

Greenheys Development Demolition Management Plan

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1. Introduction

1.1. Manchester Science Park

Manchester Science Park (MSP) is located to the South of Manchester City Centre and is broadly bound to the North by Burlington Street, to the East by Lloyd Street North, to the South by Denmark Road and to the West by Greenheys Lane. The site is operational and consists of 9 key buildings which house a community of commercial tenants from across the science and technology sectors. In close proximity to the site are places of worship, residential dwellings, a primary school, a police station, a sports centre, university buildings and a large brewery.

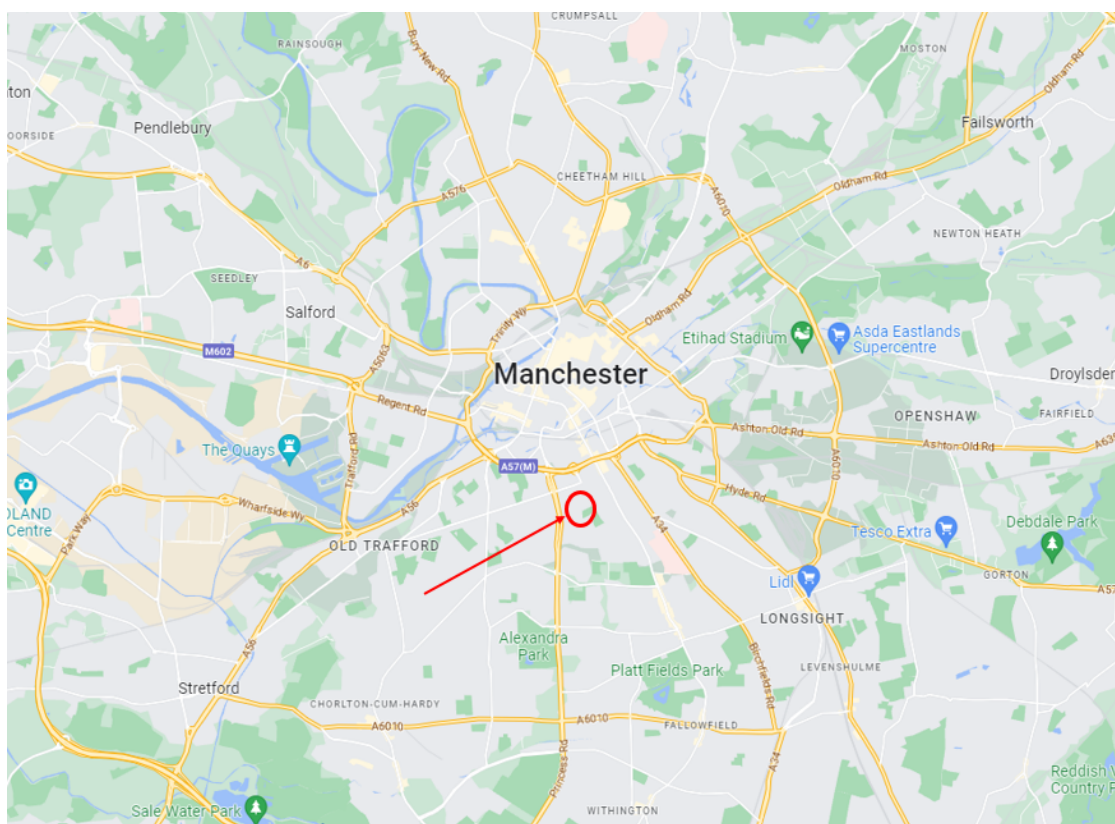


Fig1: MSP site location - M15 postcode

1.2. Demolition Site

The demolition site consists of the existing Greenheys Business Centre, No. 7 & 9 Greenheys Lane and (part of) the McDougall centre along with the immediate landscape ribbon; these buildings all fall under the demolition scope.



Fig 2: MSP site bound by red line and Greenheys development site location shown by yellow boundary

1.3. Purpose and Implementation

This document has been produced to outline the proposed demolition management strategies for the aforementioned project and is in place to ensure the suitable, secure and safe operation of the site, thereby protecting staff, the environment, MSP businesses, nearby communities and the environment from unnecessary harm. This document describes the site rules, security arrangements and intended methods of effectively managing impacts arising from demolition and construction activities.

The responsibility for implementation of this plan lies with the Principal Contractor, working in conjunction with their appointments and sub-contractors. To ensure this plan remains current and relevant, the Principal Contractor shall take control of the document and regularly revise/update as necessary to reflect any new information which arises from their demolition and construction activities.

1.4. Objectives

The objectives of this document are to ensure that:

- All practical steps are taken to minimise disruption to occupiers of Manchester Science Park and nearby communities, caused by demolition and associated tasks.
- All practical steps are taken to minimise the environmental effects of the works.
- All activities are conducted in accordance with this plan, relevant legislation, Codes of Practices, guidelines and any local environmental procedures.
- Licences, permits, consents and other statutory requirements are obtained prior to works commencing and observed during works being undertaken.
- All contractors and subcontractors are aware of the environmental issues relevant to the project through the provisions of site specific information on the environmental impacts of Demolition and the mitigation measures to be applied during inductions, briefings and tool box talks.
- Environmental controls remain adequate throughout the duration of the project.

2. The Site

2.1. Site Specific Information

Address	Greenheys Business Centre, Manchester Science Park, Pencroft Way, Manchester M15 6JJ
Nearest Public Car Park	The University of Manchester Car Park D M13 9GR
Nearest Train Station	Manchester Oxford Road
Nearest Hospital (A+E)	Manchester Royal Infirmary, Oxford Road, Manchester M13 9WL
Working Hours	Subject to planning, expected to be as follow: Monday - Friday: 0730h - 1800h (noisy works will not commence until after 0900h) Saturday: 0800h - 1400h Sunday: By prior notice and agreement only.
MSP Site Contact	Sarah Roche - Customer Operations Manager - 07949516382 Dave Jones - Facilities Team Leader - 07967740216

2.2. Site Location, Context & Access

Vehicular access - vehicular access to the development site will predominantly be off Pencroft Way with a secondary access off Greenheys Lane. The Princess Road arterial route to Manchester junctions with Greenheys Lane approx 0.5km from the development site. Contractor and staff parking for the development during the demolition phase will be contained to the development site boundary, allocated parking spaces within the wider MSP campus (in designated bay) or nearby public car parks. Staff parking in nearby residential areas will be heavily discouraged and MSP's project and estates team will work closely with community groups to ensure this is suitably policed.

Pedestrian access - Manchester Oxford Road train station is a 1.0 mile walk from the development site and there is a bus-stop directly adjacent to the West site boundary.



Fig 3: Site location map and key nearby features

2.3. Site Plan

The site will initially be bound on all sides by double-clipped heras fencing for agility, with appropriate signage to prohibit unauthorised access. Upon the demolition of structures close to the site boundaries, this will subsequently be replaced with 2.4m tall, ballasted solid hoarding. Vehicle gates along the fencing line will be manned by security/gateman staff when in operation, and securely locked when outside of working hours. The primary vehicular entrance is anticipated to be off Pencroft Way and a secondary vehicular access point to the west of the site will provide additional means of entry and removal of waste if required.

Pedestrian gates along the hoarding - limited to maximum 2 nr - will be secured with a form of access control and/or manned by security personnel. The primary pedestrian access is anticipated to be in the North-west corner of the site off the footpath running parallel with Pencroft Way. The majority of contractor parking is expected to be provisioned in the site confines during the demolition phase, with a provision of

overflow in the wider MSP campus (likely in the private car-park to the west of Synergy House).

The site's hoarding will be designed and installed in a manner to ensure adjacent public walkways (notably to the immediate south of the site) remain safe and suitable to use. Furthermore, if the erection of fencing and subsequent hoarding happens ahead of the relocation of an existing MSP cycle store located on the Greenheys site, then safe and proper access will be maintained for the store until such point the facility is repositioned within the MSP campus; this store is shown in blue in the south-east corner of Fig4 below.

Whilst the MSP estates team ensure a 24/7 presence on-site - via the estate staff during normal working hours and an external security contractor outside of those times - the security and segregation of the construction site will remain the sole responsibility of the appointed contractor.

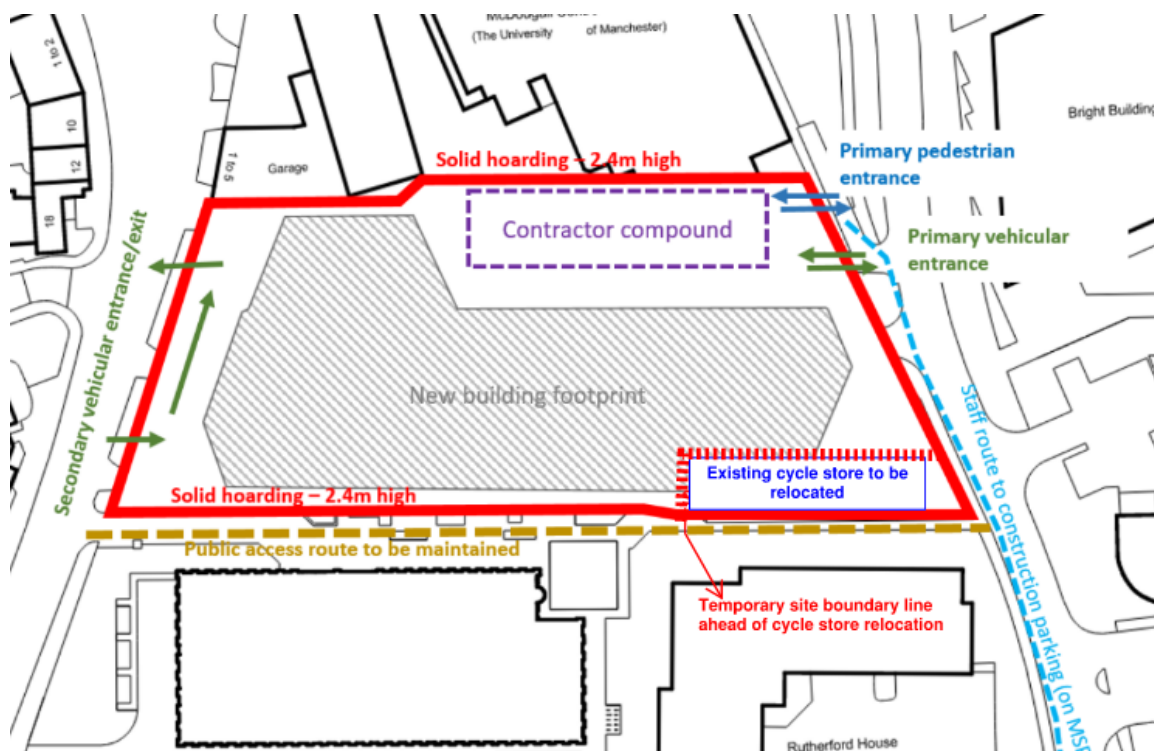


Fig 4: Expected site layout. Internal vehicle/pedestrian routes, etc. are all to be established following the appointment of a contractor.

