

# Springwell Solar Farm

## Environmental Statement

### Appendix 11.3: Detailed UXO Risk Assessment

Volume 3

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Planning Act 2008  
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(Applications: Prescribed Forms  
and Procedure) Regulations 2009



**1ST LINE DEFENCE**



## Detailed Unexploded Ordnance (UXO) Risk Assessment





## Executive Summary

### Site Location and Description

The site is located in the county of Lincolnshire between the villages of Blankney, Scopwick, Kirkby Green, and Ashby de la Launde. The villages of Metheringham, Digby, Ruskington and Cranwell are located in within 3km of the site area, to the north, east, south-east and south of the site respectively. In the wider area, the city of Lincoln is located approximately 15km north-west of the site, and the town of Sleaford is located approximately 7km south of the site.

Recent aerial imagery dated March 2022 indicates that the site predominantly occupies undeveloped agricultural land, interspersed with some limited areas of vegetation and woodland, as well as some farm access tracks, roadways and agricultural structures.

The site is approximately centred on the OS grid reference: **TF 05651 56366**.

The northern section of the site is centred on OS grid reference: **TF 07944 59315**.

The southern section of the site is centred on OS Grid Reference: **TF 03440 54307**.

### Proposed Works

Information provided by the client indicates that the site is being considered for the development of a new energy farm comprising ground mounted photovoltaic panels, battery energy storage system, project substation, grid substation and associated infrastructure.

### Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows the site to be underlain by a wide variety of different geology throughout, including: Kellaways Formation - Sandstone, siltstone and mudstone; Cornbrash Formation - Limestone; Blisworth Clay Formation - Mudstone; Blisworth Limestone Formation - Limestone; Lincolnshire Limestone Formation - Limestone; Upper Lincolnshire Limestone Member - Limestone; Lower Lincolnshire Limestone Member - Limestone.

Some minor superficial deposits of Tidal Flat Deposits, 1 - Clay and Silt; Head - Clay, Silt, Sand and Gravel; Sleaford Sand and Gravel - Sand and Gravel were also recorded.

Site-specific geotechnical information was not available to 1<sup>st</sup> Line Defence at the time of the production of this report. An assessment of maximum bomb penetration depth can be made once such data becomes available, or by a UXO specialist during on-site support.

It should be noted that the maximum depth that a bomb could reach may vary across a site and will be largely dependent on the specific underlying geological strata and its density.

### UXO Risk Assessment

1<sup>st</sup> Line Defence has assessed that there is a **Medium Risk** from items of Allied unexploded ordnance in sections of the northern and central-western areas of the site. The remainder of the site has been assessed as being at a **Low Risk** from items of Allied UXO. See risk mapping presented in **Annex Q1-Q2**

1<sup>st</sup> Line Defence has assessed that there is an overall **Medium Risk** from German and anti-aircraft unexploded ordnance across the central-western section of the site area. The remainder of the site has been assessed as being at a **Low Risk** from German and anti-aircraft unexploded ordnance. See risk mapping presented in **Annex R1-R2**.

#### The Risk from Allied UXO

- During WWII the site was partly occupied by RAF Digby which was/is situated on and immediately adjacent to the central-western section of the site. Further airfields were located in the wider site area, including RAF Metheringham which was located approximately 1km east of the northernmost section of the site, RAF Wellingore was formerly located 2km west of the central-western section of the site, and RAF Cranwell is situated approximately 2.5km south-west of the southernmost section of the site.
- RAF Digby, formerly RAF Scopwick, was a WWI-era relief landing ground for RNAS Cranwell, an inter-war training airfield and WWII-era Fighter Command airfield, and remains in active RAF service in the present-era.
- An inter-war period RAF Digby site plan dated 1932 indicates that a 'Bomb-Dropping Tower' was located within the bounds of the airfield perimeter. Although there was no reference to the location of the practice bombing range



### UXO Risk Assessment

associated with RAF Digby, historically practice bombing was often undertaken within the bounds of the airfield, and the airfield landing circle was sometimes used as a temporary target. This feature was located approximately 500m north of the central-western section of the site area.

- WWII-era RAF Digby site plans and aerial imagery indicate that the central-western section of the site comprised three 'Type A' aircraft dispersal pens, segments of the airfield perimeter fence, several pillbox structures and loopholed walls, as well as at least two LAA gun sites. Several bunded structures marked as *Small Arms Stores* were also located close to the central-western section of the site (see **Annex G3**).
- Owing to the sites proximity to an Auxiliary Unit HQ at Blankney Hall (adjacent to the northernmost section of the site), and the RAF Digby Airfield (on and adjacent to the central-western section of the site), it is possible that defensive and training exercises were carried out within and around these features. Auxiliary Units were provided with live ammunition and ordnance, and trained using real explosives. Although no record of training exercises were found, this is likely because such training was often conducted on a small scale at the discretion of individual commanders and as such was seldom recorded officially.
- Online and anecdotal accounts indicate that a Lancaster heavy bomber crashed within the northern section of the site area following a mid-air collision with a Hurricane, both of which were undertaking 'Flight Affiliation' training. Given these two planes were taking part in mock attacks, it is considered unlikely that live ammunition was in use, therefore unlikely that Allied ordnance contaminated the ground as a result of this incident.
- See **Annex O** for a visual overlay presenting the locations of all significant historic allied features and incidents recorded in the site locality.
- In summary, the risk of Allied ordnance contamination across the site is not homogenous. Owing to the recorded location and proximity of several significant allied features on and around the central-western and northern sections of the site, namely RAF Digby and Blankney Hall, these areas are assessed to be at an elevated risk from items of Allied UXO, and as such have been assessed as **Medium Risk**. The remaining areas of the site are not anticipated to be significantly elevated above the 'background' level of risk for this area of the country, therefore the rest of the site.

### The Risk from German Air Delivered UXO

- During WWII the site was located within the Rural District of East Kesteven, which sustained an overall very-low density bombing campaign, culminating in an average of 2.4 items of ordnance per 1,000 acres. This was mainly due to the largely rural and agricultural composition of the district in which the site was located. However it should be noted that the site area was located in a close proximity to several RAF airfields and their associated decoy sites which are known to have been targeted on several occasions.
- RAF Digby, which was located on and immediately adjacent to the central-western section of the site was bombed on at least three occasions. Written incident records indicate that one particular raid during August 1942 recorded the use of several unexploded HE bombs.
- Anecdotal accounts indicate that the villages located in the site locality were subject to sporadic bombing raids during WWII. The village of Scopwick was bombed on six separate occasions, the villages of Blankney, Digby and Ruskington were reportedly bombed on four occasions, and the villages of Rowston, Dorrington, Ashby-de-la-Launde were reportedly bombed on two occasions during June 1940 and August 1942.
- Blankney Park, formerly located to the north of the northernmost section of the site, was reportedly subject to one WWI-era Zeppelin raid, and the village of Metheringham further north was reportedly subject to two separate Zeppelin raids.
- **Annex P** provides a visual overlay of bombing incidents in the site locality along with a brief description. Although it should be noted that this map does not provide a comprehensive account of bombing incidents, nor does it denote exact bomb strike locations.
- Due to the size and largely rural nature of the site, it has not been possible to assess signs of damage across the entire area in detail. Although on the basis of available photography, mapping and records, the majority of the site appears to have survived the war relatively unscathed and structures in the area surrounding the site appear intact. Some signs of potential ground disturbances and potential bomb cratering are visible in WWII-era aerial imagery presented in **Annex H** within specific areas of the site area.
- Areas of the site that were typified by roadways or structures are considered likely to have received relatively frequent levels of access and monitor for items of UXO. The agricultural areas of the site are considered to have received less frequent and seasonal access, and will have been occupied by various forms of ground cover that may not have been conducive to the easy observation of evidence of UXO.
- In summary, due to the open, rural nature of the site, and the bombing incidents recorded in the site locality, it is not possible to discount the risk that an item of UXO could have fallen on site unnoticed and unrecorded. Nevertheless, the Rural District of Kesteven was subject to a very-low bombing density, and much of the site is not thought to be



### **UXO Risk Assessment**

significantly elevated above the 'background' level of risk in this region. As such, the majority of the site has been assessed as being **Low Risk** from German UXO contamination.

- However, where the central-western section of the site adjoins RAF Digby, the risk has been elevated somewhat to account for the multiple bombing raids which affected the RAF airfield. As such, this area has been assessed as **Medium Risk**. See risk mapping presented in **Annex R1-R2**.

#### **Post-WWII Redevelopment**

- Post-war OS mapping and aerial imagery indicates that the majority of the site and surrounding environs have remained undeveloped in the post-war era. Some minor works were able to be discerned, including agricultural and residential structures, access roads and roadways. Some agricultural and residential structures were also cleared during this period.
- The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

### **Recommended Risk Mitigation Measures**

The following risk mitigation measures are recommended to support the proposed works at Springwell Solar Farm:

#### **All Works**

- UXO Risk Management Plan
- Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.

#### **Medium Risk Areas**

##### **Open Intrusive Works (trial pits, service pits, open excavations, shallow foundations etc.)**

- Non-Intrusive UXO Magnetometer Survey and Target Investigation.  
*Where this type of survey is not practical (due to for example terrain or ground conditions), the following is recommended to support shallow intrusive works:*
- UXO Specialist On-site Support

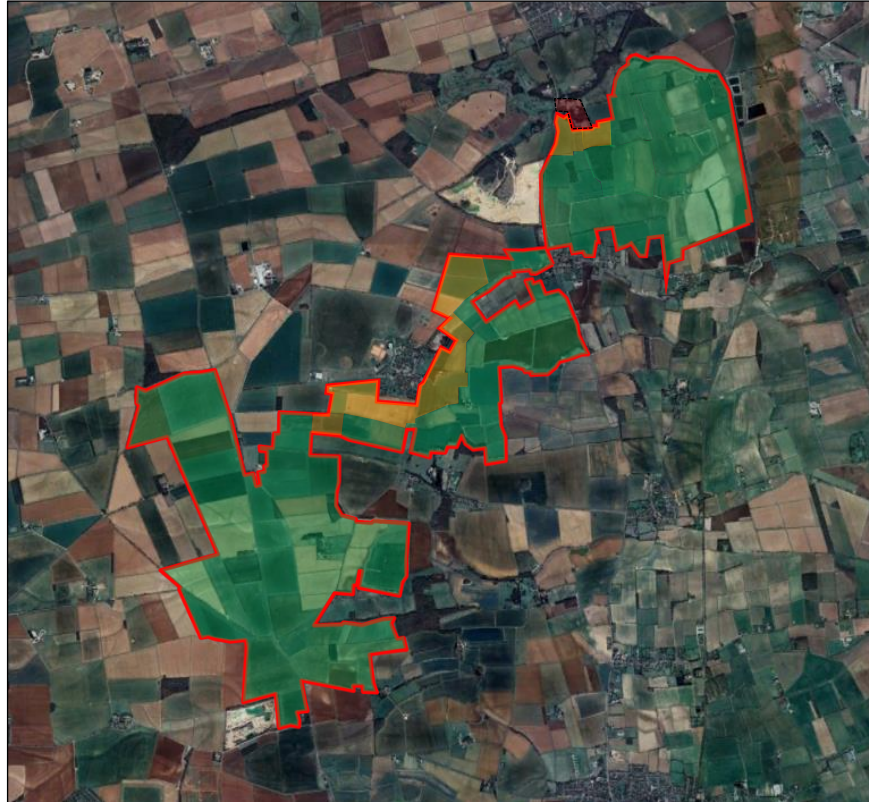
#### **Boreholes and Piled Foundations**

- Intrusive Magnetometer Survey of all borehole and pile locations/clusters down to maximum bomb penetration depth.

*Note – the above risk mitigation measures are not considered necessary for any works taking place at the location of and at the depths of any post-war development present.*



Allied UXO Risk Map



For indicative purposes – not to scale.

Please note that this assessed risk map may not take into account all post-war redevelopment/excavations on site.

-  Low Risk
-  Medium Risk

**1<sup>st</sup> Line Defence Risk Mitigation Services:**

**All Areas of the Site:**

- Site Specific Unexploded Ordnance Awareness Briefings – a service recommended to all personnel conducting intrusive works.
- UXO Risk Management Plan

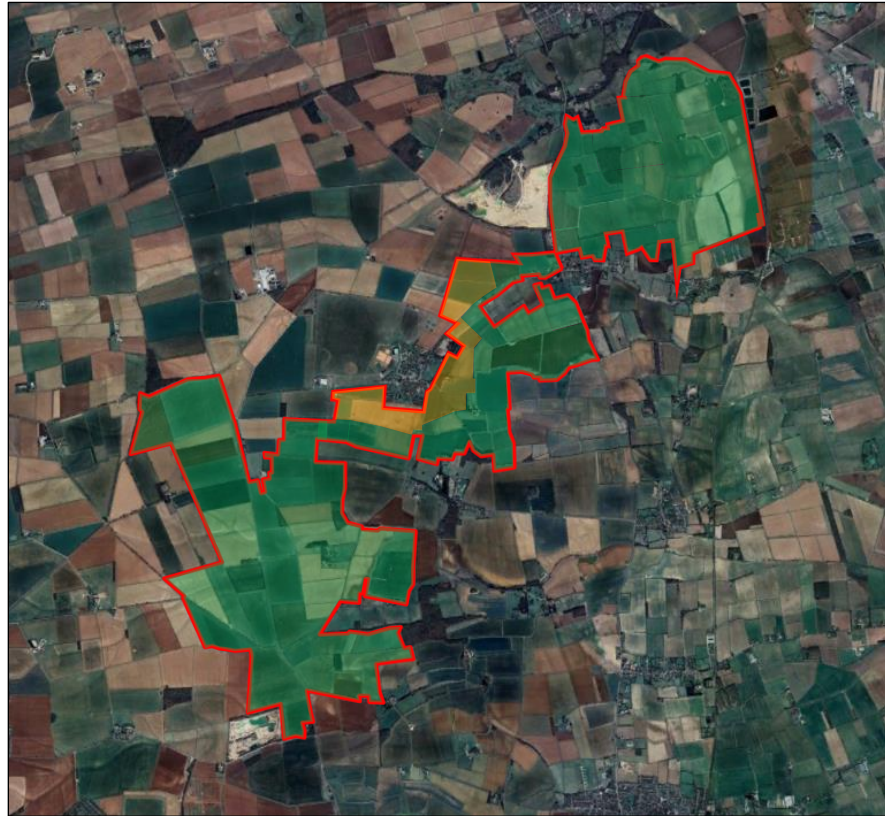
**Medium Risk Areas of the site:**

**Open Intrusive Works (trial pits, service pits, open excavations, shallow foundations etc.)**

- Non-Intrusive UXO Magnetometer Survey and Target Investigation (where appropriate.)
- UXO Specialist On-site Support





German UXO Risk Map



For indicative purposes – not to scale.

Please note that this assessed risk map may not take into account all post-war redevelopment/excavations on site.

-  Low Risk
-  Medium Risk

**1<sup>st</sup> Line Defence Risk Mitigation Services:**

**All Areas of the Site:**

- Site Specific Unexploded Ordnance Awareness Briefings – a service recommended to all personnel conducting intrusive works.
- UXO Risk Management Plan

**Medium Risk Areas of the site:**

**Open Intrusive Works (trial pits, service pits, open excavations, shallow foundations etc.)**

- Non-Intrusive UXO Magnetometer Survey and Target Investigation (where appropriate.)
- UXO Specialist On-site Support

**Boreholes and Piled Foundations**

- Intrusive Magnetometer Survey of all borehole and pile locations/clusters down to maximum bomb penetration depth.

## Glossary

<b>Abbreviation</b>	<b>Definition</b>
<b>AA</b>	Anti-Aircraft
<b>AFS</b>	Auxiliary Fire Service
<b>AP</b>	Anti-Personnel
<b>ARP</b>	Air Raid Precautions
<b>DA</b>	Delay-action
<b>EOC</b>	Explosive Ordnance Clearance
<b>EOD</b>	Explosive Ordnance Disposal
<b>FP</b>	Fire Pot
<b>GM</b>	G Mine (Parachute mine)
<b>HAA</b>	Heavy Anti-Aircraft
<b>HE</b>	High Explosive
<b>IB</b>	Incendiary Bomb
<b>JSEODOC</b>	Joint Services Explosive Ordnance Disposal Operation Centre
<b>LAA</b>	Light Anti-Aircraft
<b>LCC</b>	London County Council
<b>LRRB</b>	Long Range Rocket Bomb (V-2)
<b>LSA</b>	Land Service Ammunition
<b>NFF</b>	National Filling Factory
<b>OB</b>	Oil Bomb
<b>PAC</b>	Pilotless Aircraft (V-1)
<b>PB</b>	Phosphorous Bomb
<b>PM</b>	Parachute Mine
<b>POW</b>	Prisoner Of War
<b>RAF</b>	Royal Air Force
<b>RCAF</b>	Royal Canadian Air Force
<b>RFC</b>	Royal Flying Corps
<b>RNAS</b>	Royal Naval Air Service
<b>ROF</b>	Royal Ordnance Factory
<b>SA</b>	Small Arms
<b>SAA</b>	Small Arms Ammunition
<b>SD2</b>	Anti-personnel "Butterfly Bomb"
<b>SIP</b>	Self-Igniting Phosphorous
<b>U/C</b>	Unclassified bomb
<b>UP</b>	Unrotated Projectile (rocket)
<b>USAAF</b>	United States Army Air Force
<b>UX</b>	Unexploded
<b>UXAA</b>	Unexploded Anti-Aircraft
<b>UXB</b>	Unexploded Bomb
<b>UXO</b>	Unexploded Ordnance
<b>V-1</b>	Flying Bomb (Doodlebug)
<b>V-2</b>	Long Range Rocket
<b>WAAF</b>	Women's Auxiliary Air Force
<b>X</b>	Exploded





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# 1<sup>st</sup> Line Defence Limited

## Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Springwell Solar Farm

### 1. Introduction

#### 1.1. Background

Buried UXO can present a significant risk to construction works and development projects. The discovery of a suspect device during works can cause considerable disruption to operations as well as cause unwanted delays and expense.

UXO in the UK can originate from three principal sources:

1. Munitions resulting from wartime activities including German bombing in WWI and WWII, long range shelling, and defensive activities.
2. Munitions deposited as a result of military training and exercises.
3. Munitions lost, burnt, buried or otherwise discarded either deliberately, accidentally, or ineffectively.

This report will assess the potential factors that may contribute to the risk of UXO contamination. If an elevated risk is identified at the site, this report will recommend appropriate mitigation measures, in order to reduce the risk to as low as is reasonably practicable. Detailed analysis and evidence will be provided to ensure an understanding of the basis for the assessed risk level and any recommendations.

This report complies with the guidelines outlined in *CIRIA C681*, 'Unexploded Ordnance (UXO) A Guide for the Construction Industry.'

## **2. Method Statement**

### **2.1. Report Objectives**

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at Springwell Solar Farm. The report will also recommend appropriate site and work-specific risk mitigation measures to reduce the risk from explosive ordnance during the envisaged works to a level that is as low as reasonably practicable.

### **2.2. Risk Assessment Process**

1<sup>st</sup> Line Defence has undertaken a five-step process for assessing the risk of UXO contamination:

1. The likelihood that the site was contaminated with UXO.
2. The likelihood that UXO remains on the site.
3. The likelihood that UXO may be encountered during the proposed works.
4. The likelihood that UXO may be initiated.
5. The consequences of initiating or encountering UXO.

In order to address the above, 1<sup>st</sup> Line Defence has taken into consideration the following factors:

- Evidence of WWI and WWII German air delivered bombing as well as the legacy of Allied occupation.
- The nature and conditions of the site during WWII.
- The extent of post-war development and UXO clearance operations on site.
- The scope and nature of the proposed works and the maximum assessed bomb penetration depth.
- The nature of ordnance that may have contaminated the proposed site area.

### **2.3. Sources of Information**

Every reasonable effort has been made to ensure that relevant evidence has been consulted and presented in order to produce a thorough and comprehensible report for the client. To achieve this the following, which includes military records and archive material held in the public domain, have been accessed:

- The National Archives.
- RAF site plans obtained from the RAF Museum, Hendon.
- Historical mapping datasets.
- Historic England National Monuments Record.
  
- Available material from 33 Engineer Regiment (EOD) Archive (part of 29 Explosive Ordnance and Disposal and Search Group).
- 1<sup>st</sup> Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.



### **3. Background to Bombing Records**

#### **3.1. General Considerations of Historical Research**

This desktop assessment is based largely upon analysis of historical evidence. Every reasonable effort has been made to locate and present significant and pertinent information. 1<sup>st</sup> Line Defence cannot be held accountable for any changes to the assessed risk level or risk mitigation measures, based on documentation or other data that may come to light at a later date, or which was not available to 1<sup>st</sup> Line Defence during the production of this report.

It is often problematic and sometimes impossible to verify the completeness and accuracy of WWII-era records. As a consequence, conclusions as to the exact location and nature of a UXO risk can rarely be quantified and are, to a degree, subjective. To counter this, a range of sources have been consulted, presented and analysed. The same methodology is applied to each report during the risk assessment process. 1<sup>st</sup> Line Defence cannot be held responsible for any inaccuracies or the incompleteness in available historical information.

#### **3.2. German Bombing Records**

During WWII, bombing records were generally gathered locally by the police, Air Raid Precaution (ARP) wardens and military personnel. These records typically contained information such as the date, the location, the amount of damage caused and the types of bombs that had fallen during an air raid. This information was made either through direct observation or post-raid surveys. The Ministry of Home Security Bomb Census Organisation would then receive this information, which was plotted onto maps, charts, and tracing sheets by regional technical officers. The collective record set (regional bomb census mapping and locally gathered incidents records) would then be processed and summarised into reports by the Ministry of Home Security Research and Experiments Branch. The latter were tasked with providing the government ‘a complete picture of air raid patterns, types of weapons used and damage caused- in particular to strategic services and installations such as railways, shipyards, factories and public utilities.’<sup>1</sup>

The quality, detail and nature of record keeping could vary considerably between provincial towns, boroughs and cities. No two areas identically collated or recorded data. While some local authorities maintained records with a methodical approach, sources in certain areas can be considerably more vague, dispersed, and narrower in scope. In addition, the immediate priority was mostly focused on assisting casualties and minimising damage at the time. As a result, some records can be incomplete and contradictory. Furthermore, many records were even damaged or destroyed in subsequent air raids. Records of raids that took place on sparsely or uninhabited areas were often based upon third party or hearsay information and are therefore not always reliable. Whereas records of attacks on military or strategic targets were often maintained separately and have not always survived.

#### **3.3. Allied Records**

During WWII, considerable areas of land were requisitioned by the War Office for the purpose of defence, training, munitions production and the construction of airfields. Records relating to military features vary and some may remain censored. Within urban environments datasets will be consulted detailing the location of munition production as well as wartime air and land defences. In rural locations it may be possible to obtain plans of military establishments, such as airfields, as well as training logs, record books, plans and personal memoirs. As with bombing records, every reasonable effort will be made to access records of, and ascertain any evidence of, military land use. However, there are occasions where such evidence is not available, as records may not be accessible, have been lost/destroyed, or simply were not kept in the first place.

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<sup>1</sup> <http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/bomb-census-survey-records-1940-1945/>.



## **4. UK Regulatory Environment and Guidelines**

### **4.1. General**

There is no formal obligation requiring a UXO risk assessment to be undertaken for construction projects in the UK, nor is there any specific legislation stipulating the management or mitigation of UXO risk. However, it is implicit in the legislation outlined below that those responsible for intrusive works (archaeology, site investigation, drilling, piling, excavation etc.) should undertake a comprehensive and robust assessment of the potential risks to employees and that mitigation measures are implemented to address any identified hazards.

### **4.2. CDM Regulations 2015**

The Construction (Design and Management) Regulations 2015 (CDM 2015) define the responsibilities of parties involved in the construction of temporary or permanent structures.

The CDM 2015 establishes a duty of care extending from clients, principle co-ordinators, designers, and contractors to those working on, or affected by, a project. Those responsible for construction projects may therefore be accountable for the personal or proprietary loss of third parties, if correct health and safety procedure has not been applied.

Although the CDM does not specifically reference UXO, the risk presented by such items is both within the scope and purpose of the legislation. It is therefore implied that there is an obligation for parties to:

- Provide an appropriate assessment of potential UXO risks at the site (or ensure such an assessment is completed by others).
- Put in place appropriate risk mitigation measures if necessary.
- Supply all parties with information relevant to the risks presented by the project.
- Ensure the preparation of a suitably robust emergency response plan.

### **4.3. The 1974 Health and Safety at Work etc. Act**

All employers have a responsibility under the Health and Safety at Work etc. Act 1974 and the Management of Health and Safety at Work Regulations 1999, to ensure the health and safety of their employees and third parties, so far as is reasonably practicable and conduct suitable and sufficient risk assessments.



#### **4.4. CIRIA C681**

In 2009, the Construction Industry Research and Information Association (CIRIA) produced a guide to the risk posed by UXO to the UK construction industry (CIRIA C681). CIRIA is a neutral, independent and not-for-profit body, linking organisations with common interests and facilitating a range of collaborative activities that help improve the industry.

The publication provides the UK construction industry with a defined process for the management of risks associated with UXO from WWI and WWII air bombardment. It is also broadly applicable to the risks from other forms of UXO that might be encountered. It focuses on construction professionals' needs, particularly if there is a suspected item of UXO on site, and covers issues such as what to expect from a UXO specialist. The guidance also helps clients to fulfil their legal duty under CDM 2015 to provide designers and contractors with project specific health and safety information needed to identify hazards and risks associated with the design and construction work. This report conforms to this CIRIA guidance and to the various recommendations for good practice referenced therein. It is recommended that this document is acquired and studied where possible to allow a better understanding of the background to both the risk assessment process and the UXO issue in the UK in general.

#### **4.5. Additional Legislation**

In the event of a casualty resulting from the failure of an employer/client to address the risks relating to UXO, the organisation may be criminally liable under the Corporate Manslaughter and Corporate Homicide Act 2007.

## **5. The Role of Commercial UXO Contractors and The Authorities**

### **5.1. Commercial UXO Specialists**

The role of a UXO Specialist (often referred to as UXO Consultant or UXO Contractor) such as 1<sup>st</sup> Line Defence, is defined in CIRIA C681 as the provision of expert knowledge and guidance to the client on the most appropriate and cost-effective approach to UXO risk management at a site.

The principal role of UXO Specialists is to provide the client with an appropriate assessment of the risk posed by UXO for a specific project, and identify and carry out suitable methodology for the mitigation of any identified risks to reduce them to an acceptable level.

The requirement for a UXO Specialist should ideally be identified in the initial stages of a project, and it is recommended that this occur prior to the start of any detailed design. This will enable the client to budget for expenditure that may be required to address the risks from UXO, and may enable the project team to identify appropriate techniques to eliminate or reduce potential risks through considered design, without the need for UXO specific mitigation measures. The UXO Specialist should have suitable qualifications, levels of competency and insurances.

Please note 1<sup>st</sup> Line Defence has the capability to provide a complete range of required UXO risk mitigation services, in order to reduce a risk to as low as reasonably practicable. This can involve the provision of both ground investigation, and where appropriate, UXO clearance services.

### **5.2. The Authorities**

The police have a responsibility to co-ordinate the emergency services in the event of an ordnance-related incident at a construction site. Upon inspection they may impose a safety cordon, order an evacuation, and call the military authorities Joint Services Explosive Ordnance Disposal Operation Centre (JSEODOC) to arrange for investigation and/or disposal. Within the Metropolitan Police Operational Area, SO15 EOD will be tasked to any discovery of suspected UXO. The request for Explosive Officer (Expo) support is well understood and practiced by all Metropolitan Boroughs. The requirement for any additional assets will then be coordinated by the Expo if required.

In the absence of a UXO specialist, police officers will usually employ such precautionary safety measures, thereby causing works to cease, and possibly requiring the evacuation of neighbouring businesses and properties.

The priority given to the police request will depend on the EOD teams' judgement of the nature of the UXO risk, the location, people and assets at risk, as well as the availability of resources. The speed of response varies; authorities may respond immediately or in some cases it may take several days for the item of ordnance to be dealt with. Depending on the on-site risk assessment the item of ordnance may be removed from the site and/or destroyed by a controlled explosion.

Following the removal of an item of UXO, the military authorities will only undertake further investigations or clearances in high-risk situations. If there are regular UXO finds on a site the JSEODOC may not treat each occurrence as an emergency and will recommend the construction company puts in place alternative procedures, such as the appointment of a commercial contractor to manage the situation.

## **6. The Site**

### **6.1. Site Location**

The site is located in the county of Lincolnshire between the villages of Blankney, Scopwick, Kirkby Green, and Ashby de la Launde. The villages of Metheringham, Digby, Ruskington and Cranwell are located in within 3km of the site area, to the north, east, south-east and south of the site respectively.

In the wider area, the city of Lincoln is located approximately 15km north-west of the site, and the town of Sleaford is located approximately 7km south of the site.

The site is approximately centred on the OS grid reference: **TF 05651 56366**.

The northern section of the site is centred on OS grid reference: **TF 07944 59315**.

The southern section of the site is centred on OS Grid Reference: **TF 03440 54307**.

Site location maps are presented in **Annex A**.

### **6.2. Site Description**

Recent aerial imagery dated March 2022 indicates that the site predominantly occupies undeveloped agricultural land, interspersed with some limited areas of vegetation and woodland, as well as some farm access tracks, roadways and agricultural structures.

A recent aerial photograph and site plan are presented in **Annex B** and **Annex C** respectively.

## **7. Scope of the Proposed Works**

### **7.1. General**

Information provided by the client indicates that the site is being considered for the development of a new energy farm comprising ground mounted photovoltaic panels, battery energy storage system, project substation, grid substation and associated infrastructure.

## **8. Ground Conditions**

### **8.1. General Geology**

The British Geological Survey (BGS) map shows the site to be underlain by a wide variety of different geology throughout, including: Kellaways Formation - Sandstone, siltstone and mudstone; Cornbrash Formation – Limestone; Blisworth Clay Formation – Mudstone; Blisworth Limestone Formation – Limestone; Lincolnshire Limestone Formation – Limestone; Upper Lincolnshire Limestone Member – Limestone; Lower Lincolnshire Limestone Member – Limestone.

Some minor superficial deposits of Tidal Flat Deposits, 1 - Clay and Silt; Head - Clay, Silt, Sand and Gravel; Sleaford Sand and Gravel - Sand and Gravel were also recorded.

### **8.2. Site Specific Geology**

Site-specific geotechnical data was not provided by the client during the production of this report.



## **9. Site History**

### **9.1. Introduction**

The purpose of this section is to identify the composition of the site pre and post-WWII. It is important to establish the historical use of the site, as this may indicate the site's relation to potential sources of UXO as well as help with determining factors such as the land use, groundcover, likely frequency of access and signs of bomb damage.

### **9.2. Summary of the Historical Background of the Site**

The site area is predominantly comprised of agricultural areas of land that have remained undeveloped, however, several areas of former military use have been identified in the site locality and surrounding environs. RAF Digby, formerly RAF Scopwick, was a WWI-era relief landing ground for RNAS Cranwell, an inter-war training airfield and WWII-era Fighter Command airfield, and remains in active RAF service in the present-era. RAF Digby is located immediately north and west of the central-western section of the site. RAF Metheringham, a late-WWII Bomber Command airfield active during 1943 – 1946 was formerly located approximately 1km east of the northernmost section of the site. RAF Wellingore, a WWII-era Fighter Command airfield and relief landing ground was formerly located approximately 2km west of the central-western section of the site. RAF Cranwell, a WWI-era airship and balloon training station, WWII-era training airfield and RAF College in the present-era is located approximately 2.5km south-west of the southernmost section of the site.

During 1940 an Auxiliary Unit HQ was set up at Wellingore Hall approximately 3km west of the southern section of the site, later moving to Blankney Hall which was located immediately adjacent to the northernmost section of the site. By 1942, Blankney Hall was requisitioned by the RAF for use as a sector operations room. Ashby Hall, situated immediately adjacent to the central-southern section of the site, was used by RAF Digby as an Officers' Mess.

Further information relating to the history of the site and immediate environs is presented in [Section 11](#).

### 9.3. Ordnance Survey Historical Maps

Relevant historical maps were obtained for this report and are presented in **Annex D**. See below for a summary of the site history shown on acquired mapping.

