

Detailed
Unexploded Ordnance (UXO)
Risk Assessment

Project Name	Manchester One
Client	NX Consulting Ltd
Site Address	Manchester One, 49-53, Portland Street, Manchester, M1 3LD
Report Reference	DA21095-00
Date	6th December 2024
Author	AT
Quality Assurance	PB
Final Check	AB

1st Line Defence
3 Maple Park, Essex Road, Hoddesdon. EN11 0EX
Tel +44 (0) 1992 245 020 Email info@1stlinedefence.co.uk
Web www.1stlinedefence.co.uk Company Reg No. 07717863

1ST LINE DEFENCE

Executive Summary

Site Location and Description

The site is located in the centre of the City of Manchester.

The site comprises an existing multi-storey building with a new reception and workspaces set across 21 floors and an adjacent 2-storey commercial building in the north of site. There is also a carpark and an associated ramp to the rear of the building.

Chorlton Street bounds the site to the north with more multi-storey buildings located beyond that. To the east is a multi-storey car park, retail and office buildings located beyond. To the south is Sackville Street, where multi-storey buildings and a ground level carpark are located. To the west of the site there is Portland Street with retail units and commercial buildings located on it.

The site is approximately centred on the OS grid reference: **SJ 84285 97973.**

Proposed Works

The exact scope of proposed works was not known at this detailed stage, though it is believed that the site is to be retained in its existing commercial end use.

Geology and Bomb Penetration Depth

The British Geological Survey (BGS) map shows the site is underlain by the Chester Formation – Sandstone. Sedimentary bedrock formed between 250 and 247.1 million years ago during the Triassic 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 Risk** from German and anti-aircraft unexploded ordnance at the site of proposed works. There is an assessed **Low Risk** from Allied unexploded ordnance.

The Risk from German Air-Delivered UXO

- During WWII, the site was situated within the County Borough of Manchester, which according to official Home Office bombing statistics, sustained an overall low density of bombing with an average of 27.1 items of ordnance recorded per 1,000 acres. Bombing in the district can largely be attributed to the docklands and industrial facilities situated within the Salford and Stretford area of Greater Manchester.
- Although Manchester was not targeted to the same extent as cities such as London and Birmingham, it was subject to several major raids, the worst of which is often referred to as the 'Christmas Blitz'.
- Bomb plot and damage mapping obtained from the University of Manchester does not record any bombing on site, however does list all the buildings on site as 'demolished'. Post-war OS mapping and photography both show all the structures on site as cleared. Available Manchester bombing records are known for not being comprehensive – generally much more damage is recorded than there are associated bomb strikes. It has therefore not been possible to ascertain what caused the damage – whether it was high explosive (HE) bombing or fires caused by incendiary bombing.
- Whether resulting from bomb strikes or fires, the site would likely have been occupied by ruined structures and rubble for a time. Within seriously damaged sites, there is a much higher risk of evidence of UXBs being overlooked – being masked/obscured by debris and wreckage. Such areas are also much less likely to have been subject to regular access and checks – if they were accessed at all. UXBs falling into areas of damage was one of the most common reasons for them going unnoticed during WWII.
- In summary, multiple HE and incendiary bombing incidents were reported within the vicinity of the site, and post-WWII OS mapping, photography, and damage mapping appear to confirm the site sustained significant damage as a result. It is anticipated that both access levels and the nature of the groundcover would not have been conducive to the easy observation of evidence of UXBs, the likelihood that indicators of UXO could have been obscured and missed. As a result of these factors, the risk of German aerial delivered and anti-aircraft UXO on site has been assessed as **Medium**.

© 1st Line Defence®

The Risk from Allied UXO

- No evidence could be found to indicate that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA.
- The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding air delivered ordnance.

Post-WWII Redevelopment

- It should be noted that the construction of Manchester One (St Andrew's House/Portland Tower) will have significantly reduced the risk of UXO remaining at the location of and down to the depth of the post-war foundations and excavations. If the building has multiple basement levels, then the risk within its footprint is likely to have been entirely negated. The risk of UXO remaining is unlikely to have been significantly reduced (especially at depth) in the open areas around the main building.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at the Manchester One 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.)	• UXO Specialist On-site Support
Boreholes and Piled Foundations	• Intrusive Magnetometer Survey of all borehole and pile locations/clusters down to maximum bomb penetration depth.

Note – 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.

© 1st Line Defence®

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
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

© 1st Line Defence®

Contents

Executive Summary ii
Glossary iv
Contents v
Annexes vii
Appendices vii
1. Introduction 1
1.1. Background 1
2. Method Statement 2
2.1. Report Objectives 2
2.2. Risk Assessment Process 2
2.3. Sources of Information 2
3. Background to Bombing Records 3
3.1. General Considerations of Historical Research 3
3.2. German Bombing Records 3
3.3. Allied Records 3
4. UK Regulatory Environment and Guidelines 4
4.1. General 4
4.2. CDM Regulations 2015 4
4.3. The 1974 Health and Safety at Work etc. Act 4
4.4. CIRIA C681 4
4.5. Additional Legislation 4
5. The Role of Commercial UXO Contractors and The Authorities 5
5.1. Commercial UXO Specialists 5
5.2. The Authorities 5
6. The Site 6
6.1. Site Location 6
6.2. Site Description 6
7. Scope of the Proposed Works 6
7.1. General 6
8. Ground Conditions 6
8.1. General Geology 6
8.2. Site-Specific Geology 6
9. Site History 7
9.1. Introduction 7
9.2. Summary of the Historical Background of the Site 7
9.3. Ordnance Survey Historical Maps 7
10. Introduction to German Air Delivered Ordnance 8
10.1. General 8
10.2. Generic Types of WWII German Air Delivered Ordnance 8
10.3. Failure Rate of German Air Delivered Ordnance 9
10.4. UXB Ground Penetration 9
10.4.1. The J-Curve Principle 9
10.4.2. WWII UXB Ground Penetration Studies 9

© 1st Line Defence®

10.4.3. Site Specific Bomb Penetration Considerations 10
10.5. V-Weapons 10
11. **The Likelihood of Contamination from German Air Delivered UXBs** **11**
11.1. World War I 11
11.2. World War II Bombing of the County Borough of Manchester 11
11.3. WWII Home Office Bombing Statistics 12
11.4. Manchester Bomb & Damage Map 12
11.5. Blitz Britain: Manchester & Salford 13
11.6. WWII-Era Aerial Photography 13
11.7. Abandoned Bombs 14
11.8. Bomb Disposal Tasks 14
11.9. Evaluation of German Air Delivered UXO Records 15
12. **Introduction to Allied Ordnance** **16**
12.1. General 16
12.2. Defending the UK From Aerial Attack 16
12.3. Anti-Aircraft Artillery (AAA) 17
13. **The Likelihood of Contamination from Allied Ordnance** **18**
13.1. Introduction 18
13.2. Evaluation of Contamination Risk from Allied UXO 18
14. **The Likelihood of UXO Contamination Summary** **19**
15. **The Likelihood that UXO Remains** **20**
15.1. Introduction 20
15.2. UXO Clearance 20
15.3. Post-War Redevelopment 20
16. **The Likelihood of UXO Encounter** **21**
16.1. Introduction 21
16.2. Encountering Air Delivered Ordnance 21
17. **The Likelihood of UXO Initiation** **22**
17.1. Introduction 22
17.2. Initiating Air Delivered Ordnance 22
18. **Consequences of Initiation/Encounter** **23**
18.1. Introduction 23
18.2. Consequences of Detonation 23
19. **1st Line Defence Risk Assessment** **24**
19.1. Risk Assessment Stages 24
19.2. Assessed Risk Level 24
20. **Proposed Risk Mitigation Methodology** **25**
20.1. General 25
Bibliography **26**

© 1st Line Defence®

Annexes

List of Report Annexes	
Annex A	Site Location Maps
Annex B	Recent Aerial Photography
Annex C	Client Provided Site Plan
Annex D	Pre and Post-WWII Historical Maps
Annex E	Example of UXO Entry Hole / The 'J-curve' Effect Principle
Annex F	Examples of UXO Incidents
Annex G	WWI Map of Air Raids and Naval Bombardments
Annex H	Luftwaffe Target / Reconnaissance Mapping
Annex I	University of Manchester Bomb and Damage Map
Annex J	'Blitz Britain; Manchester and Salford'
Annex K	WWII-era RAF Aerial Photography of the Site

Appendices

List of Report Appendices	
Appendix i-iii	Examples of German Air-Delivered Ordnance
Appendix iv	Examples of Anti-Aircraft Projectiles

© 1st Line Defence®

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

Site: Manchester One
Client: NX Consulting Ltd

1. Introduction

1.1. Background

1st Line Defence has been commissioned by NX Consulting Ltd to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at Manchester One.

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.'

© 1st Line Defence®

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 Manchester One. 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 and Manchester Archives
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by NX Consulting.
- 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.

© 1st Line Defence®

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.

© 1st Line Defence®

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.

© 1st Line Defence®

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.

© 1st Line Defence®

6. The Site

6.1. Site Location

The site is located in the centre of the City of Manchester. Chorlton Street bounds the site to the north with more multi-storey buildings located beyond that. To the east is a multi-storey car park, retail and office buildings located beyond. To the south is Sackville Street, where multi-storey buildings and a ground level carpark are located. To the west of the site there is Portland Street with retail units and commercial buildings located on it.

The site is approximately centred on the OS grid reference: **SJ 84285 97973**

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

6.2. Site Description

The site comprises an existing multi-storey building with a new reception and workspaces set across 21 floors and an adjacent 2-storey commercial building in the north of site. There is also a carpark and an associated ramp to the rear of the building.

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

The exact scope of proposed works was not known at this detailed stage, though it is believed that the site is to be retained in its existing commercial end use.

8. Ground Conditions

8.1. General Geology

The British Geological Survey (BGS) map shows the site is underlain by the Chester Formation – Sandstone. Sedimentary bedrock formed between 250 and 247.1 million years ago during the Triassic period.

Superficial deposits are Till, Devensian - Diamicton. Sedimentary superficial deposit 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.

© 1st Line Defence®

9. Site History

9.1. Introduction

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

9.2. Summary of the Historical Background of the Site

The site is occupied by Manchester One, formerly known as Portland Tower and previously St. Andrew's House a high-rise building. The tower is located at 53 Portland Street from which it was named. The tower was one of the first high-rise buildings built in the 1960s in the United Kingdom, at 77 m (250 ft) tall.

9.3. Ordnance Survey Historical Maps

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

Pre-WWII		
Date	Scale	Description
1922	1;2,500	This map shows the site as it appeared pre-war. The site is evenly divided into two blocks of properties between Portland Street to the north, Chorlton Street to the east, Major Street to the south and Sackville Street to the west. The roadway of Silver Street bisects the site.

