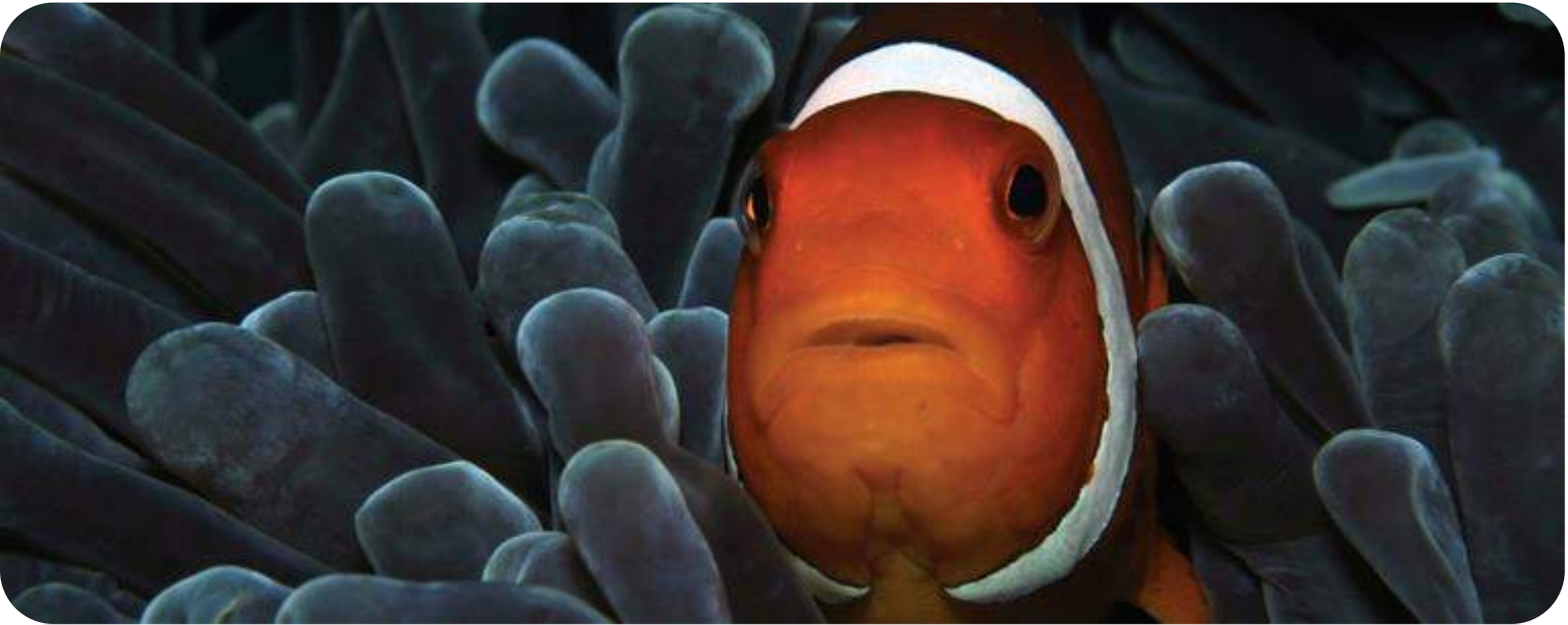




EXPLOSIVE ORDNANCE (EO) THREAT ASSESSMENT (EOTA)

Trinity Island, Manchester, M3 4JW

This assessment draws together all the available information with regards to the site of concern regarding the potential for encountering Explosive Ordnance (EO) Contamination. It assigns an Explosive Ordnance Threat Level and proposes options that may form part of an EO Threat Management Strategy to reduce any potential risks that may arise from an EO encounter - It does not detail that strategy, which depends on several factors and should be developed subsequently.

This assessment has been produced in compliance with the Construction Industry Research and Information Association guidelines (Report CIRIA 681, dated Dec 08) for the preparation of detailed Risk Assessments in the management of Unexploded Ordnance (UXO) risks in the construction industry, for which PLANIT was an instrumental driver for improved EO risk management and transparency.

HIGHEST EO/UXO THREAT LEVEL - HIGH



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GLOSSARY OF TERMS

AAA	Anti-Aircraft Ammunition
AP	Anti-Personnel/Armour Piercing (weapon)
ARP	Air-Raid Precautions
BD	Bomb Disposal
BDO	Bomb Disposal Officer
BD Section	Bomb Disposal Section
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
EOTA	Explosive Ordnance Threat Assessment
HE	High Explosive
IB	Incendiary Bomb
LSA	Land Service Ammunition
Luftwaffe	German Air Force
MoD	Ministry of Defence
RA	Royal Arsenal
SAA	Small Arms Ammunition
SI	Site Investigation
UXAAA	Unexploded Anti-Aircraft Artillery [projectile]
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V-1	'Doodlebug' – self-propelled, ground to ground missile deployed against Britain from July 1944. V – "Vergeltungswaffe" (Vengeance)
V-2	Long Range Rocket (first ballistic missile used against London from Sep 1944)
WWI	First World War 1914 – 1918 (The Great War)
WWII	Second World War 1939 - 1945

Client References:

1. Z1-SHP-G100-SK-B1-0001 - Mark Up.

EXECUTIVE SUMMARY

SITE DESCRIPTION	The site is known as Trinity Island, Manchester, M3 4JW. The National Grid Reference (NGR) for the approximate centre of the site is SJ 827 978. The Site totals approx. 1.78ha.
POTENTIAL THREAT SOURCE	<i>If an Explosive Ordnance (EO)-related threat exists</i>, the following threat items that may reasonably be considered potentially present within WW2 ground volumes across the site: • German, large, air-dropped, 50-500kg HE Bombs. • British AAA.
CIRIA 681: 'EO THREAT' v 'UXO RISK'	This assessment has been produced in accordance with the relevant CIRIA guidelines; Unexploded Ordnance (UXO) - A Guide for the Construction Industry C681 (published in 2009). CIRIA 681, for the preparation of detailed Risk Assessments in the management of UXO risks in the construction industry, has several limitations. Firstly, CIRIA 681 is <i>specific</i> to WW1 and WW2 UXBs and is not written with the assessment of other Explosive Ordnance (EO)-related articles in mind, which make up most EO-related articles discovered and must be considered in this context. Secondly, it speaks of UXO because of its narrow remit of WW1 and WW2 air-dropped bombs which remain in the ground unexploded because of enemy action. In most contexts, it would be more correct to refer to EO, since UXO is a sub-group of EO and not all EO is UXO, although <i>all</i> UXO is EO. Finally, CIRIA 681 has not been updated since its publication in 2009 and is outdated in terms of current legislation, such as the CDM Regs 2015 and the Explosives Regulations 2014. As such, users of CIRIA 681 must seek up to date advice from appropriately qualified persons where clarification may be required. This assessment is a <i>threat assessment</i> to measure the <i>likelihood</i> of an EO-related encounter. It is not a <i>risk assessment</i> in that the actual risks that an item of EO may present cannot be known until it is positively identified and assessed. If items of EO are identified, a risk assessment must then be undertaken to determine the best course of action to mitigate that risk. EO Threat assessments and subsequent risk assessment should only be undertaken by a qualified and competent person with relevant experience.
THREAT PATHWAY	For the purposes of this assessment, it has been assumed that site investigation and development works would include energetic intrusive engineering into WW2 ground volumes. It is anticipated that personnel or key equipment may complete the risk pathway during excavation and/or piling operations that may bring them into physical contact with potential threat items.
KEY FINDINGS	• The potential for a WW1 UXBs encounter is considered extremely unlikely and is discounted. • The site sits in an area that is known to have been seriously affected by air-dropped bombs, and we know that the Site was directly affected. • There has been significant development post-War, which would have gone some way to mitigate the potential for an unplanned UXO encounter, especially from UXO reasonably anticipated to be encountered at the surface or at very shallow depths such as small incendiary or anti-personnel bombs.

	- Given its Wartime role, the site area was not likely to have been used for military training (although this is not easily known) so <i>ad hoc</i> EO contamination from this source may be reasonably discounted, as can the potential for EO contamination because of storage/ manufacture. - The possibility that British AAA projectiles fell back to earth and remain as potential threat items today can rarely be entirely ruled out but is very unlikely in any case. - The estimated maximum BPD for a 500kg bomb (the benchmark) is 9.0m bgl and the estimated maximum offset is 3.3m bgl.																													
THREAT LEVEL	WW2 ground volumes that have been subjected to significant post-War intrusive engineering such as excavation may be considered free from the potential of UXB encounter. WW2 Ground Volumes that have been subjected to historic piling may be considered at a lower general threat level but the potential for UXB encounter <i>cannot be entirely ruled out</i>. The same cannot be said for the remainder of the site. The Ordnance Threat Levels for the Site as they relate to various energetic activities are assessed as: <table><tr><th rowspan="2">Ordnance Type</th><th colspan="4">Engineering Activity</th><th></th></tr><tr><th>No Excavations, no energetic engineering, Controlled Public Access</th><th>Shallow Excavations by hand/ Uncontrolled Public Access</th><th>Shallow Excavations by machine/ Controlled Public Access</th><th>Deep Excavations > 1mbgl, Energetic compaction/ rolling</th><th>Boreholes/ Piling</th></tr><tr><th colspan="6">Ordnance Threat Level</th></tr><tr><td>British AAA</td><td>NEGLIGIBLE</td><td>NEGLIGIBLE</td><td>LOW</td><td>LOW</td><td>LOW</td></tr><tr><td>Bomb 50-500kg HE</td><td>LOW</td><td>MEDIUM</td><td>MEDIUM</td><td>HIGH</td><td>HIGH</td></tr></table>	Ordnance Type	Engineering Activity					No Excavations, no energetic engineering, Controlled Public Access	Shallow Excavations by hand/ Uncontrolled Public Access	Shallow Excavations by machine/ Controlled Public Access	Deep Excavations > 1mbgl, Energetic compaction/ rolling	Boreholes/ Piling	Ordnance Threat Level						British AAA	NEGLIGIBLE	NEGLIGIBLE	LOW	LOW	LOW	Bomb 50-500kg HE	LOW	MEDIUM	MEDIUM	HIGH	HIGH
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THREAT MITIGATION	An Explosive Ordnance (EO) threat management strategy IS REQUIRED prior to intrusive engineering works.																													
THREAT REVIEW	A review of these recommendations must be undertaken considering any additional, relevant information being provided, especially with regards to the site geology and the intended intrusive engineering. Such a review may, if the EO Threat Level is deemed to have altered, make alternative recommendations from those made in this assessment and any subsequently developed threat mitigation strategy to implement work safely.																													
AIM & METHODOLOGY	The aim of this assessment is to identify any potential threats that may be posed by EO during the proposed engineering works at the site of concern and, where a threat is identified, to recommend threat mitigation options that can be developed into a Threat Mitigation Strategy that will reduce this threat to acceptable levels i.e. As Low As Reasonably Possible (ALARP). This assessment relies on the Source-Pathway-Receptor-Consequence (SPRC) risk model and the following key considerations are assessed when evaluating EO Threat levels: - The likelihood that the site of concern was contaminated by EO, considering: - Historical use of the site in relation to ordnance manufacturing, storage and disposal.																													

