Appendix O Detailed Unexploded Ordnance (UXO) Risk Assessment

Cover note

The Site boundary has been amended following the completion of the UXO report that is presented in this appendix, however the area used for the assessment was larger than the current Site boundary.

The report still refers to the original area used when the report was prepared, therefore the red lines shown on the plans do not accord with the current Site boundary as presented in the Mylen Leah Solar Farm Environmental Impact Assessment Scoping Report. However, they are considered to be representative of the current Site boundary.

Detailed
Unexploded Ordnance (UXO)
Risk Assessment

Project Name	Mylen Leah Solar Farm
Client	Statkraft Energy Limited
Site Address	Near Melbourne, East Riding of Yorkshire
Report Reference	DA20029-00
Date	5th August 2024
Author	JBM
Quality Assurance	HW
Final Check	AB

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1ST LINE DEFENCE

Executive Summary

Site Location and Description

The site comprises multiple boundaries in an area around the village of Melbourne, in the west of the East Riding of Yorkshire. The site's surrounds largely comprise undeveloped rural land, as well as several hamlets and villages. Recent aerial imagery indicates that the majority of the site comprises undeveloped land, as well as several farms and sections of road. Central Site East comprises the premises of the former RAF Melbourne, which includes hard-surfaced runways and associated infrastructure.

For convenience, the site as a whole has been divided into six separate sites, which are presented in **Annex B2.**

The North-eastern site is approximately centred on the OS grid reference: **SE 76484 46694**.

The North-western site is approximately centred on the OS grid reference: **SE 72586 44082**.

Central Site West is approximately centred on the OS grid reference: **SE 72988 40726**.

The Central Site is approximately centred on the OS grid reference: **SE 74555 41793**.

Central Site East is approximately centred on the OS grid reference: **SE 76316 41757**.

The Southern site is approximately centred on the OS grid reference: **SE 75529 38986**.

Proposed Works

Proposed works are understood to include the development of a photovoltaic power station.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows the majority of the site to be underlain by the Mercia Mudstone Group - sedimentary bedrock comprising mudstone formed between 252.2 and 201.3 million years ago during the Triassic period. A small portion of the site to the west is underlain by the Sherwood Sandstone Group - sedimentary bedrock comprising sandstone formed between 272.3 and 237 million years ago during the Permian and Triassic periods. Superficial deposits across the majority of the site comprise the Thorganby Clay Member – silty clay formed between 116 and 11.8 thousand years ago during the Quaternary period. Superficial deposits across the North-eastern site, and western portions of Central Site West, comprise the Bielby Sand Member – silty, gravelly sand formed between 116 and 11.8 thousand years ago during the Quaternary period.

Site-specific geotechnical information was not available to 1st 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

1st Line Defence has assessed that there is an overall **Medium-High Risk** from items of Allied UXO in the section of the site of proposed works comprising land once occupied by, and adjacent to, the RAF Melbourne bomb stores. The remainder of the site area occupying the premises of RAF Melbourne has been assessed as holding an overall **Medium Risk** from Allied UXO. The remainder of the site, excluding RAF Melbourne, has been assessed as holding an overall **Low Risk** from Allied UXO. There is an assessed **Low Risk** from German unexploded ordnance across the entire site of proposed works. See Risk Mapping in **Annex T** and on **Page v**.

The Risk from Allied UXO

- Central Site East (see site designations in **Annex B2**) stands in the approximate footprint of RAF Melbourne. Melbourne opened in late 1940 as a satellite for RAF Leeming, hosting Whitley bombers of 10 Squadron. Several months later, it was closed for redevelopment into a full-scale bomber airfield. It re-opened in August 1942, again as a base for 10 Squadron, which by now had been re-equipped with Halifax heavy bombers. With the end of the war in Europe in May 1945, the airfield was transferred to Transport Command. RAF Melbourne closed in the summer of 1946.
- RAF Melbourne was equipped with 36 dispersal pans, the majority of which were within or immediately adjacent to the boundary of Central Site East. As photography in **Annex F2** illustrates, ordnance was handled on or immediately adjacent to dispersal pans.
- Air Ministry site plans record that the airfield bomb store was located within the southern section of Central Site East (**Annex G3**). Armouries, and barrack and pyro stores were located within or immediately adjacent to the northern and eastern section of Central Site East.

- Various sections of Central Site East stand on, or adjacent to, the former perimeter of RAF Melbourne (see **Annex G7**).
- Operations Record Books indicate that RAF Melbourne was defended by an AA Flight consisting of 12 20mm Oerlikon AA guns. The closest recorded HAA battery was located approximately 11.9km to the north-west of the site in the vicinity of York.
- Several aircraft crashes were identified within or adjacent to the site, which are highlighted in **Annex I**, although in these specific incidents, the aircraft involved do not appear to have been carrying air-dropped ordnance.
- While other Allied features were identified in the site's wider surrounds, no evidence to suggest that military activity occurred on site other than at RAF Melbourne could be identified.
- **In summary**, the risk from Allied UXO across the site is not considered to be homogenous; see UXO Risk Mapping in **Annex T**.
- The section of the site comprising the airfield bomb stores and adjacent undeveloped land has been assessed as holding an overall **Medium-High Risk** from Allied UXO. As example historical imagery in **Annex F2** illustrates, substantial quantities of ordnance were stored at bomb dumps, and the result of previous on-site UXO support conducted by 1st Line Defence – including at the former RAF Full Sutton in 2021 – illustrates that land formerly comprising bomb dumps, or land adjacent to them, may remain contaminated with ordnance in the present day. Photography of some of the finds at Full Sutton is presented in **Annex U**.
- The remainder of Central Site East, comprising the premises of the former RAF Melbourne, has been assessed as holding an overall **Medium Risk** from Allied UXO due to its proximity to the following historical sources of potential UXO contamination:
    - The airfield armouries, and barrack and pyro stores
    - Aircraft dispersal pans, where bombers were parked and loaded/unloaded with ordnance
    - The ends of runways, where aircraft crashes occurred with greater frequency
    - The airfield perimeter, which was often considered a convenient location for the disposal of unneeded munitions
- **Proactive risk mitigation measures** are therefore recommended for any intrusive works undertaken in these zones.
- While other Allied features were identified in the site's wider surrounds, no evidence to suggest that any significant military activity occurred on site other than at RAF Melbourne could be identified. The remainder of the site has therefore been assessed as holding an overall **Low Risk** from Allied UXO.

The Risk from German Air-Delivered UXO

- During WWII the site was located within the Rural Districts of Pocklington and the Rural District of Howden; the situation of the site within these districts is illustrated in **Annex E**. Both districts sustained an overall very low density of bombing according to official Home Office statistics. These districts were not a priority for the Luftwaffe, although they were subject to 'tip and run' raids, and occasionally bombers jettisoning their payloads after failing to reach or locate their primary target. RAF Pocklington, approximately 2.15km north-east of the North-Eastern Site, was captured in Luftwaffe target photography which is presented in **Annex O**.
- Ministry of Home Security Daily Intelligence Reports record a total of four wartime bombing incidents across the entire site area, although the precise details of these incidents is not provided. No evidence that the site was directly affected by bombing could be identified across available sources.
- As the site was largely undeveloped, historical OS mapping is unable to provide any clear indications that the site may have been affected by bombing, although WWII-era aerial photography of RAF Melbourne does not provide any clear indicators of bomb damage such as cratering, scattered earth or damaged buildings.
- As most of the site was undeveloped, ground cover on site is considered to have been largely unconducive to the detection of UXO. Items of UXO penetrating soft open ground could easily go unnoticed and unreported. A bomb entry hole could be as small as 20cm in diameter and therefore easily obscured in such conditions.
- As most of the site was undeveloped, direct wartime access is anticipated to have been relatively low, although local access and monitor is anticipated to have been relatively high at the portion of the site located at RAF Melbourne, and areas of the site in close proximity to roads and farms.
- In summary, the site was situated in an area subject to a very low density of bombing according to official Home Office statistics, and only four bombing incidents across the site's local area are recorded across available sources. As the site was largely undeveloped, ground conditions and access levels are considered unconducive to the detection of UXO, although no evidence to suggest that the risk from German UXO on site is higher than the 'background level' for this part of the country could be identified. The site has therefore been assessed as holding an overall **Low Risk** from German UXO. Due to the unfavourable ground conditions and access levels across the majority of the site, **UXO Safety Awareness Briefings** are still recommended as a sensible minimum precaution, and it is recommended that a **UXO Risk Management Plan** is also put in place.

Post-WWII Redevelopment

- Comparison of historical OS mapping and recent aerial imagery indicates that post-war development across the site has been relatively minor.
- 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 the Mylen Leah Solar Farm site:

Activity	Recommended Risk Mitigation Measure
All Works	• UXO Risk Management Plan • Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.
Open Excavations (trial pits, service pits, bulk excavations, strip foundations etc.) (Medium-High and Medium Risk Areas Only)	• UXO Specialist On-site Support

Note – proactive on-site UXO support/survey should not be necessary for any works taking place at the location of and down to the depths of significantly worked post-war made ground/post-war fill.

UXO Risk Map and Recommended Risk Mitigation Measures

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.

Risk Zone	Activity	Recommended Risk Mitigation Measure
Low (German and Allied)	All Works	• UXO Risk Management Plan • Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.
Medium (Allied)	Open Excavations (trial pits, service pits, bulk excavations, strip foundations etc.)	• UXO Specialist On-site Support
Medium-High (Allied)		

Glossary

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

Contents

Annexes

List of Report Annexes	
Annex A	Site Location Maps
Annex B	Recent Aerial Photography
Annex C	Client Provided Site Plan
Annex D	Historical Mapping
Annex E	Situation of Site within East Riding of Yorkshire
Annex F	Historical Imagery of RAF Melbourne
Annex G	RAF Melbourne Site Plans
Annex H	RAF Melbourne Operations Records Book (Allied Activity)
Annex I	Military Aircraft Crashes
Annex J	RAF Aerial Imagery
Annex K	Pocklington Home Guard Photography
Annex L	Unexploded Bomb Entry Hole Example
Annex M	Recent Unexploded Bomb Finds, UK
Annex N	WWI Bomb Plot Map of Air Raids and Naval Bombardments
Annex O	Luftwaffe Target/Reconnaissance Photography
Annex P	Ministry of Home Security Daily Intelligence Reports
Annex Q	Pocklington Air Raid Files
Annex R	RAF Pocklington Operations Record Books (German Bombing)
Annex S	UK Bomb Decoy Sites
Annex T	UXO Risk Mapping
Annex U	Allied UXO Finds, Land Adjacent to Bomb Stores

Appendices

List of Report Appendices	
Appendix i -ii	Typical British Aircraft Ordnance
Appendix iii-iv	Examples of British Practice Bombs
Appendix v-vii	Examples of Land Service Ammunition
Appendix viii	Examples of Small Arms Ammunition
Appendix ix	Examples of Anti-Aircraft Projectiles
Appendix x-xii	Examples of German Air-Delivered Ordnance

1st Line Defence Limited®
Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Mylen Leah Solar Farm
Client: Statkraft Energy Limited

1. Introduction

1.1. Background

1st Line Defence has been commissioned by Statkraft Energy Limited to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at Mylen Leah Solar Farm.

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 Mylen Leah 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

1st 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, 1st 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 online and published resources.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by Statkraft Energy Limited.
- Available material from 33 Engineer Regiment (EOD) Archive (part of 29 Explosive Ordnance and Disposal and Search Group).
- 1st 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. 1st 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 1st 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. 1st 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.'

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.

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 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 1st 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 1st 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 comprises multiple boundaries in an area around the village of Melbourne, in the west of the East Riding of Yorkshire. The site's surrounds largely comprise undeveloped rural land, as well as several hamlets and villages.

For convenience, the site as a whole has been divided into six separate sites, which are presented in **Annex B2**.

The North-eastern site is approximately centred on the OS grid reference: **SE 76484 46694**.
The North-western site is approximately centred on the OS grid reference: **SE 72586 44082**.
Central Site West is approximately centred on the OS grid reference: **SE 72988 40726**.
The Central Site is approximately centred on the OS grid reference: **SE 74555 41793**.
Central Site East is approximately centred on the OS grid reference: **SE 76316 41757**.
The Southern site is approximately centred on the OS grid reference: **SE 75529 38986**.

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

6.2. Site Description

Recent aerial imagery indicates that the majority of the site comprises undeveloped land, as well as several farms and sections of road. Central Site East comprises the premises of the former RAF Melbourne, which includes hard-surfaced runways and associated infrastructure.

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

Proposed works are understood to include the development of a photovoltaic power station.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows the majority of the site to be underlain by the Mercia Mudstone Group - sedimentary bedrock comprising mudstone formed between 252.2 and 201.3 million years ago during the Triassic period. A small portion of the site to the west is underlain by the Sherwood Sandstone Group - sedimentary bedrock comprising sandstone formed between 272.3 and 237 million years ago during the Permian and Triassic periods. Superficial deposits across the majority of the site comprise the Thorganby Clay Member – silty clay formed between 116 and 11.8 thousand years ago during the Quaternary period. Superficial deposits across the North-eastern site, and western portions of Central Site West, comprise the Bielby Sand Member – silty, gravelly sand formed between 116 and 11.8 thousand years ago during the Quaternary period.

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. Historical Summary of RAF Melbourne

Central Site East comprises the premises of the former RAF Melbourne. This airbase opened in late 1940 as a satellite for RAF Leeming, hosting Whitley bombers of 10 Squadron. Several months later, it was closed for redevelopment into a full-scale bomber airfield. It re-opened in August 1942, again as a base for 10 Squadron, which by now had been re-equipped with Halifax heavy bombers. With the end of the war in Europe in May 1945, the airfield was transferred to Transport Command. RAF Melbourne closed in the summer of 1946.

Further detail regarding the operational history of RAF Melbourne is provided in Section 11.2.

9.3. Ordnance Survey Historical Maps

Historical maps were obtained for this report and are presented in **Annex D**. These maps provide an indication of the composition of the site in the WWII era. See below for a summary of the site on various mapping editions. Later sections of the report present and detail other available mapping, plans and photography and should be read in conjunction with this section as often civilian OS mapping does not show many of the historic features of some military airfields.

1946 OS Mapping			
Date	Scale	Site	Description
1946	1:10,560	North-Eastern Site (**Annex D1**)	In this immediate post-war OS mapping, this site is indicated to comprise undeveloped land and adjacent paths. The site's immediate surrounds comprise undeveloped land, including *Allerthorpe Common* to the north. To the east is the hamlet of *Waplington*, and further south-west is the village of *Thornton*.
		North-Western Site (**Annex D2**)	This site is indicated to comprise undeveloped land, including two separate areas of woodland, with the southern area labelled *Whittaker Wood*. The site is bound by a road to the east, with the remainder of its surrounds comprising undeveloped land. To the west is the hamlet of *Storwood*.
		Central Site West (**Annex D3**)	This site is indicated to comprise undeveloped land and adjacent paths. It is bound to the north and east by roads and areas of undeveloped land, to the south by undeveloped land and areas of development including the village of *Laytham*, and to the west by the *B1228*.
		Central Site (**Annex D4**)	This site is indicated to comprise undeveloped land and adjacent roads and paths, as well as *Acre House*. The site's immediate surrounds largely comprise undeveloped land and adjacent roads, with *Laytham Grange* to the south-east and *Laytham Green Farm* to the south-west.
		Central Site East (**Annex D5**)	This site is indicated to comprise undeveloped land bound by roads, with areas of development adjacent to the site boundary including *Melbourne Lodges* to the south-east, *Breckstreet Farm* in the east,

			Laytham Grange to the south-west, and *Bibbill Farm* to the north-west. It should be noted that as this site was in the vicinity of a military installation – RAF Melbourne – it may have been subject to censorship.
		Southern Site (**Annex D6**)	This site is indicated to comprise undeveloped land and adjacent roads, and areas of development including *Oak Farm* and *Foggathorpe Manor House*.. The site's surrounds comprise undeveloped land and adjacent roads, with the village of *Foggathorpe* to the south and the village of *Laytham* to the west.

10. Introduction to Allied Ordnance

10.1. General

Whilst airfields often have individual characteristics in terms of their usage, purpose and history, most military airfields utilise Allied ordnance as part of their daily operation. Typically, this ordnance can include SAA, LSA or larger air-dropped bombs, which are stored in designated areas within the station including bomb or pyrotechnic stores. Typical activities and uses that may have led to a legacy of UXO contamination at a military airfield within the UK include weapons training and firing ranges, defence exercises, weapon transport and storage areas and anti-aircraft emplacements, as well as WWII-era demolition charges and Home Guard positions.

10.2. Aircraft Munitions

The table below depicts a selection of typical aircraft ordnance. It should be noted that the range is representative of the weaponry most commonly fitted to/carried by military aircraft, and further types of weaponry may have been present at the airfield. For more examples of British air delivered ordnance, see **Appendices i-ii**.

Typical Aircraft Munitions	
Item	Description
Machine Guns/Small arms	Most military aircraft, including fighter, bomber and helicopter transporter aircraft are equipped with light armaments that employ small arms ammunition. These are typically either machine guns or light cannons, although some larger calibre guns have historically been fitted to aircraft designed specialist roles. Military aircrews are sometimes issued with a sidearm and signal flares for defence and survival should they be shot down or forced to bail out.
Cannon Rounds	Cannons are typically 20-40mm automatic guns that fire filled projectiles, usually HE, Incendiary or a mixture of the two. Cannons provide aircraft with better offensive capability, and are standard equipment for most modern aircraft. Historically, cannons were fitted to aircraft designed for a specialist role, such as ground attack aircraft or fighter interceptors.
General Purpose/Medium Capacity HE Bombs	General purpose HE bombs of various calibres have been the mainstay armament of military aircraft since the First World War. They are fuzed explosive bombs designed to destroy targets with a large blast. General purpose bombs are used for attacking ground targets and depending on the aircraft, large quantities of these can be carried. They were extensively used during WWII, and are still in service within many countries, alongside guided bombs and missiles.
Heavy Bombs	In addition to general purpose HE bombs, aircraft are sometimes capable of carrying especially large bombs designed for specialist roles or certain targets. During WWII the RAF developed a number of specialist 'earthquake bombs' designed to crack heavy fortifications. Modern equivalents of these bombs are also in service with some countries, designed for similar roles.
Incendiary Bombs	Incendiary bombs are also a mainstay of many military aircraft. They are typically smaller, filled with incendiary chemicals and are usually dropped against targets in quantity. Larger incendiary bombs are also sometimes employed, sometimes as area affect weapons against personnel.

10.3. Practice Bombs

Practice bombing is often undertaken by US and RAF aircraft, and has been part of crew training since WWI. Aircrews would load their aircraft with smaller practice bombs, which would often be fitted with a smoke or flash element to mark the position of each bomb. These are then dropped on a ground and sea targets to test accuracy, often under combat conditions. Practice bombing is intended to train pilots and bombardiers, and is often supplemented by live bombing practice at dedicated ranges.

It is possible that practice bombing was undertaken within the vicinity of RAF Melbourne, which remained an active bomber airfield throughout most of the war. 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

Land Service Ammunition (LSA) is commonly stored and utilised at most RAF Stations and is used during activities such as defensive exercises and weapons training practice. 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:

LSA would have been present at RAF Melbourne at the station's armouries, occasionally distributed to personnel for training purposes.

Land Service Ammunition (LSA)	
Item	Description
Mortar Rounds	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).
Grenades	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.
Projectiles	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).
Rockets	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.
Landmines	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. Landmines were often placed at airfields during WWII, most commonly in the form of pipemines, known as McNaughton tubes, for anti-invasion area denial.

Images of the most commonly found items of LSA are presented in **Appendices v - vii**.

10.5. Small Arms Ammunition

Small Arms Ammunition (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 imagery of SAA are presented in **Appendix viii.**

Military airfields often have SAA present from a variety of different sources. In both WWI and WWII, the primary armament of military aircraft was a machinegun or cannon. These came in various forms, including guns fixed within the wings, nose, and also flexible mounts and turrets, which were operated manually by aircrew. Prior to the 1950s, airfields were also often defended by AA machineguns and cannons, and often a purpose-built SAA range was present within an airfield for marksmanship practice or testing aircraft armaments.

Following the end of WWII and the advancement of technology in the post-war period, machineguns were no longer an effective AA defence. However, it should be noted that small-arms may have been retained for marksmanship practice at dedicated ranges.

10.6. Anti-Aircraft Artillery (AAA)

It is not uncommon for military airbases to maintain their own anti-aircraft defences. Most notably during WWII when RAF stations were targeted by the Luftwaffe and active anti-aircraft defences, including both projectile gun sites and machine gun posts, were regularly employed in the defence of airbases.

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	**Gun type**	**Calibre**	**Shell Weight**	**Shell Dimensions**
	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	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.			

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 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 an airfield. Such factors are typically dependent upon the proximity of the proposed area of works to a number of airfield features. The risk from Allied ordnance may also relate to the function of the airfield, the presence of any military training activities and any aviation incidents recorded within, or proximate to an airfield.

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

11.2. Operational Usage of RAF Melbourne[1]

RAF Melbourne opened in late 1940 as a satellite for RAF Leeming near Northallerton, with Whitley bombers of 10 Squadron making occasional use of the airfield. Melbourne's life as a satellite was a short one, and in early 1942, it closed for conversion into a full-scale bomber airfield, with the works completed in late 1942.

While construction was still underway, in August 1942 the first operational aircraft arrived – Halifax heavy bombers assigned to 10 Squadron. Bombing sorties began almost immediately, and this Squadron would continue to fly missions from RAF Melbourne until the end of the war, with approximately 4,800 sorties flown by the Squadron, mostly from Melbourne. With the war's end, 10 Squadron was reassigned to Transport Command, and acted as a transport unit until Melbourne closed in the summer of 1946.

RAF Melbourne was one of a small number of airfields equipped with the FIDO system (Fog Investigation and Dispersal Operation), which used walls of flame projected from pipes to burn away fog; as a result, it received a number of aircraft based at other airfields which had become lost due to weather conditions.

Imagery detailing RAF Melbourne's operational usage, as well as example photography of common airfield features related to ordnance, are presented in **Annex F.**

[1] Ken Delve, The Military Airfields of Britain: Northern England, The Crowood Press, 2006).

11.3. Site Plans of RAF Melbourne

Several plans of RAF Melbourne were obtained from online and published resources. A reproduction of an Air Ministry site plan for RAF Melbourne, circa 1943, includes annotations describing individual structures across the airfield and their use. The site plans for the airfield are presented in **Annex G.**

Date Range	Comments
Air Ministry site plan, circa 1943 (**Annex G1 – G3**)	Various features across the airfield are identified in this annotated reproduction of an Air Ministry site plan. Of particular note are armouries, and pyro and barrack stores in the north and east of the airfield, the airfield bomb stores in the south of the airfield, and various 'frying pan' aircraft dispersal pans – 36 in total when the airfield was complete.
Circa 1945 (**Annex G4 – G5**)	This annotated photograph of RAF Melbourne illustrates the position and length of the runways, the position of the perimeter track and connected dispersal pans, and the location of the adjacent dispersed site for other personnel including the WAAF (approximate boundary highlighted in **Annex G5**).
Early 1950s (**Annex G6 – G7**)	This early 1950s plan of RAF Melbourne shows the airfield after its closure, with proposed extensions to the runways as part of a plan to reopen the airfield illustrated. This plan includes the airfield perimeter and aircraft approach/take-off zones, which are illustrated in the context of the Central Site East boundary in **Annex G7**.

11.4. RAF Melbourne Operations Record Books

Written records regarding the daily life and operation of RAF Melbourne have been obtained from the National Archives. These sources recorded the day-to-day operations of an airfield, as well as training exercises in the immediate and surrounding area. Photographs of these, highlighting relevant information, are shown in **Annex H**. General military activity during the war is presented below.

It should be noted that the transcript below is only a selection of the numerous events accounted for in the record book. Incidents of significant note are highlighted in bold:

Date Range	Comments
2nd June 1942	Extracts from the ORB for No. 4275 AA Flight based at RAF Melbourne, noting that this unit was carrying out *AA Duties, weapon and field training*. The Appendix records that the unit was armed with Oerlikon 20mm light AA guns, and that practice firing was undertaken. Anti-Aircraft Flights were units assigned to AA defence, comprised of RAF personnel; they typically consisted of 12 gun posts.[2]

[2] https://www.rafweb.org/Organsation/Regiment2.htm.

11.6. Aircraft Crashes

Aircraft crashes have occurred been historically common at military airfields, especially during wartime. 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 airfield 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.

A military aircraft crash overlay for the area surrounding RAF Pocklington, compiled by the Pockjlington & District Local History Group, is presented in **Annex I**. Several crashes in the vicinity of the site are indicated, which are described below.

Crash No.	Transcript	Comments
10	13th October 1941. Whitley "was returning from Nurnberg to land at Linton, but was diverted to Pocklington, ran out of fuel and crashed near Waplington Hall near Allerthorpe.	Approximately m east of the North-Eastern Site boundary.
24	30th November 1942. Halifax "took off on a formation flying exercise, executed a steep turn shortly after take-off, stalled and crashed near Laytham Grange and burnt out."	Immediately north of the Southern Site boundary.
29	10th March 1943. Halifax "was being ferried to another airfield when, shortly after take-ffo, then port outer engine failed and the propeller was feathered. The pilot turned towards the failed engine, the aircraft stalled and crashed 1 mile west of Seaton Ross".	Immediately south-east of Central Site East.
57	1st January 1945. Halifax "aborted the operational task, jettisoned the bombload into the North Sea and returned to Melbourne." The pilot "was unable to maintain height and elected to attempt a forced landing near Laytham Grange close to the airfield."	In the northern section of the Southern Site.

11.7. WWII-era Aerial Photography

WWII-era aerial photography for RAF Melbourne was obtained from 'Bomber Command Airfields of Yorkshire' by Peter Jacobs,[3] and is presented in **Annex J**

Date	Comments
27th April 1942	This mid-war photograph, displaying the boundary of Central Site East, shows RAF Melbourne under construction, three months before combat aircraft returned in August. Visible features include runways, dispersal pans, and various structures. The airfield's immediate surrounds largely comprise undeveloped land, and several roads.

[3] Peter Jacobs, 'Bomber Command Airfields of Yorkshire', Pen & Sword, 2017

11.8. Online Resource: BBC People's War

The 'BBC People's War' archive is an online resource recording various wartime memories. One account of relevance to this report was identified, and is transcribed in the table below.

