commence.

2 RESEARCH

2.1 Sources of Information

Zetica Ltd researched the military history of the Area of Search and its surrounding area using a range of information sources. The main sources of information are detailed in the following sections and referenced at the end of this report.

2.2.1 Zetica Ltd Defence Related Site Records

Zetica Ltd's in-house records were consulted, including reference books and archived materials from past work in the region. Relevant documents have been cited within the bibliography of this report.

2.2.2 Zetica Ltd Bombing Density Records and Maps

Reference has been made to the Zetica Ltd bomb risk maps located on Zetica's website [redacted]

2.2.3 Ministry of Defence and Government Records

Government departments and units within the Ministry of Defence (MoD) were approached for information of past and present military activity in the area. These included the Department of Communities and Local Government (DCLG) records of abandoned bombs.

2.2.4 Other Historical Records, Maps and Drawings

Numerous reference documents including historical maps, aerial photographs and drawings have been consulted from sources such as the National Archives, the Royal Air Force (RAF) Museum, the US National Archives & Records Administration (NARA), the National Collection of Aerial Photography (NCAP), the Britain from Above database, the Imperial War Museum (IWM), Historic England and the Defence of Britain Project.

2.2.5 Local Authority Records

Information was obtained from Lincolnshire County Council and North Lincolnshire Council.

2.2.6 Local Record Offices and Libraries

The Lincolnshire Archives were consulted for records.

2.2.7 Local Historical and Other Groups

Local history groups and archaeological bodies were consulted, including the Lincolnshire Historic Environment Record (HER).

Local history groups, local libraries and archaeological societies provided information. These included:

- The Airfield Research Group
- The British Association for Local History
- The Council for British Archaeology
- The Humber Archaeological Society
- The Naval Dockyards Society
- The Pillbox Study Group
- The Second World War Experience Centre
- The Society for Army Historical Research
- Subterranea Britannica
- The UK Fortifications Club
- The Victorian Military Society
- World War Two (WWII) Railway Studies Group.

Local newspapers were also consulted.

2.2 Data Confidence Level

In general, there is a high level of confidence in the researched information sources used for this report. Exceptions to this are specifically detailed in the text of the report.

3 MILITARY ACTIVITY

The following sections outline the recorded military activity in the Area of Search. The potential UXO hazard from WWI and WWII bombing is detailed in Section 4.

Each sub-section provides hyperlinks to further information on potential sources of UXO hazard. These are also available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

3.1 Anti-Invasion Defences

For further information on military defences, and the potential UXO hazards associated with them, follow the links below:

- Anti-Invasion Defences
- Home Guard
- Mined Locations
- Mortar & Gun Emplacements
- Pillboxes

The Area of Search was under the control of Northern Command during World War Two (WWII). In 1940 after the fall of Norway, the threat of a German invasion from the North was significant. Northern Command occupied some 20,000km^2, including 624.4km of beaches, of which 287km were suitable for amphibious landing. Flat plains inland offered easy access to the industrial North and important port facilities were exposed.

A dense network of defence sites were created as part of the anti-invasion preparations. Static defences were built to interrupt and delay the progress of any invading force.

3.1.1 Stop Lines

Beyond the first line of beach defences, defensive structures were constructed inland along 'Stop Lines' in order to impede enemy progress for long enough to allow mobile defending forces to counterattack.

Fortifications included roadblocks, Anti-Tank (AT) blocks, AT ditches, scaffolding, Dannert wire, pillboxes, anti-landing obstacles (see Plate 2), machine gun and spigot mortar emplacements were erected. An extremely dense network of defence sites was created. These defences were aided by the Lincolnshire fenland, which crossed many dykes and rivers forming a natural barrier.

Stop lines were manned by regular Army and Home Guard units. For example, the 205th Infantry Brigade were deployed along stop lines on and in the vicinity of the Area of Search.

The locations of these defences are further detailed in Table 1 (Appendix 1) and on the accompanying P11428-21-R1-MAP01-A.

3.1.2 Home Guard

Stop Lines and anti-invasion defences were often manned by members of the Home Guard, backed up by regular Army troops wherever possible. The troops were issued with 'No Withdrawal' orders. The concept of 'defence in depth' was paramount and was rigorously applied by the Home Guard in the Lincolnshire area.

The 4th, 5th, 6th, 7th, and 8th Lindsey Battalions of the Home Guard are known to have operated in the vicinity of the Area of Search.

During the war, Home Guard units established defensive positions to protect vulnerable or valuable locations, such as Immingham Docks.

The ordnance supply for the use of the Home Guard included substantial supplies of Mills bombs (fragmentation grenades), Bosche Bumps (a type of pipe mine), and Self-Igniting Phosphorus (SIP) grenades, as well as Small Arms Ammunition (SAA). SIP grenades replaced the more unstable Molotov Cocktails in 1941. By August 1941, an estimated 6 million SIP grenades had been buried in boxed caches in the UK.

It is considered that all locations occupied or used by the Home Guard offer a moderate risk of UXO being present. Home Guard units were located in all towns and large villages. Many of the factories, foundries and shipyards in the region had their own units. Records of Home Guard related sites are rarely preserved, and none have been found in or in close proximity to the Area of Search.

By December 1944, Home Guard stores and ammunition in the Area of Search were assembled in readiness for stand down.

Given the irregular nature of Home Guard activities the possibility of items of UXO being discovered at any location occupied or used for training by the Home Guard can never be totally discounted.