	○ Historical use of the site in relation to Military training and related activities. ○ Evidence of offensive aerial and/ or naval bombardment during armed conflict. • The likelihood that EO may be encountered during proposed engineering works. ○ Evidence of Unexploded Bombs (UXBs). ○ Previous EO incidents and/or EO survey/clearance activities. ○ Extent of post-war redevelopment. ○ Extent and effectiveness of post-War EO Survey/ Clearance operations. • The likelihood and consequences of encountering and/or initiating EO during the proposed engineering works. PLANIT UXB Limited’s approach to EO threat assessment has been fundamental in driving change throughout the UK Commercial Explosive Ordnance Disposal (EOD) Industry and was instrumental in the drafting of CIRIA 681. If the likelihood of encountering EO is significant, information about the nature of that EO and the expected levels of contamination is considered within the source-pathway-receptor context of contamination. Our approach provides transparency to our EO threat assessment process allowing the Client to make valid decisions on what is a specialist activity; empowering them to maintain control over this vital aspect of their project. Should a confirmed pathway exist, the information is processed through our proprietary Threat Assessment Model to arrive at a valid and transparent Threat Level, which allows relevant conclusions to be made about the EO Threat at the site of concern and aid the development of an appropriate Threat Mitigation Strategy if required.
RELIABILITY OF HISTORICAL RECORDS	This assessment is drawn from detailed research into the available historical evidence. Every effort is made to gather all the relevant material; however, PLANIT cannot be held responsible for any changes to the assessed level of risk or proposed risk mitigation strategies due to subsequent information that may come to light later. The accuracy and detail of wartime historical records is difficult to verify, not least of which is due to the conditions under which much of this information was gathered and recorded. Additionally, recording of information was less formalised in the early days of the German air campaign against the UK mainland (Pre-Bomb Census Record) and much information recorded early on was lost during subsequent air raids. Records for rural, sparsely populated areas are not always reliable, being based on second-hand information in many cases; records of attacks on military installations were often recorded independently from general records and many such archives have been lost or remain undisclosed to the public. Consequently, the exact location, quantity, and nature of the EO threat cannot be definitive but rather remains subjective and is based on the careful analysis by experts of the available information. PLANIT cannot accept liability for any gaps in the historical record.

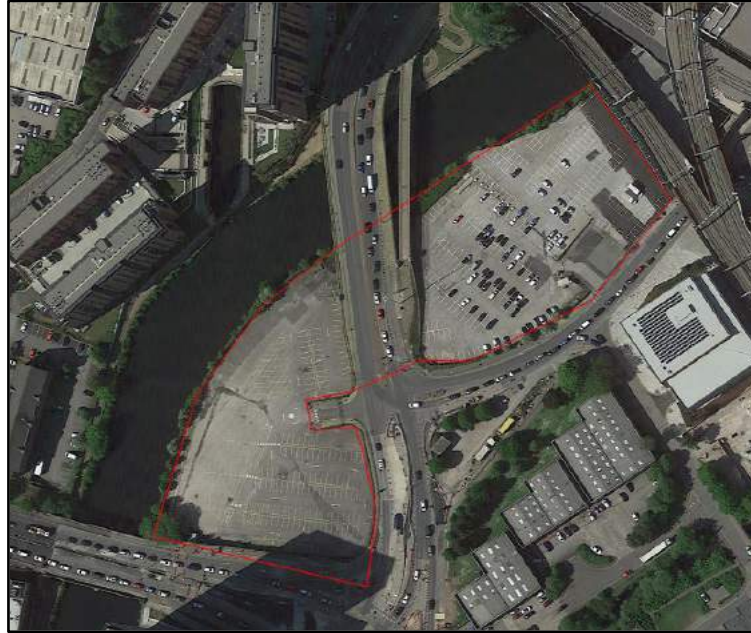
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SITE LOCATION & DESCRIPTION

SITE OF CONCERN

The site is known as **Trinity Island, Manchester, M3 4JW**. The National Grid Reference (NGR) for the approximate centre of the site is **SJ 827 978**.



The Site lies immediately adjacent and east of River Irwell, bisected by the A6042. Regent Road forms the southern boundary and the railway line running east to west forms that to the north. The Site is entirely developed being turned over to car parking, entirely covered with hard-standing (concrete).

The Site totals approx 1.78 ha.

GEOLOGICAL ENVIRONMENT

Information on the site-specific geological environment is not available at the time of writing of this assessment. However, historic BH logs are available for sites in proximity to the site of concern. These BH records show the general geology to be on average:

Geology	Depth
Made Ground	2m
Sand	2-2.5m
Sandy Clay	2.5-5m
Weathered Sandstone	5.5m

REVIEW OF RELEVANT DATASETS

SOURCES OF INFORMATION	PLANIT ensures that Explosive Ordnance Threat Assessments (EOTAs) are as comprehensive as possible and detailed research is undertaken to collate all the available EO-related information that relates to the site of concern. Information sources may include, but are not restricted to: • National Historic Archives. • Local Authority & Council Archives. • English Heritage National Monuments Record. • PLANITs extensive archives drawn from many years of detailed research and operational experience of EO Risk Management activities in the UK and abroad. • Joint Service EOD Centre (JSEOD). • Historic Mapping and Aerial Photography. • Related documents such as military bombing and casualty records. • Local libraries and history groups. • Open sources such as published books and internet searches. • Anecdotal evidence from eyewitnesses.
SITE HISTORY	Pre-WW2, the site was well developed and occupied by multi-storey buildings and vehicle access off Water Street. The complex occupying the site is labelled a '<i>Cleansing Depot</i>'. The 1956 map record (the next available) shows one distinct area which have been cleared of built structures, likely because of bomb damage. By no later than 1988, a new built structures appears in the centre of the Site and the built structures in the north of the Site have been cleared for a Car Park. By 1994, the Site has been entirely cleared of built structures and is dedicated to car parking from this time to the present day.
EO MANUFACTURE & STORAGE	During WW1 and WW2, Lincolnshire housed several facilities involved in the manufacture, storage, filling, and testing ordnance. The nearest explosive manufacturing sites (known as His Majesty's Explosive Filling Factories (HMEFs)) were: • Trafford Park (HMEF). • Hyde Road, Gorton, Manchester (National Shell Factory – manufacturing 4.5" shell (projectile) casings). The nearest Royal Ordnance Facilities (ROFs) established in the run up to WW2 were: • ROF Chorley. • ROF Radway Green. None of these sites would have posed a potential threat to the site of concern.
MILITARY HISTORY	There is no evidence to indicate that the site was ever used for military purposes.
CIVIL DEFENCE	Anti-Aircraft Artillery (AAA) Batteries. The Luftwaffe targeted AAA batteries. They were also a source of unexploded AA shells which could land a great distance from the firing point during WWII, although typically fell within 15km and could be distributed over a wide area. AAA batteries present a potential source of UXO hazard because of the storage, use and disposal of ordnance associated with the armaments used. They may have a risk from small caches of ammunition buried locally to them. Three types of AAA batteries existed:

	• Heavy Anti-Aircraft (HAA) batteries of large guns designed to engage high flying bomber aircraft. These tended to be relatively permanent gun emplacements. • Light Anti-Aircraft (LAA) weaponry designed to counter low flying aircraft. These were often mobile and were moved periodically to new locations around strategic targets such as airfields. • Rocket batteries (ZAA) firing 3" or 3.7" AA rockets with a maximum altitude of 5,800m and a ground range of 9km were also relatively permanent emplacements. Many AAA batteries were associated with searchlights and consequently 'visible' at night, providing clear targets to the Luftwaffe bombers and a potential for UXB. Manchester possessed a peak of 56 Heavy Anti-Aircraft (AA) Batteries during WW2, including 4.5, 3.7 and 3-inch AA guns. None of these were sited on or near to the site of concern to have created a direct source of potential ordnance contamination. Decoy Sites. To draw enemy aircraft away from towns and other strategically important targets, a series of decoys were developed between 1940 and 1941. They were estimated to have drawn at least 5% of the total weight of bombs away from their intended targets. Almost 800 static decoy sites were built at around 600 locations in England and numerous temporary and mobile decoys were also deployed. Several different types of decoy were devised: • Night-time dummy airfields (Q sites). • Daytime dummy airfields (K sites). • Diversionary fires to simulate successful bombing raids on airfields (QF sites), petroleum depots (P sites) and major towns and cities (Starfish or SF sites). • Simulated urban lighting (QL sites). • Dummy Heavy Anti-Aircraft (HAA) batteries, factories, and buildings (C series). • Mobile decoys representing 'hards' for troop embarkation (MQLs), tanks and other vehicles. As would be expected Manchester had several Civil Defence ('Starfish') sites designed to protect the city from aerial attack. The London's Starfish Sites were located at: • Chat Moss. • Tatton Park. • Park Moor (now in Lyme Park Country Park). • Churnal Moor. • Mossley. • Carrington Moss. • Ludworth Moor. • Reddish. • Elkstone (north Staffordshire). None of these sites would indicate the possibility that erroneous Luftwaffe bombing would have produced a consequent UXO risk on the site of concern.
WW1	Greater Manchester suffered two aerial bombardments during WW1; on 26 Sep 1916 Zeppelin L21 dropped 20 HE bombs on Bolton, mistaking the town for Derby. Significant damage was caused, and 13 people were killed. On 12 Apr 1918 Zeppelin L61 bombed Wigan at 2300hrs in a raid that lasted some 12 minutes. Three people were killed and a further nine were injured during the raid. Neither of these raids would have affected the Site of concern and therefore the risk from WW1 unexploded ordnance is negligible.
	During WWII, the site sat close to several industrial and strategic installations key to the war effort that were in the area – including Mills, Quarries and Railway infrastructure. Luftwaffe target maps do not list specific

WW2 – GERMAN AERIAL BOMBING CAMPAIGN

locations on or close to the site although the concept of specific targets, when bombing in and around Manchester, was only relevant prior to the accidental Luftwaffe raid on London on 24th Aug 1940. This attack broke the unofficial agreement not to bomb opposing capitals and led to the gradual breakdown of the Amsterdam draft international rules prohibiting the attacking of civilian infrastructure outside of combat zones (purely industrial areas); Great Britain, including Manchester, was now opened to air attacks. As well as the air raids targeting Manchester itself, unused bombs were routinely jettisoned whilst returning to base following an unsuccessful raid. In addition, the high-altitude area bombing during this period was notoriously inaccurate with areas surrounding specific targets suffering during attacks on the targets themselves.