BBC People's War	
Record Transcription	Comments
"It was May 1943, and for the next two years I helped in a small way in the demolition work Bomber Command did in Germany. In 1944 one of our Halifax's G-George returned safely from ops. I brought her into dispersal, turned her, put the chocks up against the wheels, went up to the cockpit with the form 700 as the skipper did an engine run to do a mag check. As soon as the engines stopped, an armourer outside shouted 'open the bomb doors skipper'. **As they opened there was an almighty crash and there before our eyes was a 250lb bomb lying on the ground with the fins broken off. G-George had brought an egg back and laid it on my dispersal.** 'The armourer and I moved the bomb to the side of dispersal. Whilst doing this he told me that he had only just finished his armourer course. My God, I thought. Here I am at 2.30 in the morning, holding a torch, whilst this guy unscrews the plastic cap off the tail end of the bomb.' 'It's an instantaneous fuse' he says. 'I need a special tool to get it out, but you can get the fuse out with your fingers'. 'There I am holding the torch, a sprog armourer with his grubby fingers diving into the intimate innards of a bomb. **After about ten minutes of this, I decided I did not want to be a dead hero, only a living coward, so I told him to leave the bomb in peace, which he did. It lay there for about three weeks,** and every morning until it was moved, we used to give it a friendly kick — not too hard, I must say."[4]	This account recalls an incident whereby a bomber returned from a raid with undelivered ordnance, which subsequently fell from the aircraft and onto the dispersal pan when the bomb doors were opened. Initial attempts to defuse the bomb were called off, and it was finally disposed of three weeks later. Although bomb crews were encouraged to dispose of unused ordnance before returning to base, it was not uncommon for bombs to remain on-board an aircraft that, for whatever reason, was unable to jettison its bombs before landing.

[4] https://www.bbc.co.uk/history/ww2peopleswar/stories/92/a2830592.shtml.

11.9. Evaluation of Contamination Risk from Allied UXO

1st Line Defence has considered the following potential sources of Allied ordnance contamination:

Allied UXO Records Summary	
Sources of Allied UXO Contamination	**Conclusion**
Site Usage *Airfields contain a number of features that may increase the risk of UXO contamination. Physical proximity to such a feature is usually indicative of risk.*	Central Site East (see site designations in **Annex B2**) stands in the approximate footprint of RAF Melbourne. Melbourne opened in late 1940 as a satellite for RAF Leeming, hosting Whitley bombers of 10 Squadron. Several months later, it was closed for redevelopment into a full-scale bomber airfield. It re-opened in August 1942, again as a base for 10 Squadron, which by now had been re-equipped with Halifax heavy bombers. With the end of the war in Europe in May 1945, the airfield was transferred to Transport Command. RAF Melbourne closed in the summer of 1946.
Dispersal Pans *Dispersal pans were used to re-equip aircraft between sorties. Frequently temporary stores were located at dispersal pans.*	RAF Melbourne was equipped with 36 dispersal pans, the majority of which were within or immediately adjacent to the boundary of Central Site East. As photography in **Annex F2** illustrates, ordnance was handled on or immediately adjacent to dispersal pans.
Ordnance Stores/Armoury *Ordnance stores contained large quantifiers of munitions. Adjacent areas may have been used to bury or dispose of excess ordnance.*	Air Ministry site plans record that the airfield bomb store was located within the southern section of Central Site East (**Annex G3**). Armouries, and barrack and pyro stores were located within or immediately adjacent to the northern and eastern section of Central Site East.
Proximity to Perimeter Fence *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.*	Various sections of Central Site East stand on, or adjacent to, the former perimeter of RAF Melbourne (see **Annex G7**).
Defensive Positions *Airfields were frequently defended by numerous defensive positions. It is not uncommon for items of LSA and SAA to be encountered in the vicinity of such locations.*	Online research indicates the presence of a searchlight battery approximately 500m east of the North-Eastern Site.[5]
Firing Ranges *Firing ranges were common at most airfields. Many firing range also feature grenade pits.*	No evidence of firing ranges, practice butts or any other areas could be identified within the boundary of the site.
Demolition Charges *Many airfields were undermined by demolition mines such as McNaughton Tubes and Pipe Mines. Many of these devices were not removed or lost.*	No evidence of the use of demolition charges such as pipe mines and other area-denial weaponry at RAF Melbourne could be found within available records.
Military Camps *It was frequent for military camps to be positioned adjacent to airfields. If a military camp was located proximate to a site then it is possible unauthorised ordnance disposal may have been undertaken in the area*	Site plans for RAF Melbourne indicate the presence of a dispersed site immediately north of Central Site East; the approximate footprint is highlighted in **Annex G5**. Online research also indicates the presence of Storwood POW Camp, approximately 630m south-west of the North-Western Site.[6]

[5] https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=22157fd6-7c36-4ee3-86c9-cde61341419a&resourceID=19191.
[6] https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=b970f314-778a-4944-bdf5-88aca2d2ea08&resourceID=19191.

Training Exercises / Home Guard Activity *It was common for defence training activities to be undertaken in the vicinity of airfields. Such exercises frequently involved the deployment of live ordnance.*	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. No positive evidence could be found to confirm the presence of HG units within proximity to RAF Melbourne. Despite this, it should be noted that HG units were sometimes employed to defend or police RAF installations. The nearby town of Pocklington maintained its own Home Guard platoon, photography of which is presented in **Annex K**, and it was common for most towns and villages to maintain their own HG unit. Training was frequently undertaken at RAF bases as they were large, open military controlled areas. Such training has the potential to have involved the usage of land service ammunition such as grenades and mortars, which have the potential to have been defective or else incorrectly deployed and not recovered.
Anti-Aircraft Defences *Airfields were defended by a range of AAA. Ordnance is frequently encountered in the vicinity of AA batteries.*	Operations Record Books indicate that RAF Melbourne was defended by an AA Flight consisting of 12 20mm Oerlikon AA guns. The closest recorded HAA battery was located approximately 11.9km to the north-west of the site in the vicinity of York.
Aircraft Crashes ***Aircraft crashes were common at airfields. The most common places for aircraft to crash was at the ends of runways. Airfield in the south of England were often used by damaged aircraft for the purposes of emergency landings. Crashes can be sources for potential UXO contamination, especially if the aircraft was en-route to or returning from operations.***	Several aircraft crashes were identified within or adjacent to the site, which are highlighted in **Annex I**, although in these specific incidents, the aircraft involved do not appear to have been carrying air-dropped ordnance.

12. Introduction to German Air Delivered Ordnance

12.1. General

During the summer of 1940 the Luftwaffe launched a major offensive against British airfields. The campaign, known as the Battle of Britain, saw the Luftwaffe attempt to attain air superiority prior to the invasion of Great Britain. To this end they extensively bombed British airfields, especially within the South and East of England. Although the objectives of the Luftwaffe altered in September 1940 to encompass towns, cities and industry, airfields were regularly targeted by the Luftwaffe until the conclusion of the war. The specifics of any bombing within the RAF station or the surrounding area is discussed in the following sections.

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 x-xii**.

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 **Annex L**). 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 M**.

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 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 L**).

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 – Mercia Mudstone Group and Sherwood Sandstone Group
- 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.

On December 24th 1944, a flight of Heinkel He 111 bombers launched 45 V-1s off the Yorkshire coast, an area that was otherwise out of range of V-weapon attacks.[7] Approximately 15 fell in the Manchester area, the main target, with the remainder falling across north-eastern England. One fell in the vicinity of Pocklington, which is included in the extract below, taken from Paul Bright's 'Air War over East Yorkshire in World War II':

"24/12/44

Three air-launched V-1s land in East Yorkshire. "One dived to the ground at Willerby, on the western outskirts of Hull, where it exploded and did some damage to housing and the Springhead Pumping Station. A second fell harmlessly at South Cliffe, four miles south of Market Weighton. ***The third blew up as it crashed to earth at Barmby Moor, close to RAF Pocklington****."*[8]

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.

[7] https://northeastatwar.co.uk/2019/02/02/24th-december-1944-v1-attack/.
[8] Paul Bright, Air War over East Yorkshire in World War II, Flight Recorders Publication, 2005, p. 146.

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 N**. This source shows that several incidents are recorded to the east of York.

An online resource notes that on 12th March 1918, Zeppelin L 62 dropped four HE bombs at the village of Melbourne, all of which "fell in fields".[9] The precise location of the bombing is not recorded, however.

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 vicinity of an 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 the Rural Districts of Pocklington and Howden

Luftwaffe bombing tactics at the start of WWII prioritised on the destruction of strategic military targets, which if destroyed would pave the way for Operation Sea Lion, the planned amphibious invasion of Britain. Accordingly, in the years preceding WWII, German military intelligence meticulously mapped and photographed RAF stations designating them as strategic bombing targets. When the German strategic bombing campaign began in July 1940, fighter and bomber stations as well as RAF Chain Home radar stations were systematically targeted, severely limiting the RAF's capability to defend the country. Although Luftwaffe strategy prioritised targets in the south-east of England early in the war, targets further north were also attacked for their strategic or industrial value, and 'tip and run' or 'nuisance' raids were conducted across the UK.

By the end of August 1940 the RAF was in disarray and close to collapse, with airfields badly damaged and aircrew losses critical. However, retaliatory bombing raids on Berlin by RAF Bomber Command throughout August had angered Hitler, and on 4th September 1940 Hitler announced in a speech his directive to 'erase' Britain's cities. This change in tactics gave the RAF a chance to rebuild and rearm, and ultimately, despite the civilian cost, prevented German air dominance in Britain's skies.

During WWII the site was located within the Rural Districts of Pocklington and Howden; the situation of the site within these districts is illustrated in **Annex E**. Both districts sustained an overall very low density of bombing, as represented by bomb density data figures, see Section 13.3. These districts were not a priority for the Luftwaffe, although they were subject to 'tip and run' raids, and occasionally bombers jettisoning their payloads after failing to reach or locate their primary target. RAF Pocklington, approximately 2.15km north-east of the North-Eastern Site, was captured in Luftwaffe target photography which is presented in **Annex O**.

Records of bombing incidents in the civilian areas of the district 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 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.

[9] https://www.iancastlezeppelin.co.uk/12-march-1918.

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 Districts of Pocklington and Howden between 1940 and 1945.

Record of German Ordnance Dropped on the Rural District of Pocklington		
Area Acreage		101,518
Weapons	High Explosive bombs (all types)	161
	Parachute mines	3
	Oil bombs	1
	Phosphorus bombs	0
	Fire pots	0
	Pilotless aircraft (V-1)	2
	Long range rocket bombs (V-2)	0
Total		167
Number of Items per 1,000 acres		1.6
Source: Home Office Statistics This table does not include UXO found during or after WWII.		

Record of German Ordnance Dropped on the Rural District of Howden		
Area Acreage		69,947
Weapons	High Explosive bombs (all types)	92
	Parachute mines	4
	Oil bombs	0
	Phosphorus bombs	0
	Fire pots	0
	Pilotless aircraft (V-1)	0
	Long range rocket bombs (V-2)	0
Total		96
Number of Items per 1,000 acres		1.4
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. Ministry of Home Security Daily Intelligence Reports

Daily Intelligence Reports, compiled by the Ministry of Home Security, were obtained from the National Archives, Kew. Reports received in the Home Security War Room summarising air raid damage and other information of importance to civil defence, collated for the benefit of the Minister and senior officials, the Cabinet and Liaison Officers of other government departments.

Several incidents were recorded in the site's vicinity, which are visualised in an overlay presented in **Annex P**. It should be noted that only the Civil Parish involved is recorded, without the precise location of the bombing incident

Ministry of Home Security Daily Intelligence Reports	
Date Range	Comments
15th February 1941	Seaton Ross. No casualties. Laytham. No casualties.
27th April 1941	Allerthorpe. No casualties.
3rd March 1945	Melbourne. No casualties.

13.5. East Riding of Yorkshire Air Raid Files

Air Raid Files, recording air raids across the East Riding of Yorkshire, were obtained from the National Archives, Kew. One report of relevance to this assessment was identified, which is presented in **Annex Q**. The report notes that enemy aircraft flew over RAF Pocklington, dropping bombs in the vicinity of the airfield.

13.6. RAF Pocklington Operations Record Books

Operations Record Books for RAF Pocklington, approximately 2km north-east of the North-Eastern Site, were obtained from the National Archives, Kew Operations record books for RAF stations detail all significant events that took place during the period of their use by the military. This also included any attacks/bombing by Luftwaffe aircraft at the base in question. These log books were checked for any reference to air raids and bomb damage within and in the immediate area of the aerodrome throughout the war. A transcript of which is presented below, and presented in **Annex R**.

RAF Pocklington Operations Record Book (German Bombing)	
Date Range	Comments
29th April 1942	Flares dropped in the vicinity of RAF Pocklington, but no bombs recorded to have been dropped.
19th May 1942	One bomb is recorded to have been dropped at Fangfoss, approximately 4 miles (6.5km) west of RAF Pocklington.

13.7. WWII-era Bombing Decoy Sites Mapping

WWII-era mapping plotting the location of bombing decoy sites was obtained from the National Archives, and is presented in **Annex S**. Map No. 1042 (right side of Annex) displays black circles - *Sites Decoyed* – that is, locations which decoys (highlighted in red and green) mimic. No airfields or decoys are plotted within several kilometres of the site.

13.8. WWII-Era Aerial Photography

WWII-era aerial photography for RAF Melbourne was obtained from published literature. 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 J**).

WWII-Era Aerial Photography	
Date/Title	Description
27th April 1942	This mid-war photograph, displaying the boundary of Central Site East, shows RAF Melbourne under construction. Visible features include runways, dispersal pans, and various structures. The airfield's immediate surrounds largely comprise undeveloped land, and several roads. No potential indicators of bomb damage, such as cratering, scattered earth, or damaged buildings are clearly apparent within or adjacent to the site boundary.

13.9. 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.

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

13.10. 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. If any relevant information is received at a later date, Statkraft Energy Limited will be advised.

13.11. Evaluation of German Air Delivered UXO Records

German Air Delivered UXO Records Summary	
Factors	**Conclusion**
Density of Bombing *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.*	During WWII the site was located within the Rural Districts of Pocklington and Howden; the situation of the site within these districts is illustrated in **Annex E**. Both districts sustained an overall very low density of bombing according to official Home Office statistics. These districts were not a priority for the Luftwaffe, although they were subject to 'tip and run' raids, and occasionally bombers jettisoning their payloads after failing to reach or locate their primary target. RAF Pocklington, approximately 2.15km north-east of the North-Eastern Site, was captured in Luftwaffe target photography which is presented in **Annex O**. Ministry of Home Security Daily Intelligence Reports record a total of four wartime bombing incidents across the entire site area, although the precise details of these incidents is not provided. No evidence that the site was directly affected by bombing could be identified across available sources.
Damage *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.*	As the site was largely undeveloped, historical OS mapping is unable to provide any clear indications that the site may have been affected by bombing, although WWII-era aerial photography of RAF Melbourne does not provide any clear indicators of bomb damage such as cratering, scattered earth or damaged buildings.
Ground Cover *The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.*	As most of the site was undeveloped, ground cover on site is considered to have been largely unconducive to the detection of UXO. Items of UXO penetrating soft open ground could easily go unnoticed and unreported. A bomb entry hole could be as small as 20cm in diameter and therefore easily obscured in such conditions.
Access Frequency *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.*	As most of the site was undeveloped, direct wartime access is anticipated to have been relatively low, although local access and monitor is anticipated to have been relatively high at the portion of the site located at RAF Melbourne, and areas of the site in close proximity to roads and farms.
Bomb Failure Rate	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.
Abandoned Bombs	1st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1st Line Defence could find no evidence of bomb disposal tasks within the site boundary 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	
Quality of the Historical Record	The research has evaluated WWII-era Ordnance Survey maps, historical imagery of RAF Melbourne, site plans for RFA Melbourne, ORBs for RAF Melbourne and RAF Pocklington, a record of aircraft crashes in the site area, Luftwaffe reconnaissance imagery, Ministry of Home Security Daily Intelligence Reports, East Riding of Yorkshire Air Raid Files, and published and online resources. The record set is of generally satisfactory quality, with a wide range of sources available for consultation, although some of the available bombing records for the area are limited in specific details.
Allied Ordnance	• Central Site East (see site designations in **Annex B2**) stands in the approximate footprint of RAF Melbourne. Melbourne opened in late 1940 as a satellite for RAF Leeming, hosting Whitley bombers of 10 Squadron. Several months later, it was closed for redevelopment into a full-scale bomber airfield. It re-opened in August 1942, again as a base for 10 Squadron, which by now had been re-equipped with Halifax heavy bombers. With the end of the war in Europe in May 1945, the airfield was transferred to Transport Command. RAF Melbourne closed in the summer of 1946. • RAF Melbourne was equipped with 36 dispersal pans, the majority of which were within or immediately adjacent to the boundary of Central Site East. As photography in **Annex F2** illustrates, ordnance was handled on or immediately adjacent to dispersal pans. • Air Ministry site plans record that the airfield bomb store was located within the southern section of Central Site East (**Annex G3**). Armouries, and barrack and pyro stores were located within or immediately adjacent to the northern and eastern section of Central Site East. • Various sections of Central Site East stand on, or adjacent to, the former perimeter of RAF Melbourne (see **Annex G7**). • Operations Record Books indicate that RAF Melbourne was defended by an AA Flight consisting of 12 20mm Oerlikon AA guns. The closest recorded HAA battery was located approximately 11.9km to the north-west of the site in the vicinity of York. • Several aircraft crashes were identified within or adjacent to the site, which are highlighted in **Annex I**, although in these specific incidents, the aircraft involved do not appear to have been carrying air-dropped ordnance. • While other Allied features were identified in the site's wider surrounds, no evidence to suggest that military activity occurred on site other than at RAF Melbourne could be identified. • In summary, the risk from Allied UXO across the site is not considered to be homogenous; see UXO Risk Mapping in **Annex T**. • The section of the site comprising the airfield bomb stores and adjacent undeveloped land has been assessed as holding an overall **Medium-High Risk** from Allied UXO. As example historical imagery in **Annex F2** illustrates, substantial quantities of ordnance were stored at bomb dumps, and the result of previous on-site UXO support conducted by 1st Line Defence – including at the former RAF Full Sutton in 2021 – illustrates that land formerly comprising bomb dumps, or land adjacent to them, may remain contaminated with ordnance in the present day. Photography of some of the finds at Full Sutton is presented in **Annex U**. • The remainder of Central Site East, comprising the premises of the former RAF Melbourne, has been assessed as holding an overall **Medium Risk** from Allied UXO due to its proximity to the following historical sources of potential UXO contamination: ○ The airfield armouries, and barrack and pyro stores

	○ Aircraft dispersal pans, where bombers were parked and loaded/unloaded with ordnance ○ The ends of runways, where aircraft crashes occurred with greater frequency ○ The airfield perimeter, which was often considered a convenient location for the disposal of unneeded munitions • **Proactive risk mitigation measures** are therefore recommended for any intrusive works undertaken in these zones. • While other Allied features were identified in the site's wider surrounds, no evidence to suggest that any significant military activity occurred on site other than at RAF Melbourne could be identified. The remainder of the site has therefore been assessed as holding an overall **Low Risk** from Allied UXO.
German Air-Delivered Ordnance	• During WWII the site was located within the Rural Districts of Pocklington and the Rural District of Howden; the situation of the site within these districts is illustrated in **Annex E**. Both districts sustained an overall very low density of bombing according to official Home Office statistics. These districts were not a priority for the Luftwaffe, although they were subject to 'tip and run' raids, and occasionally bombers jettisoning their payloads after failing to reach or locate their primary target. RAF Pocklington, approximately 2.15km north-east of the North-Eastern Site, was captured in Luftwaffe target photography which is presented in **Annex O**. • Ministry of Home Security Daily Intelligence Reports record a total of four wartime bombing incidents across the entire site area, although the precise details of these incidents is not provided. No evidence that the site was directly affected by bombing could be identified across available sources. • As the site was largely undeveloped, historical OS mapping is unable to provide any clear indications that the site may have been affected by bombing, although WWII-era aerial photography of RAF Melbourne does not provide any clear indicators of bomb damage such as cratering, scattered earth or damaged buildings. • As most of the site was undeveloped, ground cover on site is considered to have been largely unconducive to the detection of UXO. Items of UXO penetrating soft open ground could easily go unnoticed and unreported. A bomb entry hole could be as small as 20cm in diameter and therefore easily obscured in such conditions. • As most of the site was undeveloped, direct wartime access is anticipated to have been relatively low, although local access and monitor is anticipated to have been relatively high at the portion of the site located at RAF Melbourne, and areas of the site in close proximity to roads and farms. • In summary, the site was situated in an area subject to a very low density of bombing according to official Home Office statistics, and only four bombing incidents across the site's local area are recorded across available sources. As the site was largely undeveloped, ground conditions and access levels are considered unconducive to the detection of UXO, although no evidence to suggest that the risk from German UXO on site is higher than the 'background level' for this part of the country could be identified. The site has therefore been assessed as holding an overall **Low Risk** from German UXO. Due to the unfavourable ground conditions and access levels across the majority of the site, **UXO Safety Awareness Briefings** are still recommended as a sensible minimum precaution, and it is recommended that a **UXO Risk Management Plan** is also put in place.

15. The Likelihood that UXO Remains

15.1. 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.

15.2. 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.). 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.

15.3. Post-War Redevelopment

Comparison of historical OS mapping and recent aerial imagery indicates that post-war development across the site has been relatively minor.

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.

16. The Likelihood of UXO Encounter

16.1. 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.

16.2. 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.

16.3. 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.

17. The Likelihood of UXO Initiation

17.1. 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.

17.2. 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:

UXB Initiation	
Direct Impact	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.
Re- starting the Clock	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.
Friction Impact	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.

17.3. 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.

18. Consequences of Initiation/Encounter

18.1. 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.

18.2. 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.

19. 1st Line Defence Risk Assessment

19.1. 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.

19.2. Assessed Risk Level

1st Line Defence has assessed that there is an overall **Medium-High Risk** from items of Allied UXO in the section of the site of proposed works comprising land once occupied by, and adjacent to, the RAF Melbourne bomb stores. The remainder of the site area occupying the premises of RAF Melbourne has been assessed as holding an overall **Medium Risk** from Allied UXO. The remainder of the site, excluding RAF Melbourne, has been assessed as holding an overall **Low Risk** from Allied UXO. There is an assessed **Low Risk** from German unexploded ordnance across the entire site of proposed works. See Risk Mapping in **Annex T**.

Bomb Stores and Adjacent Land

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Anti-Aircraft Artillery Projectiles		✓		
Allied Land Service and Small Arms Ammunition			✓	

Remainder of Site comprising former RAF Melbourne

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Anti-Aircraft Artillery Projectiles		✓		
Allied Land Service and Small Arms Ammunition			✓	

Remainder of Site, excluding RAF Melbourne

Ordnance Type	Risk Level			
	Negligible	Low	Medium	High
German Unexploded HE Bombs		✓		
German 1kg Incendiary Bombs		✓		
Anti-Aircraft Artillery Projectiles		✓		
Allied Land Service and Small Arms Ammunition		✓		

20. Proposed Risk Mitigation Methodology

20.1. General

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

Recommended Risk Mitigation Measures	
Activity	**Recommended Risk Mitigation Measure**
All Works	• **UXO Risk Management Plan** 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 1st Line Defence for help/more information. • **Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.** 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.
Open Excavations (trial pits, service pits, bulk excavations, strip foundations etc.) (Medium-High and Medium Risk Areas Only)	• **Unexploded Ordnance (UXO) Specialist Presence on Site to support open excavations** When on site the role of the UXO Specialist would include: ◦ 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. ◦ 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. ◦ To aid incident management which would involve liaison with the local authorities and police should ordnance be identified and present an explosive hazard.

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, 1st Line Defence should be consulted to see if a re-assessment of the risk or mitigation recommendations is necessary.

1st Line Defence Limited **5th August 2024**

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.

Bibliography

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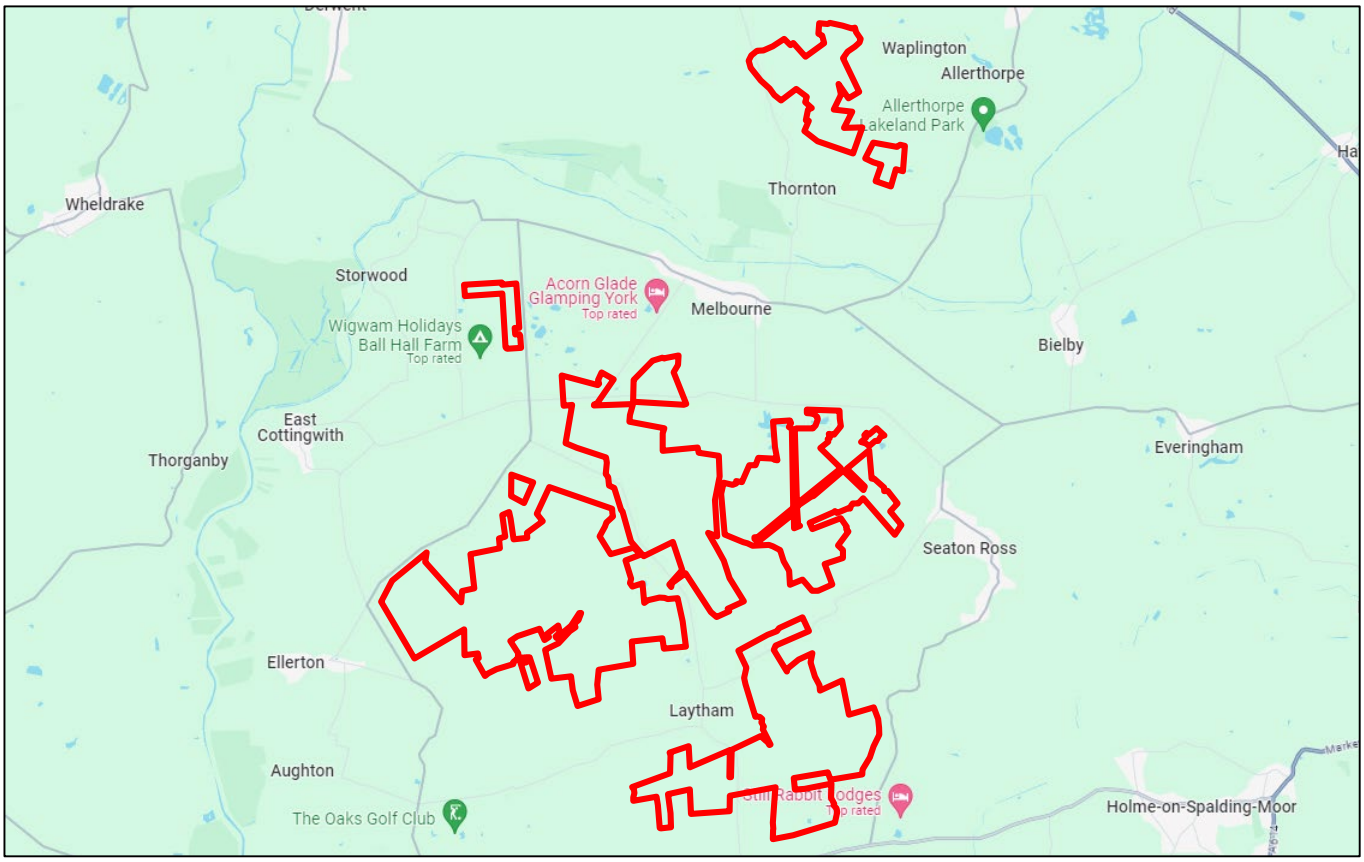
This report has been prepared by 1st Line Defence Limited with all reasonable care and skill. The report contains historical data and information from third party sources. 1st Line Defence Limited has sought to verify the accuracy and comprehensiveness of this information where possible but cannot be held accountable for any inherent errors. Furthermore, whilst every reasonable effort has been made to locate and access all relevant historical information, 1st Line Defence cannot be held responsible for any changes to risk level or mitigation recommendations resulting from documentation or other information which may come to light at a later date.