3.2 Anti-Aircraft Defences

For further information on military defences, and the potential UXO hazards associated with them, follow the links below:

- Anti-Aircraft Guns
- Barrage Balloons
- Bombing Decoys

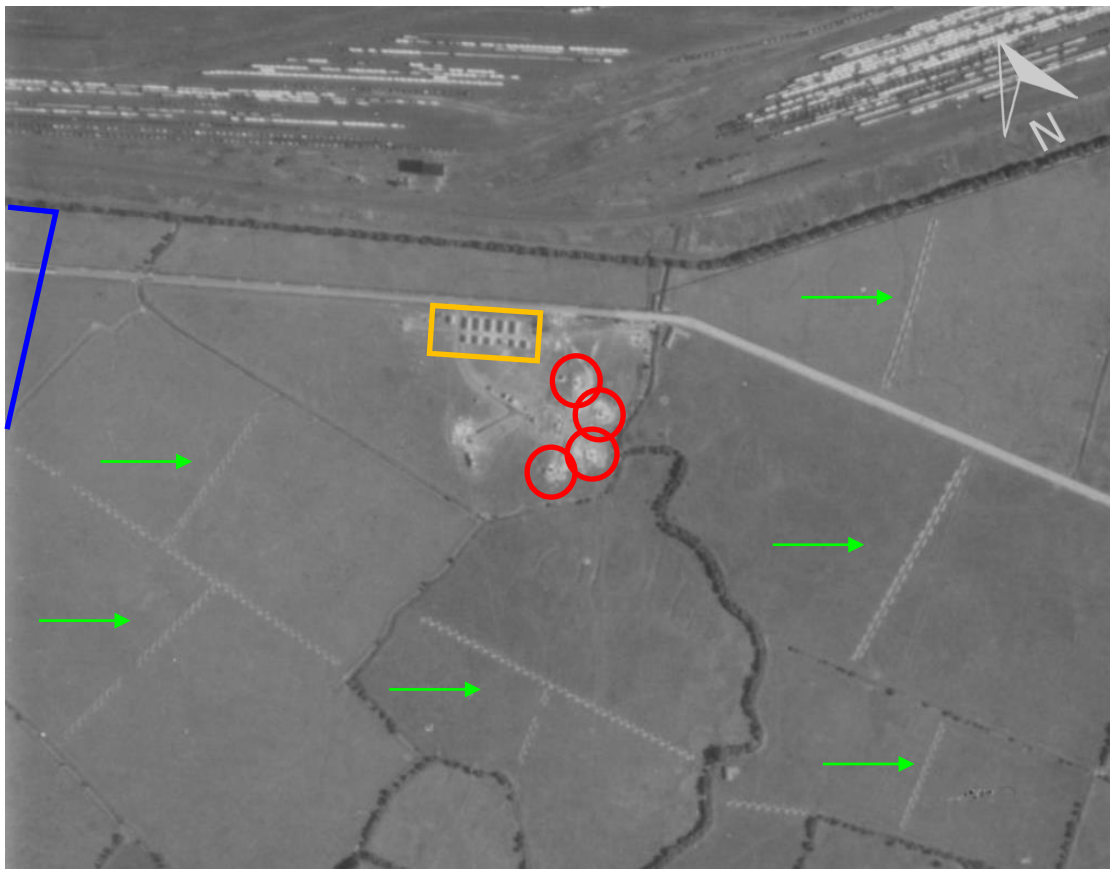
3.2.1 Anti-Aircraft (AA) Defences

During WWII there were 3No. Heavy AA (HAA) batteries in close proximity to the Area of Search.

HAA batteries were permanent fixtures and had associated ammunition stores and accommodation nearby. HAA batteries in close proximity to the Area of Search were manned by the Home Guard as well as regular Army troops, such as the 221 Battery of the 91st Royal Artillery (RA) Regiment and the 2nd Battalion Coldstream Guards.

Plate 2 is an aerial photograph of HAA battery Humber L (TA 180154), approximately 0.3km east of the Area of Search, dated the 3rd September 1940. An associated accommodation camp and a network of anti-landing obstacles have also been identified.

Plate 2 Aerial photograph of Humber L HAA battery, 3rd September 1940



Source: NCAP *Not to Scale*

Legend	Area of Search	Gun emplacements
	Accommodation camp	Anti-landing obstacles

HAA batteries were often associated with searchlight emplacements. During WWII there were 2No. searchlight emplacements in close proximity to the Area of Search. Searchlight emplacements typically consisted of a small ring-ditch to provide shelter during an air raid, a predictor emplacement for calculating the range and height of targets, a Light AA (LAA) machine gun pit, a generator, and hutted accommodation.

The documented HAA batteries and searchlight emplacements within the Area of Search are identified in Tables 2 and 3 (Appendix 1) and on P11428-21-R1-MAP01-A.

Measures were also taken to prevent enemy aircraft landing in the event of invasion. Obstructions were constructed around airfields and on other open sites deemed fit for use as landing grounds. Solid obstructions (such as concrete blocks), posts or stakes, felled trees, haystacks, scaffolding with wire and trenching were the main measures used.

Known locations of anti-landing obstacles in close proximity to the Area of Search are identified in in Table 1 (Appendix 1) and on the accompanying P11428-21-R1-MAP01-A.

3.2.2 Bombing Decoys

Bombing decoys were designed to draw enemy aircraft away from towns and cities and other strategically important targets and would often have associated LAA gun defences.