WWII-era		
Date	Scale	Description
1946	1:63,360	<p>This WWII-era OS mapping edition dated 1946 shows the site to predominantly comprise sections of open agricultural land, interspersed with small areas of woodland, roadways and farm access tracks. Several farms and named structures are depicted throughout the site area, including <i>Brickyard Farm</i>, <i>Scopwick Low Field Farm</i> and <i>Fox Covert</i> in the northern section of the site; <i>Sheffield House</i>, <i>Rowston Top</i> and <i>Glebe Farm</i> in the central areas of the site; <i>Slate House</i> and <i>Peacock Lodge</i> in the southern area of the site. <i>Ashby Lodge</i>, <i>Gorse Hill Covert</i> and <i>Thompson's Bottom</i> are depicted in a close proximity to the west of the southern area of the site.</p> <p>Several residential areas are visible in a close proximity to specific areas of the site. This includes <i>Blankney Hall</i> and <i>Blankney Park</i> to the immediate north-east of northernmost section of the site, the villages of <i>Scopwick</i> and <i>Kirkby Green</i> are adjacent to the northern and central areas of the site, the village of <i>Rowston</i> to the east of the central area of the site, the village of <i>Ashby de la Launde</i> and <i>Bloxholm Hall</i> to the east of the southern section of the site, and settlement of <i>Brauncewell</i> to the south of the site.</p>

### 9.4. Pre-WWII Historical Photography of the Site

Pre-WWII historical aerial photography has been obtained from the Imperial War Museum. This imagery provides a view of part of the site in 1930's (see **Annex E**). See below for a description:

Title of Photograph	Comments
1930's	<p>This pre-WWII era oblique aerial image taken during the 1930's shows the RAF Digby airfield and the central-western section of the site, from the south-east looking north-west. This image shows the airfield's technical, administration and accommodation area with two large aircraft hangars in the in the process of construction at the time this image was taken.</p> <p>In the background, several unidentified bi-plane types can be seen parked on the flying ground, with surrounding fields further to the west and north-west.</p> <p>In the foreground, a roadway can be seen, a sports field associated with the airfield, along with some surrounding vegetation and agricultural fields.</p>

## 10. Introduction to Allied Ordnance

### 10.1. General

Many areas across the UK may be at risk from Allied UXO because of both wartime and peacetime military use. Typical military activities and uses that may have led to a legacy of military UXO at a site include former minefields, home guard positions, anti-aircraft emplacements, training and firing ranges, military camps, as well as weapons manufacture and storage areas.

Although land formerly used by the military was usually subject to clearance before returned to civilian use, items of UXO are sometimes discovered and can present a potential risk to construction projects.

This section of the report discusses the generic types of Allied ordnance typically encountered on areas associated with former military activity.

### 10.2. Fighter and Bomber Aircraft Munitions

During WWII, fighter, bomber and fighter-bomber aircraft types are known to have operated out of RAF Digby which was located immediately adjacent to the central-western section of the site. The airfield primarily operated fighter aircraft types, namely the Hawker Hurricane and Supermarine Spitfire types, however a wide variety of different aircraft types were also stationed at Digby for short periods of time including Bristol Blenheim night fighters and Hawker Hurricane Mk.IIC ground attack aircraft armed with 250lb aerial bombs and 20mm cannons.

Examples of Typical British Aircraft Ordnance can be found in **Appendices i-ii**.

Typical Fighter/Bomber Ammunition	
Item	Description
<b>Browning Machine Gun</b>	Allied aircraft were typically equipped with one of several types of Browning machine gun. Variants include the .30 06 calibre M1919 used by US forces, the .303 calibre Mk II used by the Commonwealth or the .50 Cal M2/3 Browning. Browning machine gun ammunition (of all calibres) would typically be considered SAA (See Section 10.5).
<b>Hispano Suiza HS.404</b>	Owing to the inability of the Browning machine-gun to penetrate armoured aircraft the majority of fighters were re-equipped with the Hispano Suiza HS.404. The Hispano Cannon was typically equipped with a 130g incendiary or HE round. The round contained between 6 and 11 grams of explosive.
<b>General Purpose/Medium Capacity HE Bombs</b>	During WWII RAF and USAAF Light and Heavy bombers deployed a range of conventional HE bombs. Typical HEs ranged from 100lbs (54kg) to 2000lbs (1061kg). Higher capacity general-purpose bombs weighed 4000lbs (2122kgs). Allied general purpose bombs typically carried a filling weight 1/3 of total weight.  In the latter stages of WWII numerous fighter aircraft were also adapted to fill the dual purpose of interception and bombing. Fighter aircraft were typically equipped with either the standard issue British 500lb (227kg) or 1000lb (454kg) HE bomb.
<b>Heavy Bombs</b>	In addition to general purpose HE bombs the allied produced a range of heavy capacity HE bombs for the purpose of targeting U-boat bunkers, coastal batteries, and other heavily armoured defensive positions. The Barns Wallis 'Tallboy' and 'Grandslam' weighed 12,000 lb (5,400 kg) and 22,000 lb (10,000 kg) respectively. The tallboy had a filling weight of 5,200 lb (2,400 kg), around 700 were deployed in WWII. The Grandslam had a filling weight of 22,000 lb (10,000 kg), around 43 were deployed during WWII. Considering the size of the Heavy bombs it is highly unlikely that one would have been incorrectly disposed of within an RAF airfield.
<b>Incendiary Bombs</b>	The 4lb Incendiary bomb was the standard light incendiary bomb used by Bomber Command during the Second World War. The bomb consisted of a magnesium body with a cast iron/steel nose. The bomb could be dropped individually but was usually carried in a 250lb small bomb container. 90 bombs were usually carried per container. Cluster versions of the 4lb incendiary were introduced in 1944, these being 500lb, 750lb and 1000lb which contained 106, 158 and 235 4lb bombs. There were also a high explosive variants which were intended to hinder fire services. Production peaked in 1943 with 3 million IBs produced per month.

### 10.3. British Practice Bombs

During WWII the RAF practiced for bombing raids on mainland Europe using practice bombs. These items of ordnance, commonly between 8.5lb-25lb in weight, often contained a small explosive charge or emitted coloured smoke or a flash to simulate bombing raids.

Although RAF Digby was primarily a Fighter Command station, considering that pre-WWII RAF site plans record the presence of a ‘Bomb-Dropping Tower’ within the bounds of RAF Digby and owing to the fact that fighter bomber aircraft were stationed here, it is likely that practice bombing exercises were conducted. Practice bombing is considered to have taken place at most locations under the control of Bomber Command and could even include the landing grounds of RAF stations, which were sometimes used as makeshift target areas during the early stages of WWII; prior to the establishment of dedicated inland ranges. Dedicated records concerning incidents of practice bombing are however rare. Examples of British practice bombs can be found in **Appendices iii-iv**.

### 10.4. Land Service Ammunition

Considering the close proximity of an airfield, which were frequently patrolled and used by RAF personnel and Home Guard units for training exercises, and owing to the Auxiliary Unit HQ located in the immediate site locality, the risk of encountering items of LSA at the site of proposed works must be considered.

The term LSA covers items of ordnance that are propelled, placed, or thrown during land warfare. These items may be filled or charged with explosives, smoke, incendiary, or pyrotechnics and can be divided into five main groups:

Land Service Ammunition	
Item	Description
<b>Mortar Rounds</b>	A mortar round is normally nosed-fused and fitted with its own propelling charge. Its flight is stabilised by the use of a fin. They are usually tear-drop shaped (though older variants are parallel sided), with a finned ‘spigot tube’ screwed or welded to the rear end of the body which houses the propellant charge. Mortars are either High Explosive or Carrier (i.e. smoke, incendiary, or pyrotechnic).
<b>Grenades</b>	A grenade is a short range weapon designed to kill or injure people. It can be hand thrown or fired from a rifle or a grenade launcher. Grenades either contain high explosive or smoke producing pyrotechnic compounds. The common variants have a classic ‘pineapple’ shape.
<b>Projectiles</b>	A projectile (or shell) is propelled by force, normally from a gun, and continues in motion using its kinetic energy. The gun a projectile is fired from usually determines its size. A projectile contains a fuzing mechanism and a filling. Projectiles can be high explosive, carrier or Shot (a solid projectile).
<b>Rockets</b>	Rockets were commonly designed to destroy heavily armoured military vehicles (anti-tank weapon). The device contains an explosive head (warhead) that can be accelerated using internal propellants to an intended target. Anti-aircraft rocket batteries were also utilised as part of air defence measures.
<b>Landmines</b>	A landmine is designed to be laid on or just below the ground to be exploded by the proximity or contact of a person or vehicle. Landmines were often placed in defensive areas of the UK to obstruct potential invading adversaries.

In the UK unexploded or partially exploded mortars and grenades are the most common items of LSA encountered, as they could be transported and utilised anywhere. They are mostly encountered in areas used for military training and are often found discarded on or near historical military bases. Images of the most commonly found items of LSA are presented in **Appendices v - vii**.





**10.5. Small Arms Ammunition**

Owing to the proximity of airfield defensive features, dispersal areas and SAA stores, as well as the Auxiliary Unit HQ located in the immediate site locality, the risk of encountering items of SAA at the site of proposed works must be considered.

The most common type of ordnance encountered on land used by the military are items of Small Arms Ammunition (SAA). SAA refers to the complete round or cartridge designed to be discharged from varying sized hand-held weapons such as rifles, machine guns and pistols. SAA can include bullets, cartridge cases and primers/caps. Example images of the most SAA are presented in **Appendix viii**.

**10.6. Defending the UK From Aerial Attack**

During WWII the War Office employed a number of defence tactics against the Luftwaffe from bombing major towns, cities, manufacturing areas, ports and airfields. These can be divided into passive and active defences (examples are provided in the table below).

Active Defences	Passive Defences
<ul style="list-style-type: none"> <li>• Anti-aircraft gun emplacements to engage enemy aircraft.</li> <li>• Fighter aircraft to act as interceptors.</li> <li>• Rockets and missiles were used later during WWII.</li> </ul>	<ul style="list-style-type: none"> <li>• Blackouts and camouflaging to hinder the identification of Luftwaffe targets.</li> <li>• Decoy sites were located away from targets and used dummy buildings and lighting to replicate urban, military, or industrial areas.</li> <li>• Barrage balloons forced enemy aircraft to greater altitudes.</li> <li>• Searchlights were often used to track and divert adversary bomber crews during night raids.</li> </ul>

Active defences such as anti-aircraft artillery present a greater risk of UXO contamination than passive defences. Unexploded ordnance resulting from dogfights and fighter interceptors is rarely encountered and difficult to accurately qualify.



**10.6.1. Anti-Aircraft Artillery (AAA)**

During WWII three main types of gun sites existed: heavy anti-aircraft (HAA), light anti-aircraft (LAA) and 'Z' batteries (ZAA). If the projectiles and rockets fired from these guns failed to explode or strike an aircraft they would descend back to land. The table below provides further information on the operation and ordnance associated with these type of weapons.

Anti-Aircraft Artillery				
Item	Description			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers. They often fired large HE projectiles, which were usually initiated by integral fuzes, triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LAA Ammunition	<b>Gun type</b>	<b>Calibre</b>	<b>Shell Weight</b>	<b>Shell Dimensions</b>
	3.0 Inch	76mm	7.3kg	76mm x 356mm
	3.7 Inch	94mm	12.7kg	94mm x 438mm
	4.5 Inch	114mm	24.7kg	114mm x 578mm
	40mm	40mm	0.9kg	40mm x 311mm
Z-AA	The three inch unrotated rocket/projectile known as the UP-3 had initially been developed for the Royal Navy. The UP-3 was also used in ground-based single and 128-round launchers known as "Z" batteries. The rocket, containing a high explosive warhead was often propelled by cordite.			

The conditions in which anti-aircraft projectiles may have fallen unnoticed within a site area are analogous to those regarding air delivered ordnance. Unexploded anti-aircraft projectiles could essentially have fallen indiscriminately anywhere within range of the guns. The chance of such items being observed, reported and removed during the war depends on factors such as land use, ground cover, damage and frequency of access – the same factors that govern whether evidence of a UXB is likely to have been noted. More information about these factors with regards to this particular site can be found in the German Air Delivered Ordnance section of this report.

Illustrations of Anti-Aircraft artillery, projectiles and rockets are presented at **Appendix ix**.

## **11. The Likelihood of Contamination from Allied Ordnance**

### **11.1. Introduction**

When undertaking construction work within or immediately adjacent to a site with previous and/or current military use, it is often considered likely to contain an elevated risk of contamination from Allied UXO. This assumption of risk is based on the following reasoning:

- The clearance of ordnance from military camps, depots, storage facilities, ranges and training areas were not always effectively managed, or undertaken to equivalent degrees of certainty. In addition, search and detection equipment used over seventy years ago following WWII has proved ineffective both for certain types of UXO and at depths beyond capability.
- In the vast majority of cases, explosive ordnance would have been stored and available for use at military installations. Ordnance ranged from small arms and land service ammunition to weapons components and larger, air delivered items. During periods of heightened activity, ordnance was also frequently lost in transit, particularly between stores and assigned training locations.
- The military generally did not anticipate that their land would be later sold for civilian development, and consequently appropriate ordnance disposal procedure was not always adhered to. It was not uncommon for excess or unwanted ordnance to be buried or burnt within the perimeters of a military establishment as a means of disposal. Records of such practice were rarely kept.

There are several factors that may serve to either affirm, increase, or decrease the level of risk within a site with a history of military usage. Such factors are typically dependent upon the proximity of the proposed area of works to training activities, munition productions and storage, as well as its function across the years.

This section will examine the history of the proposed site and assess to what degree, if any, the site could have become contaminated as a result of the military use of the surrounding area.

### **11.2. UXO Contamination on Military Airfields**

The primary features identified by 1<sup>st</sup> Line Defence as providing an indication of potential UXO contamination are listed below.

- **Ordnance/Bomb Stores.** Most airfields would have a designated ordnance storage area often consisting of several banded huts/magazines. Ordnance may have been burnt, buried or otherwise disposed of in areas proximate to ordnance stores.
- **Aircraft Dispersal Areas/Pans.** Dispersal pans were used to refit and re-equip aircraft between sorties. Often contamination has been found to result – ordnance is being discarded or else incorrectly disposed of close to these features. In addition, it was common for ordnance to be stored in temporary structures adjacent to dispersal areas. Ordnance has been encountered up to 5m from the edge of a dispersal pan and up to depths of a metre within the ground depending on ground conditions.
- **Ammunition Stores/Armouries.** It was common for several ammunition stores to be located in areas around an airfield with the purpose of arming aircrew. These stores may contain a range of SAA and LSA including grenades and other explosives.
- **Perimeter Fences.** Areas of land adjacent to the perimeter fence were frequently the chosen locations of the RAF to bury or dispose of excess and unwanted ordnance.
- **Defensive Positions.** Airfields were defended from air attack by light and/or heavy anti-aircraft batteries as well as pillboxes. It is common for both live and expended ordnance to be encountered in the vicinity of such features.



- **Centre of runway formation.** The 'A' shaped layout between RAF Station runways were often used for bombing practice due to its highly visible nature from the air.
- **Defensive Mining/Demolition Charges.** Numerous airfields were mined so that in the event of an invasion they could be destroyed, preventing them from falling into enemy hands. Although efforts were made to remove mines post-war, there have been several discoveries of explosives close or beneath runways and other key infrastructure.

Further to an airfield's physical characteristics there are a number of operational factors that may contribute to an increase in UXO risk. These factors may relate to training activities and air incidents, such as aircraft crashes, within or proximate to an airfield.

- **Training activities.** Defence training activities, including anti-invasion exercises, were frequently undertaken at airfields. Training activities may have involved the deployment of live or dummy ordnance. Many airfields and their environs were also used as training centres for the Home Guard as they were large, open, military owned stations. Home Guard units were often tasked with certain elements of station defence. In addition many airfields were used as military camps in preparation for the D-day offensive of 1944.
- **Aircraft Incidents.** There are numerous incidents of aircraft crashes at airfields during WWII. An aircraft crash may result in the dispersal of ordnance over an area.
- **WWII-era change of use.** Many airfields were upgraded and remodelled during WWII to enable bases to house larger aircraft, or transition between RAF and USAAF usage. Within current or Cold War stations, these alterations often continued to accommodate jet aircraft and in some cases nuclear armaments. During significant handovers of the airfield's authority it is more likely that ordnance was moved, lost, or disposed of unrecorded.

### **11.3. Military History of the Site of Proposed Works**

#### **11.3.1. RAF Digby**

RAF Digby which was formerly located immediately adjacent to the central section of the site was primarily used as a training airfield and Fighter Command airfield during its period of operation, primarily equipped with Hawker Hurricane and Supermarine Spitfires from a variety of squadrons. The airfield undertook mainly daytime fighter patrols during the early war period and Battle of Britain. RAF Digby became the parent station for the Royal Canadian Air Force with 11 out of the 32 squadrons stationed at RAF Digby during WWII being from the RCAF. Fighter, fighter bomber and night fighter variants were operated by squadrons at the airfield, the latter of which used Bristol Blenheim types. Hurricane Mk.IIc variants equipped with cannons and two 250lb bombs were also used for ground attack during operations over occupied Europe. In the present-era, RAF Digby is used as the HQ for Joint Cyber and Electromagnetic Activities Group (JCG) which is a branch of the UK Strategic Communications group, providing signals support to the three main services on operations around the world. See **Annex F** for images of RAF Digby.

#### **11.3.2. Additional Allied Military Features in Site Locality**

Several other RAF Fighter Command, Bomber Command and training airfields are known to have been located throughout the site locality and surrounding environs. This included RAF Methwingham, a late-WWII Bomber Command airfield active during 1943 – 1946 was formerly located approximately 1km east of the northernmost section of the site. RAF Wellingore, a WWII-era Fighter Command airfield and relief landing ground was formerly located approximately 2km west of the central-western section of the site. RAF Cranwell, a WWI-era airship and balloon training station, WWII-era training airfield and RAF College in the present-era is located approximately 2.5km south-west of the southernmost section of the site.

#### 11.4. Auxiliary Unit, Blankney Hall

In addition to the several airfields in the area, an Auxiliary Unit was stationed at Blankney Hall, located immediately adjacent to the northernmost section of the site.<sup>2</sup> The hall was requisitioned by the military for use as an Auxiliary Unit Headquarters for all the secret underground Operational Bases (OBs) and Observation Posts (OPs) that were located throughout Lincolnshire. These bases were manned by highly trained and well equipped Auxiliers which were to serve as the British resistance, intended to fight on behind enemy lines in the event of a German invasion of Britain.<sup>34</sup>

An online resource states that Auxiliary Units were “made up of men who knew their own territory. [...] They were trained to use firearms, explosives, silent killing, and sabotage. A pistol was issued to each man [...] and AUs were given priority access to all sorts of ordnance. Some patrols had daggers, grenades, sniper rifles, gelignite, plastic explosives, detonators, fuse pressure switches, trip switches and anti-tank sticky bombs”.<sup>5</sup>

Blankney Hall was subsequently taken over by the RAF and used to billet personnel from several of the nearby airfields. The Hall burnt down in 1945 and the remaining structure was demolished in 1960.<sup>6</sup>

#### 11.5. Air Ministry Site Plans of RAF Digby and RAF Metheringham

RAF site plans dated 1918, 1932 and 1945 for RAF Digby and a site plan dated 1944 for RAF Metheringham were obtained from the RAF Museum Hendon and Metheringham Airfield Visitor Centre. The plan identifies the buildings and significant features present at the airfields and explains what they were used for. The site plans are presented in **Annex G**.

Date Range	Comments
1918  RAF Museum Hendon <b>Annex G1</b>	This WWI-era RAF site plan dated 1918 indicates that the western-central section of the site was situated immediately adjacent to the airfield perimeter of Scopwick Training Depot Station. Several airfield features including the aircraft hangars, administration and accommodation structures are depicted in the south-east section of the airfield to the north-west of the site. An airfield key details that a ‘Machine Gun Range’, ‘Ammunition Store’, and ‘Bomb-dropping Tower’ were located within the airfield perimeter but no exact location is given.
1932  RAF Museum Hendon <b>Annex G2</b>	This interwar period RAF site plan dated 1932 gives a good account of RAF Digby Airfield, which is situated immediately adjacent to the central-western section of the site. The closest discernible airfield features to this section of the site are the ‘Football Field’ ‘Rugby Field’ and ‘Hockey Field’, whilst a ‘Sewage Disposal Works’ associated with the airfield is located within the this section of the site area.  Two areas marked as ‘Stonepit Plantation’ and ‘Rowston Plantation’ are shown to be situated between the airfield and the central-western section of the site area.  The ‘Armoury’, ‘MG [Machine Gun] Range’ and ‘Pyro Store’ are shown to be located in the wider area in the south-eastern and central areas of the airfield.
1945	This WWII-era RAF site plan dated 1945 gives a good account of the RAF Digby, showing several airfield features both within and immediately adjacent to the

■ [REDACTED]  
 ■ [REDACTED]  
 ■ [REDACTED]  
 ■ [REDACTED]  
 ■ [REDACTED]



<p>RAF Museum Hendon <b>Annex G3 – G4</b></p>	<p>central-western section of the site. Two ‘Enlarged Overblister Hangars’ and four aircraft ‘Dispersal Pens’ are shown to be within this section of the site area. ‘Officer and Sergeant Quarters’ and the airfield sports fields are depicted close to this section of the site.</p> <p>Other notable features depicted in the south-eastern section of the RAF airfield include the ‘Small Arms Ammunition Stores’, ‘Pyro Store’, ‘Detonator Store’, ‘MG Test Butt’, ‘MG Range’ and ‘2 Pdr Ammunition Store’.</p>
<p>1944  Metheringham Airfield Visitor Centre <b>Annex G5</b></p>	<p>This WWII-era RAF site plan dated 1944 shows the RAF Metheringham airfield which is situated approximately 1km east of the northernmost section of the site. The airfield Bomb Store Area, Detonator Store and Fuzing Point are shown to be in the northern section of the airfield.</p>

**11.6. Explosive Ordnance Clearance Tasks**

At the time of writing, no estate intelligence or other information has been obtained regarding either 29 EOD & S Gp or historic EOC operations that have been undertaken within the site. 1<sup>st</sup> Line Defence also do not currently have access to data that may be relevant including 5131(BD) SQN Archive, SD Training Technical Advisory Section (TAS) and MACA Records (bomb disposal callouts). Specific information on EOC tasks at RAF Digby / Scopwick may also be held by the MOD.

Information obtained from an online government database recording the date, number of items and approximate location of unexploded ordnance recovered during 2010 – 2015, indicates that items of UXO have been discovered in the vicinity of RAF Digby in recent years. This included one item of small arms ammunition (SAA) in October 2010. Although the exact locations of these incidents are not known, since RAF Digby is an active RAF base with over a century of use by the military, it is likely that this item was encountered within the bounds of the RAF Digby aerodrome.<sup>7</sup>

It should be noted that even if EOC task(s) were undertaken on a site, such action is not considered to have had a significant impact on the mitigation of any UXO risk present. Indeed, UXO can still be uncovered within areas that have been subject to EOC tasks, as outlined in CIRIA C681:

*UXO is sometimes discovered after the MoD clearance has been undertaken. For this reason any site with previous military use involving military ordnance should be considered as containing UXO.<sup>8</sup>*

<sup>7</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/471707/20150320-FOI-02246-Unexploded\\_Ordnance-Stats.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/471707/20150320-FOI-02246-Unexploded_Ordnance-Stats.pdf)

<sup>8</sup> CIRIA C681

### 11.7. Online/Anecdotal References to Allied Activity in Site Locality

Anecdotal references referring to Allied activity in the site locality and affecting the nearby RAF airfields were obtained from a variety of online sources including first hand anecdotal accounts from local residents. Some examples of the references relating to the site are transcribed below. Features located on or in a close proximity to the site are highlighted in bold.

Online/Anecdotal References to Allied Activity in Site Locality	
Extracts from RAF Lincolnshire: RAF Digby A History <sup>9</sup>	
Date Range	Comments
August 1939	It was quite a leisurely life and before long I felt that I was part of the team; which was just as well because August saw Digby on manoeuvres and some postings of the “experienced staff”, leaving the “new boys” to fill the gaps. So, instead of being a 9 till 5 job, it was 0800 to 2359 with messages flowing thick and fast and <b>bombers from Waddington, Scampton and Hemswell bombing Digby with small bags of flour and “tear gas”</b> .
November 1941 – 1945	In addition to its flying duties, Digby had been a sector station, responsible for Northern England with the <b>Sector Operations Room located in Blankney Hall from November 1941 – 1945</b> . Part of this hall was seriously damaged by fire, but fortunately the Operations Room was still able to carry out its duties from Blankney.
Mid 1941 – 1944	Not all Digby’s wartime operations were conducted in the air. <b>The Station was also the home of No 14 Bomb Disposal Squad from mid—1941 onwards</b> . Commanded initially by Pilot Officer A E Haarer, the squad was based in the old Station armoury building. The Unit had many hair raising experiences — both at Digby itself and at other Stations in the local area — but managed somehow to suffer no casualties in its 2 ½ years at Digby.
February 1942 - 1946	<b>During World War II Ashby Hall was used by RAF Digby and accommodated amongst other functions an Officers' Mess and the Stn Accounts Flight.</b> No 609’s pilots moved into Ashby Hall in late Feb 1942. The incoming Canadian Squadron, No 411, which replaced 609, were not very impressed with the state of Ashby Hall. However, they soon settled in again, and later took part in the Combined Operations raid on Dieppe on 19 August, carrying out 4 operational sweeps during the day. It is not clear when the Squadrons vacated Ashby de la Launde Hall, probably around 1946. However we do know that the Hall fell into disrepair and was derelict until 1961.
11 <sup>th</sup> August 1944	A/S/L Raine reported on 11th August 1944 that “Conditions at RAF Digby are definitely bad. <b>Something in the neighbourhood of 2000 men have been given one field in which to pitch canvas</b> . Tents are crammed guy rope to guy rope throughout the field. Facilities of all kinds are poor and the men will not be very happy unless considerable improvements are made. Bathing facilities inadequate.”
15 <sup>th</sup> January 1943	I was on duty the night the German plane crashed on the airfield (Coleby Grange) note - 15 Jan 1943, crew of five all died and are buried in the Scopwick War Graves. It was my first experience of the horror of war and it happened right before our eyes.

### 11.8. Aircraft Crashes

Air crashes were common at WWII era airfields. These incidents most commonly occurred during take-off and landing. Consequently there is an increased level of risk associated to areas situated at the ends of the runways. The risk of contamination resulting from crashes depends on the nature of the incident and the aircraft involved. Airfields were not used solely by the aircraft stationed at that base, and an airfield may have been used by any aircraft during an emergency.

This table details some of the recorded aircraft accidents that occurred in the site vicinity. Obtained from the Bomber County Aviation Resource aircraft incident log and Air Safety Network online database of worldwide accidents and incidents involving aircraft, balloons, gliders, gyroplanes, helicopters, ultralights, UAV's and zeppelins/airships since 1902.<sup>1011</sup> It should be noted that this list is not anticipated to be an exhaustive list. Those incidents known to have been located on site have been highlighted in bold.

Date	Aircraft Type	Registration	Comments
01/05/1934	Hawker Hart & Bristol Bulldog	K3152 & K3928	RAF College Cranwell. Hawker Hart Trainer K3152, RAF College, Cranwell: Written off (destroyed) 1/5/34 in a mid-air collision with Bristol Bulldog K3928 (also of the RAF College, Cranwell), near RAF Digby, Scopwick Heath, Lincolnshire. Both crews killed.
11/02/1941	Hurricane	T9521	2sqn. The aircraft failed to level-up on approach to the airfield, and hit a soft patch on the runway heavily This resulted in the undercarriage collapsing on the aircraft. No injuries were reported to P/O B.R. Waliter. The aircraft itself was deemed beyond the units' capacity to repair.
12/02/1941	Wellington	P9247	149 Sqn. North west of Digby Returning from a night time operational sortie, Sgt R Warren was looking for RAF Waddington in thick cloud that was practically at ground level, on descent he saw the ground just before hitting it, the aircraft was written off after it had caught fire.
12/02/1941	Wellington	P9247	149sqn. Near Digby, Coded OJ-M, the aircraft was airborne at 1820 from Mildenhall for Hannover. On return, the crew noticed flares being fired through cloud from Waddington The aircraft crashed whilst letting down through the cloud layer in an attempt to land at Waddington. Sgt F.F. Early killed, remaining 5 crew unhurt.
15/02/1941	Beaufighter	R2150	29 Sqn. (ferry flight) - While on a ferry flight to Digby, one engine stalled during landing. P/O J. Buchanan was killed on impact with the ground.
20/02/1941	Beaufighter	R2193	29 Sqn. On returning to the airfield after completing its patrol, the undercarriage failed to lower due to a burst hydraulic pipe. P/O V.R. Lovell managed to land without injury to himself.
24/02/1941	Hurricane	L1715	2sqn. The aircraft taxied in to a tractor while on it's way to the runway. No injuries were reported to Sgt J.J. Solski, but the aircraft had to be dismantled and sent off-site for repair.
25/02/1941	Hurricane	V1145	2sqn. The pilot lost consciousness at 21,000ft after not connecting his oxygen pipe. He regained consciousness at

■ [REDACTED]  
 ■ [REDACTED]





			7000ft and managed to gain control of the aircraft, but landed heavily on the runway. The heavy landing resulted in the undercarriage collapsing. P/O G.A Russell reported no serious injuries in the incident, but the aircraft had to be dismantled and sent off-site for repair.
05/03/1941	Hurricane	W9135	402sqn. Aircraft lost control after getting caught in another aircraft's slip stream on landing back at the base. Despite P/O F.B. Foster's best attempts to correct, the aircraft it made heavy contact with the runway. No injuries were reported, but the aircraft had to be dismantled and sent off-site for repair.
10/03/1941	Hurricane	P3273	402sqn. Aircraft suffered a heavy landing on returning to the airfield, causing the undercarriage to collapse. It was later found that Sgt A.G. Carless had not be cleared for night flying and this was his first time. No injuries were reported, but the aircraft was deemed beyond the units capacity to repair.
25/03/1941	Hurricane	P3767	401sqn. Crashed 1 mile north of the airfield while doing an engine test. F/O C.P. Henderson (Canadian) was killed in the incident.
17/04/1941	Spitfire	X4848	412sqn. Neal did not ensure his undercarriage was locked down properly, resulting in it collapsing on landing. The aircraft was beyond the units repair capabilities.
27/04/1941	Hurricane	V7620	401sqn. Suffered a heavy landing after poor throttle response from the aircraft. No injuries were reported to P/O M.C. Godefroy (Canadian), but the aircraft had to be dismantled and sent off-site for repairs.
29/06/1941	Blenheim	K7124	406sqn. Lost its engine cowling upon landing, which in turn caused damage to the undercarriage. The aircraft was later repaired on site and F/O H.E. Mitchell received no injuries.
03/07/1941	Spitfire	R7251	411sqn. The undercarriage of F/O R C Westons' Spitfire did not lower. The cockpit warning lights failed. The damage sustained was too great for the unit to repair and the aircraft needed to be dismantled and taken away.
12/07/1941	Spitfire	R7127	411sqn. Sgt M R Sharun had a burst tyre on landing at 18:50. The aircraft swung and the undercarriage collapsed. It had to be dismantled and returned to the factory for the repair work.
14/07/1941	Spitfire	X4010	412sqn. Sgt S A Ferguson held off approximately 10 feet too high on his approach and brought the aircraft down for a heavy landing causing the undercarriage to collapse. The damage was too much and the aircraft was dismantled and returned to the factory for repair.
21/07/1941	Spitfire	R7162	411sqn. After practicing cloud flying maneuvers, Sgt J H Long brought his aircraft back to RAF Digby at 16:40. The aircraft had a heavy landing and ballooned. The pilot opened up but did not catch it in time, came down with the left wing low causing the port undercarriage to collapse. The aircraft had to be dismantled and returned to the factory.
31/07/1941	Spitfire	P7908	485sqn. Sgt/P L P Griffith had a burst port tyre on landing, the undercarriage collapsed and the aircraft swung. It had to be dismantled and taken away for repair.



01/08/1941	Spitfire	R6612	412sqn. Sgt RA Ellis landed at 17:00 after an aerobatic flight with the undercarriage retracted de to a faulty lever. The aircraft was beyond the units capability to repair
05/08/1941	Spitfire	P8076	411sqn. Whilst setting off on a practice scramble, P/O J E T Asselin attempted to take off with the brakes fully applied. The tail lifted and the aircraft tipped on to it's nose. The O/C notes he was in too much of a hurry.
15/08/1941	Spitfire	P7829	412sqn. Sgt PV Brodeur had a heavy down wind landing. At 3 feet from the ground he heard the undercarriage warning horn, attempted to take off again but failed to gain any height damaging the port wheel. The aircraft was repairable by the unit on site.
12/09/1941	Spitfire	P8436	401sqn. 500 yards to the south east corner of Digby Satellite airfield. Sgt JAO Levesque of the Royal Canadian Air Force was injured when his Spitfire came down short of the airfield. He crash landed when his engine failed on the approach, it came in far too fast with insufficient time to lower the undercarriage.
17/09/1941	Spitfire	P8179	401sqn. Digby Satellite WC1. The aircraft was damaged beyond the repair capability of the unit when Squadron Leader NR Johnstone hit rough ground when taxiing, the smoke float dropped.
22/09/1941	Spitfire	P7923	411sqn. P/O Morrison of the Royal Canadian Air Force struck a totem pole on the edge of the aerodrome when landing at 22:20. The pilot had no experience in type of night landings. He was also not made aware of any obstacles around the aerodrome. The damage was repairable by the on site unit.
25/09/1941	Spitfire	P8169	401sqn. Digby Satellite WC1. (Canadian) pilot H C Godefroy made three to four attempts to lock the undercarriage down on his Spitfire, when convinced that it was locked down he made his landing. At the end of the runway the undercarriage collapsed. Further inspection showed that the locking pins were damaged, probably due to previous heavy landings. The damage was repaired on site.
27/09/1941	Spitfire	P7918	412sqn. Returning at 19:15 from operations over France Sgt JN Brookhouse hit a flare box on landing in high winds. The undercarriage collapsed. The aircraft was repaired on site.
03/10/1941	Spitfire	P7564	401sqn. Digby Satellite WC1. Sgt B G Hodgkinson overshot his landing at 12:00, landing too fast he went through a hedge and the undercarriage collapsed. The aircraft was beyond the repair capabilities of the unit on site.
10/10/1941	Spitfire	P8371	411sqn. On a flight at dusk Sgt Powers of the Royal Canadian Air Force hit an unlighted totem pole on the boundary of the aerodrome, the pilots had not been briefed or warned of any poles in the area. The aircraft was damaged beyond the repair capabilities of the unit on site.
15/10/1941	Spitfire	P8086	412sqn. On his first night time landing on type, Sgt J A S Ferguson came in to land too fast, leveled off too late and hit the ground hard causing the undercarriage to collapse.