1ST LINE DEFENCE

Unit 3, Maple Park,
Essex Road, Hoddesdon,
Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: Statkraft Energy Limited

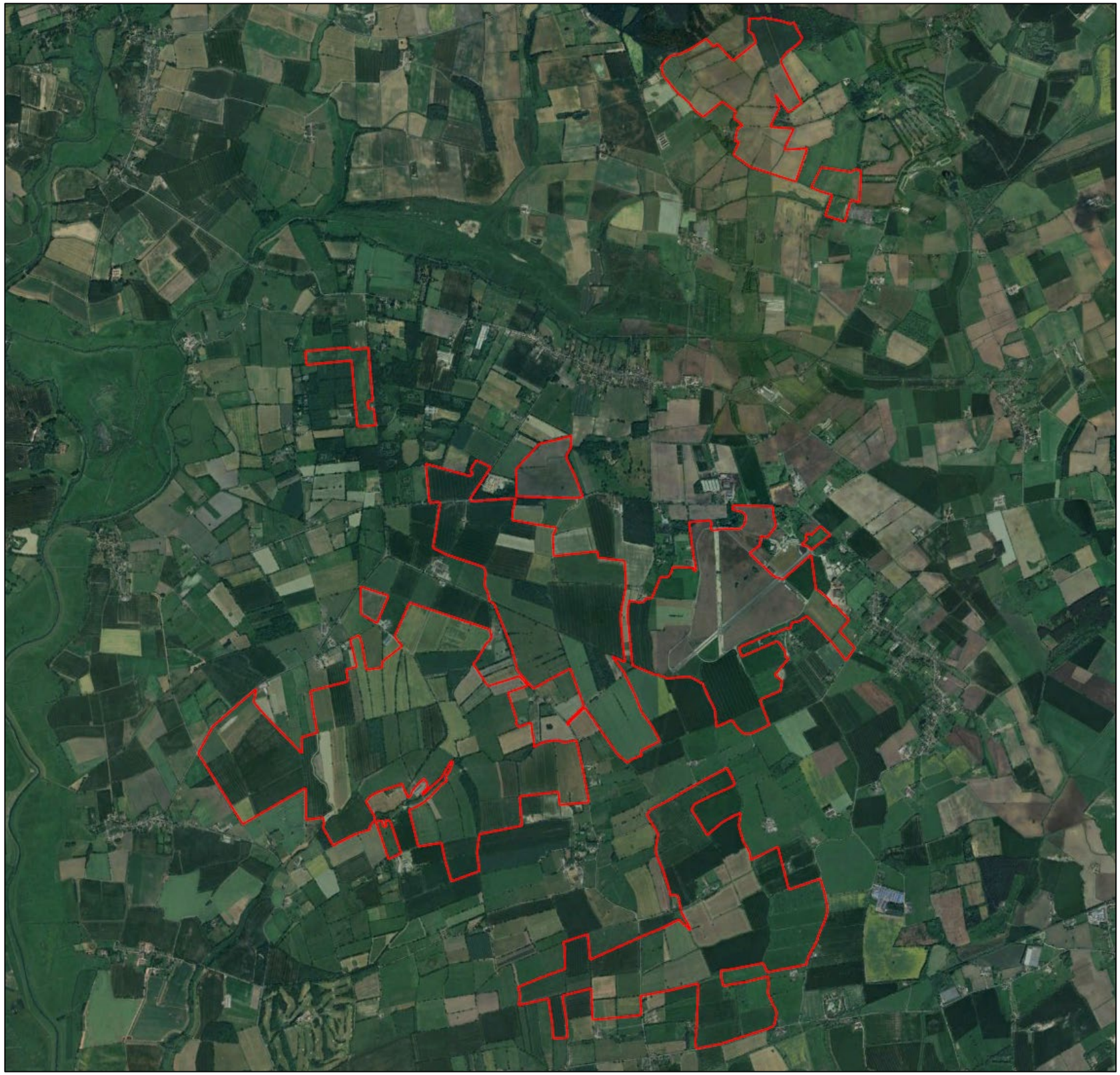
Project: Mylen Leah Solar Farm

Ref: DA20029-00

Source: Google Maps

Approximate site boundary

N



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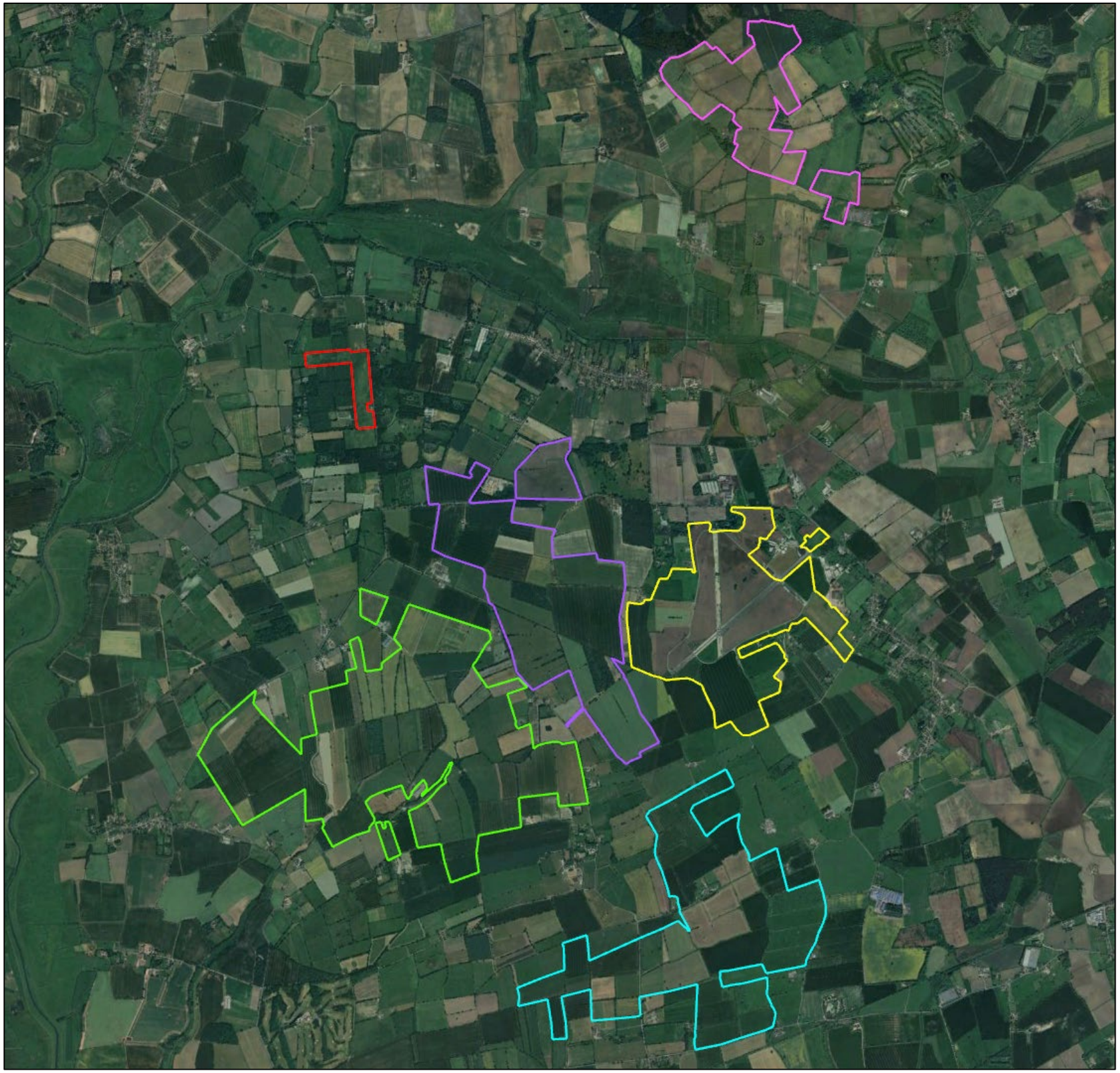

North-Eastern Site

North-Western Site

Central Site West

Central Site

Central Site East

Southern Site

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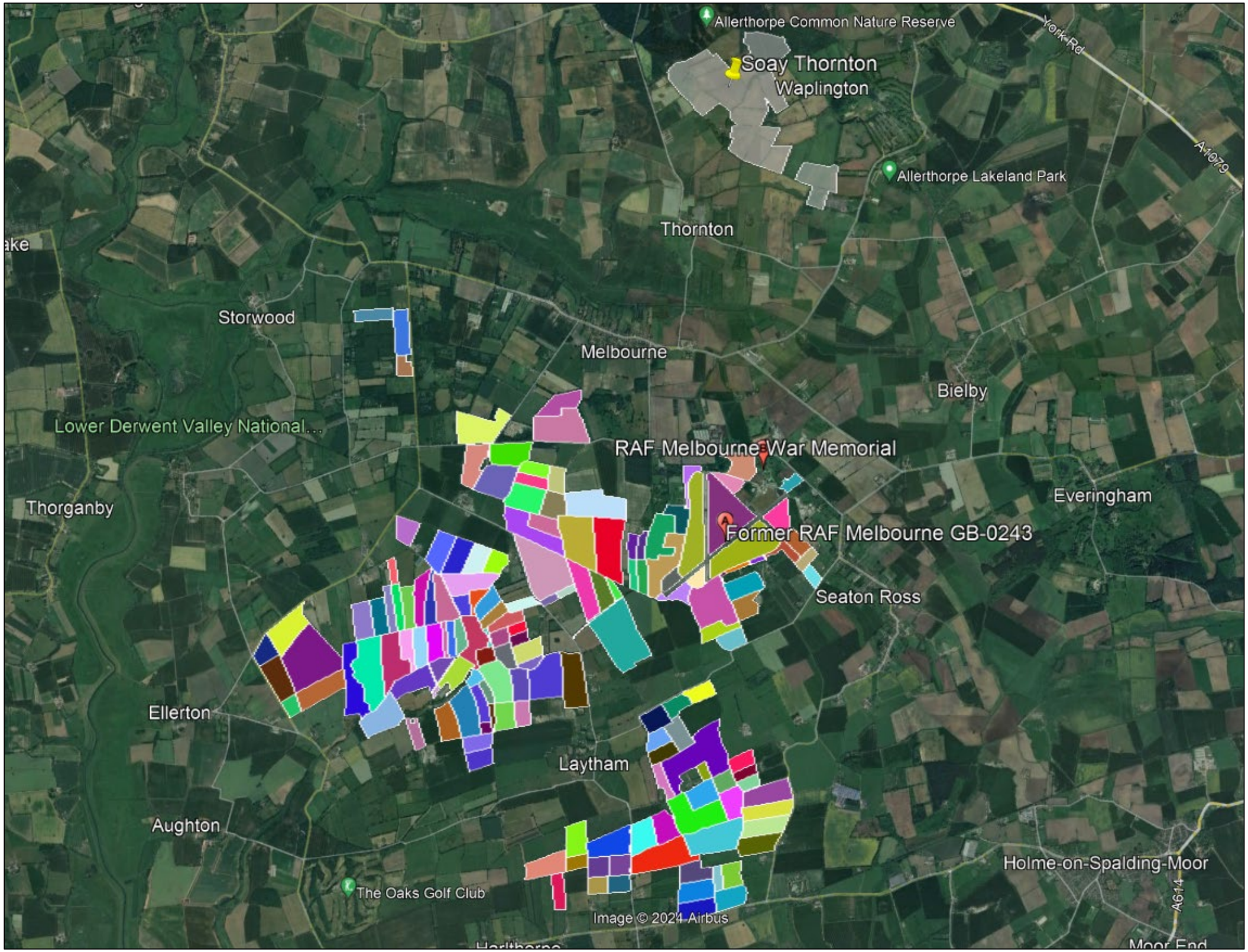

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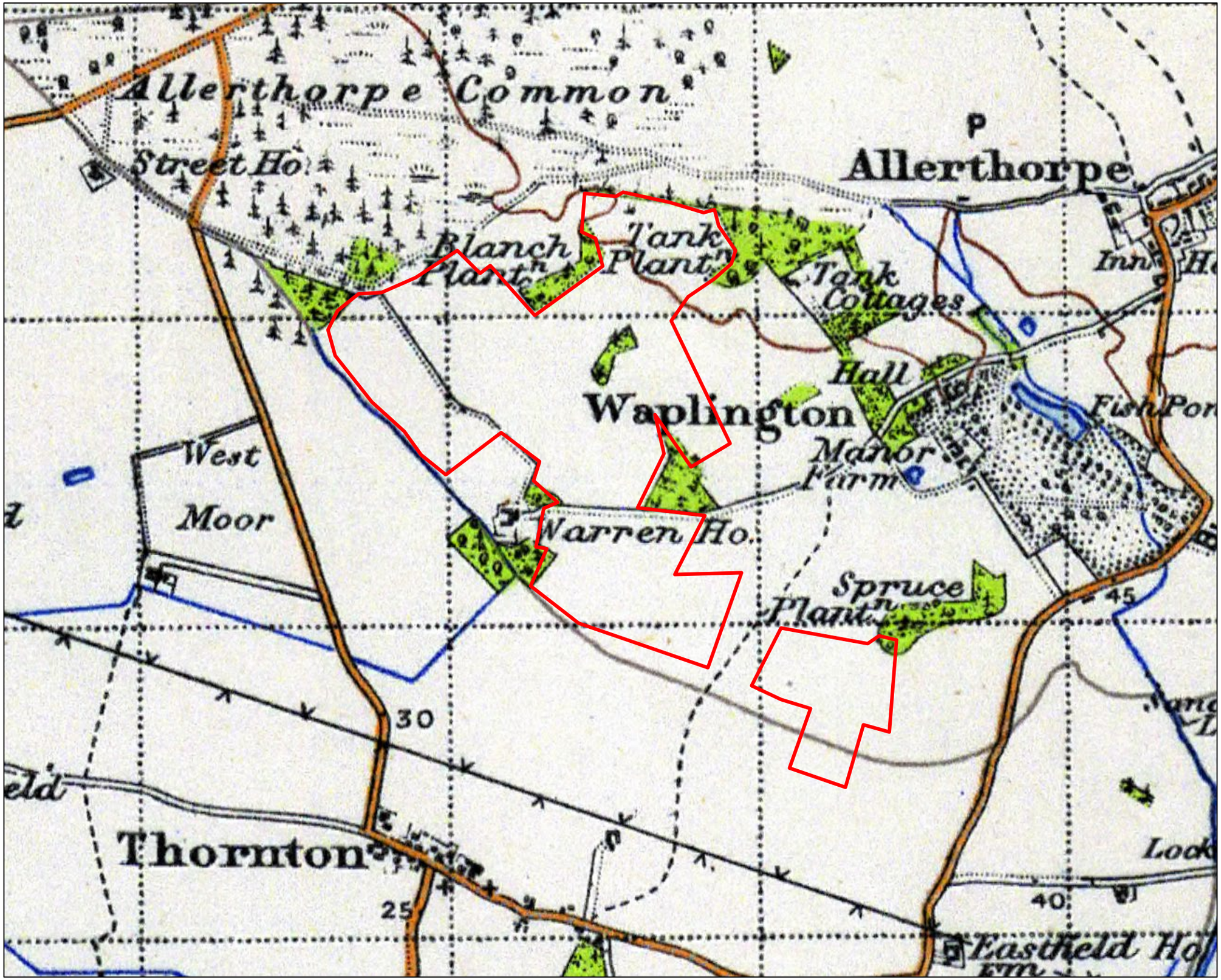

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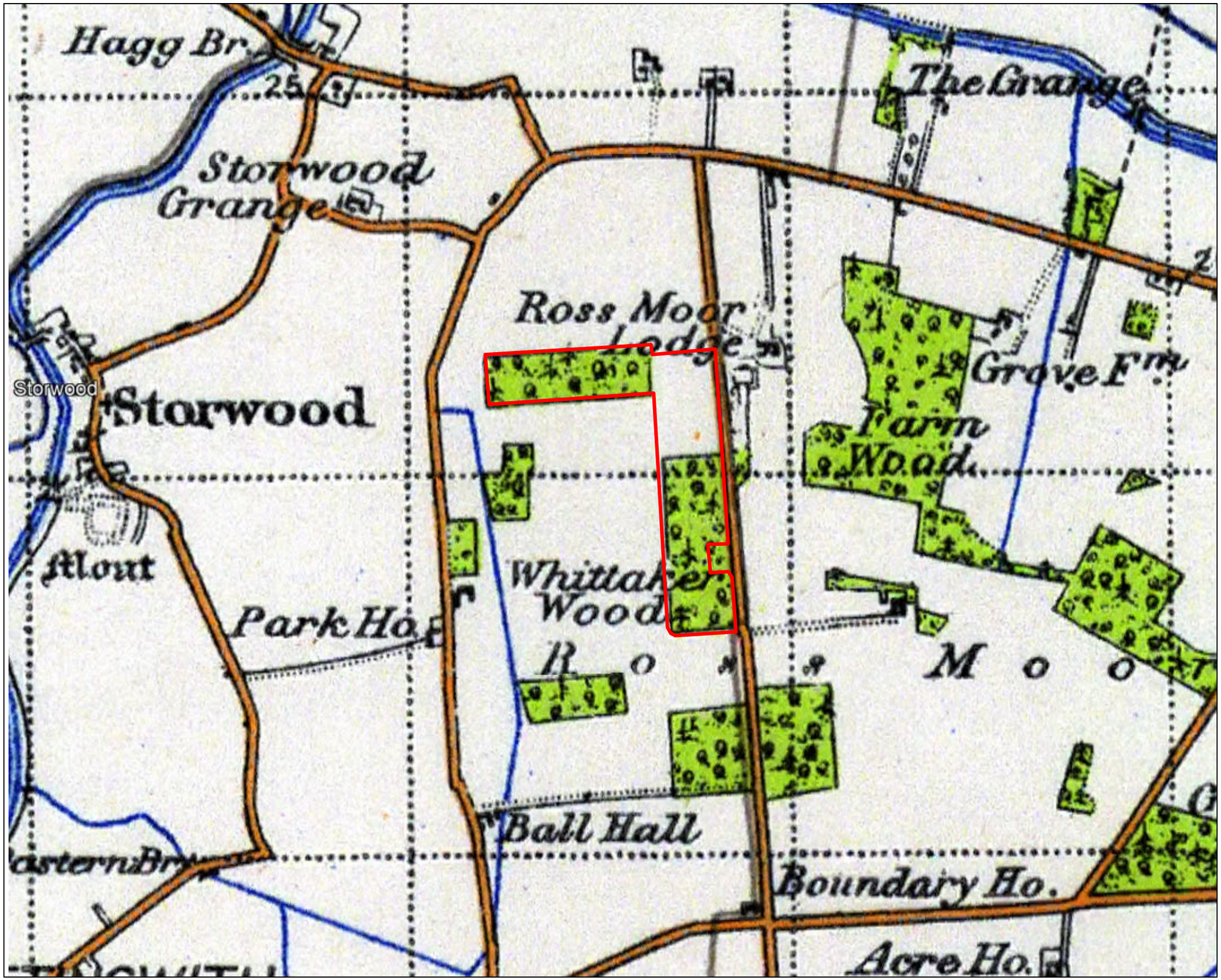

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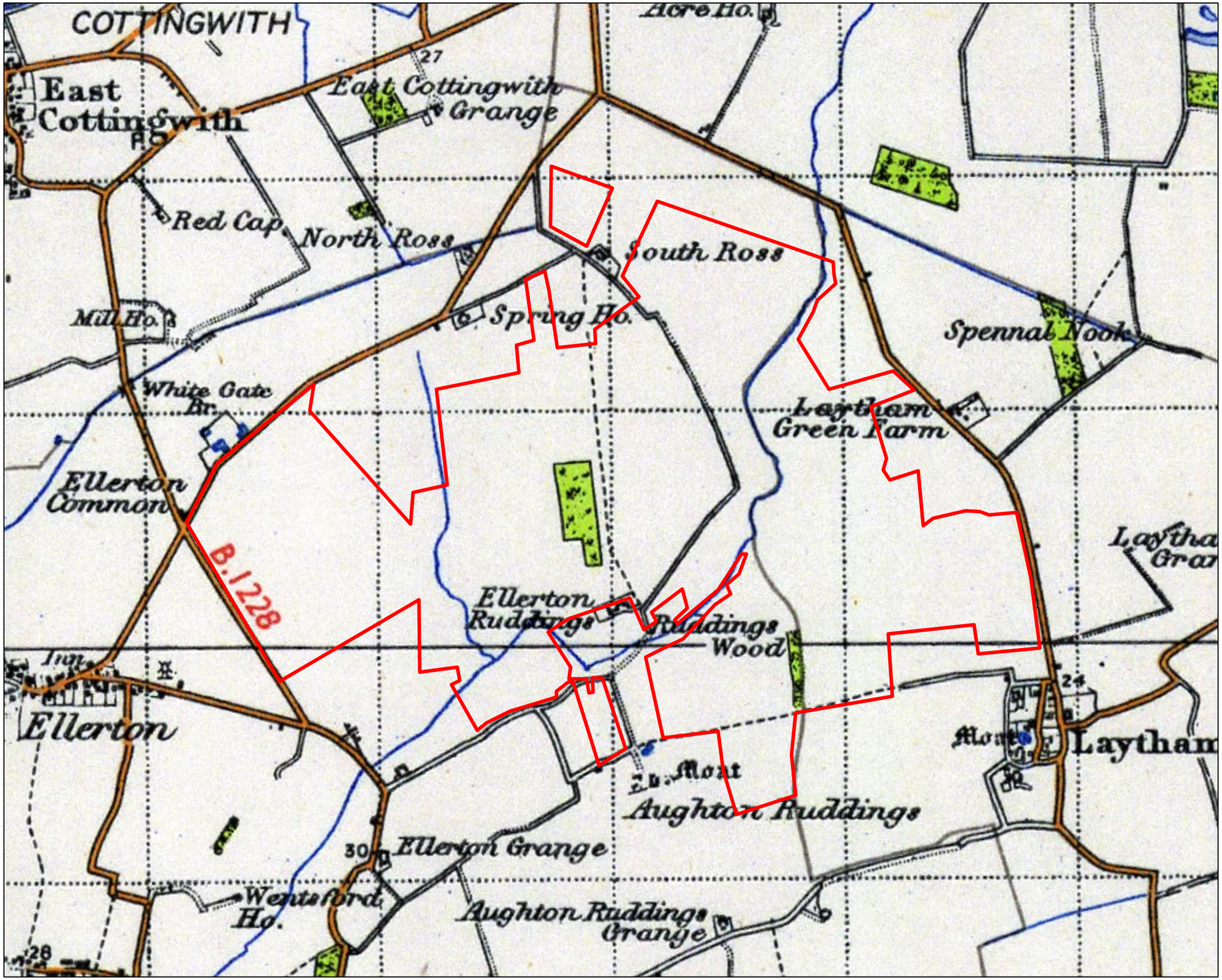

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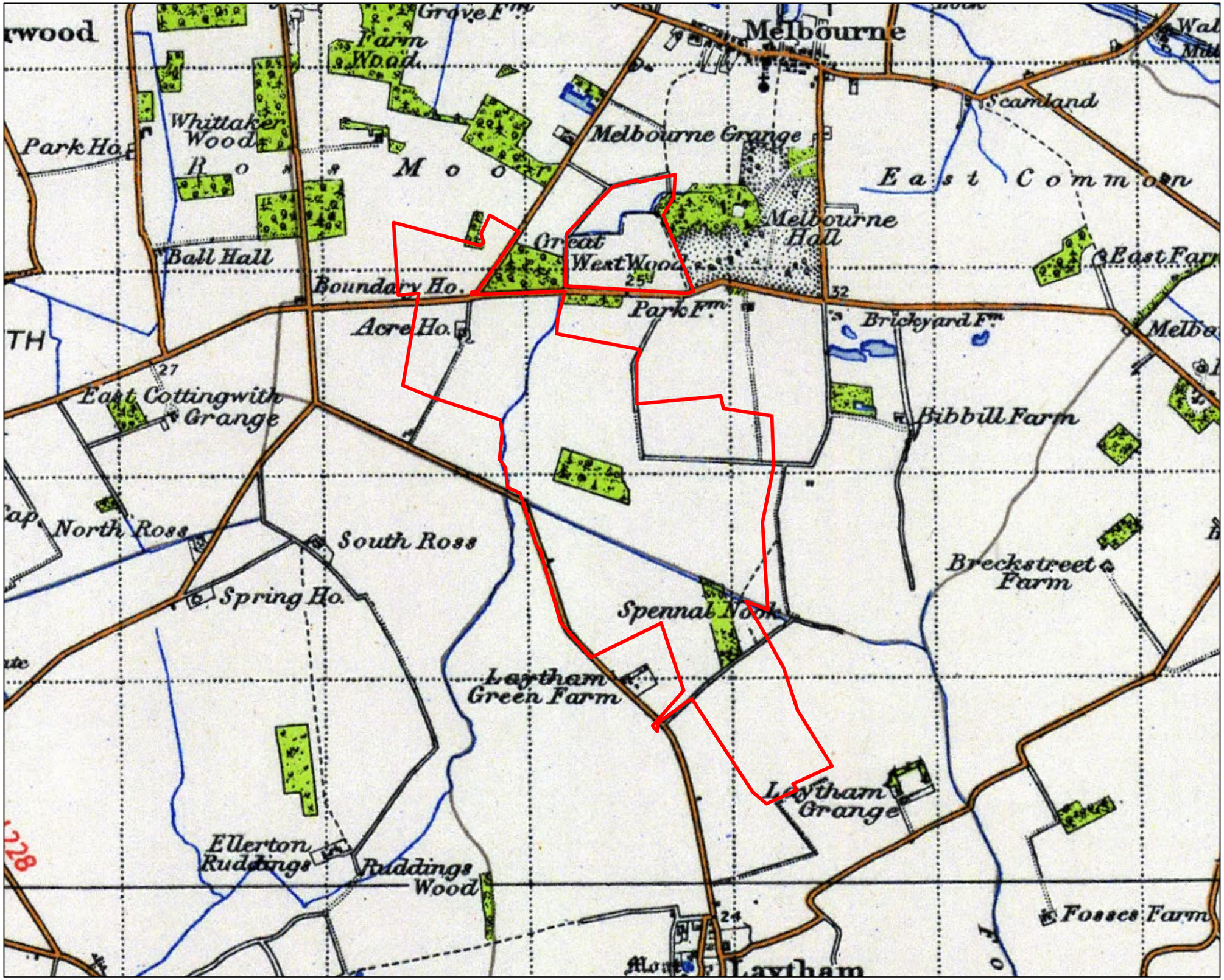