There was 1No. bombing decoy in the vicinity of the Area of Search. This was decoy Q85 located at Ludborough (TF 284960), approximately 1km west of the Area of Search. It was a 'Q' decoy, a

dummy airfield designed to lure enemy bomber aircraft away from RAF Binbrook, approximately 7.1km southwest of the Area of Search.

Successful bombing decoys can provide a high UXO hazard due to the possibility of UXBs located at depth.

Documented bombing decoys in the vicinity of the Area of Search are identified on the accompanying P11428-21-R1-MAP01-A.

3.3 Military Airfields

For further information on military airfields, and the potential UXO hazards associated with them, follow the link below:

- Military Airfields

1No. military airfield was identified within the Area of Search. Details are provided below.

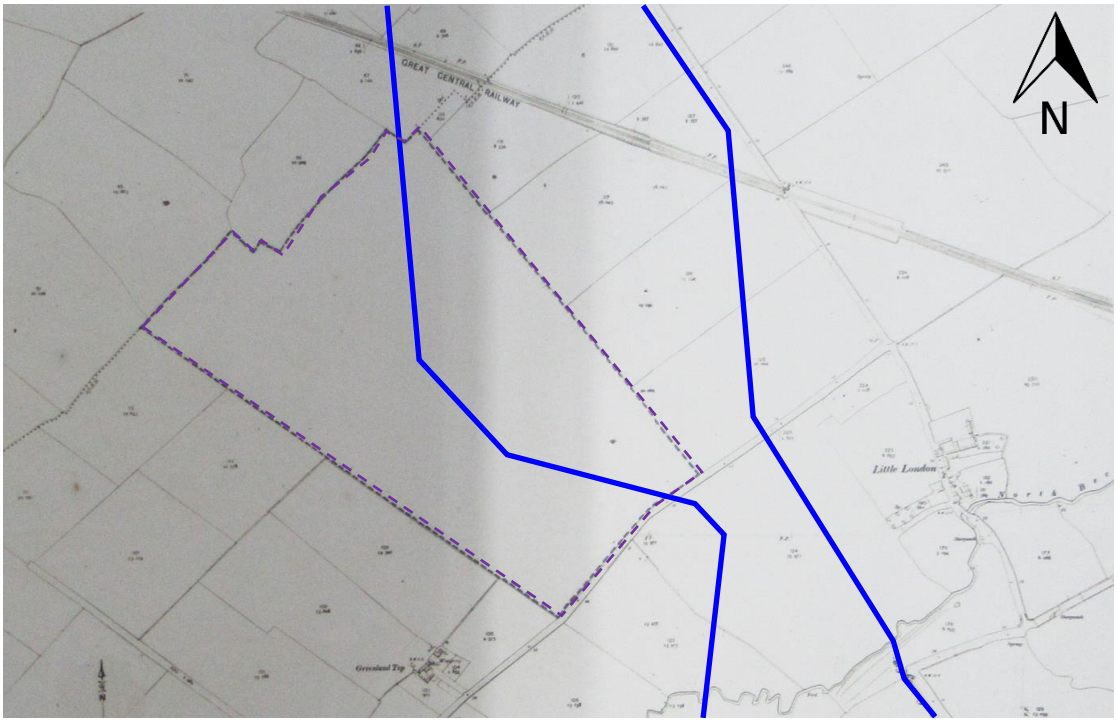
3.3.1 RFC/RAF Greenland Top

Royal Flying Corps (RFC)/Royal Air Force (RAF) Greenland Top (TA 180115) was a WWI Home Defence airfield that opened in 1916.

It was used by 505 Flight of No. 251 Squadron, which operated DH6 aircraft on anti-submarine patrols over the Humber estuary and the North Sea.

Figure 2 is a plan of RFC/RAF Greenland Top dating from 1918.

Figure 2 Plan of RFC/RAF Greenland Top, 1918



Source: National Archives *Not to Scale*

Legend	Area of Search	Airfield boundary

The airfield closed in 1919 and was subsequently returned to agricultural use.

Airfields located within the Area of Search are identified on P11428-21-R1-MAP01-A.

3.4 Aircraft Crashes

For further information on military aircraft crashes, and the potential UXO hazards associated with them, follow the link below:

- Aircraft Crashes

During WWII, 3No. bomber aircraft crashed in the Area of Search. These are likely to have had live munitions on board, predominantly SAA for .303" and 0.5" machine guns and 20mm cannons. They may also have been associated with other possible UXO hazards including UXB, and the crash sites are considered to provide a potential UXO hazard to the Area of Search.

In addition, 6No. bomber aircraft crashed in close proximity to the Area of Search during WWII. It is possible that these crashes resulted in the jettisoning of bombs or the scatter of SAA from the aircraft's machine guns, potentially including the Area of Search.

Post-WWII, 1No. fighter aircraft crashed in close proximity to the Area of Search. Post-WWII crash sites were usually more thoroughly cleared and are less likely to have munitions on board that could remain undetected in the ground.

Table 4 (Appendix 1) details the aircraft crashes documented in and in close proximity to the Area of Search.

Aircraft crashes considered to provide a UXO hazard to the Area of Search are identified on P11428-21-R1-MAP01-A.

3.5 Explosives Factories, Munitions Depots and Disposal Areas

For further information on explosives factories, munitions depots and disposal areas, and the potential UXO hazards associated with them, follow the links below:

- Explosives Factories
- Munitions Depots
- Munitions Disposal Areas

No records of any explosives factories or munitions depots on or in close proximity to the Area of Search have been found.