Post-WWII		
Date	Scale	Description
1948	1:1,250	All of the structures on site have been cleared since the previous map edition, as part of wide-scale clearance on site and in the surrounding area. Only a small area of property south-east of the site boundary survives between Portland Street and Major Street.
1965	1:1,250	This map shows the post-war development of the area, with the site assuming it's modern layout.

© 1st Line Defence®

10. Introduction to German Air Delivered Ordnance

10.1. General

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

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

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

10.2. Generic Types of WWII German Air Delivered Ordnance

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

Generic Types of WWII German Air Delivered Ordnance		
Type	**Frequency**	**Likelihood of Detection**
High Explosive (HE) bombs	In terms of weight of ordnance dropped, HE bombs were the most frequently deployed by the Luftwaffe during WWII.	Although efforts were made to identify the presence of unexploded ordnance following an air raid, often the damage and destruction caused by detonated bombs made observation of UXB entry holes impossible. The entry hole of an unexploded bomb can be as little as 20cm in diameter and was easily overlooked in certain ground conditions (see **Annex E**). 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.

© 1st Line Defence®

10.3. 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 F**.

10.4. 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.

10.4.1. 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 E**).

10.4.2. 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.

© 1st Line Defence®

10.4.3. 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 – Chester Formation – Sandstone
- 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.

10.5. V-Weapons

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

Although these weapons caused considerable damage, their range was limited by their position of deployment across Europe and as a result the vast majority of V-weapon strikes were directed against targets in the south-east of England, predominantly in the London Boroughs and Home Counties. This limitation of capability meant targets in Manchester were generally too far to be considered for V-weapon strikes by the Luftwaffe. The risk from V-weapons is therefore considered negligible and will not be further addressed in this report.

© 1st Line Defence®

11. The Likelihood of Contamination from German Air Delivered UXBs

11.1. 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 G**. This source does not record any incidents to have occurred within the area of the site.

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

11.2. World War II Bombing of the County Borough of Manchester

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

During WWII, the site was located within the County Borough of Manchester, which sustained an overall low density of bombing, as represented by bomb density data figures, see **Section 11.3**. Manchester was not targeted with the same intensity and frequency as other major British cities such as Liverpool, Coventry, and Birmingham, however it was still subject to several major raids in the years 1940-1941. These raids tended to be focused on the Salford and Stretford areas of Greater Manchester, where the majority of the docklands and industrial facilities were located. Luftwaffe target mapping, presented in **Annex H**, does label several businesses in the surrounding area of the site, including a post office and several Mills; the nearest encircled target is the Old Street Goods Station.

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.

© 1st Line Defence®

11.3. 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 County Borough of Manchester between 1940 and 1945.

Record of German Ordnance Dropped on the County Borough of Manchester		
Area Acreage		27,255
Weapons	High Explosive bombs (all types)	712
	Parachute mines	18
	Oil bombs	7
	Phosphorus bombs	0
	Fire pots	0
	Pilotless aircraft (V-1)	1
	Long range rocket bombs (V-2)	0
Total		738
Number of Items per 1,000 acres		27.1
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.

11.4. Manchester Bomb & Damage Map

A bomb map for Manchester was obtained from the University of Manchester Library. This map indicates the position, date and type of bombs dropped within the district as well as structures which have been damaged. A section of the map showing the site is described below and presented in **Annex I**.

.

Manchester Bomb Map	
Date Range	Comments
1939-45	Bomb plot and damage mapping obtained from the University of Manchester does not record any bombing on site, however does list all the buildings on site as 'demolished'. The date of this demolition is given as the 23rd December 1940.

© 1st Line Defence®

11.5. Blitz Britain: Manchester & Salford

The published source Blitz Britain: Manchester and Salford by Graham Pythian presents a transcript of the document 'Manchester Emergency Committee's Log Book of Bombing Incidents 22-24 December 1940' (hence covering the 'Manchester Blitz' period). This is stated to have been obtained from the Emergency Committee Records/Police Museum and Archives, though it was not possible to obtain original documents. The most relevant incidents have been described below and are presented in **Annex J**.

Blitz Britain: Manchester & Salford		
Date	Location	Record Transcription
22nd – 23rd December 1940	Portland Street; Sackville Street; Silver Street	Incendiary bombs 7.50pm, 22nd. Major incident. Several warehouses gutted. Incident still open (29th). Under military control.
	Sackville Street & Mount Street, Chorlton-on-Medlock	Incendiary bombs at 9.10pm, 22nd. Warehouse property damaged by fire. Ivy Mills, Sackville Street, extensively damaged. Gutted. Fires extinguished by fire brigade and incident closed.
23rd – 24th December 1940	Silver Street; Chorlton Street	HE dropped at 11pm. Large fire resulted. Eight walking casualties reported. Incident still open.
	Major Street – Chorlton Street, Sackville Street, Bloom Street – Princess Street	Shower of incendiary bombs 11.45pm causing many destructive fires and linking up with (the bomb strike mentioned above). Incident still open.

11.6. WWII-Era Aerial Photography

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

WWII-Era Aerial Photography	
Date/Title	Description
16th May 1948	This image shows the site post-war. All the pre-war buildings on site have been cleared
9th July 1953	This image shows the site in the early 1950s. The site is still a cleared area of land and appears to be in use as an unofficial car park.
24th August 1961	This image shows the construction of the current building on site is in progress.
4th July 1969	This image shows the construction of the current building on site has been finished.

© 1st Line Defence®

11.7. 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.

11.8. 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, NX Consulting Ltd will be advised.

© 1st Line Defence®

11.9. 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 situated within the County Borough of Manchester, which according to official Home Office bombing statistics, sustained an overall low density of bombing with an average of 27.1 items of ordnance recorded per 1,000 acres. Bombing in the district can largely be attributed to the docklands and industrial facilities situated within the Salford and Stretford area of Greater Manchester. Although Manchester was not targeted to the same extent as cities such as London and Birmingham, it was subject to several major raids, the worst of which is often referred to as the 'Christmas Blitz'. Bomb plot and damage mapping obtained from the University of Manchester does not record any bombing on site, however does list all the buildings on site as 'demolished'.
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.*	Bomb plot and damage mapping obtained from the University of Manchester does not record any bombing on site, however does list all the buildings on site as 'demolished'. Post-war OS mapping and photography both show all the structures on site as cleared.
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.*	Given the site was occupied by a number of structures pre-war, it is anticipated groundcover would have been conducive to the detection of evidence of UXO, at least at the beginning of the war. Following the significant damage recorded on site, there is a chance the site would have been occupied by rubble for a time, leading to groundcover becoming significantly less conducive to the detection of UXO.
Access Frequency *UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied.*	Similarly to groundcover, it is expected the site would have been subject to frequent access at the beginning of the war, however following damage it is likely access would have significant reduced and/or ceased. Infrequent access increases the likelihood of items of UXO going unnoticed.
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.

© 1st Line Defence®

12. Introduction to Allied Ordnance

12.1. General

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

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

It should be highlighted that there is no evidence that the site formerly had any military occupation or usage that could have led to contamination with such items of Allied ordnance. Despite this, urban areas, such as the location of the site, can be at risk from buried unexploded anti-aircraft projectiles fired during WWII – as addressed below.

12.2. Defending the UK From Aerial Attack

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

Active Defences	Passive Defences
• Anti-aircraft gun emplacements to engage enemy aircraft. • Fighter aircraft to act as interceptors. • Rockets and missiles were used later during WWII.	• Blackouts and camouflaging to hinder the identification of Luftwaffe targets. • Decoy sites were located away from targets and used dummy buildings and lighting to replicate urban, military, or industrial areas. • Barrage balloons forced enemy aircraft to greater altitudes. • Searchlights were often used to track and divert adversary bomber crews during night raids.

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

© 1st Line Defence®

12.3. Anti-Aircraft Artillery (AAA)

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

Anti-Aircraft Artillery				
Item	**Description**			
HAA	These large calibre guns such as the 3.7" QF (Quick Firing) were used to engage high flying enemy bombers. They often fired large HE projectiles, which were usually initiated by integral fuzes, triggered by impact, area, time delay or a combination of aforementioned mechanisms.			
LAA	These mobile guns were intended to engage fast, low flying aircraft. They were typically rotated between locations on the perimeters of towns and strategically important industrial works. As they could be moved to new positions with relative ease when required, records of their locations are limited. The most numerous of these were the 40mm Bofors gun which could fire up to 120 x 40mm HE projectiles per minute to over 1,800m.			
Variations in HAA and LAA Ammunition	**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.			

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

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

© 1st Line Defence®

13. The Likelihood of Contamination from Allied Ordnance

13.1. Introduction

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

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

13.2. 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
Military Camps .	1st Line Defence could find no evidence of a military camp within the site.
Anti-Aircraft Defences *Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.*	1st Line Defence could find no evidence of Anti-Aircraft defences such as a HAA or LAA gun emplacement occupying or bordering the site. The closest HAA was located approximately 2.5km of the site, in the vicinity of Lower Broughton. Despite this distance the maximum effective range of an AA projectile can be up to 15km. The conditions in which HAA or LAA projectiles may have fallen unnoticed within a site footprint are generally analogous to those regarding German air delivered ordnance.
Home Guard Activity	Evidence of Home Guard activity is often difficult to locate, owing to the ad-hoc nature of Home Guard activity within each local area. Such training was often conducted on a small scale at the discretion of individual commanders and as such was seldom recorded officially. As such, no positive evidence could be found to confirm the presence of HG units within proximity to the site.
Defensive Positions *Defensive positions suggest the presence of*	There is no evidence of any pillbox, emplacement or other defensive features formerly located on or bordering the site footprint.
Training or firing ranges	No evidence of training or firing ranges could be found within the site or surrounding area.
Defensive Minefields	There is no evidence of defensive minefields affecting the site.
Ordnance Manufacture	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.
Military Related Airfields	The site was not situated within the perimeters or vicinity of a military airfield.