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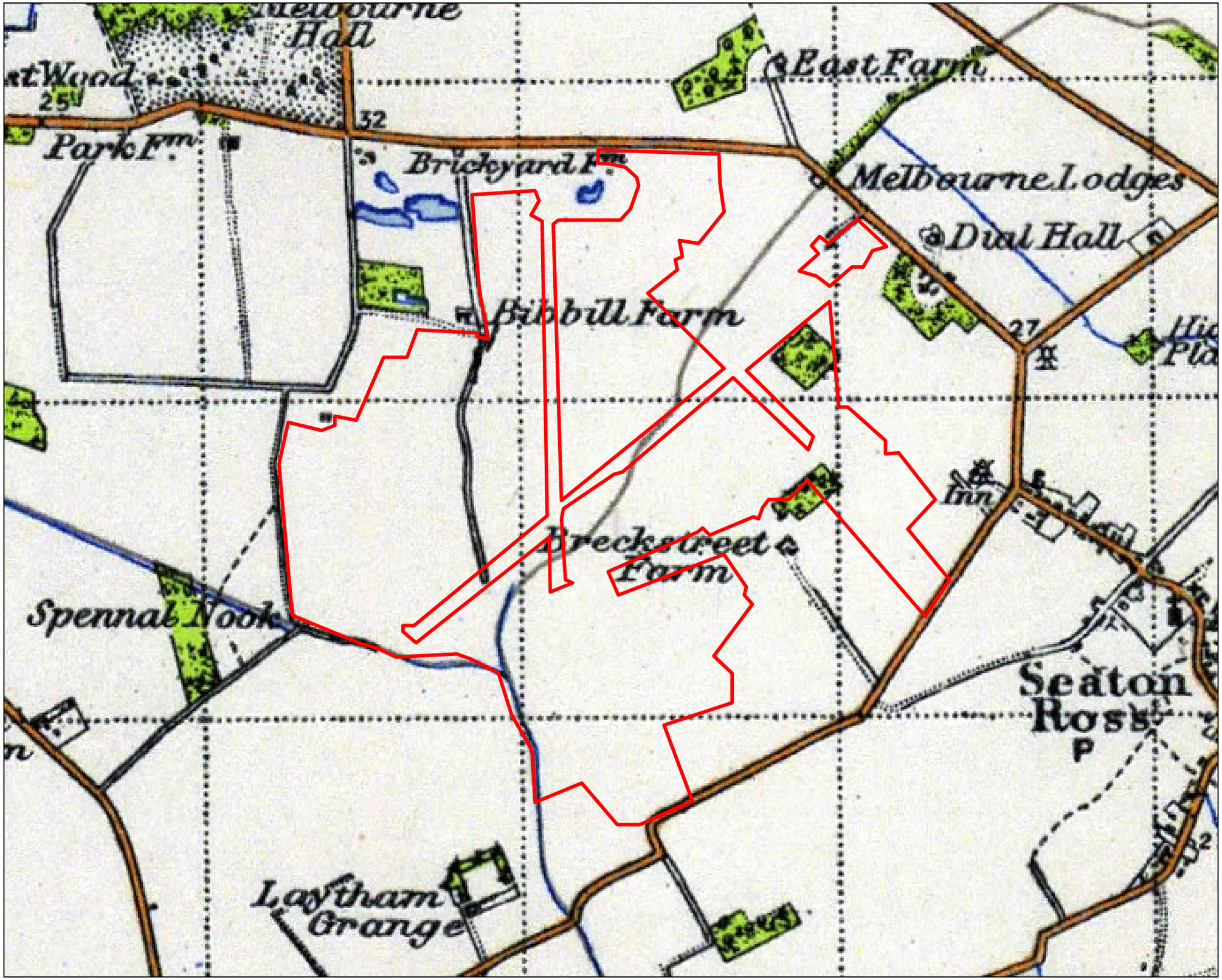

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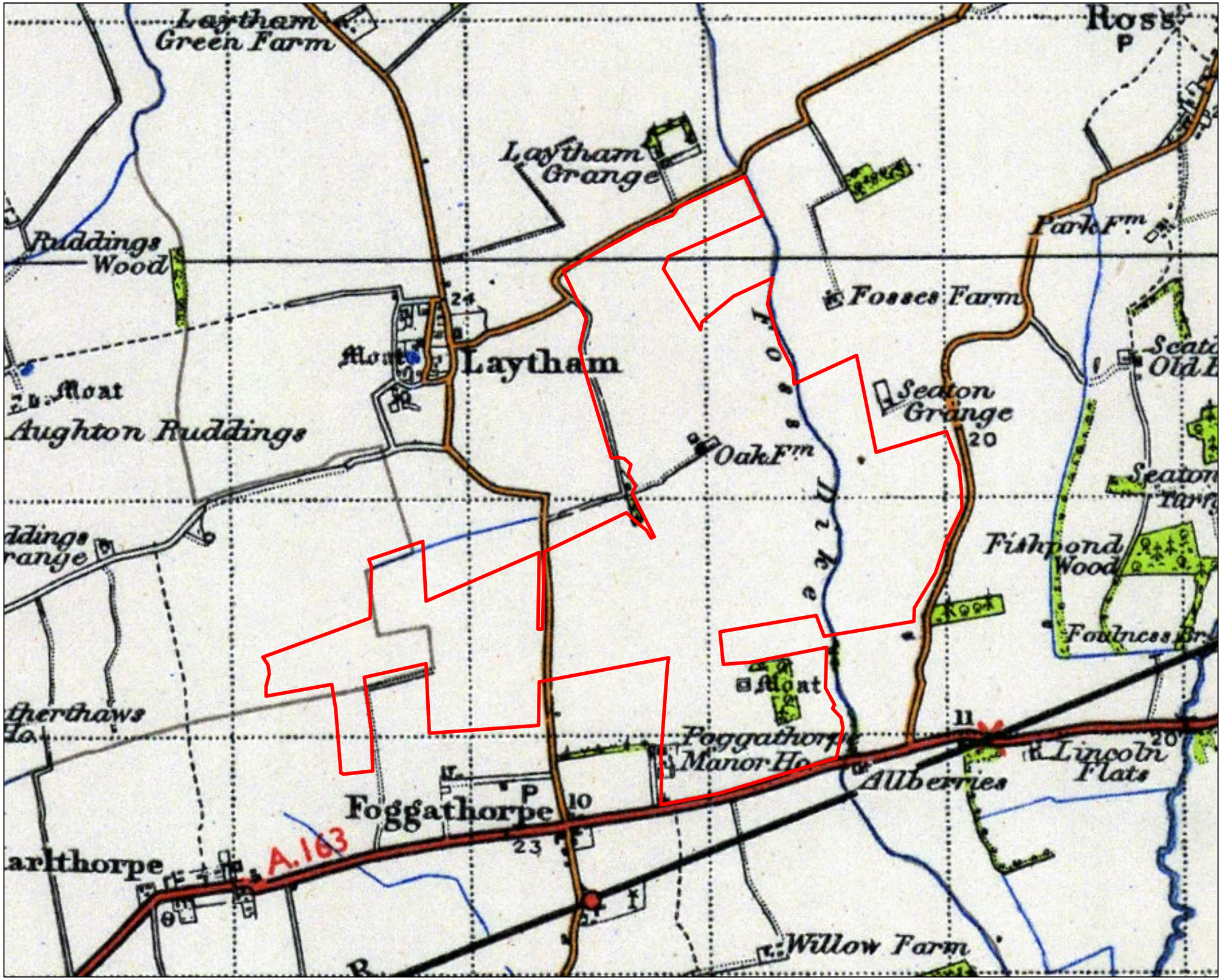

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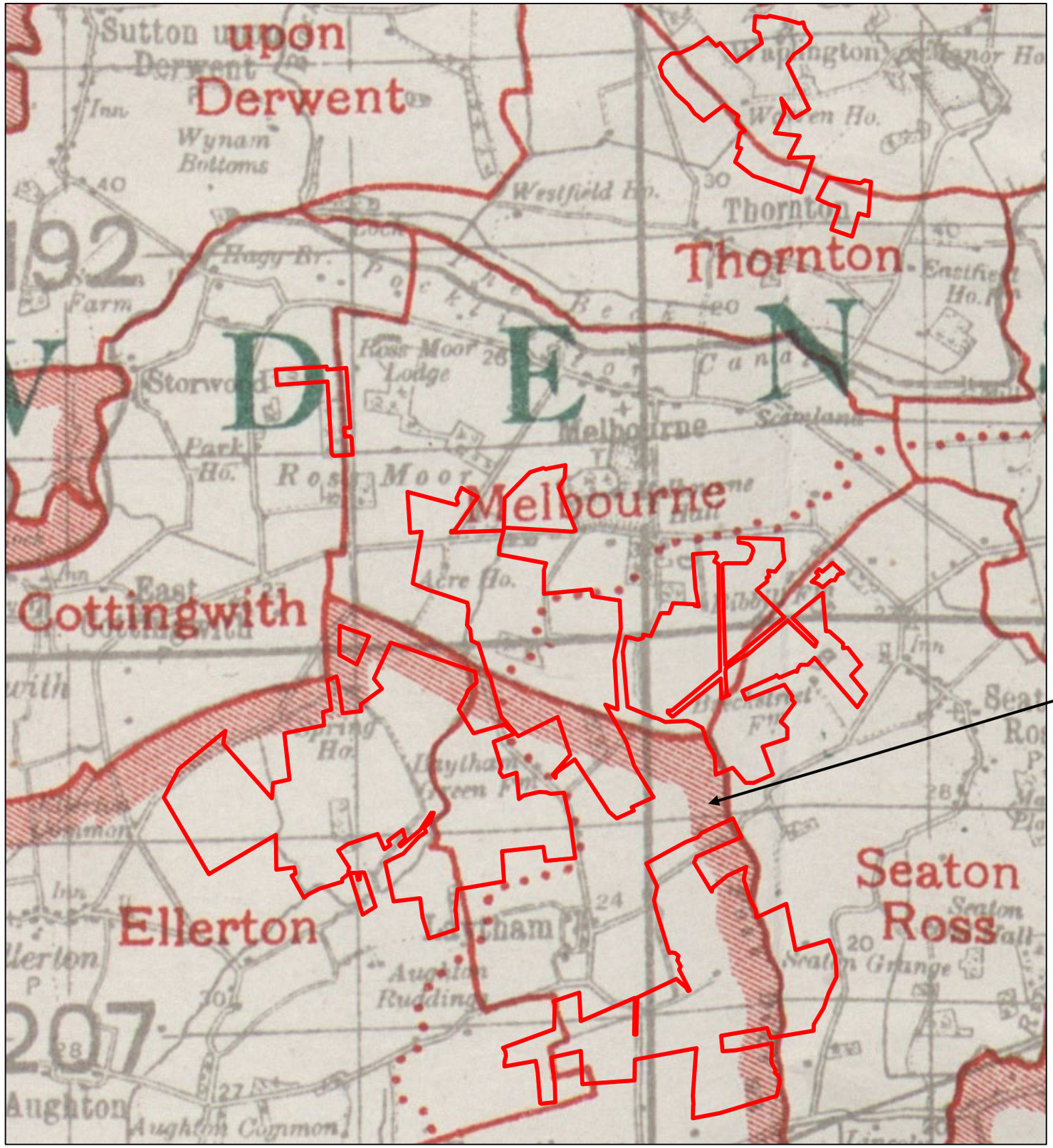

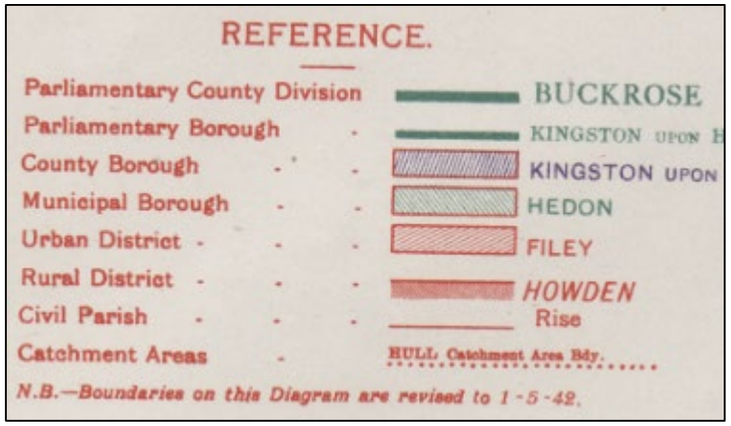

Boundary between the Rural District of Pocklington (to the north),
And the Rural District of Howden (to the south)

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Source: National Library of Scotland

Handley Page Halifax bomber, landing at RAF Melbourne after a raid on Turin, Italy, 21st April 1943.

Halifax being worked on by ground crew on one of RAF Melbourne's dispersal pans.

Below: Halifax approaching the south-eastern runway at RAF Melbourne, photographed from the village of Seaton Ross.

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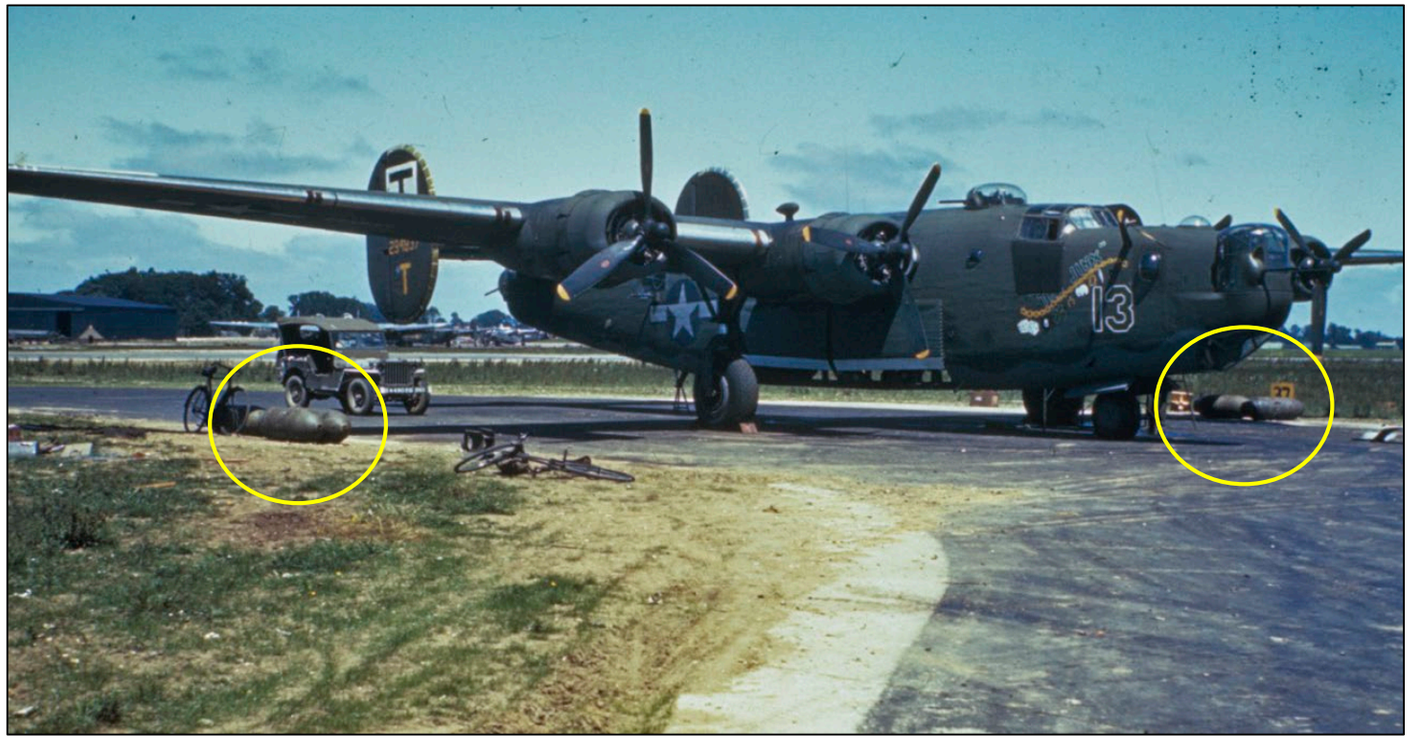
Source: Various Sources

Below: Bomb store at RAF Eye, displaying the typical arrangement of ordnance in a bomber ordnance pen.

Below: B-24 Liberator at RAF Eye, with bombs either side of the dispersal pan, awaiting stowage on the aircraft or return to the bomb stores.



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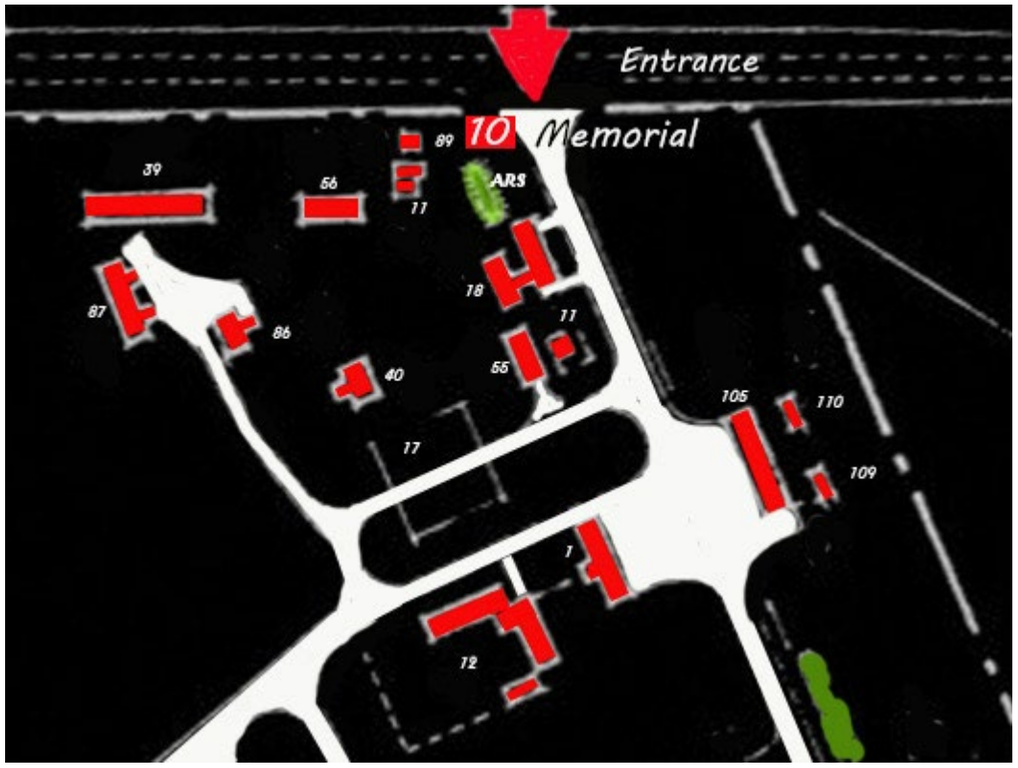
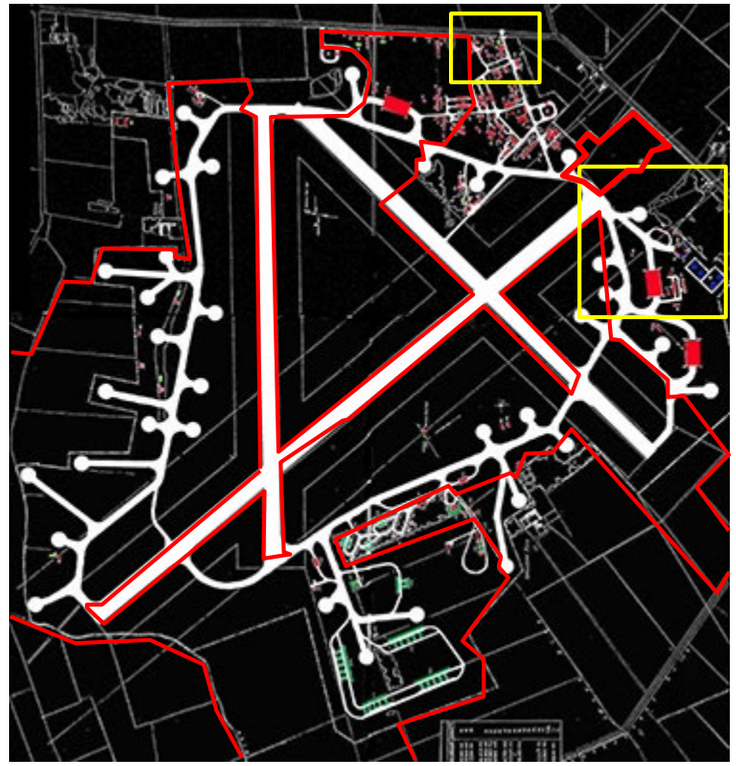
Source: The American Air Museum



Airfield Entrance Area

1. Station headquarters - TB - 9023/41.
7. Petrol compound (MT) 17747/40
11. Sub Station - TB - 12813/40.
12. AMWD hut & yard - 10312/42.
18. Guard house - TB - 10311/42.
39. Barrack stores - ex contractors.
55. Fire tender house - N - 12410/41.
56. Fire party hut - N - 2965/42.
87. Link trainer - TB - 4188/42.
89. M&E plinth - TB -.
105. Station office - N - 12400/41.
109. Latrine - TB - 12400/41 RAF.
110. Latrine - TB - 12400/41 WAAF.



Airfield FIDO System

70. Technical Latrine - 9025/41.
78. Maintenance Unit - N - 12777/41.
79. Armoury MU - N - 12777/41.
80. Maintenance & Staff Block - N -.
89. M&E Plinth - TB -.
98. Fido Instillation - Tanks - J.G. -4--3-.
99. Fido Instillation - Sleeping Quarters - N.
100.Fido Instillation - Stores - N.
101. Fido Instillation - Static Water Tank - B.
102. Fido Instillation - Fire Tender Hut - N.
103. Fido Instillation - Pump House - TB.

Fog Investigation and Dispersal Operation (FIDO) (which was sometimes referred to as "Fog Intense Dispersal Operation" or "Fog, Intense Dispersal Of") was a system used for dispersing fog and 'pea soup' fog (dense smog) from an airfield so that aircraft could land safely.

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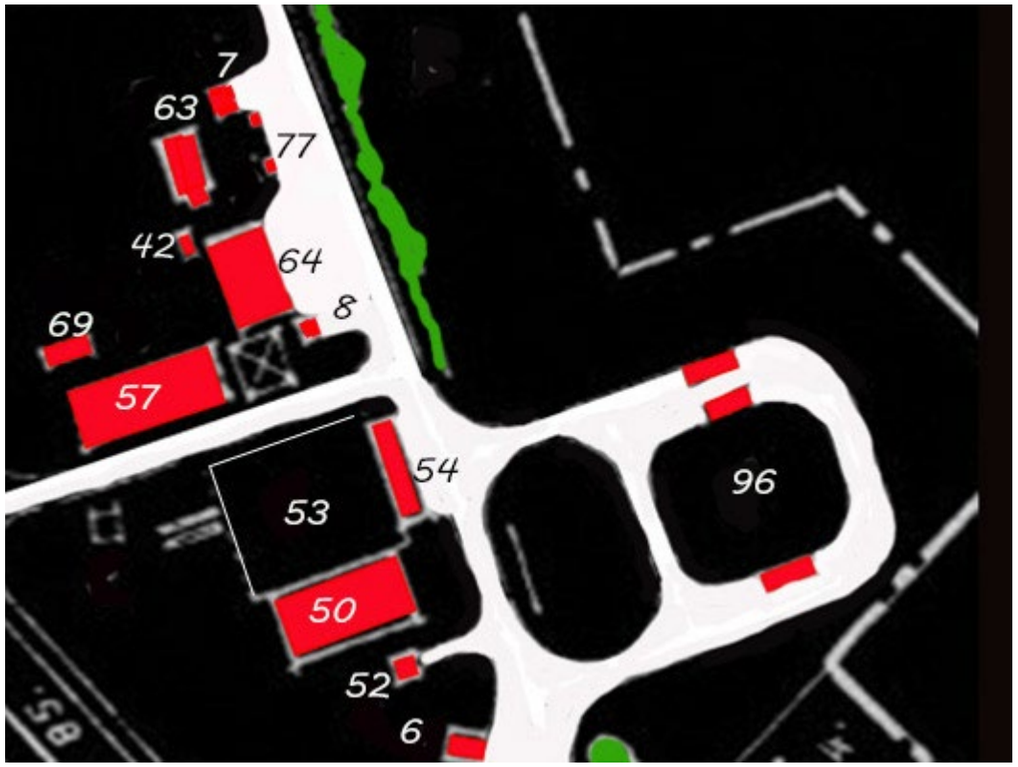
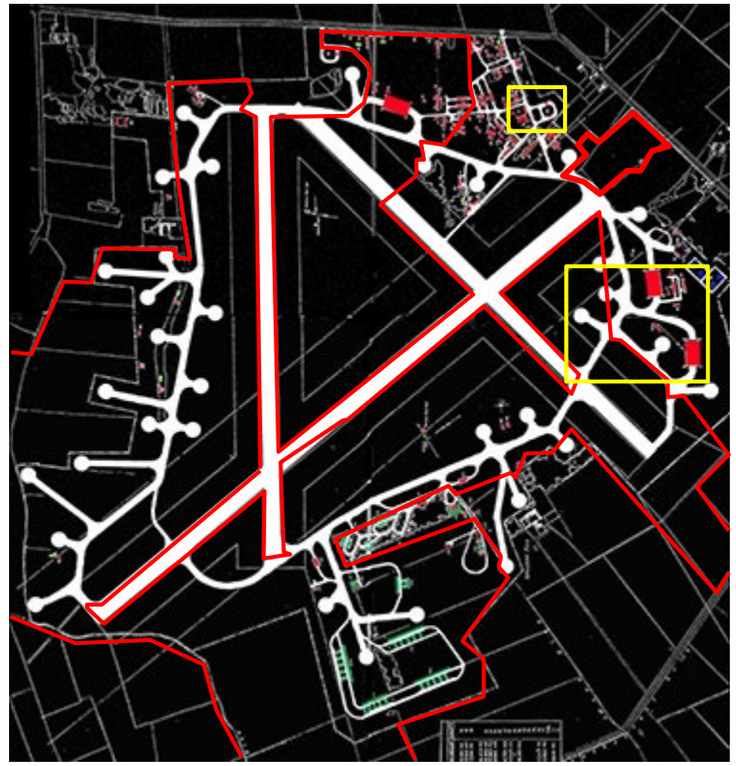
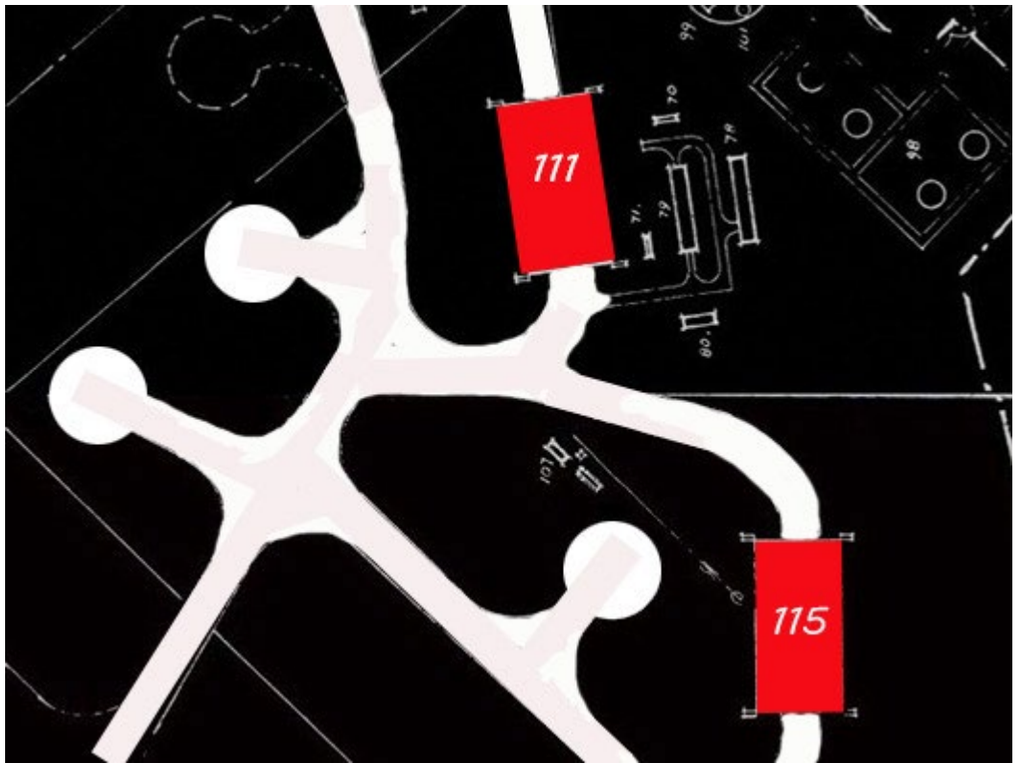
Source: Atlantikwall Online Archive