Disposal of excess or surplus munitions commonly took place in areas surrounding establishments where ordnance was used or stored. This includes AA batteries, anti-invasion defences, and naval bases. No records have been found to indicate that any dedicated munitions disposal areas were established within the Area of Search.

Records of post-war EOC tasks undertaken in the vicinity of the Area of Search demonstrates the background hazard of munitions disposal around heavily defended localities such as 'Stop Lines' (see Section 5.1).

3.6 Firing Ranges and Military Training Areas

For further information on firing ranges and military training areas, and the potential UXO hazards associated with them, follow the links below:

- Artillery Ranges
- Bombing Ranges
- Military Training Areas

- Small Arms Ranges

No records of any firing ranges or military training areas on or in close proximity to the Area of Search have been found.

3.7 Other Military Establishments

Documented locations of other military establishments are recorded on P11428-21-R1-MAP01-A. Military establishments on or in close proximity to the Area of Search are described below.

3.7.1 Immingham Naval Base

Construction of Immingham Docks (TA 200162), adjacent to the Area of Search, began in 1906 and culminated in 1912, when the port opened for commercial use. It was initially designed for the exportation of coal. The dock comprising a port facility and adjoining railways belonging to the Great Central Railway (GCR).

With the outbreak of WWI, 12No. torpedo boats and several destroyers from the 7th Flotilla were stationed at Immingham Docks, owing to its strategic position on the River Humber. Further naval ships were stationed at Immingham throughout WWI, including His Majesty's Ship (HMS) Leander, destroyers from the 9th Flotilla, and submarines of the 8th Submarine Flotilla.

Plate 3 is a photograph of Royal Navy (RN) torpedo boats at Immingham Docks, dating from WWI.

Plate 3 Torpedo boats at Immingham Docks, WWI

Source: Lincolnshire Archives *Not to Scale*

After the end of the war Immingham Docks returned to civilian use. A tramway was opened between Grimsby and Immingham Docks in 1928, and in the 1930s the docks were frequently used for civilian cruises.

In WWII Immingham Docks became the headquarters (HQ) for the RN Flag Officer for the Humber, and it was used once again as a base for naval vessels and submarines. It remained a naval HQ until 1949, when it returned to commercial use. Immingham Docks remains open today as a major port complex for energy production.

4 BOMBING

4.1 WWI Bombing

For further information on WWI bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.1. Alternatively, use the following link.

- WWI Bombing

During WWI an estimated 9,000No. German bombs were dropped over Britain. It was the first time that strategic aerial bombing had been used, initially from Zeppelin airships. The location of the East Coast made it vulnerable to WWI bombing.

Significant targets in the area primarily comprised docks and harbours along the Humber, including industrial areas such as Grimsby and Cleethorpes. The Area of Search consisted of predominantly rural areas, with a few large towns and cities, and thus was not generally targeted for WWI bombing.

An indicative list of significant WWI bombing incidents in the vicinity of the Area of Search is given in the following section.

5th – 6th March 1915

High Explosive (HE) bombs were dropped at Killingholme, in the immediate vicinity of the Area of Search.

28th July 1916

An air raid over the East Riding of Yorkshire, Lincolnshire, and Norfolk saw numerous HE bombs dropped in these regions, including on Immingham and Killingholme, adjacent to the Area of Search.

4.2 WWII Bombing

For further information on WWII bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.2. Alternatively, use the following link.

- WWII Bombing

Details of WWII bombing in the vicinity of the Area of Search are provided in the following sections.

4.2.1 Bombing in Northeast Lincolnshire

From prior to the declaration of war in 1939, Britain was subjected to reconnaissance flights by the Luftwaffe which was building up a photographic record of potential targets. As early as 1937, German aircraft were flying up the Humber Estuary to photograph docks and factories.

Some areas of Northeast Lincolnshire and Humberside were heavily bombed in WWII, particularly Kingston upon Hull and Grimsby. In addition, military establishments in the region, such as airfields, were also specifically targeted.

Bombing in the region was mostly concentrated on the coast and along the banks of the Humber Estuary. Bombing on the more rural inland areas was often the result of 'tip and run' raids or nuisance raids by aircraft operating alone or in small formations.