© 1st Line Defence®

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 pre- and post-WWII Ordnance Survey maps, pre-WWII oblique aerial photography, Luftwaffe target mapping, University of Manchester bomb and damage map, and interactive 'Christmas Blitz' map, Graham Phythian's 'Blitz Britain; Manchester and Salford', damage cards for housing and properties, and post-WWII aerial photography. The record set is of generally mixed quality, while there are a number of record sets available for consultation, they are not all comprehensive and do not always corroborate each other. Nevertheless, the available record sets for this site have allowed us to make a comprehensive assessment of the risk.
German Air-Delivered Ordnance	• During WWII, the site was situated within the County Borough of Manchester, which according to official Home Office bombing statistics, sustained an overall low density of bombing with an average of 27.1 items of ordnance recorded per 1,000 acres. Bombing in the district can largely be attributed to the docklands and industrial facilities situated within the Salford and Stretford area of Greater Manchester. • Although Manchester was not targeted to the same extent as cities such as London and Birmingham, it was subject to several major raids, the worst of which is often referred to as the 'Christmas Blitz'. • Bomb plot and damage mapping obtained from the University of Manchester does not record any bombing on site, however does list all the buildings on site as 'demolished'. Post-war OS mapping and photography both show all the structures on site as cleared. Available Manchester bombing records are known for not being comprehensive – generally much more damage is recorded than there are associated bomb strikes. It has therefore not been possible to ascertain what caused the damage – whether it was high explosive (HE) bombing or fires caused by incendiary bombing. • Whether resulting from bomb strikes or fires, the site would likely have been occupied by ruined structures and rubble for a time. Within seriously damaged sites, there is a much higher risk of evidence of UXBs being overlooked – being masked/obscured by debris and wreckage. Such areas are also much less likely to have been subject to regular access and checks – if they were accessed at all. UXBs falling into areas of damage was one of the most common reasons for them going unnoticed during WWII. • In summary, multiple HE and incendiary bombing incidents were reported within the vicinity of the site, and post-WWII OS mapping, photography, and damage mapping appear to confirm the site sustained significant damage as a result. It is anticipated that both access levels and the nature of the groundcover would not have been conducive to the easy observation of evidence of UXBs, the likelihood that indicators of UXO could have been obscured and missed. As a result of these factors, the risk of German aerial delivered and anti-aircraft UXO on site has been assessed as **Medium**.
Allied Ordnance	• No evidence could be found to indicate that the site formerly had any military occupation or usage that could have led to contamination with items of Allied ordnance, such as LSA and SAA. • The conditions in which HAA or LAA projectiles may have fallen unnoticed within the site boundary are however analogous to those regarding air delivered ordnance.

© 1st Line Defence®

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

1st Line Defence has found no evidence in the public domain or within internal records that any official ordnance clearance operations have taken place on site. Note however that we have not received confirmation of this fact from the 33 EOD Regiment Archive (now part of 29 EOD & Search Group). It should also be noted that in addition to 29 EOD & Search Group archival information, 1st Line Defence also do not currently have access to data that may be relevant including 5131(BD)SQN Archive, SD Training Technical Advisory Section (TAS) and MACA Records (bomb disposal callouts).

If such information is available at a later date, it is recommended that it be reviewed as it will assist with understanding both levels and types of contamination likely to be present, and may indicate risk reduction in certain areas.

15.3. Post-War Redevelopment

Significant post-war development has occurred on site, with all of the current structures on site built post-war.

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.

© 1st Line Defence®

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.

© 1st Line Defence®

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.

© 1st Line Defence®

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.

© 1st Line Defence®

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 Risk** from German and anti-aircraft unexploded ordnance at the site of proposed works. There is an assessed **Negligible Risk** from Allied unexploded ordnance.

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	✓			

This report has been undertaken with due diligence, and all reasonable care has been taken to access and analyse relevant historical information. By necessity, when dealing historical evidence, and when making assessments of UXO risk, various assumptions have to be made which we have discussed and justified throughout this report. Our reports take a common-sense and practical approach to the assessment of risk, and we strive to be reasonable and pragmatic in our conclusions.

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

© 1st Line Defence®

20. Proposed Risk Mitigation Methodology

20.1. General

The following risk mitigation measures are recommended to support the proposed works at Manchester One:

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.)	• **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.
Boreholes and Piled Foundations	• **Intrusive Magnetometer Survey of all borehole and pile locations down to a maximum bomb penetration depth:** 1st Line Defence can deploy a range of intrusive magnetometer techniques to clear pile locations. The appropriate technique is influenced by a number of factors, but most importantly the site's ground conditions. The appropriate survey methodology would be confirmed once the enabling works have been completed.

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 **6th December 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.

© 1st Line Defence®

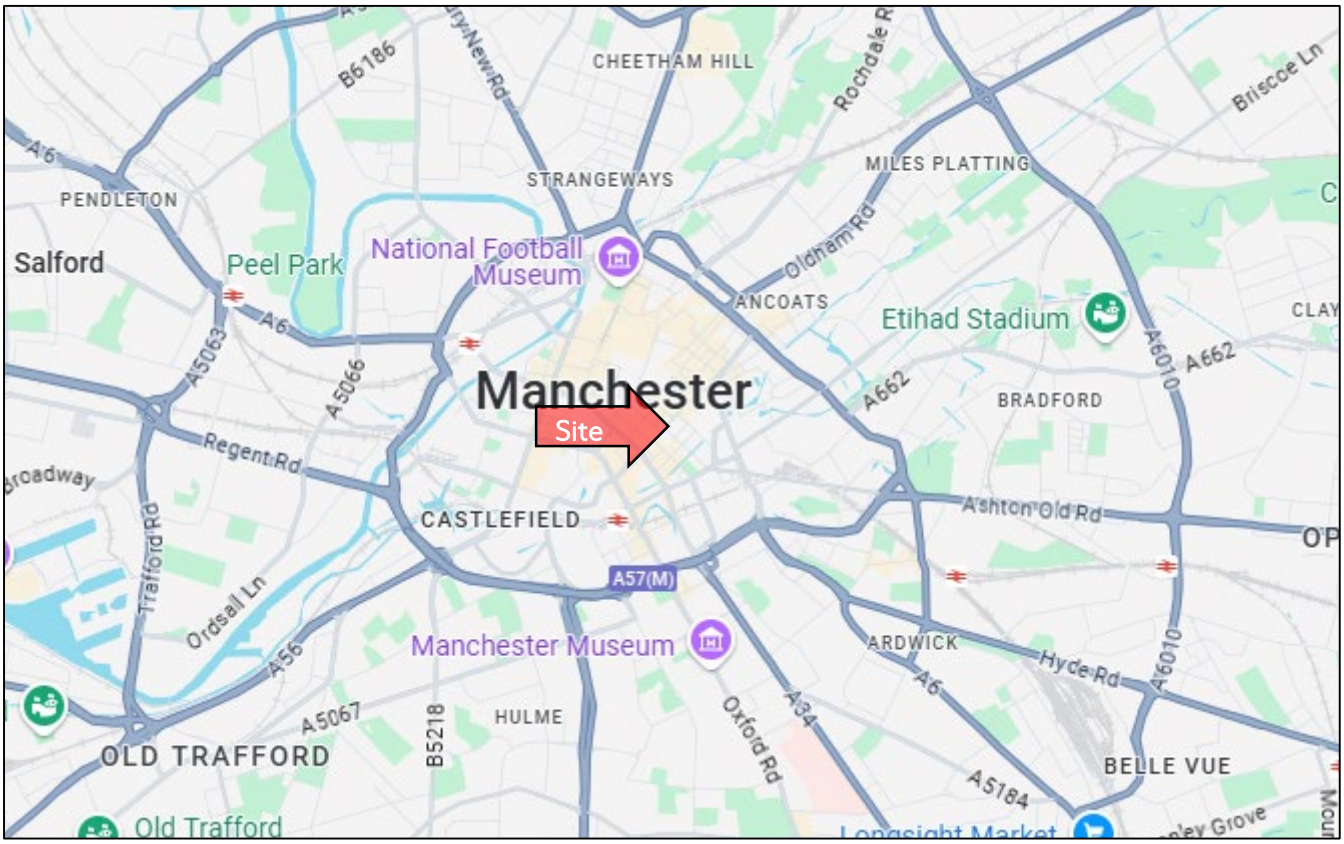
Bibliography

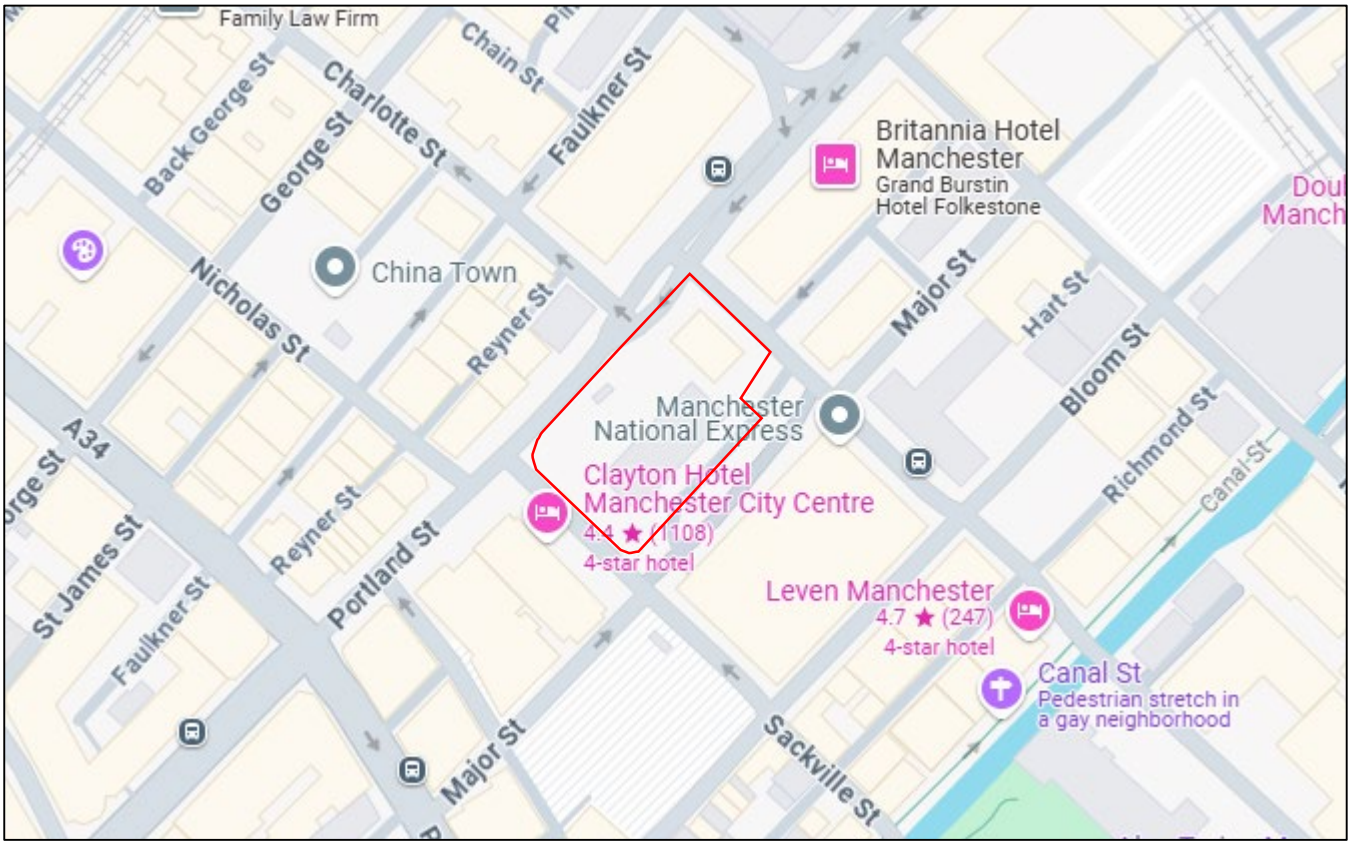
- Bates, H. E., Flying Bombs over England, Frogletts Publications Ltd., 1994
- Clarke, N. J., Adolf's British Holiday Snaps: Luftwaffe Aerial Reconnaissance Photographs of England, Scotland and Wales, Fonthill Media Ltd., 2012
- Dobinson, C., AA Command: Britain's Anti-Aircraft Defences of the Second World War, Methuen., 2001
- Fegan, T., The 'Baby Killers': German Air raids on Britain in the First World War, Leo Cooper Ltd., 2002
- Fleischer, W., German Air-Dropped Weapons to 1945, Midland Publishing., 2004
- Jappy, M. J., Danger UXB: The Remarkable Story of the Disposal of Unexploded Bombs during the Second World War, Channel 4 Books., 2001
- Morris, J., German Air Raids on Britain: 1914 – 1918, The Naval & Military Press., 1993
- Price, A., Blitz on Britain, The Bomber Attacks on the United Kingdom 1939 – 1945, Purnell Book Services Ltd., 1977
- Ramsey, W., The Blitz Then and Now, Volumes 1,2 & 3, Battle of Britain Prints International Ltd., 1987, 1988 & 1990
- Scofield, J., Modern Military Matters., Council for British Archaeology., 2004
- Stone, K., et al., Unexploded Ordnance (UXO) A Guide For The Construction Industry (C681)., CIRIA, 2009
- Whiting, C., Britain Under Fire: The Bombing of Britain's Cities 1940-1945, Pen & Sword Books Ltd., 1999