			To repair the aircraft it had to be dismantled and sent to a repair facility.
15/10/1941	Spitfire	AA738	401sqn. Digby Satellite WC1 Sgt J K Ferguson had a heavy landing and undercarriage collapse at 18:10 whilst landing at dusk. The aircraft was beyond the units capacity to repair.
30/10/1941	Spitfire	AB302	92 Sqn. Australian pilot Sgt D K Ryder had a heavy landing in high wind, when taxiing back to the dispersal the undercarriage collapsed on rough ground. It was damaged beyond the units capacity to repair.
03/11/1941	Spitfire	AA739	411sqn. Sgt Powers of the Royal Canadian Air Force forgot to lower his undercarriage on landing at 12:00 after a local flight. The aircraft needed to be dismantled and taken away for repair.
14/11/1941	Spitfire	AA751	92 Sqn. Sgt W H L Johnston had a heavy landing on return from a practice dogfighting sortie at 1515hrs, shearing several bolts on the undercarriage. The aircraft was beyond the repair of the onsite unit.
15/11/1941	Spitfire	W3444	92sqn. This aircraft was wrecked when it crashed whilst landing in the dark at 1830hrs on return from night flying practice. Pilot Sgt Wilson was injured and hospitalised.
15/11/1941	Spitfire	AB847	92sqn. This aircraft was damaged in a mid-air collision over Lincoln with Spitfire AD293, and was further damaged when it force-landed at Digby at 1300hrs. Pilot F/Lt Richardson was uninjured.
21/11/1941	Lysander	P1714	12 Grp AA Flt. The aircraft landed down wind and overshot the runway. The pilot opened up the throttle with the actuating gear fully back, causing the the aircraft to go vertical and then the engine to stall. The stall resulted in the aircraft losing height and hitting the ground killing Sgt N.A. Ritchie (Canadian).
15/12/1941	Spitfire	W3574	609 Sqn. On a training flight, practicing formation landings, RFFG Malengreau (Belgium) landed with the undercarriage up, he intended to go round again due to another aircraft landing, but, he saw enough space and set it down, forgetting to lower the undercarriage. The aircraft needed to be dismantled and taken away for repair.
22/01/1942	Spitfire Mk.Vb & Spitfire Mk.Vc	AD229 & AB188	609 Sqn & 92 Sqn. Sergeant Godfrey de Renzi of 92 Sqn RAF (shown as French by some sources, but English according to CWGC), saw the manoeuvres and joined in. Someone was careless and the 92 Squadron aircraft (Spitfire Vb AD229) collided with Offenberg's (Spitfire Vc AB188 "PR-Y") over Blankney Heath, cutting off the tail. The horrified pupil saw both aircraft crash vertically into the snow. Both pilots were killed.
11/03/1945	Hurricane Mk.IIC & Lancaster	PZ740 & LM130	<b>1690 (BDT) Flt (RAF) &amp; 463 Sqn (RAAF). Fighter Affiliation exercise at night. During the exercise Lancaster LM130 of 463 Sqn and Hurricane PZ740 of 1690 Flight flown by Flg Off Parlato RNZAF collided. The Lancaster crashed into the Ashholt Field at Blankney village, 9 miles north of Sleaford, Lincolnshire, and all the crew were killed. The Hurricane pilot was also killed.</b> <i>Lancaster crashed within the northern section of the site.</i>

### 11.9. Evaluation of Contamination Risk from Allied UXO

1<sup>st</sup> Line Defence has considered the following potential sources of Allied ordnance contamination:

Sources of Allied UXO Contamination	Conclusion
<p><b>Military Related Airfields</b></p> <p><i>Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.</i></p>	<p>RAF Digby, formerly RAF Scopwick was a WWI-era relief landing ground for RNAS Cranwell, an inter-war training airfield and WWII-era Fighter Command airfield, and remains in active RAF service in the present-era. RAF Digby is located immediately north and west of the central-western section of the site.</p> <p>RAF Metheringham, a late-WWII Bomber Command airfield active during 1943 – 1946 was formerly located approximately 1km east of the northernmost section of the site.</p> <p>RAF Wellingore, a WWII-era Fighter Command airfield and relief landing ground was formerly located approximately 2km west of the central-western section of the site.</p> <p>RAF Cranwell, a WWI-era airship and balloon training station, WWII-era training airfield and RAF College in the present-era is located approximately 2.5km south-west of the southernmost section of the site.</p>
<p><b>Dispersal Pens</b></p> <p><i>Dispersal pens were used to re-equip aircraft between sorties. Frequently temporary stores were located at dispersal pens.</i></p>	<p>WWII-era RAF site plans and aerial imagery indicate that the central-western section of the site comprised three 'Type A' aircraft dispersal pens associated with RAF Digby, designed to protect fighter aircraft stationed at the airfield (see <b>Annex G3</b>).</p>
<p><b>Ordnance Manufacture/Storage</b></p> <p><i>Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.</i></p>	<p>No information of ordnance being produced or disposed of within the proposed site area could be found. WWII-era RAF site plans indicates that several bunded structures labelled as the <i>small arms storage area</i> associated with RAF Digby were located in close proximity to the western-central section of the site.</p>
<p><b>Proximity to Perimeter Fence</b></p> <p><i>Although seemingly innocuous, areas of open ground adjacent to the perimeter fence are considered of elevated risk as they were considered prime locations for ordnance burial.</i></p>	<p>WWII-era RAF site plans indicate that specific areas of the central-western section of the site comprised segments of the airfield perimeter fence of RAF Digby, whilst other areas were located immediately adjacent to this airfield feature.</p>
<p><b>Firing ranges</b></p> <p><i>Firing ranges were common at most airfields. Many firing range also feature grenade pits.</i></p> <p><i>Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.</i></p>	<p>No evidence of training or firing ranges could be found within the site or surrounding area. A small arms range and aircraft machine gun range associated with RAF Digby and RAF Metheringham were located in the wider area, approximately 400m west and 1.1km east of the site respectively. See <b>Annex I</b> for images of an aircraft using the aircraft machine gun range at RAF Digby.</p>



<p><b>Defensive Positions</b></p> <p><i>Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.</i></p>	<p>Several pillbox structures and loopholed walls associated with the RAF Digby airfield were located within the northern area of the central-western section of the site.</p>
<p><b>Demolition Charges</b></p> <p><i>Many airfields were undermined by demolition mines such as McNaughton Tubes and Pipe Mines. Many of these devices were not removed or lost.</i></p>	<p>No evidence of the use of demolition charges such as pipe mines and other area-denial weaponry at RAF Digby could be found within available records.</p>
<p><b>Military Camps</b></p> <p><i>Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.</i></p>	<p>During 1940 an Auxiliary Unit HQ was set up at Wellingore Hall approximately 3km west of the southern section of the site, later moving to Blankney Hall which was located immediately adjacent to the northernmost section of the site. By 1942, Blankney Hall was requisitioned by the RAF for use as a sector operations room. The Auxiliary Unit Headquarters subsequently moved to Danby Hall near Spilsby approximately 30km east of the site.<sup>12</sup></p> <p>Ashby Hall situated adjacent to the central-southern section of the site area was used as an officers mess and as accommodation for Canadian pilots and crew stationed at RAF Digby from November 1942.</p> <p>RAF Digby is situated on and immediately adjacent to the central-western section of the site, RAF Metheringham was formerly located approximately 1km east of the northernmost section of the site, RAF Wellingore was formerly located 2km west of the central-western section of the site, RAF Cranwell is situated approximately 2.5km south-west of the southernmost section of the site.</p>
<p><b>Training Exercises / Home Guard Activity</b></p> <p><i>It was common for defence training activities to be undertaken in the vicinity of airfields. Such exercises frequently involved the deployment of live ordnance.</i></p>	<p>Evidence of Home Guard activity is often difficult to locate, owing to the ad-hoc nature of Home Guard activity within each local area. Such training was often conducted on a small scale at the discretion of individual commanders and as such was seldom recorded officially. As such, no positive evidence could be found to confirm the presence of HG units within proximity to the site.</p> <p>However it is likely that defensive training exercises were carried out within and around the RAF Digby airfield. It is also likely that training exercises occurred in the vicinity of Blankney Hall and the surrounding ground whilst it was serving as an Auxiliary Unit HQ.</p>
<p><b>Anti-Aircraft Defences</b></p> <p><i>Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.</i></p>	<p>The closest HAA battery was located approximately 11km north-west of the site, in the vicinity of Sharps Farm. At least two LAA battery gun sites have been identified within the central-western sections of the site in the immediate proximity of the RAF Digby airfield. Despite this distance the maximum effective range of an AA projectile can be up to 15km.</p> <p>The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are generally analogous to those regarding German air delivered ordnance.</p>





<p><b>Defensive Minefields</b></p> <p><i>Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.</i></p>	<p>There is no evidence of defensive minefields affecting the site.</p>
<p><b>Practice Bombing</b></p> <p><i>Training at airfields sometimes consisted of practice bombing within the airfield perimeter or later in the war at a dedicated range. These bombs could become buried following penetration, and may remain overlooked.</i></p>	<p>An inter-war period site RAF site plan dated 1932 indicates that a 'Bomb-Dropping Tower' was located within the bounds of the airfield perimeter, although a specific location is not given.</p> <p>Although, there was no specific mention to the location of the practice bombing range associated with RAF Digby, historically, practice bombing was often undertaken within the bounds of the airfield perimeter, and the airfield landing circle was sometimes used as a temporary target. This feature was located approximately 500m north of the central-western section of the site area.</p>

## 12. Introduction to German Air Delivered Ordnance

### 12.1. General

During WWI and WWII, the UK was subjected to bombing which often resulted in extensive damage to city centres, docks, rail infrastructure and industrial areas. The poor accuracy of WWII targeting technology and the nature of bombing techniques often resulted in neighbouring areas to targets sustaining collateral damage.

In addition to raids which concentrated on specific targets, indiscriminate bombing of large areas also took place. This occurred most prominently in the London 'Blitz', though affected many other towns and cities. As discussed in the following sections, a proportion of the bombs dropped on the UK did not detonate as designed. Although extensive efforts were made to locate and deal with these UXBs at the time, many still remain buried and can present a potential risk to construction projects.

The main focus of research for this section of the report will concern German air delivered ordnance dropped during WWII, although WWI bombing will also be considered.

### 12.2. Generic Types of WWII German Air Delivered Ordnance

To provide an informed assessment of the hazards posed by any items of unexploded ordnance that may remain in situ on site, the table below provides information on the types of German air delivered ordnance most commonly used by the Luftwaffe during WWII. Images and brief summaries of the characteristics of these items of ordnance are listed in **Appendices i-iii**.

Generic Types of WWII German Air Delivered Ordnance		
Type	Frequency	Likelihood of detection
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see <b>Annex J</b> ). Furthermore, ARP documents describe the danger of assuming that damage, actually caused by a large UXB, was due to an exploded smaller bomb. UXBs therefore present the greatest risk to present-day intrusive works.
1kg Incendiary bombs (IB)	In terms of the number of weapons dropped, small IBs were the most numerous. Millions of these were dropped throughout WWII.	IBs had very limited penetration capability and in urban areas would often have been located in post-raid surveys. If they failed to initiate and fell in water, on soft vegetated ground, or bombed rubble, they could easily go unnoticed.
Large Incendiary bombs (IB)	These were not as common as the 1kg IBs, although they were more frequently deployed than PMs and AP bomblets.	If large IBs did penetrate the ground, complete combustion did not always occur and in such cases they could remain a risk to intrusive works.
Aerial or Parachute mines (PM)	These were deployed less frequently than HE and IBs due to size, cost and the difficulty of deployment.	If functioning correctly, PMs would generally have had a slow rate of descent and were very unlikely to have penetrated the ground. Where the parachute failed, mines would have simply shattered on impact if the main charge failed to explode. There have been extreme cases when these items have been found unexploded. However, in these scenarios, the ground was either extremely soft or the munition fell into water.
Anti-personnel (AP) bomblets	These were not commonly used and are generally considered to pose a low risk to most works in the UK.	SD2 bomblets were packed into containers holding between 6 and 108 submunitions. They had little ground penetration ability and should have been located by the post-raid survey unless they fell into water, dense vegetation or bomb rubble.



### **12.3. Failure Rate of German Air Delivered Ordnance**

It has been estimated that 10% of WWII German air delivered HE bombs failed to explode as designed. Reasons for why such weapons might have failed to function as designed include:

- Malfunction of the fuze or gain mechanism (manufacturing fault, sabotage by forced labour or faulty installation).
- Many were fitted with a clockwork mechanism that could become immobilised on impact.
- Failure of the bomber aircraft to arm the bombs due to human error or an equipment defect.
- Jettisoning the bomb before it was armed or from a very low altitude. This most likely occurred if the bomber aircraft was under attack or crashing.

From 1940 to 1945, bomb disposal teams reportedly dealt with a total of 50,000 explosive items of 50kg, over 7,000 anti-aircraft projectiles and 300,000 beach mines. Unexploded ordnance is still regularly encountered across the UK, see press articles in **Annex K**.

### **12.4. UXB Ground Penetration**

An important consideration when assessing the risk from a UXB is the likely maximum depth of burial. There are several factors which determine the depth that an unexploded bomb will penetrate:

- Mass and shape of bomb.
- Height of release.
- Velocity and angle of bomb.
- Nature of the ground cover.
- Underlying geology.

Geology is perhaps the most important variable. If the ground is soft, there is a greater potential of deeper penetration. For example, peat and alluvium are easier to penetrate than gravel and sand, whereas layers of hard strata will significantly retard and may stop the trajectory of a UXB.

#### **12.4.1. The J-Curve Effect Principle**

J-curve is the term used to describe the characteristic curve commonly followed by an air delivered bomb dropped from height after it penetrates the ground. Typically, as the bomb is slowed by its passage through underlying soils, its trajectory curves towards the surface. Many UXBs are found with their nose cone pointing upwards as a result of this effect. More importantly, however, is the resulting horizontal offset from the point of entry. This is typically a distance of about one third of the bomb's penetration depth, but can be higher in certain conditions (see **Annex J**).

#### **12.4.2. WWII UXB Ground Penetration Studies**

During WWII the Ministry of Home Security undertook a major study on actual bomb penetration depths, carrying out statistical analysis on the measured depths of 1,328 bombs as reported by bomb disposal (BD) teams. Conclusions were drawn predicting the likely average and maximum depths of penetration of different sized bombs in different geological strata.

For example, the largest common German bomb (500kg) had a likely concluded penetration depth of 6m in sand or gravel but 11m in clay. The maximum observed depth for a 500kg bomb was 11.4m and for a 1,000kg bomb 12.8m. Theoretical calculations suggested that significantly greater penetration depths were probable.





### **12.4.3. Site Specific Bomb Penetration Considerations**

When considering an assessment of the bomb penetration at the site of proposed works the following parameters should be used:

- WWII geology – Kellaways Formation - Sandstone, siltstone and mudstone; Cornbrash Formation – Limestone; Blisworth Clay Formation – Mudstone; Blisworth Limestone Formation – Limestone; Lincolnshire Limestone Formation – Limestone; Upper Lincolnshire Limestone Member – Limestone; Lower Lincolnshire Limestone Member – Limestone.
- Impact angle and velocity – 10-15° from vertical and 270 metres per second.
- Bomb mass and configuration – The 500kg SC HE bomb, without retarder units or armour piercing nose (this was the largest of the common bombs used against Britain).

It has not been possible to determine maximum bomb penetration capabilities at this stage due to the limitations of site-specific geotechnical information provided for the purpose of this report. An assessment can be made once further information becomes available or by an UXO Specialist on-site.

### **12.5. V-Weapons**

Hitler's 'V-weapon' campaign began from mid-1944. It used newly developed unmanned cruise missiles and rockets. The V-1, known as the *flying bomb* or *pilotless aircraft*, and the V-2, a long range rocket, were launched from bases in Germany and occupied Europe. A total of 9,251 V-1s and 1,115 V-2s were recorded in the United Kingdom.

Although these weapons caused considerable damage, their relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today. Even if the 1,000kg warhead failed to explode, the weapons are so large that they would have been observed and dealt with at the time. Therefore, any V-weapons referenced in this report are referenced not as a viable risk factor, but primarily in order to help account for evidence of damage and clearance reported.



**12.6. Introduction to WWII-era Bombing Decoy Sites**

The decoy principal – drawing German bombers away from their designated targets onto dummy sites five or six miles away – began in WWI to protect RAF stations. In 1939, a new department was set up to investigate and coordinate the concept of defence by deception. A whole range of decoy sites were developed – some of them became very elaborate and covered large areas.

Common WWII Decoy Site Variants	
Decoy Type	Description
K-site	Daytime dummy airfield. Dummy aircraft and infrastructure.
Q-site	Night time dummy airfield. Intended to represent the working lights of an airfield after dark.
QL	Night time dummy infrastructure. Replicating the lights and workings of marshalling yards, naval installations, armament factories etc.
QF	Fire based decoy. Initially for aircraft factories, RAF maintenance units and ordnance works to simulate them on fire following bombing.
Oil QF	Simulation of burning oil tanks.
Starfish	Replicating a city under incendiary attack.

By June 1944, decoy sites had been attacked on 730 occasions. Attacks ranged from a single night-time bomber dropping its load onto a "Q" site, to the mass attacks on Starfish sites. In misleading air attacks away from intended targets, they were responsible for protecting cities, key Allied installations and saved the lives of thousands of people.

As WWII decoys were specifically designed to be bombed, proposed works planned in the vicinity of such installations can be at an elevated risk from German air delivered UXBs. It was not uncommon for evidence of UXBs at a decoy site to be overlooked following an air raid. Given that such installations were on open ground, sometimes agricultural fields, UXB entry holes were not always evident.

Three 'Q -site' RAF decoys, intended to simulate an RAF airfield at night were located approximately 4km, 6km and 7km east, north and south-east of the site respectively. These decoy sites were intended to draw Luftwaffe attention away from RAF Digby and RAF Waddington.



### 13. The Likelihood of Contamination from German Air Delivered UXBs

#### 13.1. World War I

During WWI Britain was targeted and bombed by Zeppelin Airships as well as Gotha and Giant fixed-wing aircraft. The objective of these raids was to unnerve the British public, to destroy strategic targets and to ultimately attempt to coerce Britain's capitulation from the war. A WWI map of air raids and naval bombardments across the UK was consulted, see **Annex L**. This source shows that several settlements to the north and south of the site, including Sleaford, were recorded to have been affected by bombs dropped during Zeppelin raids.

Information regarding the bombing of Lincolnshire was obtained from Ian Castle's 'Britain's First Blitz-1914-1918'<sup>13</sup> project and is presented in the section below.

##### 13.1.1. World War I Bombing of Rural District of East Kesteven

The district of East Kesteven Lincolnshire and adjacent areas are recorded to have been bombed numerous occasions by Zeppelin airships as detailed below. Bombing incidents recorded on or in a close proximity to the site area are highlighted in bold.

31<sup>st</sup> July/1<sup>st</sup> August 1916:

*L 16, commanded by Kapitänleutnant Erich Sommerfeldt, crossed the coast near Skegness at about 11.35pm, shortly after L 14. She dropped only six incendiary bombs, causing no damage. Proceeding across Lincolnshire towards Newark, she dropped two incendiaries at Caythorpe at 1.35am. Five minutes later L 16 dropped another at Skinnand, followed at 1.55am by one at Langford Common. **Turning for the coast, she dropped two final bombs, at Metheringham at 2.15am and West Ashby at 2.25am, before heading out to sea.***

23<sup>rd</sup>/24<sup>th</sup> September 1916:

*L 14 and L 17 came in together over the Lincolnshire coast at about 10.00pm. L 17, commanded by Kapitänleutnant Hermann Kraushaar, advanced towards Lincoln with L 14, and an HE bomb dropped at the hamlet of Waddingworth has been attributed to her. At about 10.45pm the two separated with L 14 approaching Lincoln. A searchlight at Washingborough caught L 14 in its beam allowing the 12-pdr gun at Canwick to fire 19 rounds at her. Perhaps presuming this activity denoted he was already over Lincoln, Manger released his entire bomb load, which fell on the neighbouring villages of Heighington, Washingborough and Greetwell.*

*Kapitänleutnant Franz Eichler brought L 13 in over Lincolnshire, north of Skegness, at about 10.30pm. She headed south-west to Wainfleet then continued towards Boston. She hovered near Boston for some time then struck off westwards towards Sleaford. At 11.50pm L.13 was just south of Sleaford when mobile anti-aircraft guns at Rauceby opened fire and five minutes later a BE2c from RNAS Cranwell took off, but L 13 was gone before the pilot could gain the required altitude. In reaction to the guns, Eichler dropped five incendiary bombs. One landed at the village of Silk Willoughby and four around Holdingham, but none caused any damage. Eichler released 13 HE bombs over Rauceby from where the guns were firing but **the only damage was to a house and some farm buildings. Passing to the north of Sleaford, L 13 released seven incendiary bomb over Leasingham, where they caused no damage.***

12<sup>th</sup>/13<sup>th</sup> April 1918:

*Kapitänleutnant Michael von Freudenreich, commanding L 63, came inland south of Skegness on the Lincolnshire coast at about 10.05pm. From Wrangle, L 63 headed west, passing south of Coningsby at 10.25pm. **Four minutes later the AA gun at Braucewell, just east of the***



*airfield at Cranwell where flares were burning, opened fire. L 63 released a 100kg HE bomb which exploded harmlessly in a field at Blankney Park. Now heading north, von Freudenreich dropped 18 bombs (2 x 300kg, 15 x 50kg and one incendiary) at 10.35pm, a mile east of Metheringham. These bombs, amounting to over a ton in weight, merely smashed a few windows.*

*At about that time she reached Waddington, south of Lincoln, where flares were alight on the airfield. L 64 dropped a 50kg bomb, which exploded in a field close by, and three more fell a little further east, at Mere. None of these bombs caused any damage. At 10.54pm, the AA gun at Brauncewell, that had earlier engaged L.63, now opened on L 64 as she headed away towards the coast at Wainfleet, where she arrived at about midnight.*

WWI bombs were generally smaller and dropped from a lower altitude than those used in WWII. This resulted in limited UXB penetration depths. Aerial bombing was often such a novelty at the time that it attracted public interest and even spectators to watch the raids in progress. For these reasons there is a limited risk that UXBs passed undiscovered in the urban environment. When combined with the relative infrequency of attacks and an overall low bombing density, the risk from WWI UXBs is considered low and will not be further addressed in this report.

### 13.2. World War II Bombing of Rural District of East Kesteven

The Luftwaffe’s main objective for the attacks on Britain was to inhibit the country’s economic and military capability. To achieve this they targeted airfields, depots, docks, warehouses, wharves, railway lines, factories, and power stations. As the war progressed the Luftwaffe bombing campaign expanded to include the indiscriminate bombing of civilian areas in an attempt to subvert public morale.

During WWII the site was located within the Rural District of East Kesteven, which sustained an overall very-low density bombing campaign, as represented by bomb density data figures presented in [Section 11.3](#). This was mainly due to the largely rural and agricultural composition of the district in which the site was located. However it should be noted that the site area was located in a close proximity to several RAF airfields and their associated decoy sites which are known to have been targeted on several occasions. This included RAF Digby located immediately adjacent to the central-western section of the site, RAF Metheringham approximately 1km east of the northern section of the site, RAF Wellingore approximately 2km west of the southern section of the site, and RAF Cranwell approximately 2.5km south-west of the southernmost section of the site. See **Annex M** for Luftwaffe reconnaissance imagery of RAF Digby.

There was approximately 385 air raid warnings in Sleaford and the Rural District East Kesteven. Despite the largely rural compositions, a total of 74 bombing incidents were recorded across the Rural District. The villages of Blankney, Digby and Ruskington were reportedly bombed on four occasions, the villages of Rowston, Dorrington, Ashby-de-la-Launde were reportedly bombed on four occasions, and the village of Scopwick was bombed on six separate occasions during June 1940 and August 1942.<sup>14</sup> RAF Digby located immediately adjacent to the central-western section of the site was reportedly subject to at least three bombing raids by lone German bombers throughout WWII.<sup>15</sup> RAF Metheringham which was located approximately 2km east of the northern section of the site was reportedly strafed on one occasion by a night fighter<sup>16</sup>

Records of bombing incidents in the civilian areas of the Rural District of East Kesteven were typically collected by Air Raid Precautions wardens and collated by Civil Defence personnel. Some other organisations, such as port and railway authorities, maintained separate records. Records would be in the form of typed or hand written incident notes, maps and statistics. Bombing data was carefully

■ [REDACTED]  
■ [REDACTED]  
■ [REDACTED]

analysed, not only due to the requirement to identify those parts of the country most needing assistance, but also in an attempt to find patterns in the Germans’ bombing strategy in order to predict where future raids might take place.

Records of bombing incidents are presented in the following sections.

### 13.3. WWII Home Office Bombing Statistics

The following table summarises the quantity of German air delivered bombs (excluding 1kg incendiaries and anti-personnel bombs) dropped on the Rural District of East Kesteven between 1940 and 1945.

<b>Record of German Ordnance Dropped on the Rural District of East Kesteven</b>		
<b>Area Acreage</b>		<b>123,406</b>
<b>Weapons</b>	High Explosive bombs (all types)	296
	Parachute mines	2
	Oil bombs	2
	Phosphorus bombs	0
	Fire pots	0
	Pilotless aircraft (V-1)	0
	Long range rockets (V-2)	0
<b>Total</b>		<b>300</b>
<b>Number of Items per 1,000 acres</b>		<b>2.4</b>

Source: Home Office Statistics

This table does not include UXO found during or after WWII.

Detailed records of the quantity and locations of the 1kg incendiary and anti-personnel bombs were not routinely maintained by the authorities as they were frequently too numerous to record. Although the risk relating to IBs is lesser than that relating to larger HE bombs, they were similarly designed to inflict damage and injury. Anti-personnel bombs were used in much smaller quantities and are rarely found today but are potentially more dangerous. Although Home Office statistics did not record these types of ordnance, both should not be overlooked when assessing the general risk to personnel and equipment.



**13.4. RAF Digby Report on Enemy Air Attack**

Written records were obtained from the National Archives in Kew detailing enemy air raids on RAF airfields in Lincolnshire. It should be noted that this record set is not anticipated to be comprehensive in nature. A transcript of the relevant written records is presented in the table below. Example imagery of these entries are presented in **Annex N**.

RAF Digby Report on Enemy Air Attack – Annex N	
Date Range	Comments
3 <sup>rd</sup> August 1942	<p>The attack occurred at 17.52 hours on the 3<sup>rd</sup> August, 4 UX HE were dropped. Bomb No.1 fell on Air Ministry property near W.T. Station and the remaining 3 fell in fields adjacent to the Aerodrome.</p> <p>The Dornier reported by eye witnesses, made the bombing run as indicated on 6" tracing at a height estimated at 500'. It was stated to come out of cloud to the North East of the Aerodrome, half circled the landing ground, and released the HE flying E.S.E. As will be seen from the plot, Bombs Nos.1, 2 and 3 fell close together and are in a straight stick, whereas No.4 fell 570' yards from No.3 This may be explained by the report made by Flight Lieut. O'Hara, BDS Officer on the station, who stated that he saw the plane immediately after the first 3 HE had been released. He observed the 3 bombs falling from the aircraft, which was at that time banking from the east with the right wing uppermost. It must have been on this manoeuvre that Bomb No.4 was released presumably being thrown out of line with the rest of the stick, because of the tilting of the fuselage and the turning eastwards of the aircraft.</p> <p>Three of the HE have been recovered, Bomb No.1 by the RAF BDS which was a 500kg SC. Bomb Nos. 3 and 4 recovered by Army BDS were 500kg SDs. Bomb No.2 is still to be recovered but is estimated by BDS to be 500KG.</p> <p>Aerodrome is provided with 8 Light A/A Posts (Lewis and Hispano). The Bofors guns, with which the Station was supplied, were removed.</p>

**13.5. Online/Anecdotal References to the Bombing of the Site Locality**

Anecdotal references referring to Luftwaffe bombing raids in the site locality and affecting the nearby RAF airfields were obtained from a variety of online sources including first hand anecdotal accounts from local residents. Some examples of the references relating to the site are transcribed below. Those incidents that occurred on or in a close proximity to the site area are highlighted in bold.

Online/Anecdotal References to Bombing of Site Locality	
Extracts from RAF Lincolnshire: RAF Digby A History <sup>17</sup>	
Date Range	Comments
August 1940	<p><b>On an overcast day, Digby was attacked by a single JU 88. The last 2 of a stream of Hurricanes were still in the air at the time of the attack, but neither seems to have seen the enemy aircraft. He, unfortunately, seems to have seen them, as he dropped his bombs harmlessly on the airfield, fired a few desultory bursts from his machine guns and headed for the safety of the overcast.</b></p>
Spring 1941	<p><b>One afternoon late in the spring of 1941 a single Ju-88 appeared through the clouds over Digby and made quite a mess of part of the Station. Bomb blast lifted a small saloon car into the air and hung it on a tree like a Christmas decoration quite near to the guardroom.</b></p>

<sup>17</sup> [REDACTED]

1942	During 1942 Digby suffered at least one aerial attack. A marauding Dornier-17 dropped a stick of bombs which straddled the Station sports field, the corner of the Sergeants' Mess and the field behind the old Digby Post Office. (I believe this may have been the occasion when the final bomb in the stick landed on a farmer on his tractor in the field causing a sad fatality).
1940 – 1945	Bishop Kenneth Healey, of Long Sutton, was Vicar of Digby (and Bloxholm and Ashby-de-la-Launde) during the first 3 ½ years of the war, and. recalls some those times.  “In spite of all the enemy bombing of Lincolnshire, the damage that I remember to have been done at RAF Digby was on 2 or 3 daylight raids, in low cloud conditions. A high proportion of the bombs dropped failed to explode: I remember the policeman calling at my Vicarage (Ashby-de—la—Launde) to consult my large scale Ordnance Map to get a correct siting on one such very large unexploded bomb for his report. “
<b>Extracts from Metheringham Airfield Visitor Centre: Airfield History<sup>18</sup></b>	
<b>Date Range</b>	<b>Comments</b>
March 1945	“In March 1945, Bomber Command suffered the last intruder raids of the Luftwaffe when various night fighters flew over various aerodromes in the UK and shot the place up.”  Two occasions that happened at Waddington, on one occasion the bomb dump was set on fire and we had shell casings littering the trees, you could hear bullets whistling through the air. That was rather frightening. Then they did in fact manage to set the Waddington bomb dump on fire one night and something was burning there, various people from RAF Waddington came around to all the outlying houses, farms and everyone, telling everyone to get out quick, because if the bomb dump went off, it would level a fair area of land in the area but they managed to get the fire under control.”
<b>Extracts from William Alvey School: Bombs over Sleaford WW2<sup>19</sup></b>	
<b>Date Range</b>	<b>Comments</b>
1940 – 1944	The nearest incident to Sleaford were the one high explosive bomb which dropped at Holdingham on the 30th August 1940, and the incendiary bombs which dropped at Quarrington on the 15th March 1941.  Anwick appears to have drawn the attention of the Germans more than other villages around Sleaford. On no fewer than seven occasions they were bombed, the first visit being on June 6th, 1940. <b>Scopwick</b> was bombed on six separate occasions between June 1940 and August 1942.  A number of villages were bombed on four occasions. They were Billingham, Martin, Ruskington, <b>Blankney</b> , Temple Bruer, <b>Digby</b> , and the villages which received attention from the Lutwaffe on three occasions were Heckington and Wilsford.  Bombs are recorded to have fallen twice at North Kyme, Timberland, Helpringham, <b>Rowston</b> , Dorrington, <b>Ashby-de-la-Launde</b> . Walcott, Little Hale and Aswarby.
<b>Extracts from Action Stations 2: Military Airfields of Lincolnshire and the East Midlands<sup>20</sup></b>	
<b>Date Range</b>	<b>Comments</b>
14 <sup>th</sup> April 1941	<b>Ju 88 daylight – cloud cover bombing of Digby, one bomb hit a small truck. Killed LAC Owen of 402 Squadron. First casualty.</b>

<sup>18</sup> [REDACTED]

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### 13.6. WWII-Era Aerial Photography

WWII-era aerial photography for the site area was obtained from the National Monuments Record Office (Historic England). This photography provides a record of the potential composition of the site during the war, as well as its condition immediately following the war (see **Annex H**).