The site in question sits to the western edge of the main areas within Manchester that were targeted, mostly during the 'Manchester Blitz' of 22-24 Dec, 1940 - Salford Docks, Manchester's industrial centre and Trafford Park (with the areas surrounding them also being affected by the same air raids). Many Manchester companies were involved in war production work including the Fairey Aviation plant at Ringway, the Ferranti factory at Hollingwood, Metropolitan Vickers works at Trafford Park and the A.V. Roe (Avro) plant at Chadderton. In

addition, Ford operated a factory in Eccles building Rolls Royce Merlin engines for the Lancaster bomber and the Mosquito fighter bomber.

The Luftwaffe mounted consecutive heavy attacks on the Manchester area on the nights of 22/23rd and 23/24th Dec 1940. Large areas of Manchester, Salford and Stretford were devastated, killing some 684 people and injuring a further 2,364. The first raid of this 'Manchester Blitz' saw 272 tons of HE bombs and 1,023 canisters of Incendiary Bombs (IBs) dropped. During the second raid, 171 aircraft dropped a further 195 tons of HE bombs and 893 canisters of IBs.

The site is in Region 10 (Manchester) for Civil Defence purposes. Manchester received some 3,465 Tonnes of HE bombs throughout the war although Cheshire and Chester were much less affected:

Ordnance Type	Number of Bombs		
	Region 10	Cheshire	Chester Rural District
50Kg HE	1403 (79)* + 576 (1)**	594 (25)	1
250Kg HE	727 (49) + 368	301 (19)	13
500Kg HE	114 (7) + 57 (3)	58 (6)	10 (1)
1000Kg HE	2 (2) + 6	1 (1)	
Parachute Mine	514 (77) + 592	139 (16)	
V1 'Doodlebug'	14	6	1
V2 Long Range Rocket	0		
Small Incendiary Bombs	25 454	3 639	
50Kg Phosphorus Bomb	Unknown		
Fire Pots	Unknown		
Oil Bomb	212 (4) + 202	48 (1)	
Containers	Unknown		
Unclassified Ordnance	8 114 (1 341) + 10 658	2 806 (524)	

The bombs recorded as falling on the County Borough of Manchester are summarised below:

Area Acreage	27,255
High explosive Bombs (All Types)	712
Parachute Mines	18
Oil Bombs	7
Phosphorus Bombs	-
V1 'Doodlebug'	1
Total	738
Items per 1000 acres	27.1

UNEXPLODED BOMBS (UXBs)	Between 1940 and 1945, Bomb Disposal (BD) Teams cleared over 50,000 items of German air-dropped ordnance of 50Kg or larger, 7 000 anti-aircraft artillery (AAA) projectiles and more than 30 000 beach mines – This work claimed the lives of 394 Officer's and men. The War Office at the time stated that over 200 000 HE bombs exploded in Britain during WW2 with some 25, 195 remaining a threat as UXBs i.e., 11%. Some 93% of all UXBs were 50Kg HE and 250Kg HE aerial bombs. No UXBs are recorded on the site.
ABANDONED BOMBS	A post-air raid search of damaged buildings and facilities would have included a specific search for bomb entry holes. If such evidence was discovered, then BD Teams would have been tasked (in order of strict priority from Category A, the highest priority, to category D, the lowest) to assess the potential UXB and to recommend a course of action. UXO that was deemed to be a high enough priority, were tackled by the BD Teams who made strenuous efforts to recover and dispose of these items. However, it was not always possible to recover such items either through physical constraints, a lack of resources or a change in priority. Such UXO (mostly UXBs) were noted as 'Abandoned'. Due to the low priority of abandoned bombs, records that detail them are sketchy and sometimes contradictory. Others were subsequently recovered after the War when time and resources permitted, and others remain <i>abandoned</i>. It is worth remembering that 'abandoned' bombs may also include suspected UXBs that were reported but not confirmed, but simply efforts to locate the 'bomb' were exhausted. No Abandoned Bombs are recorded on the site of concern.
BOMB CENSUS INFORMATION	Bomb maps from the period do not record HE bombs detonating within the site because of aerial bombardment from Zeppelins and/or airplanes during WW1. Manchester's Bomb Damage Maps are comprehensive and at least eight (8) HE bombs are recorded detonating within the Site boundary with bomb damage recorded in the south-east corner of the site as a result.
HISTORICAL STREET MAPS	Historical street plans of the period are a useful indicator of whether an area may have suffered bomb damage. The street layout prior to WW2 is the start state and major changes to street layout or building boundaries may indicate that the change was due to bomb damage. In this instance, the map record shows significant changes to the Site, which are likely a result of WW2 bomb damage.
HISTORICAL AERIAL PHOTOGRAPHY	The same rational applies with historic aerial photography as it does when we examine historical street plans – changes between pre-war and post-war images may indicate the possibility of damage caused by bombs falling on the site. Sometimes, detail is such that it allows bomb damage to be seen directly on sites of concern. Unfortunately, in this instance, post-War aerial photography is not currently unavailable so no meaningful analysis can be done.

THREAT ANALYSIS

IS THERE EVIDENCE THAT THE SITE WAS LIKELY AFFECTED BY LARGE, AIR-DROPPED HIGH EXPLOSIVE BOMBS?	Yes. Bomb Census/ Map information is known to be incomplete and of varying accuracy which is unsurprising considering the conditions under which this information was recorded. However, there is excellent evidence to show that the Site was affected by large air-dropped bombs during WW2. Of all the large bombs that were recorded as falling in Group 10 shows a typical bomb mix (where 50 and 250kg HE bombs usually predominate with the 50kg bomb accounting for most of the bombs dropped. UXBs may potentially remain in an area that has experienced aerial bombardment.
IS THERE EVIDENCE THAT THE SITE WAS LIKELY AFFECTED BY ANY OTHER EXPLOSIVE ORDNANCE CONTAMINATION EVENTS?	Possibly, though very unlikely. The potential for British AAA falling back to earth as UXO and remaining on the site undiscovered can rarely be entirely ruled out, especially in areas that have suffered extensive bomb damage although it is very unlikely in any event. The potential for <i>ad hoc</i> military activity to have generated explosive ordnance contamination at any site is generally unquantifiable but cannot be reasonably entirely ruled out in this instance given the history of the site. No other EO contamination events are known to potentially impact on the site.
IF ENCOUNTERED, WHAT ORDNANCE TYPES ARE ANTICIPATED?	<i>If a UXO-related threat exists</i>, the following threat items that may reasonably be considered potentially present within WW2 ground volumes across the site would be: • German, air-dropped, 50-500kg HE Bombs. • British AAA.
WHAT IS THE EXPLOSIVE ORDNANCE / UXB ENCOUNTER DEPTH?	Ministry of Homeland Defence Security Bomb Penetration Studies. A major study was completed by the Ministry of Homeland Security during WW2, during which the penetration depths of 1, 328 air-dropped bombs (as reported by the BD Sections of the day and mostly in the Birmingham area) were recorded. It was concluded, not surprisingly, that the penetration depths of different sized bombs varied according to the geology into which they fell. The average Bomb Penetration Depth (BPD) of 430 x 50Kg HE bombs in London Clay was found to be 4.6m and that for a 250Kg bomb 6.1m. Also, they concluded that a 500Kg bomb, the largest common bomb dropped during the War, had a likely penetration depth of 6m in sand and 8.7m in clay – the maximum observed for a 500Kg was 10.2m and for a 1000Kg bomb was 12.7m. It should be remembered that these depths were achieved unencumbered by obstacles to penetration such as buildings, concrete, and brickwork. The ‘J’ Curve. The ‘J-curve’ describes the path of a bomb (dropped from a normal altitude of about 5 000m) into homogenous ground will continue its line of flight (unless deflected by a substantial obstacle) but then turn upwards towards the surface before it stops. The horizontal distance (the ‘offset’) between the point of entry and final resting position was typically 1/3 of the ultimate penetration depth for a bomb. Therefore, if a bomb fell close to the exterior of a building or site and did not explode, the path that the bomb subsequently travelled beneath the ground, the “J-Curve”, may have delivered it beneath the building or site footprint. The J-curve is often misunderstood and used to describe the path taken by a bomb dropped from low flying aircraft to which it should not be applied.

The final BPD of an air-dropped depends upon several factors; the velocity (as a function of the mass and speed) of the bomb, – PLANIT uses a standard velocity of 267m/s for assessment purposes – the angle of penetration of the bomb, the physical features through which the bomb travelled prior to impact with the ground, and the geology of the ground into which it entered - Generally, the softer the ground, the deeper the expected penetration depth of the bomb. Peat, alluvium, and soft clays are easier to penetrate than gravels and/or sand and water content also plays a part. In addition, it must be remembered that ‘barrier geology’ such as very dense gravels or bedrock i.e., geology dense enough to stop the progress of a bomb underground, is an important factor in determining the median BPD.

Additionally, if a significant degree of *post-War* made ground is present, which is likely in this case, then this must be added to the estimated penetration depth to arrive at a more precise BPD from today’s ground levels. Given the known geological profile, the following UXB/UXO encounter depths and offsets from *WW2 ground levels* are estimated:

Type of Ordnance	Av. BPD (m bgl)	Geology Multiplication Factor	Adjusted Av. BDP (m bgl to 1sf)	Barrier Geology Max. Depth	Potential BPD (m bgl to 1 sf)	Offset (m to 1sf)
British AAA projectiles	2.0	1.0	2.0	na	2.0	0.6
Air-dropped Bombs: 50kg	4.0	1.0	4.0	na	4.0	1.2
Air-dropped Bombs: 250kg	6.0	1.0	6.0	na	6.0	2.0
Air-dropped Bombs: 500kg	9.0	1.0	9.0	na	9.0	3.0
Air-dropped Bombs: 1000kg	11.0	1.0	11.0	na	11.0	3.3

It must be remembered that UXB/UXO on land can be found *at any depth* from WW2 ground level down to their maximum estimated depths.

The estimated maximum BPD for a 500kg bomb (the benchmark) is **9.0m bgl** and the estimated maximum offset is **3.3m bgl**.

HOW COULD AN UNCONTROLLED DETONATION BE BROUGHT ABOUT?