3. Site Rules

Please see Appendix A for a copy of the MSP Contractor Rules. Whilst these rules are largely for works within occupied MSP buildings (i.e. not the scope of the Greenheys new-build), any points which relate to site impacts such as noisy works, deliveries, parking, etc. must be adhered to. Similarly, all points under the 'Contractor Code of Conduct' are mandatory and pertinent items are expected to be included in the Principal Contractor's site specific induction.

3.1. Emergencies

If an incident or accident occurs, follow the Principal Contractor's site specific procedures and contact emergency services on 999.

3.2. Security and Site Access

Access into the Greenheys construction site will be via the Principal Contractor's processes and procedures, and will be managed under the Principal Contractor's SSOW, (safe system of work).

Out of hours working - It is the responsibility of the Principal Contractor to implement appropriate procedures for any intended works on site out of hours which must also be in compliance with the local authority's rules surrounding noisy works. It is the responsibility of the Principal Contractor to act as host and to ensure that their contractors comply with all appropriate procedures. Individual contractors and subcontractors will not be allowed onto site out of hours unless they are supported and accompanied by the Principal Contractor for the duration of their works or visit.

Photography and Video recording - Photography and Video recording is not permitted without prior authorisation from the Bruntwood SciTech construction team. Any images or recordings that are to be used for external purposes also require approval from Bruntwood SciTech.

Searches - MSP Site Security are authorised to request any personnel to demonstrate the authority for carrying goods which may be the property of Bruntwood SciTech. Such requests may include requests to show the contents of (hand) bags, cases, packages and vehicles.

3.3. Site Assets and Equipment

Removal of goods from site - No items are to be removed from the site without prior written permission from the asset/equipment owner.

Security of portable electronic equipment and valuables - Items of portable electronic equipment and valuables should not be left unsecured/unattended for any length of time. Such items should be locked away securely out of sight when not in use.

Mobile Phones and Wireless technology - Use of mobile phones and wireless technology is not permitted on the construction site except in clearly identified areas. For items with built-in camera technology, please refer to the 'Photography and Video Recording' policy section above.

Personal effects brought on to site - Personal effects brought on to site remain the responsibility of the individual. Bruntwood takes no responsibility for the safeguarding of personal effects.

Tools, Work Equipment and Electrical Equipment - Tools and work equipment used on the site must be compliant with UK legislation and the user must be able to demonstrate competence prior to using the tool/equipment. This includes hand tools, office equipment, laboratory equipment, ladders etc. All electrical items plugged into the mains must be tested by a competent electrician prior to use on site.

Lost and Found - All items found on the Greenheys construction site, including cash and documents must be handed to the Principal Contractor. All items found on the MSP campus site must be handed to the MSP security team.

3.4. Use of Vehicles and Driving

Vehicles - All vehicles used and driven on the MSP site must be compliant with UK legislation and have a valid MOT, road tax and insurance where applicable.

Licence to drive or operate a vehicle on site - Any driver of a vehicle driven or operated on the construction site must be in possession of a valid licence for the type and application of a vehicle used or operated. This applies to personal, commercial, construction vehicles and plant

Parking - All contractor parking is to be either within the confines of the construction site boundary, within the designated parking spaces allocated to the main contractor by the MSP estates team or in nearby public car parks. Contractors travelling on foot between off-site car parks and the construction site must be respectful of the communities and businesses en route and avoid littering or demonstrating offensive behaviour. Contractor car parking is not allowed in nearby residential areas and the MSP estates team work closely with the local community groups to ensure this is adequately policed.

Under no circumstances are non-emergency vehicles to be parked on double lines anywhere on the MSP site or in the surrounding residential areas. No vehicles, including construction delivery vehicles, contractor vehicles or plant, can be parked in such a way as to cause impediment or hindrance to local residents, businesses and park users.

Fuel Leaks - Any fuel leak observed or detected must be reported to the Principal Contractor and MSP estates team in order to prevent contamination of the local water courses, drainage systems and to prevent ignition.

Drivers Rules

- No person is allowed to operate vehicles and plant unless trained and licensed to do so.
- No passengers are to be carried unless the vehicle is specifically designed to do so.
- No children or animals are to be brought onto the project in delivery or other vehicles.
- Drivers/operators must be familiar with all operating controls and safety devices of the particular piece of plant they are to use.
- Drivers/operators are to carry out pre-use safety checks of the unit prior to use each shift.
- All drivers/operators are to drive carefully at all times and note the presence of pedestrians on site.
- All drivers/operators are to only operate the vehicle/plant strictly in accordance with manufacturers' recommendations/instructions.
- All drivers/operators must comply fully with all local authority, MSP and Principal Contractor site safety signage including:

- Speed limits
- Stop signs
- Give way signs
- One-way signs etc.
- Loading restriction signs
- No parking
- Reversing is to be kept to a minimum and only undertaken when clear all round vision is available and under the direction of a trained banksman.
- Hazard warning lights or flashing beacons to be on all times the vehicle is moving.
- Seat-belt “correctly fitted” lights to be displayed at all times on site dumpers, telehandlers, etc.
- Excavations only to be approached when safe to do so and guided by a trained banksman (stop blocks or other adequate edge protection must be available).
- Outside the cab drivers must wear appropriate PPE (subject to the Principal Contractor’s SSoW) which may include:
 - Head protection
 - Foot protection
 - Eye protection
 - Hand protection
 - High visibility clothing
 - Other PPE as required by the task method statement
- Vehicles left unattended must be left in a safe condition and with the key removed or immobilised.
- No reversing onto public highways/roads.
- Vehicles exiting onto public roads must pass through a wheel wash or similar to ensure cleanliness standards of the local area are maintained. If the tracking of dirt onto local highways is evident from the construction site then the Principal Contractor is to immediately put in place a sufficient road cleaning regime.
- Open top lorries to be sheeted.
- Dumper operators must leave the unit when it is being loaded and keep a safe distance away if the cab does not have adequate debris protection.
- All roads and pedestrian routes are to remain clear from obstructions, parked vehicles, skips, etc.

Deliveries

- Deliveries and construction traffic should enter the site via Pencroft Way or Greenheys Lane through designated vehicle gates.
- Unless otherwise agreed with the MSP estates team, all deliveries should be during normal working hours.
- All reasonable measures must be taken to avoid congestion along the local road network, especially around Greenheys Lane where there are pre-existing resident concerns with the quantity of parked vehicles, 2 bus stops and frequent complaints of speeding motorists around a blind bend.
- Deliveries must be scheduled in advance through a booking system with the Principal Contractor to ensure congestion does not spill out onto the local road network.

3.5. Prohibitions

No pets or animals are permitted on the site at any time.

Gambling is not permitted on the site at any time.

Smoking (including e-cigarettes) - is not permitted in any building at any time and is subject to the requirements of UK law. Smoking must be done in designated shelters provided by the Principal Contractor which must be at least 10 metres away from any building.

Alcohol and illegal substances are not permitted to be opened or consumed on the site at any time. Illegal substances of any nature are not permitted on site. Breaches will be dealt with as a criminal offence under UK law.

Firearms and explosives including fireworks are not permitted on the site under any circumstance.

3.6. Safe System of Work (SSoW)

Site Boundary - Upon commencement of the works, the Bruntwood Project Manager will issue the Principal Contractor with a Transfer of Responsibility Certificate (TORC) which acts to transfer to them the SSoW management from the site owner (MSP). This TORC will include details on what specific areas, processes and systems are included in the transfer. All construction activities are to be contained within the designated development site boundary (TORC area), except for specific boundary construction works where access outside the boundary is required. Approval to proceed with these works will be required and coordinated with the Bruntwood construction team.

Permits - The Principal Contractor is to manage and operate their own permit system as part of their safe system of work (SSOW) within the defined TORC area. The processes & permits are to be located onsite and available for the Bruntwood construction team to review without any restriction or impediment.

Bruntwood Construction Inspections - Throughout the course of the project, the Bruntwood construction team and its representatives will undertake regular site inspections for the purposes of monitoring progress, workmanship & quality, health & safety standards, ensuring CDM regulation adherence and other such matters. The Principal Contractor and its appointed subcontractors are to facilitate these visits at all times without any impediment or obstruction.

Hoarding & Fencing - Hoarding is to be located on or within the site boundary. Heras fence may be required at certain times for flexibility and agility, and when installed should be double clipped with dust screen mesh and wind ports and designed to suit wind loading, etc. Daily site inspections of the hoarding and site boundary, by the Principal Contractor, and are to be logged and recorded.

Branding - All display/advertising/screening branding is to be approved by Bruntwood before installation.

4. Demolition

4.1. Site Management & Personnel

Bruntwood team involvement

- Major Projects dept. project manager
- Major Projects dept. CDM/H&S manager
- MSP Customer Operation Manager (COM)
- MSP Facilities Team Lead (FTL) and Facilities Team Members (FTMs)
- MSP Site Risk Manager

Demolition Contactor team

- Contracts manager
- Site manager [SMSTS or higher qualified]
- Site supervisor(s) [SSSTS or higher qualified]
- CDM/H&S manager
- Heavy plant operatives - including but not limited to excavator operator, crusher operator, Brock (or similar) operator, Bobcat (or similar) operator [suitably qualified in plant-specific operations]
- Trade-qualified and basic labour - directly employed and outsourced operatives.
- Waste removal sub-contractor/supplier.
- Suppliers for welfare unit, generators, temporary WC facilities, fencing, security, task lighting, light and heavy equipment.

Other key personnel

- Bruntwood Energy lead, responsible for arranging the disconnection of utilities to the various buildings.
- Service isolation contractor
 - Project/contracts manager
 - Site manager
 - CDM/H&S manager/responsible person
- AEC asbestos surveyor and analyst lead.
- Tyler Grange ecological and arboricultural project surveyors
- First Line Defence UXO surveyor and on-site supervisor for medium-risk areas (see UXO section below).

4.2. Plant and Equipment

- Demolition-specification excavators in the range 14-42t with pulveriser, shear, grab and bucket attachments.
- Scaffold towers, podiums and hop ups.
- Hand tools including but not limited to pneumatic drills, drill drivers, reciprocating saws, sledgehammers, lump hammers, bolsters, shovels, brooms, wrecking-bars and other such equipment.
- Robotic Brok breakers.
- Bobcat (or similar) wheeled or tracked plant.
- Circular saws and various sized angle grinders.
- Concrete breakers/jackhammers.
- Hydraulic MEWPs.
- Concrete pulveriser crusher.
- Segregated roll on/roll off skips for general and recyclable waste streams.
- Heras fencing panels, weighting blocks and associated fixings.
- Proprietary ballasted hoarding system.
- Tree protection "heras" in line with the Tree Report produced by Tyler Grange

- Fully bonded fuel tank with drip tray and spill kit

Plant certificates will be obtained for all plant used and copies of the certificates retained on site to demonstrate compliance with relevant legislation (e.g: PUWER, LOLER, etc.).