<b>WWII-Era Aerial Photography</b>	
<b>Date</b>	<b>Description</b>
<p>29<sup>th</sup> July 1943</p> <p><b>Annex H1</b></p> <p>(IBBC)</p>	<p>This Luftwaffe target aerial photograph taken in 1943 shows the central-western section of the site and the RAF Digby Airfield. The airfield appears to comprise a grass flying ground which has been camouflaged with creosote oil to give the impression that the flying ground comprised several agricultural fields.</p> <p>Several major airfield features can be discerned, including the aircraft hangars, SAA storage area, pyro and detonator stores, MG range and small arms range, landing circle and aircraft dispersal pens. An LAA gun pit and associated magazine are also visible to the north of the airfield and close to the central-western extent of the site.</p> <p>Three aircraft dispersal pens and several small unidentified structures in the southern section of the airfield are depicted within the central-western area of the site.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H2</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the northern section of the site, which appears to predominantly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. Some minor residential/agricultural structures and large areas of woodland can be seen throughout this section of the site.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H3</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the northern section of the site, which appears to predominantly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. Some minor residential/agricultural structures and large areas of woodland can be seen throughout this section of the site.</p> <p>The village of Scopwick is shown to make up the southern extent of this section of the site.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H4</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the central-northern section of the site, which appears to predominantly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. A small quarry can be seen within the northernmost section of the site in this image, adjacent to a roadway bisecting the village of Scopwick which is situated between the northern and central-northern sections of the site.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H5</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the central-western section of the site and the RAF Digby Airfield. The airfield appears to comprise a grass flying ground, concrete perimeter track, dispersal pens, aircraft hangars, technical area, administration, accommodation area.</p> <p>The central-western section of the site is shown to comprise a dispersal area in the southern section of the airfield, and borders the airfield perimeter in several areas. The SAA storage area is also shown to be close to this area of the site.</p> <p>An LAA gun pit is located in an area of the site to the east of the airfield accommodation area and sports fields.</p> <p>Several ground disturbances can be discerned on and close to this section of the site around the RAF Digby airfield.</p>
<p>22<sup>nd</sup> April 1944</p> <p><b>Annex H6</b></p>	<p>This aerial photograph shows the central-western section of the site and the RAF Digby Airfield. The airfield appears to comprise a grass flying ground, dispersal pens, aircraft hangars, technical area and administration area.</p>



(Historic England)	<p>The central-western section of the site is shown to comprise at least three aircraft dispersal pens and other small unidentified structures associated with RAF Digby, bordering the airfield perimeter in several areas.</p> <p>An LAA gun pit is located in an area of the site to the south of the airfield flying ground.</p> <p>Several ground disturbances can be discerned on and close to this section of the site around the RAF Digby airfield.</p>
<p><b>Annex H7</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the south-eastern section of the site, which appears to mostly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. A cluster of structures that appear to be agricultural in nature are depicted in the centre of this image next to a small wooded area.</p> <p>Further to the north-east of this image, Ashby Hall, which was requisitioned by the Air Ministry to billet aircrew from RAF Digby can be seen.</p>
<p>22<sup>nd</sup> April 1944</p> <p><b>Annex H8</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the southern section of the site, which appears to predominantly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. Some limited areas of woodland and some residential/agricultural structures can be seen within and adjacent to this area of the site. A number of possible ground disturbances can be seen across the site and to the south-west.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H9</b></p> <p>(Historic England)</p>	<p>This aerial photograph shows the southern section of the site, which appears to predominantly comprise open areas of undeveloped agricultural land interspersed with farm access tracks and roadways. Some minor residential/agricultural structures can be seen in the eastern extent of this image.</p>
<p>16<sup>th</sup> April 1947</p> <p><b>Annex H10</b></p> <p>(Historic England)</p>	<p>This aerial photograph of RAF Metheringham gives a good accounts of the airfield and associated features. The airfield is laid out in an 'A-Frame' type arrangement, with three runways numerous 'Spectacle' aircraft dispersals. The airfield bomb store area and fuzing points are shown to be on the northern side of the flying ground.</p>

**13.7. Dorrington and Ruskington Q Site Decoys**

Three 'Q -site' RAF decoys, intended to simulate an RAF airfield at night, were located approximately 4km, 6km and 7km east, north and south-east of the site respectively. These decoy sites were intended to draw Luftwaffe attention away from RAF Digby and RAF Waddington. Anwick, a village located approximately 7km south-east of the site and situated immediately adjacent to the Ruskington RAF 'Q site' decoy, was reportedly bombed on no fewer than seven occasions.

**13.8. Abandoned Bombs**

A post air-raid survey of buildings, facilities, and installations would have included a search for evidence of bomb entry holes. If evidence of an entry hole was encountered, Bomb Disposal Officer Teams would normally have been requested to attempt to locate, render safe, and dispose of the bomb. Occasionally, evidence of UXBs was discovered but due to a relatively benign position, access problems, or a shortage of resources the UXB could not be exposed and rendered safe. Such an incident may have been recorded and noted as an 'abandoned bomb'.

Given the inaccuracy of WWII records, and the fact that these bombs were 'abandoned', their locations cannot be considered definitive or the lists exhaustive. The MoD states that 'action to make the devices safe would be taken only if it was thought they were unstable'. It should be noted that other than the 'officially' abandoned bombs, there will inevitably be UXBs that were never recorded.

1<sup>st</sup> Line Defence holds no records of officially registered abandoned bombs at or near the site of the proposed works.

**13.9. Bomb Disposal Tasks**

The information service from the Explosive Ordnance Disposal (EOD) Archive Information Office at 33 Engineer Regiment (now part of 29 EOD & Search Group) no longer processes commercial requests for information. It has therefore not been possible to include any updated official information regarding bomb disposal/clearance tasks with regards to this site. A database of known disposal/clearance tasks has been referred to which does not make reference to such instances occurring within the site of proposed works.

### 13.10. Evaluation of German Air Delivered UXO Records

Factors	Conclusion
<p><b>Density of Bombing</b></p> <p><i>It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.</i></p>	<p>During WWII the site was located within the Rural District of East Kesteven, which sustained an overall very-low density bombing campaign, culminating in an average of 2.4 items of ordnance per 1,000 acres.</p> <p>This was mainly due to the largely rural and agricultural composition of the district in which the site was located. However it should be noted that the site area was located in a close proximity to several RAF airfields and their associated decoy sites which are known to have been targeted on several occasions.</p> <p>RAF Digby which was located on and immediately adjacent to the central-western section of the site was bombed on at least three occasions. Written incident records indicate that one particular raid during August 1942 recorded the use of several unexploded HE bombs.</p> <p>Anecdotal accounts indicate that the villages located in the site locality were subject to sporadic bombing raids during WWII. The village of Scopwick was bombed on six separate occasions, the villages of Blankney, Digby and Ruskington were reportedly bombed on four occasions, and the villages of Rowston, Dorrington, Ashby-de-la-Launde were reportedly bombed on two occasions during June 1940 and August 1942.</p> <p>Blankney Park, formerly located to the north of the northernmost section of the site, was reportedly subject to one WWI-era Zeppelin raid, and the village of Metheringham further north was reportedly subject to two separate Zeppelin raids.</p> <p><b>Annex O</b> provides a visual overlay of bombing incidents in the site locality. Although it should be noted that this map does not provide a comprehensive account of bombing incidents, nor does it denote exact bomb strike locations.</p>
<p><b>Damage</b></p> <p><i>If buildings or structures on a site sustained bomb or fire damage, any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.</i></p>	<p>Due to the size and largely rural nature of the site, it has not been possible to assess signs of damage across the entire area in detail. Although on the basis of available photography, mapping and records, the majority of the site appears to have survived the war relatively unscathed and structures in the area surrounding the site appear intact.</p> <p>As shown within <b>Annex H</b>, some signs of potential ground disturbances and potential bomb cratering are visible within WWII-era aerial imagery in specific areas of the site.</p> <p>It may be noted that evidence of damage at locations within the Order Limits which consist of open ground would likely be difficult to discern. The absence of visible damage throughout the site is therefore not necessarily indicative of a lack of bombing on site.</p>
<p><b>Ground Cover</b></p> <p><i>The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.</i></p>	<p>As much of the site was occupied by open rural land, it is considered possible that UXBs could have gone undetected, as bomb entry holes may have been obscured or overlooked. For example, the entry hole for a 50kg UXB can be as small as 20cm in diameter. As such, the possibility that an item of UXO fell on site unnoticed and unrecorded cannot be confidently discounted. Areas that were occupied by structures, roadways and other infrastructure are considered to have been more conducive to observation of evidence of UXO.</p>



<b>Access Frequency</b> <i>UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.</i>	Access and general monitor within sections of the site comprising structures and roadways is considered to have been broadly frequent. As such, any incidents in such areas are likely to have been noticed and recorded, although this cannot be completely guaranteed.  Large sections of the site were occupied by open agricultural land which was likely to have been subject to only seasonal access by farmers, and therefore the possibility that items of UXO may have gone missing in such areas is considered more likely.
<b>Bomb Failure Rate</b>	There is no evidence to suggest that the bomb failure rate in the locality of the site would have been dissimilar to the 10% normally used.
<b>Abandoned Bombs</b>	1 <sup>st</sup> Line Defence holds no records of abandoned bombs at or within the site vicinity.
<b>Bombing Decoy sites</b>	1 <sup>st</sup> Line Defence could find no evidence of bombing decoy sites within the site vicinity. Three 'Q Site' RAF decoy sites were located in the wider vicinity approximately 4km, 6km and 7km from the site in the vicinity of Dorrington, Ruskington and Potter Hanworth, intended to draw Luftwaffe attention from RAF Digby and RAF Waddington.
<b>Bomb Disposal Tasks</b>	1 <sup>st</sup> Line Defence could find no evidence of bomb disposal tasks within the Order Limits and immediate area.

## 14. The Likelihood of UXO Contamination Summary

The following table assesses the likelihood that the site was contaminated by items of German air delivered and Allied ordnance. Factors such as the risk of UXO initiation, remaining, and encountering will be discussed later in the report.

UXO Contamination Summary	
<b>Quality of the Historical Record</b>	<p>The research has evaluated pre and post-WWII Ordnance Survey maps, Home Office bombing statistics, Luftwaffe reconnaissance imagery, RAF site plans, written incident records, WWII-era RAF and USAAF aerial imagery, as well as additional online, anecdotal and in-house record sets.</p> <p>The record set is generally of a satisfactory quality. Some written accounts detailing the bombing of RAF Digby were available and some decent anecdotal accounts were available regarding the bombing of villages in the site locality, although these did not specify locations and extent of the incidents. Furthermore, due to the fact that there were no major/named structures within the site during WWII which would be used to identify the location of bombing incidents, only a general picture of bombing can be ascertained. As such, it has not been possible to get a fully comprehensive picture of the bombing incidents across the site area.</p>
<b>Allied Ordnance</b>	<ul style="list-style-type: none"> <li>• During WWII the site was partly occupied by RAF Digby which was/is situated on and immediately adjacent to the central-western section of the site. Further airfields were located in the wider site area, including RAF Metheringham which was located approximately 1km east of the northernmost section of the site, RAF Wellingore was formerly located 2km west of the central-western section of the site, and RAF Cranwell is situated approximately 2.5km south-west of the southernmost section of the site.</li> <li>• RAF Digby, formerly RAF Scopwick, was a WWI-era relief landing ground for RNAS Cranwell, an inter-war training airfield and WWII-era Fighter Command airfield, and remains in active RAF service in the present-era.</li> <li>• An inter-war period RAF Digby site plan dated 1932 indicates that a ‘Bomb-Dropping Tower’ was located within the bounds of the airfield perimeter. Although there was no reference to the location of the practice bombing range associated with RAF Digby, historically practice bombing was often undertaken within the bounds of the airfield, and the airfield landing circle was sometimes used as a temporary target. This feature was located approximately 500m north of the central-western section of the site area.</li> <li>• WWII-era RAF Digby site plans and aerial imagery indicate that the central-western section of the site comprised three ‘Type A’ aircraft dispersal pens, segments of the airfield perimeter fence, several pillbox structures and loopholed walls, as well as at least two LAA gun sites. Several bunded structures marked as <i>Small Arms Stores</i> were also located close to the central-western section of the site (see <b>Annex G3</b>).</li> <li>• Owing to the sites proximity to an Auxiliary Unit HQ at Blankney Hall (adjacent to the northernmost section of the site), and the RAF Digby Airfield (on and adjacent to the central-western section of the site), it is possible that defensive and training exercises were carried out within and around these features. Auxiliary Units were provided with live ammunition and ordnance, and trained using real explosives. Although no record of training exercises were found, this is likely because such training was often conducted on a small scale at the discretion of individual commanders and as such was seldom recorded officially.</li> <li>• Online and anecdotal accounts indicate that a Lancaster heavy bomber crashed within the northern section of the site area following a mid-air collision with a Hurricane, both of which were undertaking ‘Flight Affiliation’ training. Given these two planes were taking part in mock attacks, it is considered unlikely that live ammunition was in use, therefore unlikely that Allied ordnance contaminated the ground as a result of this incident.</li> </ul>



	<ul style="list-style-type: none"> <li>• See <b>Annex O</b> for a visual overlay presenting the locations of all significant historic allied features and incidents recorded in the site locality.</li> <li>• In summary, the risk of Allied ordnance contamination across the site is not homogenous. Owing to the recorded location and proximity of several significant allied features on and around the central-western and northern sections of the site, namely RAF Digby and Blankney Hall, these areas are assessed to be at an elevated risk from items of Allied UXO, and as such have been assessed as <b>Medium Risk</b>. The remaining areas of the site are not anticipated to be significantly elevated above the 'background' level of risk for this area of the country, therefore the rest of the site has been assessed as <b>Low Risk</b>. See risk mapping presented in <b>Annex Q1</b>.</li> </ul>
<p><b>German Air Delivered Ordnance</b></p>	<ul style="list-style-type: none"> <li>• During WWII the site was located within the Rural District of East Kesteven, which sustained an overall very-low density bombing campaign, culminating in an average of 2.4 items of ordnance per 1,000 acres. This was mainly due to the largely rural and agricultural composition of the district in which the site was located. However it should be noted that the site area was located in a close proximity to several RAF airfields and their associated decoy sites which are known to have been targeted on several occasions.</li> <li>• RAF Digby, which was located on and immediately adjacent to the central-western section of the site was bombed on at least three occasions. Written incident records indicate that one particular raid during August 1942 recorded the use of several unexploded HE bombs.</li> <li>• Anecdotal accounts indicate that the villages located in the site locality were subject to sporadic bombing raids during WWII. The village of Scopwick was bombed on six separate occasions, the villages of Blankney, Digby and Ruskington were reportedly bombed on four occasions, and the villages of Rowston, Dorrington, Ashby-de-la-Launde were reportedly bombed on two occasions during June 1940 and August 1942.</li> <li>• Blankney Park, formerly located to the north of the northernmost section of the site, was reportedly subject to one WWI-era Zeppelin raid, and the village of Metheringham further north was reportedly subject to two separate Zeppelin raids.</li> <li>• <b>Annex P</b> provides a visual overlay of bombing incidents in the site locality along with a brief description. Although it should be noted that this map does not provide a comprehensive account of bombing incidents, nor does it denote exact bomb strike locations.</li> <li>• Due to the size and largely rural nature of the site, it has not been possible to assess signs of damage across the entire area in detail. Although on the basis of available photography, mapping and records, the majority of the site appears to have survived the war relatively unscathed and structures in the area surrounding the site appear intact. Some signs of potential ground disturbances and potential bomb cratering are visible in WWII-era aerial imagery presented in <b>Annex H</b> within specific areas of the site area.</li> <li>• Areas of the site that were typified by roadways or structures are considered likely to have received relatively frequent levels of access and monitor for items of UXO. The agricultural areas of the site are considered to have received less frequent and seasonal access, and will have been occupied by various forms of ground cover that may not have been conducive to the easy observation of evidence of UXO.</li> <li>• In summary, due to the open, rural nature of the site, and the bombing incidents recorded in the site locality, it is not possible to discount the risk that an item of UXO could have fallen on site unnoticed and unrecorded. Nevertheless, the Rural District of Kesteven was subject to a very-low bombing density, and much of the site is not thought to be significantly elevated above the 'background' level of risk in this region. As such, the majority of the site has been assessed as being <b>Low Risk</b> from German UXO contamination.</li> </ul>



- However, where the central-western section of the site adjoins RAF Digby, the risk has been elevated somewhat to account for the multiple bombing raids which affected the RAF airfield. As such, this area has been assessed as **Medium Risk**. See risk mapping presented in **Annex R1-R2**.



## **16. The Likelihood that UXO Remains**

### **16.1. Introduction**

It is important to consider the extent to which any explosive ordnance clearance (EOC) activities or extensive ground works have occurred on site. This may indicate previous ordnance contamination or reduce the risk that ordnance remains undiscovered.

### **16.2. UXO Clearance**

Former military sites (or at least certain areas within their footprint) are often subject to clearance before they are returned to civilian use by the MoD. If a site is retained by the military, it is possible that no clearance operations have ever been undertaken. However, UXO is sometimes still discovered even on sites where clearance operations are known to have been undertaken. The detail and level of survey and targeted investigation undertaken by the military will depend on the former use of the site and purpose of the clearance (i.e. disposal, redevelopment, return to agriculture, etc.).<sup>21</sup> The level of clearance will also depend on the available technology, resources and practices of the day.

It therefore cannot be assumed that the risk of UXO remaining has been completely mitigated, even though EOC tasks have been undertaken at a former military site.

### **16.3. Post-War Redevelopment**

Post-war OS mapping and aerial imagery indicates that the majority of the site and surrounding environs have remained undeveloped in the post-war era. Some minor were able to be discerned, including agricultural and residential structures, access roads and roadways. Some agricultural and residential structures were also cleared during this period.

The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

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<sup>21</sup> CIRIA C681





## **17. The Likelihood of UXO Encounter**

### **17.1. Introduction**

For UXO to pose a risk at a site, there should be a means by which any potential UXO might be encountered on that site.

The likelihood of encountering UXO on the site of proposed works would depend on various factors, such as the type of UXO that might be present and the intrusive works planned on site. In most cases, UXO is more likely to be present below surface (buried) than on surface.

In general, the greater the extent and depth of intrusive works, the greater the risk of encountering. The most likely scenarios under which items of UXO could be encountered during construction works is during piling, drilling operations or bulk excavations for basement levels. The overall risk will depend on the extent of the works, such as the numbers of boreholes/piles (if required) and the volume of the excavations.

Generally speaking, the risk of encountering any type of UXO will be minimal for any works planned within the footprint and down to the depth of post-war foundations and excavations.

### **17.2. Encountering Air Delivered Ordnance**

Since an air delivered bomb may come to rest at any depth between just below ground level and its maximum penetration depth, there is a chance that such an item (if present) could be encountered during shallow excavations (for services or site investigations) into the original WWII ground level as well as at depth.

### **17.3. Land Service/Small Arms Ammunition Encounter**

Items of LSA and SAA are mostly encountered in areas previously used for military training. Such items could have been lost, burnt, buried or discarded during being in use by the military. Due to this, LSA are most likely to be encountered at relatively shallow depths – generally in the top 1m below ground level. Therefore, such items are most likely to be encountered during open excavation works. In some cases, there is the potential that LSA or SAA may be present on the surface of the ground – especially in areas with active military use or were recently in use by the MoD.

## **18. The Likelihood of UXO Initiation**

### **18.1. Introduction**

UXO does not spontaneously explode. Older UXO devices will require an external event/energy to create the conditions for detonation to occur. The likelihood that a device will function can depend on a number of factors including the type of weaponry, its age and the amount of energy it is struck with.

### **18.2. Initiating Air Delivered Ordnance**

Unexploded bombs do not spontaneously explode. All high explosive filling requires significant energy to create the conditions for detonation to occur.

In recent decades, there have been a number of incidents in Europe where Allied UXBs have detonated, and incidents where fatalities have resulted. There have been several hypotheses as to the reason why the issue is more prevalent in mainland Europe – reasons could include the significantly greater number of bombs dropped by the Allied forces on occupied Europe, the preferred use by the Allies of mechanical rather than electrical fuzes, and perhaps just good fortune. The risk from UXO in the UK is also being treated very seriously in many sectors of the construction industry, and proactive risk mitigation efforts will also have affected the lack of detonations in the UK.

There are certain construction activities which make initiation more likely, and several potential initiation mechanisms must be considered:

<b>UXB Initiation</b>	
<b>Direct Impact</b>	Unless the fuze or fuze pocket is struck, there needs to be a significant impact e.g. from piling or large and violent mechanical excavation, onto the main body of the weapon to initiate a buried iron bomb. Such violent action can cause the bomb to detonate.
<b>Re- starting the Clock</b>	A small proportion of German WWII bombs employed clockwork fuzes. It is probable that significant corrosion would have taken place within the fuze mechanism over the last 70+ years that would prevent clockwork mechanisms from functioning. Nevertheless, it was reported that the clockwork fuze in a UXB dealt with by 33 EOD Regiment in Surrey in 2002 did re-start.
<b>Friction Impact</b>	The most likely scenario resulting in the detonation of a UXB is friction impact initiating the shock-sensitive fuze explosive. The combined effects of seasonal changes in temperature and general degradation over time can cause explosive compounds to crystallise and extrude out from the main body of the bomb. It may only require a limited amount of energy to initiate the extruded explosive which could detonate the main charge.



### **18.3. Land Service /Small Arms Ammunition Initiation**

Items of LSA generally do not become inert or lose their effectiveness with age. Time can cause items to become more sensitive and less stable. This applies equally to items submerged in water or embedded in silts, clays, or similar materials. The greatest risk occurs when an item of ordnance is struck or interfered with. This is likely to occur when mechanical equipment is used or when unqualified personnel pick up munitions.

If left alone, an item of LSA will pose little/no risk of initiation. Therefore, if it is not planned to undertake construction/intrusive works at the site, the risk of initiation of any LSA that may be present would be negligible. Similarly, those accessing a contaminated area would be at minimal risk if they do not interfere with any UXO present on the ground. Clearly for many end uses, however, the presence of UXO anywhere on a site would not be acceptable as it could not be guaranteed that the items will not be handled, struck or otherwise affected, increasing the likelihood of initiation.

Items of SAA are much less likely to detonate than LSA or UXBs, but can be accidentally initiated by striking the casing, coming into contact with fire, or being tampered with/dismantled. It is likely that the detonation of an item of SAA would result in a small explosion, as the pressure would not be contained within a barrel. Detonation would only result in local overpressure and very minor fragmentation from the cartridge case.



## **19. Consequences of Initiation/Encounter**

### **19.1. Introduction**

The repercussions of the inadvertent detonation of UXO during intrusive ground works, or if an item or ordnance is interfered with or disturbed, are potentially profound, both in terms of human and financial cost. A serious risk to life and limb, damage to plant and total site shutdown during follow-up investigations are potential outcomes. However, if appropriate risk mitigation measures are put in place, the chances of initiating an item of UXO during ground works is comparatively low.

The consequences of encountering UXO can be particularly notable in the case of high-profile sites (such as airports and train stations) where it is necessary to evacuate the public from the surrounding area. A site may be closed for anything from a few hours to a week with potentially significant cost in lost time. It should be noted that even the discovery of suspected or possible item of UXO during intrusive works (if handled solely through the authorities), may also involve significant loss of production.

### **19.2. Consequences of Detonation**

When considering the potential consequences of a detonation, it is necessary to identify the significant receptors that may be affected. The receptors that may potentially be at risk from a UXO detonation on a construction site will vary depending on the site specific conditions but can be summarised as follows:

- People – site workers, local residents and general public.
- Plant and equipment – construction plant on site.
- Services – subsurface gas, electricity, telecommunications.
- Structures – not only visible damage to above ground buildings, but potentially damage to foundations and the weakening of support structures.
- Environment – introduction of potentially contaminating materials.

## 20. 1<sup>st</sup> Line Defence Risk Assessment

### 20.1. Risk Assessment Stages

Taking into account the quality of the historical evidence, the assessment of the overall risk from unexploded ordnance is based on the following five considerations:

1. That the site was contaminated with unexploded ordnance.
2. That unexploded ordnance remains on site.
3. That such items will be encountered during the proposed works.
4. That ordnance may be initiated by the works operations.
5. The consequences of encountering or initiating ordnance.

### 20.2. Assessed Risk Level

1<sup>st</sup> Line Defence has assessed that the risk from items of unexploded ordnance is not homogenous throughout the site area. See Risk Mapping presented in **Annex Q-R**.

#### 20.2.1. Assessed Risk from items of Allied UXO within the Northern and Central-Western Sections of the Site

1<sup>st</sup> Line Defence has assessed that there is a **Medium Risk** from items of Allied unexploded ordnance in sections of the northern and central-western areas of the site. This is due to the proximity of significant allied features and activity recorded on and around these sections of the site, namely RAF Digby and Blankney Hall. See risk mapping presented in **Annex Q1**.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
Allied Land Service and Small Arms Ammunition			✓	
Allied Aerial Bombs and Practice Bombs			✓	

#### 20.2.2. Assessed Risk from items of Allied UXO across the Remainder of the Site

1<sup>st</sup> Line Defence has assessed that there is an overall **Low Risk** from items of Allied UXO across the remaining areas of the site. See risk mapping presented in **Annex Q1**.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
Allied Land Service and Small Arms Ammunition		✓		
Allied Aerial Bombs and Practice Bombs		✓		

**20.2.3. Assessed Risk from items of German UXO within the Central-Western and Central-Eastern Sections of the Site**

1<sup>st</sup> Line Defence has assessed that there is an overall **Medium Risk** from German and anti-aircraft unexploded ordnance across the central-western section of the site area, owing to the increased level of German bombing on and around RAF Digby, a known Luftwaffe target. See risk mapping presented in **Annex R1**.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs			✓	
German 1kg Incendiary Bombs			✓	
Anti-Aircraft Artillery Projectiles			✓	

**20.2.4. Assessed Risk from items of German UXO across the Remainder of the Site**

1<sup>st</sup> Line Defence has assessed that there is an overall **Low Risk** from German and anti-aircraft unexploded ordnance across the remaining areas of the site. See risk mapping presented in **Annex R1**.

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Anti-Aircraft Artillery Projectiles		✓		

Please note – although the risk from unexploded ordnance on this site has been assessed as ‘Low’, this does not mean there is ‘no’ risk of encountering UXO. This report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified throughout this report. Our reports take a common-sense and practical approach to the assessment of risk, and we strive to be reasonable and pragmatic in our conclusions.

It should however be stressed that if any suspect items are encountered during the proposed works, 1<sup>st</sup> Line Defence should be contacted for advice/assistance, and to re-assess the risk where necessary. The mitigation measures outlined in the next section are recommended as a minimum precaution to alert ground personnel to the history of the site, what to look out for, and what measures to take in the event that a suspect item is encountered. It should also be noted that the conclusions of this report are based on the scope of works outlined in the ‘Proposed Works’ section of this report. Should the scope of works change or additional works be proposed, 1<sup>st</sup> Line Defence should be contacted to re-evaluate the risk.

## 21. Proposed Risk Mitigation Methodology

### 21.1. General

The following risk mitigation measures are recommended to support the proposed works at Springwell Solar Farm:

Type of Work	Recommended Mitigation Measure
All Works	<ul style="list-style-type: none"> <li> <b>UXO Risk Management Plan</b>  It is recommended that a site-specific plan for the management of UXO risk be written for this site. This plan should be kept on site and be referred to in the event that a suspect item of UXO is encountered at any stage of the project. It should detail the steps to be taken in the event of such a discovery, considering elements such as communication, raising the alarm, nominated responsible persons etc. Contact 1<sup>st</sup> Line Defence for help/more information. </li> <li> <b>Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.</b>  As a minimum precaution, all personnel working on the site should be briefed on the basic identification of UXO and what to do in the event of encountering a suspect item. This should in the first instance be undertaken by a UXO Specialist. Posters and information on the risk of UXO can be held in the site office for reference. </li> </ul>
Shallow Intrusive Works/Open Excavations in Medium Risk Areas	<ul style="list-style-type: none"> <li> <b>A Non-Intrusive UXO Magnetometer Survey</b>  A Non-Intrusive survey is undertaken using a man-portable magnetometer. Data is recorded and then interpreted to map magnetic fields and model discrete magnetic anomalies which may show the characteristics of UXO. The anomalies can then be investigated by a target investigation team. Where this type of survey is not practical (due to for example terrain or ground conditions), on-site UXO specialist support is recommended. </li> <li> <b>Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works</b>  When on site the role of the UXO Specialist would include: <ul style="list-style-type: none"> <li>Monitoring works using visual recognition and instrumentation, including immediate response to reports of suspicious objects or suspected items of ordnance that have been recovered by the ground workers on site.</li> <li>Providing UXO awareness briefings to any uninformed staff and advise staff of the need to modify working practices to take account of the ordnance risk.</li> <li>To aid incident management which would involve liaison with the local authorities and police should ordnance be identified and present an explosive hazard.</li> </ul> </li> </ul>
Borehole/Piles in Medium Risk Areas	<ul style="list-style-type: none"> <li> <b>Intrusive Magnetometer Survey of all borehole and pile locations down to a maximum bomb penetration depth:</b>  1<sup>st</sup> Line Defence can deploy a range of intrusive magnetometer techniques to clear pile locations. The appropriate technique is influenced by a number of factors, but most importantly the site's ground conditions. The appropriate survey methodology would be confirmed once the enabling works have been completed. </li> </ul>



In making this assessment and recommending these risk mitigation measures, if known, the works outlined in the 'Scope of the Proposed Works' section were considered. Should the planned works be modified or additional intrusive engineering works be considered, 1<sup>st</sup> Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

**1<sup>st</sup> Line Defence Limited**

**10/02/2023**

This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.