Unexploded Bombs rarely spontaneously explode, although evidence that they sometimes do is growing. High Explosive (HE) requires a great deal of energy to create the necessary conditions for detonation to occur. In the case of WWII German bombs being disturbed during intrusive ground works, there are a few scenarios to be considered:

- **Direct impact onto the main body of the bomb.** Although this is a possibility, there is little chance of generating enough energy to detonate the explosive fill unless the fuse itself is directly struck.
- **Re-starting the mechanical clock-timer in a bomb fuse.** This is a possibility. It is probable that environmental conditions have corroded the fuse sufficiently to prevent clockwork mechanisms from functioning. However, under some conditions, fuse elements will be in a good condition and additional movement of a bomb fuse may be sufficient to restart a previously ‘jammed’ mechanical clockwork mechanism.
- **Induction of a static charge, creating enough current to initiate an electric fuse.** This is an unlikely event. Environmental conditions are likely to have corroded the fuse, degrading its components sufficiently to prevent them from functioning. Any elements of the fuse capable of holding a charge would have dissipated in the time since the bomb failed to function.
- **Friction impact initiating fuse elements causing bombs to detonate.** Although remote, this is the most likely scenario that may result in a bomb detonating. Weathering within the fuse pocket can cause the explosives within the fuse to breakdown, crystallize and exude from the fuse itself. Violent

	physical disturbance of this exuded material carries the remote possibility of initiating the fuse mechanism which in turn will initiate the bomb.												
WHAT WOULD THE EFFECTS OF SUCH A DETONATION BE TO THE SITE?	The effects of WWII German bombs detonating have been the subject of a few well recorded studies. The general effect of an explosive detonation will depend upon: • The size of the bomb and its Net Explosive Quantity (NEQ) (i.e., how much explosive material it contains). • The type of fill in the bomb (i.e., high explosive, incendiary, photoflash). • The physical location of the bomb. Whether it is: ○ On the surface. ○ Partially buried. ○ Buried (A bomb is considered 'buried' when it is more than 2½ times its own length below ground level and covered). • The locations of the bomb in relation to other structures. • The strength and design of structures near to the seat of an explosion. • The nature of the ground (i.e., sand, gravel, clay, marsh etc.). • The location of the bomb in relation to human and animal populations. There would be the potential for ground shock to damage important underground structures including sewers, communication cables, and foundations. The potential Damage Radii to various underground structures has been assessed by extrapolating from the Joint Service Publication 364 which is the MOD Manual for assessing bomb damage. Potential damage radii for underground structures are assessed as: <table border="1"> <thead> <tr> <th>Underground Structure</th><th>Damage Radius (m)</th></tr> </thead> <tbody> <tr> <td>Brick Walls</td><td>30</td></tr> <tr> <td>Foundations</td><td>60</td></tr> <tr> <td>Cast Iron/ Concrete Pipes</td><td>15</td></tr> <tr> <td>Earthenware/ brick Sewers</td><td>25</td></tr> <tr> <td>Electric Cables/ Steel Pipes</td><td>12</td></tr> </tbody> </table>	Underground Structure	Damage Radius (m)	Brick Walls	30	Foundations	60	Cast Iron/ Concrete Pipes	15	Earthenware/ brick Sewers	25	Electric Cables/ Steel Pipes	12
Underground Structure	Damage Radius (m)												
Brick Walls	30												
Foundations	60												
Cast Iron/ Concrete Pipes	15												
Earthenware/ brick Sewers	25												
Electric Cables/ Steel Pipes	12												
WOULD THE SITE CONDITIONS AFFECT THE BOMB FAILURE RATE?	There is no evidence to suggest that bomb failure rate at the site of concern would have been any different from that routinely experienced, i.e., 10-15% of all bombs dropped .												
WOULD UXBs HAVE BEEN DISCOVERED DURING WW2?	Density of Bombing. Manchester received a high density of bombing in WW2, and the site sits within the focus of those aerial attacks. We know that the site layout changed between the start of the War and the end, likely because of aerial bombing. We also know that the Site was directly affected, which would have made data gathering at the time more complicated and the likelihood of overlooking UXBs higher. In addition, UXBs could have landed on the site and gone unnoticed amongst the debris, especially given the diminutive size of bomb entry holes. Frequency of Access. Since the site was occupied and used at the time of the air raids, the site of concern would have been subject to post-air raid survey and clearance. Post-raid survey activities would have been as thorough as possible. This would have made the likelihood of identifying smaller items of EO (such as Incendiaries and AP bomblets) quite high whilst larger UXBs would have been more readily identified.												

	Ground Cover. The site was developed at the time of the attacks and as such its physical characteristics would likely have acted to retard the progress of UXBs underground by reducing their overall velocity prior to impact. However, bomb penetration statistics were collected at the time in similar conditions and therefore the maximum potential bomb penetration depths must be considered as the 'worst case'. This is also true of bombs falling into water. Peripheral Bomb Damage. Given the degree of bomb damage inflicted on the Site, the possibility of post-air raid operations failing to identify UXB entry holes is likely.
DOES THE SITE'S DEVELOPMENT HISTORY AFFECT THE POTENTIAL FOR UXO ENCOUNTER?	Yes. The fact that the Site has undergone post-War development, especially in the centre of the Site, is significant. Any intrusive engineering over the years involving earth moving/ excavation would likely have encountered shallow EO contamination at the time, which would have been dealt with. Ground volumes that have been thoroughly excavated post-War may be considered free of potential threat items. The same cannot automatically be said for ground volumes that have been piled post-War. In post-War piled areas, the number and interval of piles may reduce the potential for an EO encounter, but it cannot be reasonably ruled out since the possibility that historic piles have either missed buried EO by chance or simply pushed them aside without detonation cannot be entirely discounted. In areas where redevelopment has not been significant, the potential for EO encounter remains as it did immediately Post-War. It is worth noting that historical development either immediately post-War or in the 1960/ 70 and 80s would not have taken any account of the potential for UXBs at the site of concern nor would any effective technology be available to detect such potential threat items. Modern structures tend to have foundation designs that go deeper than historic buildings and risk encountering UXBs at depths beyond existing historic foundation levels that were not detected by excavation or bomb survey.
DOES THE UXO THREAT VARY ACROSS THE SITE?	Yes – In so far as the threat of an EO encounter changes in relation to several factors. Generally, for ground volumes within the site already subjected to extensive redevelopment involving the displacement of earth, the potential for an unanticipated encounter with relatively small calibre EO <i>within the volumes of ground excavated/disturbed</i> may be considered unlikely. Additionally, volumes of ground within the site already subjected to historical piling may be considered to present a lower potential EO encounter threat, <i>within the ground volume occupied by the piles</i>, especially from large UXBs - This is not to state that there is <i>no threat</i>, and the degree and density of historic, post-War piles must be established so that the potential for an encounter may be correctly assessed. The same cannot be said of other areas of the site where WW2 ground volumes, including those beneath existing structures down to the adjusted bomb penetration depth, where the EO threat must initially be considered to remain as it did immediately post-War.

THREAT ASSESSMENT	
POTENTIAL EXPLOSIVE ORDNANCE THREAT ITEMS	Due to the limited number of bombs dropped then and that such bombing is not known to have affected the Site, the potential for a WW1 UXB encounter is considered extremely unlikely. The Site is known to have been affected by large, air-dropped bombs – Official Bomb Census records and historic street maps corroborate this conclusion. Direct bomb damage would have hampered UXO search/ clearance efforts and likely created conditions in which the possibility of overlooking a UXB entry hole was increased. The possibility that British AAA projectiles fell back to earth and remain as potential threat items today can rarely be entirely ruled out but is very unlikely in any case. Given its Wartime role, it is extremely unlikely that the site area was used for military training, although this is not easily known, so <i>ad hoc</i> EO contamination from this source may be reasonably discounted, as can the potential for EO contamination because of storage/ manufacture. There has been significant development post-War, especially that in the centre of the Site, which would have gone some way to mitigate the potential for an unplanned UXO encounter, especially from UXO reasonably anticipated to be encountered at the surface or at very shallow depths such as small incendiary or anti-personnel bombs. Ground volumes that have been fully occupied by foundation slabs etc. or which have been entirely excavated for whatever reason may reasonably be considered free from the potential for an unplanned UXO encounter and therefore may be discounted from a UXO-threat perspective. This is not the case for ground volumes occupied by post-War piled foundations, although the encounter risk is reduced - This would apply beneath the former building footprint within the site if piled. Where historic, post-War foundations do not extend to the estimated maximum Bomb Penetration Depth (BPD), the ground volume beneath these structures must be considered potentially at risk from a UXO-Threat perspective. Given the available evidence, the following EO-related articles are reasonably considered to remain as potential threats within the Site boundary today: • Large, air-dropped, German HE Bombs including 50, 250, 500 and 1,000kg bombs (of WW2 vintage). • Large British AAA projectiles.
ENGINEERING WORKS	The nature of future intrusive engineering is unspecified at the time of writing. However, it is supposed that both site investigation and subsequent construction works will involve energetic intrusion into previously undisturbed WW2 ground volumes. The planned engineering works must be considered as part of the development of any threat mitigation strategy.
RISK PATHWAY	For the purposes of this assessment, it has been assumed that engineering works would likely include energetic intrusion into previously undisturbed WW2 ground volumes. As a consequence, key equipment and personnel may complete the risk pathway during intrusive engineering works that may bring them into physical contact with potential threat items.
CURRENT EXPLOSIVE ORDNANCE THREAT LEVELS	WW2 ground volumes that have been subjected to significant post-War intrusive engineering such as excavation may be considered free from the potential of UXB encounter. WW2 Ground Volumes that have been subjected

to historic piling may be considered at a lower general threat level but the potential for UXB encounter *cannot be entirely ruled out*. The same cannot be said for the remainder of the site.

The Ordnance Threat Levels for the remainder of the Site as they relate to various energetic activities are assessed as:

Ordnance Type	Engineering Activity				Boreholes/ Piling
	No Excavations, no energetic engineering, Controlled Public Access	Shallow Excavations by hand/ Uncontrolled Public Access	Shallow Excavations by machine/ Controlled Public Access	Deep Excavations > 1mbgl, Energetic compaction/ rolling	
	Ordnance Threat Level				
British AAA	NEGLIGIBLE	NEGLIGIBLE	LOW	LOW	LOW
Bomb 50-500kg HE	LOW	MEDIUM	MEDIUM	HIGH	HIGH

WHAT ARE THE CONSEQUENCES OF AN UNCONTROLLED DETONATION?

The consequences of the uncontrolled detonation of any of the items of ordnance listed above are:

Asset	Consequence
People	Lost time injury >7 days
Plant	Unit Level Damage
Property	Major Wider Damage
Environmental	Major Effect

THREAT MATRICES

EXPLOSIVE ORDNANCE (EO) DANGER RATING (ODR)

The 'Explosive Ordnance Danger Rating' (ODR) is assessed for the different types of ordnance in terms of the potential harm that may result were the ordnance to detonate as designed and is a function of the calibre of the ordnance and whether it is encountered on the 'surface' or 'buried'¹.