4.3. Welfare

Site team welfare is to be provided via a mobile welfare unit, positioned on the existing Greenheys car-park towards the eastern edge of the demolition site. Power supplies are to be self generated, water is to be connected to a temporary site supply, foul drainage will be contained and collected. The mobile welfare unit will satisfy CDM 2015 regulation requirements and provide toilets, washing facilities, drinking water, changing space, rest area, space to prepare food and eat/drink and locker storage.

4.4. Surveys

Services - A GPR survey has been carried out and is included in the appendices. Before breaking ground, contractors must CAT scan the area in question to determine the accuracy of survey information and precise location of subterranean services.

Bats & Ecology - As stated in Tyler Grange's preliminary ecology survey, there is a potential for bat roosts in some of the existing buildings scheduled for demolition and as such, prior to demolition works being instructed, a roost emergence survey will be conducted by Tyler Grange and any outcoming advice, recommendations or mitigation requirements will be complied with in full ahead of works commencing. Surveys are planned to occur in May when the survey season re-opens.

Asbestos - Ahead of works being carried out, a fully intrusive pre-demolition asbestos survey will be carried out by AEC (Airborne Environmental Consultants Ltd) across all buildings scheduled for demolition; this is being undertaken in phases to reflect the occupation level of the existing buildings and is not complete at the time of writing this plan due to the existence of tenants in the existing Greenheys Business Centre and Greenheys Lane properties. The final phase of intrusive surveys will be undertaken post the final tenant vacating the property, which is anticipated to be in early June 2023.

If any asbestos containing materials (ACM's) are discovered through these surveys then an appropriate removal plan will be put into action, as outlined in the principles below. All applicable regulations including but not limited to the Construction (Design and Management) Regulations 2015 and Control of Asbestos Regulations 2012 will be adhered to in full regarding process, procedure, notices and qualifications.

Site investigation - A phase 1 site investigation report exists for the site as included in the scheme's planning application and PNoD. A phase 2 site investigation survey is underway at the time of creating this plan and a respective report is expected to be completed by May 2023. Findings of this survey may impact the strategy of demolition and extent of subterranean removals. All and any mandatory recommendations made through the Phase 2 site investigation will be complied with in full if relevant to the demolition phase of the project.

UXO - A UXO assessment has been undertaken for the site which establishes the majority of the area to be low-risk, with a medium risk zone in the south west corner of site. Recommendations are made in this report (contained within Appendix F) including

training briefings for construction operatives involved in excavation works and the appointment of a UXO surveyor to oversee below ground works in the medium risk zone, all of which will be adhered to in full.

4.5. Asbestos

At the time of creating this plan, the first phase of intrusive asbestos surveys across the buildings being demolished is underway, however the final phase of survey is not expected to conclude until June 2023 once vacant possession of the properties is achieved - the intrusive nature of the surveys makes it impractical to undertake whilst tenants remain in situ. Any ACM's discovered through these surveys will be suitably removed following the process outlined below and in strict adherence to the requirements of the Control of Asbestos Regulations 2012.

- All and any ACMs, regardless of category of risk and minimal regulatory removal requirements, will be exclusively handled by a licensed asbestos removal contractor - either directly appointed by the client or sub-contracted by the selected demolition contractor subject to client's express approval and demonstration of competence and capability.
- Any work involving the disturbance and removal of asbestos will be in strict adherence to the guidance of HSG 247 and ACoP L143.
- Any operative involved in the purposeful disturbance or removal of an ACM - regardless of whether such works is deemed non-licenses or licensable - will be suitably trained and qualified as a licensed asbestos contractor.
- All licensed and notifiable asbestos works will only be carried out following the submission of an ASB5 notice to the HSE and lapsing of the required notification period.
- Prior to the commencement of asbestos removals a detailed asbestos removal plan will be submitted to, and approved by, the Bruntwood Major Project's CDM team; this plan will be inclusive of thorough risk assessments, method statements, details of training of personnel, records for face-fit test RPE items, proposals for the provision of specialist welfare, safety controls for the reoccupation of respective areas and other such matters.
- Prior to areas of asbestos removal being reoccupied following licenced removal works, a Certificate of Reoccupation will be issued upon completion of a four-stage process undertaken by a suitably trained and qualified analyst. This process will involve thorough visual inspections of the work area, transit routes, waste areas, decontamination units followed by air monitoring inside the working area enclosure ahead of it's dismantling and disposal; NB. air test results must not show an airborne concentration of greater than 0.01fibres/ml.
- All demolition operatives not involved in the removal or purposeful disturbance of asbestos will hold at least UKATA Asbestos Awareness training (or equivalent standard) dated within the prior 12 month period.

4.6. Works Sequence

Prior to commencement of works:

Undertaking in full of the intrusive prior demolition asbestos survey, phase 2 site investigation survey, bat emergence survey and UXO surveys. All mandatory recommendations and requirements outcoming from these surveys and reports will be completed in full prior to the commencement of demolition works.

Operation No 1: Services isolation

Before the strip-out and demolition of Greenheys Business Centre and adjacent properties takes place all local/internal services will be isolated and decommissioned by suitably competent engineers. This will take place following vacant possession of all properties and non-exhaustively include LV power, data comms, alarm systems, security systems, open and closed loop water services, waste pipework services, refrigerant systems, heating and cooling systems and other such service media. All service isolation certificates will be handed over to the demolition contractor before demolition commencement.

Operation No 2: Utility Disconnections

Alongside the local services disconnection, incoming utilities to the properties will be disconnected by the relevant and respective service providers. These services include;

- Power; ENW are the infrastructure provider and will manage the disconnection of the various supplies to the Greenheys Business Centre and No7/9 Greenheys Lane terrace properties.
- Water; Waterplus will manage the disconnection of water supplies to the Greenheys Business Centre and No7/9 Greenheys Lane terrace properties.
- Gas; GTC will manage the disconnection of gas supplies to the Greenheys Business Centre and No7/9 Greenheys Lane terrace properties.

The McDougall centre furniture store building scheduled for demolition has been surveyed and evidently takes its service media feeds from infrastructure in the adjacent buildings which are being retained. Disconnection of services in the areas of demolition will therefore be achieved by local services isolations (operation no.1) and not require utilities disconnections from statutory providers.

Operation No 3: Demolition Site Set-up

The boundary of the site will be established through fencing as per the comments and site plan in section 2.3 of this plan. Fencing will also be established around specified trees for protection as recommended in Tyler Grange's arboricultural reports and rhino barriers will be used to create safe walkways and traffic routes. Warning signs will be displayed at the appropriate points around the perimeter of the site to deter unauthorised access. A mobile welfare unit will be set-up on site, providing all the amenities as outlined in section 4.4. Prior to demolition and construction works commencing, a Construction Phase Plan and supporting documentation will be submitted to the Bruntwood Major Project CDM's team for review and approval. Prior to any works commencing on site and before any structural demolition works a thorough, systematic search of the building is to be undertaken by the Contractor's site manager to ensure no trespassers, other unauthorised persons or site personnel are within the building. The integrity of the exclusion zone will be checked at the beginning and end of every working day and after breaks to ensure, so far as it is reasonably practicable to do so, that no person is within the remains of the building. Once demolition has commenced no person is to enter the buildings.

Operation No 4: Soft Strip

Upon completion of the pre demolition asbestos survey, undertaking of any outcoming asbestos removals and issue of reoccupation certificates, the internal strip out of the properties will commence. Safety controls as established in the Construction Phase Plan and task specific RAMS will be implemented and maintained through the duration of

strip-out works. Tool box talks will be delivered on pertinent subject matters at the commencement and throughout the duration of the strip-out works.

The internal strip-out scope will non-exhaustively include the removal and disposal of decommissioned building service media and associated appliances, ceiling finishes, floor finishes, loose and fixed furniture, residual equipment from the use of the building and internal/external joinery items (i.e. doors, windows, skirting, etc.). Outcoming strip-out materials will be sorted and segregated through material-specific waste skips for the benefit of recycling.

The outline sequence of works is expected to be as follows:

- Working systematically away from the building's access points, fixed and loose furniture and equipment will be transferred - by pallet truck or similar device to minimise manual handling - into an exclusion zone externally where it will be mechanically re-handled into a skip for subsequent removal to a recycling facility.
- Using hand tools (see below), internal and external joinery - nonexhaustively including doors, windows, skirtings, panelling, non-structural timber, cubicles and such like - along with redundant items of building servicing will be removed from the properties and moved externally for mechanical or physical rehandling into material-specific skips for subsequent removal to a recycling centre. Appropriate working at height equipment will be employed where required and regularly inspected when in use. Movement of waste items resulting from this process will be via trolleys, pallet trucks, wheeled bins and wheeled cages.
- Using hand tools, wall, ceiling and floor finishes will subsequently be removed and disposed of via the same means as above.
- Where deemed practicable and safer to do so by virtue of reduced manual handling, some items of strip-out as outlined above may be left to the main demolition phase where items of equipment, joinery or redundant service media can be extracted and moved to skips using demolition specific plant fitted with appropriate attachments - such as excavators with grab attachments.
- Where the above cannot be applied to specific tasks, the demolition contractor will generate task-specific RAMS to ensure all given tasks are completed safely and by appropriately trained personnel.
- Once the strip-out works have been completed and approved by the site manager, the properties will be signed off for demolition.

A non-exhaustive list of the tools, plant and equipment expected to be used for soft strip works:

- Scaffold towers, podiums and hop ups.
- Scissor lifts and other internal MEWPs.
- Hand tools including but not limited to pneumatic drills, drill drivers, reciprocating saws, sledgehammers, lump hammers, bolsters, shovels, brooms, wrecking-bars and other such equipment.
- Pallet trucks
- Circular saws and various sized angle grinders.
- Floor scrapers.

Operative PPE will non-exhaustively include the following as a minimum, with further specific items of PPE required to higher risk activities:

- Safety boots
- Safety gloves
- Eye protection

- Hearing protection
- High-vis jacket
- Hard hat

Operation No 5: Demolition of buildings

There are 4 buildings on site which will be demolished, identified as per Fig5 below. Building 1 is also referred to as the Greenheys Business Centre, Buildings 2 & 3 are also referred to as No.7 and No. 9 Greenheys Lane respectively and Building 4 is also referred to as the McDougall Centre Furniture Store.



Fig5: Overview of buildings scheduled for demolition.

Building No 1 is a two storey building for the most part with a small section being 3 stories. The make up of the building consists of a mixture of timber and steel pitched roof with corrugated roofing panels, double skin brick walls sat on a concrete base. Building No 2 and 3 are two storey terraced houses which consist of a timber pitched roof with concrete roof tiles, double skin brick walls sat on a concrete base. Building No 3 is connected via flashing to an adjoining property (an existing garage outside of the demolition site boundary and under separate ownership). Building No 4 is a single story brick building which has been extended from its eastern elevation since first construction; both the main building and extensions will be demolished.