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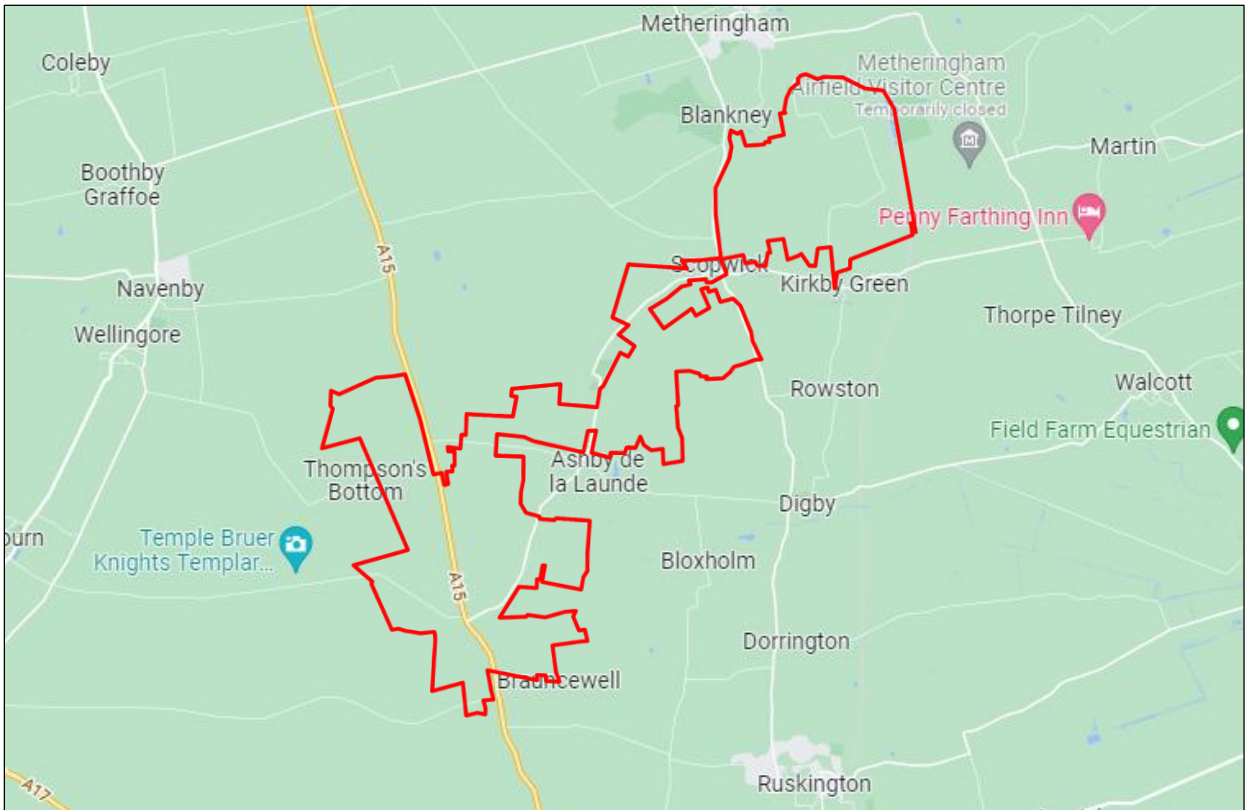
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# Site Location Maps



Unit 3, Maple Park  
Essex Road, Hoddesdon,  
Hertfordshire. EN11 0EX



**—** Approximate site boundary



Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Google Maps

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**1ST LINE DEFENCE**

Unit 3, Maple Park  
Essex Road, Hoddesdon,  
Hertfordshire. EN11 0EX



 **Approximate site boundary**

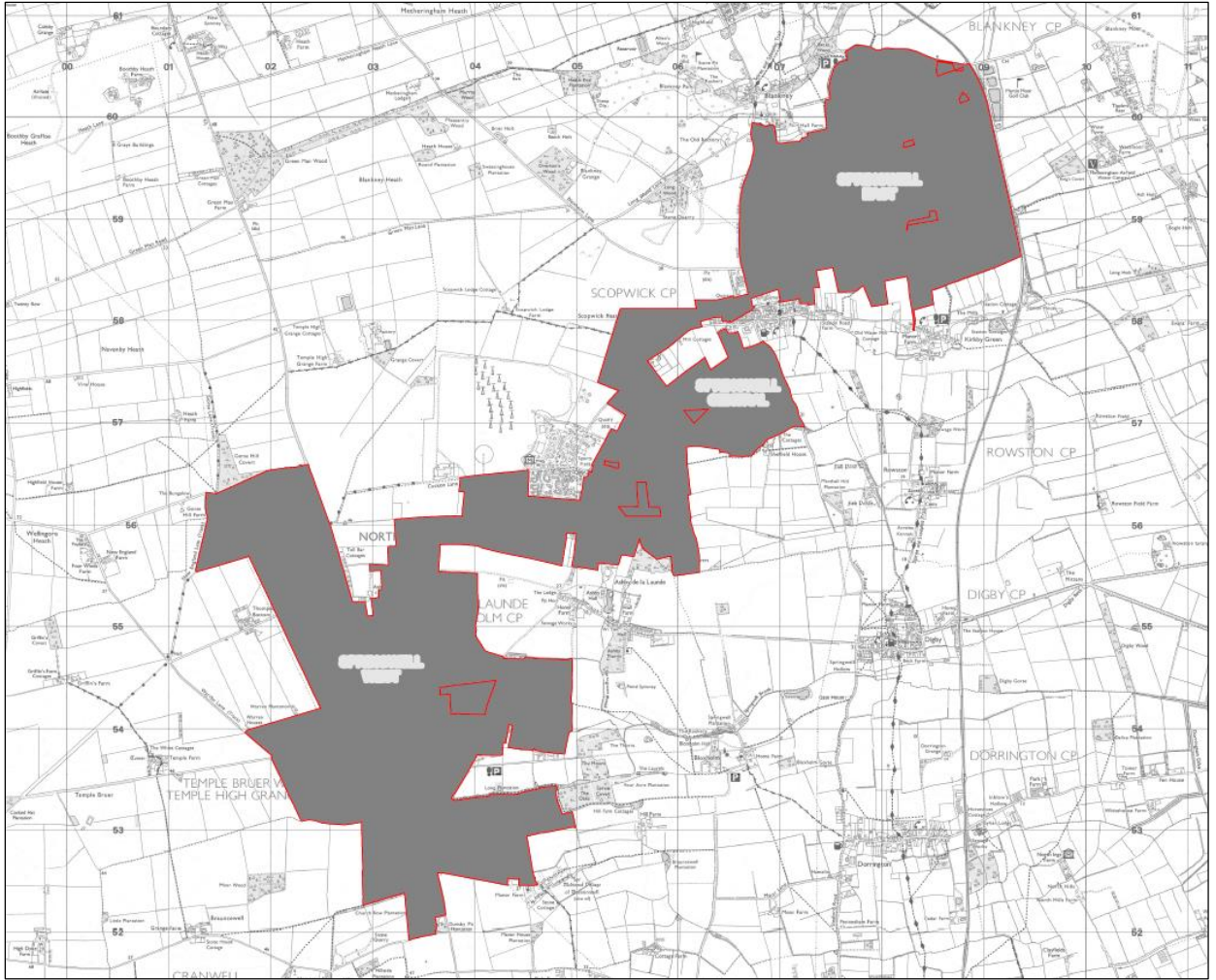


Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Google Earth™ Mapping Services

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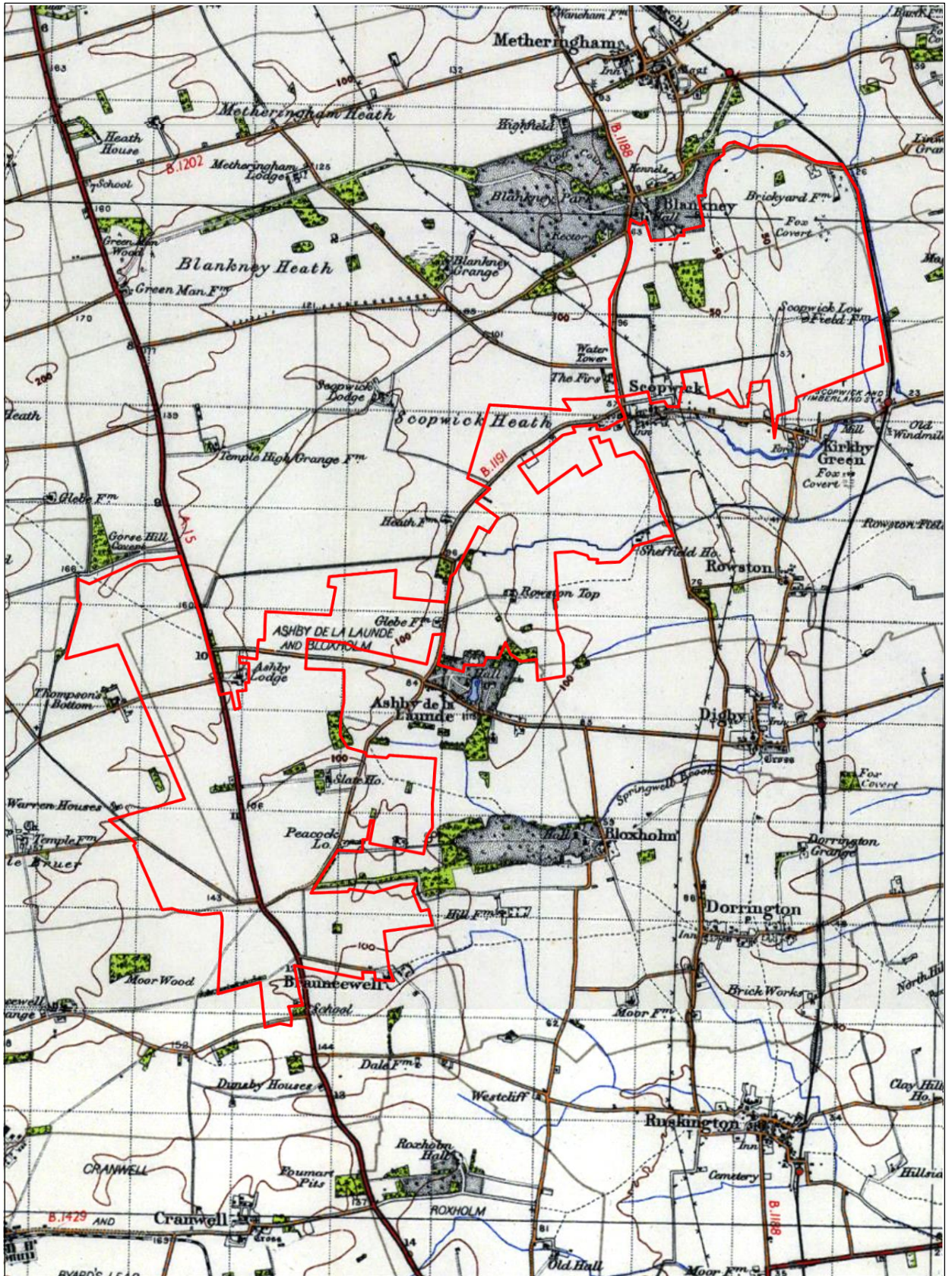
Unit 3, Maple Park  
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Unit 3, Maple Park  
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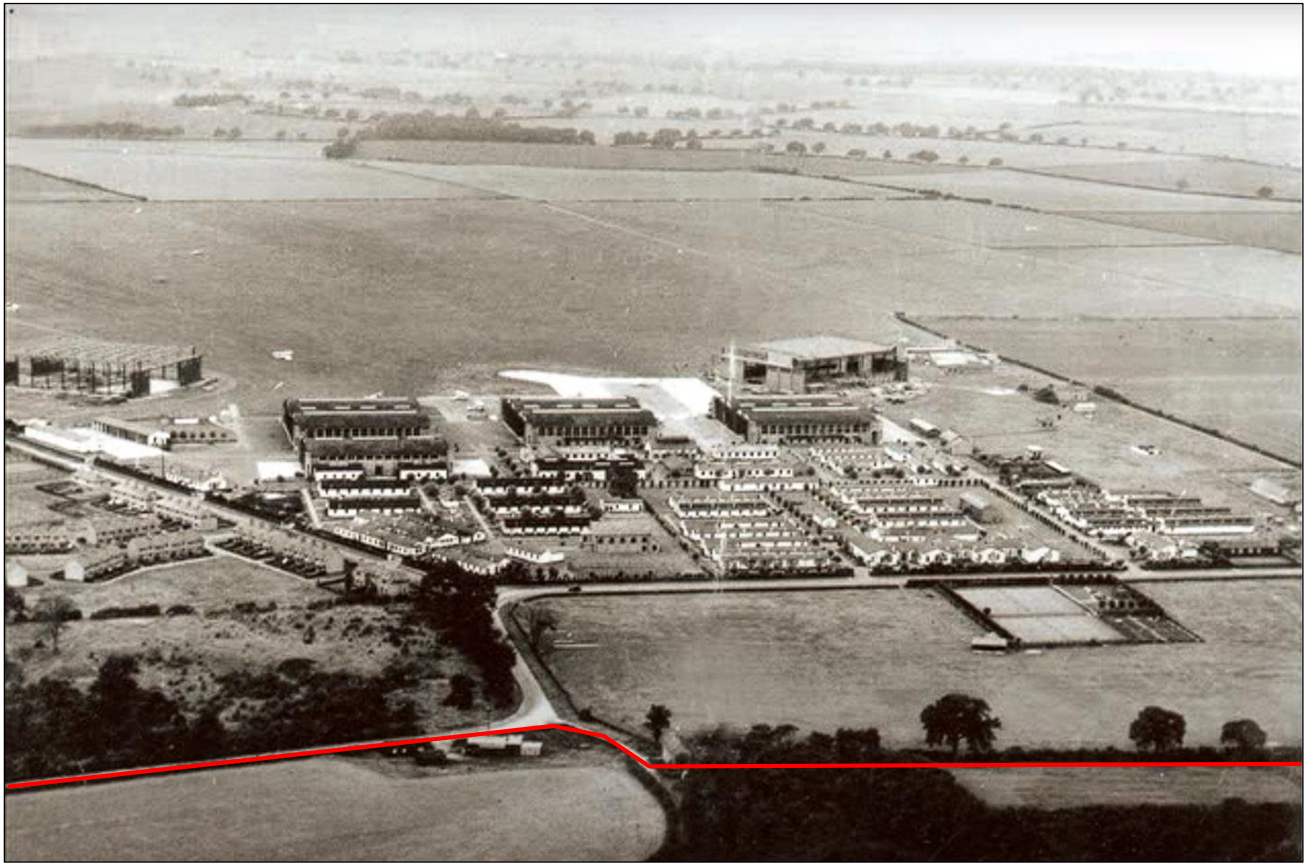
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: National Library of Scotland

 **Approximate site boundary**





Unit 3, Maple Park  
Essex Road, Hoddesdon,  
Hertfordshire. EN11 0EX



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Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: The National Archives, Kew

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(Above) Avro 504N (J9264) of No.2 FTS following a crash whilst attempting to land at RAF Digby, circa 1928.



(Left) Several Hawker Hind light bombers parked on the apron at RAF Digby undergoing refuelling. Two Belfast Truss hangars can be seen in the background, circa 1935.



(Above) Hawker Audax light bombers parked at RAF Digby, circa 1936.



(Above) A Gloster Gladiator fighter (K7985) of No.73 Squadron RAF Digby circa 1937.





(Above) Supermarine Spitfires of No.411 Squadron parked around the technical area at RAF Digby, circa June 1941.



(Above) A snow covered RAF Digby during the winter of 1940 – 1941. A single Supermarine Spitfire can be seen, along with the fort style airfield control tower and a Belfast Truss type aircraft hangar.



Unit 3, Maple Park  
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Hertfordshire. EN11 0EX



Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Various

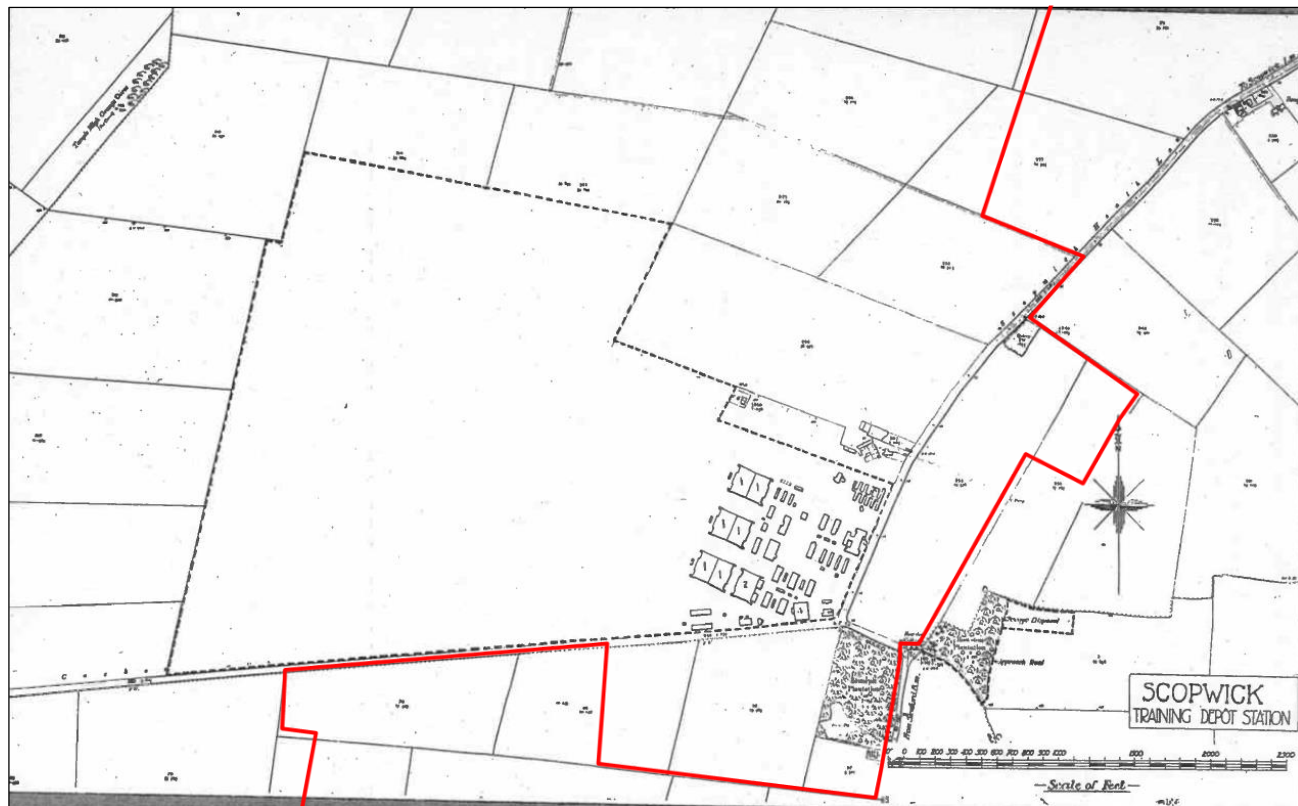
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(Above) Two pilots running towards two RCAF Hawker Hurricane Mk.IIb fighters of 402Sqn (AE-X P3021 and AE-S) being prepared by ground crew at RAF Digby, circa 1941.



(Above) A Bristol Blenheim Mk.I bomber (AR-E) landing at RAF Digby after a demonstration flight in January 1940.

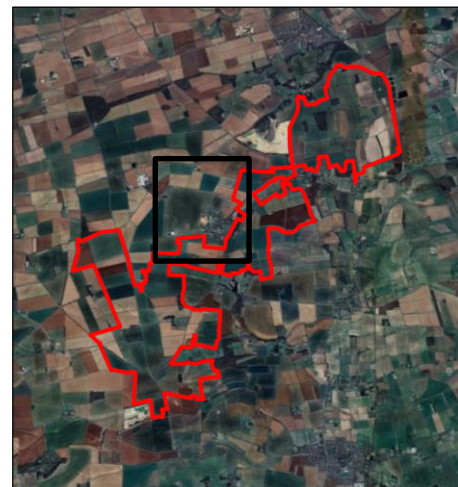


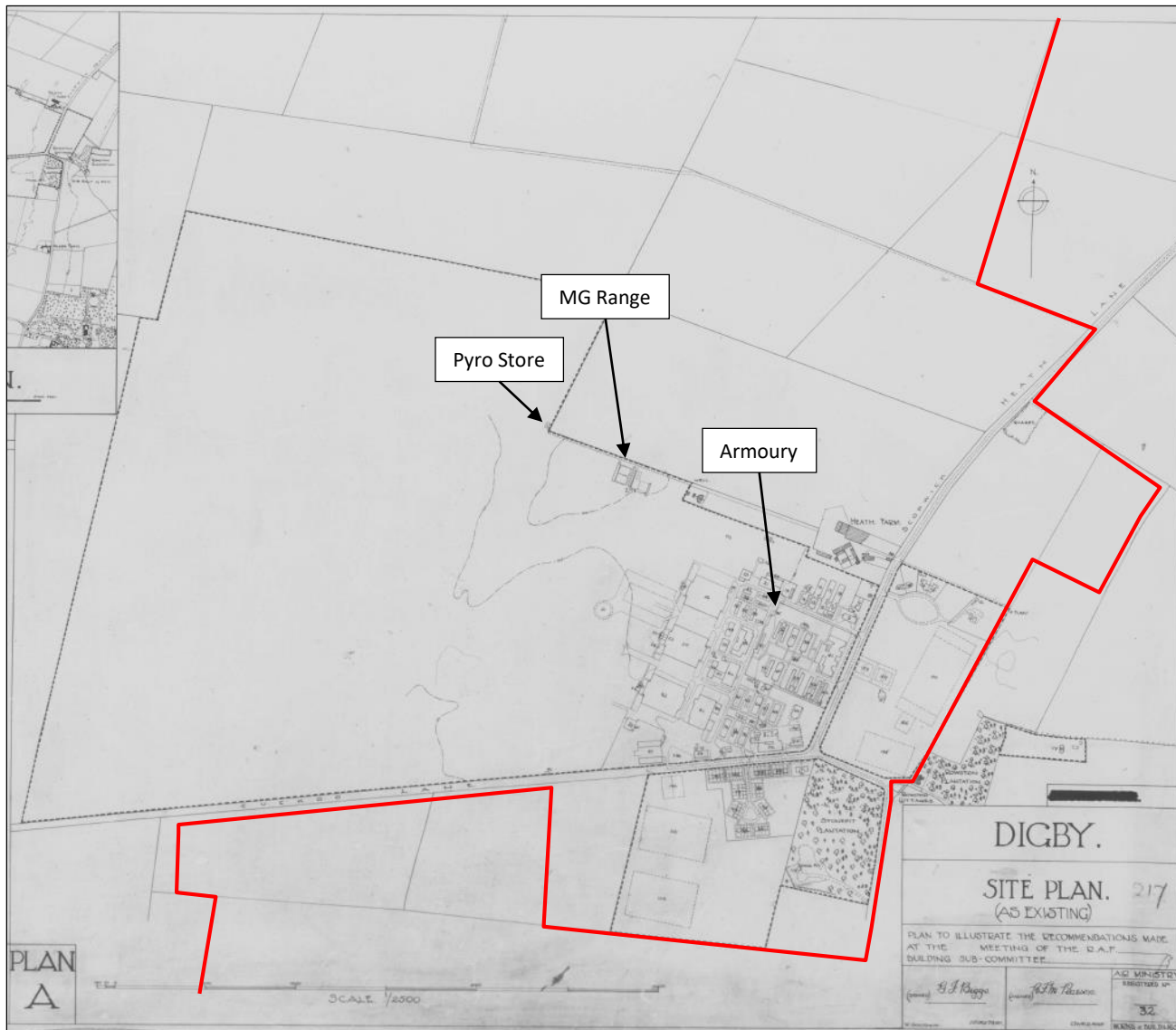
**SCOPWICK.**

Training Depot Station (Midland Area ; No. 12 Group, 27th Wing).

ACCOMMODATION.		Map Reference.
<i>Technical Buildings.</i>		
6 Aeroplane Sheds (each 170' x 100')	.. ..	1
A.R.S. Shed (with 2 Plane Stores) (170' x 100')	.. ..	2
Salvage Shed	.. ..	—
2 M.T. Sheds	.. ..	—
Workshop (Wood)	.. ..	—
Workshop (Metal)	.. ..	—
Carpenters', 100' x 28'. Sailmakers', 90' x 28'. Dope, 40' x 28'. Machine, 30' x 28'. Engine, 80' x 28'. Coppersmiths', 30' x 14'. Smiths', 30' x 14'.	.. ..	—
Technical Stores	.. ..	—
Oil Store	.. ..	—
Petrol Store	.. ..	—
Instructional Huts—		
General Lecture Hut	.. ..	—
Gunnery Instruction Hut	.. ..	—
Gunnery Workshop	.. ..	—
Wireless and Bombing Hut	.. ..	—
Buzzing and Picture-target Hut	.. ..	—
Depôt Offices	.. ..	—
3 Unit Commanders' Offices	.. ..	—
Power House	.. ..	—
Latrines	.. ..	—
Guard House	.. ..	—
Compass Platform	.. ..	—
Machine Gun Range	.. ..	—
Ammunition Store	.. ..	—
Bomb-dropping Tower	.. ..	—

Please note RAF Digby was originally named RAF Scopwick, as per the titles of the above and left plans.





REFERENCE.

No.	Description	No.	Description	No.	Description
1	PROTECTIVE STORE	41	BARBERS' SHOP	71	POST OFFICE
2	MUNICIPALITY	42	LATRINE & ABUCTION	72	POST OFFICE
3	PROCESSESS	43	OFFICE	73	POST OFFICE
4	PROCESSESS	44	OFFICE	74	POST OFFICE
5	PROCESSESS	45	OFFICE	75	POST OFFICE
6	PROCESSESS	46	OFFICE	76	POST OFFICE
7	PROCESSESS	47	OFFICE	77	POST OFFICE
8	PROCESSESS	48	OFFICE	78	POST OFFICE
9	PROCESSESS	49	OFFICE	79	POST OFFICE
10	PROCESSESS	50	OFFICE	80	POST OFFICE
11	PROCESSESS	51	OFFICE	81	POST OFFICE
12	PROCESSESS	52	OFFICE	82	POST OFFICE
13	PROCESSESS	53	OFFICE	83	POST OFFICE
14	PROCESSESS	54	OFFICE	84	POST OFFICE
15	PROCESSESS	55	OFFICE	85	POST OFFICE
16	PROCESSESS	56	OFFICE	86	POST OFFICE
17	PROCESSESS	57	OFFICE	87	POST OFFICE
18	PROCESSESS	58	OFFICE	88	POST OFFICE
19	PROCESSESS	59	OFFICE	89	POST OFFICE
20	PROCESSESS	60	OFFICE	90	POST OFFICE
21	PROCESSESS	61	OFFICE	91	POST OFFICE
22	PROCESSESS	62	OFFICE	92	POST OFFICE
23	PROCESSESS	63	OFFICE	93	POST OFFICE
24	PROCESSESS	64	OFFICE	94	POST OFFICE
25	PROCESSESS	65	OFFICE	95	POST OFFICE
26	PROCESSESS	66	OFFICE	96	POST OFFICE
27	PROCESSESS	67	OFFICE	97	POST OFFICE
28	PROCESSESS	68	OFFICE	98	POST OFFICE
29	PROCESSESS	69	OFFICE	99	POST OFFICE
30	PROCESSESS	70	OFFICE	100	POST OFFICE



Unit 3, Maple Park  
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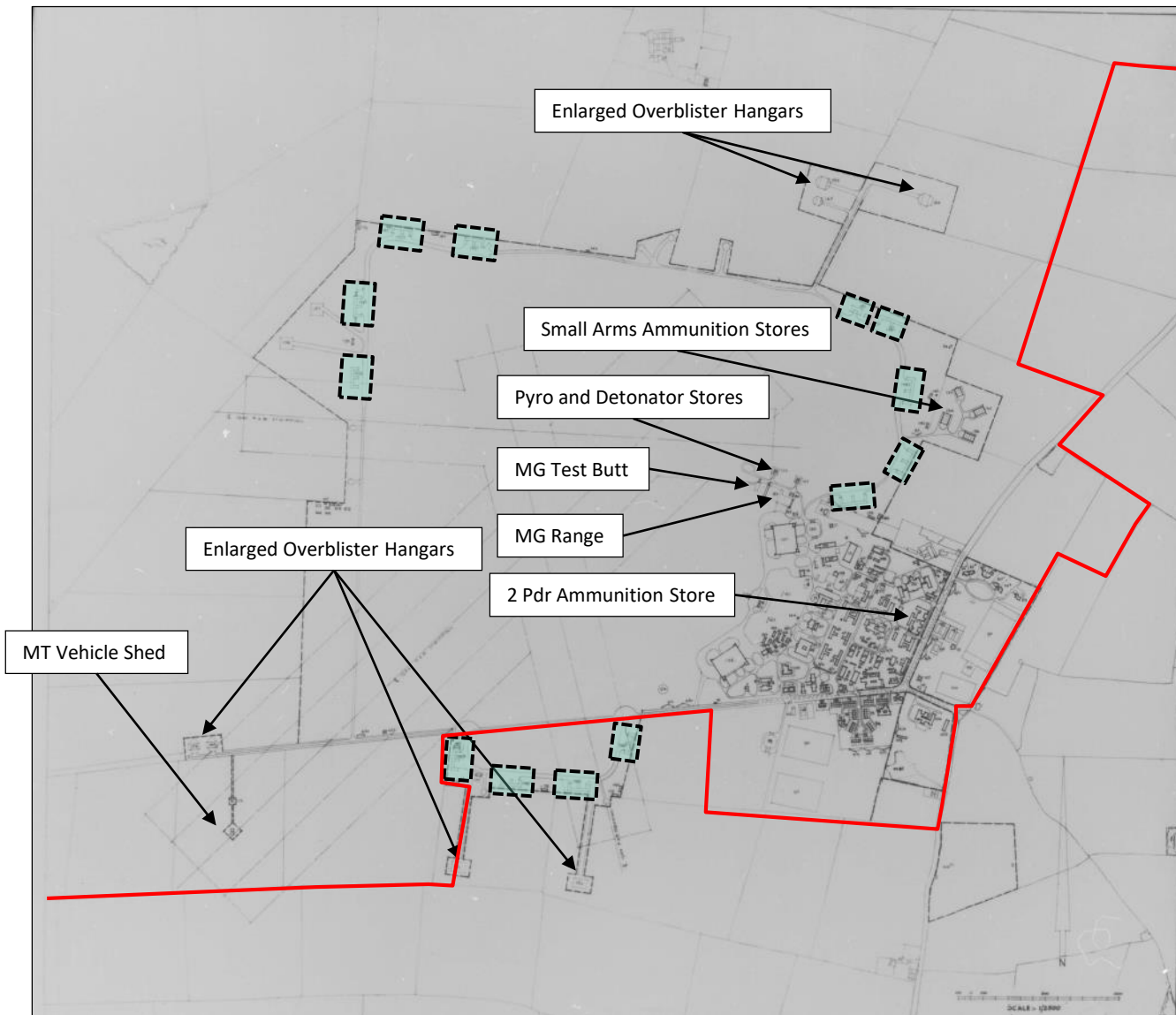
Project: **Springwell Solar Farm**


Ref: **DA17125-00**

Source: RAF Museum Hendon

— Approximate site boundary





 Aircraft Dispersal Pen



Unit 3, Maple Park  
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 Approximate site boundary



SCHEDULE OF BUILDINGS									
SPONSOR	BUILDING	TYPE	COMET	DRG. NO.	NUMBER	BUILDING	TYPE	COMET	DRG. NO.
1	FIRE PARTY BLOCK			214/59	132	DEFONATOR STORE			
2	DECONTAMINATION CENTRE			622/57	133	FYDTECHNICS			
3	SICK QUARTERS AND ANNEXE			700/50	134	COMPASS PLATFORM			
4	SQUADRON OFFICES			08.250	135	GROCERY SHOP & STORE			
5	AMBULANCE GARAGE & MORTUARY			5705/54	136				
6	SHIELT TRENCHES			8878/56	137	STATION STORE			
7	PETROL TANKER SHED			4187/55	138	DINING ROOM & INSTITUTE			
8	TECHNICAL LATRINE			750/54	139	WT RECEIVING STATION			
9	FIRE TENDER SHIELT			4265/57	140	WT STATION			
10	CONTROL TOWER			207/56	141	WT D.P. STATION			
11	N.F.E. STORE			3254/59	142	CAMOUFLAGE STORE			
12	LINK TANKER			1762/59	143	S.A.A. STORES & CUBICLE			
13	M.T. STORAGE			2802/58	144-145	S.A.A. STORES & CUBICLE			
14	ENGINE WORKSHOP			286/57	147	DISPERSAL PENS (ALEXHEIM)			
15	LECTURE ROOM				148	" (HURRICANE)			
16	SHIELT TRENCHES				135-140	SLEEPING SHELTERS			
17	LECTURE ROOM				141-145	FIRE PONS (MANS)			
18	SQUASH COURT (SINGLE)			1402/37	146-148	" (S&B)			
19	POWER HOUSE			11507/50	149	ARMY GUARD			
20	OFFICERS MESS & QUARTERS				150	M.T. PETROL INSTALLATION			
21	GAS DEFENCE CENTRE			9152/37	151-153	LATRINE & A.GUN CREW			
22	WORKS SERVICES OFFICE			6929/57	154	SLEEPING SHELTERS			
23	CONTRACTORS OFFICE & STORE			174/57	155	BATTLE HEADQUARTERS			
24	EDUCATIONAL HUT			DR. 428/50	156	STORE			
25	CLASS ROOM			08.87	157-164	ENLARGED OVERHEATER HANGAR			
26	FUEL STORE				165	BLISTED HANGAR			
27	A.A. BRIGADE H.Q.				166-168	BARRACK HUTS			
28	GUARD HOUSE			166/23	169	LATRINE & ABLUTIONS			
29	BARRACK BLOCK			481/36	170	SHOWERS & DRESSING ROOM			
30	LATRINE & ABLUTIONS				171	GUARD HUT			
31	BARRACK BLOCK			481/36	172	LATRINE			
32	BATH HOUSE				173	A.A. DETACHMENT H.Q.			
33	LATRINE & ABLUTIONS				173-185	DISPERSAL HUTS			
34	ACCOUNTS OFFICE				184-186	A.A. GUN CREW HUT			
35	BARRACK BLOCK				187	DISPERSAL HUT			
36	LATRINE & ABLUTIONS				188	GREEN ARMY HUT			
37	BARRACK BLOCK				189	ARMY BARRACK HUTS			
38	LATRINE & ABLUTIONS				192	GUARD ROOM			
39	BARRACK BLOCK								
40	HIGH LEVEL WATER TANK								
41	PUMP HOUSE			DR. 160					
42	BARRACK BLOCK			444/36					
43	INSTITUTE			1022/23					
43A	DINING ROOM			769/23					
43	BARRACK BLOCK			1132/36					
43*	BERGANTS MESS			DR. 2					
44	BARRACK BLOCK			1132/36					
44*	SHOP & STORE N.A.A.F.I.			DR. 60					
45-46	BARRACK BLOCKS			2418/36					
47-49	"			444/36					
49	MAIN STORES			4287/58					
50	ARMOURY			01.01/57					
51	WORKSHOP			4923/55					
52	ARTICULATED TRAILER SHED			433/57					
53*	SINGLE OFFICERS QUARTERS			DR. 438/52					
53	BULK OIL STORAGE			493/52					
54	SINGLE OFFICERS QUARTERS			9895/59					
55	2 P.M. AMMUNITION STORES			491/52					
56	OFFICERS MESS & QUARTERS			719/27					
57	QUICK COURT			036/57					
58	ARMOURY								
59	SALVAGE YARD								
60	BULK PETROL INSTALLATION			12959/62					
61	SICK QUARTERS			274/56					
62	W.A.A.F. DECONTAMINATION								
63	" MESS & QUARTERS			DR. 998/50					
64	COMPRESSOR HOUSE SEWAGE								
65	WORKS SERVICES OFFICE & STORE			DR. 441/50					
66	TENNIS COURT			142/21					
66*	MARRIED OFFICERS QUARTERS			100/21					
67	"			4505/56					
68	SINGLE SERGANTS QUARTERS			359/81					
69	MARRIED OFFICERS QUARTERS			442/22					
70	QUARTERS MARRIED W.O.								
71	"			302/22					
72	"								
73	"								
74	"								
75	"								
76	"								
77	"								
78	"								
79	"			1523/25					
80	"								
81	N.F.E. STORE								
82	HEADQUARTER OFFICE			3326/56					
83	M.G. RANGE			1150/55					
84	ENGINE TEST HOUSE			879/36					
84*	MORTUARY			1475/24					
85	INCINERATOR								
86	LECTURE ROOM & OIL CONTAINER STORE			329/36					
87	INFLAMMABLE STORE								
88	SEWAGE WORKS & TOOL HOUSE								
89	GYMNASIUM			DR. 409/50					
90	CHURCH FURNITURE STORE								
91	PARACHUTE STORE			3353/25					
92	SPORTS PAVILION			1146/36					
93	QUARTERS MARRIED W.O.			DR. 442/22					
94	TENNIS COURTS AIRMEN (A&R)								
95	FOOTBALL GROUND ASSOCIATION								
96	TENNIS COURT OFFICERS								
97	"								
98	FOOTBALL GROUND RUGBY								
99	CRICKET GROUND								
100	HOCKEY GROUND								
101	CRICKET NET HUTS								
102-103*	MARRIED OFFICERS QUARTERS			370/36					
104	M.G. TEST PUTT			2642/35					
105	SERGEANTS MESS & QUARTERS			1100/35					
106	" QUARTERS			277/36					
107-107*	AIRCRAFT SHED			3272/35					
108	SUB-STATION			7187/36					
109	INFANTS SCHOOL			3272/35					
110	OPERATIONS BLACK			DR. 624/56					
111	W.T. D.F. STATION			805/40					
112	" " WEST ROOM			4082/36					
113	M.T. VEHICLE SHED			3907/36					
114	"			7829/37					
115	"			1400/36					
116	TECHNICAL LATRINE			230/36					
117	PETROL TANKER SHED			4187/36					
118	CENTRAL HEATING STATION			898/37					
120	PETROL INSTALLATION AVIATION			41.98/37					
121	"								

**DIGBY**

**RECORD SITE PLAN**

SCALE: 1/2500

PLAN BASED ON NO 5 WORKS AREA  
DRG. NO. DY 1005

HALF SCALE REPRODUCTION OF DRG. NO: 2643/45. SECRET NO: D.G. OF W. 6082/45. AIR MINISTRY.