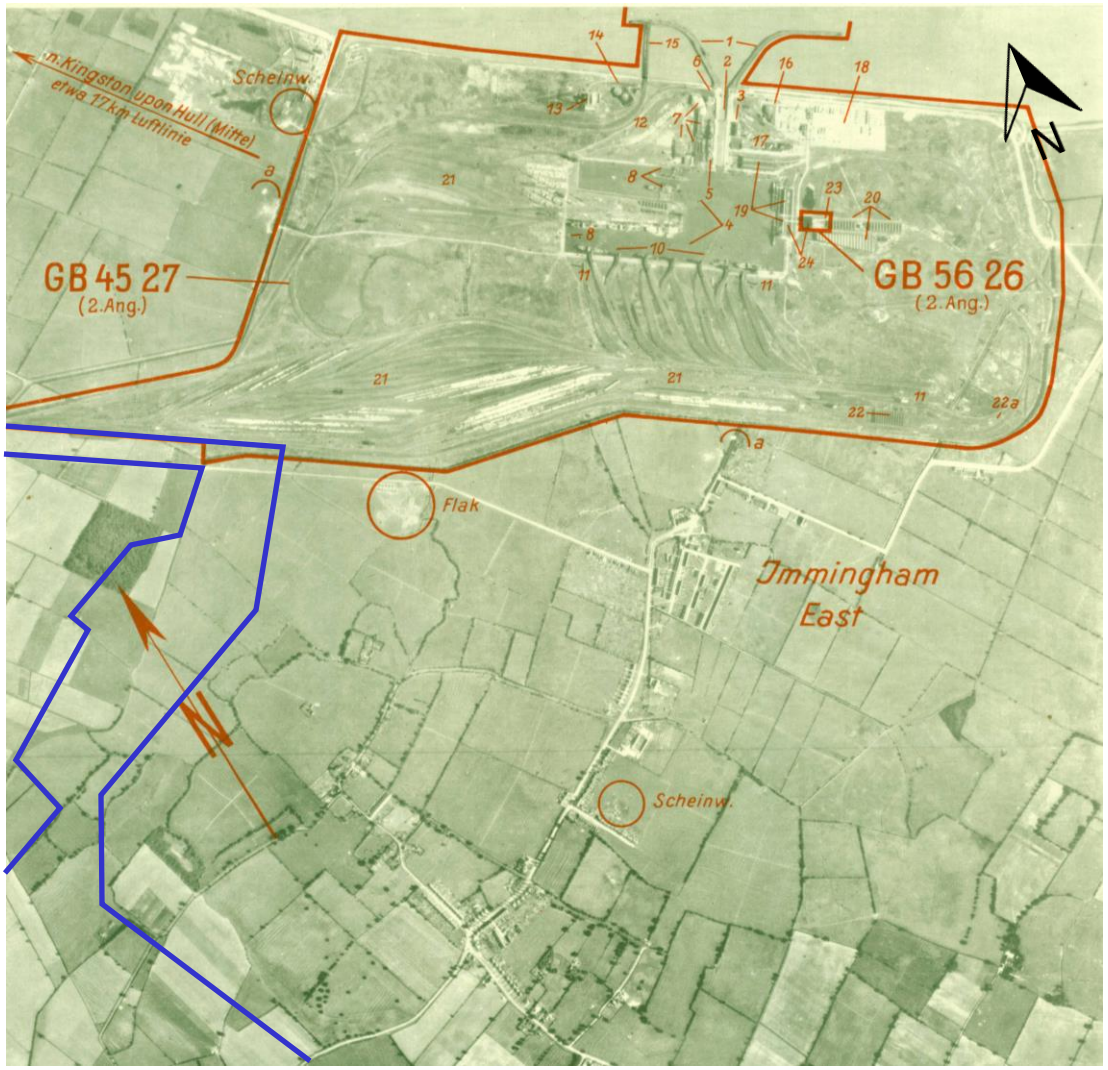
4.2.2 Strategic Targets

The presence of strategic targets significantly increased the likelihood of bombing within the local area. Airfields, docks, industrial facilities, transport infrastructure and anti-invasion defences were all targeted by Luftwaffe bombers.

During WWII, the Area of Search was a predominantly rural area and did not encompass any designated strategic targets. The main strategic target in the vicinity of the Area of Search was Immingham Dock, adjacent to the Area of Search.

Plate 4 is a Luftwaffe target photograph of Immingham Dock dated the 3rd September 1940. The port facilities (GB 45 27), a granary (56 26), Humber L HAA Battery ('Flak') and searchlights ('Scheinw.') are identified in red.

Plate 4 Luftwaffe target photograph of Immingham Dock, 3rd September 1940



Source: NARA *Not to Scale*

Legend	Area of Search

4.2.3 Bombing Densities and Incidents

Table 5 (Appendix 1) gives details of the overall bombing statistics recorded for the Local Authority (LA) Districts of the Area of Search (highlighted by bold text) and surrounding districts. These were categorised as Rural Districts (RD), Urban Districts (UD), Municipal or Metropolitan Boroughs (MB) and County Boroughs (CB). WWII bomb density levels are defined below:

<5 bombs per 405ha is a Very Low regional bombing density.

5-15 bombs per 405ha is Low.

15-50 bombs per 405ha is Moderate.

50-250 bombs per 405ha is High.

>250 bombs per 405ha is Very High.

Note that Table 5 (Appendix 1) excludes the figures for V1s (Pilotless Aircraft or Flying Bombs), V2s (Long Range Rockets) and Incendiary Bombs (IBs). Discrepancies between this list and other records, such as bomb clearance records, demonstrate that this data is likely to under-represent actual bombing.

No records have been found to indicate that any significant air raid incidents occurred on or in close proximity to the Area of Search. The Area of Search was predominantly rural in nature, with few strategic targets in the immediate vicinity. Nearby bombing incidents were typically isolated incidents, resulting from overspill from air raids on important strategic targets, such as docks and harbours on the River Humber, or airfields and other military establishments.

Note that air raid incident reports do not always give precise details of the bombs which fell, often only indicating in which street or area they fell.

More detailed Air Raid Precaution (ARP) and LA records would be included as part of a site-specific UXO Desk Study and Risk Assessment.

In general, the WWII bombing densities across the Area of Search were low and it is considered unlikely that a significant UXB hazard exists for the majority of the area. There is the potential for discrete areas to have had a higher WWII bombing density than the regional averages, particularly around military establishments. These areas would be more precisely defined in a detailed UXO Desk Study and Risk Assessment for the chosen route.

5 EXPLOSIVE ORDNANCE CLEARANCE ACTIVITIES

Official UK bombing statistics have been compiled from both British and German sources. There were differences in the way the figures were originally reported and collated which has led to discrepancies in the summary data.