Ahead of all demolition works, the properties will first be thoroughly inspected and cleared by the demolition site manager for any site personnel and unauthorised persons.

Demolition of Building No 1: Upon completion of asbestos removals and strip-out works, the demolition scope will commence. The demolition of this building will be undertaken by a combination of mechanical means as well as by hand in a more sensitive area. The areas using mechanical machinery will use demolition-specification excavators with

appropriate attachments - including pulverisers, hydraulic breakers, grab attachments, buckets. The area surrounding will be segregated into drop zones and established using appropriate signage and heras fencing. The sections to be taken down by hand will follow the manual handling safe system of work established in the Construction Phase Plan. There will be a site security guard and entry will be restricted to demolition personnel only. Banksman will be positioned at points outside of the demolition zone to ensure no unauthorised access to the demolition zone is allowed during the demolition of the building. The scope of demolition works as attached to this plan will be followed and the below outline sequence is expected. The appointed demolition contractor will reserve the right to modify the sequence and method of works as appropriate.

Using a selector grab attachment on a demolition-spec excavator the contractor will systematically remove sections of the building's roof coverings and structure, and subsequently fold-in sections of the building's external and internal walls, allowing all arisings to fall into the building footprint and onto the building's concrete ground slab. Upper floors will be removed by excavators with selector grab, pulverizer and breaker attachments. During this process the operator will grab and remove any metal roofing/cladding, doors, windows and other such specific items and either place them directly into skips or set aside from the immediate works area for processing and loading into skips at a later stage. The contractor will sequentially follow this process around the general area of the building allowing all arising to fall inward of the building's footprint. Trained and experienced banksman will be on-site at all times during the operation of the excavator and other heavy demolition plant.

The west elevation of building 1 is directly adjacent to a public footpath, and this section will be taken down with care to avoid risk of injury to the public. Subject to a specific method statement from a demolition contractor, it is expected that a scaffold licence will be obtained, system scaffold erected on the Greenheys Lane footpath with netting and crash-decks, and the west elevation subsequently demolished by hand with waste materials being 'pushed' into the building's footprint. Subject to further risk assessments, the demolition contractor may apply for temporary footpath and/or lane closure on Greenheys Lane during the undertaking of this element.

Once the building has been fully demolished all the general waste, wood, metal etc. will be segregated and placed into appropriate skips. Low-value bricks, floor slabs and other such materials will be transferred to a crusher, crushed and stockpiled for use in the subsequent development's ground works (e.g. employed for use in the pilemat or subbase). Any external bricks deemed of higher value will be more carefully removed and prepared for reclamation salvage.

Demolition of Buildings No 2 and 3: The demolition of these terrace properties is largely expected to follow the process of building no 1. Access to the east of the properties will be gained for heavy plant (i.e. excavators with attachments) for demolition by mechanical means, and removals on the western edge closer to the Greenheys Lane footpath will be undertaken by hand. Unlike building no 1, the west elevations of buildings 2 and 3 do not sit directly on the public footpath edge, and so a safety buffer zone can be established through heras fencing without the need for highway/footpath licences.

Extra care and precautions will be taken for the demolition of the most northern wall of buildings 2 and 3 which are directly adjacent to a retained building under separate ownership; demolition in this area will be exclusively by hand and include extra safety controls such as crash decks to avoid the risk of debris falling outside of the building 2/3 footprint and causing damage to retained buildings.

Demolition of Building No 4 : The majority of the building consists of a single storey brick and steel beamed structure with a heavily fenestrated frontage. There is also a single storey section which has been added onto the property at a later stage which has a timber joisted flat roof. There is an existing wall to be retained which separates the areas scheduled for demolition and retention; this wall is structurally isolated from the areas for demolition and is believed to have formerly been an external wall. As such, structures will be removed up to the point of this wall. External grade doors and windows will subsequently be installed (where not already existent) to the retained elements of the building to ensure a weathertight and secure property. Access can be gained on all exposed east/south/west elevations for heavy plant to allow demolition by mainly mechanical plant means. Exclusion zones will be established around the boundaries of the property and demolition will largely follow the processes set out for buildings 1-3. Rainwater goods will be adapted as required post demolition of the specified areas to ensure surface water is suitably drained to the below ground network.

4.7. General Comments

- The awarded contractor must at all times whilst on site comply with the requirements of the Health and Safety at Work Act 1974, the Construction (Design and Management) Regulations 2015 and all other relevant safety legislation codes, standards and guidance.
- The awarded contractor must be familiar with the British Standard B.S 6187 Code of Practice for Demolition 2011 which has been referred to during the preparation of this document.
- All site personnel are to hold a CSCS card as a minimum. Trade-specific competence qualifications will be required and randomly checked throughout the duration of works by the Bruntwood Major Projects CDM team.
- All waste removals will be accompanied by a duty of care waste transfer note which describes the waste. Copies are to be retained on site. The contractor will stipulate a waste and recycling plan prior to commencement of works.
- The demolition contractor will ensure all plant and equipment is fit for purpose, checked/serviced within the required maintenance period.
- Working hours will be in compliance with the relevant law and local regulations.
- The demolition contractor will monitor the condition of the local highway when HGV's are leaving the site. Jet/wheel wash facilities will be installed if necessary.
- All visitors will receive an induction from the site management team before being admitted access to the site. During the induction, the current activities will be described so as to assist visitors in anticipating the presence of mobile plant and hazards around the site. Visits by non-operatives will be hosted and chaperoned by a suitable member of the demolition site team.

5. Environment Management

5.1. Dust

The Principal Contractor's site is located within MSP, which encompasses a collection of occupied buildings and is directly adjacent to residential dwellings, places of worship and a primary school. These occupied buildings and local roads are considered to be sensitive receptors which may be adversely affected by the generation and dispersion of dust, resultant from construction activities. Nevertheless, it is also recognised that in periods of high winds the receptors affected by wind-blown dust could be areas further away than those mentioned if suitable dust mitigation measures are not implemented.

The generation of dust outside of the site boundaries is a potential source of statutory nuisance and can lead to complaints being received which may be actionable through legal proceedings. Furthermore, dust can also have an impact on human health and similarly the local ecology.

Potential sources of dust during construction activities could include:

- Site clearance
- Ground excavation and earthworks
- Earth moving operations
- Site levelling
- Vehicle movement (especially on rough ground)
- Cutting, grinding, drilling etc. operations
- Stockpiling of excavated materials
- Unintentional spillage and loss of load from vehicular transportation
- Tipping

Nuisance caused by the generation of dust could be exacerbated by prevailing winds and a prevailing climate.

It is believed that particulate dust emissions from construction activities have the potential to impact on local site users and the local ecology and as such, mitigation and control measures should be implemented to minimise or totally negate this impact.

On-going monitoring should be undertaken by construction supervisors at regular intervals to assess the level of dust which escapes the site boundaries and settles in the nearby vicinity. Any received complaints regarding fugitive dust should be logged and dealt with appropriately.

With regards to mitigation measures, the following have been identified as appropriate actions:

- Ensure construction traffic follows specifically designated routes, is limited to slow speeds and is covered if transporting loose materials.
- Introduce a wheel-wash facility for vehicles leaving the site.
- Regular road sweeping should be carried out, the frequency of these will be determined by the site activities taking place.
- Damp down or enclose stockpiles as appropriate. It may be necessary to spray with chemical bonding agents to prevent the escape of fugitive dust.
- Site stockpiles away from sensitive receptors as identified above.

- Introduce enclosures where safe and practicably possible around activities which are deemed to generate high levels of dust.
- Cutting and grinding should employ dust mitigation measures where possible (i.e. wet cutting).
- Complete prohibition of burning of any materials on the site.

5.2. Noise

Similar to the ramifications of excessive dust noted above, excessive levels of noise outside the construction site boundaries can constitute a statutory nuisance and lead to complaints and potential subsequent legal action. The sensitive receptors to noise have been identified as the same as sensitive receptors for dust. Tenants, customers and users of MSP are gifted the legal right to free use and enjoyment of their relative demises which could be impeded by the intrusion of excessive noise. Additionally, excessive noise which is produced from construction activities can disrupt the balance of the nearby ecology.

A simple control measure to limit the exposure of the nearby population to noise would be to perform 'noisy' and disruptive works outside the usual working hours for the site, however, it is also imperative that construction works do not impact on the nearby domestic population. Therefore, any works which are considered to be excessively loud should be communicated to supervision and managerial staff at Bruntwood to procure a sensible and appropriate way forward.

Control measures which should be implemented, as necessary, are listed below and are based on guidance from the BRE Pollution Control Guide: Part 1- Pre-project Planning and Effective Management:

- Acoustic barriers to be implemented for static activities where necessary and practicable.
- All construction plant and machinery must comply with EU noise emission limits.
- All vehicles used for construction purposes should be fitted with effective exhaust silencers and attenuators.
- All generators should be 'sound reduced' models and fitted with acoustic covers.
- Ancillary plant should be positioned so as to cause minimum noise disturbance to identified sensitive receptors.
- Drop heights of materials should be minimised.
- No plant or machinery should be left running unnecessarily..

5.3. Vibration

The issue of vibration and suggestive implemented measures of mitigation and control is closely linked to the above matter regarding excessive noise. As such, it is likely that by diligently controlling the emission of noise, the contractor will inherently limit the emission of vibration which could constitute a statutory nuisance if it adversely affects the nearby population or ecology.

5.4. Light Disturbance

During certain periods of the year, it will likely be necessary to unnaturally light the construction site, construction office, roads, complexes etc. for safety and accessibility reasons. It is likely that this lighting could impact the nearby population or wildlife, and needs noting that unnecessary light emission could affect drivers who pass the site if such lighting is unsuitably positioned/aimed.

A sensible mitigation measure for light related nuisance would be to limit construction activity times to daylight hours and angle all site lighting appropriately so as not to purposely aim beams of light outside of the construction site boundaries.

5.5. Waste Management

The Principal Contractor is to develop and implement a site waste management plan (SWMP) which describes the procedures for the management of waste arising from the construction activities. The SWMP shall comply with the relevant regulatory standards.

5.6. Vermin

Maintenance of a clean and tidy site including vermin control is essential. All appropriate pest control measures are to be adopted as necessary by the Principal Contractor.

5.7. Water

Under no circumstance can it be allowed for any contaminants to enter the local water courses, notably including the surface water culvert in Greenheys Lane. Regular inspections should be carried out to ensure no stored chemicals, stockpile materials, plant/machinery fluids etc. are leaking or being carried into the nearby water courses, especially during and after occasions of heavy rainfall. Appropriate spill kits, bunding, etc. shall be designed and provided to ensure that there is no risk of contamination/run-off etc, in to the canal. If it is noted that any water courses have become contaminated, this must be brought to the attention of the Bruntwood construction team immediately, and the relevant Authorities notified.