© 1st Line Defence®

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.

This report was written by, is owned by and is copyrighted to 1st Line Defence Limited. It contains important 1st Line Defence information which is disclosed only for the purposes of the client's evaluation and assessment of the project to which the report is about. The contents of this report shall not, in whole or in part be used for any other purpose apart from the assessment and evaluation of the project; be relied upon in any way by the person other than the client, be disclosed to any affiliate of the client's company who is not required to know such information, nor to any third party person, organisation or government, be copied or stored in any retrieval system, be reproduced or transmitted in any form by photocopying or any optical, electronic, mechanical or other means, without prior written consent of the Managing Director, 1st Line Defence Limited, Unit 3, Maple Park, Essex Road, Hoddesdon EN11 0EX. Accordingly, no responsibility or liability is accepted by 1st Line Defence towards any other person in respect of the use of this report or reliance on the information contained within it, except as may be designated by law for any matter outside the scope of this report.



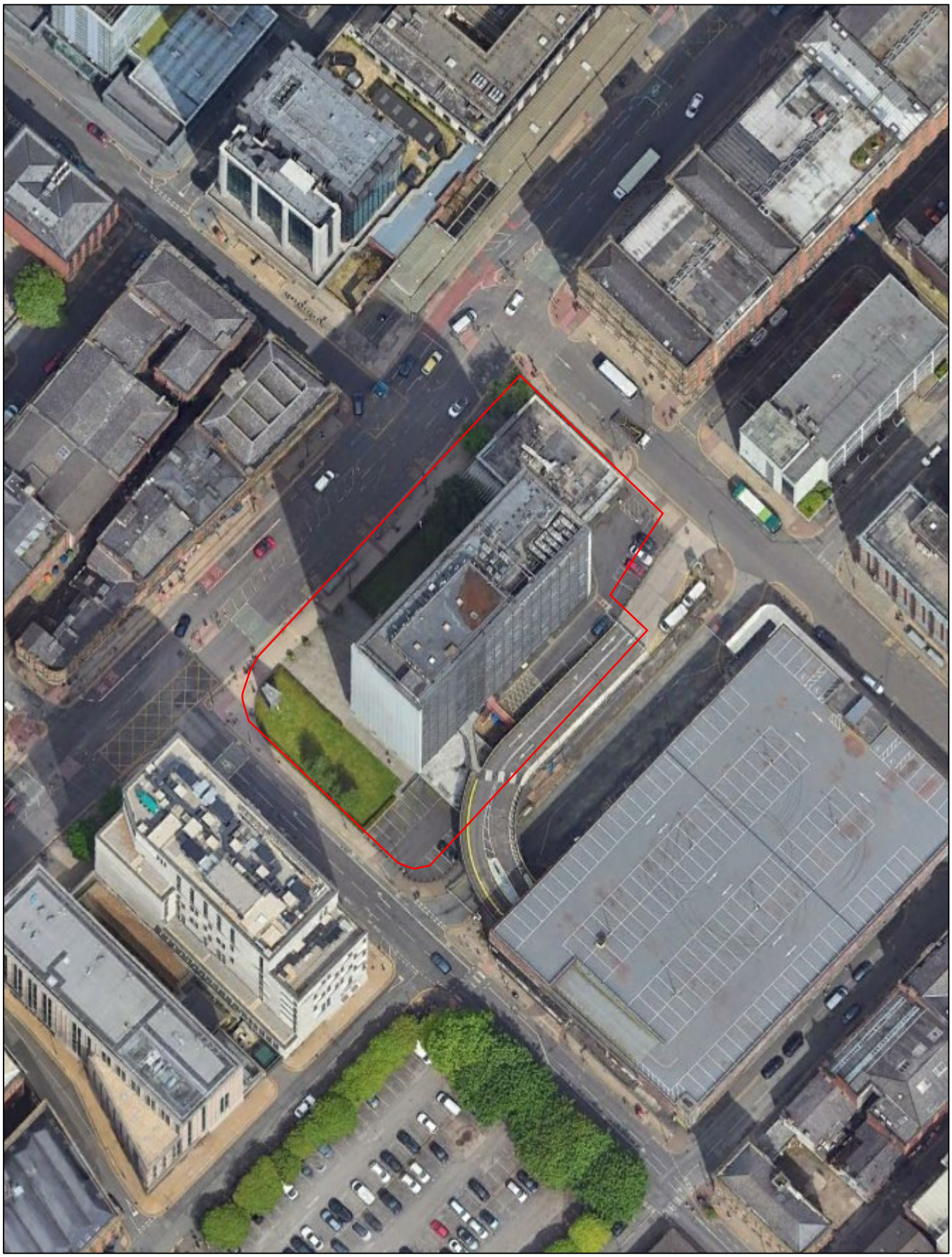


1ST LINE DEFENCE

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

Client:	NX Consulting Ltd	Approximate site boundary	N
Project:	Manchester One		
Ref:	DA21095-00	**Source:** Google Maps	

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

Approximate site boundary

N

Project: Manchester One

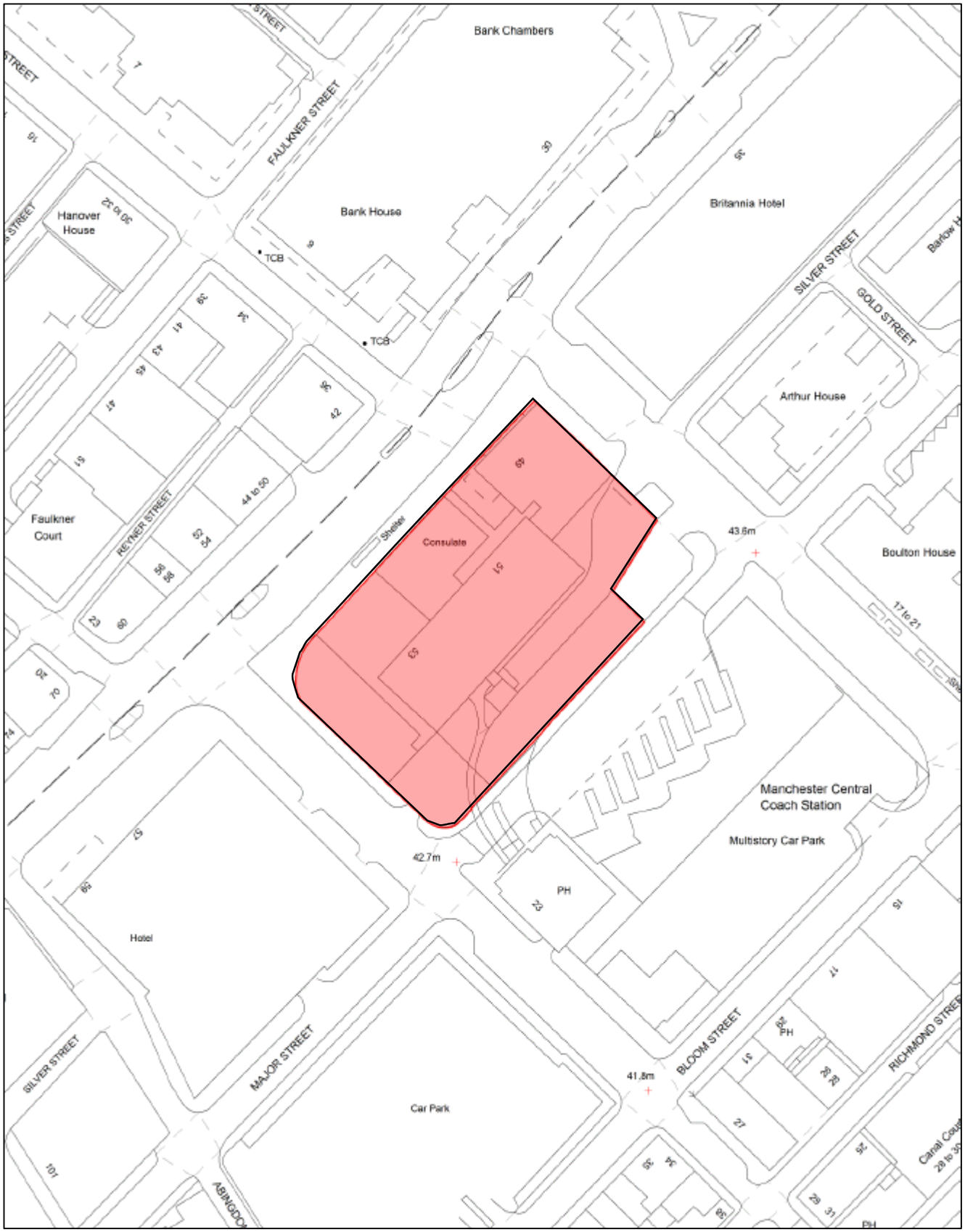
Ref: DA21095-00

Source: Google Earth

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

Client Provided Site Plan

Annex: C



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: NX Consulting Ltd

Project: Manchester One

Ref: DA21095-00

Source: NX Consulting Ltd.