Based on data from 1939 to 1945, War Office statistics indicate that 200,195No. HE bombs exploded within Great Britain. Additionally, 25,195No. HE bombs (representing 11%) were recorded as UXBs. However, records from the Royal Engineers who were responsible for bomb disposal at the time indicate that as of 27th February 1946 upwards of 45,000No. UXBs were disposed of.

On average 8.5% of UXBs later self-exploded. In some cases the bombs had delayed action fuzes or were never intended to explode, their purpose being to cause inconvenience and fear. Given the discrepancy in records and the fact that UXBs are still being found unexpectedly, it is clear that the original figures are understated and provide only an approximation of the number of potential UXBs in the UK.

War Office statistics also show that between October 1940 and May 1941 most of the UXBs (93%) were either 50kg or 250kg. It should be noted that details of the recovery and the size of the UXB were not always accurately reported.

The larger WWII UXBs are often difficult to recover due to both penetration depths and the presence of two or more fuzes, combined with more sensitive fillings of explosive mixtures including Amatol and Trialen.

5.1 Abandoned Bombs

For further information on abandoned bombs, and the potential UXO hazard associated with them, follow the link below:

- Abandoned Bombs

No records have been found indicating that any officially abandoned bombs are located on the Area of Search.

5.2 EOC Tasks

Zetica holds records of the following EOC task having been undertaken in the vicinity of the Area of Search.

1965-1967

A significant quantity of SAA and close combat munitions were cleared from former anti-invasion defence sites and training ranges near Theddlethorpe in the vicinity of the Area of Search.

6 UXO HAZARD ASSESSMENT

The table below defines the likelihood of UXO encounter within the identified constraint areas.

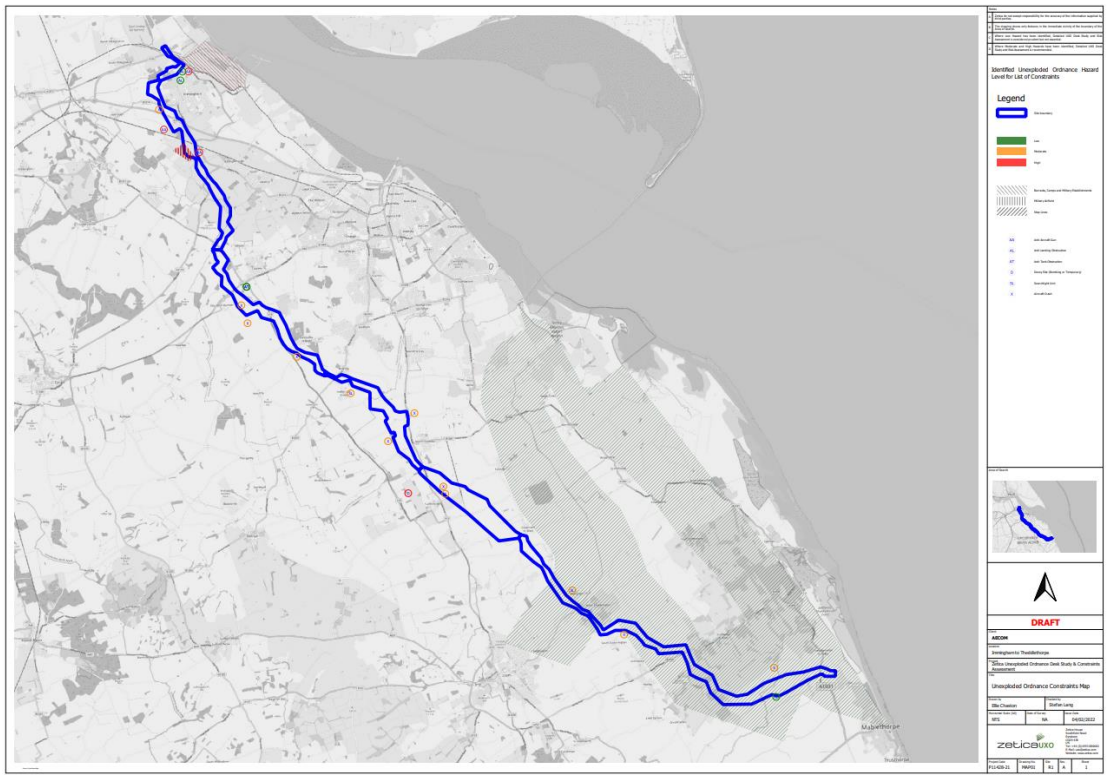
Definitions of UXO Hazard Constraint Level for the Area of Search	
Hazard Level	**Definition**
Low	It is considered unlikely that UXO will be encountered within the footprint of the constraint.
Moderate	Ordnance will have been stored or used within the footprint of the constraint and the potential for UXO to remain cannot be discounted.
High	There is an elevated probability that UXO will be encountered within the footprint of the constraint.

A number of potential sources of UXO hazards offering constraints within the Area of Search have been identified. These are shown in Figure 3, also provided as the accompanying P11428-21-R1-MAP01-A.

For the majority of the Area of Search, evidence indicates that the risk of a UXO hazard being present owing to local military activity is low. There is credible evidence to conclude that at discrete locations, a moderate to high UXO hazard level may exist, especially within the boundaries of former or current military establishments such as airfields and defensive installations.

As with all locations, the potential presence of UXO as the result of enemy action, unauthorised disposal or unrecorded military activity cannot be totally discounted.