5.8. Site Roads

All vehicles leaving the construction site are to be inspected by the Principal Contractor to ensure that loads are appropriately covered/protected to prevent debris being dropped on the site road.

The principal contractor is to perform daily road inspections of the roads directly around the site which include (non-exhaustively) Greenheys Lane, Pencroft Way, Burlington Street and Denmark Road.

Any vehicle reversing off site is to be managed by a suitably qualified Banksman. No unloading of vehicles is permitted on Greenheys Lane or Pencroft Way.

Appendix A - MSP Contractor Site Rules

bruntwood

Contractor Guidelines

Building Rules

1. All contractors must ensure they complete a site induction/pre-start meeting prior to undertaking works.
2. Day to day maintenance/reactive contractors can access the building via signing in at Greenheys with our FTM team where they will either receive keys or be given access by our team. Once the works are completed, contractors are required to sign out using the same process.
3. Asbestos: During the induction the contractor is to review the building asbestos register to suitably identify the location of any asbestos containing materials within the premises. They must then sign and date the asbestos acknowledgement sheet.
4. Fire Alarm: Prior to commencing works on site if required all fire detection systems should be suitably isolated and covered in agreement with the Customer Operations Manager/Facilities Team Leader and weekly fire alarm testing confirmed with the contractor during the induction process.
5. Any high risk procedures (e.g. hot works) and works that are likely to interfere with the fire alarm system must be arranged in advance with the Customer Operations Manager/Facilities Team Leader. The necessary permits to work will be produced before any procedures commence.
6. Access is limited between 6.00am – 6.00pm Monday to Friday. Out of hours works may be permitted ONLY by prior arrangement with the Customer Operations Manager/Facilities Team Leader with at least 2 working days' notice.
7. If access to occupied suites is required arrangements must be made with the Customer Operations Manager/Facilities Team Leader in advance of attendance.
8. Drilling and loud hammering will only be permitted up to 8.00am and after 6.00pm. Should you need to carry out noisy works within the working day a confirmed timeframe between 12.00pm - 2pm would need to be approved in advance with both the Customer Operations Manager/Facilities Team Leader and the customer affected.
9. Lifts must only be used with prior consent from the Customer Operations Manager/Facilities Team Leader and only with adequate protection to the lift car where necessary..
10. Deliveries are to take place as discussed in the pre-start meeting and must be signed for by the contractor.
11. All materials are to be stored in designated areas only. Materials, tools or access equipment are not to be left unsupervised at any time. Fire escapes, stairwells, landings, doorways and corridors are to be kept CLEAR AT ALL TIMES.
12. All waste is to be cleared from site as agreed in the pre-start meeting.

13. Parking on site is restricted to visitor parking bays located in Greenheys car park and is at the discretion of the Customer Operations Manager/Facilities Team Leader.
14. Food or drink must not be consumed in any part of the building except in the allocated welfare facilities.
15. There is no on-site facility for making phone calls and therefore mobile phones need to be issued if required by the contractor.

Contractor Code of Conduct

1. Staff must wear their company uniform in smart/ clean condition and wear a company name badge.
2. All relevant personal protective equipment (PPE) with the company name clearly displayed to be provided by the contractor and must be worn in designated areas at all times.
3. Smoking is strictly prohibited in any part of the building. There is no designated smoking area and you are not permitted to smoke in front of any of the entrances or around the perimeter of the building.
4. Use of radios or stereo equipment is not permitted on site at any time.
5. Welfare facilities and designated toilets will be agreed in the pre-start meeting. No other facilities are to be used. Contractors must keep these toilets in a clean and tidy condition. Misuse will result in the facility being withdrawn.
6. Unruly behavior, shouting, swearing or spitting will not be tolerated under any circumstances. We undertake regular reviews of all working areas and contractors that are found not to be adhering to the above rules may be asked to leave the site immediately.

Sarah Roche - Customer Operations Manager - 07949 516 382

Dave Jones - Facilities Team Leader - 07967 740 216



Appendix B - Existing Site Images



Image 1: West elevation of buildings 1, 2 & 3.



Image 2: West elevation of buildings 1, 2 & 3.



Image 3: North elevation of building 1 and west elevation of building 4 visible behind fencing.



Image 4: South-east section of building 1 and adjacent car park (within demolition site).



Image 5: East elevation of building 1. East elevation of building 4 visible in back ground.



Image 6: Service yard in west section of building 1.



Image 7: South elevation of building 1.



Image 8: South elevation (eastern portion) of building 1.

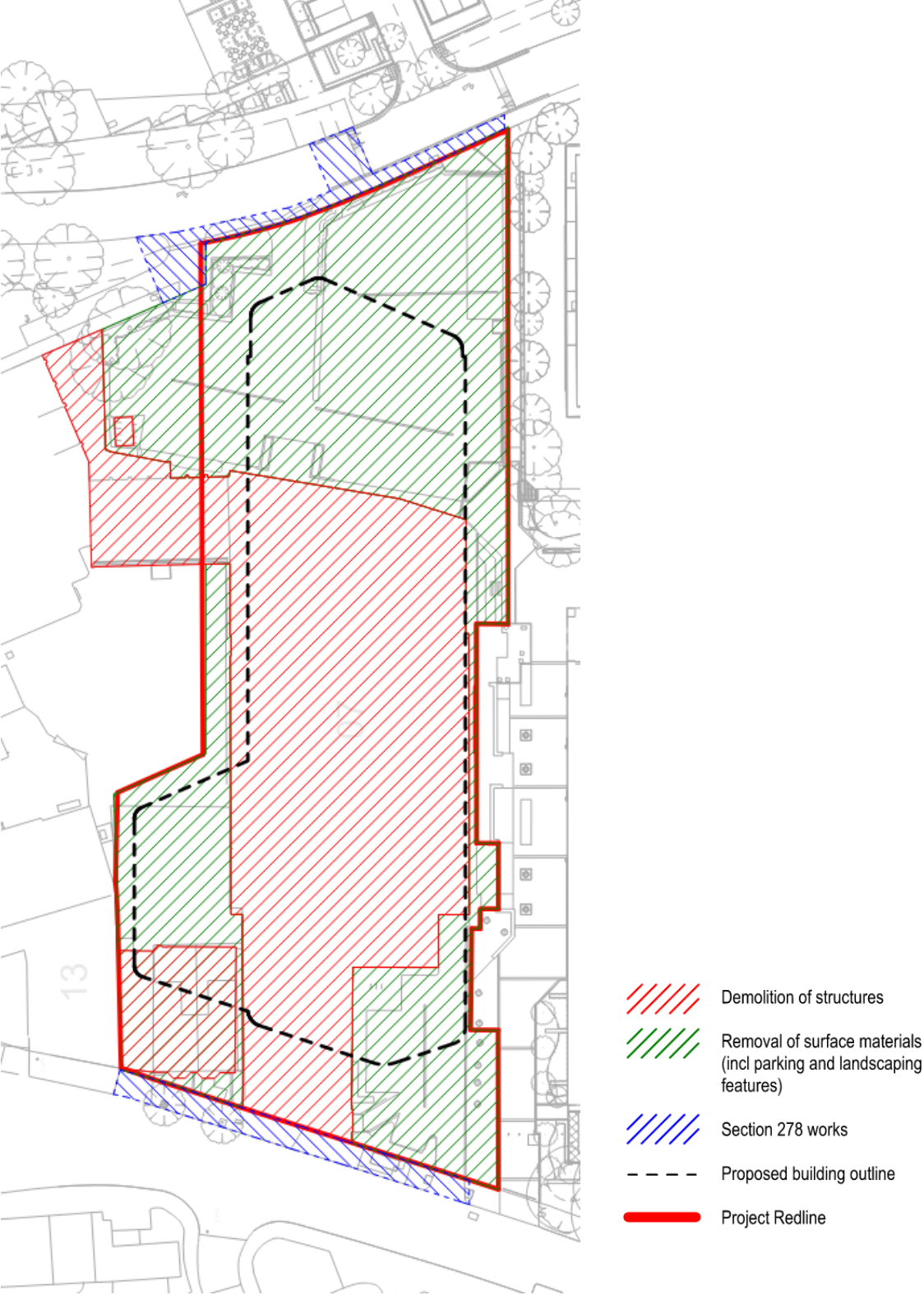


Image 9: South elevation (western portion) of building 1.



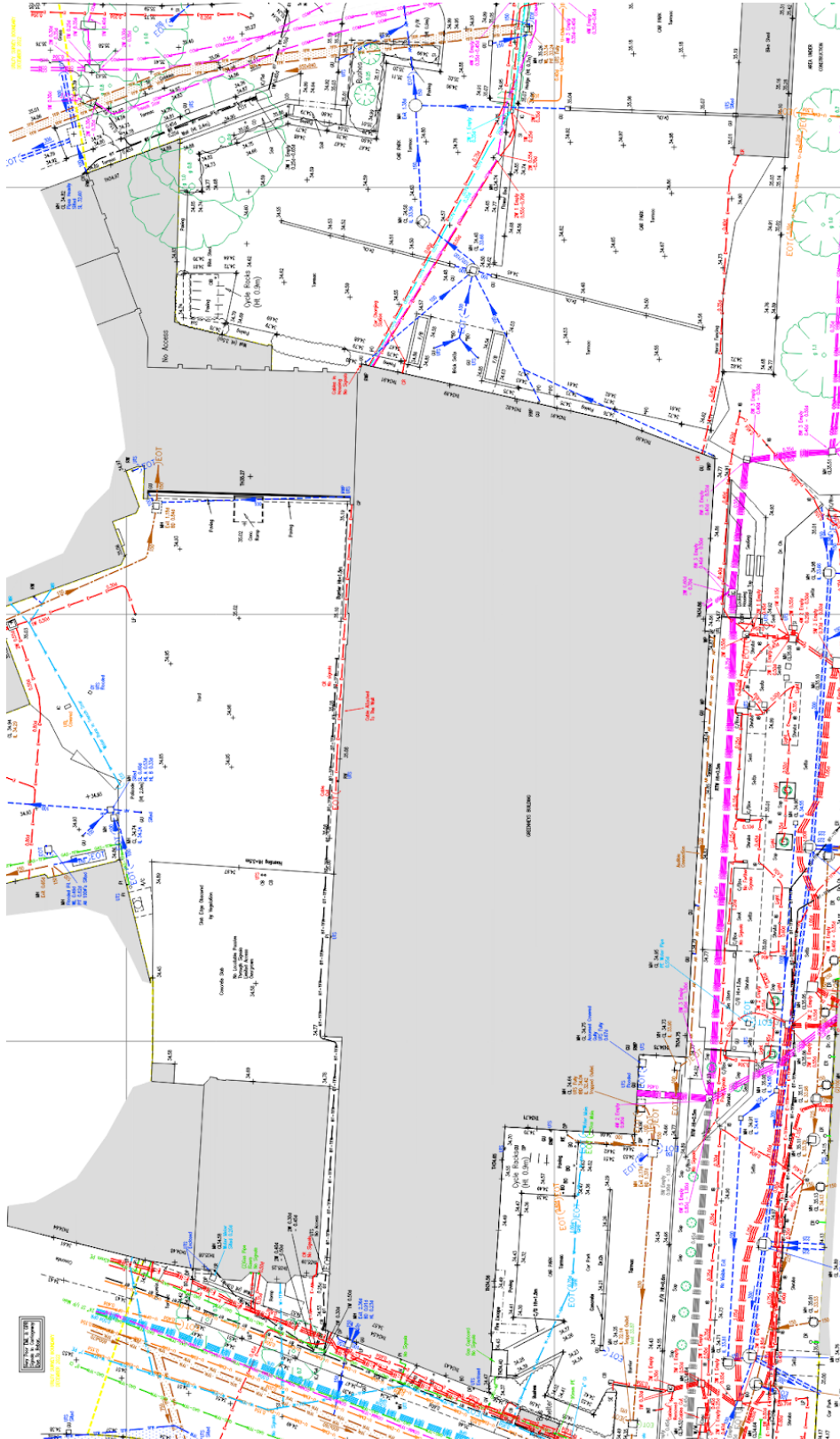
Appendix C - Demolition Plan

For further details see BDP plan GRE-BDP-ZZ-XX-DR-A-04-001 P04



Appendix D - GPR Survey

For further details see ND Oliver plan 9872/005/2-Rev0.