Unit 3, Maple Park  
Essex Road, Hoddesdon,  
Hertfordshire. EN11 0EX

Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: **RAF Museum Hendon**



SCHEDULE OF BUILDINGS	
<b>SITE 1 - AIRFIELD</b>	<b>ROAD STORES</b>
<ul style="list-style-type: none"> <li>1. 100' x 100' CONCRETE</li> <li>2. 100' x 100' CONCRETE</li> <li>3. 100' x 100' CONCRETE</li> <li>4. 100' x 100' CONCRETE</li> <li>5. 100' x 100' CONCRETE</li> <li>6. 100' x 100' CONCRETE</li> <li>7. 100' x 100' CONCRETE</li> <li>8. 100' x 100' CONCRETE</li> <li>9. 100' x 100' CONCRETE</li> <li>10. 100' x 100' CONCRETE</li> <li>11. 100' x 100' CONCRETE</li> <li>12. 100' x 100' CONCRETE</li> <li>13. 100' x 100' CONCRETE</li> <li>14. 100' x 100' CONCRETE</li> <li>15. 100' x 100' CONCRETE</li> <li>16. 100' x 100' CONCRETE</li> <li>17. 100' x 100' CONCRETE</li> <li>18. 100' x 100' CONCRETE</li> <li>19. 100' x 100' CONCRETE</li> <li>20. 100' x 100' CONCRETE</li> <li>21. 100' x 100' CONCRETE</li> <li>22. 100' x 100' CONCRETE</li> <li>23. 100' x 100' CONCRETE</li> <li>24. 100' x 100' CONCRETE</li> <li>25. 100' x 100' CONCRETE</li> <li>26. 100' x 100' CONCRETE</li> <li>27. 100' x 100' CONCRETE</li> <li>28. 100' x 100' CONCRETE</li> <li>29. 100' x 100' 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<p>METHERINGHAM</p> <p>RECORD SITE PLAN</p> <p>SITE NO. (UNFILED) 4422</p> <p>DATE 1944</p>	



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Essex Road, Hoddesdon,  
Hertfordshire. EN11 0EX

Project: **Springwell Solar Farm**





Ref: **DA17125-00**

Source: Metherringham Airfield Visitor Centre

— Approximate site boundary





-  Aircraft Dispersal Pen
-  Ordnance Storage Area
-  Small Arms Range
-  LAA Gun Site







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 Approximate site boundary



Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: International Bomber Command Centre



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— Approximate site boundary



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Source: International Bomber Command Centre

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— Approximate site boundary

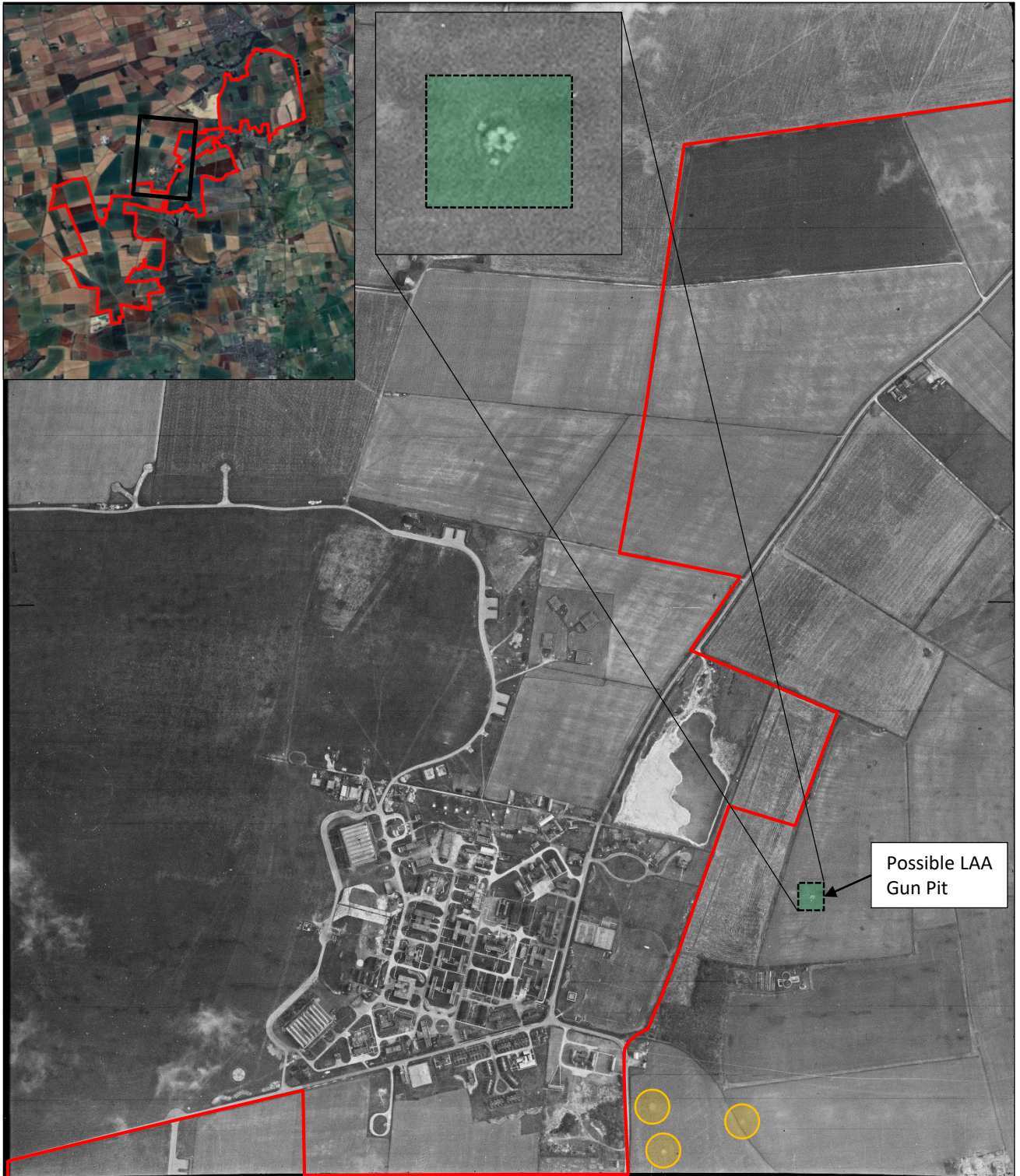


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Possible LAA Gun Pit

 Potential Ground Disturbance

 Approximate site boundary



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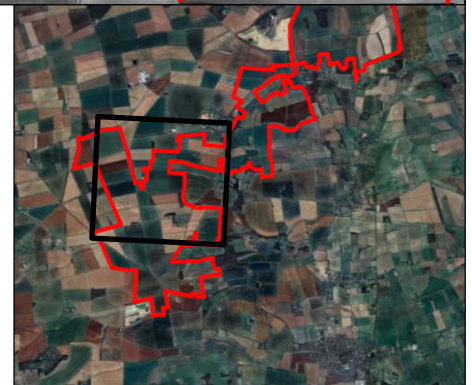
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 Potential Ground Disturbance



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 Approximate site boundary





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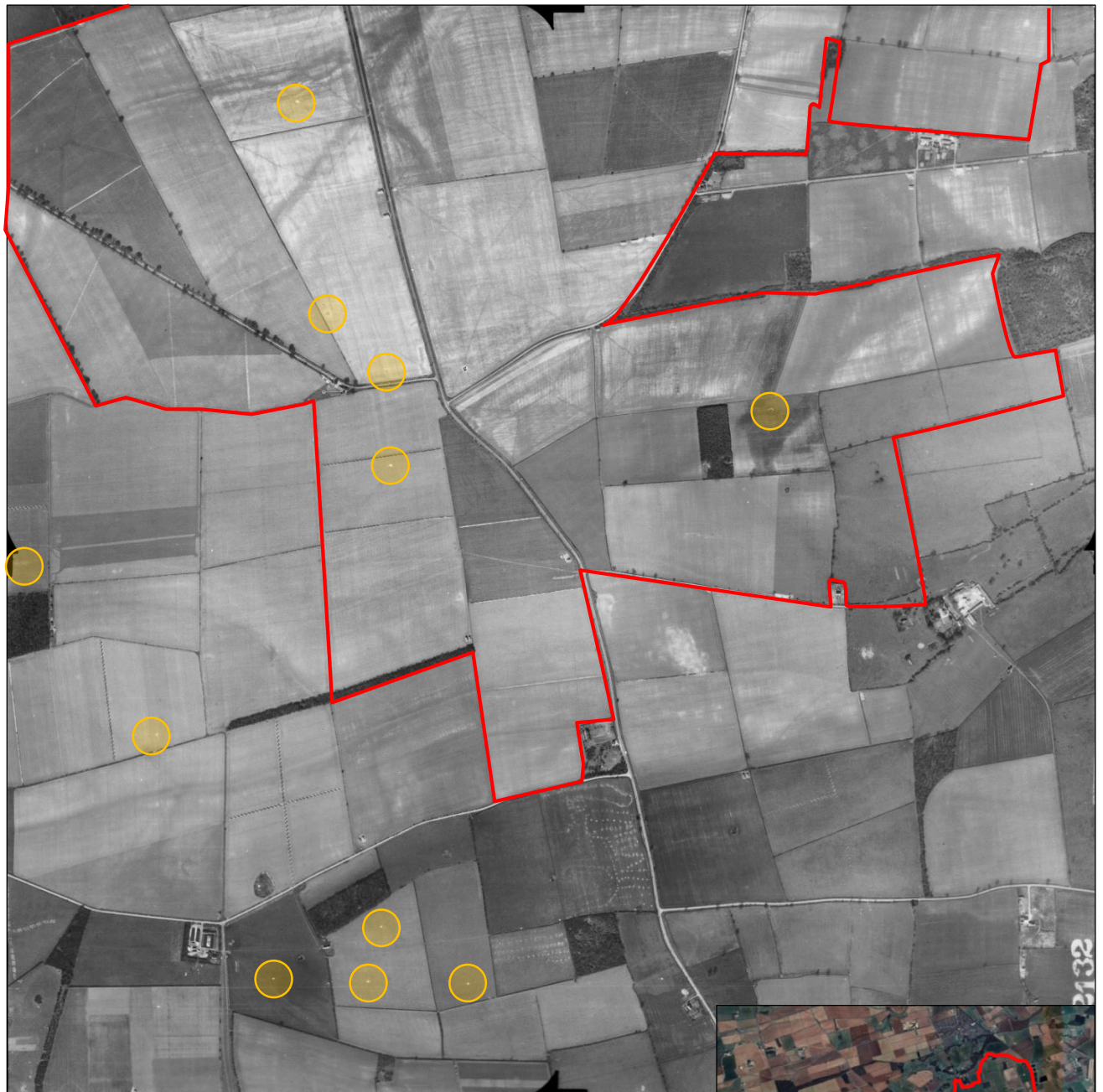


Project: **Springwell Solar Farm**

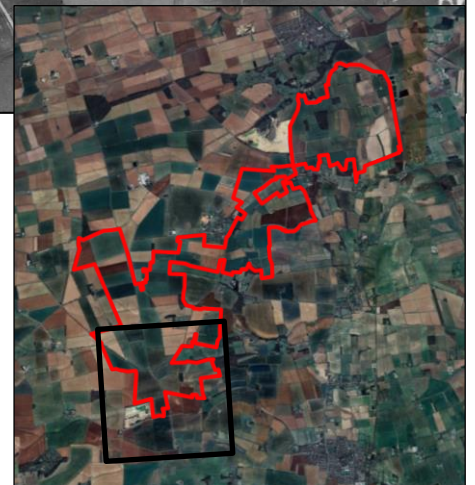
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 Potential Ground Disturbance



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 Approximate site boundary

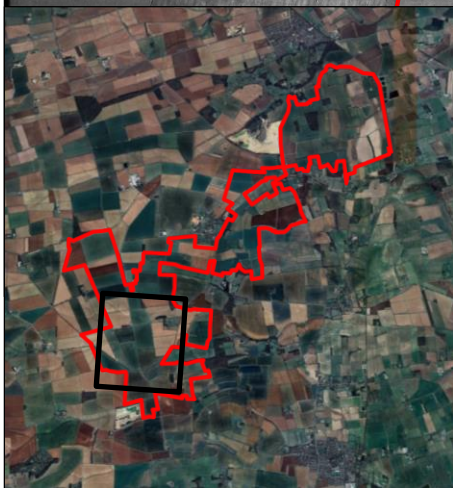


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 Potential Ground Disturbance

 Approximate site boundary



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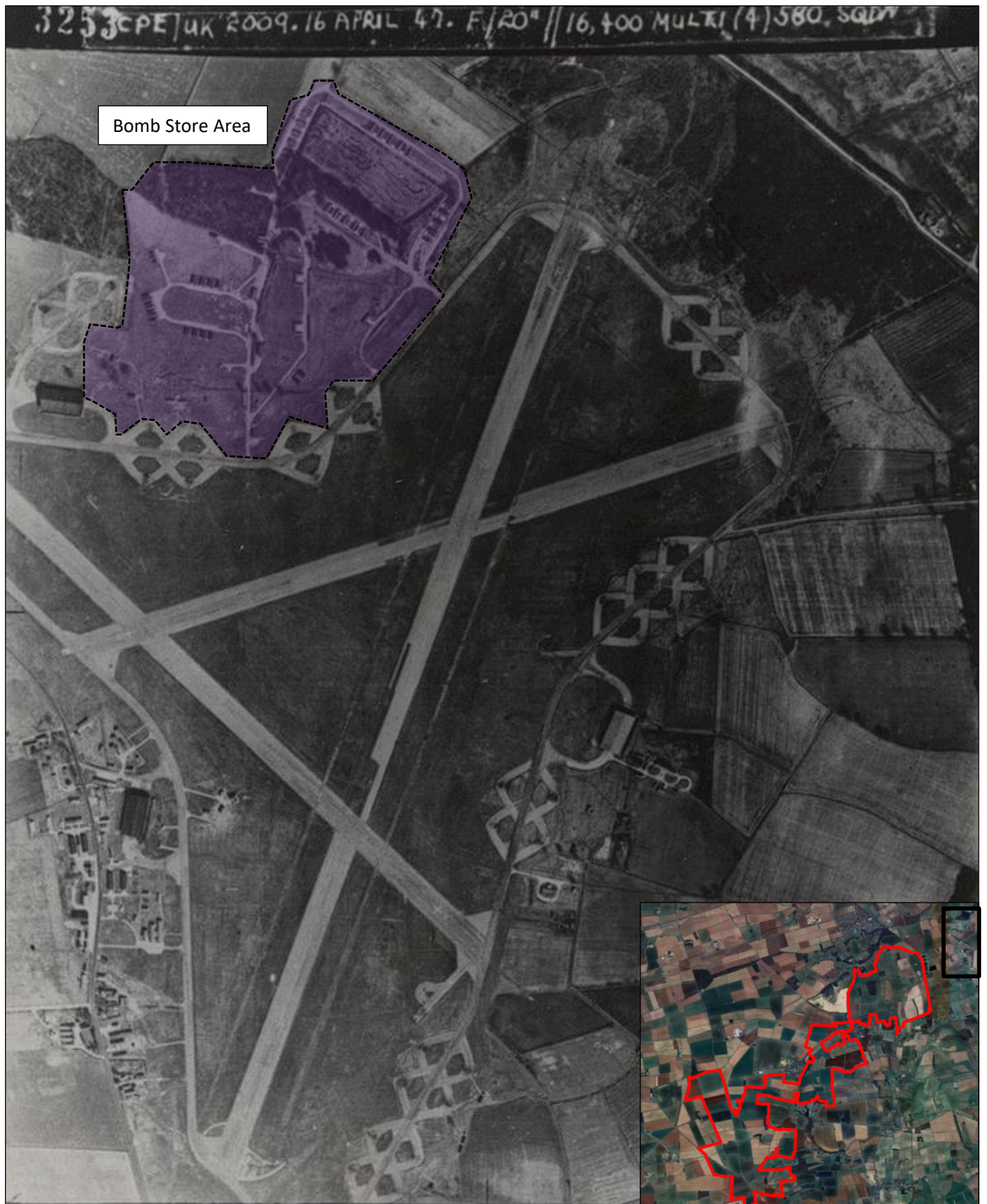
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Source: International Bomber Command Centre

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Bomb Store Area

Approximately 1km east of the northernmost section of the site



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— Approximate site boundary



Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: International Bomber Command Centre



(Above) Four machine guns on the starboard wing of a Spitfire during test firing whilst parked at RAF Digby. Spent cartridges are shown to be ejected from under the wing, circa 12<sup>th</sup> January 1940.



(Above) Four machine guns on the starboard wing of a Spitfire during test firing whilst parked at RAF Digby, circa 12<sup>th</sup> January 1940.



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 Approximate site boundary

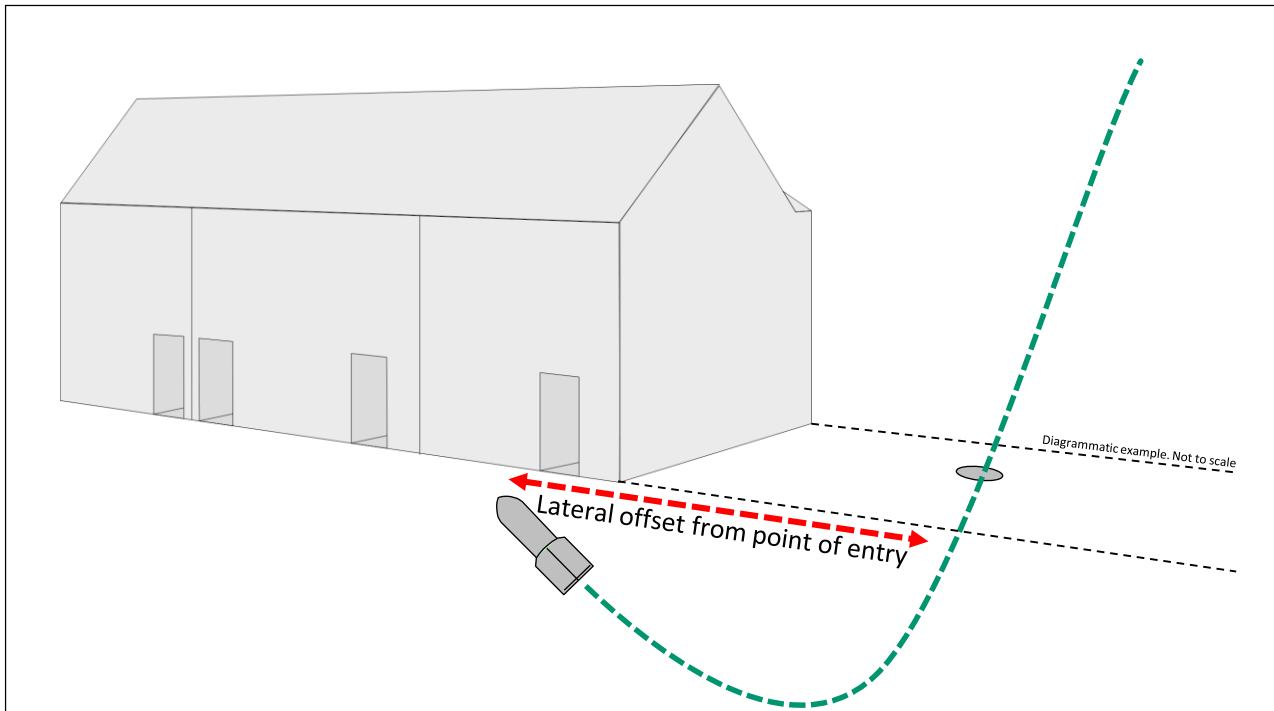


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Source: Airfields of Britain Conservation Trust

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**Top:** J-curve Effect - Due to angle of entry, unexploded bombs would often end their trajectory at a lateral offset from point of entry, often ending up beneath adjacent extant structures/sites. The photograph above shows a 250kg unexploded bomb found in Bermondsey in 2015, pointing upwards, demonstrating 'J-curve'.



One of the most common scenarios for UXO going unnoticed was when a UXB fell into a 'bomb site' (such as the area shown **Top Left**), the entry hole of the bomb obscured by any debris and rubble present. Note that the entry hole of a 50kg UXB could be as little as 20cm in diameter (**Left**).

## Recent Unexploded Bomb Finds, UK

BBC

NEWS

### Bermondsey bomb: World War Two device safely removed



An unexploded World War Two bomb found in south London has been driven away safely under police and Army escort.

The 500lb (250kg) device was found on a building site in Grange Walk, Bermondsey on Monday.

March 2015

BBC

NEWS

### Bethnal Green WW2 bomb: Experts remove unexploded device



An unexploded World War Two bomb that prompted the evacuation of 700 people in east London has been made safe and removed by the military.

Families spent the night in a school hall after the 500lb bomb was found in the basement of a building site on Temple Street, in Bethnal Green, on Monday afternoon.

A 200m (650ft) exclusion zone was set up around the device.

August 2016

BBC

NEWS

### Bath WW2 bomb scare: Device defused, police say



A 500lb World War Two bomb found on the site of a former school in Bath has been defused and made safe.

The discovery of the bomb on Thursday led to the evacuation of hundreds of homes and many road closures in the Lansdown area of the city.

A cordon around the site was lifted on Friday evening, more than 24 hours after residents were asked to leave their homes.

May 2016

BBC

NEWS

### London City Airport reopens after WW2 bomb moved



London City Airport has reopened after an unexploded 500kg World War Two bomb was safely moved from the area.

The device was discovered at the King George V Dock on Sunday during planned work at the east London airport.

All flights were cancelled on Monday after an exclusion zone was put in place, with the closure affecting up to 16,000 passengers and nearby residents being evacuated from their homes.

May 2015



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Project: **Springwell Solar Farm**Ref: **DA17125-00**

Source: BBC News

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BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

The explosion was reported at BASF's Ludwigshafen toluene diisocyanate (TDI) plant, which recently broke ground for a 300,000 metric tons per year TDI production plant and other construction to expand its facilities.



### BASF Provides Some Details

Responding to a request from *PaintSquare News* for more information on Wednesday (Feb. 27), BASF's manager of media relations and corporate communications Europe, Ursula von Stetten, wrote in an email, "So here [are] the facts: The detonation took place at 10:00 a.m. One person was injured; the injury is not serious. He will be kept in the hospital for some days.

"Cause of the detonation was an explosive device, presumably a bomb deriving from the Second World War. The device detonated when grounding work was done. No details on [a] delay [are] available. At the moment, the exact circumstances of the incident are [being] evaluated."

1<sup>st</sup> March 2013

## WWII bomb injures 17 at Hattingen construction site



Seventeen people were injured on Friday when a construction crew unwittingly detonated a buried World War II-era bomb in Hattingen.

An excavator apparently drove over a 250-kilogramme (550 pound) American bomb, damaging surrounding buildings. Most of the injured suffered auditory trauma from the blast, and the excavator operator suffered injuries to his hands, police in the German state of *North Rhine-Westphalia* said.

"The hole was astoundingly small for such a large bomb full of so many explosives," Armin Gebhard, head of the Arnsberg department for military ordnance removal, told *The Local*. "But of course it damaged all the surrounding buildings too. We are really happy it wasn't worse."

19<sup>th</sup> September 2013



## World War II bomb kills three in Germany



A special commission is investigating the causes of the explosion, while prosecutors are considering whether the team leader should face charges of manslaughter through culpable negligence, the BBC's Oana Lungescu reports from Berlin.

The blast happened an hour before the defusing operation was due to start.

Officials said the three men who died were experienced sappers, or combat engineers, who over 20 years had defused up to 700 bombs.

More than 7,000 people were immediately evacuated when the 500kg bomb was found. Several schools, a kindergarten and local companies remain closed.

2<sup>nd</sup> June 2010



June 2006

## SPiegel ONLINE

### Blast Kills One

### World War II Bomb Explodes on German Motorway

A highway construction worker in Germany accidentally struck an unexploded World War II bomb, causing an explosion which killed him and wrecked several passing cars.



A World War II bomb has exploded during construction work on a German highway, killing one worker and injuring several motorists who were driving past, police said.

The worker had been cutting through the road surface near the south-western town of Aschaffenburg when his machine struck the bomb and triggered it. Police said they weren't sure yet what type of bomb it was. "The explosion seems to have been too small for it to have been an aircraft bomb," a police spokesman said.

23<sup>rd</sup> October 2006



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### Unexploded Second World War bomb discovered under Somerset footpath

By [Western Daily Press](#) | Posted: January 21, 2014



The unexploded bomb was found in Somerset.

**Comments (0)**

An unexploded bomb dropped in Britain during the Second World War has finally been discovered – underneath a popular footpath in Somerset.

21 August 2014 Last updated at 15:01

### Unexploded WW2 bomb found at Kenfig Pool, Bridgend



Dean Smith believes the shell was made in Germany

**Bomb experts have been called to a south Wales nature reserve after an unexploded World War Two shell was discovered by a walker in Bridgend.**

Dean Smith, 38, of Pyle, was walking near Kenfig Pool on Saturday when he saw a tin sticking out of the sand.

He reached down to pick it up, but ending up falling and landed with the 25-long (0.5m) bomb on top of him.

The site has been cordoned off by police and the Royal Logistics Corps will carry out a controlled explosion.

**Related Stories**

- 'Panic' as dog nearly drowns grenade
- WW2 bomb found at wind farm exploded
- WWII bomb found in kitchen cupboard

### Mortar thought to be from WWII found on Oshawa's Camp-X grounds

August 24, 2016 | 5:42 am



What is believed to be a World War II mortar has been discovered in south Oshawa. A man out in Intrepid Park, the site of the Camp-X Second World War training grounds, discovered the round with his metal detector on Tuesday evening. Durham police are held the scene overnight awaiting military officials from Trenton to come and properly detonate the mortar.

### Unexploded bomb found in farmer's field

17 May 2010



A live Second World War mortar shell was blown up by Army experts after a farmer found it in his field. The discovery was made in the field alongside the A20 between Folkestone and Dover. The mortar shell, which was around a foot long and 3in in diameter, was around 50ft from the main road.

The farmer alerted police and PC Trevor Moody and PCSO Michelle Brady went to the field. PC Moody contacted the Army who sent in a bomb disposal unit. An Army officer confirmed the live shell was from the Second World War and was packed with high explosives.

They moved it a safe distance away from the A20 and carried out a controlled explosion.

PC Moody said: "Given that we live in an area that saw much action during the Second World War, it is not uncommon for us to be alerted about unexploded bombs."

The incident was on Thursday.

Click here for more news from Kent.

### Royal Navy bomb disposal experts remove a World War Two shell discovered in a nature reserve

- A World War Two bomb was discovered in a Plymouth nature reserve
- Amateur metal detector found the shell and partially dug it up
- Royal Navy experts carried the explosive away before disposing of it

By VALERIE EDWARDS FOR MAILONLINE  
 PUBLISHED: 01:29, 13 January 2016 | UPDATED: 09:51, 13 January 2016

A World War Two bomb was reportedly found at Eford Nature Reserve in Plymouth after a member of the public was metal detecting and partially dug it up.

The Royal Navy Bomb Disposal team was called in to remove the bomb and police have closed off Military Lane, with the possibility of Military Road also being closed.

Police were called at around 1.30pm yesterday after what appeared to be a shell was discovered and partially dug up near Military Lane, Eford.



### Holiday beach cordoned off after landslide sends more than a THOUSAND Second World War bombs and rockets tumbling onto the sands

- Bad weather led to ground movement which exposed the huge arsenal at Mappleton, East Riding
- A dog walker stumbled across the deadly find on Saturday and 15 controlled explosions were carried out
- Rockets, mortar bombs and 25-pounder bombs were recovered after they were fired into the cliffs by RAF aircraft during the war
- Most of the devices were dummy rounds used for bombing practice but contain enough explosives to cause terrible injuries



Bomb Beach Alley: Rockets were found after a landslide on Mappleton beach in 2012


### Army bomb disposal team called to Blacksole Bridge in Herne Bay

by [Aidan Barlow](#) [a.barlow@thetmggroup.co.uk](#) | 08 July 2015

It was like a scene from Dad's Army when Army bomb disposal experts found wartime explosives made by the Home Guard in makeshift bottles.

A team was called to the Blacksole Bridge in Herne Bay after the wartime bombs were found.

The team from the Royal Logistics Corps set up a 30 metre exclusion zone for pedestrians around the railway embankment after the suspected homemade phosphorous bombs were found.



The scene at Blacksole Bridge after wartime explosives were found in the railway cutting

### Unexploded bomb found in Axminster

Update: The bomb disposal unit has made the device safe and the road has re-opened.

Six homes have been evacuated today after the discovery of an unexploded device in Axminster.

A Royal Navy bomb disposal team have been called to the scene after a 'historic German device' was discovered in a garden.

Police have set up a 20m cordon around the garden in Alexandra Road and evacuated homes in the surrounding area as a precaution.



### Storms and floods unearth unexploded wartime bombs

By [Claire Marshall](#)  
 BBC environment correspondent

There has been a dramatic increase in the number of wartime bombs unearthed because of the winter storms and flooding.

Bomb disposal teams in the South West have dealt with double the number of unexploded ordnance than in the same period last year.

Since mid December, the Royal Navy's Southern Dive Unit has retrieved or disposed of 244 items of ordnance.

During the same period last year, they dealt with just 108 items.

Almost 70 years after the end of WWII, one legacy of that conflict continues to turn up on beaches and harbours around Britain.

Unexploded shells, bombs and mines continue to be discovered every year, and the Royal Navy's Southern Dive Unit is tasked with making these devices safe.

Its area of responsibility stretches for some 2,250km (1,400 miles). It begins from the highwater mark in Hull and proceeds seaward to the territorial limit, and then runs clockwise around the British Isles - including the Isle of Wight, Channel Islands, and Isles of Scilly - to finish in Liverpool.




The storms have uncovered a lethal past

**Related Stories**

- Ancient trees revealed by storms

Land Service Ammunition (LSA) resulting from historic military activity is commonly encountered across the UK by the public and construction industry alike. Such finds are much more common in rural areas than in urban environments, and can often be anticipated in areas such as former RAF stations or ranges. However, such items are also encountered entirely by surprise where the landowner or developer has no knowledge of any previous military use of the land.



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# the LINCOLNITE

OCTOBER 2, 2017 9.27 AM THIS STORY IS OVER 62 MONTHS OLD

## Bomb disposal teams deal with WWII canisters found in woods

Emergency services were called to the scene.



Teams were called to a previous incident in Woodhall Spa on May 10 this year

Army bomb disposal teams have dealt with a World War Two device found in Lincolnshire woodland over the weekend.

Lincolnshire Police told motorists to avoid the Roughton Woods area near Woodhall Spa on Sunday, October 1 as emergency services were called to the scene.

Explosive ordnance disposal specialists from the army came to deal with the device.