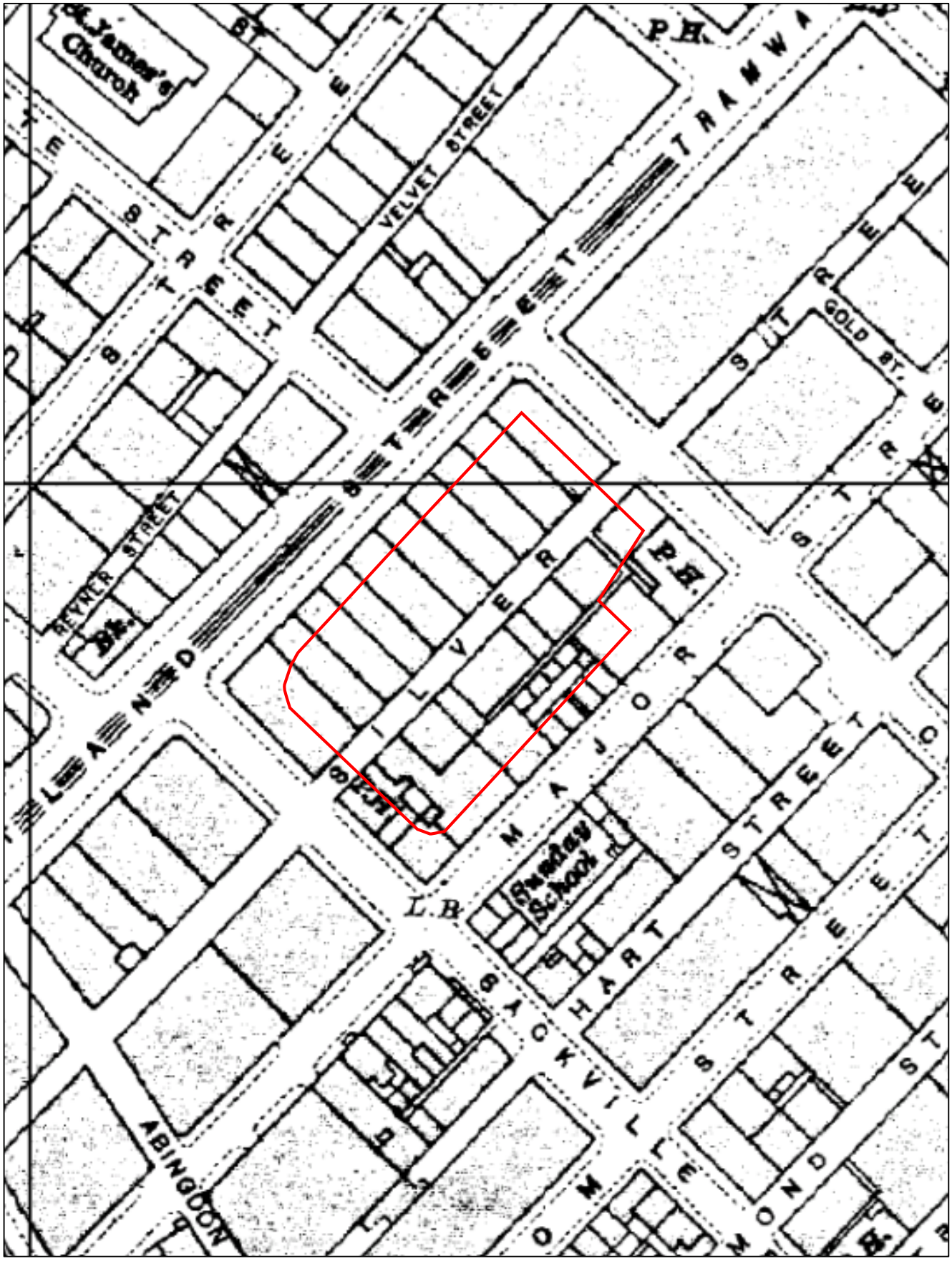
— Approximate site boundary

N

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

Pre-WWII Historical Map 1922

Annex: D1



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: NX Consulting Ltd

Project: Manchester One

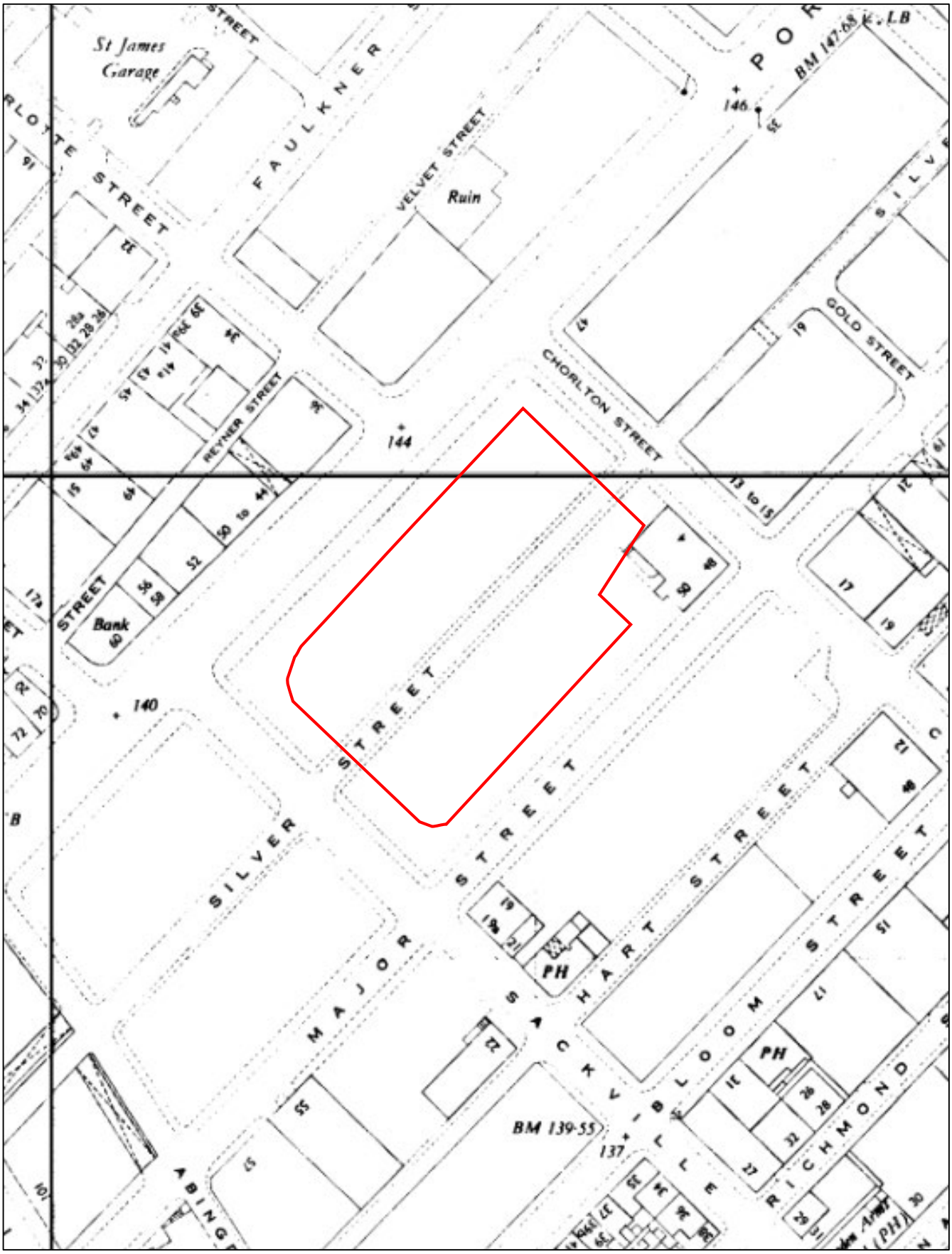
Ref: DA21095-00

Source: Landmark Maps

Approximate site boundary

N

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

Approximate site boundary

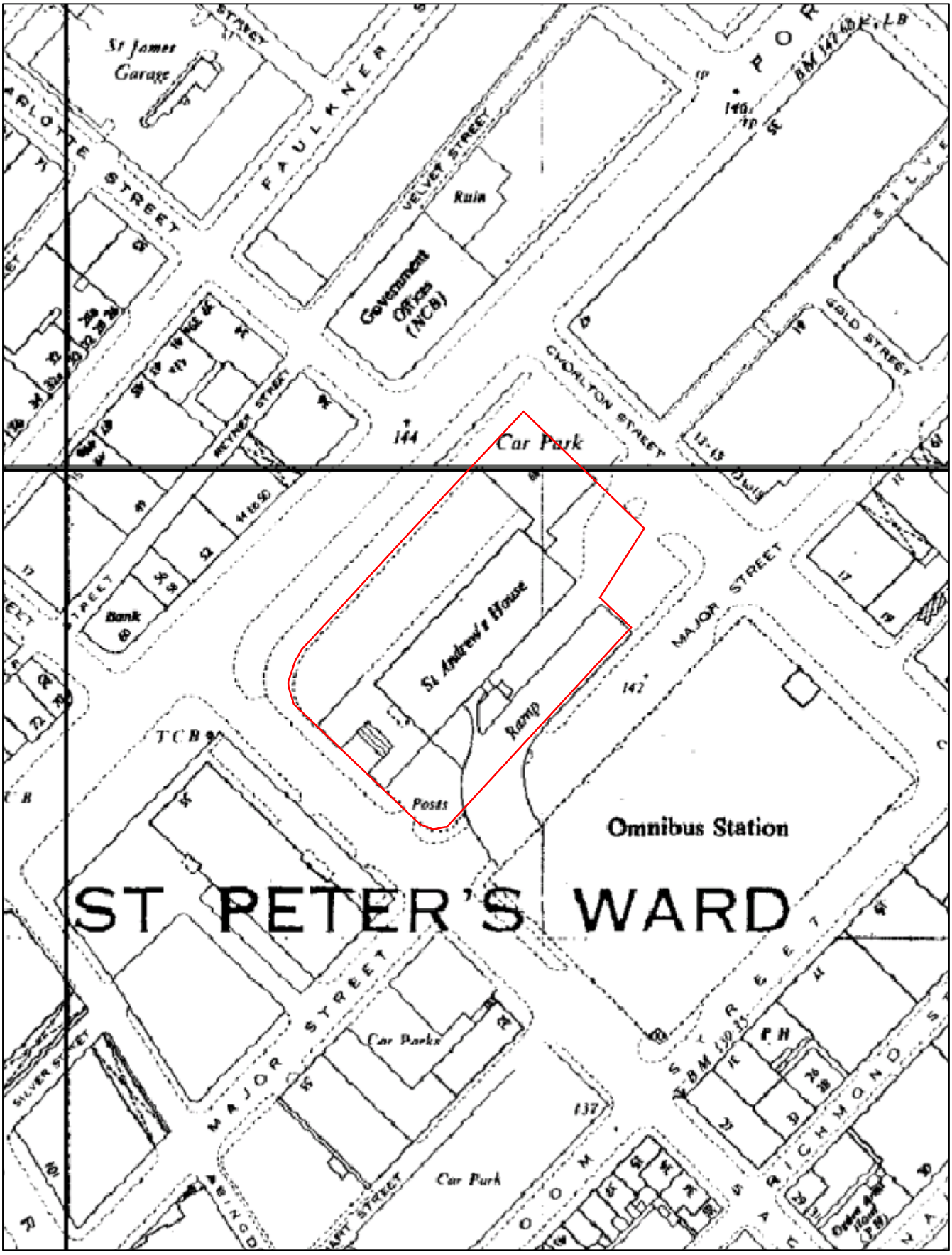
Project: Manchester One

N

Ref: DA21095-00

Source: Landmark Maps

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



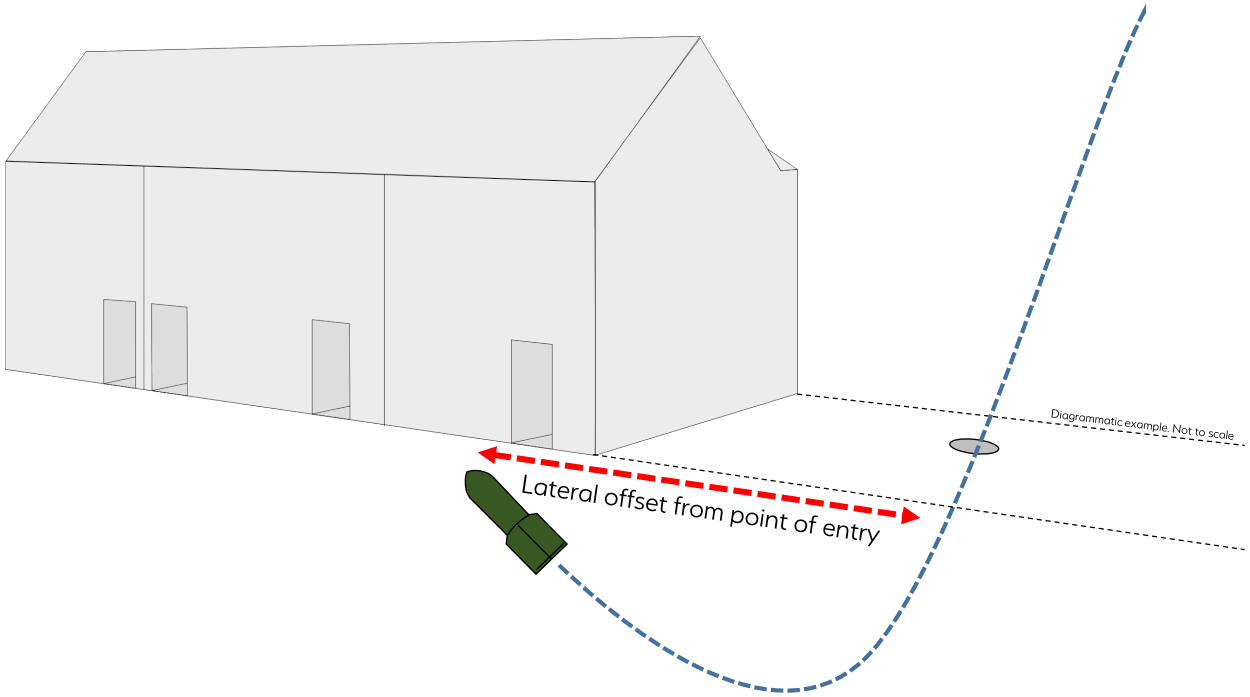
1ST LINE DEFENCE

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

Client:	NX Consulting Ltd	Approximate site boundary	N
Project:	Manchester One		
Ref:	DA21095-00	Source: Landmark Maps	

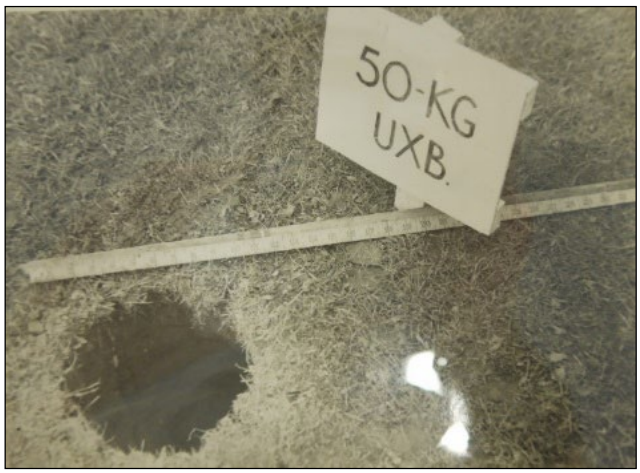
Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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**).

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: NX Consulting Ltd

Project: Manchester One

Ref: DA21095-00 **Source:** Various sources

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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