Appendix E - Demolition Scope

Specification No:	Date:
DW2325-D-1-P02	24th February 2023
Project:	
Greenheys Redevelopment Manchester Science Park Demolition Specification	
Client:	
Bruntwood SciTech Limited	

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Signature:



Report status: **Second Issue**

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Date: 24th February 2023

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CONTENTS

1.0	General Requirements and Specific Considerations
2.0	Services Affected by Demolition
3.0	Demolition Work
4.0	Site
5.0	Materials Arising



DEMOLITION

This Specification is to be read with all relevant Preliminaries and General Conditions of Contract

GENERAL REQUIREMENTS

110 DESK STUDY/ SURVEY

Scope: Before starting demolition work, examine available all available information, carry out a survey of the structures, site and surrounding area.

Submit a report and method statements in pdf format describing:

- Form, condition and details of the existing structures, site and surrounding area.
- Extent: The demolition extent is to include the existing Greenheys Buildings together with the terraced properties at No's 7 & 9 Greenheys Lane, the existing furniture store and the small single storey ancillary buildings between the furniture store and the former sports hall and is to include all walls, columns, beams, pitched roofs, flat concrete and timber roofs, suspended concrete, pre-cast concrete and timber floors and grubbing up all walls, slabs and foundations to MINIMUM 900mm below existing ground level.
- Form, location and removal methods of and flammable, toxic or hazardous materials found to be present on site.
- Form, location and removal methods of materials for reuse or recycling.
- Type and location of adjoining or surrounding premises which may be adversely affected by noise, vibration, dust or removal of structure.
- Identification and location of services above and below ground, including those required for the Contractor's own use. Confirm arrangements for disconnection and removal of services.
- Type and location of features of historical, archaeological, geological or ecological importance.
- Sequence and method of demolition
- Arrangements for protection of personnel and the public, including exclusion of unauthorized persons.
- Arrangements for control of site transport and traffic.
- Proposed programme of work.
- Special requirements.

115 EXISTING BUILDING CONSTRUCTION

The buildings are of differing constructions.

Greenheys Building comprises 3 separate building forms:-

- Single storey front section comprising dual pitched roof formed with steel trusses, supported on steel posts embedded in the brickwork side walls.
- Main office building comprising dual pitched roof formed with steel trusses again supported on steel posts embedded in brickwork and blockwork walls. Mezzanine floors have been installed to the majority of the floorplate using pre-cast concrete floor units, generally supported on loadbearing masonry walls.
- Rear 2 storey office area is constructed with in-situ concrete columns and beams supporting suspended concrete floor and flat concrete roof. There is a small basement beneath this area containing plant.
- Ground floor to all buildings is cast in-situ concrete slabs.
- The front building and main office building were originally constructed as bus garages and floor pits etc may be present. In addition, the demolition contractor should anticipate that there may be oil / fuel contamination in the ground due to former uses of the buildings.

No's 7 & 9 Greenheys Lane

- 2 storey 'domestic' type construction comprising loadbearing masonry walls supporting timber upper floor and roofs.

Furniture Store

- Single storey high building comprising steel frame supporting a flat woodwool slab roof.

Ancillary Buildings

- Small single storey flat roof structures constructed with masonry walls and timber roofs.

120 EXTENT OF DEMOLITION

General:

- Demolish all existing Greenheys buildings including all floor slabs. Building walls and structures are to be demolished to at least 900mm below ground level.
- Demolition of No 7 & 9 Greenheys Lane must fully consider the adjacent garage property at No's 1-5 Greenheys Lane, as the garage will remain operational during the demolition works.
- Demolition of the furniture store and small ancillary buildings, taking full consideration that the former sports hall building is to remain and will be operational during the demolition works.
- At proposed new foundation and lift pit locations, any existing foundation are to be fully grubbed up and all existing foundations must be removed to at least 1m below the proposed finished ground floor level.



Aerial view from East indicating structures to be demolished and the Garage and Sports Hall buildings that are to remain occupied during the works

125 SPECIFIC CONSIDERATIONS

Demolition of No 7 & 9 Greenheys Lane

- Demolition of No 7 & 9 Greenheys Lane must fully consider the adjacent garage property, which will be operational during the demolition process.
- The 'link' between No 7 and the garage appears to be the infill of a former road access, constructed with suspended timber joists at first floor level and timber trusses at roof level. The floor joists and roof trusses are supported on the boundary wall to the garage and therefore this section must be propped and carefully dismantled to avoid ANY damage to the party wall. In addition, the garage roof must be protected to prevent any demolition materials falling through or damaging the roof coverings. It must also be noted that the first floor joists and floor are in very poor condition due to water ingress through the roof over many years.



Underside of first floor joists



Roof trusses



Street elevation.

Note the party wall between the garage (No 1-5) and No 7 Greenheys Lane extends above the garage roof level and therefore great care must be taken to ensure the safety of the occupiers of the garage and the garage building and roof.

Demolition of Furniture Store and Ancillary Buildings

- Demolition of the furniture store and small ancillary buildings must fully consider the adjacent sports hall building, which will be operational during the demolition process.
- Doorways between the sports hall building and the ancillary buildings / furniture store must be fully sealed prior to demolition commencing by construction of cavity masonry walls.

Hard Landscaped Area to South of Greenheys

- The recently completed landscaped area to the South of the Greenheys Buildings contains drainage that must not be affected by any demolition materials, debris or dust. In addition, the soft landscaping immediately to the South of the Greenheys Building contains fibre optic cables which serve the whole campus and these MUST NOT be damaged in any way.

Surrounding Streets & Footpaths

- The site is bounded by footpaths and highways and consideration must be given in relation to protection of the public and the local infrastructure during the works. This includes applying for any temporary road / footpath closures as required.

130 GROUNDWORKS

- General: As below.
- Under Proposed Buildings - Old foundations, slabs and the like: Break out to a depth of at least 900mm below proposed formation level.
- At new foundation and lift pit locations fully grub up any relic foundations down to natural strata to prevent obstructions during the proposed piling works
- Under Proposed Car Park Areas and Hardstanding's - Demolish all structures down to approx. 450mm below proposed formation level.
- Contaminated material: Remove and carry out remediation as instructed by the client or required by the Local Authority.

140 BENCH MARKS

- Unrecorded bench marks and other survey information: Give notice when found.
- Do not remove or destroy.

SERVICES AFFECTED BY DEMOLITION

210 SERVICES REGULATIONS

- Work carried out to or which affects new or existing services: Carry out in accordance with the Byelaws or Regulations of the relevant Statutory Authority and with full agreement with Manchester Science Park.

220 LOCATION OF SERVICES

- Services affected by the Works: Locate and mark positions.
- Mains services: Arrange with the appropriate authorities for location and marking of positions.
- Standard: In accordance with National Joint Utilities Group (NJUG) 'Guidelines on the positioning and colour coding of underground utilities' apparatus'.
- Refer to Desktop Utility Search dated 11/03/2019 and Underground Utility Survey drawing 08074 / 003, both prepared by Messrs. N D Oliver together with any more recent surveys.

230 DISCONNECTION - ARRANGED BY CONTRACTOR

- General: Arrange for disconnection of services with the appropriate authorities for disconnection of services and removal of fittings and equipment prior to demolition as follows: Gas, Water, Electricity, Fire Alarm system, IT Cabling, Intruder Alarm system, Telephone system.
- Timing: Do not start demolition until disconnections are completed.

240 DISCONNECTION OF DRAINS

- General: Locate disconnect and seal disused drain connections. Refer to DW Consulting drainage drawing.
- Sealing: Within the site and permanent.

250 DRAINS STILL IN USE

- General: Protect drains, manholes, inspection chambers, gullies, vent pipes and fittings still in use and ensure that they are kept free of debris.
- Damage: Make good damage arising from demolition work. Leave clean and in working order at completion.

270 SERVICES WHICH ARE TO REMAIN

- Damage: Give notice and notify service authority or owner of damage arising from the execution of the works.
- Repairs: Complete as directed, and to the satisfaction of the service authority or owner.

DEMOLITION WORK

310 WORKMANSHIP

- Standard: Demolish structures in accordance with BS 6187.
- Operatives:
 - Appropriately skilled and experienced for the type of work.
 - Holding or in training to obtain relevant CITB Certificates of Competence.
- Site staff responsible for supervision and control of work: Experienced in the assessment of risks involved and methods of demolition to be used.

320 GAS OR VAPOUR RISKS

- Precautions: Prevent fire or explosion caused by gas or vapour.

330 DUST CONTROL

- General: Reduce airborne dust by periodically spraying demolition works with an appropriate wetting agent. Keep public roadways and footpaths clear of mud and debris.
- Lead dust: Submit method statement for control, containment and clean-up regimes.

340 HEALTH HAZARDS

- Precautions: Protect site operatives and general public from hazards associated with vibration, dangerous fumes and dust arising during the course of the Works.

370 PARTLY DEMOLISHED STRUCTURES

- General: Leave in a stable condition, with adequate temporary support at each stage to prevent risk of uncontrolled collapse. Keep safe outside working hours.
- Temporary works: Prevent debris from overloading.
- Unauthorised persons: Prevent access with adequate fencing etc.

380 DANGEROUS OPENINGS

- General: Illuminate and protect. Keep safe outside working hours.