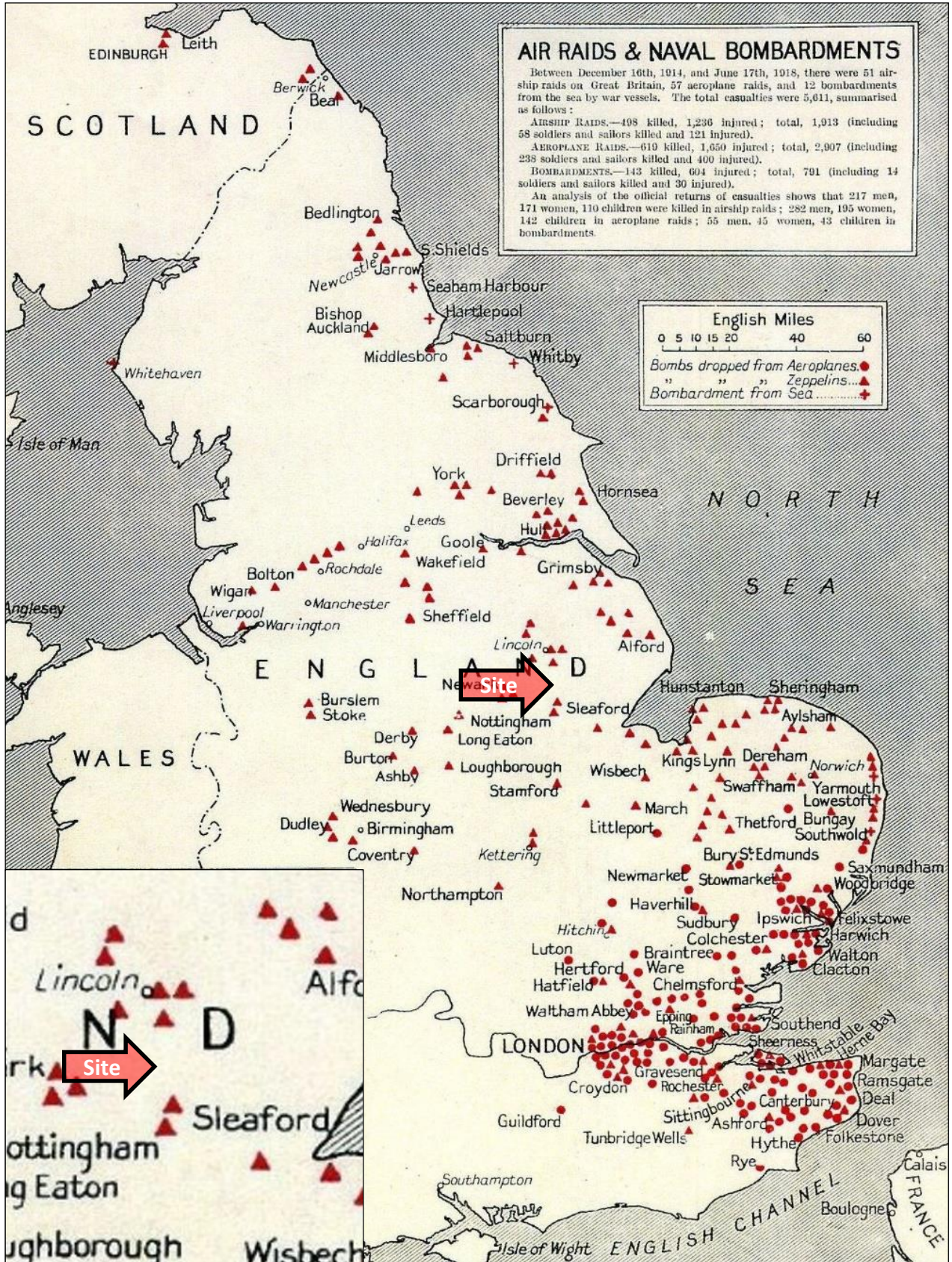
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Ref: **DA17125-00**

Source: The Lincolnite



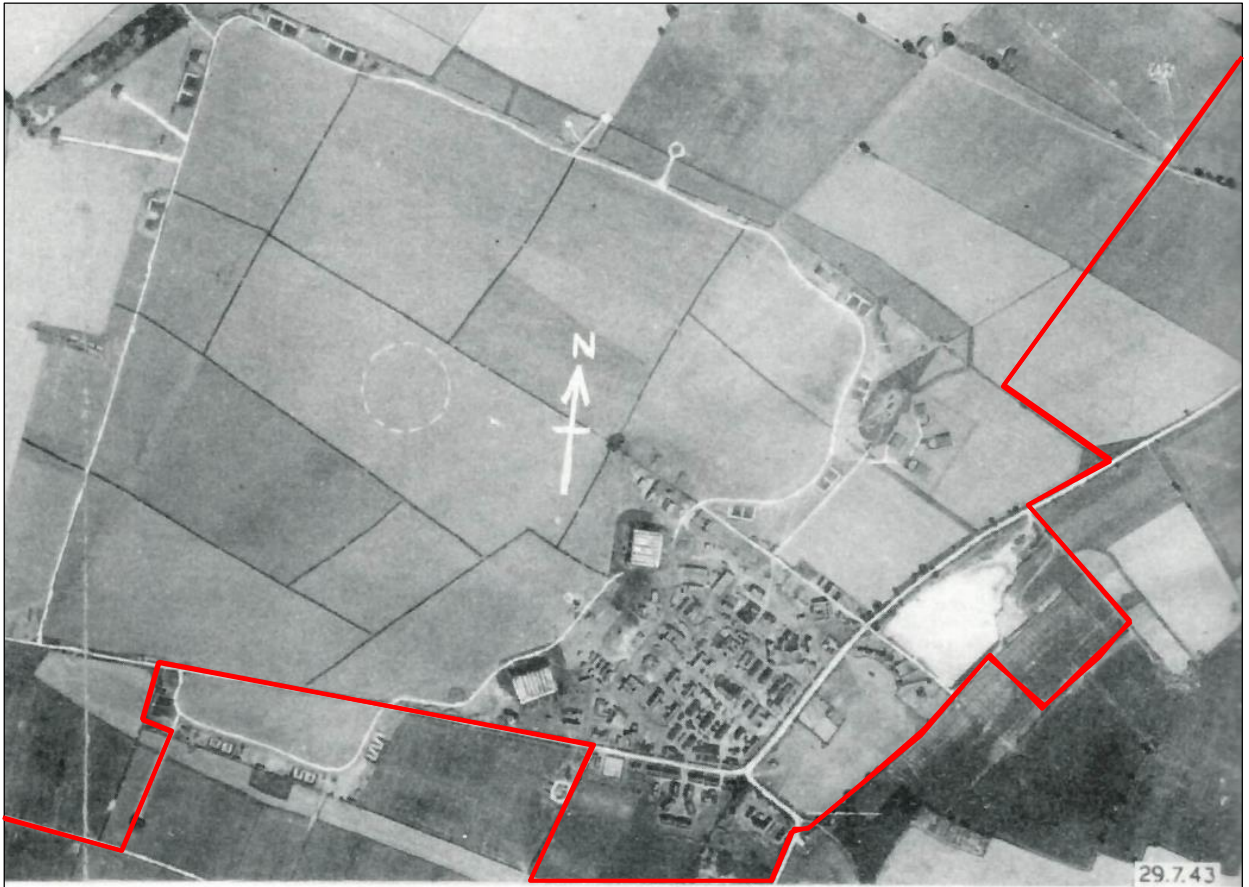
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Luftwaffe Photograph, 29<sup>th</sup> July 1943



## RAF Digby

Designated Luftwaffe target



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— Approximate site boundary



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Source: International Bomber Command Centre

Luftwaffe Photograph, 29<sup>th</sup> July 1943

GB 10 59 bc

Nur für den Dienstgebrauch!

Bild Nr. 2871 Z 10 V.

Aufnahme v. 16. 2. 43

## Digby Flugplatz

Länge (westl. Greenw.): 0° 27'      Nördl. Breite: 53° 06'

Zielhöhe über NN: 30 m

Maßstab in Bildmitte etwa 1:15 500

Lfl. Kdo. 3      April 1943

Karte 1:100000  
GB/E 14

1. 3 Startbahnen in Vorbereitung, etwa 1200, 1200 und 1300 m lang	etwa 6 000 qm
2. 2 Flugzeughallen	etwa 7 000 qm
3. Lager- und Werkstattgebäude	etwa 15 000 qm
4. Unterkunfts- und Wirtschaftsgebäude	etwa 700 qm
5. Schaltzentrale	etwa 2 400 qm
6. Muni-Lager	etwa 150 qm
7. Tankstelle	
8. Flugleitung	

9. Splitterschutzboxen für Flugzeuge	
10. 6 Flugzeugboxen	etwa 1 800 qm
11. Kleinkampfanlagen	
<b>A Funkstelle</b>	
12. 2 Funkmaste	
13. 2 Funkgebäude	etwa 180 qm
Bebaute Fläche	etwa 33 230 qm

Gleisanschluß nicht vorhanden

IWM

## RAF Digby

Designated Luftwaffe target



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RGS/12/1 (285)

MOST SECRET.REPORT SERIAL NO. F. S. 122.

Report on daylight Enemy air attack on Digby R.A.F. Station, Region 3, Lincolnshire, on 3rd. August, 1942.

Investigation carried out by Leeds Flying Squad.  
Members - G. Hartley and E.P. Murphy.

Digby Aerodrome, a Fighter Command Station, is situated 6½ miles North of Sleaford and 10 miles S.S.E. of Lincoln.

The attack occurred at 17.52 hours on the 3rd. August, 4 U.X.H.E. were dropped. Bomb No. 1 fell on Air Ministry property near W.T. Station and the remaining 3 fell in fields adjacent to the Aerodrome.

Warning. The Station received the Air Raid alarm at 17.51 hours.

Weather. Conditions at the time of the attack were -

9/10ths cloud at 600' base.

Visibility 4,000 yards.

Wind, North-East, 15 miles per hour.

Although it was reported to be fine during the attack, intermittent light showers were experienced generally during the afternoon.

Defences. 2 Light A/A Gun Posts were manned, but were not in action. Fighters were patrolling the Station area.

Details of the attack.

17.38 hours. Digby Operations received a report of an aircraft over the Wash flying West at 1,000'.

17.43 hours. This aircraft was allotted the designation of X.635.

17.45 hours. X.635 reported over Boston, still flying West. Spitfires of the Blue and Green Section of



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Source: The National Archives, Kew

General. The Dornier, as reported by eye witnesses, made the bombing run as indicated on the 6" tracing at a height estimated at 500'. It was stated to come out of cloud to the North East of the Aerodrome, half circled the landing ground, and released the H.E., flying E.S.E. As will be seen from the plot, Bombs Nos. 1, 2 and 3 fell close together and are in a straight stick, whereas No. 4 fell 570' yards from No. 3. This may be explained by the report made by Flight. Lieut. O'Hara, B.D.S. Officer on the Station, who stated that he saw the plane immediately after the first 3 H.E. had been released. He observed the 3 bombs falling from the aircraft, which was at that time banking from the East with the right

wing uppermost. It must have been on this manoeuvre that Bomb No. 4 was released, presumably being thrown out of line with the rest of the stick, because of the tilting of the fuselage and the turning eastwards of the aircraft.

It was when the H.E. were released that the Dornier was spotted by the patrolling Spitfires and quite probably the crew of the enemy aircraft saw the fighters at the same time. This may account for the H.Es. being uncharged. The presence of the fighters would probably have some adverse influence on the nerves of the bomber's crew.

There seems little doubt that it was this same Dornier that had the engagement with the Hurricane of Squadron Leader Fitzgerald. Although the Squadron Leader stated he was in the vicinity of Cranbrook, evidence suggests that he may have been to the East of Digby. Machine gunning was heard at the Station, and whereas no ground posts fired, nor did the fighters, it seems reasonable to assume that this machine gunning was from the Hurricane or the Dornier, which suggests that they were at no great distance from Digby at the time.

The R.O.C. Post, Bl, Sleaford, reports that the enemy aircraft was picked up flying South from Digby Village to Square 5371, where it turned Westwards passing near Cranwell R.A.F. Station, going out to the West on to the Derby R.O.C. Board. Later it is reported to have returned into the Lincoln R.O.C. Area to the South of Sleaford. The accompanying 1" tracing shows the suggested track from the evidence available.



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suggested track from the evidence available.

Three of the H.E. have been recovered, Bomb No. 1 by R.A.F. B.D.S. which was a 500 kg. S.C. Bomb Nos. 3 and 4 recovered by Army B.D.S. were 500 kg. S.Ds. Bomb No. 2 is still to be recovered, but is estimated by B.D.S. to be 500 kg.

It appears probable that the enemy, on coming out of cloud and finding himself over an aerodrome, was manoeuvring for an attack on the vulnerable building area, when he became aware of the presence of the Spitfires, and being in a position to attack the W.T. Station, did so. On the other hand, on the occasion of the last attack on Digby, the Defence Officer states that the W.T. Station was the objective.

One point raised by Flight. Lieut. Smith of the R.A.F. Regiment, the Station Defence Officer, is that although the Aerodrome is provided with 8 Light A/A Posts (Lewis and Hispano) he has only sufficient men to man 5 of them. Further, on the day previous to the attack, the Bofors guns, with which the Station was supplied, were removed.



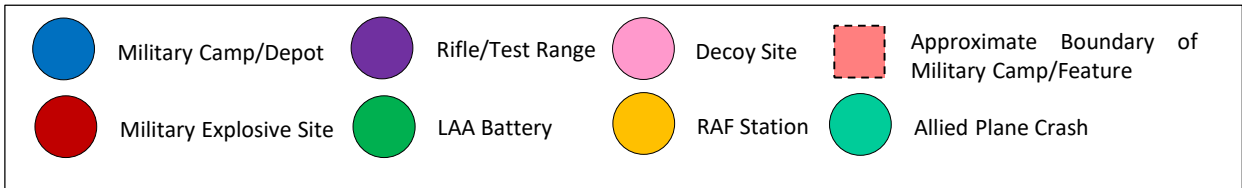
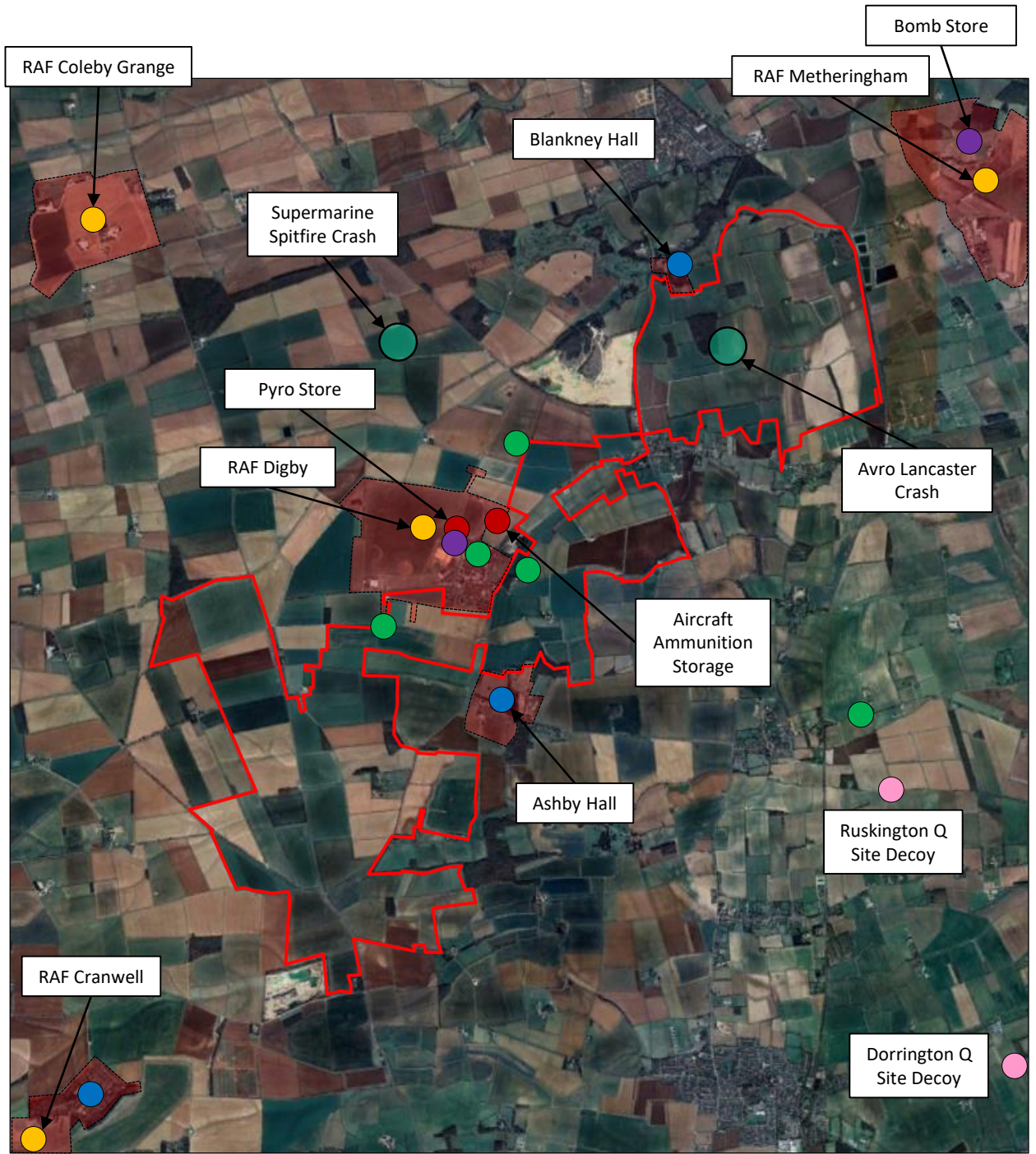
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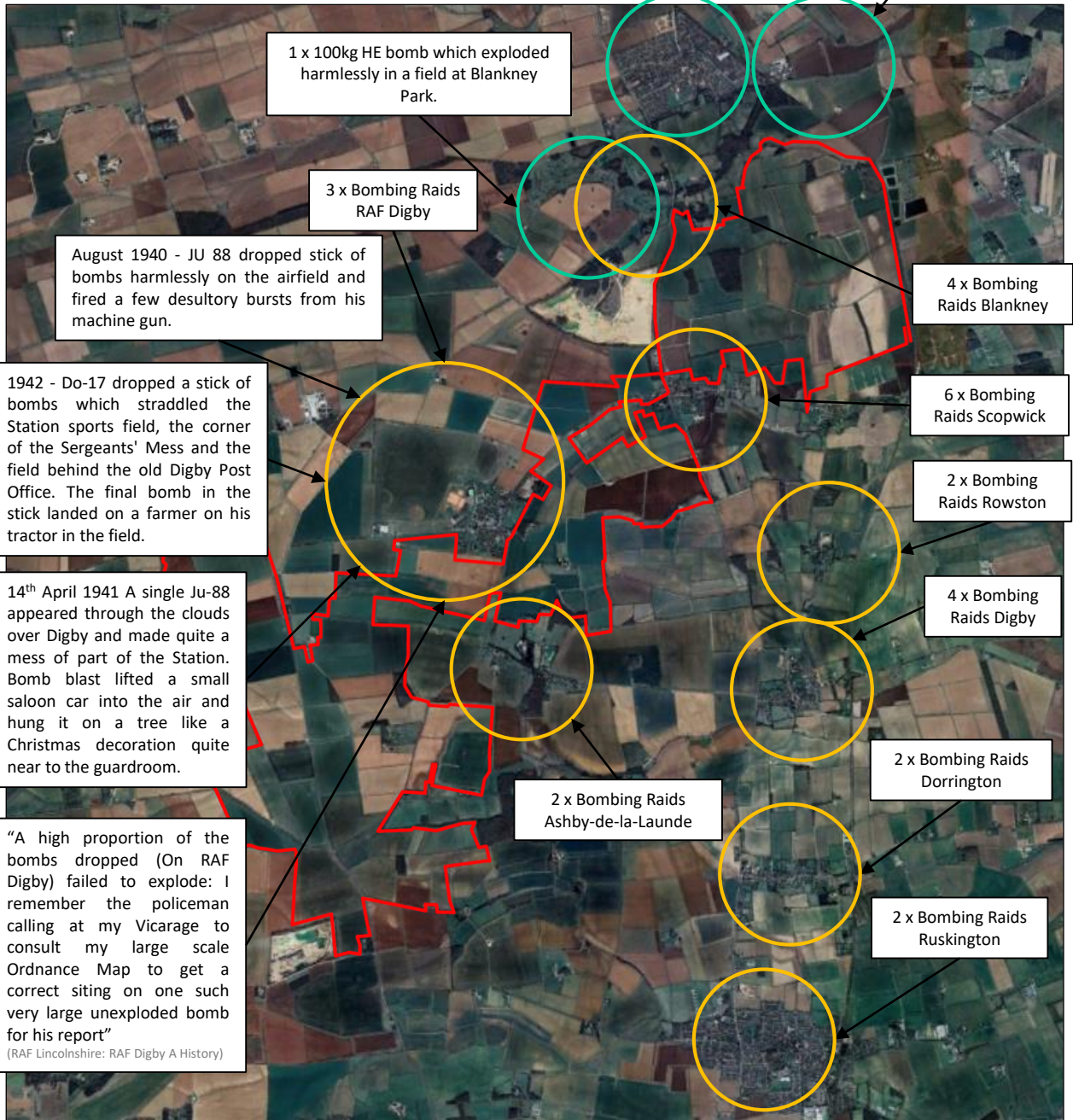
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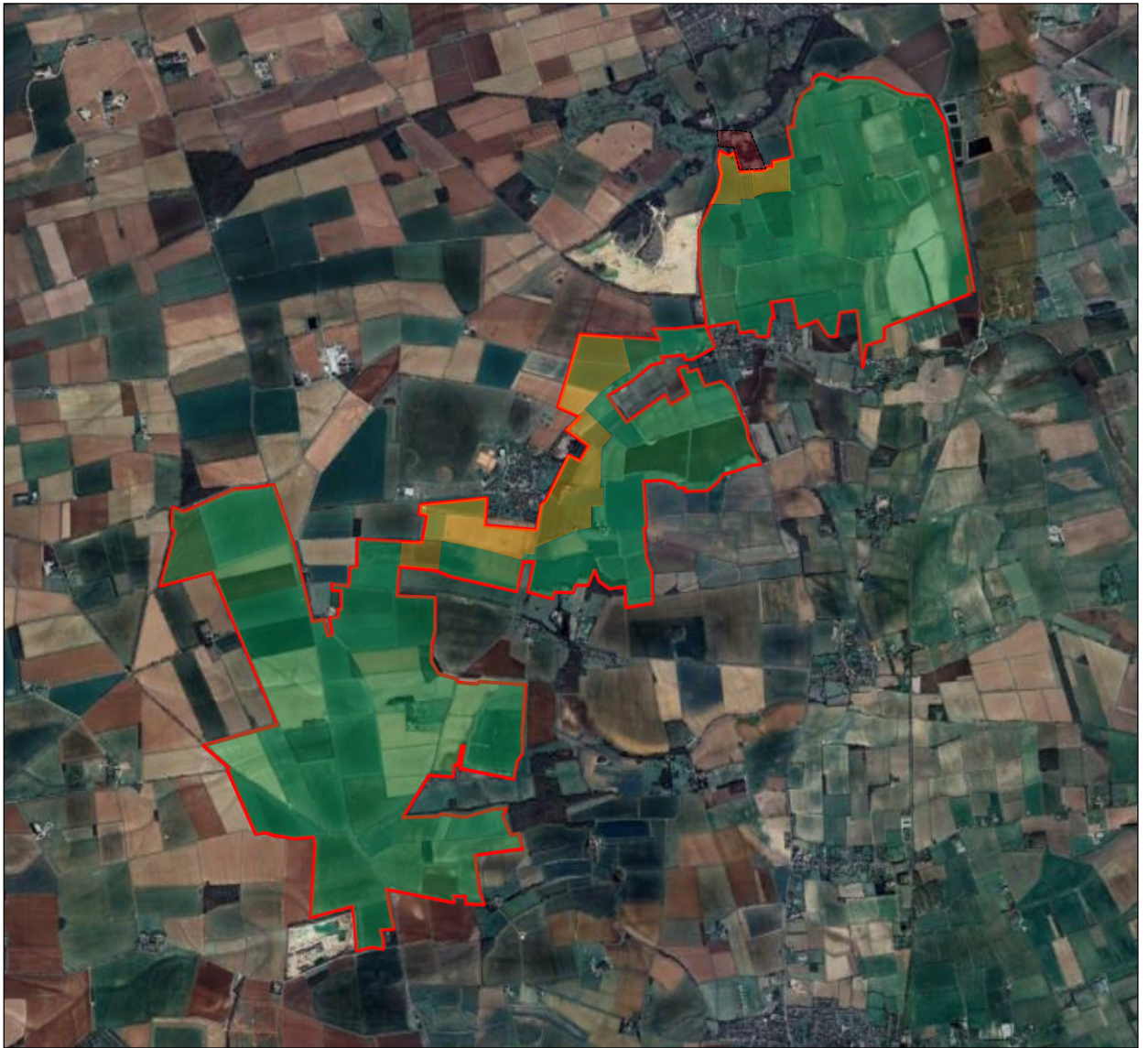
Source: The National Archives, Kew



Please note, this bomb plot map does not provide a comprehensive view of the German bombing across the study area. This maps intended purpose is to provide a general indication as to where bomb strikes landed in the area. These plots are approximate and based off written and anecdotal accounts which provided a location.



- WWII Anecdotal Bombing Raids
- WWI Anecdotal Bomb Incidents



For indicative purposes – not to scale.  
 Please note that this assessed risk map may not take into account all post-war redevelopment/excavations on site.

- Low Risk
- Medium Risk

**All Risk Areas:**

- Site Specific Unexploded Ordnance Awareness Briefings to all personnel conducting intrusive works
- UXO Risk Management Plan

**Medium Risk Area:**

- Non-Intrusive UXO Magnetometer Survey and Target Investigation (where appropriate.)
- Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works



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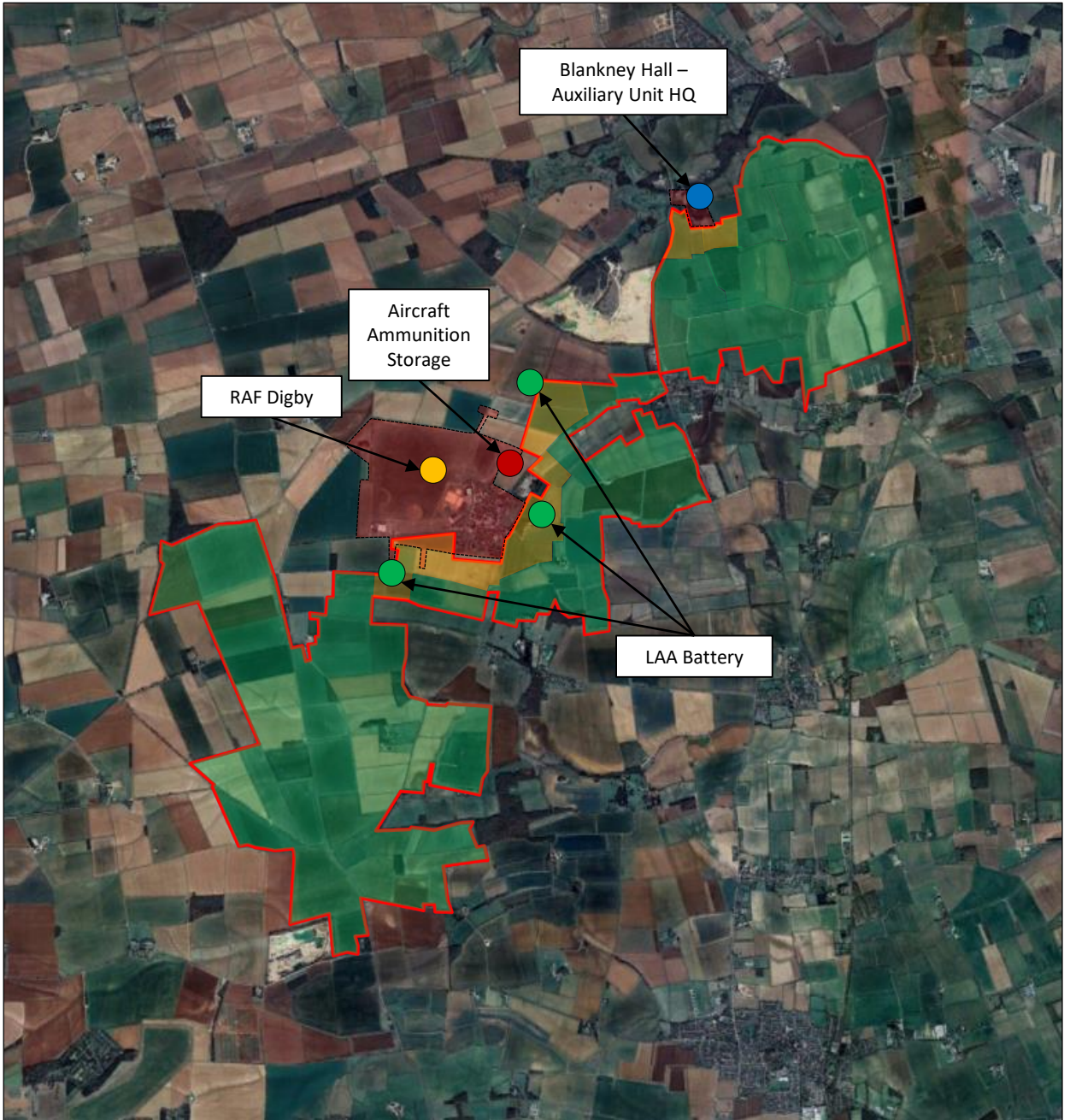
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Source: 1<sup>st</sup> Line Defence

— Approximate site boundary







- Low Risk
- Medium Risk



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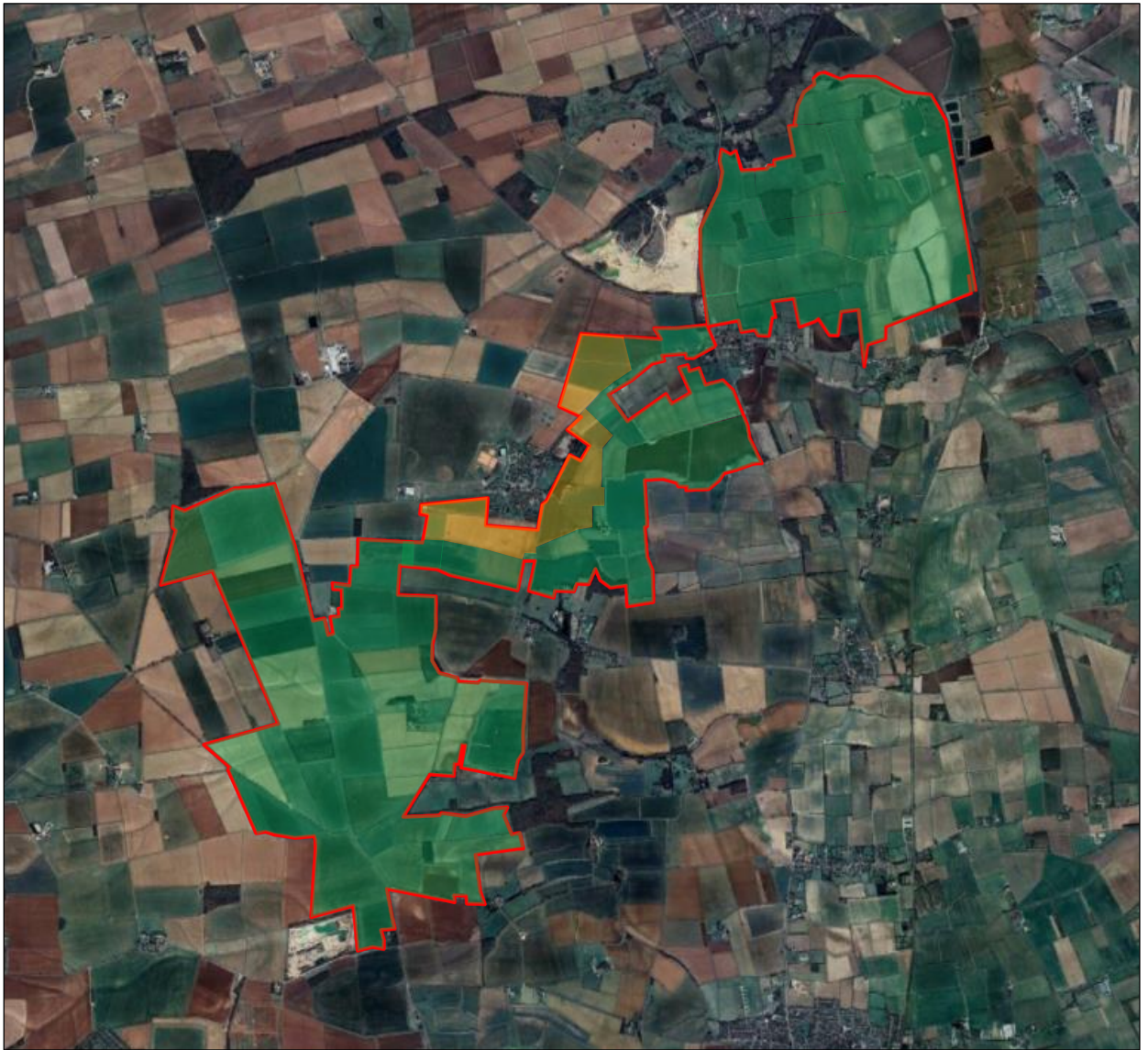
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: 1<sup>st</sup> Line Defence

— Approximate site boundary





For indicative purposes – not to scale.