Fuel Stores

6. Petrol Installation [Aviation] - 18439/40.
7. Petrol Compound [MT] - 17767/40.
8. Bulk Oil Compound - 17702/40.
42. Technical Latrine - TB - 9026/41.
50. MT Shed Marston - 8140/43.
52. RU Pyro Stores - TB - 5488/42.
53. MT Wash down Workshop & Yard - C - 7445/43.
54. Lubricant & Inflammable Stores - TB - 17706/40.
57. Link Trainer Building - TB - -----/41.
63. Main Workshops - N - 3031/42.
64. MT Shed & Yard 4bay & workshop N.
69. Technical Latrine TB - 9025/41 [RAF].
77. Petrol MT [2No Pumps] - 4728/42.
96. Bulk Petrol Instillation - 9941/41 [48000galls]





Aircraft Hangars

111. Aircraft Shed - ST - 3553/42 - T2 type.
115. Aircraft Shed - ST - GI 2272 - B1 type.

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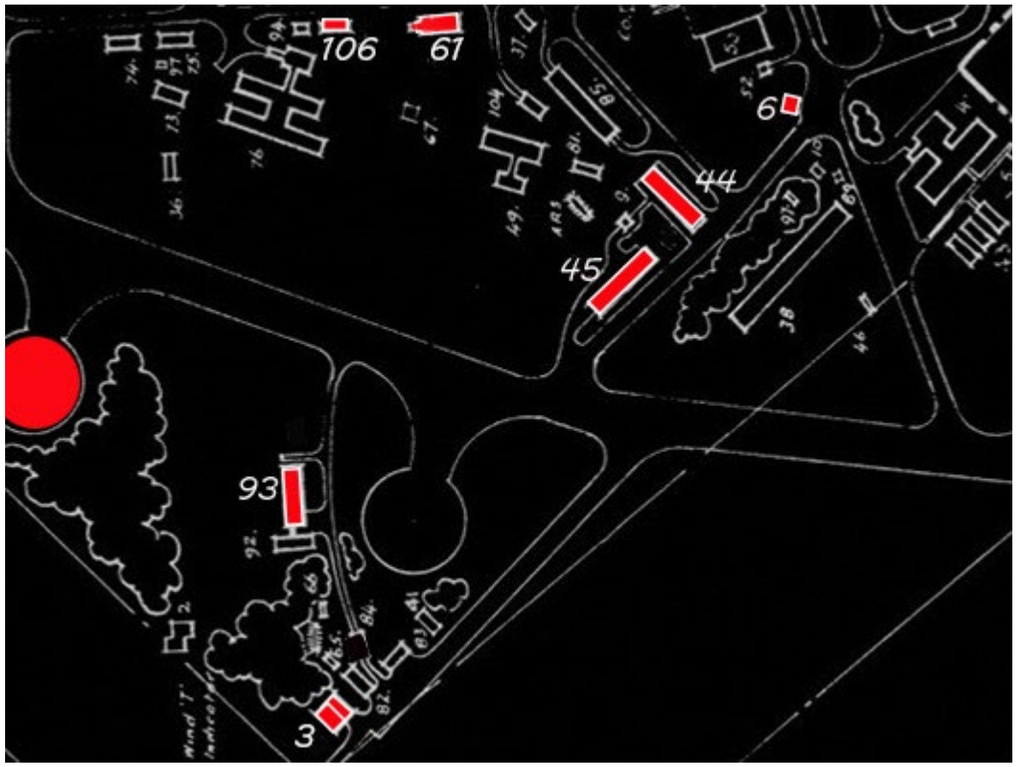
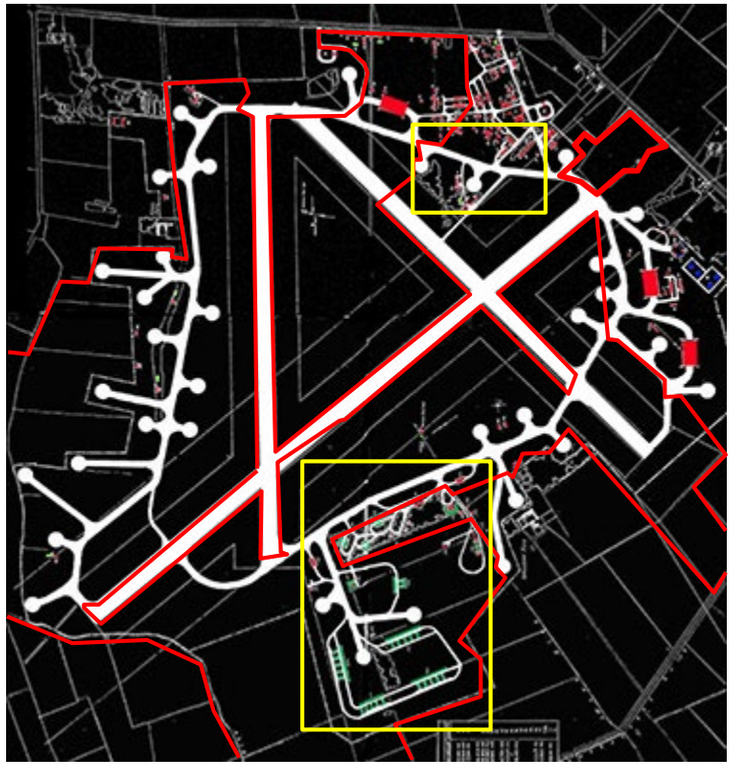
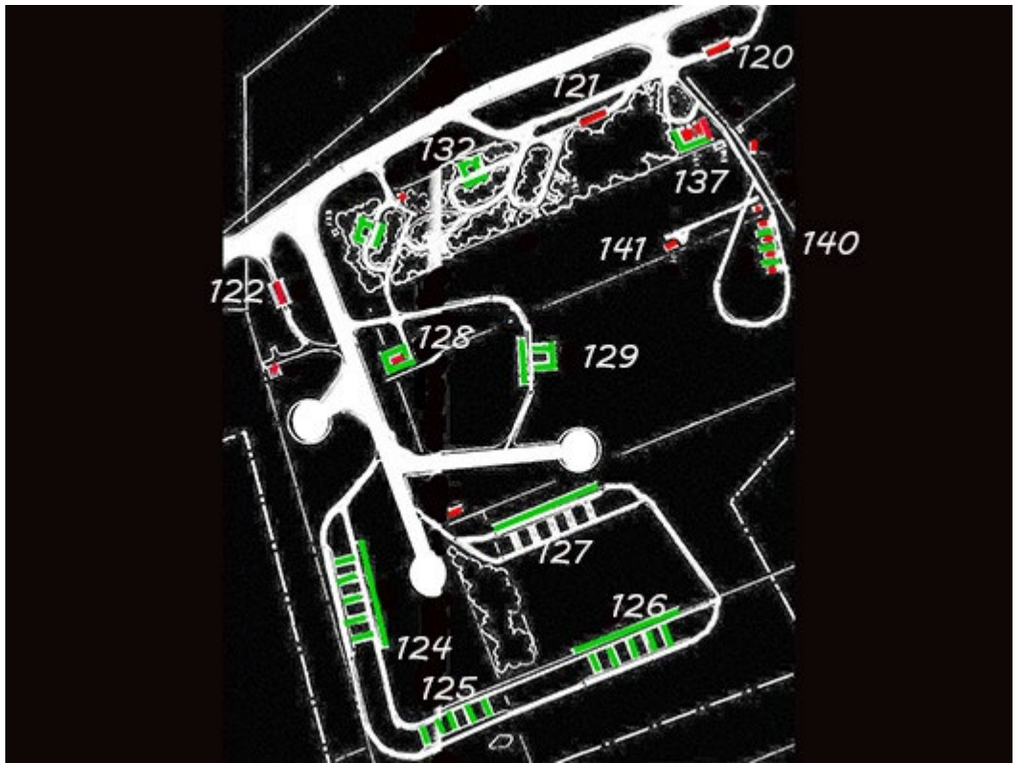


Northern Airfield Infrastructure

106. Dingy Shed - TB - 2901/43.
61. Parachute Stores - TB - 10825/42.
6. Petrol Instillation [Aviation] 18436/40. 24000 gals.
44. Armoury - TB - 17705/40.
45. Maintenance Unit - TB - 17705/40.
93. Crew Briefing Room - TB- 4701/43.
3. Watch Office - TB - 4514.





Bomb Stores

120. Fuzing Point Building - light - 15964/40.
121. Fuzing Point Building - Heavy light - 15964/40.
122. Fuzing Point Building - Ultra heavy - 7900/41.
124-5-6-7 Bomb Stores - 'D' - 3164/42.
128. Component Store - 18185/42.
129. Fuzed & Spare Bombs - 4780/42.
132. Incendiary Bomb Store - 18185/42.
137. Incendiary & Pyro Store - 18185/42.
140. S.B.C. Stores No.4 (Small Bomb Containers)
141. Pyro Store - N - 1272/41.

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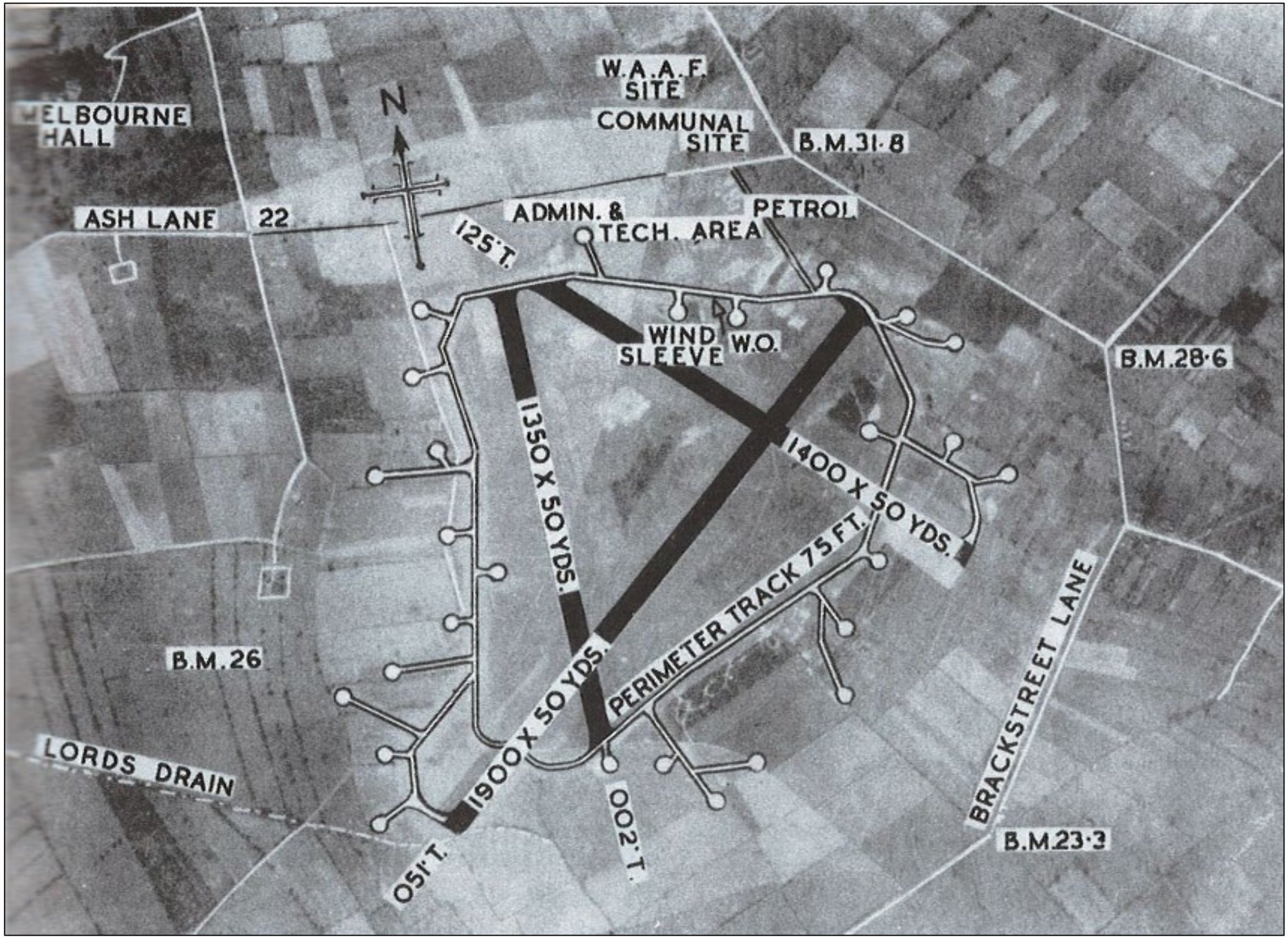

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Source: Ken Delve, The Military Airfields of Britain: Northern England

Approximate location of dispersal camp

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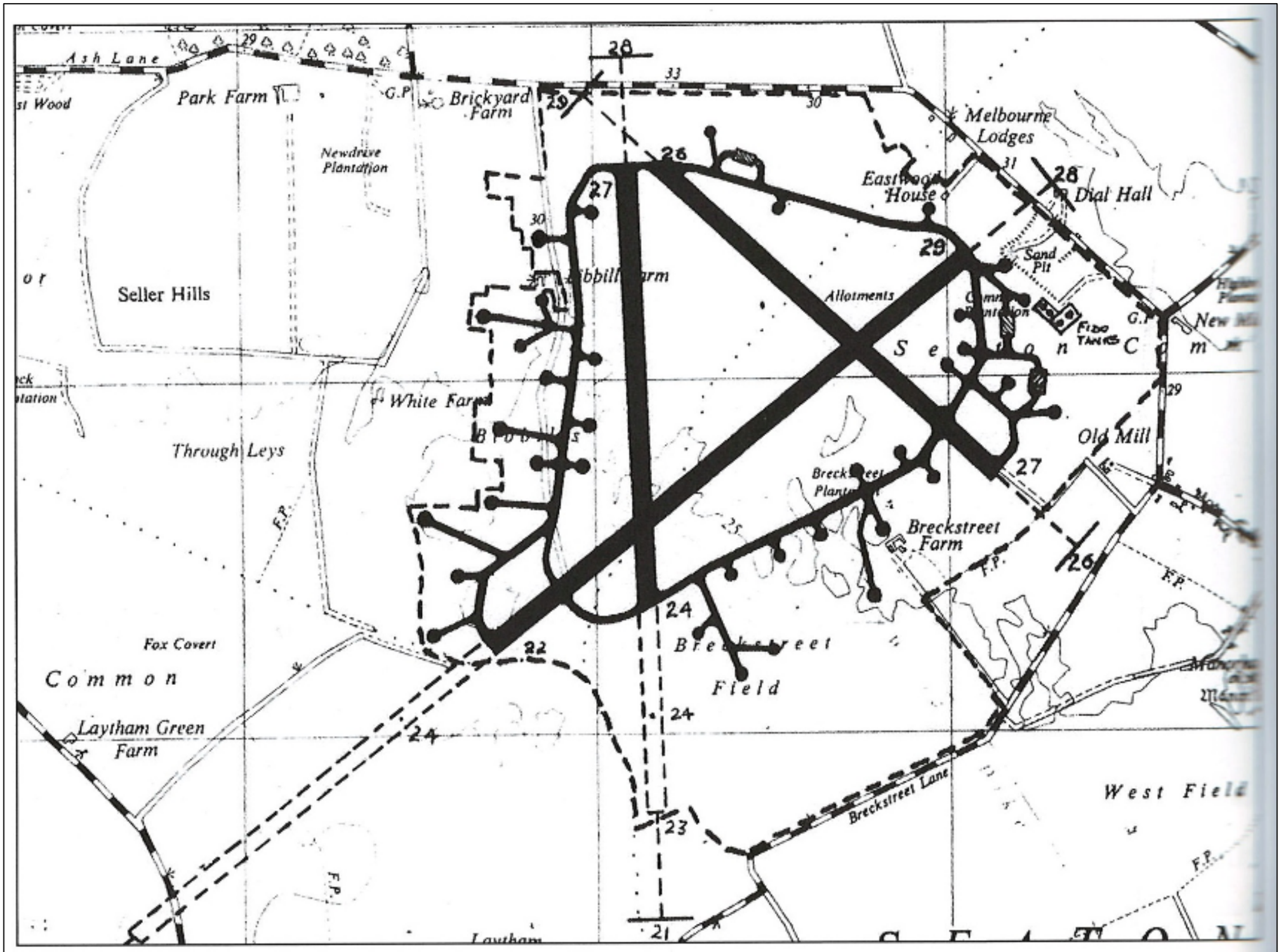

Airfield plan of Melbourne early 1950s; the possible extension to the main runway is shown by the dotted line.

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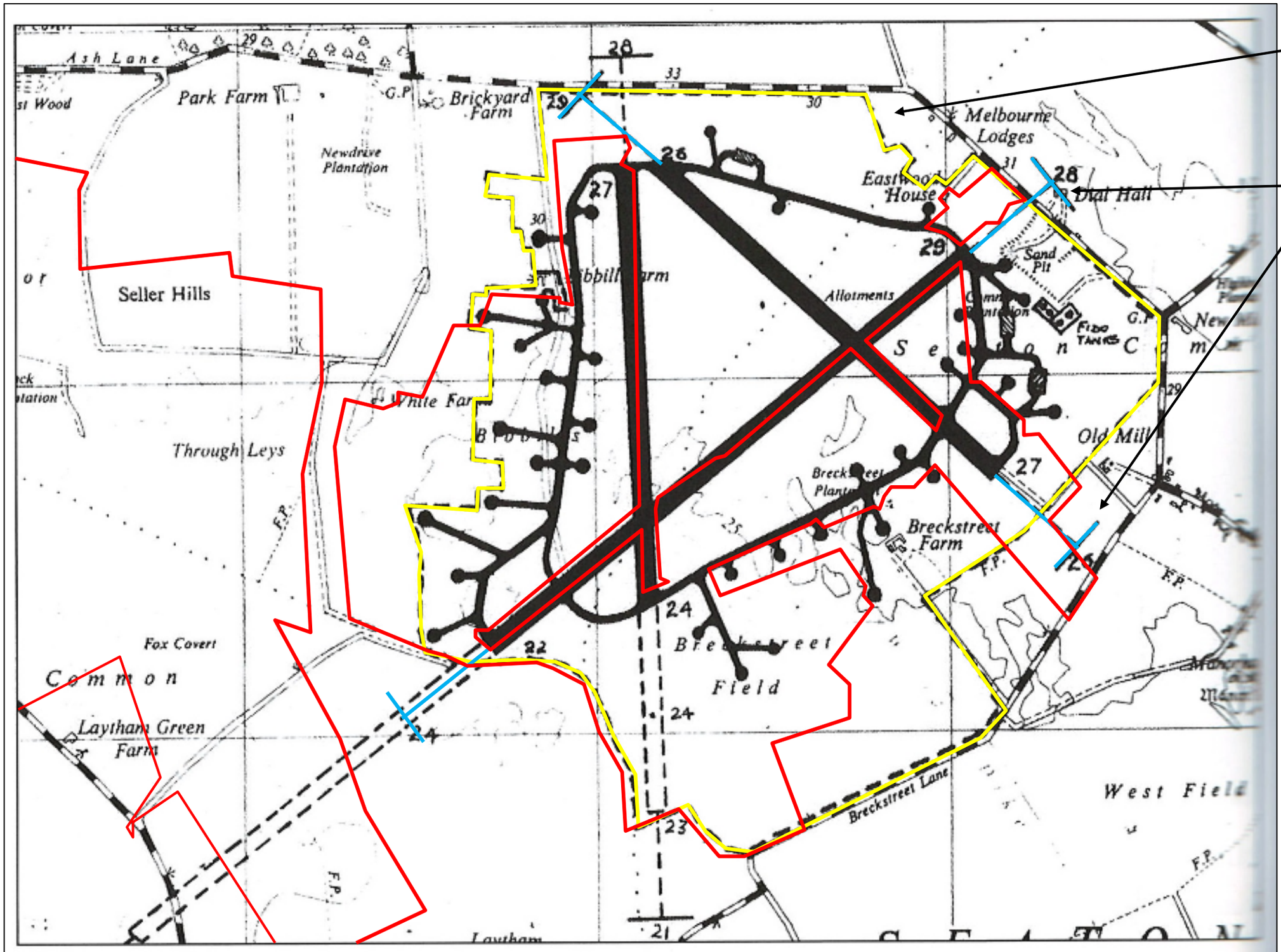

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R.A.F. Form 540. OPERATIONS RECORD BOOK. Page No. 1.

No. of pages used for MONTH

of (Unit or Formation) 4275. A.A. Flight.

Place	Date	Time	Summary of Events.	Reference to Appendics.
Melbourne.	2.6.42.		This Flight was first formed by a detachment from 4033 Special Flight, under the Command of F/Lt. Carfree. Daily Routine Duties.	Manning and State of Readiness and Gun Crew Orders are attached as Appendix 'A'.
Melbourne.	21.9.42.		P/O. E.R.W. Gittins was posted to this Unit as its Commanding Officer.	
Melbourne.	6.11.42.		When the Flight was made up to strength it was named 4275. A.A. Flight, and carried out normal A.A. Duties, weapon and field training.	

MANNING AND READINESS.

From first light to last light, Hispanos will each be manned by TWO men, of whom one will be nominated as Detachment Commander. Their tour of duty will be for one hour, and they will change round at half time. Times of manning will be given with the Colours of the Day.

The No: 1 of a Hispano Detachment

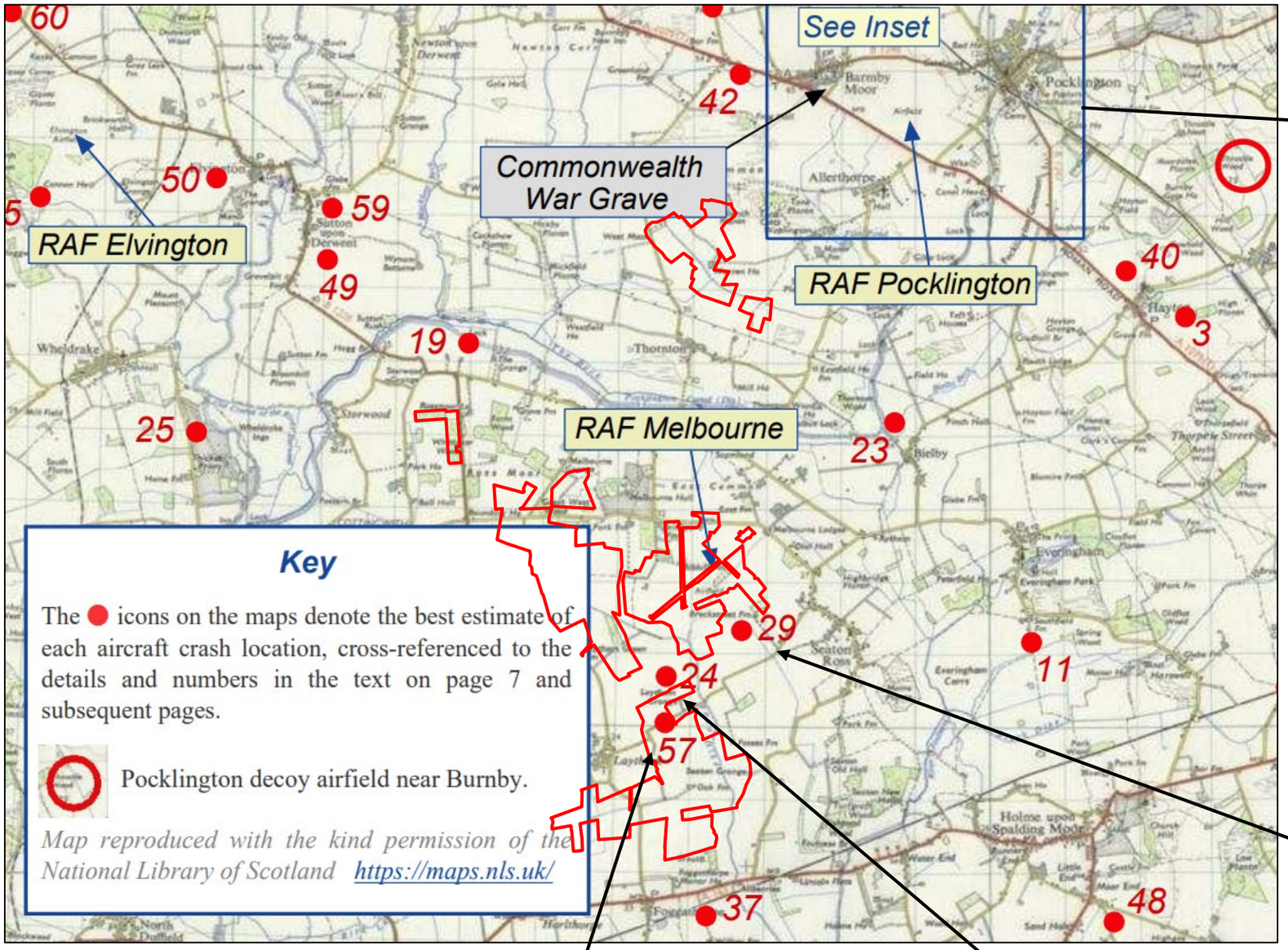
AMMUNITION.

Magazines will be filled with 32 rounds only. Magazines emptied or partially emptied during action will be refilled as soon as the situation permits.

Hispano Magazines will be filled as follows:-
Ball, 65%. H.E. 25%. Tracer, 10%
The first round to be fired in each magazine will be BALL.

Stoppage during practice firing will not be cleared for at least a minute after. Stoppage during an engagement will be cleared immediately.

All faulty or damaged rounds to be returned to Flight Headquarters.