Figure 3 UXO constraints within the Area of Search



Source: Zetica *Not to Scale*

7 RECOMMENDATIONS

Avoidance

Where possible, the proposed route corridor options should be diverted around the identified UXO hazard constraints.

UXO Desk Study and Risk Assessment

Once a preferred route option or options have been selected it is recommended that a detailed UXO desk study and risk assessment is commissioned to confirm the UXO hazard level along the route.

Risk Mitigation Plan

Where a potential UXO hazard is identified by the desk study and risk assessment, a document will be provided that summarises the UXO risk mitigation measures recommended for the intended types of development and common working practices. Non-intrusive geophysical surveys can be undertaken to further delineate the potential UXO hazard along the preferred route options, whilst also identifying other buried hazards and features such as archaeology, changes in ground conditions, buried obstructions and utilities.

APPENDICES

Appendix 1 Tables

Table 1 Anti-invasion defences in the Area of Search

Grid Reference	Type	Location
TA 177158	Anti-Landing Obstruction	In a field off Manby Road, Immingham
TA 176154	Anti-Landing Obstruction	Near Church Field House, Immingham
TF 457864	Anti-Landing Obstruction	In a field at Willow Farm, Theddlethorpe
TA 208057	Anti-Tank Obstruction	Oaklands, Laceby

Table 2 WWII HAA batteries in the Area of Search

Grid Reference	Serial No.	Location (Parent)	Armament
TA 185120	S/H20	Stallingborough (Humber)	4x 3.7” guns; 4x 5.25” guns; BHQ
TA 169131	H37	- (Humber)	Unarmed
TA 180158	L	Immingham (Humber)	Armament unknown

Table 3 WWII AA searchlights in the Area of Search

Grid Reference	Location
TA 189505	Alvingham (i)
TF 407911	Waltham (i)

Table 4 Aircraft crashes in the Area of Search

Grid Reference	Location	Type	Serial No.	Date
TF 274985	3 miles south of RAF Grimsby	Hampden I	L4153	27/02/1940
TF 288999	Field 2 miles south of RAF Grimsby	Whitley IV	K9032	07/04/1940
TF 385897	Mill Hill, South Cockerington	Junkers Ju88C-2	R4+KL	21/12/1940
TA 120107	Field at Great Limber, Brocklesby	Heinkel He111	5J+KN	1940
TF 301959	Field at Ludborough, Louth	Wellington III	X3960	12/03/1942
TF 300963	Cold Harbour Farm, Ludborough	Halifax II	W1218	07/06/1942
TA 206055	Field at Irby-upon-Humber	Dornier	Do217M-1	18/08/1943
TA 206055	Field near Irby-upon-Humber	Blenheim IV	V6120	27/10/1943
TA 229019	Field at Hatcliffe Top Farm	Lancaster III	JB596	17/12/1943
Post-WWII crashes				
TR 390885	North of RAF Manby	Meteor T	7 WL478	19/02/1959

Table 5 Bombing statistics

Area	Bombs Recorded				
	High Explosive	Parachute Mines	Other	Total	Bombs per 405ha (1000 acres)
Mablethorpe & Sutton UD	51	1	0	52	8.0
Grimsby RD	204	6	0	210	5.3
Glanford Brigg RD	663	12	1	676	4.9
Louth RD	608	10	0	618	4.0
Caistor RD	195	1	0	196	1.6

Appendix 2 Glossary and Definitions

Abandoned Explosive Ordnance (AXO)	Abandoned Explosive Ordnance is explosive ordnance that has not been used during an armed conflict, that has been left behind or disposed of by a party to an armed conflict, and which is no longer under control of that party. Abandoned explosive ordnance may or may not have been primed, fuzed, armed or otherwise prepared for use.
Close Combat Munitions	Items of ordnance thrown, propelled or placed during land warfare, to include grenades, mortars, projectiles, rockets and land mines.
Demil	Derived from the term 'Demilitarisation', it refers to the break down and the recycling or disposal of ordnance components.
Detonation	The high-speed chemical breakdown of an energetic material producing heat, pressure, flame and a shock wave.
Device	This term is used for any component, sub-assembly or completed ordnance, which may or may not have an explosive risk. It can apply to detonators, primers, gaines, fuzes, shells or bombs.
Explosive	The term explosive refers to compounds forming energetic materials that under certain conditions chemically react, rapidly producing gas, heat and pressure. Obviously, these are extremely dangerous and should only be handled by qualified professionals.
Explosive Ordnance (EO)	Explosive Ordnance is all munitions containing explosives, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads, guided and ballistic missiles, artillery, mortar, rocket, small arms ammunition, mines, torpedoes, depth charges, pyrotechnics, cluster bombs & dispensers, cartridge & propellant actuated devices, electro-explosive devices, clandestine & improvised explosive devices, and all similar or related items or components explosive in nature.
Explosive Ordnance Clearance (EOC)	Explosive Ordnance Clearance is a term used to describe the operation of ordnance detection, investigation, identification and removal, with EOD being a separate operation.
Explosive Ordnance Disposal (EOD)	Explosive Ordnance Disposal is the detection, identification, on-site evaluation, rendering safe, recovery and final disposal of unexploded explosive ordnance.
Explosive Ordnance Reconnaissance (EOR)	Explosive Ordnance Reconnaissance is the detection, identification and on-site evaluation of unexploded explosive ordnance before Explosive Ordnance Disposal.
Explosive Remnants of War (ERW)	Explosive Remnants of War are Unexploded Ordnance (UXO) and Abandoned Explosive Ordnance (AXO), excluding landmines.