BBC NEWS



Plymouth unexploded WW2 bomb: Thousands of people displaced

A 500kg (1,102lb) German World War Two bomb that forced the evacuation of thousands of people in Plymouth has been detonated at sea.

The unexploded device was **found in a garden** on St Michael Avenue on Tuesday, sparking four days of disruption.

On Friday police closed roads and rail and bus services were stopped as the bomb was transported 1.4 miles (2.3km) through the city's streets.

The device was taken by boat beyond the breakwater and detonated at 21:51 GMT.





500kg German HE Bomb, February 2024

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: NX Consulting Ltd

Project: Manchester One

Ref: DA21095-00

Source: BBC News

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

Manchester area evacuated as unexploded bomb found near old Coronation Street studio

MANCHESTER city centre was in lock down after an "unexploded cartridge" was found on a building site.

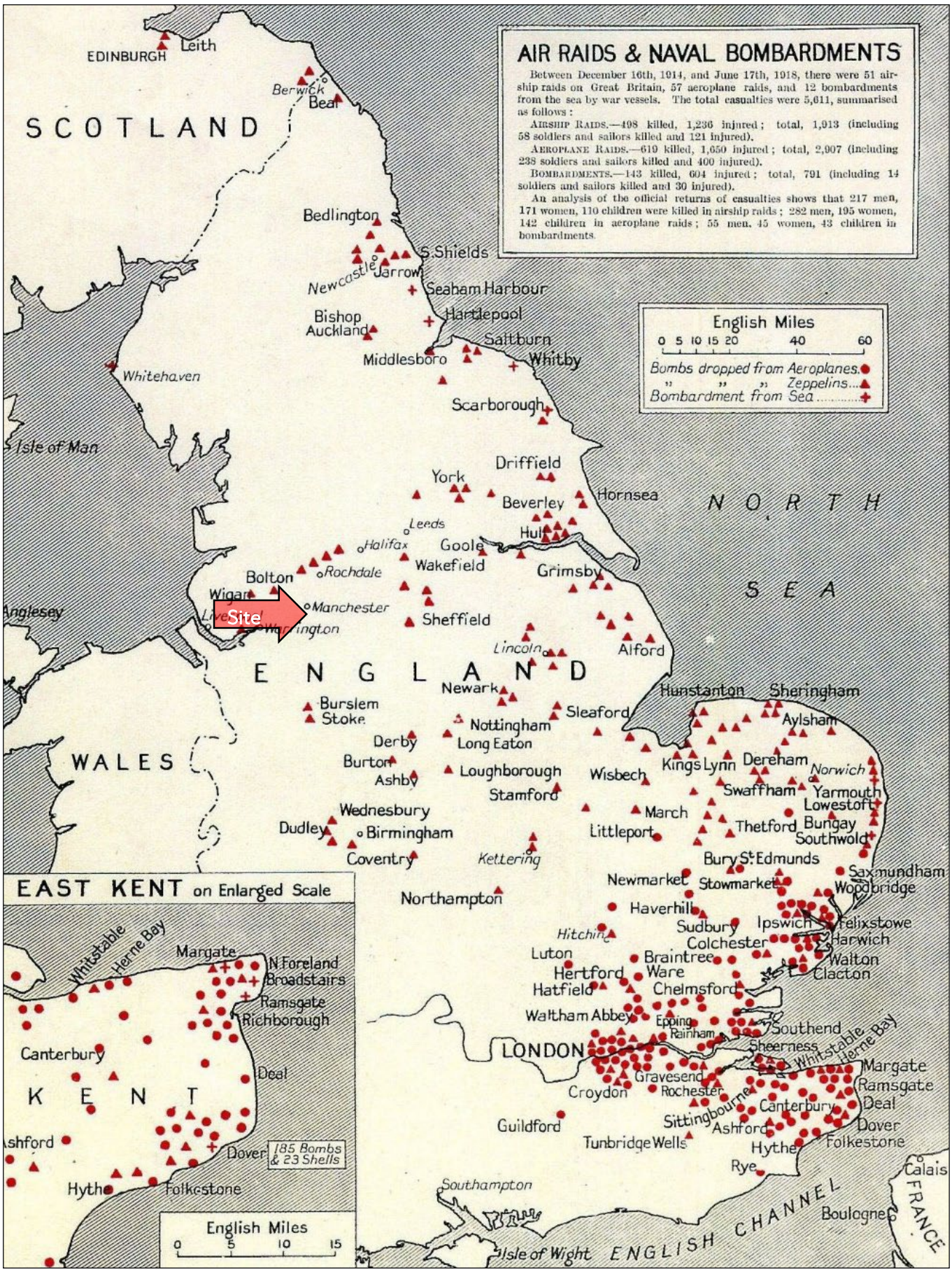
A number of streets between Manchester city centre and Salford were closed because of a police incident.

Irwell Street was closed from Trinity Way to New Quay Street – near the former Old Granada Studios.