Potential Threat Item	Ordnance Category Description	Danger Radii (m)	Ordnance Danger Rating (ODR)
	No Explosive Ordnance (EO) suspected to be present.	NA	1
British AAA	Landmines, Anti-Personnel, HE; HE in Bulk <5Kg; Pyrotechnics, Small Arms Ammunition (SAA): Projectiles, HE <75mm calibre; Projectiles, Mortar, HE 50mm to < 75mm calibre; Grenades, Hand, HE; Grenades, Rifle, HE. British AAA Projectiles, HE < 125mm calibre; Rockets, HE, Anti-Tank (HEAT); Bombs PIAT, HE	100+	2
Bomb 50kg HE	Aerial Bombs, HE, 50Kg (Surface/ buried); Aerial Bombs, Blast, HE & Sea Mines 20-250Kg; Aerial Bomb, HE, 250-500Kg (Buried) Bombs, Mortar, HE <105mm calibre; Bombs, Mortar, Spigot, HE; Landmines, Anti-Tank	300+	3
Bomb 250/500kg HE	Projectile, HE > 125mm calibre; Aerial Bombs, HE, 1000kg (buried), HE, 1500-2500Kg (Surface); Aerial Bomb, Blast, HE & Sea Mines 500-1500Kg (Surface)	500+	4
	Aerial Bombs, HE, 2000-10000Kg (Buried); Aerial Bombs, Blast, HE & Sea Mines 1500-4000Kg (Surface)	800+	5

¹ An item of Explosive Ordnance (EO) is 'buried' when it is 2 ½ times its own length underground.

ENCOUNTER RISK (ER)

The Encounter Risk (ER) is a function of the Explosive Ordnance Danger Rating (ODR) and the Likelihood Factor (LF) (i.e. how likely is it that certain items are present underground) – The higher the Explosive Ordnance Danger Rating (DR) and the higher the Likelihood Factor (LF), the higher the Encounter Risk (ER).

Likelihood of Encounter	Likelihood Factor (LF)	EXPLOSIVE ORDNANCE DANGER RATING (ODR)				
		1	2	3	4	5
		ENCOUNTER RISK (ER) = LF x ODR				
Extremely Unlikely	0	0	0	0	0	0
Very Unlikely	1	1	2 British AAA	3	4	5
Unlikely	2	2	4	6 Bomb 50kg HE	8 Bomb 250/500kg HE	10
Likely	3	3	6	9	12	15
Very Likely	4	4	8	12	16	20
Extremely Likely	5	5	10	15	20	25

EXPLOSIVE ORDNANCE (EO) THREAT LEVEL

The 'Ordnance Threat Level' is a function of the Encounter Risk (ER) and the Site Activity Factor (SAF) i.e. what type of activity is being undertaken at the site.

Encounter Risk (ER)	Explosive Ordnance (EO) Type	Site Activity Factor (SAF)				
		No Excavations, no energetic engineering, Controlled Public Access	Shallow Excavations by hand/ Uncontrolled Public Access	Shallow Excavations by machine/ Controlled Public Access	Deep Excavations > 1mbgl, Energetic compaction/ rolling	Boreholes/ Piling
		1	2	3	4	5
		Explosive Ordnance (EO) Threat Level = ER x SAF				
0		0	0	0	0	0
1 (1 – 2)	British AAA	1	2	3	4	5
2 (3- 5)		2	4	6	8	10
3 (6 – 9)	Bomb 50-500kg HE	3	6	9	12	15
4 (10 – 15)		4	8	12	16	20
5 (16+)		5	10	15	20	25

Explosive Ordnance Threat Level	ASSETS AFFECTED				EXPLOSIVE ORDNANCE (EO) THREAT MITIGATION REQUIREMENTS
	PEOPLE	PLANT	PROPERTY	ENVIRONMENT	
NEGLIGIBLE	NOT APPLICABLE				
LOW	First aid injury	Slight damage	Slight damage	Slight Effect	Monitor & manage potential risks
MEDIUM	Medical Injury to Lost time <7 days	Slight Damage to Item write off	Minor to Major damage	Minor to Local Effect	Review & emplace strict control measures if necessary
HIGH	Lost time injury >7 days to Fatality	Unit level to Multiple damage	Major wider damage to Catastrophe	Major to Massive Effect	Intolerable Risk Level. Immediate control measures required to mitigate risks to acceptable levels prior to any further works

EXPLOSIVE ORDNANCE (EO) THREAT MITIGATION OPTIONS

ACTIVITY	THREAT MITIGATION CONSIDERATIONS	FINAL THREAT LEVEL
ALL ACTIVITIES	If planned intrusive engineering works are breaking into ground volumes where the potential for UXB encounter is created, <i>i.e., Within previously undisturbed ground volumes</i>, then a UXO Threat Management Strategy IS REQUIRED prior to intrusive engineering works at the site of concern. Explosive Ordnance Safety Awareness Briefings. An explosive ordnance Safety Briefing should be included as part of routine site health and safety training and form a key element of the Site Health & Safety Plan. This should be conducted by a trained specialist and would assist conformance with the CDM Regulations 2015. The briefing will instruct all personnel on the identification of EO hazards, actions to take in the event of an EO incident to protect personnel, key equipment, property, and the public. Explosive Ordnance Site Safety Instructions. Explosive Ordnance Site Safety Instructions should be drafted for inclusion in the site-specific health and safety manual and would include information on dealing with an EO incident safely and appropriately. These instructions would form part of the permanent site documentation and will be an aide memoire for identifying potential EO hazards, making a preliminary threat assessment as well as specific guidelines on what to do in the event of a confirmed incident.	AS LOW AS REASONABLY PRACTICABLE (ALARP)
SITE INVESTIGATION WORKS	Site investigation works should be supported by UXO survey as appropriate. Consideration should be given to whether the works are shallow or deep from the perspective of UXO Survey. 'Shallow' Survey is survey of the ground from 0.0m bgl to 6.5m bgl and 'Deep' UXO Survey is that beyond 6.5mbgl. • Boreholes. PLANIT can conduct a non-intrusive survey of a 5m x 5m box which will accurately allow your borehole to proceed into a volume of ground under which there are no ferrous obstructions. Several locations may be provided within a survey box, allowing maximum flexibility for positioning, and preventing any boreholes being terminated because of encountering a potential threat item at depth. • Trial Pits. Using shallow non-intrusive survey, the area for your trial pit can quickly be surveyed and confirmed as free from ferrous anomalies/UXO. Data is interpreted on-site and therefore locations can be changed very efficiently in the event of a potential obstacle. Window Sampling. Using shallow non-intrusive survey, the area for your window sample can quickly be surveyed and confirmed as free from ferrous	AS LOW AS REASONABLY PRACTICABLE (ALARP)

	anomalies/UXO. Data is interpreted on-site and therefore locations can be changed very efficiently in the event of a potential obstacle.	
SHALLOW INTRUSIVE ENGINEERING WORKS	Where 'shallow' engineering may complete the risk-receptor pathway, there are two options available to effectively deal with the EO Threat when conducting shallow intrusive ground works. On-Site UXO Support. On-site UXO Support for shallow ground works would involve the presence of an appropriately trained and experienced UXO Technician during this phase of construction. The role of the UXO Technician is to: • Conduct EO Safety Awareness Briefings as required. • Monitor all intrusive ground works using visual and instrument aided means to locate any EO that may be uncovered during site works. • Provide an immediate and expert assessment of any EO that may be discovered. • Assist in implementing an appropriate and safe response to an EO incident. • Design and emplace protective works as an immediate response to protect personnel, key equipment, property and the public as may be required. • Advise on best safe working practice considering the perceived EO Threat. • Act as the liaison with the Authorities on behalf of the Client in the event of an EO incident. Shallow Non-Intrusive UXO Survey. PLANIT can deploy industry leading technology that will survey your site of concern non-intrusively (if ground conditions permit) to identify potential EO Threat Items. Any anomalies identified following the non-intrusive survey that may be EO should then be subject to Controlled Excavation to confirm them as EO and remove the threat or discount them. Once the non-intrusive survey and controlled excavation are complete, there is no further requirement for UXO Support at the site of concern since all EO Threats would have been identified and dealt with.	AS LOW AS REASONABLY PRACTICABLE (ALARP)
DEEP INTRUSIVE ENGINEERING WORKS	There are a few options available to effectively deal with potential EO Threats when conducting deep intrusive ground works. Which approach is applicable will depend upon the ground conditions of the site of concern: Deep Non-Intrusive UXO Survey. PLANIT can deploy industry leading technology that will survey your site of concern non-intrusively (if ground conditions permit) to identify potential EO Threat Items at depth – UXO Survey should proceed to the expected UXB penetration depth or maximum depth of intrusive ground works, whichever is shallower. As a benchmark, PLANITs Deep Non-Intrusive Survey can identify a bomb 500Kg HE to some 8.0m bgl in average ground and larger bombs deeper. This approach is ideal for covering large areas quickly and can be employed to survey piling runs and borehole locations.	AS LOW AS REASONABLY PRACTICABLE (ALARP)

	Any anomalies identified following the non-intrusive survey that may be EO should then be subject to Controlled Excavation to confirm them as EO and remove the threat or discount them. Once the non-intrusive survey and controlled excavation are complete, there is no further requirement for UXO Support at the site of concern since all EO Threats would have been identified and dealt with. Magcone UXB Survey. PLANIT can deploy world class Magcone Survey Systems to survey either pile locations or small areas ahead of intrusive engineering including piling and drilling. The Magcone system is very versatile and can survey to great depths if required. Down-Hole Magnetometer UXO Survey. PLANIT can deploy down-borehole UXO Survey equipment that will clear ahead of a piling or borehole rig as it descends underground. The main drawbacks of this approach are that it is time consuming, 'blind' (insofar as the borehole may proceed for some depth before a potential threat item is identified, at which stage the borehole will have to be terminated and relocated, wasting time and money), equipment heavy and expensive. Any anomalies identified during this survey that may be EO should either be subject to Controlled Excavation to confirm them as EO and remove the threat or discount them or relocate the borehole or adjust the piling plan. <i>UXO Survey should proceed to the expected UXB penetration depth or maximum depth of intrusive ground works, whichever is shallower.</i>	
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ANNEXES