390 ASBESTOS CONTAINING MATERIALS

- General: The Contractor shall fully take into consideration the Asbestos Registers for the buildings. The Contractor must also be vigilant regarding any currently unknown asbestos materials within the buildings and site, and these should be reported to the Client if found.
- Remove any asbestos containing materials found in accordance with all appropriate and statutory procedures and requirements.
- Methods for safe removal: Submit details and statutory risk assessments.

391 ASBESTOS CONTAINING MATERIALS

- Discovery: Give notice immediately of suspected asbestos containing materials discovered during demolition work. Avoid disturbing such materials.
- Methods for safe removal: Submit details and statutory risk assessments.

395 SURROUNDING & ADJACENT BUILDINGS

- The Greenheys Buildings and No's 7 and 9 Greenheys Lane are part of Manchester Science Parks and all surrounding buildings are fully occupied, some with sensitive equipment and uses that would be affected by any heavy vibrations. In addition, residential accommodation exists on Greenheys Lane and there is a large and busy mosque to the South.
- The Contractor must carry out dilapidation surveys of all surrounding buildings and the demolition works MUST be carried out in a manner that does not cause excessive vibrations.
- The Contractor should allow for vibration monitoring to the surrounding buildings.
- Working hours must be agreed with the Client.

SITE

410 UNFORESEEN HAZARDS

- Unrecorded voids, tanks, chemicals, etc. discovered during demolition: Give notice.
- Methods for safe removal, filling, etc: Submit details.

420 OPEN BASEMENTS, ETC

- General: If open basements are to be left in place they are proceed as follows.
- Temporary support: Leave adequate buttress walls or provide temporary support to basement retaining walls up to ground level.
- Safety: Make remaining sections of retaining and buttress walls safe and secure.
- Water movement: Remove basement floors to any cellars or basements found under the proposed buildings to allow installation of piling and to allow water to drain.

430 FILLING OF BASEMENTS, ETC

- Temporary support: Leave adequate buttress walls or provide temporary support to basement retaining walls up to ground level.
- Agree extent and method of removal of basement walls with CA.
- Water movement: - Under proposed buildings remove basement floors to allow water drainage or penetration (depending on water table).
- Filling: Remove organic material and soil from basements and other voids. Fill with compacted DOT2 in readiness for the new construction, unless instructed otherwise by the Client.
- Basements in hardstanding areas are to be proof rolled and any 'soft spots' excavated down to firm material and backfilled with compacted granular material.

440 SITE CONDITION AT COMPLETION

- Debris: Clear away and leave the site in a tidy condition.

442 SITE SURFACE AT COMPLETION

- Levels: Grade the site to suit the following construction.
- Under Proposed Buildings - 400mm below proposed finished levels
- Car Park Areas - 450mm below proposed finished levels
- Access Road Areas - 500mm below proposed finished levels
- Block Paved Areas - 310mm below proposed finished levels (increase to 450mm if ground is frost susceptible / cohesive)
- External Concrete Slabs - 450mm below proposed finished levels
- Pathways - 300mm below proposed levels

MATERIALS ARISING

510 CONTRACTOR'S PROPERTY

- Components and materials arising from the demolition work: Property of the Contractor except where otherwise provided.
- Remove from site as work proceeds where not to be reused or recycled for site use.

511 CLIENTS PROPERTY

- Components and materials to remain the property of the Client: to be confirmed with Employer before commencement

520 RECYCLED MATERIALS

- Materials arising from demolition work: May be recycled or reused elsewhere in the project, subject to compliance with the appropriate specification and in accordance with any site waste management plan.
- Evidence of compliance: Submit full details and supporting documentation.
- Verification: Allow adequate time in programme for verification of compliance.



Appendix F - UXO Survey



1ST LINE DEFENCE



Detailed Unexploded Ordnance (UXO) Risk Assessment

Project Name	Greenheys Business Centre
Client	Bruntwood SciTech
Site Address	Greenheys Business Centre, Manchester M15 6JJ
Report Reference	DA17581-00
Date	04/04/23
Authored by	JL
Quality Assurance	AS
Final Check	AT



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Executive Summary

Site Location and Description

Greenheys Business Centre is located within the Greenheys area of the city of Manchester.

The site is currently occupied a brick and glass clad warehouse building. Areas of car parking are located in the east and west of the site.

It is bordered to the north by areas of car parking and cleared ground. A takeaway restaurant – located within a terraced property – and the McDougall Centre can also be found to the north. Pencroft Way runs along the eastern boundary of the site, while immediately to the south are structures associated with the Manchester Science Park. Greenheys Lane is situated adjacent to the west of the site.

The site is approximately centred on the OS grid reference: **SJ 84280 96286**.

Proposed Works

Information provided by the client indicates that development proposals include a 6-storey biohub, with a range of labs, supporting offices, associated access roads, parking and limited landscaped areas.

Geology and Bomb Penetration Depth

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

Superficial deposits comprise Till, Devensian – Diamicton – a sedimentary superficial deposit formed between 116 and 11.8 thousand years ago during the Quaternary period.

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.

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 the risk of German UXO contamination on site is not homogenous, with the south-western section of the site assessed as **Medium Risk** from German and anti-aircraft unexploded ordnance, and the remainder assessed as **Low Risk**. There is also an assessed **Low Risk** from Allied unexploded ordnance.

The Risk from German Air Delivered UXO

- During WWII the site was situated in the County Borough of Manchester. According to official Home Office bombing statistics, this borough sustained an overall low density of bombing, with 738 items of ordnance recorded to have fallen within the 27,255 acre borough, or an average of 27.1 items per 1,000 acres.
- During WWII the site was occupied predominantly by industrial premises. A series of terraced properties were located at the eastern and western edges of the site, adjoining Park Street and Greenheys Lane, while a small section of Park Street ran through the eastern extent of the site.
- Manchester Bomb and Damage mapping shows that seven incendiary bombs struck the large industrial structures within the centre of the site, with written records indicating Piggot Street (15m west of the site) and Greenheys Lane (bordering the west of the site) were also subject to incendiary bombing.
- An unexploded HE bomb is plotted on the adjoining Drill Hall north of the site. It was the only military installation in Manchester to be hit during the Manchester Blitz, where the UXB passed through the commanding officers' office and the unit swimming pool without exploding.¹ Immediately west of the hall (north of the site) a fire bomb is plotted.

¹ <https://manchesterhistory.net/manchester/tours/tour10/area10page9.html>

**UXO Risk Assessment**

- Given the site was developed, damage would have likely taken the form of rubble, debris, discoloured roofing or cleared ground. Aerial imagery – dated 1946 – shows no major signs of damage across the majority of the site. However, an area of the south-west of the site where a residential property stood pre-war has since been cleared. Such areas of clearance are indicative of wartime damage and are highlighted in **Annex N2**.
- At the start of WWII, the site was occupied by industrial premises and some residential properties. As a consequence, the ground cover across the site is believed to have been conducive to the detection of UXO, as any incidents would have likely resulted in a highly visible trail of rubble and debris. It is thought likely that evidence of UXO, such as bomb entry holes, are more likely to have been noted and reported under these conditions. Likewise, access across the site is likely to have been frequent, with built-up, developed areas more likely to have been subject to regular access by workers/residents.
- However, the detection of UXO indicators within the premises and houses would have been dependent upon the vigilance of individual staff and residents. Had the properties in the south-west been damaged and subsequently cleared, it is anticipated that the ground cover in this area would have become less conducive to the detection of evidence of UXO. Similarly, access may have decreased following bombing in the area, particularly if properties were evacuated after bombing incidents. Reduced access and cleared ground decreases the likelihood that evidence of UXO would have been spotted, reported and dealt with.
- In summary, the risk of German UXO contamination across the site is not considered to be homogenous, with much of the site designated **Low Risk** and the remainder of the site assessed as **Medium Risk**.
- Post-war OS mapping (1951) and aerial imagery – dated 1946 – shows an area of clearance in the south-west of the site where residential properties previously stood. As there are no bomb strikes recorded in this section of the site besides incendiaries which likely affected the whole site, it is possible that an unreported incident occurred here, thus causing damage. Such areas of clearance are often indicative of bomb damage and cannot be considered conducive towards the observation of UXO, owing to the rubble and debris that typically resulted amongst such conditions. UXO entry holes could be as small as 20cm in diameter, and obscured within areas of clearance due to rubble/debris. A combination of these factors means that the possibility of UXO contamination in this section of the site cannot be confidently reduced. As such, risk mitigation measures are considered a prudent precautionary measure across this area which has been deemed **Medium Risk** as a result. A 10m 'buffer zone' has been applied to the area immediately surrounding site to account for J-curve, whereby an item of UXO would come to rest at a lateral offset from point of entry (see **Annex F**).
- The remainder of the site has been assessed as **Low Risk** based on the following factors: the incendiary bombs which fell across the site are not considered to have caused significant structural damage to the industrial buildings in this area, with 1946 aerial imagery showing no obvious indicators of damage, such as roof repairs. Given the lack of damage, ground conditions in this sector of the site are considered to have remained favourable towards the detection of UXO for the duration of the war. Additionally, this area would have benefitted with access from workers and monitor from residential properties on Park Street and the roadway itself. As a result, proactive risk mitigation measures are not considered necessary within these areas. A 'risk map' showing the extent of the above discussed risk zones is presented in **Annex O**.
-

The Risk from Allied UXO

- The Burlington Street Drill Hall was located immediately north of the site. Built in 1885 it was subsequently used by local regiments. During WWII it was used as the headquarters of the 61st City of Manchester Battalion of the Home Guard. Given the nature of the site, it was likely used for practice – potentially with items of SAA and LAA brought onto site for demonstrative purposes – and administrative purposes. However, given the structures that divide the Drill Hall from the site, it is not considered to increase the risk of contamination from Allied UXO to any significant extent.
- There is no evidence 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.

**UXO Risk Assessment****Post-WWII Redevelopment**

- The site does not appear to have undergone significant structural development since WWII, the warehouses seem largely unchanged. These structures have been used for multiple purposes since 1945. By 1975 they were occupied by Sunvene's venetian blinds store.² In the east of the site the terraced properties on either side of Park Street have since been removed. Park Street itself has been significantly altered and re-diverted slightly to the east and has been renamed Pencroft Way. Currently, the Greenheys Building provides office space as part of the wider Manchester Science Park, thought to have been redeveloped in the 1990s.
- The risk of UXO remaining is considered to be mitigated at the location of and down to the depth of any post-war redevelopment on site. For example, the risk from deep buried UXO will only have been mitigated within the volumes of any post-war pile foundations or deep excavations for basement levels. The risk will however remain within virgin geology below and amongst these post-war works, down to the maximum bomb penetration depth.

Recommended Risk Mitigation Measures

The following risk mitigation measures are recommended to support the proposed works at Greenheys Business Centre:

All Works

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

Medium Risk Areas**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.