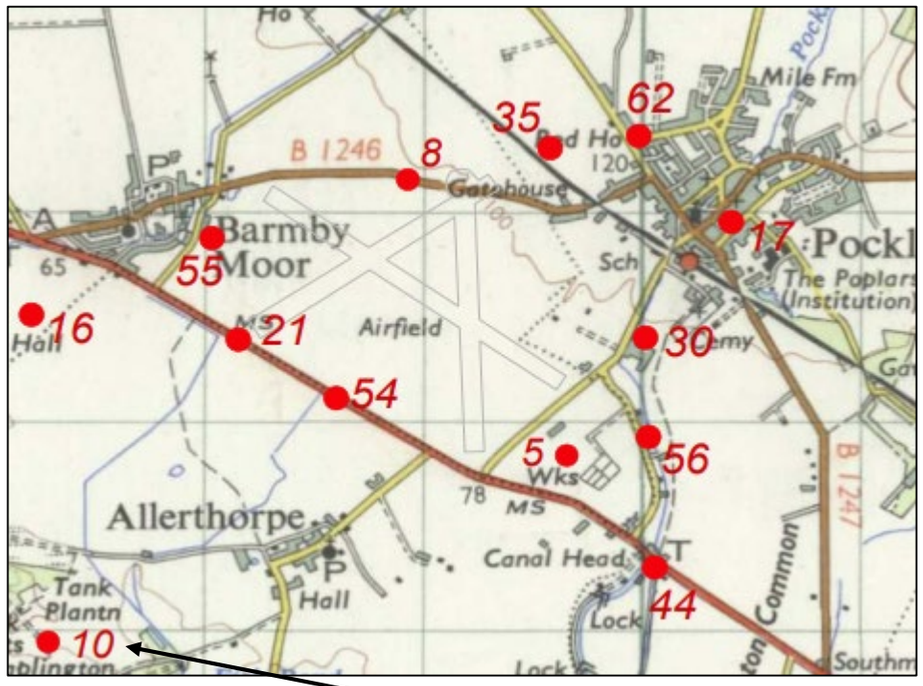


Key

The ● icons on the maps denote the best estimate of each aircraft crash location, cross-referenced to the details and numbers in the text on page 7 and subsequent pages.

Pocklington decoy airfield near Burnby.

Map reproduced with the kind permission of the National Library of Scotland https://maps.nls.uk/



13 Oct 1941 *Whitley Z9155* Sergeant Clive Gordon Lord RAAF

This aircraft of No. 58 Squadron based at RAF Linton-on-Ouse was returning from Nurnburg to land at Linton, but was diverted to Pocklington, ran out of fuel and crashed near Waplington Hall near Allerthorpe *[10]*. All 5 crew were killed, 2 being buried at Barmby Moor, another at Pocklington cemetery.

1 Jan 1945 *Halifax LV785* Flying officer J Charles Winter RAF

This aircraft from No. 10 Squadron took off from its base at RAF Melbourne to attack a coking plant at Dortmund but, shortly thereafter, the starboard outer engine failed and caught fire. The fire was extinguished by the fire extinguisher system, the crew aborted the operational task, jettisoned the bombload into the North Sea and returned to Melbourne. However, the initial approach to land was too high and, during the subsequent overshoot and climb, the starboard inner engine also failed.

With both starboard engines now failed, the pilot was forced to restrict the power on the 2 port engines to maintain directional control but was unable to maintain height and elected to attempt a forced landing near Laytham Grange close to the airfield *[57]*, with the aircraft catching fire.

Both air gunners were killed in the crash, one being buried in Pocklington cemetery. The remaining 5 crew were injured but, aided by several civilians, were rescued.

30 Nov 1942 *Halifax W7871* Flight Sergeant Edward John Wilmott RAFVR

This aircraft of No. 10 Squadron based at RAF Melbourne took off on a formation flying exercise, executed a steep turn shortly after take-off, stalled and crashed near Laytham Grange *[24]* and burnt out. 8 fatalities, 3 of whom were buried at Barmby Moor.

10 Mar 1943 *Halifax W1039* Sergeant Geoffrey Francis Peck RAFVR

This aircraft of No. 10 Squadron based at RAF Melbourne was being ferried to another airfield when, shortly after take-off, the port outer engine failed and the propeller was feathered. The pilot turned towards the failed engine, the aircraft stalled and crashed 1 mile west of Seaton Ross *[29]*, killing the crew. 2 buried at Barmby Moor.

1ST LINE DEFENCE

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Hertfordshire. EN11 0EX
Email: info@1stlinedefence.co.uk
Tel: +44 (0)1992 245 020

Client: Statkraft Energy Limited

Project: Mylen Leah Solar Farm

Ref: DA20029-00

— Approximate site boundary

N

Source: Pocklington & District Local History Group

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Source: Peter Jacobs, 'Bomber Command Airfields of Yorkshire'

Below: Pocklington Home Guard Platoon, early 1940s.

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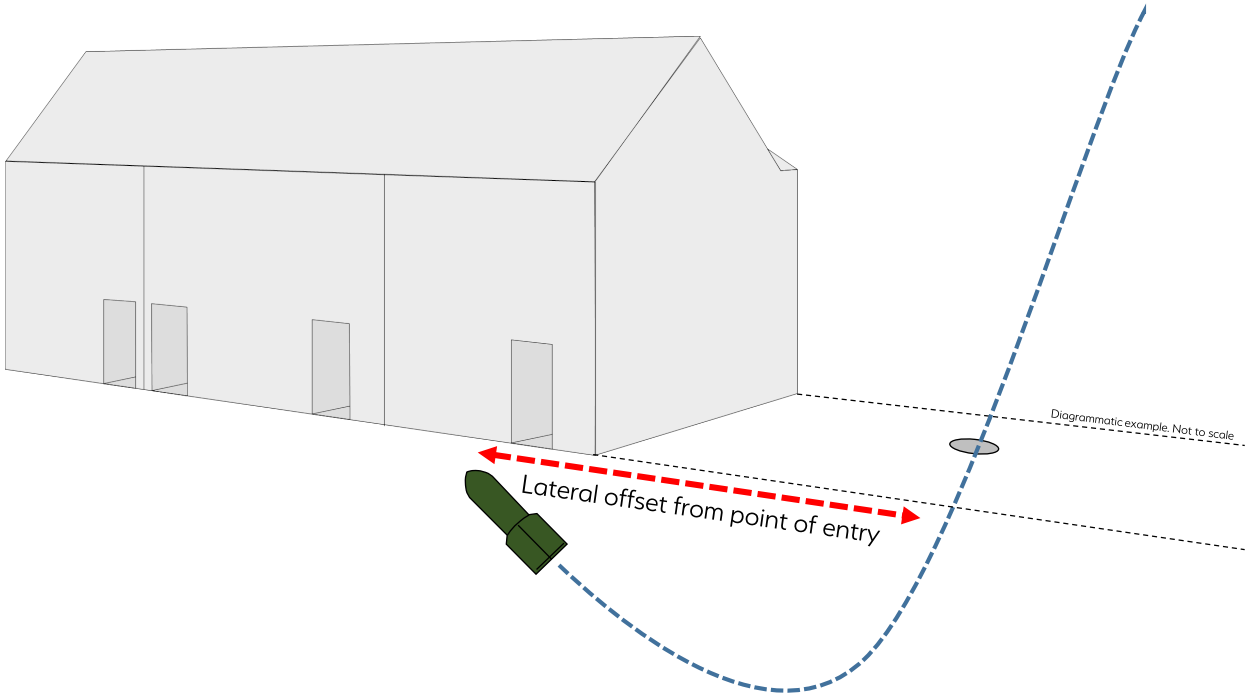
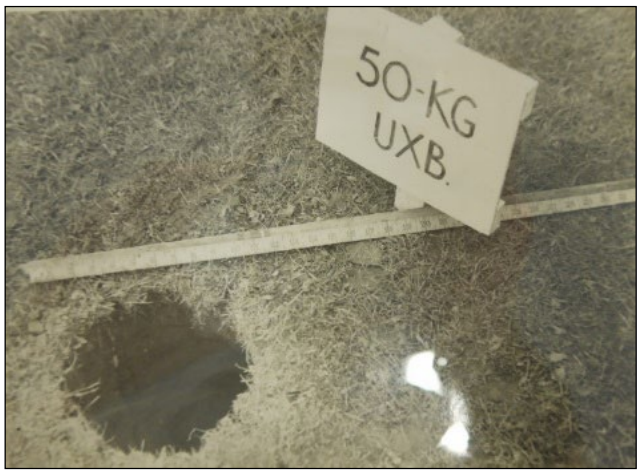
Source: https://pocklingtonhistory.com/district/melbourne/HomeGuard/index.php

Example of UXO Entry Hole / The 'J-curve' Effect Principle





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**).

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Project:	Mylen Leah Solar Farm
Ref:	DA20029-00
Source:	Various sources

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.

Two primary schools were closed and hundreds of homes were evacuated as a precaution.

A cordon and 656ft (200m) exclusion zone was lifted at about 18:15 GMT as the bomb was removed to a quarry in Kent to be detonated, police said.

The Metropolitan Police force said the device was a 'SA' 250kg WWII German air-dropped bomb, known to the Army's Royal Logistic Corps bomb disposal experts.

250kg German HE Bomb, March 2015

BBC NEWS

WW2 bomb found near London City Airport blown up

An unexploded World War Two bomb found near London City Airport has been detonated.

The 500kg device was discovered at the King George V Dock on Sunday during planned work at the airport.

It was closed and all flights were cancelled on Monday after an exclusion zone was put in place.

The detonation, which took take place off Shoeburyness, Essex, was postponed on Tuesday because of high winds and dangerous conditions for divers.

The 1.5m-long German bomb - which was found in a bed of silt, 15m underwater - was carefully removed from the Thames and placed in a secure location a mile away from the coast of Essex.

500kg German HE Bomb, February 2018

BBC NEWS

Exeter WW2 bomb is detonated after homes evacuated

More than 2,600 households and 12 university halls of residence were cleared before the 2,200lb (1,000kg) device **was destroyed** on Saturday.

Police said the blast left a crater about the size of a double-decker bus.

Police have reported large pieces of metal debris hitting buildings and said some properties in the 100m (330ft) exclusion zone had sustained "structural damage".

1000kg German HE bomb, February 2021

BBC NEWS

Great Yarmouth: Huge blast after unplanned WW2 bomb detonation

A World War Two bomb found in Great Yarmouth has detonated while work was being done to defuse it, causing a huge blast that was heard for miles.

Army specialists were attempting to disarm it when there was an unplanned detonation at about 17:00 GMT.

People on social media said they heard a loud bang and felt buildings shake 15 miles (24km) away.

There have been no reports of injuries among the Army, emergency services or the public, Norfolk Police said.

Cordons were put in place when the bomb was first discovered close to two gas pipes on Tuesday, and work began to make it safe.

250kg German HE Bomb, February 2023

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Client:	Statkraft Energy Limited		
Project:	Mylen Leah Solar Farm		
Ref:	DA20029-00	Source:	BBC News

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."

1st 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."

19th September 2013

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.

23rd October 2006

BBC NEWS

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.

2nd June 2010

June 2006

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NEWS

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Unexploded WW1 artillery shell found in Newark

7 December 2020

The bomb was found when a marina worker was dredging the water

An unexploded World War One artillery shell has been found in a river by a marina worker.

James Wilkinson, who works at Newark Marina in Nottinghamshire, was dredging the water at about 11:00 GMT when he uncovered the device.

A specialist bomb disposal unit carried out a controlled explosion to detonate the 18lb and 6in long "highly explosive" device.

Kirby residents react after grenade is detonated on housing estate

12th November 2020

Residents react after wartime grenade 'with pin still in it' is detonated on housing estate

By George King
Digital Audience and Content Editor
@Georgehenryking

Share

1 Comments

Essex Police officers were called to the Taylor Wimpey housing development in Thorpe Road, Kirby Cross, after the 70 plus-year-old hand grenade was discovered.

All Sections THE YORKSHIRE POST Sign in Subscribe

Army called after unexploded WW2 shell found in village near Ilkley

Police have released photos of an old wartime mortar shell that was found in a rural Yorkshire village.

By Grace Newton
Published 2nd Apr 2020, 12:04 BST
Updated 2nd Apr 2020, 12:06 BST

Army bomb disposal experts from the Royal Logistics Corps were called to Addingham, near Ilkley, yesterday to make the device safe.

Manchester Evening News NEWS IN YOUR AREA MAN UTD MAN CITY WHAT'S ON SPORT MORE

Police warning after discovery of unexploded mortar shell in Glossop moorland

Derbyshire Police described the find as 'very dangerous and unusual'

Bookmark Comments 1

NEWS By Fionnula Hainey, UK and world news writer

This unexploded mortar shell was found on moorland above Glossop (Image: Facebook/Glossop Police SNT)

The force said officers were alerted to the large metal shell on Saturday (February 20) by a member of the public.

It was identified by experts as an unexploded mortar shell, which the force described as 'very dangerous and unusual'.

Express & Star

Dozens more mortar shells found during work on Burntwood housing estate

By Luke Bartlett | Burntwood | Published: May 24, 2018 | 1 Comments

A large number of mortar shells have been discovered on a building site in Burntwood forcing businesses to evacuate.

The shells were found by Staffordshire Police on the site near Milestone Way, in Chasetown, and a 200m (656ft) cordon was soon after put in place.

Members of the public are being advised to stay away from the area near Morrisons supermarket while police deal with the shells.

Developers Taylor Wimpey and Barratt Homes were behind the plans to build 150 homes at Milestone Way.

Unexploded WW2 bomb found at Kenfig Pool, Bridgend

23 August 2014

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 fin sticking out of the sand.

He reached down to pick it up, but ending up falling and landed with the 2ft-long (0.6m) bomb on top of him.

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

Swindon Advertiser

News Sport Crime What's On Opinion Announcements

News Traffic and Travel Property Politics Health News Business news

Worker on old school site in Swindon finds buried explosives

25th November 2022

At around 9.30am, the digger rubbed against the lid of something which was approximately 600mm below ground - and would have blown up instantly if broken.

AW Bombs are yellow phosphorous hand grenades in half pint clear glass bottles weighing 1.5lbs each, which ignite instantly once their liquid contents react with the outside air.

deadline.

NEWS ENVIRONMENT IN BRIEF TOP STORIES

December 14, 2020 0 1983

Locals on Isle of Wight find 1ft long unexploded WW2 bomb

AN UNEXPLODED World War Two bomb has been discovered by locals on the Isle of Wight.

Bomb disposal experts were deployed to the B3323 in Shorwell, after police arrived and identified the dangerous device.

SuffolkNews

Icklingham mortar bomb is blown up by Army

Published: 16:46, 25 February 2015

Police had to guard an unexploded WW2 4in calibre mortar bomb overnight in a field near Icklingham until Army bomb disposal could blow it up on Tuesday.

The bomb had been found by farmworkers using a digger at about 2.50pm on Monday but by the time the Regiment Royal Logistic Corps' 621 Squadron, 11 Explosive Ordanance Disposal, from Colchester, had examined it it was too dark to carry out a controlled explosion.

Two bombs detonated by army after being found near wind farm at Howden in East Yorkshire

By Grace Newton
Published 8th Oct 2020, 17:21 BST
Updated 8th Oct 2020, 17:22 BST

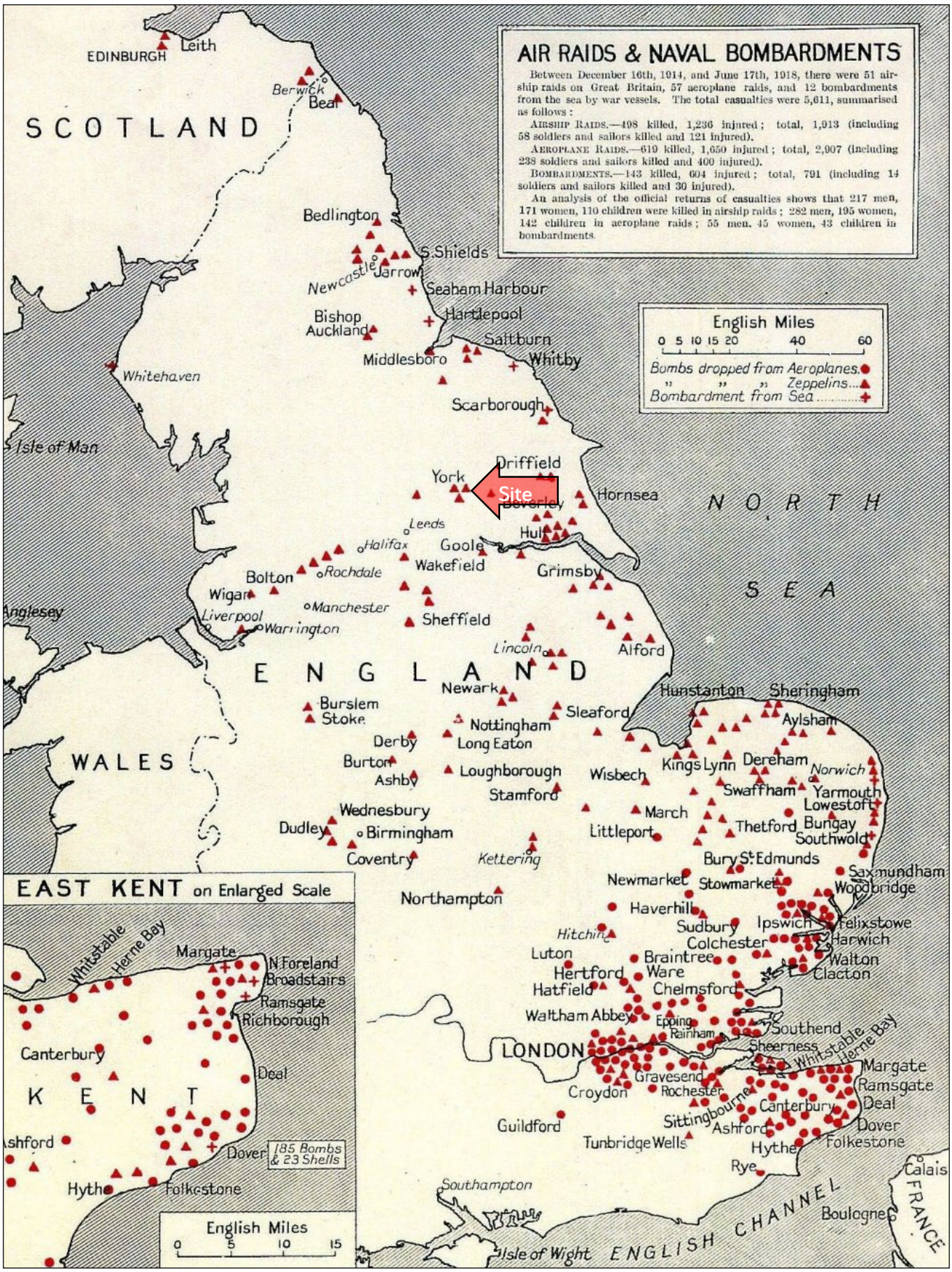
Police at the scene near the Spaldington Airfield wind farm (photo: Sean Stewart)

Army bomb disposal experts have detonated two explosive devices found near a wind farm in the East Yorkshire countryside.

The ordnance - believed to date from World War Two - was discovered on land close to the Spaldington Airfield wind farm site, which has five turbines.

The first was found during work in a field on Wednesday afternoon and a Royal Logistics Corps team from Catterick Garrison detonated it on Thursday morning after the scene had been secured by police.

Another bomb was then found nearby around two hours after the first explosion, and again was detonated in a controlled explosion.



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Project: Mylen Leah Solar Farm

Ref: DA20029-00

Source: J. Morris, German Air Raids on Britain

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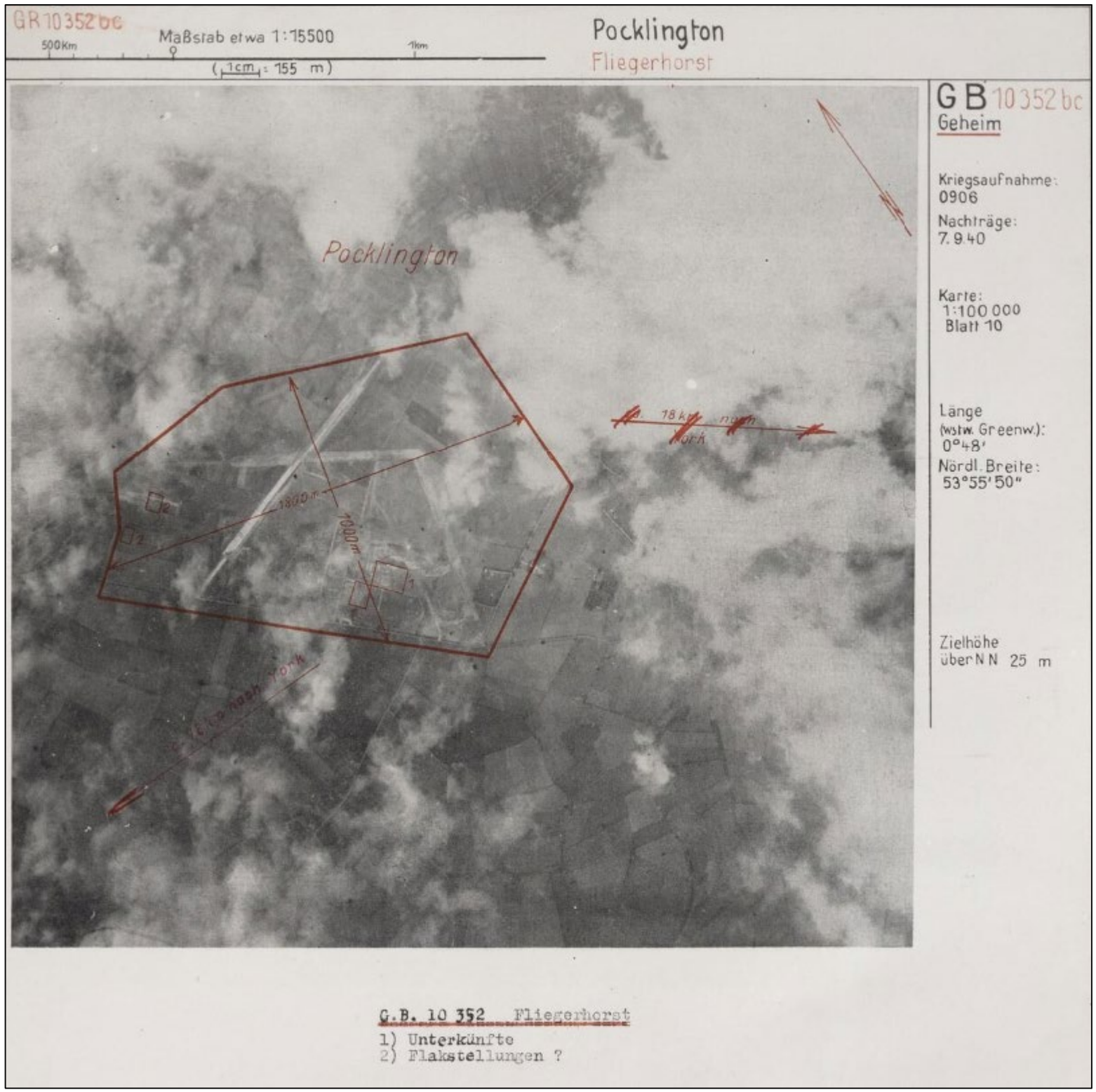
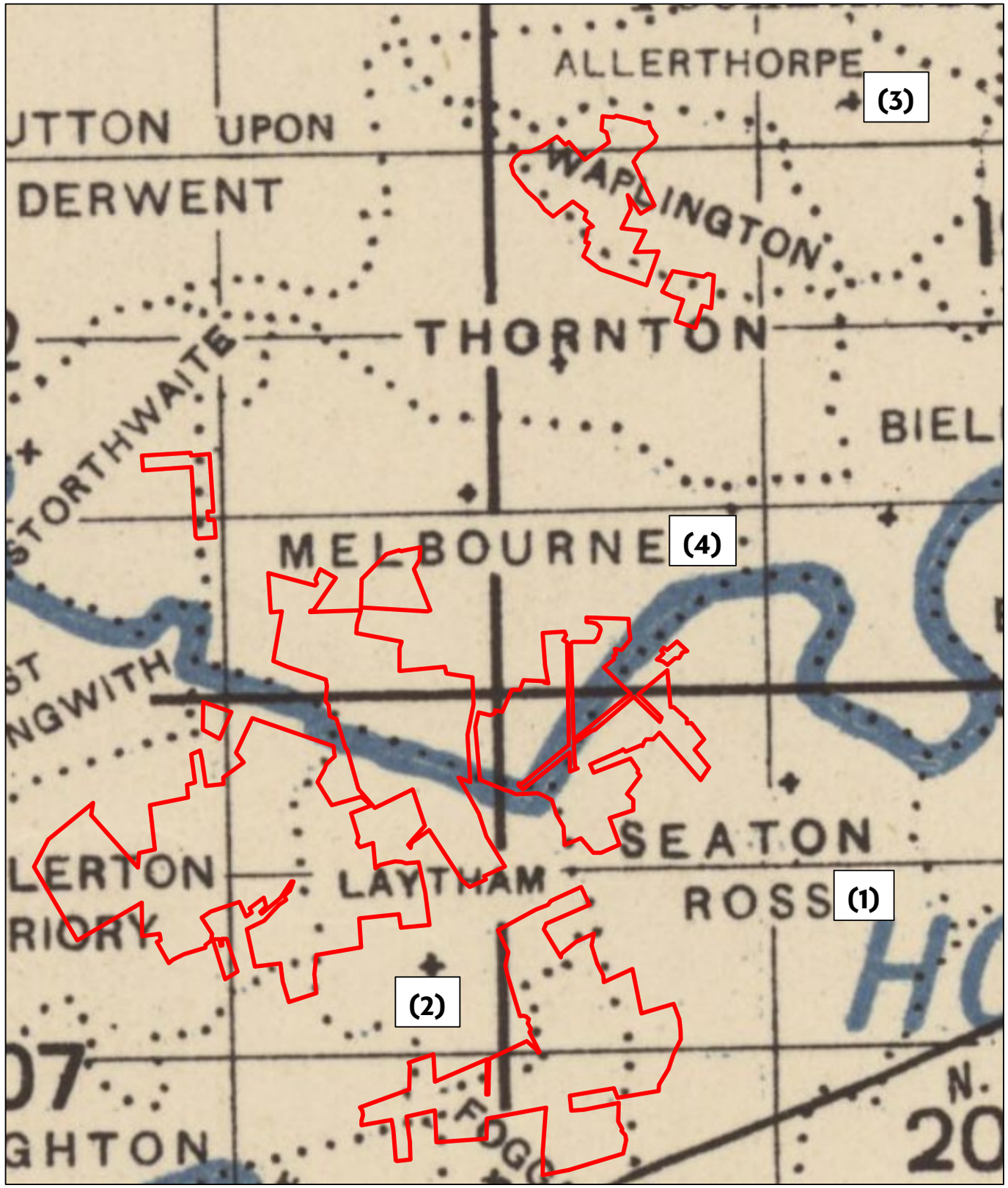


Pocklington – Airbase

The north-eastern site boundary, outside the scope of this photograph, is Approximately 2.15km south-west of RAF Pocklington.



Parish Boundary .....

Left: Mapping showing the historical Civil Parish boundaries, pre-1894 reforms.

The incidents below are recorded to have fallen within the boundary of the associated Civil Parish.

15th February 1941
Seaton Ross. No casualties. (1)
Laytham. No casualties. (2)

27th April 1941
Allterthorpe. No casualties. (3)

3rd March 1945
Melbourne. No casualties. (4)

Note that only the Civil Parish involved is recorded, without the precise location of the bombing incident.