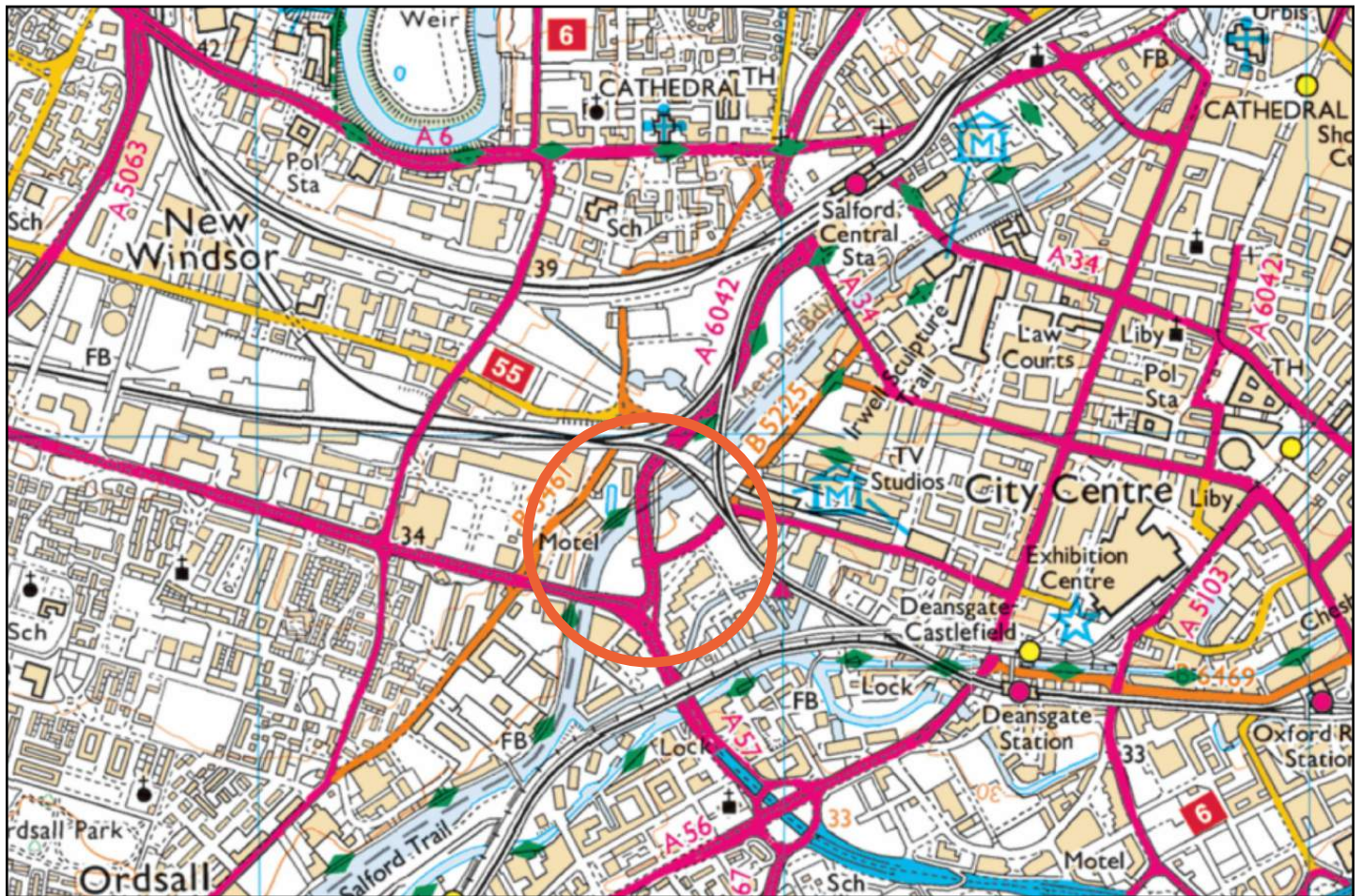
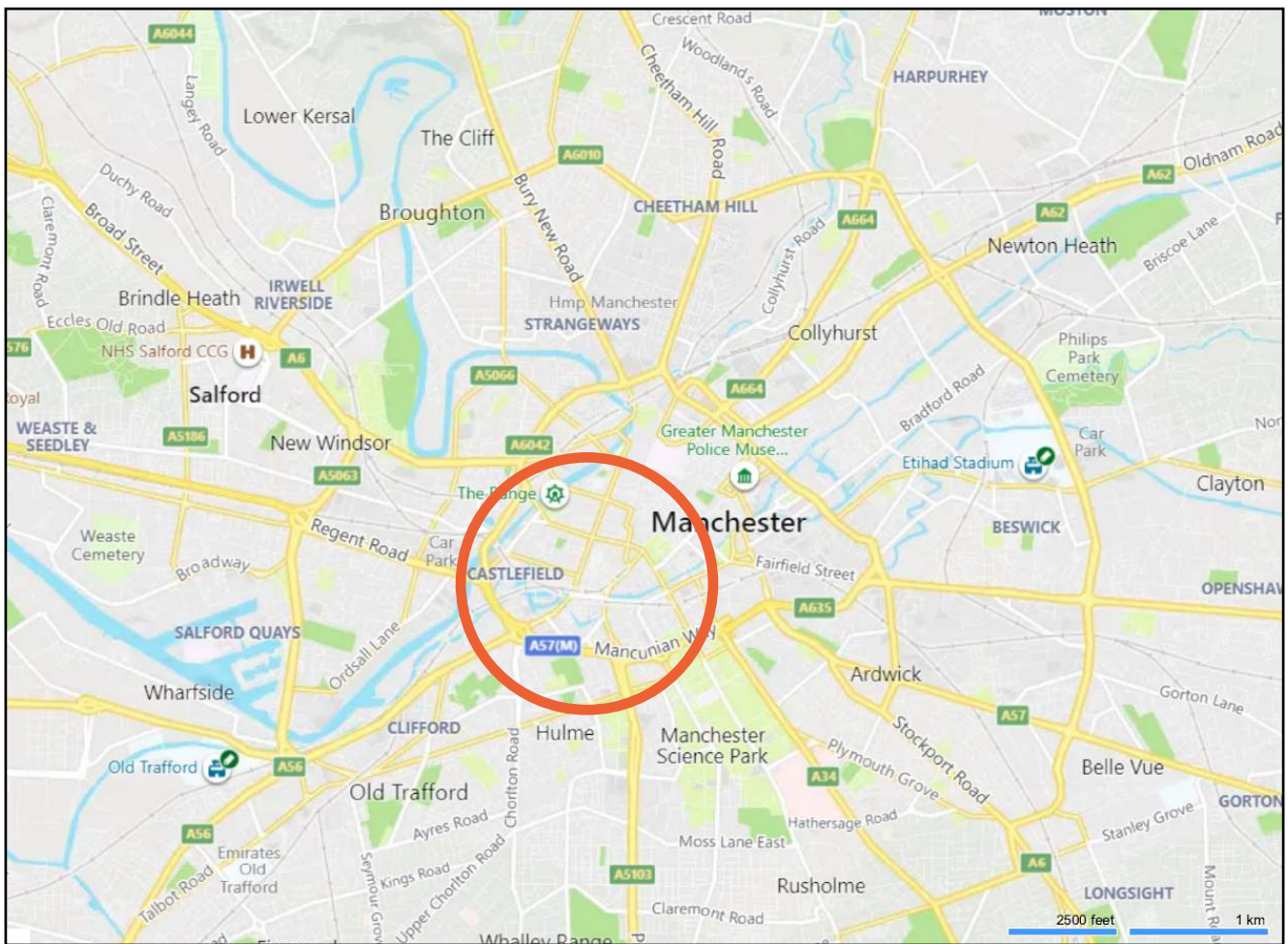
- A. Site Location & Layout.
- B. Bomb Census/ Map Information.
- C. Historic Street Maps.

BIBLIOGRAPHY

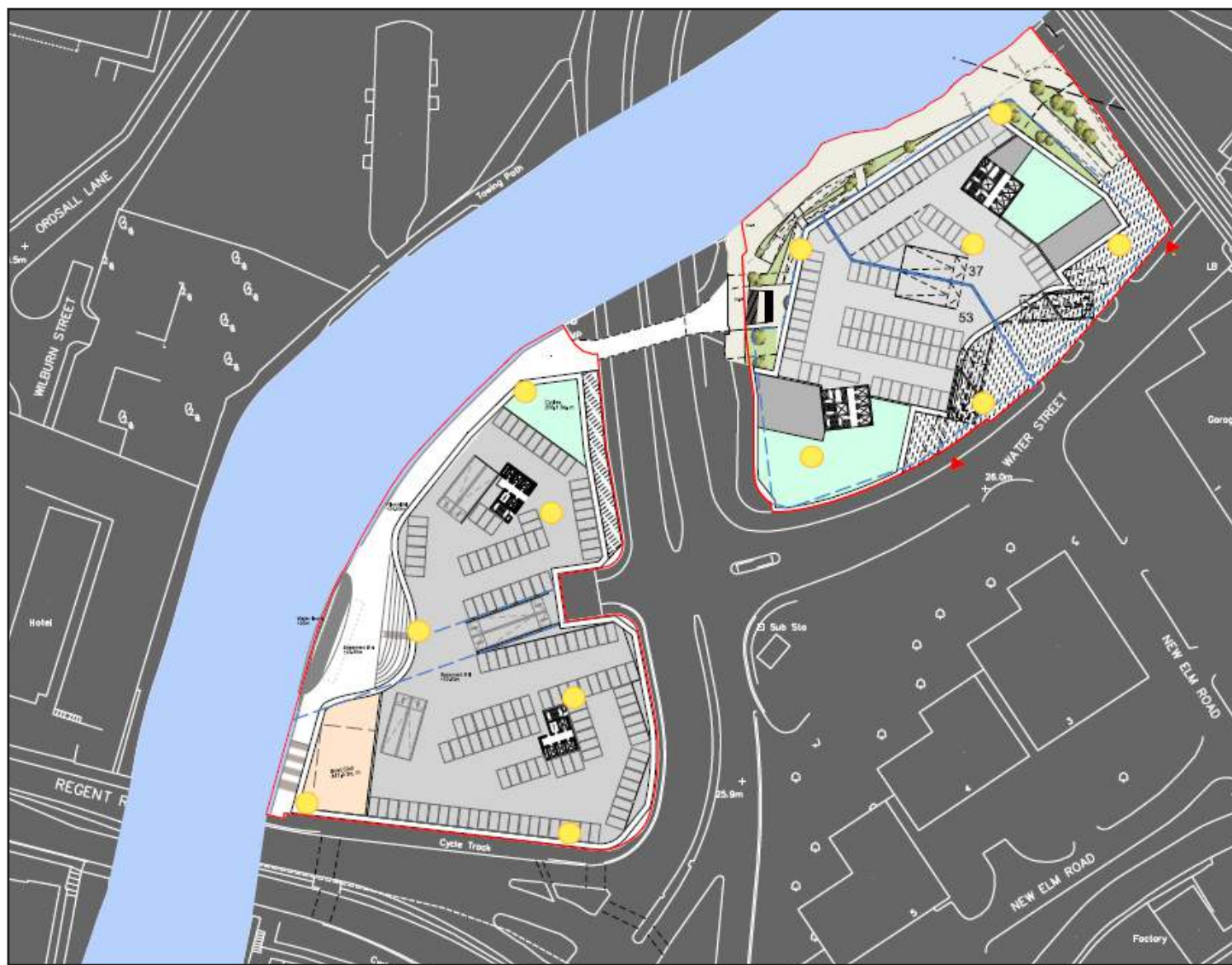
Some of the key sources consulted during this assessment are listed below:

- Bates, H, E., Flying Bombs over England, (Frogletts Publications Ltd. 1994).
- 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).
- 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, Volume 1, (Battle of Britain Prints International Limited. 1987).