Explosive Substances and Articles (ESA)	Explosive substances are solid or liquid substances (or a mixture of substances), which are either: • capable by chemical reaction in itself of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. • designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these as a result of a non-detonative, self-sustaining, exothermic reaction. Explosive article is an article containing one or more explosive substances.
Fuze	A fuze is the part of an explosive device that initiates the main explosive charge to function. In common usage, the word fuze is used indiscriminately, but when being specific (and in particular in a military context), fuze is used to mean a more complicated device, such as a device within military ordnance.
Gaine	Small explosive charge that is sometimes placed between the detonator and the main charge to ensure ignition.
Geophysical survey	A geophysical survey is essentially a range of methods that can be used to detect objects or identify ground conditions without the need for intrusive methods (such as excavation or drilling). This is particularly suited to ordnance as disturbance of ordnance items is to be avoided where ever possible.
Gold line	This is the estimated limit of blast damage from an explosive storage magazine. It usually means that development within this zone is restricted.
High Explosive	Secondary explosives (commonly known as High Explosives (HE)) make up the main charge or filling of an ordnance device. They are usually less sensitive than primary explosives. Examples of secondary explosives are: Nitro glycerine (NG), Trinitrotoluene (TNT), AMATOL (Ammonia nitrate + TNT), Gunpowder (GP), and Cyclotrimethylenetrinitramine (RDX).
Munition	Munition is the complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations, including demolitions. This includes those munitions that have been suitably modified for use in training, ceremonial or non-operational purposes. These fall into three distinct categories:- • inert - contain no explosives whatsoever. • live - contain explosives and have not been fired. • blind - have fired but failed to function as intended.

Primary Explosive	Primary explosives are usually extremely sensitive to friction, heat, and pressure. These are used to initiate less sensitive explosives. Examples of primary explosives are: Lead Azide, Lead Styphnate, and Mercury Fulminate. Primary explosive are commonly found in detonators.
Propellants	Propellants provide ordnance with the ability to travel in a controlled manner and deliver the ordnance to a predetermined target. Propellants burn rapidly producing gas, pressure and flame. Although usually in solid form they can be produced in liquid form. Examples of propellants are: Ballistite often found in a flake form and Cordite used in small arms ammunition.
Pyrotechnic	A pyrotechnic is an explosive article or substance designed to produce an effect by heat, light, sound, gas or smoke, or a combination of any of these, as a result of non-detonative, self-sustaining, exothermic chemical reactions.
Small Arms Ammunition (SAA)	SAA includes projectiles around 12mm or less in calibre and no longer than approximately 100mm. They are fired from a variety of weapons, including rifles, pistols, shotguns and machine guns.
Unexploded Anti-Aircraft (UXAA) Shell	UXAA shells are army ordnance commonly containing HE, though they can also contain pyrotechnic compounds that produce smoke. Most commonly, these were 3.7” and 4.5” HE shells, although they ranged from 2” to 5.25” calibre.
Unexploded Bomb (UXB)	UXB is a common term for unexploded air-dropped munitions.
Unexploded Ordnance (UXO)	UXO is explosive ordnance that has been either primed, fuzed, armed or prepared for use and has been subsequently fired, dropped, launched, projected or placed in such a manner as to present a hazard to operations, persons or objects and remains unexploded either by malfunction or design.
V1	The Vergeltungswaffe-1, V-1, also designated Fieseler Fi 103/FZG-76, known colloquially in English as the Flying Bomb, Buzz Bomb or Doodlebug, was the first guided missile used in WWII and the forerunner of today's cruise missile.
V2	The Vergeltungswaffe 2 (V-2) (‘Reprisal Weapon 2’) was the first ballistic missile. It was used by the German Army primarily against Belgian and British targets during the later stages of WWII. The V-2 was the first man-made object launched into space, during test flights that reached an altitude of 189km (117 miles) in 1944.

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Established for over 30 years, Zetica's services include

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- ☑ Intrusive ground investigations

More details are available at

[redacted]


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Notes

A	Zetica do not accept responsibility for the accuracy of the information supplied by third parties.
B	The drawing shows only features in the immediate vicinity of the boundary of the Area of Search.
C	Where Low Hazard has been identified, Detailed UXO Desk Study and Risk Assessment is considered prudent but not essential.
D	Where Moderate and High Hazards have been identified, Detailed UXO Desk Study and Risk Assessment is recommended.

Identified Unexploded Ordnance Hazard Level for List of Constraints

Legend

- Site boundary
- Low
- Moderate
- High
- Barracks, Camps and Military Establishments
- Military Airfield
- Stop Lines
- AA Anti-Aircraft Gun
- AL Anti-Landing Obstruction
- AT Anti-Tank Obstruction
- D Decoy Site (Bombing or Temporary)
- SL Searchlight Unit
- X Aircraft Crash

Area of Search

DRAFT

Client: **AECOM**

Location: Immingham to Theddlethorpe

Project: Zetica Unexploded Ordnance Desk Study & Constraints Assessment

Title: Unexploded Ordnance Constraints Map

Drawn by	Checked by
Ellie Chaston	Stefan Lang

Horizontal Scale (A0)	Date of Survey	Issue Date
NTS	NA	04/02/2022

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Project Code	Drawing No.	Site	Rev.	Sheet
P1142B-21	MAP01	R1	A	1

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