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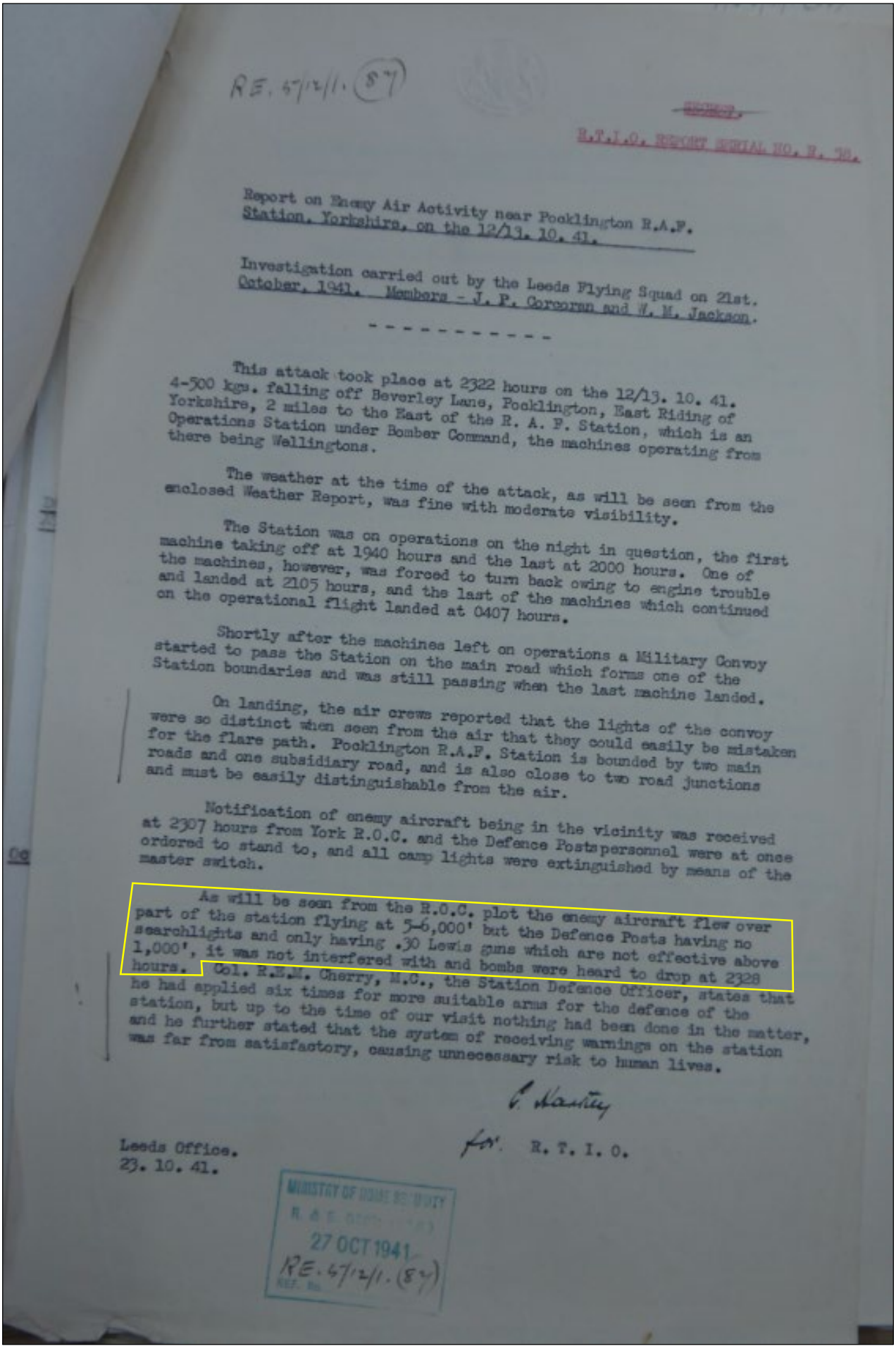
— Approximate site boundary

N

Source: Mapping from National Library of Scotland; Bomb records from The National Archives, Kew



RE. 47/12/1. (87)

SECRET.

R.T.I.O. REPORT SERIAL NO. R. 38.

Report on Enemy Air Activity near Pocklington R.A.F. Station, Yorkshire, on the 12/13. 10. 41.

Investigation carried out by the Leeds Flying Squad on 21st. October, 1941. Members - J. P. Corcoran and W. M. Jackson.

- - - - - - - - - - -

This attack took place at 2322 hours on the 12/13. 10. 41. 4-500 kgs. falling off Beverley Lane, Pocklington, East Riding of Yorkshire, 2 miles to the East of the R. A. F. Station, which is an Operations Station under Bomber Command, the machines operating from there being Wellingtons.

The weather at the time of the attack, as will be seen from the enclosed Weather Report, was fine with moderate visibility.

The Station was on operations on the night in question, the first machine taking off at 1940 hours and the last at 2000 hours. One of the machines, however, was forced to turn back owing to engine trouble and landed at 2105 hours, and the last of the machines which continued on the operational flight landed at 0407 hours.

Shortly after the machines left on operations a Military Convoy started to pass the Station on the main road which forms one of the Station boundaries and was still passing when the last machine landed.

On landing, the air crews reported that the lights of the convoy were so distinct when seen from the air that they could easily be mistaken for the flare path. Pocklington R.A.F. Station is bounded by two main roads and one subsidiary road, and is also close to two road junctions and must be easily distinguishable from the air.

Notification of enemy aircraft being in the vicinity was received at 2307 hours from York R.O.C. and the Defence Posts personnel were at once ordered to stand to, and all camp lights were extinguished by means of the master switch.

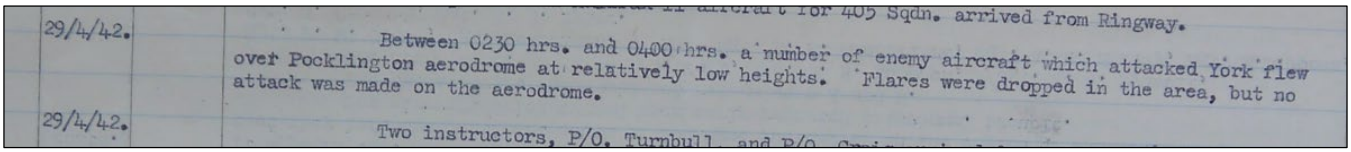
As will be seen from the R.O.C. plot the enemy aircraft flew over part of the station flying at 5-6,000' but the Defence Posts having no searchlights and only having .30 Lewis guns which are not effective above 1,000', it was not interfered with and bombs were heard to drop at 2328 hours. Col. R.E.M. Cherry, M.C., the Station Defence Officer, states that he had applied six times for more suitable arms for the defence of the station, but up to the time of our visit nothing had been done in the matter, and he further stated that the system of receiving warnings on the station was far from satisfactory, causing unnecessary risk to human lives.

for R. T. I. O.

Leeds Office.
23. 10. 41.

MINISTRY OF HOME SECURITY
R. A. F. Stn.
27 OCT 1941
RE. 47/12/1. (87)
REF. No.

29th April 1942

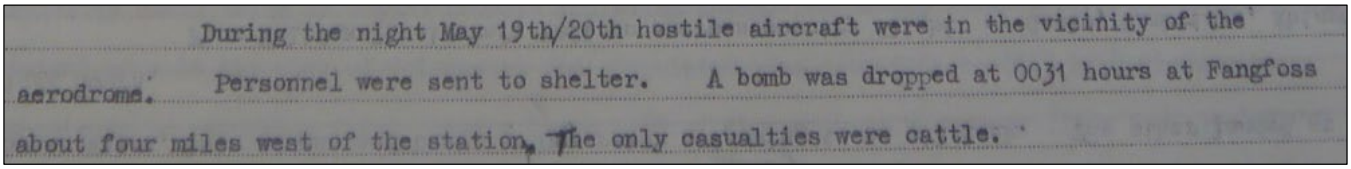


29/4/42. ... aircraft for 405 Sqdn. arrived from Ringway.

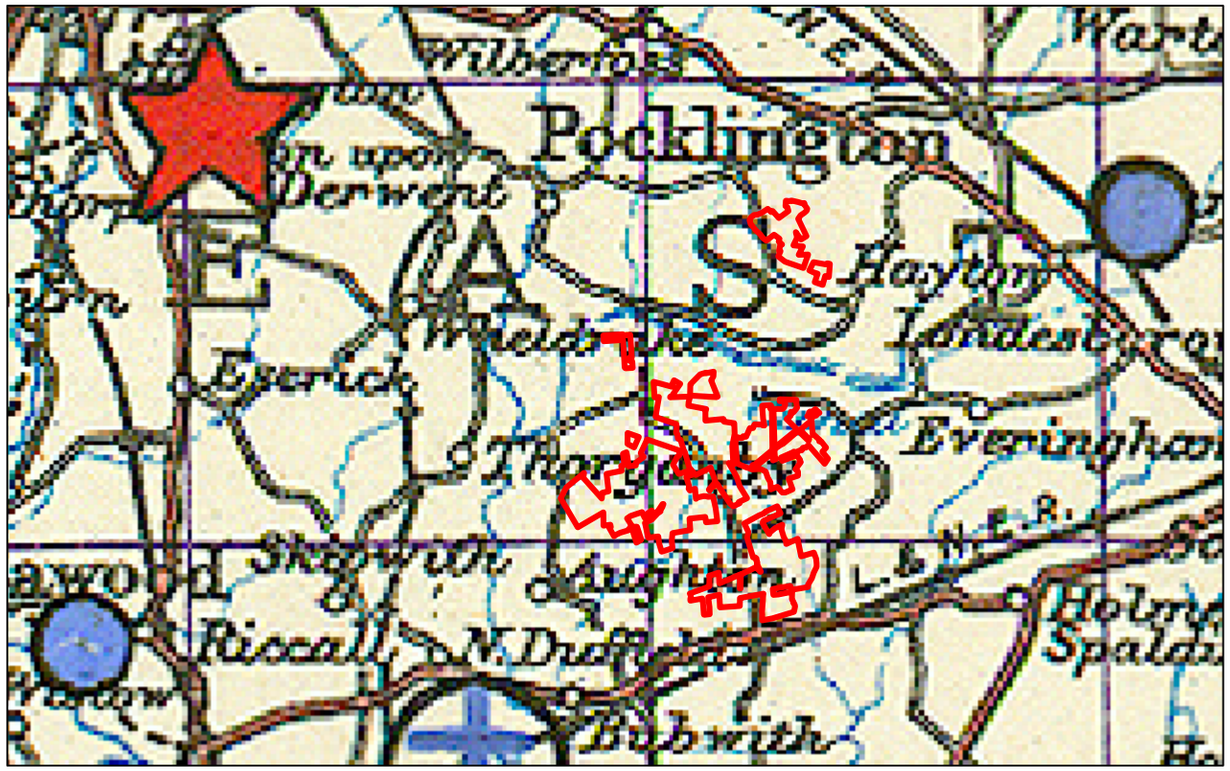
29/4/42. Between 0230 hrs. and 0400 hrs. a number of enemy aircraft which attacked York flew over Pocklington aerodrome at relatively low heights. Flares were dropped in the area, but no attack was made on the aerodrome.

Two instructors, P/O. Turnbull, and P/O. ...

19th May 1942



During the night May 19th/20th hostile aircraft were in the vicinity of the aerodrome. Personnel were sent to shelter. A bomb was dropped at 0031 hours at Fangfoss about four miles west of the station. The only casualties were cattle.



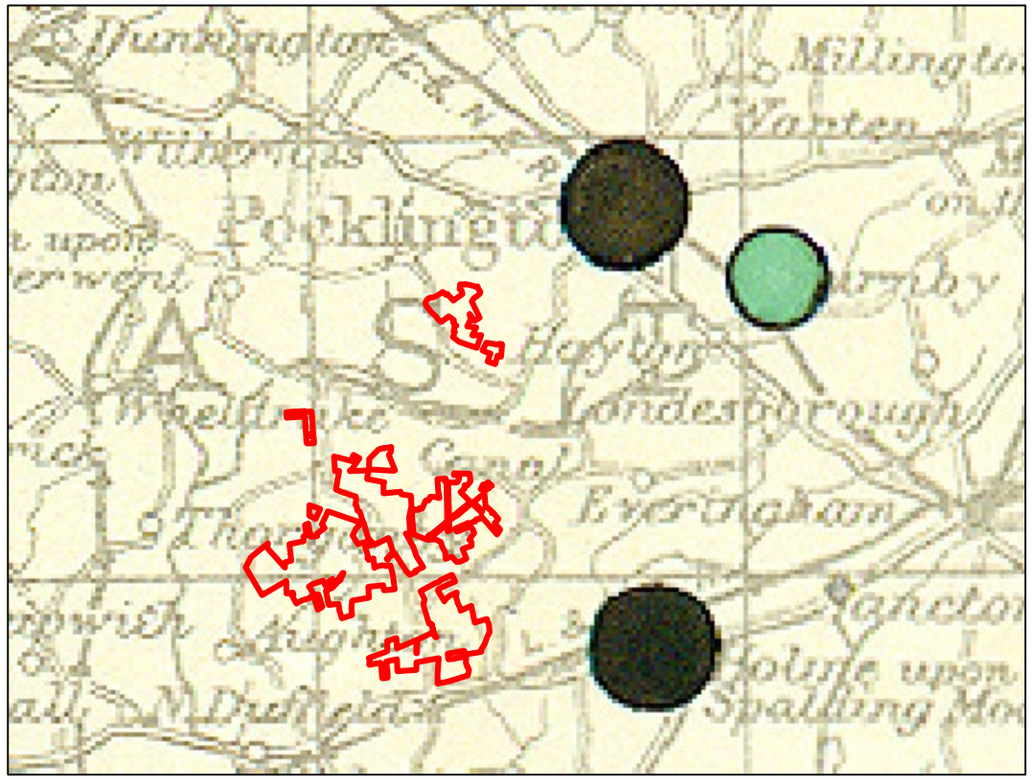
Copy of "DEFENCE MEASURES" MAP.
Original made and held by
Colonel Turner's Dept. Air Ministry.
C/o. G.P.O. Shepperton, Mddx.

KEY

- Q Site
- SF (with or without QL)
- QF (with or without QL)
- Cover Plan Site
- K Site (with or without Q)
- Dummy Buildings

K.P.I.D. MAP No: 1018

TOP SECRET



TOP SECRET

DEFENCE MEASURES MAP

KEY

- Site Decoyed
- Starfish
- Q F. Q L. etc.

Compiled by K.P.I.D from lists
Supplied by Colonel Turner's Dept.
Air Ministry, Shepperton Mddx.

K.P.I.D MAP No: 1042.

H.M.S. 16/1/46. PART II.

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Project: Mylen Leah Solar Farm

Ref: DA20029-00

— Approximate site boundary

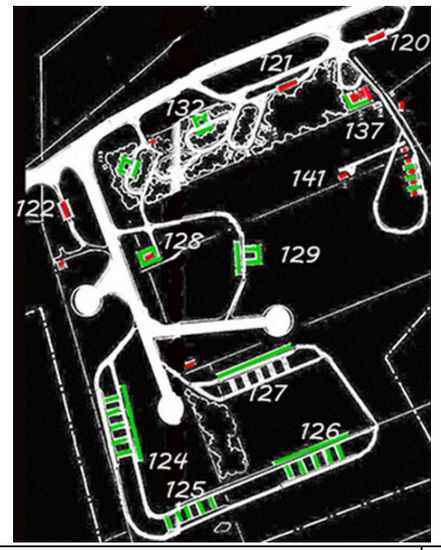
N

Source: The National Archives, Kew

Medium Risk Area –
RAF Melbourne

Medium-High Risk Area –
Bomb stores and adjacent land

Risk Zone	Activity	Recommended Risk Mitigation Measure
Low (German and Allied)	All Works	• UXO Risk Management Plan • Site Specific UXO Awareness Briefings to all personnel conducting intrusive works.
Medium (Allied)	Open Excavations (trial pits, service pits, bulk excavations, strip foundations etc.)	• UXO Specialist On-site Support
Medium-High (Allied)		



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Approximate site boundary

N

Source: 1st Line Defence

In 2021, 1st Line Defence undertook non-intrusive UXO magnetometer surveys at locations several hundred metres distant from a former RAF bomb store at Full Sutton. During the first phase, over 30 practice bombs were recovered, along with an ammunition box, a bomb nose plug and dozens of bomb tail pistols. Dozens of additional practice bombs were found during the second phase of support.

Below are photographs of some of the UXO finds, including practice bombs.

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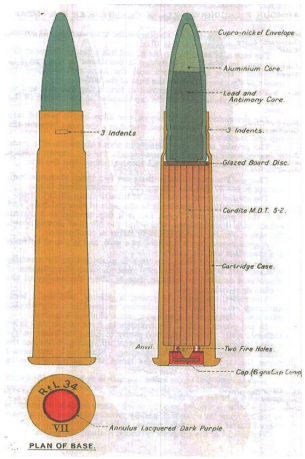
British 303. Round

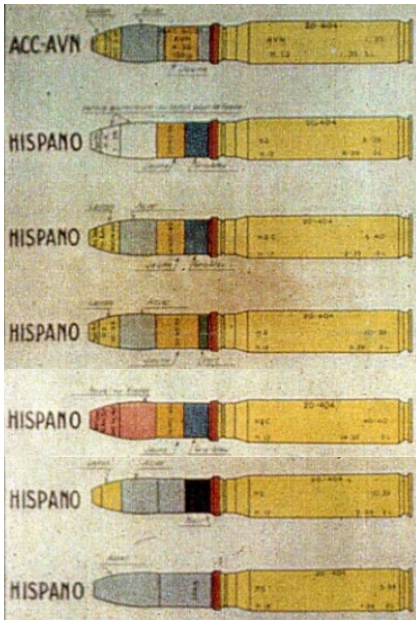
Bullet Diameter	7.92mm
Case length	56.44mm
Overall length	78.11mm
Type	Rifle Ammunition
Use	303 rounds were used in machine guns on aircraft, as well as in aircraft defence, and SAA.
Remarks	First produced in 1889 and still in use today, the .303inch cartridge has progressed through ten 'marks' which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



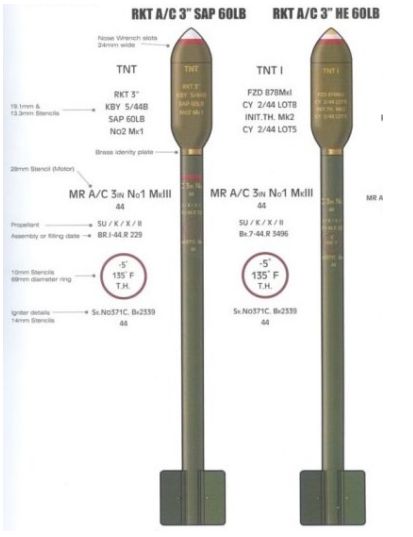
Hispano Suiza HS.404

Weight	HE - 0.13kg (13lbs), complete Round 0.2kg (0.57lbs) Armour Piercing – 0.17kg (0.37lbs) complete round0.29kg (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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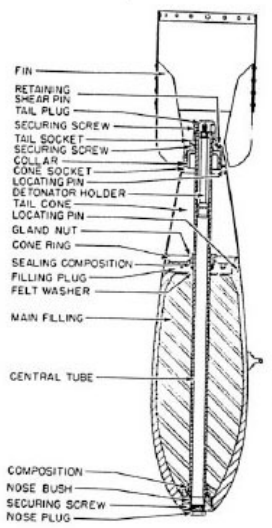
Project: Mylen Leah Solar Farm

Ref: DA20029-00

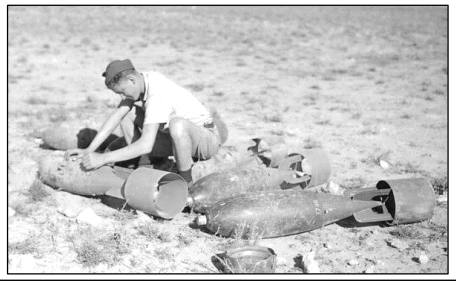
Source: Various sources

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 71.12com)
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 band across the nose or the tail.

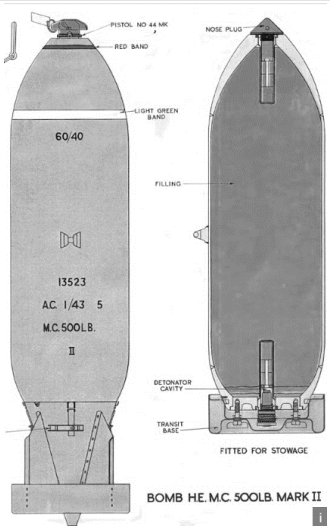


Above - A Westland Whirlwind being armed with 250lbs underwing. Below - 250s in N. Africa.



500lb General Purpose Bomb

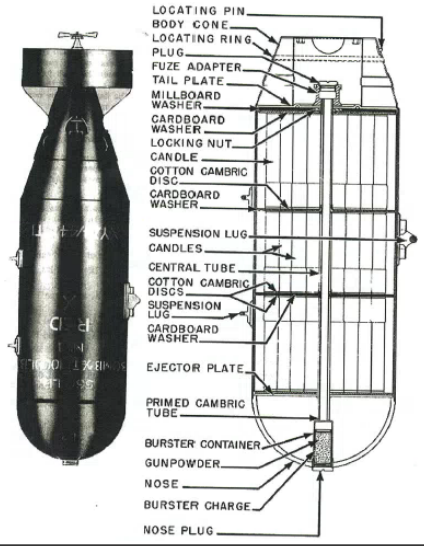
Weight	509lbs
Explosive Weight	262lbs
Fuze Type	Nose fuses included the AM-M103, M118, and M119. Tail fuses included AM-M102A2 or the M114A1
Dimensions	35.7" by 13" (90.67cm x 33.02cm)
Use	The 500lbs general purpose bomb was the most commonly deployed item, of Allied aerially delivered ordnance. 1,729,611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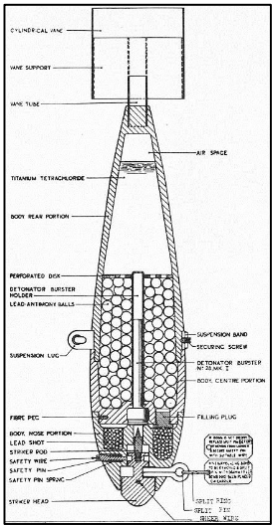
Project: Mylen Leah Solar Farm

Ref: DA20029-00

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.

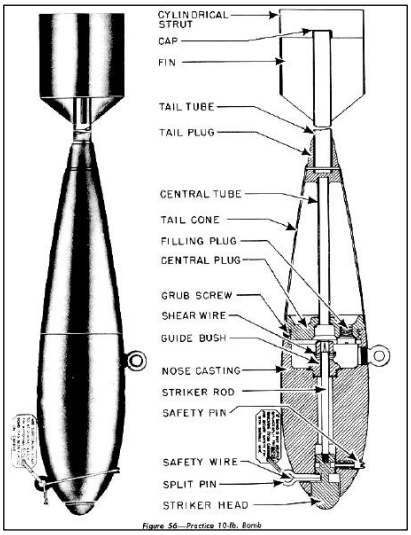


Figure 56—Practice 10-lb. Bomb

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.

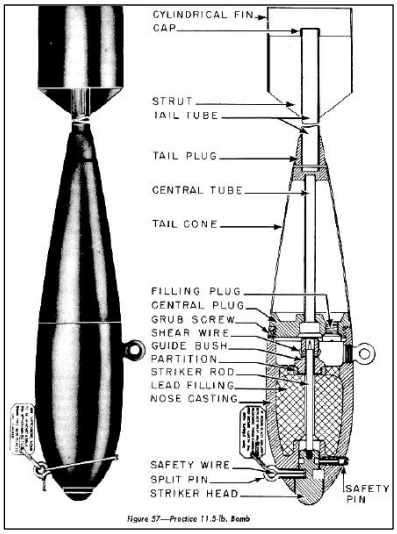


Figure 57—Practice 11.5-lb. Bomb

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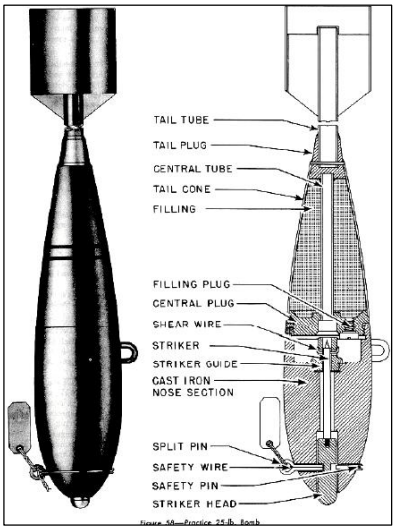
Client: Statkraft Energy Limited

Project: Mylen Leah Solar Farm

Ref: DA20029-00 **Source:** Various sources

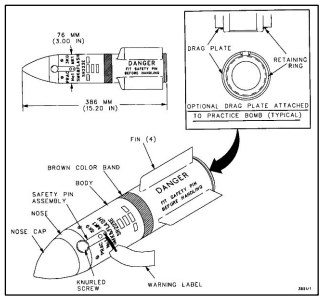
25 lb Practice Bomb

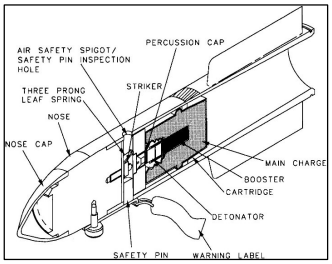
Bomb Weight	25 lb (11 – 11.5 kg)
Explosive Weight	1 lb (approx. 0.45 g)
Fuze Type	Explosive fuze and bursting charge.
Bomb Length	22 in (550 – 560 mm)
Body Diameter	4 in (100 mm)
Use	Dropped by Allied forces in order to practice bombing accuracy. Practice bombs used a small bursting charge to release 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 filing 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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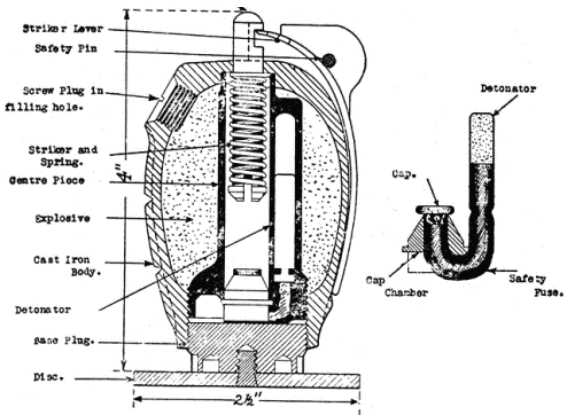
Ref: DA20029-00 **Source:** Various sources

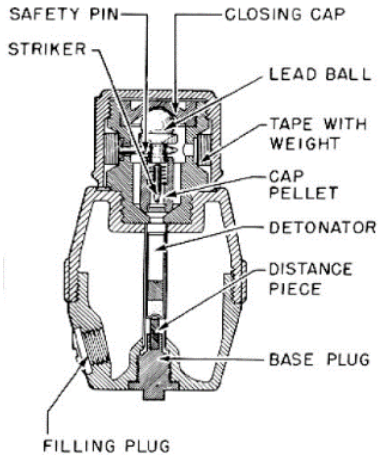
No. 36 'Mills' Grenade

Weight	Approx. 765g filled (1lb 11.25oz)
Explosive Weight	71g (2oz) filling.
Fuze Type	4-7 second delay hand-throwing fuze. No. 6 Detonator
Dimensions	95 x 61mm (4 x 2.4in)
Use	Fragmentation explosive at approx. 30m range 100m range of damage.
Remarks	First introduced in 1915, its classic grooved, cast-iron 'pineapple' design was designed to provide uniform fragmentation. The detonator is inserted before use after removing the base plug.