A nearby block of flats was evacuated due to the unexploded device.

Witnesses reported a large police presence and police dogs.

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

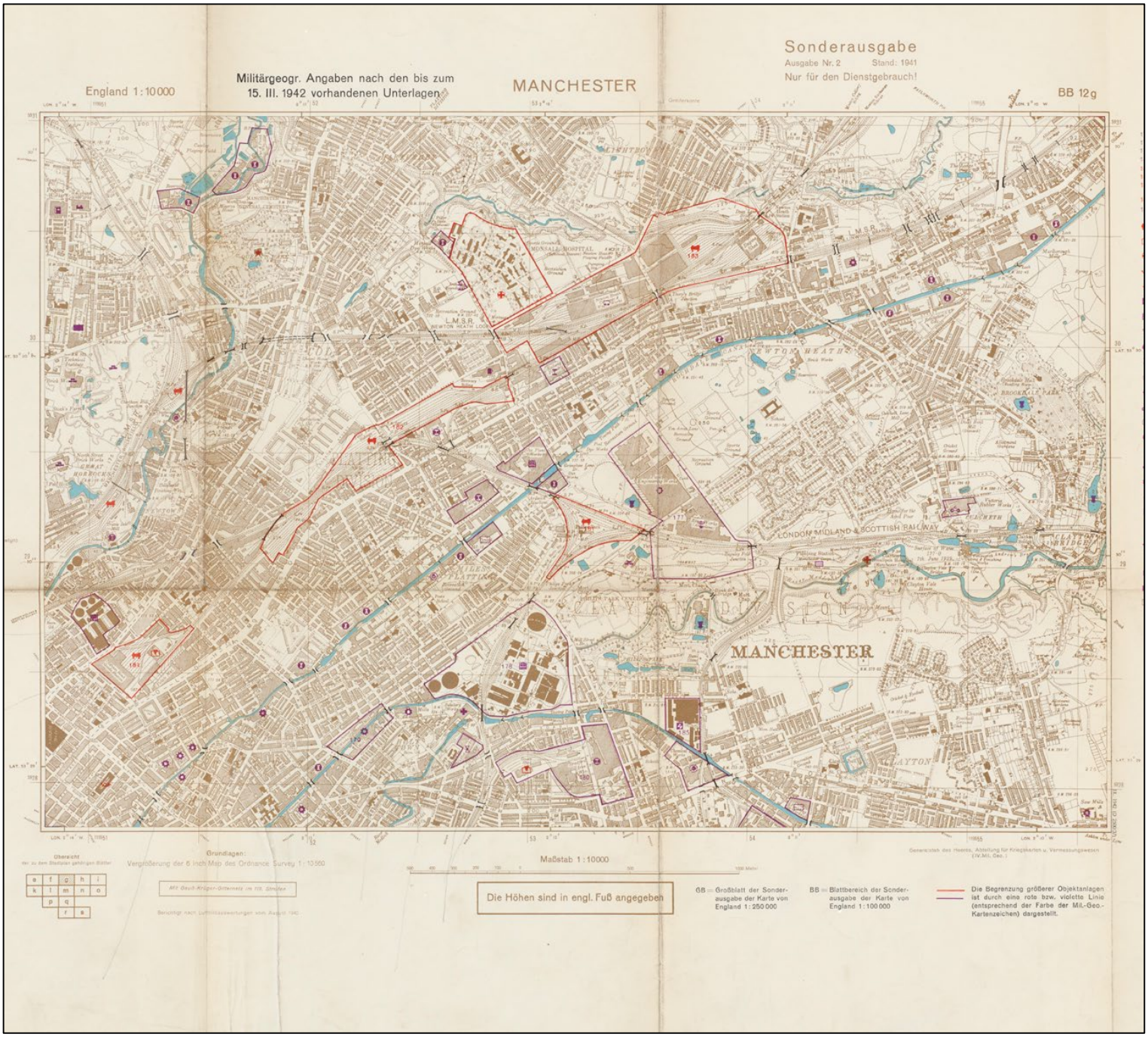
Project: Manchester One

Ref: DA21095-00

Source: J. Morris, German Air Raids on Britain

N

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



The site is located approximately 1km south-west of this map.

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: NX Consulting Ltd

Project: Manchester One

Ref: DA21095-00

Source: https://www.flickr.com/photos/manchesterarchiveplus/9602565382/in/photostream/

N

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

Project: Manchester One

Ref: DA21095-00

Source: The University of Manchester Library

Approximate site boundary

N

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

SUMMARY OF INCIDENTS OCCURRING ON THE 'A' DIVISION ON THE NIGHT OF 22 & 23 DECEMBER 1940

34. PORTLAND ST; SACKVILLE ST; SILVER ST
Incendiary bombs 7.50 p.m. 22nd. Major incident. Several warehouses gutted. Incident still open [29/12/40]. Under military control.

66. SACKVILLE ST & MOUNT ST, C-ON-M
Incendiary bombs at 9.10 p.m. 22nd. Warehouse property damaged by fire. Ivy Mills, Sackville St, extensively damaged. Gutted. Fires extinguished by fire brigade and incident closed.

INCIDENTS ARISING FROM ENEMY AIR RAID ON 23RD/24TH DECEMBER 1940

33. SILVER ST, CHORLTON ST [SEE NOS 37,38, 39]
H.E. dropped 11.00 p.m. Large fire resulted. Eight walking casualties reported. Incident still open.

37. MAJOR ST – CHORLTON ST, MAJOR ST – .
38. SACKVILLE ST, BLOOM ST – PRINCESS ST
39. Shower of incendiary bombs 11.45 p.m. causing many destructive fires and linking up with No. 33. No. 39 misreported. Incident still open.

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.
www.1stlinedefence.co.uk



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: NX Consulting Ltd

Approximate site boundary

Project: Manchester One

N

Ref: DA21095-00

Source: National Monuments Record Office (Historic England)

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

Approximate site boundary

Project: Manchester One

N

Ref: DA21095-00

Source: National Monuments Record Office (Historic England)

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

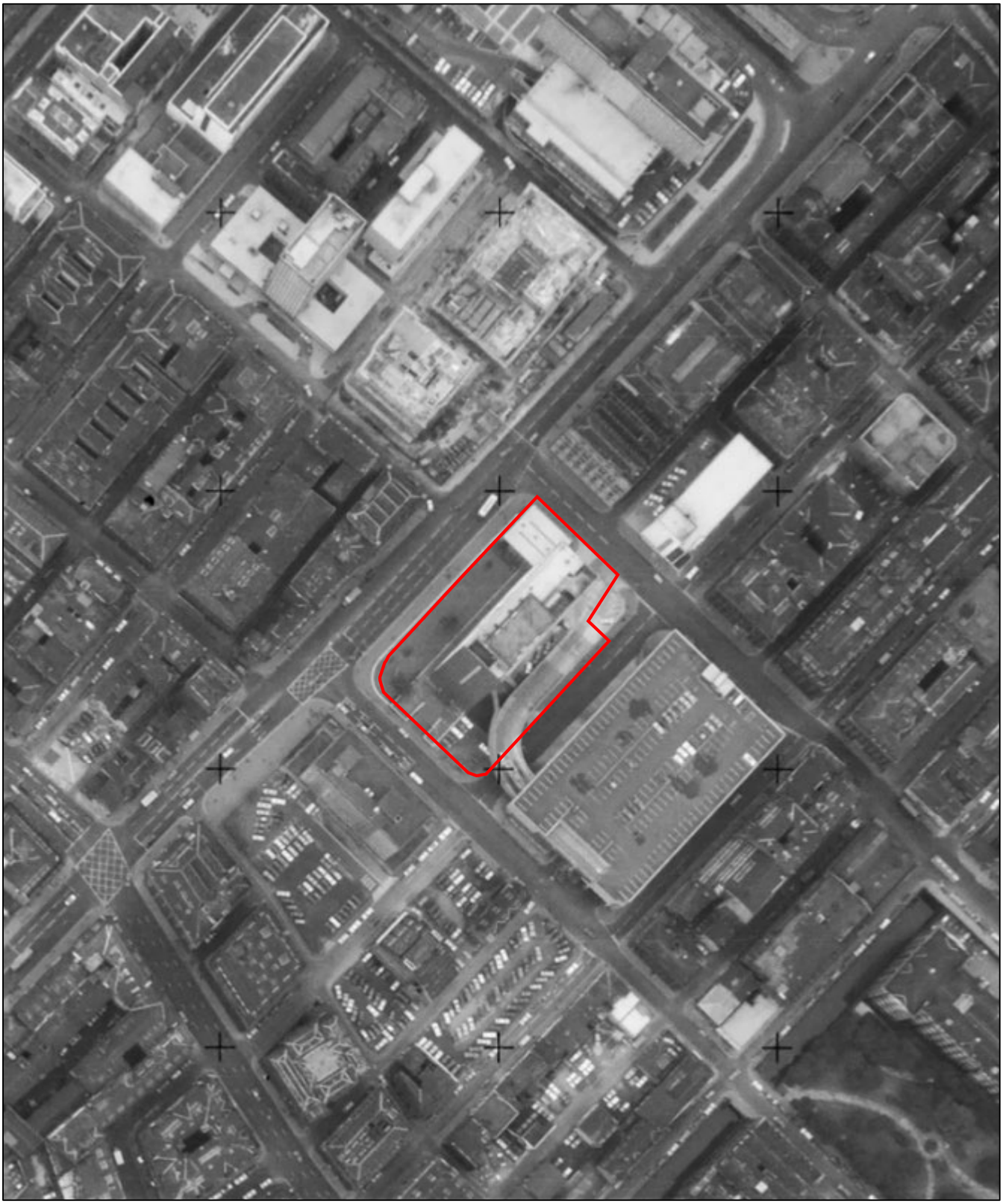
Approximate site boundary

Project: Manchester One

Ref: DA21095-00

Source: National Monuments Record Office (Historic England)

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.



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: NX Consulting Ltd

Approximate site boundary

Project: Manchester One

N

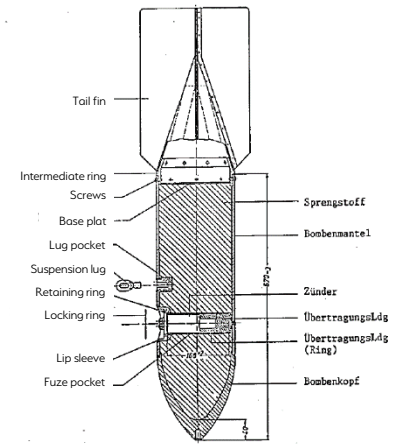
Ref: DA21095-00

Source: National Monuments Record Office (Historic England)

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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.