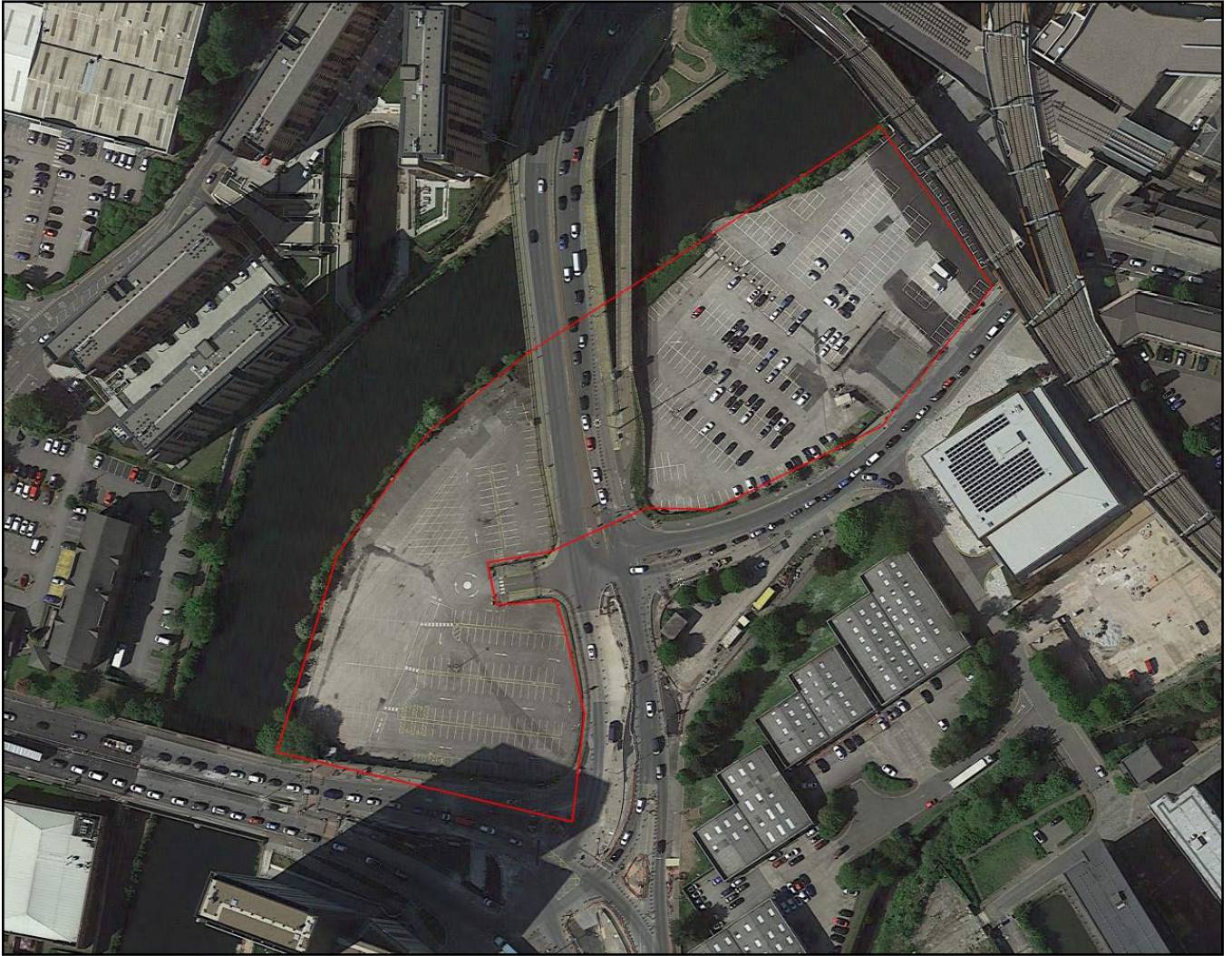
- Ramsey, W., The Blitz Then and Now, Volume 2, (Battle of Britain Prints International Limited. 1988).
- Ramsey, W., The Blitz Then and Now, Volume 3, (Battle of Britain Prints International Limited. 1990).
- Whiting, C., Britain Under Fire: The Bombing of Britain's Cities 1940-1945, (Pen & Sword Books Ltd. 1999).



Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Location    A - 1
Project Ref:	Trinity Island, Manchester, M3 4JW	
Client:	Geotechnics Limited	



Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Boundary □	  A - 2
Project Ref:	Trinity Island, Manchester, M3 4JW		
Client:	Geotechnics Limited		



Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Boundary 	  A - 3
Project Ref:	Trinity Island, Manchester, M3 4JW		
Client:	Geotechnics Limited		

HE Bomb Strikes

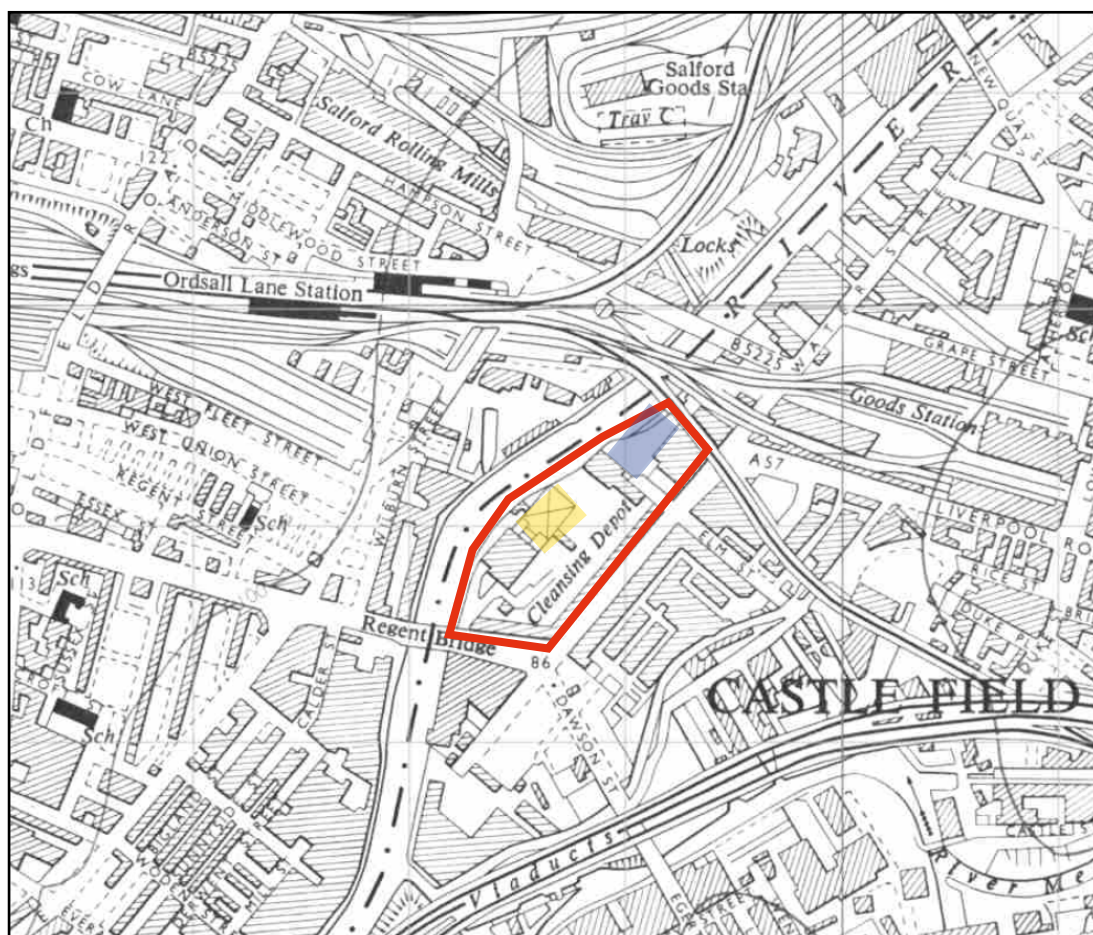


Bomb Damaged Buildings

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Project Ref:	Trinity Island, Manchester, M3 4JW	
Client:	Geotechnics Limited	



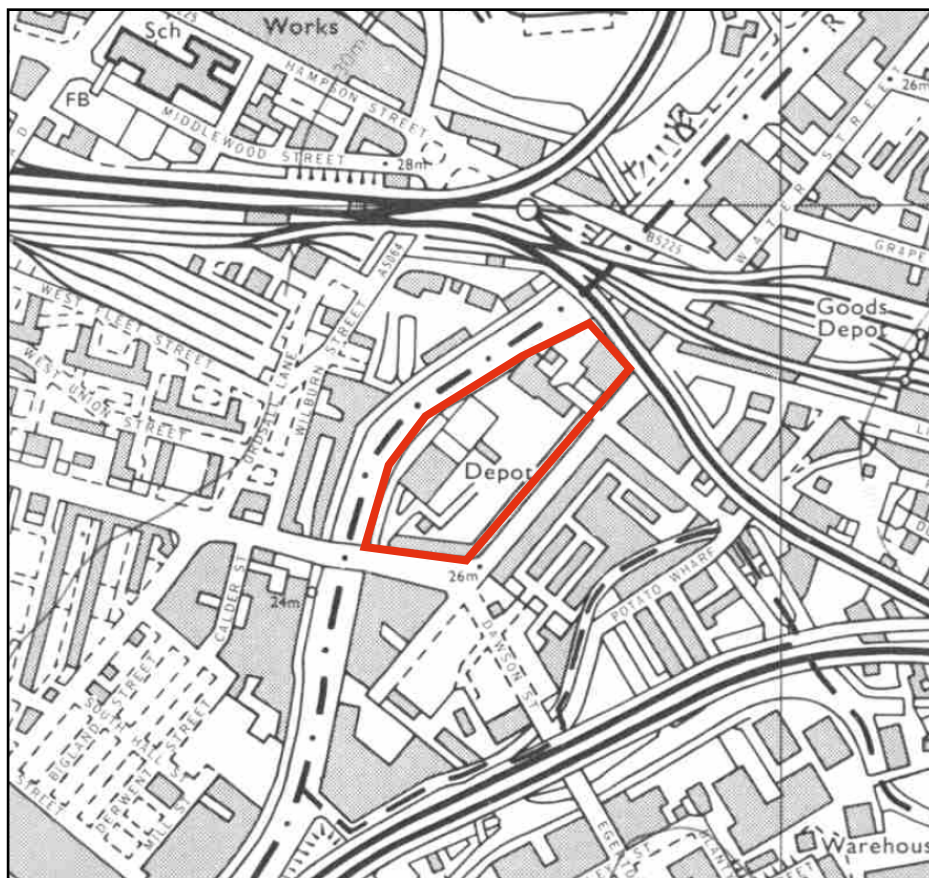
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1956

Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Boundary Likely bomb damaged area Post-War Development	  
Project Ref:	Trinity Island, Manchester, M3 4JW		
Client:	Thomasons Limited		