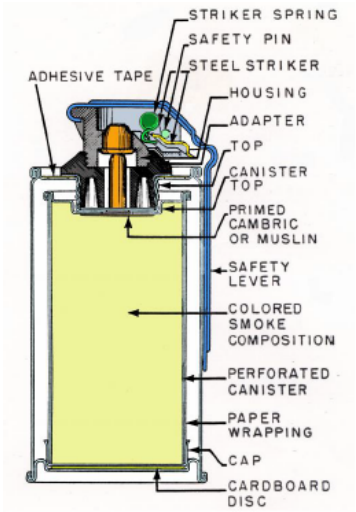
No. 69 Grenade

Weight	Approx. 383g (13.5oz)
Fill 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	115 x 60mm (4.5 x 2 .4 in)
Use	A blast grenade for use as an offensive weapon. Detonator was inserted before use.
Remarks	Introduced December 1940 and made from the plastic Bakelite as opposed to conventional metals. Detection is difficult due to this low metal content.



No. 83 Smoke Grenade

Weight	Approx. 680g (1.5lb)
Explosive Weight	Approx. 170-200g. (6-7 oz)
Fuze Type	Originally used a friction system using a match head composition. Later developed to a striker lever ignition system.
Dimensions	Approx. 62 x 140mm (2.44 x 5.5 in)
Use	Use as a target or landing zone marking device and as a screening method for troop / unit movement.
Remarks	This basic design stayed relatively unchanged up to the 1980's. The letters CCC were often etched into the body of the grenade in the colour of the smoke.



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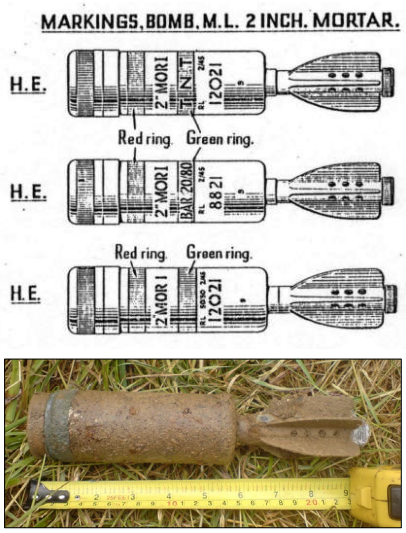
Project: Mylen Leah Solar Farm

Ref: DA20029-00 **Source:** Various sources

2 inch Mortar High Explosive

Weight	Approx. 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	It had greater range and firepower over hand and rifle grenades, and was used to attack targets behind cover with high explosive rounds.
Identification	HE has a rounded edge to a flat back. Can either be a black body colour with red and yellow band or dark green with yellow band. Brass cap on top. Practice will have hole all the way through the top.



2 inch Mortar Smoke

Weight	Approx. 910g (2lb)
Maximum Range	460m (500yards)
Filling	White phosphorus and smoke fill
Dimensions	51 x 290mm (2in x 11.4 in)
Fuze Type	An impact fuze which initiates a bursting charge. This ruptures the mortar bomb's body and disperses the phosphorus filler.
Identification	Smoke mortars have a recess and emission holes. May still see light green body paint. Look for stained ground around munition.
Use	As a screening device for unit movement or to impair enemy field of vision.

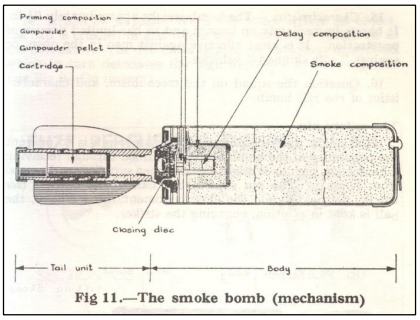
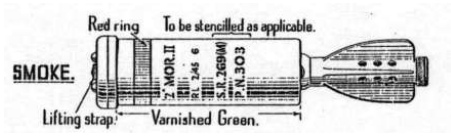
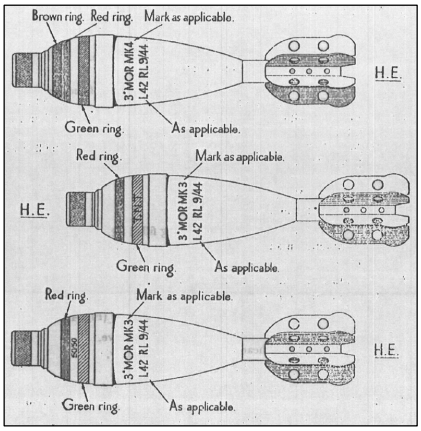


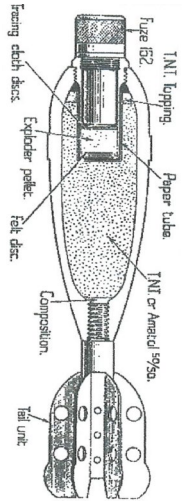
Fig 11.—The smoke bomb (mechanism)



3 inch Mortar High Explosive

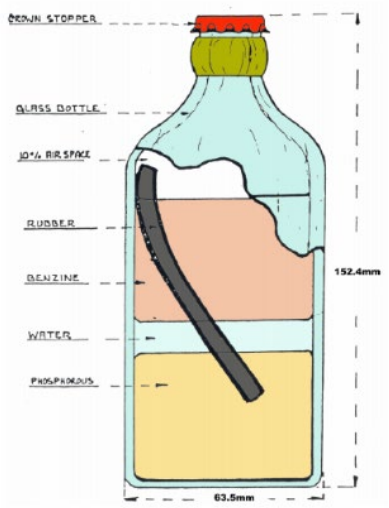
Weight	Approx. 4.5kg (10lb)
Maximum Range	1,460 (Mk1) – 2,560m (Mk2) (1,600 – 2,800yds)
Dimensions	81mm (3in)
Filling	Amatol
Firing Mechanism	Drop, fixed striker
Remarks	Fin-stabilised bomb fired by means of a charge consisting of a primary cartridge in the tail and four secondary cartridges.
Identification	An old style mortar. Often no way of telling if HE or practice, so treat as HE.





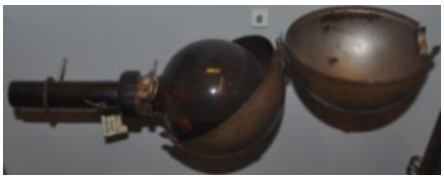
No. 76 Self Igniting Phosphorous (SIP) Grenade

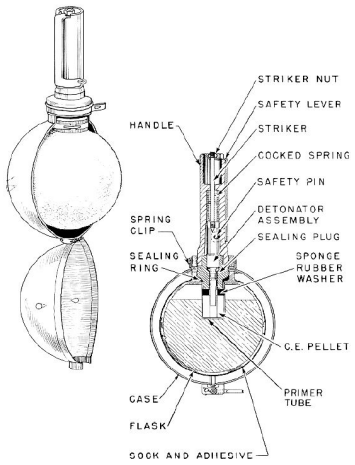
Weight	Approx. 1lb 3oz
Filling	White Phosphorous and Benzene
Design	The filling was contained in a ½ pint sized glass bottle with water and a strip of rubber. Over time the rubber dissolved to create a sticky which would self ignite when the bottle broke.
Use	Originally intended as an anti-tank incendiary 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. Not all locations were officially recorded and some caches were lost and encountered post-war. In all cases, the grenades are still found to be dangerous.



No. 74 Grenade ("Sticky Bomb") Mk1

Weight	Approx. 1.1kg (2.25lb)
Filling	Approx. 600g Nobel's No.283 (Nitro-glycerine) (1.33lb)
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 of the target and smash the glass explosive container against it.
Remarks	Timer fuze was located in the handle. This would explode after 3-6 secs.





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.

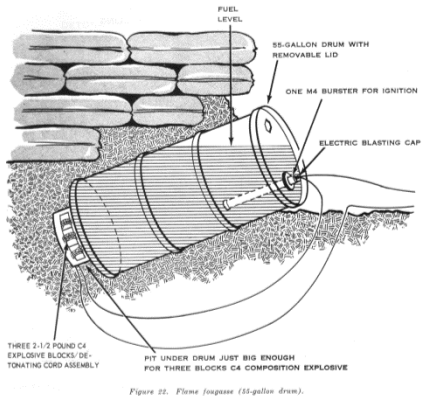
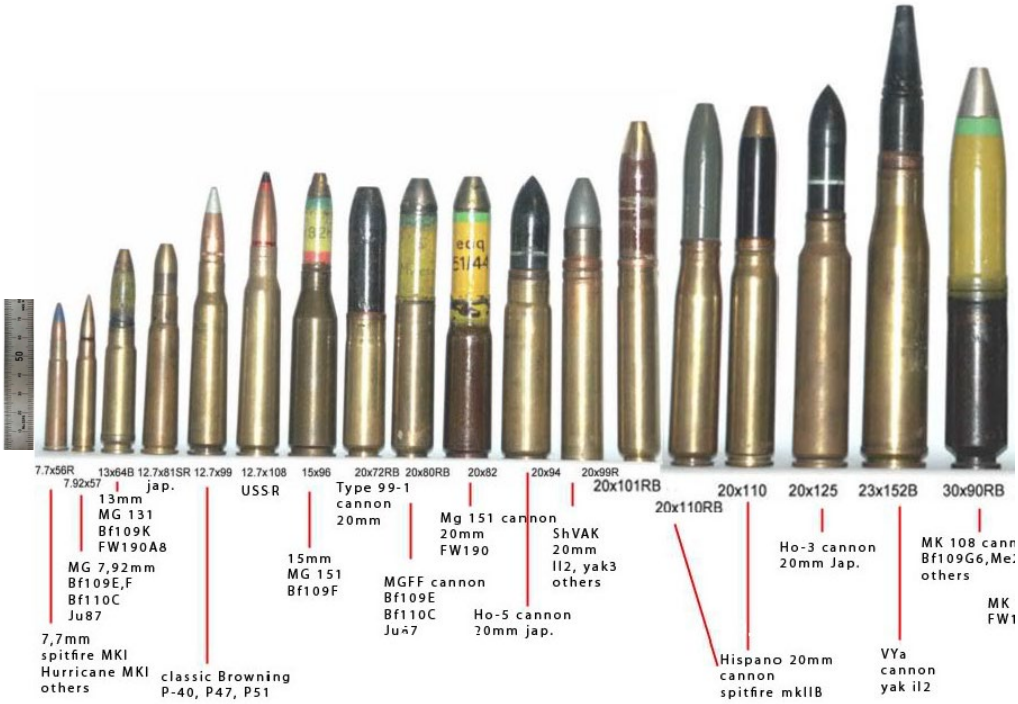
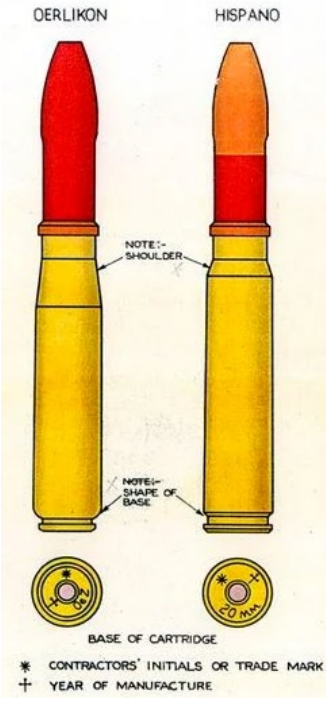


Figure 22. Flame fougasse (55-gallon drum).

Common WWII-era Aircraft Mounted Gun Ammunition

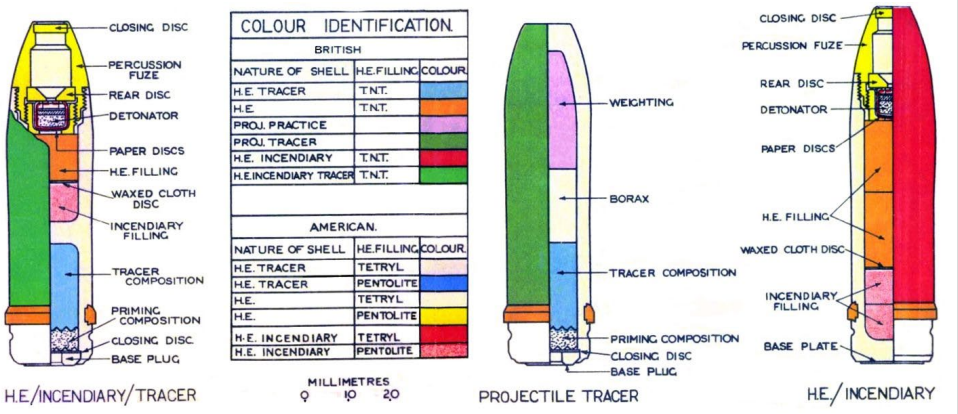


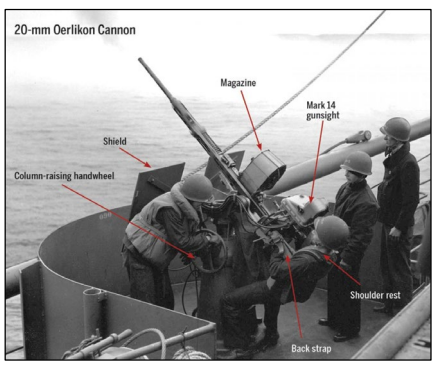


.303 British Rifle Ammunition

Bullet Diameter	7.92mm
Case length	56.44mm
Overall length	78.11mm
Type	Rifle Ammunition
Propellant	Originally black powder. Later Cordite followed by Nitrocellulose
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.

20mm Oerlikon Cannon Rounds





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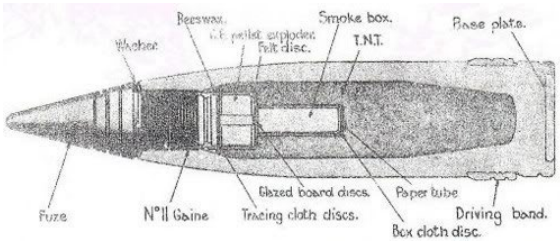
Project: Mylen Leah Solar Farm

Ref: DA20029-00 **Source:** Various sources

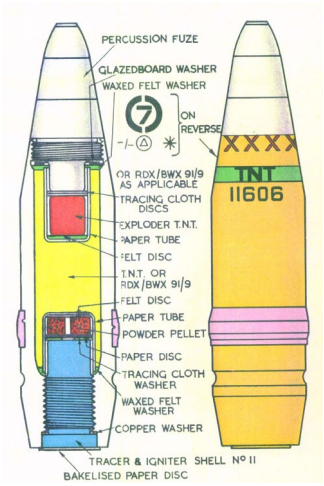
3.7 Inch QF Anti-Aircraft Projectile

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	The 3.7in AA Mks 1-3 were the standard Heavy Anti-Aircraft guns of the British Army and were commonly used on the Home Front.
Ceiling	30,000ft to 59,000ft



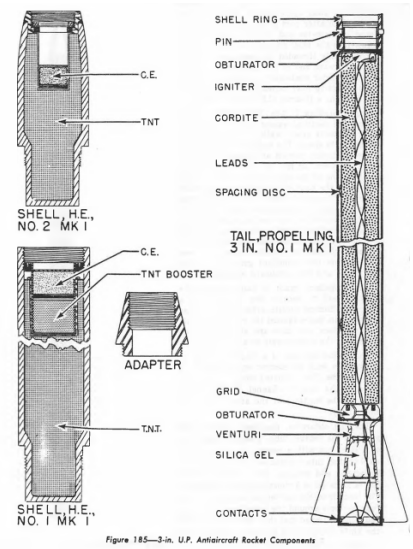
40mm Bofors Projectile

Projectile Weight	1.96lb (0.86kg)
Explosive Weight	300g (0.6lb)
Fuze Type	Impact Fuze
Rate of Fire	120 rounds per minute
Projectile Dimensions	40 x 180mm
Ceiling	23,000ft (7000m)
Remarks	Light quick fire high explosive anti-aircraft projectile. Each projectile fitted with small tracer element. If no target hit, shell would explode when tracer burnt out. Designed to engage aircraft flying below 2,000ft.



3in Unrotated Projectile (UP) Anti-Aircraft Rocket ("Z" Battery)

HE Projectile Weight	3.4kg (7.6lb)
Explosive Weight	0.96kg (2.13lb)
Filling	High Explosive – TNT. Fitted with aerial burst fuzing
Dimensions of projectile	236 x 83mm (9.29 x 3.25in)
Remarks	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. Shell consists of a steel cylinder reduced in diameter at the base and threaded externally to screw into the shell ring of the rocket motor.



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Client: Statkraft Energy Limited

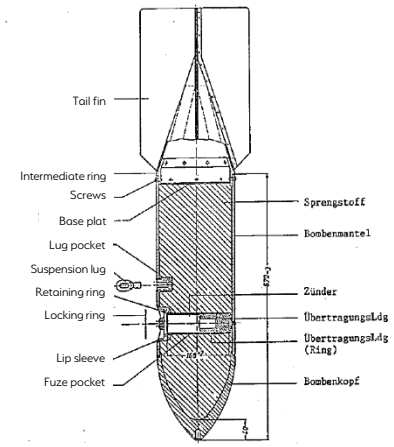
Project: Mylen Leah Solar Farm

Ref: DA20029-00

Source: Various sources

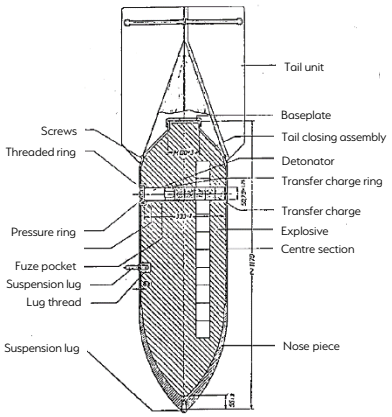
SC 50kg High Explosive Bomb

Bomb Weight	40-54kg (88-119lb)
Explosive Weight	25kg (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.



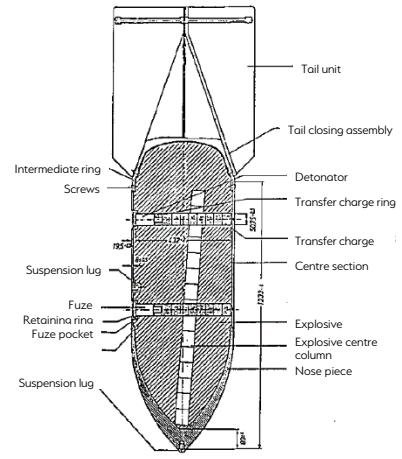
SC 250kg High Explosive Bomb

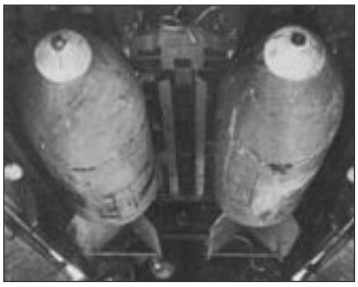
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground 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 High Explosive Bomb

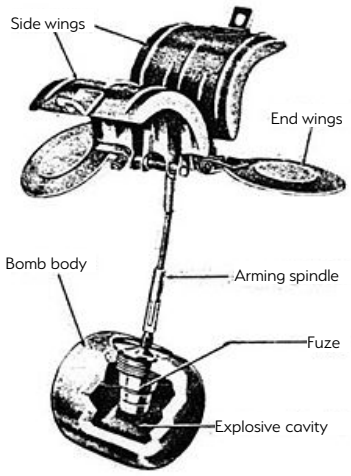
Bomb Weight	480-520kg (1,058-1,146lb)
Explosive Weight	250-260kg (551-573lb)
Fuze Type	Electrical impact/mechanical time delay fuze
Bomb Dimensions	1957 x 640mm (77 x 25.2in)
Body Diameter	470mm (18.5in)
Use	Against fixed airfield installations, hangars, assembly halls, flyovers, underpasses, high-rise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





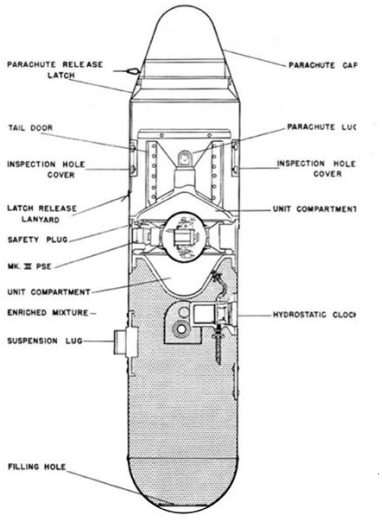
SD2 Anti-Personnel 'Butterfly Bomb'

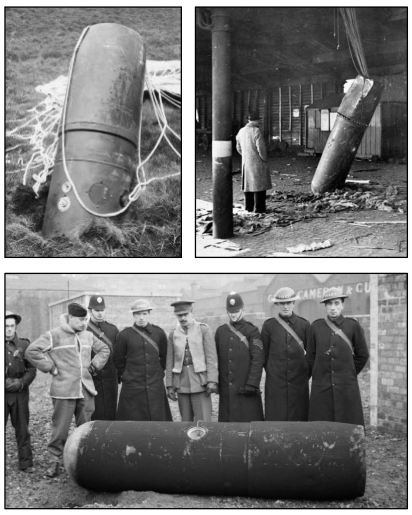
Bomb Weight	Approx. 2kg (4.41lb)
Explosive Weight	Approx. 7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an anti-personnel/fragmentation weapon. They were delivered by air, being dropped in containers of 23-144 sub-munitions that opened at a predetermined height, thus scattering the bombs.
Remarks	Quite rare. First used against Ipswich in 1940, but were also dropped on Kingston upon Hull, Grimsby and Cleethorpes in June 1943, amongst various other targets in UK. As the bombs fell the outer case flicked open via springs which caused four light metal drogues with a protruding 5 inch steel cable to deploy in the form of a parachute & wind vane, which armed the device as it span.



Parachute Mine (Luftmine B / LMB)

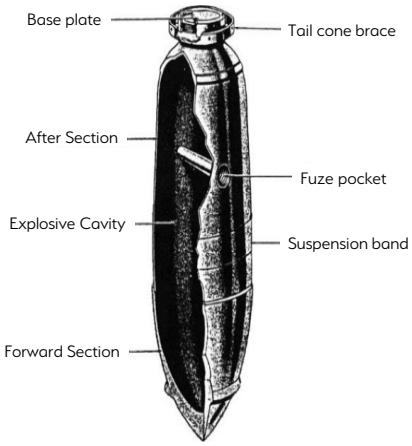
Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/time delay/hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level to maximise damage to a wider area.
Remarks	Deployed a parachute when dropped in order to control its descent. Had the potential to cause extensive damage within a 100m radius.





SC 1000kg High Explosive Bomb

Bomb Weight	Approx. 993-1027kg (2,189-2,264lb)
Explosive Weight	Approx. 530-620kg (1168-1367lb)
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 (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC-type bombs were 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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Client: Statkraft Energy Limited

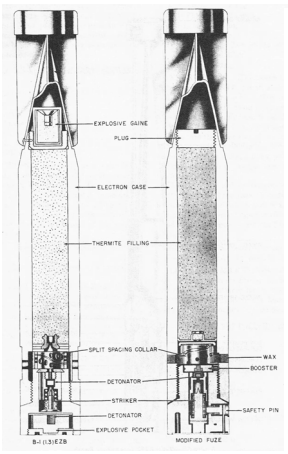
Project: Mylen Leah Solar Farm

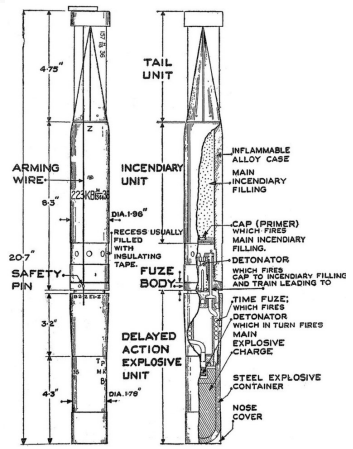
Ref: DA20029-00

Source: Various sources

1kg Incendiary Bomb

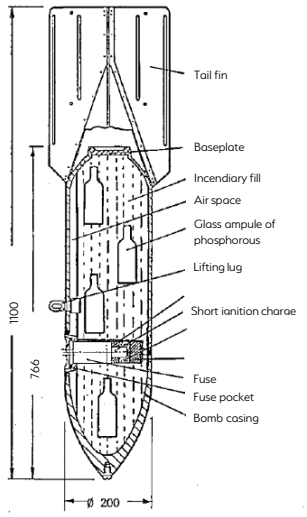
Bomb Weight	Approx. 1.0 - 1.3kg (2.2 and 2.9lb)
Explosive Weight	Approx. 680g (1.5lb) Thermite 8-15gm Explosive Nitropenta
Fuze Type	Impact fuze
Bomb Dimensions	350 x 50mm (13.8 x 1.97in)
Body Diameter	50mm (1.97in)
Use	As incendiary – dropped in clusters on towns and industrial complexes.
Remarks	Magnesium 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.

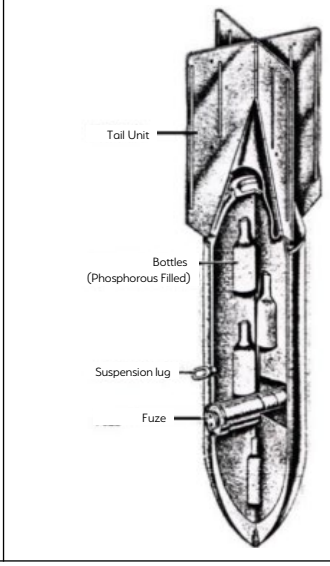




C50 A Incendiary Bomb

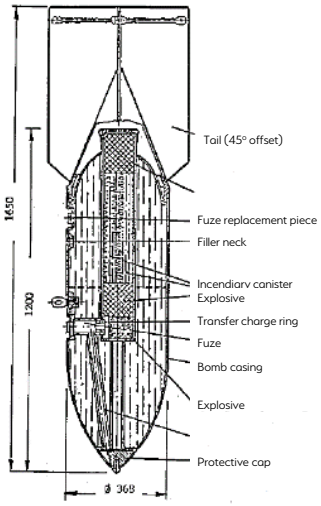
Bomb Weight	Approx. 41kg (90.4lb)
Explosive Weight	Approx. 0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against any targets where an incendiary effect is required.
Remarks	Early fill was a phosphorous/carbon disulphide incendiary mixture.





Flam C-250 Oil Bomb

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 Trialen filling have cylindrical paper-wrapped pellets, 1-15/16in. in length and diameter.



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