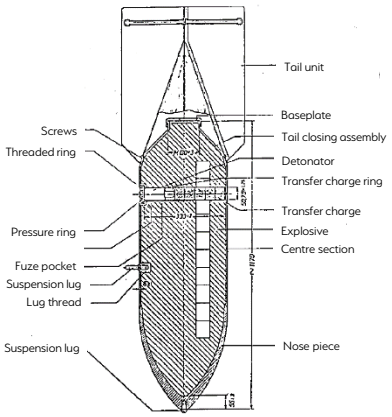






SC 250kg High Explosive Bomb

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).

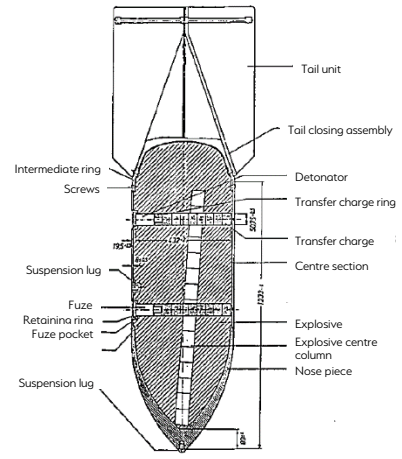




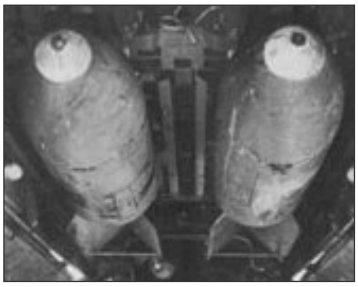


SC 500kg High Explosive Bomb

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.



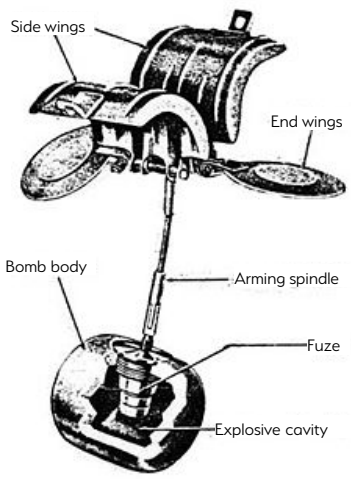




Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

SD2 Anti-Personnel 'Butterfly Bomb'

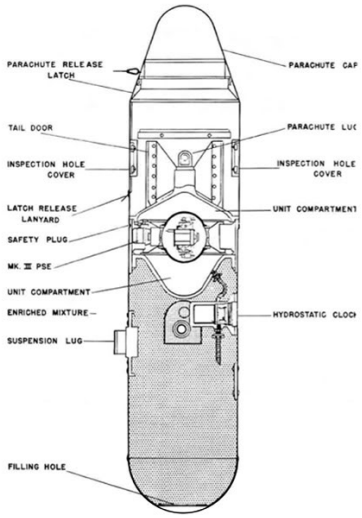
Bomb Weight	Approx. 2kg (4.41lb)
Explosive Weight	Approx. 7.5oz (225 grams) of Amatol surrounded by a layer of bituminous composition.
Fuze Type	41 fuze (time) , 67 fuze (clockwork time delay) or 70 fuze (anti-handling device)
Body Diameter	3in (7.62 cm) diameter, 3.1in (7.874) long
Use	Designed as an 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.

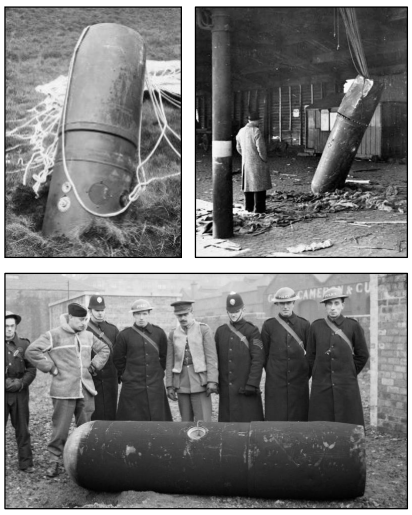




Parachute Mine (Luftmine B / LMB)

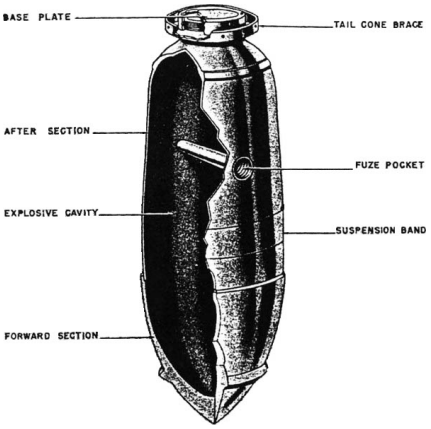
Bomb Weight	Approx. 990kg (2176lb)
Explosive Weight	Approx. 705kg (1,554lb)
Fuze Type	Impact/time delay/hydrostatic pressure fuze
Dimensions	2.64m x 0.64m (3.04m with parachute housing)
Use	Against civilian, military and industrial targets. Used as blast bombs and designed to detonate above ground level 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.





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: NX Consulting Ltd

Project: Manchester One

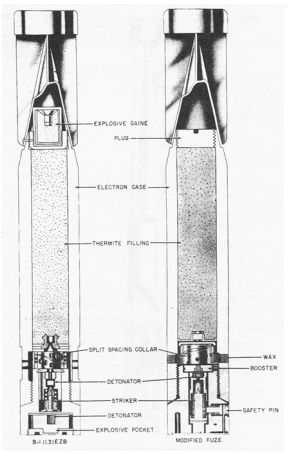
Ref: DA21095-00

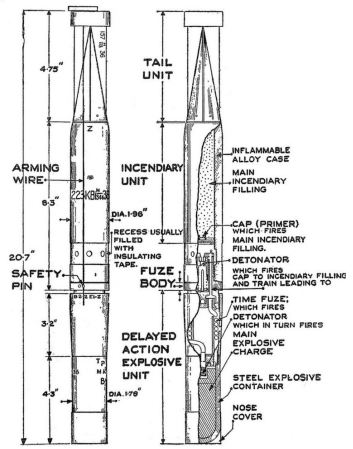
Source: Various sources

Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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.

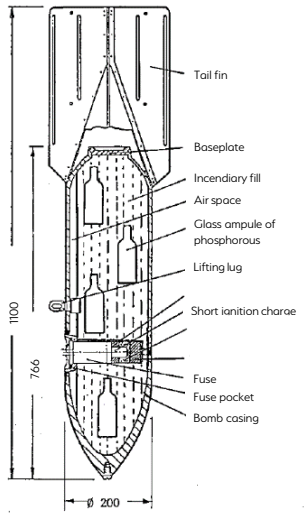


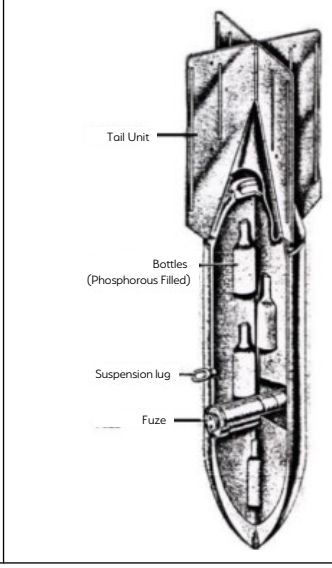




C50 A Incendiary Bomb

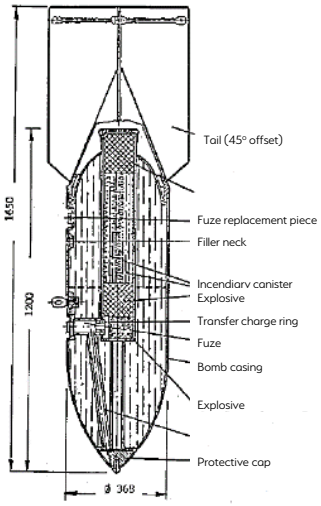
Bomb Weight	Approx. 41kg (90.4lb)
Explosive Weight	Approx. 0.03kg (0.066lb)
Incendiary Filling	12kg (25.5lb) liquid filling with phosphor igniters in glass phials. Benzine 85%; Phosphorus 4%; Pure Rubber 10%
Fuze Type	Electrical impact fuze
Bomb Dimensions	1,100 x 280mm (43.2 x 8in)
Use	Against any targets 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.





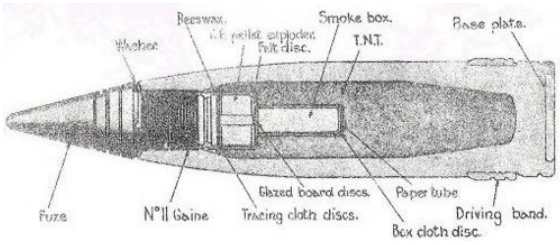
Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

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





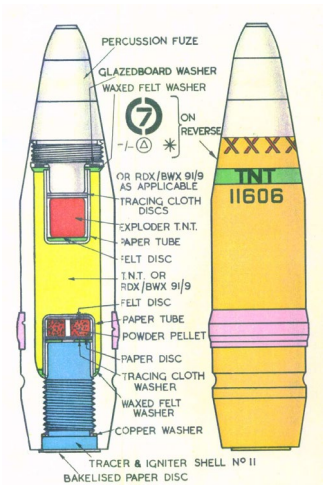


40mm Bofors Projectile

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.



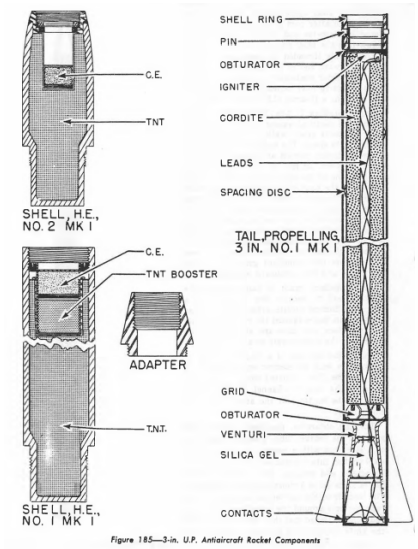




3in Unrotated Projectile (UP) Anti-Aircraft Rocket ("Z" Battery)

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.





Produced by and Copyright to 1st Line Defence® Ltd. Registered in England and Wales with CRN: 7717863. VAT No: 128 8833 79.

1st Line Defence

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

Call +44 (0) 1992 245 020
Email info@1stlinedefence.co.uk
Web www.1stlinedefence.co.uk



Front cover image credit: London Bomb Census Mapping, The National Archives (HO 193)