Please note that this assessed risk map may not take into account all post-war redevelopment/excavations on site.

- Low Risk
- Medium Risk

**All Risk Areas:**

- Site Specific Unexploded Ordnance Awareness Briefings to all personnel conducting intrusive works
- UXO Risk Management Plan

**Medium Risk Area:**

- Non-Intrusive UXO Magnetometer Survey and Target Investigation (where appropriate.)
- Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works
- Intrusive Magnetometer Survey of all Borehole and pile locations down to a maximum bomb penetration depth



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— Approximate site boundary




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-  Low Risk
-  Medium Risk

 Approximate site boundary



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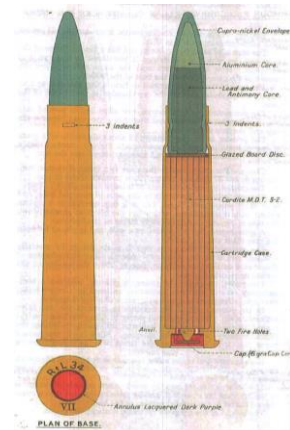
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## British 303. Round

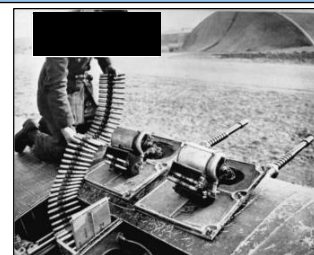
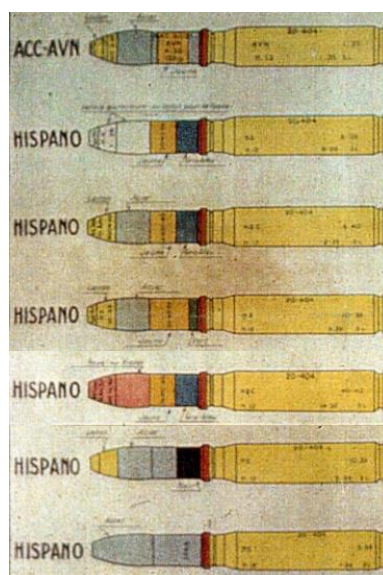
Bullet Diameter	7.92mm
Case length	56.44mm
Overall length	78.11mm
Type	Rifle Ammunition
Use	303 rounds were used in machine guns on aircraft, as well as in aircraft defence, and SAA.
Remarks	First produced in 1889 and still in use today, the .303inch cartridge has progressed through ten 'marks' which eventually extended to a total of around 26 variations.

Bullet Type	Colour of tip	Colour of Annulus
Armour Piercing	Green	Green
Ball	None	Purple
Incendiary	Blue	Blue
Observing	Black	Black
Proof	None	Yellow
Tracer Short Range	White	Red
Tracer Dark Ignition	Grey	Red
Tracer Long Range	Red	Red



## Hispano Suiza HS.404

Weight	HE - 0.13kg (13lbs), complete Round 0.2kg (0.57lbs) Armour Piercing - 0.17kg (0.37lbs) complete round 0.29kg (0.64lbs)
Explosive Weight	HE & HEI - 0.014kg. Armour Piercing and shot rounds may not have been filled with an explosive element.
Fuze Type	No.253 MK.1A Direct Action (Percussion) Fuse
Dimensions	20mm x 110m
Use	The Hispano Suiza HS.404 was widely used by both fighter and bomber aircraft throughout WWII
Remarks	Although relatively small, if encountered en masse unexploded HE canon round may present a risk to people and plant.



## RP-3 60lbs Rocket

Weight	37kg (80lbs)
Explosive Weight	25kg (25kg)
Fuze Type	No. 899 MK 1
Dimensions	55.88cm x 11.43cm (22" x 4.5")
Use	A rocket typically deployed from the air at ground targets such as tanks, trains, and shipping.
Remarks	The RP-3 was a high explosive rocket designed to destroy armoured vehicles. If detonated an RP-3 may present a serious risk to both workers and equipment.



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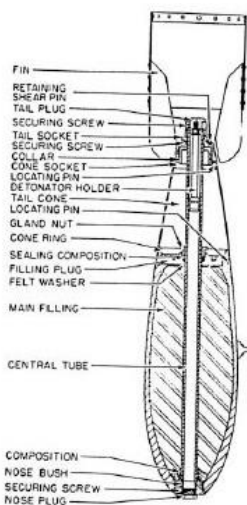
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Various sources

## 250lb General Purpose Bomb

Weight	247lbs
Explosive Weight	123lbs
Fuze Type	Nose fuses included the AM-M103, M118, and M119. Tail fuses included AM-M102A2 or the M114A1
Dimensions	28" x 10.3" (137.66cm x 71.12cm)
Use	The 250lbs bomb was used to target railways, small buildings, ammunition dumps, planes, and hangers. Bombs were typically mounted under the wings.
Remarks	Allied ordnance was typically 'lustreless' or 'olive drab'. Bombs were typically marked with a yellow ban across the nose or the tail.

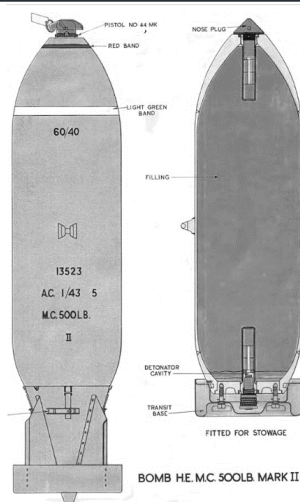


Above - A Westland Whirlwind being armed with 250lbs underwing. Below - 250s in N. Africa



## 500lb General Purpose Bomb

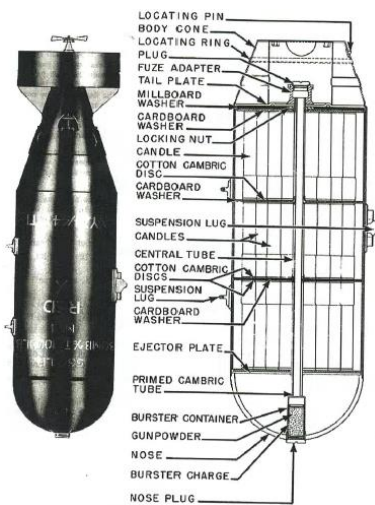
Weight	509lbs
Explosive Weight	262lbs
Fuze Type	Nose fuses included the AM-M103, M118, and M119. Tail fuses included AM-M102A2 or the M114A1
Dimensions	35.7" by 13" (90.67cm x 33.02cm)
Use	The 500lbs general purpose bomb was the most commonly deployed item, of Allied aerially delivered ordnance. 1,729,611 500lbs were deployed by the allies.
Remarks	Allied ordnance was typically 'lustreless' or 'olive drab'. Bombs were typically marked with a yellow ban across the nose or the tail.



A Hawker Tempest being equipped with 500lbs general purpose bombs circa 1943 - 1945

## 1000lb Medium capacity bomb

Weight	1,021lbs (464.09kg)
Explosive Weight	480lbs (approx. 47% of bomb weight)
Fuze Type	Nose fuses included the AM-M103, M118, and M119. Tail fuses included AM-M102A2 or the M114A1
Dimensions	72.6" x 52.5" (184.4cm x 133.35)
Use	The bomb was usually fitted under the wings of fighter aircraft and used for the tactical bombing of strategic targets. From 1944 the bomb was rationed for the purpose of supporting land operations.
Remarks	The bomb is made of case steel with an amatol 50/50 or 60/40 amtex filling.



Above, a 1000lbs. Below, a 1000lbs being fitted to a P-40 Warhawk



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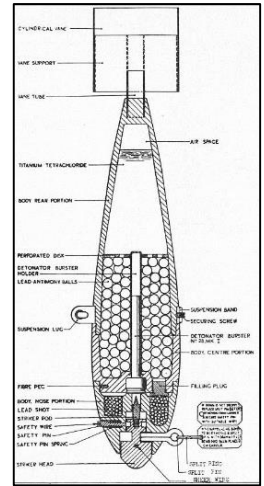
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Ref: **DA17125-00**

Source: Various sources

## 8.5 lb Practice Bomb

Bomb Weight	85 lb (approx. 3.9 kg)
Explosive Weight	1 lb (approx. 0.45 g)
Fuze Type	Explosive fuze and bursting charge.
Bomb Length	15.9 in (405 mm)
Body Diameter	Max. 2.95 in (75 mm)
Use	Dropped by Allied forces in order to practice bombing accuracy. Practice bombs used a small bursting charge to release smoke to mark their position.
Remarks	Had a moulded plastic shell. The Mk I had smoke filling and the Mk III had a flash filling, a mixture of gunpowder and magnesium turnings.



## 10 lb Practice Bomb

Bomb Weight	10 lb (approx. 4.5 kg)
Explosive Weight	1 lb (approx. 0.4 g)
Fuze Type	Explosive fuze and bursting charge.
Bomb Length	18 in (460 mm)
Body Diameter	Max. 3 in (76 mm)
Use	Dropped by Allied forces in order to practice bombing accuracy. Practice bombs used a small bursting charge to release smoke to mark their position.
Remarks	The Mk I had smoke filling and the Mk III had a flash filling, a mixture of gunpowder and magnesium turnings.

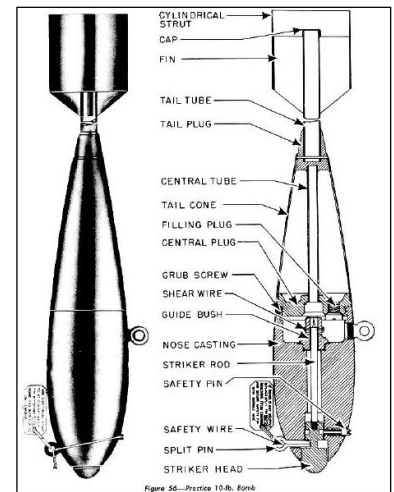


Figure 56—Practice 10-lb. Bomb

## 11.5 lb Practice Bomb

Bomb Weight	11.5 lb (approx. 5.0 kg to 5.3 kg)
Explosive Weight	1 lb (approx. 0.45 g)
Fuze Type	Explosive fuze and bursting charge.
Bomb Length	460 mm (18 in)
Body Diameter	Max. 3 in (76 mm)
Use	Dropped by Allied forces in order to practice bombing accuracy. Practice bombs used a small bursting charge to release smoke to mark their position.
Remarks	Available with smoke or flash filling. Mk II was made of Bakelite. Most often had a white shell.

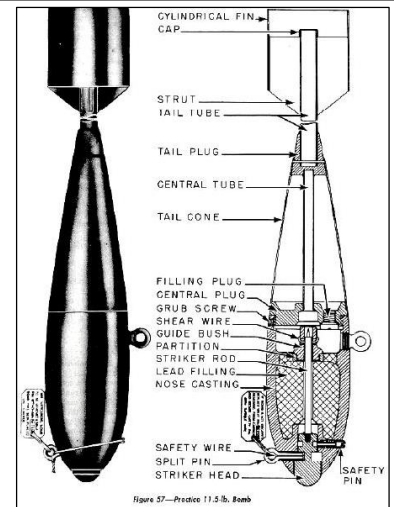


Figure 57—Practice 11.5 lb. Bomb



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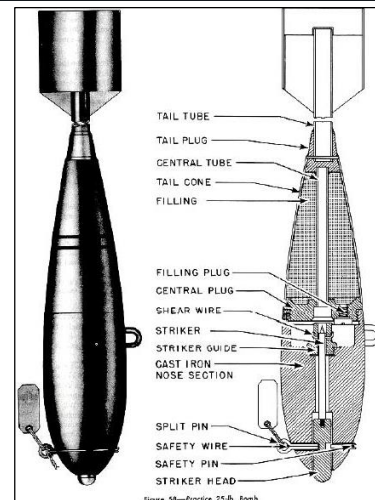
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Various sources

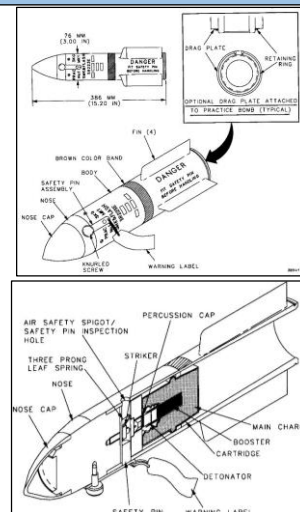
## 25 lb Practice Bomb

Bomb Weight	25 lb (11 – 11.5 kg)
Explosive Weight	1 lb (approx. 0.45 g)
Fuze Type	Explosive fuze and bursting charge.
Bomb Length	22 in (550 – 560 mm)
Body Diameter	4 in (100 mm)
Use	Dropped by Allied forces in order to practice bombing accuracy. Practice bombs used a small bursting charge to release smoke to mark their position.
Remarks	Mks I and IV had a smoke filling and Mks III and V had a flash filling for use at night. The 25 lb Practice Bomb was usually white with a cast iron nose.



## 3 kg Practice Bomb

Bomb Weight	3 kg (approx. 6.6 lb)
Explosive Weight	Contains a smoke or flash filling.
Fuze Type	Varied
Bomb Length	386 mm (15.2 in)
Body Diameter	76 mm (3 in)
Use	Dropped by Allied forces in order to practice bombing accuracy. The 3kg Practice Bomb used a traditional detonator.
Remarks	Coloured banding around the casing denotes the filling of the bomb. The image to the left is a low explosive example.



## Buried and Decayed Practice Bombs



Examples of buried 3kg Practice Bombs.



Practice bombs found after a landslide in Mappleton Beach.



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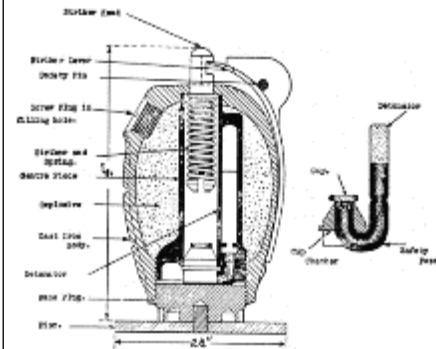
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

Source: Various sources

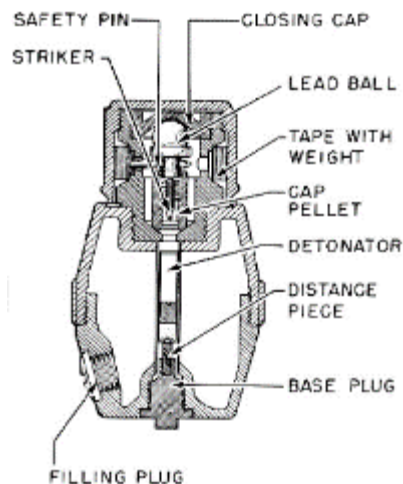
## No. 36 'Mills' Grenade

Weight	760g filled (1lb 6oz)
Explosive Weight	71g (2.5 oz) Baratol filling.
Fuze Type	4 second delay hand-throwing fuze
Dimensions	95 x 61mm (3.7 x 2.4in)
Use	Fragmentation explosive at approx. 30m range 100m range of damage.
Remarks	First introduced in 1915 its classic grooved 'pineapple' design was designed to provide uniform fragmentation. Approx. over 70million were produced.



## No. 69 Grenade

Weight	383g (0.81lb)
Explosive Weight	93g (3.25 oz) of either Amatol, Baratol or Lyddite
Fuze Type	'All-ways' Fuze. Comprised of a safety cap, a weighted streamer attached to a steel ball bearing and a safety bolt designed to detonate from any point of impact.
Dimensions	114 x 60mm (4.5 x 2.4 in)
Use	A blast grenade for use as an offensive weapon.
Remarks	Introduced December 1940 and made from the plastic Bakelite as opposed to conventional metals. Detection is difficult due to this low metal content.



## L2 Grenade

Weight	454g (16 oz)
Explosive Weight	164g. (16 oz)
Fuze Type	Time Friction Fuze
Dimensions	Approx. 99 x 57 mm (3.9 x 2.2 in)
Use	A widely used anti-personnel grenade, a version of the American M26. Variants still see use in the present day.
Remarks	The L2 series also came as a Practice (L3) grenade and a Drill (L4) Grenade. The Drill variant, with a non-functional fuze and no filing, is visible on the far right.



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Source: Various sources



## Mortars

## Typical 2 Inch High Explosive Mortar

Weight	1.02kg (2.25lb)
Maximum Range	460m (500yards)
Filling	200g RDX/TNT
Dimensions	51 x 290mm (2in x 11.4 in )
Fuze Type	An impact fuze which detonates the fuze booster charge and in turn the high explosive charge.
Use	A small, portable mortar introduced into the British army in 1938. It had greater range and firepower over hand and rifle grenades, and was used to attack targets behind cover with high explosive rounds.
Remarks	Detonation causes the mortars bomb body to shatter producing optimum fragmentation and blast effect at the target.



## Typical 3 inch Smoke Mortar

Weight	4.5kg (9lb 14oz)
Maximum Range	2515m ( 2,750 yards)
Filling	White phosphorus & smoke fill (also came in Explosive & Illuminating models)
Bomb Dimensions	490 x 76mm ( 19.3in x 3in)
Fuze Type	An impact fuze which initiates a bursting charge. This ruptures the mortar bomb 's body and disperses the phosphorus filler
Use	As a screening devices for unit movement or to impair enemy field of vision.
Remarks	This mortars long cylindrical body and tail sometimes causes it to be misrecognised as a German incendiary bomb.



## ML 4.2 inch Mortar

Weight	9kg (19lb 13oz)
Maximum Range	3,750m (4,100 yards)
Filling	High explosive, smoke (white phosphorous or Titanium Tetrachloride) or chemical
Bomb Dimensions	500 x 105 mm (19 in x 4 in)
Fuze Type	Sensitive fuze with HE bursting charge.
Use	A widely used heavy motor which first saw use in 1942 and saw usage throughout the post-war period.
Remarks	Different markings denoted different fillings. See image to the right.



L to R: HE, Smoke, Chemical, Smoke BE.



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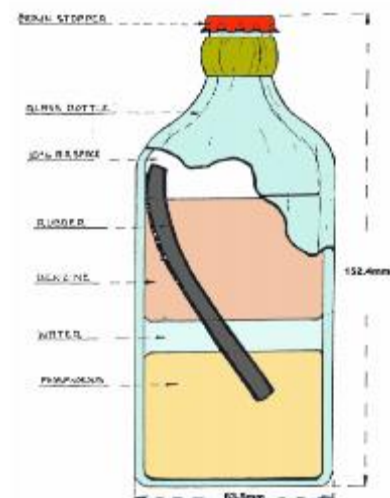
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Ref: **DA17125-00**

Source: Various sources

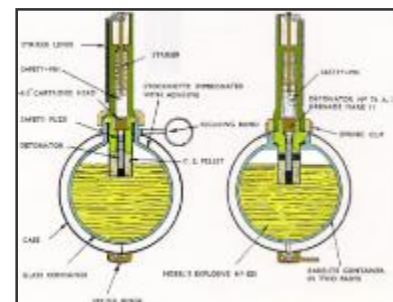
**Self Igniting Phosphorous (SIP) Grenades**

Weight	Various
Filling	White Phosphorous and Benzene
Design	The filling was contained in a pint sized glass bottle with water and a strip of rubber. Over time the rubber dissolved to create a sticky liquid which would self ignite when the bottle broke.
Use	Originally intended as an anti-tank incendiary weapon deployed by hand. Designed to be produced cheaply without consuming materials needed to produce armaments on the front line.
Remarks	The Home Guard hid caches of these grenades during the war for use in the event of an invasion. Not all locations were officially recorded and some caches were lost. Occasionally discovered today. In all cases, the grenades are still found to be dangerous.



**No. 74 Grenade (Sticky Bomb)**

Weight	Approx. 1.1kg ( 2lb 4oz)
Filling	Approx. 600g Nobel's No.283 (Nitroglycerine)
Design	A glass ball on the end of a Bakelite (plastic) handle. The inside of the ball would contain the explosive filling and the outside a very sticky adhesive coating.
Use	An anti-tank grenade primarily issued to the home guard. It required the user to come in very close proximity with the target and smash the glass explosive container against it.
Remarks	One of a number of weapons developed for use as an <i>ad hoc</i> solution to the lack of sufficient anti-tank guns in the aftermath of the Dunkirk evacuation amid fear of German invasion.



**Flame Fougasse Bomb**

Weight	Various
Filling	Initially a mixture of 40% petrol and 60% gas. Ammonal provided the propellant charge.
Design	Usually constructed from a 40-gallon drum dug into a roadside and camouflaged.
Use	As an improvised anti-tank bomb. When triggered the Fougasse could project a beam of burning sticky fuel in a fixed direction from up to 3m (10ft) wide and 27m (30yards) long.
Remarks	A highly unorthodox weapon designed by the Petroleum warfare department to address a critical lack of weapons in 1940. 50,000 are estimated to have been distributed around the UK.

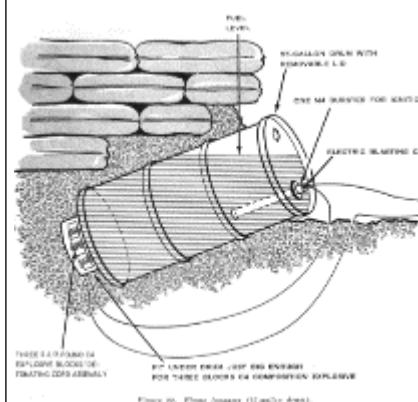


Figure 26. Flame Fougasse (12 gal/40 litres)



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Ref: **DA17125-00**

Source: Various sources

# Examples of Small Arms Ammunition

## Cannon Ammunition



## Rifle Ammunition



## Buried and Decayed Ammunition



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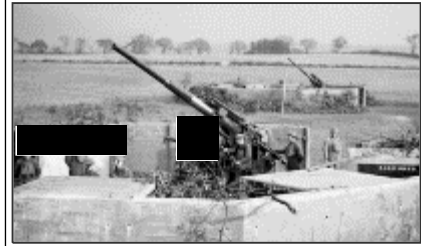
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## QF 3.7 Inch WWII Anti-Aircraft Projectile

Projectile Weight	28lb (12.6 kg)
Explosive Weight	2.52lbs
Fuze Type	Mechanical Time Fuze
Dimensions	3.7in x 14.7in (94mm x 360mm)
Rate of Fire	10 to 20 rounds per minute
Use	High Explosive Anti-Aircraft projectile. 4.5in projectiles were also used in this role.
Ceiling	30,000ft to 59,000ft



## 40mm Bofors Projectile

Projectile Weight	1.96lb (0.86kg)
Explosive Weight	300g (0.6lb)
Fuze Type	Proximity and Mechanical Time Fuze
Rate of Fire	120 rounds per minute
Projectile Dimensions	40mm x 310mm (1.6in x 12.2in)
Ceiling	23,000ft (7000m)



## Unrotated Projectile (UP) – Z Battery

Projectile Weight	84lb (24.5kg)
Warhead Weight	4.28lb (1.94kg)
Warhead	Aerial Mine with a No. 700 / 720 fuze
Filling	High Explosive
Dimensions	1930mm x 82.6mm (76 x 3.25in)
Use	As a short range rocket-firing anti-aircraft weapon developed for the Royal Navy. It was used extensively by British ships during the early days of World War II. The UP was also used in ground-based single and 128-round launchers known as Z Batteries.



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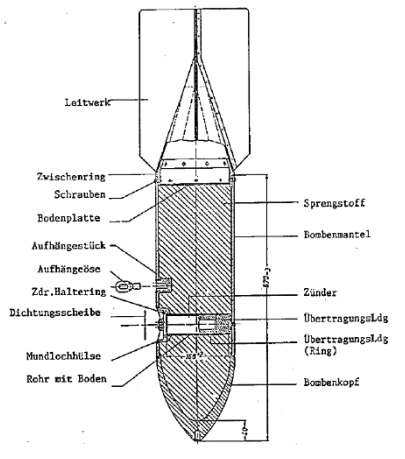
Project: **Springwell Solar Farm**

Ref: **DA17125-00**

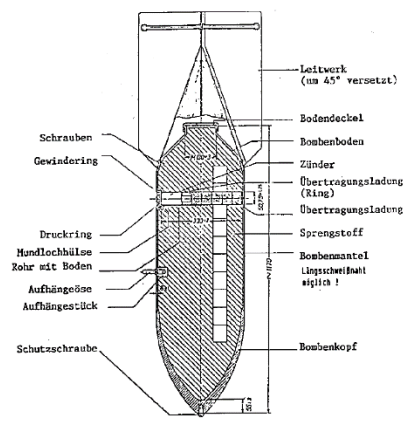
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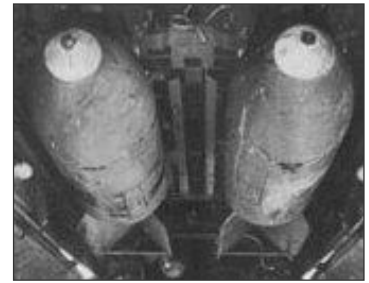
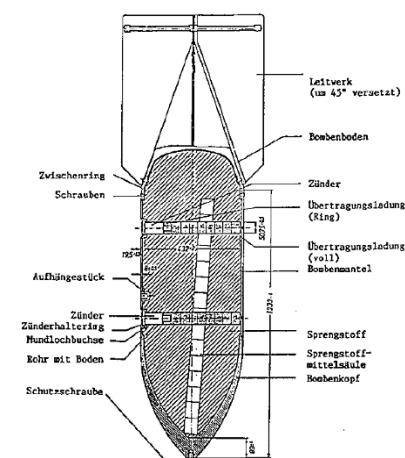
SC 50kg	
Bomb Weight	40-54kg (110-119lb)
Explosive Weight	c25kg (55lb)
Fuze Type	Impact fuze/electro-mechanical time delay fuze
Bomb Dimensions	1,090 x 280mm (42.9 x 11.0in)
Body Diameter	200mm (7.87in)
Use	Against lightly damageable materials, hangars, railway rolling stock, ammunition depots, light bridges and buildings up to three stories.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.



SC 250kg	
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground installations.
Remarks	It could be carried by almost all German bomber aircraft, and was used to notable effect by the Junkers Ju-87 Stuka (Sturzkampfflugzeug or dive-bomber).



SC 500kg	
Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise buildings and below-ground installations.
Remarks	40/60 or 50/50 Amatol TNT, trialene. Bombs recovered with Trialene filling have cylindrical paper wrapped pellets 1-15/16 in. in length and diameter forming

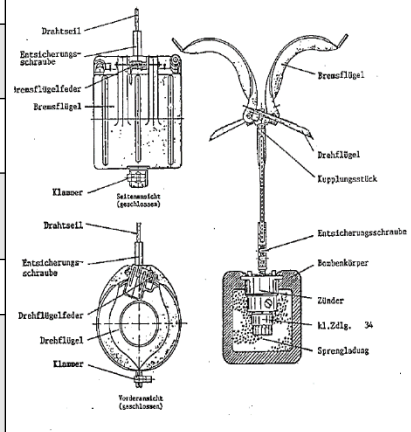


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SD2 Butterfly Bomb	
Bomb Weight	2kg (4.41lb)
Explosive Weight	7.5oz (212.6 grams ) of TNT surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Bomb Dimensions	Length 240 mm Width 140 mm Height 310 mm
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	It was designed as an anti-personnel/fragmentation weapon. They were delivered by air, being dropped in containers that opened at a predetermined height, thus scattering the bombs.
Remarks	The smallest and most common conventional German bomb. Nearly 70% of bombs dropped on the UK were 50kg.



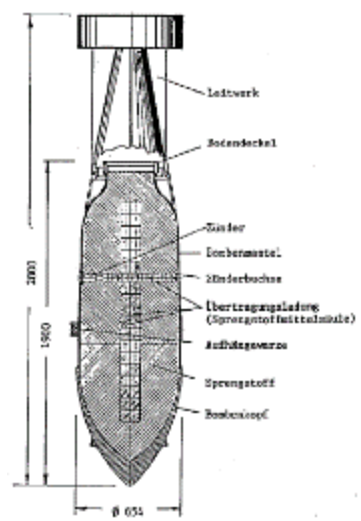
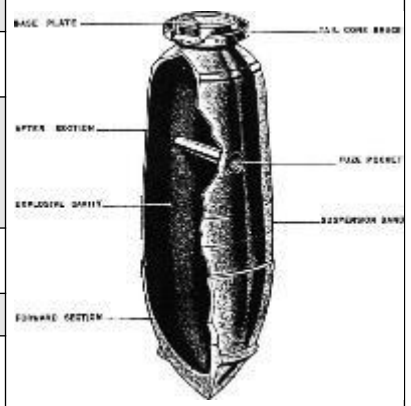
## Parachute Mine (Luftmine B / LMB)

Bomb Weight	987.017kg (2176lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Impact/ Time delay / hydrostatic pressure fuze
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against civilian, military and industrial targets. Designed to detonate above ground level to maximise damage to a wider area.
Remarks	Parachute Mines were normally carried by HE 115 (Naval operations), HE 111 and JU 88 aircraft types. Deployed a parachute when dropped in order to control its descent.



## SC 1000kg

Bomb Weight	996-1061kg (1,058-1,146lb)
Explosive Weight	530-620kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (77 x 25.2in)
Body Diameter	654mm (18.5in)
Use	SC type bombs are General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses. They are usually of three piece welded construction



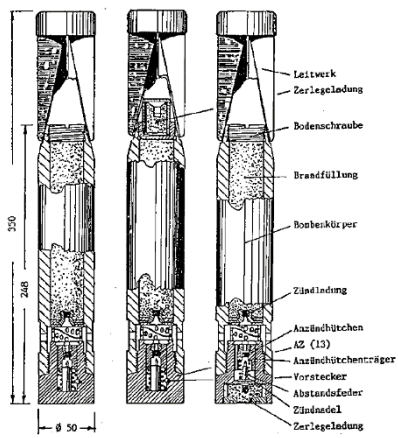
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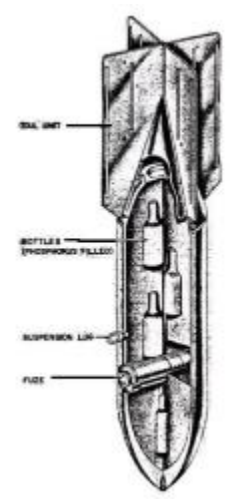
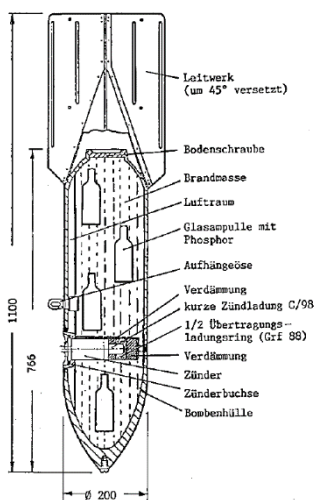
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Source: Various sources

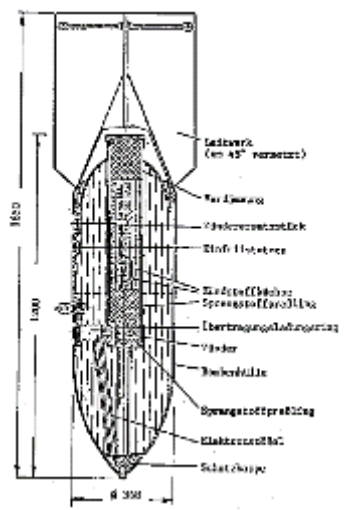
1kg Incendiary Bomb	
Bomb Weight	1.0 and 1.3kg (2.2 and 2.87lb)
Explosive Weight	680gm (1.3lb) Thermit
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters against towns and industrial complexes
Remarks	Magnesium alloy case. Sometimes fitted with high explosive charge. The body is a cylindrical alloy casting threaded internally at the nose to receive the fuze holder and fuze.



C50 A Incendiary Bomb	
Bomb Weight	c41kg (90.4lb)
Explosive Weight	0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against all targets where an incendiary effect is to be expected
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture



Flam C-250 Oil Bomb	
Bomb Weight	125kg (276lb)
Explosive Weight	1kg (2.2lb)
Fuze Type	Super-fast electrical impact fuze
Filling	Mixture of 30% petrol and 70% crude oil
Bomb Dimensions	1,650 x 512.2mm (65 x 20.2in)
Body Diameter	368mm (14.5in)
Use	Often used for surprise attacks on living targets, against troop barracks and industrial installations. Thin casing – not designed for ground penetration



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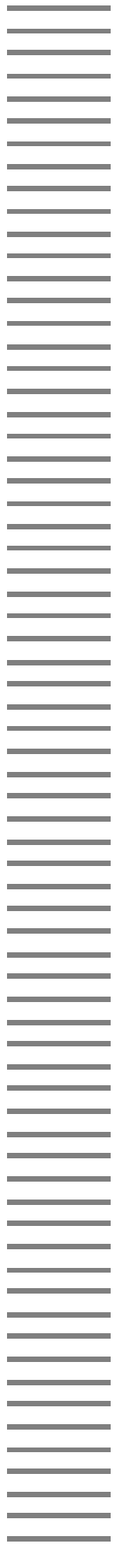
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Source: Various sources

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