C-1

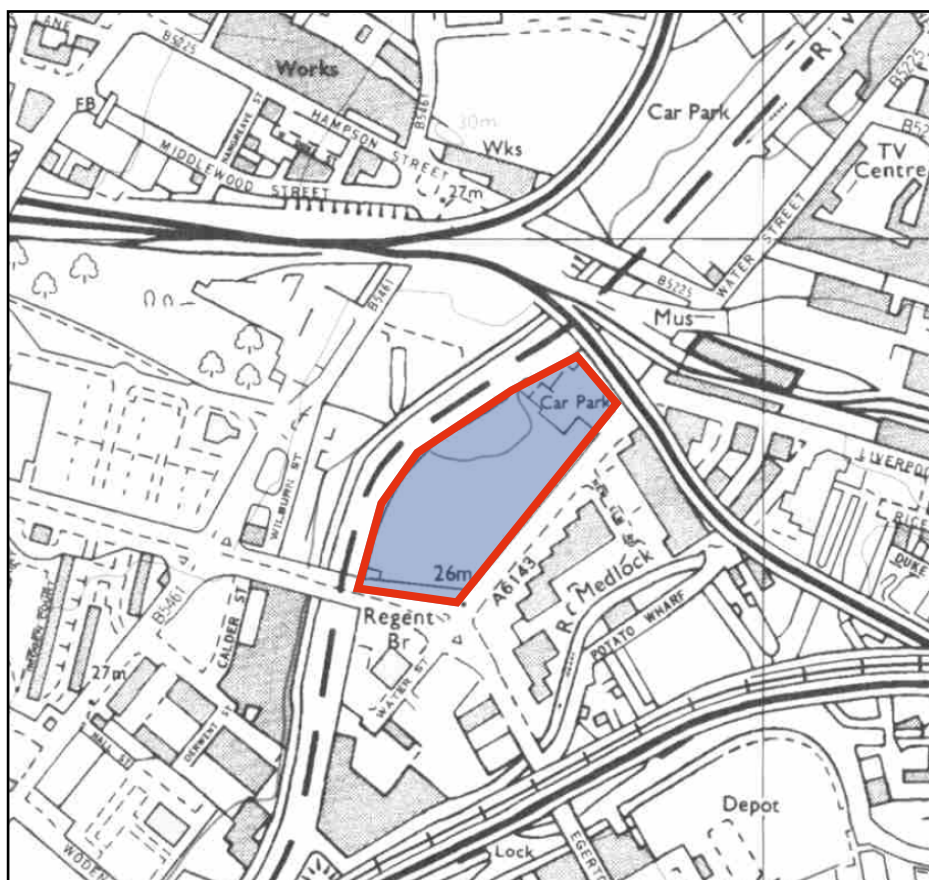
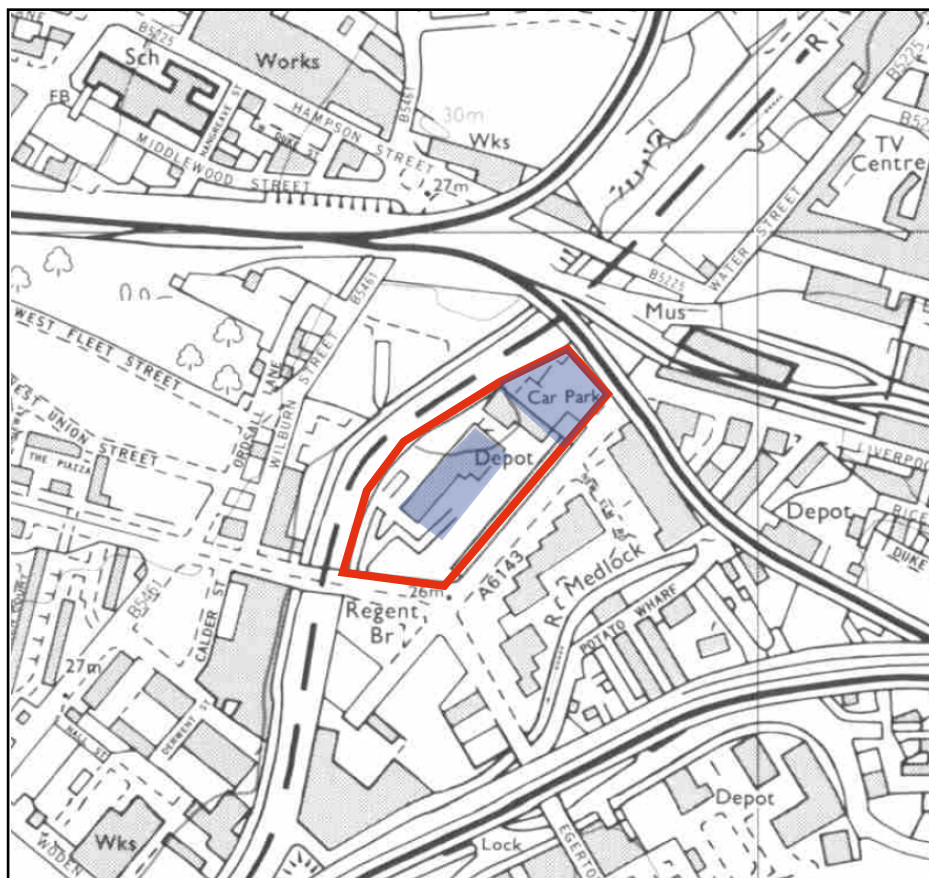


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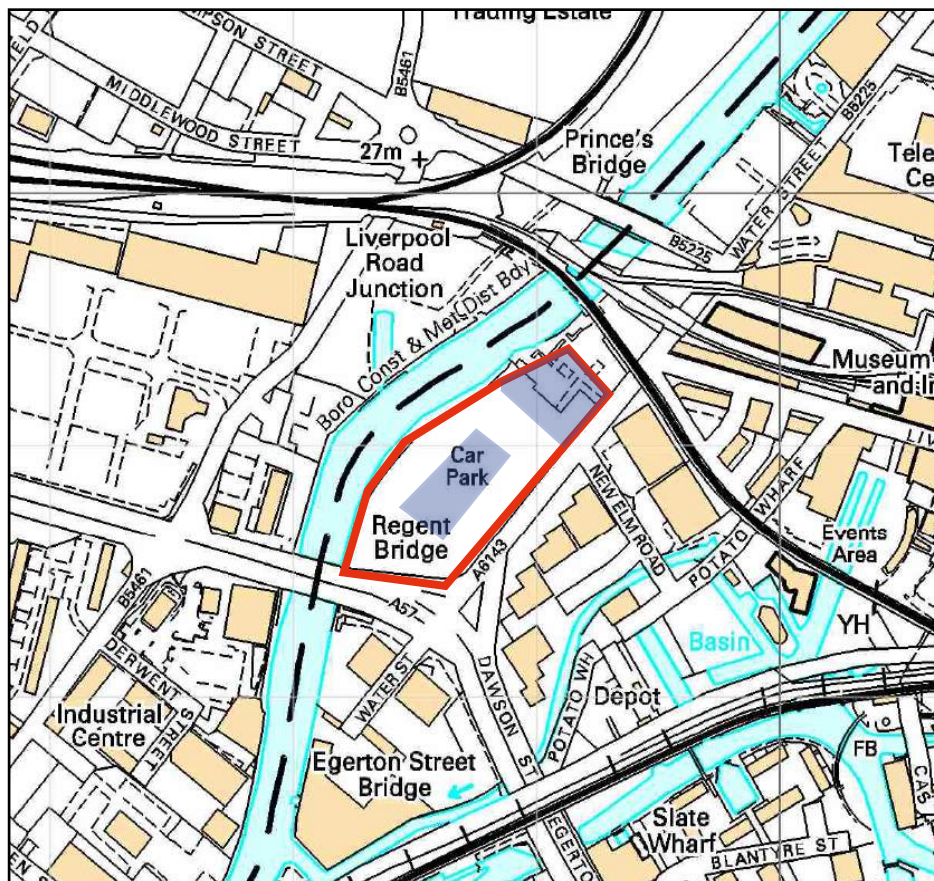


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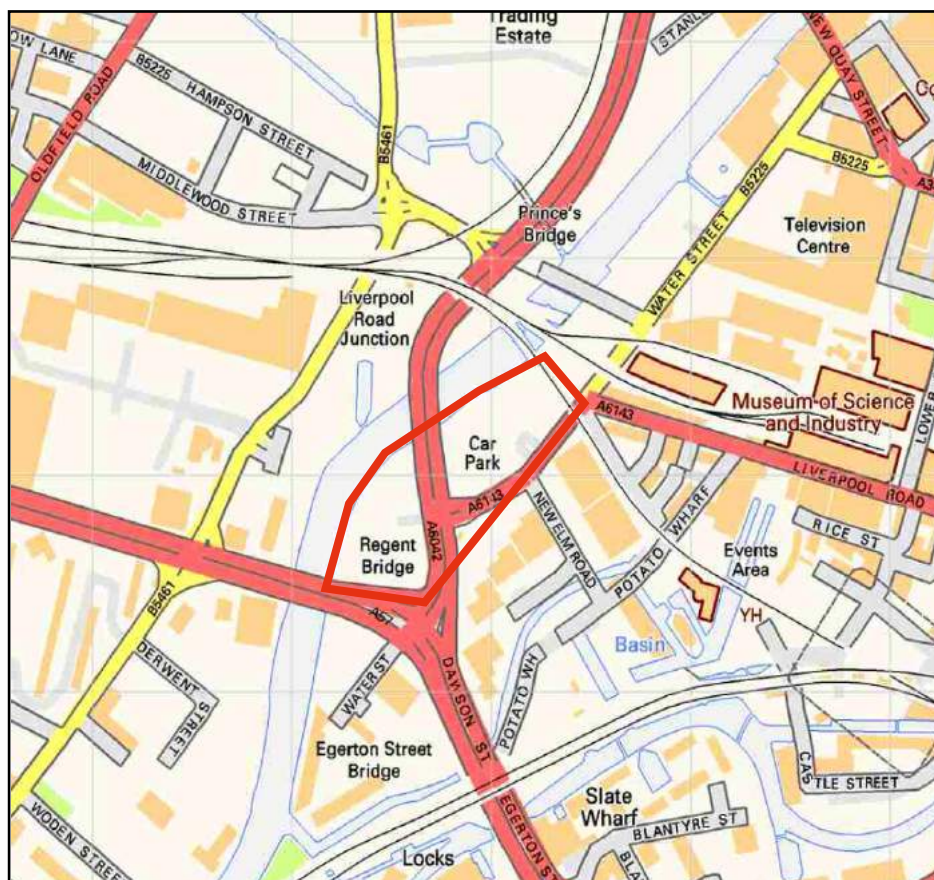
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Project Ref:	Trinity Island, Manchester, M3 4JW		
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Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Boundary Post-War Development	   C-3
Project Ref:	Trinity Island, Manchester, M3 4JW		
Client:	Thomasons Limited		



2002



2014

Doc Ref:	EOTA Trinity Island, 13/04/2021	Key: Site Boundary Post-War Development	  C - 4
Project Ref:	Trinity Island, Manchester, M3 4JW		
Client:	Thomasons Limited		