² <https://www.gracesguide.co.uk/Sunvene>



German UXO Risk Map



For indicative purposes – not to scale.

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

-  Low Risk
-  Medium Risk

All Risk Areas:

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

Medium Risk Area:

- Unexploded Ordnance (UXO) Specialist Presence on Site to support open excavation works
- Intrusive Magnetometer Survey of all Borehole and pile locations down to a maximum bomb penetration depth

Please note that UXO Support/Survey would not be deemed necessary in areas of and down to the depth of any post-war fill or significantly worked post-war Made Ground.

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

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1st Line Defence Limited

Detailed Unexploded Ordnance (UXO) Risk Assessment

Site: Greenheys Business Centre
Client: Bruntwood SciTech

1. Introduction

1.1. Background

1st Line Defence has been commissioned by Bruntwood SciTech to conduct a Detailed Unexploded Ordnance (UXO) Risk Assessment for the works proposed at Greenheys Business Centre.

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

UXO in the UK can originate from three principal sources:

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

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

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

2. Method Statement

2.1. Report Objectives

The aim of this report is to conduct a comprehensive assessment of the potential risk from UXO at Greenheys Business Centre. 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 Central Library.
- Historical mapping datasets.
- Historic England National Monuments Record.
- Relevant information supplied by Bruntwood SciTech.
- Available material from 33 Engineer Regiment (EOD) Archive (part of 29 Explosive Ordnance and Disposal and Search Group).
- 1st Line Defence's extensive historical archives, library and UXO geo-datasets.
- Open sources such as published books and internet resources.

3. Background to Bombing Records

3.1. General Considerations of Historical Research

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

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

3.2. German Bombing Records

During WWII, bombing records were generally gathered locally by the police, Air Raid Precaution (ARP) wardens and military personnel. These records typically contained information such as the date, the location, the amount of damage caused and the types of bombs that had fallen during an air raid. This information was made either through direct observation or post-raid surveys. The Ministry of Home Security Bomb Census Organisation would then receive this information, which was plotted onto maps, charts, and tracing sheets by regional technical officers. The collective record set (regional bomb census mapping and locally gathered incidents records) would then be processed and summarised into reports by the Ministry of Home Security Research and Experiments Branch. The latter were tasked with providing the government 'a complete picture of air raid patterns, types of weapons used and damage caused- in particular to strategic services and installations such as railways, shipyards, factories and public utilities.'³

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.

³ <http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/bomb-census-survey-records-1940-1945/>.

4. UK Regulatory Environment and Guidelines

4.1. General

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

4.2. CDM Regulations 2015

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

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

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

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

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

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

4.4. CIRIA C681

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

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

4.5. Additional Legislation

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

5. The Role of Commercial UXO Contractors and The Authorities

5.1. Commercial UXO Specialists

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

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

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

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

5.2. The Authorities

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

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

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

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

6. The Site

6.1. Site Location

Greenheys Business Centre is located within the Greenheys area of the city of Manchester.

It is bordered to the north by areas of car parking and cleared ground. A takeaway restaurant – located within a terraced property – and the McDougall Centre can also be found to the north. Pencroft Way runs along the eastern boundary of the site, while immediately to the south are structures associated with the Manchester Science Park. Greenheys Lane is situated adjacent to the west of the site.

The site is approximately centred on the OS grid reference: **SJ 84280 96286**.

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

6.2. Site Description

The site is currently occupied a brick and glass clad warehouse building. Areas of car parking are located in the east and west of the site.

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

7. Scope of the Proposed Works

7.1. General

Information provided by the client indicates that development proposals include a 6-storey biohub, with a range of labs, supporting offices, associated access roads, parking and limited landscaped areas.

8. Ground Conditions

8.1. General Geology

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

Superficial deposits comprise Till, Devensian – Diamicton – a sedimentary superficial deposit formed between 116 and 11.8 thousand years ago during the Quaternary period.

8.2. Site-Specific Geology

Borehole data has been provided by Bruntwood SciTech. Data was taken from the University of Manchester's Monitoring Borehole (drilled at former McDougall Building), which was sunk in the car park 20m north of site in 1999. See below for a brief example description of the geology encountered.

Example Borehole	
Depth (m)	Description
G.I. – 0.50	MADE GROUND.
0.50 – 5.00	Grey CLAY & CLAY and SAND.
6.00 – 8.00	Grey/brown sandy CLAY with gravel and cobbles.
8.00 – 9.00+	Gravel of variable lithology.
9.00 – 11.00+	Fine to medium grained red SANDSTONE. (rock head expected between 9.00 and 11.00m).

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

Historically located in Chorlton-upon-Medlock, in 1848 the site was occupied by a large residential property on Greenheys Lane overlooking the now culverted Corn Brook. With an extensive area of garden, the site would quickly become subsumed by an ever-expanding Manchester. Surrounding areas were substantially developed for housing and industrial purposes throughout the late nineteenth and early twentieth centuries. The warehouses on site – referred to as Greenheys House – are believed to have been constructed in the early part of the twentieth century.

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 – Annex D1		
Date	Scale	Description
1932-1933	1:2,500	This map shows the site to be predominantly occupied by large structures, possibly industrial in nature. A cul-de-sac, <i>Park Mews</i>, runs from <i>Greenheys Lane</i> into the centre of the site. Several terraced properties, likely residential, can be located in the east of the site. Two further such properties lie in the west adjoining <i>Greenheys Lane</i> – possibly the original Greenheys House. A section of <i>Park Street</i> runs through the east of the site. To the north of the site are further terraced properties, outbuildings, areas of hard-standing, and a <i>Drill Hall</i>. <i>Park Street</i> and residential terraced properties are situated to the east. Further such properties on <i>Park Street</i> and <i>Orchard Street</i> can be found to the south, while <i>Greenheys Lane</i> runs along the western boundary.

Post-WWII – Annex D2		
Date	Scale	Description
1951	1:2,500	The site footprint appears to have changed significantly since the previous mapping edition. A large structure now covers much of the centre of the site, including the area where <i>Park Mews</i> was located. The terraced properties in the west of the site have been removed and an area of cleared ground now occupies the south-west corner of the site. The east of the site appears largely the same, with terraced properties and <i>Park Street</i> remaining. Although the site's immediate environs remain largely the same, some alterations have occurred. Several outbuildings immediately north of the site no longer appear in situ. Additionally the previously labelled <i>Drill Hall</i> is now the <i>McDougall Centre</i>. Approximately 20m east of the site, some structures on the other side of <i>Park Street</i> look to have been removed.

9.4. Pre-WWII Photography of the Site

Pre-WWII aerial photography has been obtained from the Aerofilms collection available from *Britain From Above* and Manchester Central Library. This imagery provides a view of the site in 1924, 1927 and 1937 (see **Annex E**). See below for a description:

Title of Photograph	Comments
Greenheys, Chorlton-on-Medlock, General view looking south east showing also Whitworth Park, Manchester, 1924 – Annex E1	This image taken from the north-west indicates that the site is predominantly occupied by industrial warehouses. Several terraced properties adjoin Park Street in the east of the site, while a larger property can be found on Greenheys Lane in the west. A roadway, Park Street, runs through the eastern section of the site.
EPW017614 – Greenheys Lane and environs, Manchester, 1927 – Annex E2	Taken from the south-west, the site appears to consist mainly of industrial structures, possibly warehouses. A series of terraced properties can be found in the east of the site, while a property can be seen in the west adjoining Greenheys Lane.
EPW055077 – The Victoria University of Manchester, Oxford Road and the city, Manchester, from the south-west, 1937 – Annex E3	This image taken from the south shows that the majority of the site is now occupied by industrial structures, believed to be warehouses. The terraced properties on Park Street remain in situ, as does the larger property on the site's western boundary with Greenheys Lane.

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 F). 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.

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 G**.

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 Effect Principle

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

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.

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. Sedimentary bedrock formed between 250 and 247.1 million years ago during the Triassic period.
- 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 relatively low numbers allowed accurate records of strikes to be maintained. These records have mostly survived. There is a negligible risk from unexploded V-weapons on land today. Even if the 1,000kg warhead failed to explode, the weapons are so large that they would have been observed and dealt with at the time. Therefore, any V-weapons referenced in this report are referenced not as a viable risk factor, but primarily in order to help account for evidence of damage and clearance reported.

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 H**. This source does not record any WWI bombing incidents to have affected the site area.

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. This was mainly due to the significant number of targets, including the docks (shown on Luftwaffe reconnaissance imagery in **Annex I**), Manchester Central Station, and Gaythorn Gas Works. Manchester and the wider area were not targeted to the same extent as cities such as London and Birmingham, although Manchester city centre and Salford were nonetheless subject to several major raids. The first raid on the city was in September 1940, with the worst being in December 1940, often referred to as the 'Christmas Blitz', whereby the city was raided for two consecutive nights which resulted in an estimated 684 people losing their lives, and more than 2,000 being injured.⁴

Records of bombing incidents in the civilian areas of the County Borough of Manchester 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.

⁴ <https://www.iwm.org.uk/history/the-manchester-blitz>

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 rockets (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 and Damage Map

A local map showing bomb strikes and the extent of resulting bomb damage was obtained from the University of Manchester Library. This map was compiled during/following WWII by Manchester Council's City Architect's Department.

This map was created by the City Architects Department and plots the locations of bomb strikes in Manchester, including fire bombs, H.E. bombs, and land mines. The map also shows the extent of bomb damage in the city, categorised as '*Demolished building*' or '*Partially damaged structure*'.

The section showing the area of the site is described in the table below and presented in **Annex J**.

University of Manchester Library Bomb Map	
Date Range	Comments
1940-1945	This map shows that seven incendiary bombs fell across the large industrial structures within the site on 9th October 1940. However, no damage is recorded on this map within the site boundary. An unexploded high explosive (HE) bomb fell on the Drill Hall to the north on 11th October 1940. On 10th October a fire bomb fell in this same area, with two further fire bombs located to the north-west and south-east of the site on 9th October 1940

11.5. Interactive 'Christmas Blitz' Bomb Map

A local bomb map, compiled by the Manchester Evening News and utilising data from the Commonwealth and War Graves Commission, was consulted during the production of this report. This map, named the Manchester Christmas Blitz Map, shows the locations of civilian deaths in Greater Manchester between 22nd and 24th December 1940. During this two day period, a reported 800 people were killed as a result of air raids.⁵

As this map only records bombs which resulted in fatalities, it is not considered a comprehensive account of Christmas bombing raids. The closest fatal bomb strike to the site occurred approximately 95m to the north-east of the site, along Burlington Street. A section of the map showing the site and its surroundings is presented in **Annex K**.

11.6. Air Raid Damage Files

Written ARP Incident Records were obtained from The National Archives. This record was compiled by local Air Raid Precaution (ARP) personnel and volunteers during the war and records the location, date and time of bombing raids, as well as the types of bomb used and the damage caused.

This record set was checked, and no references to the site were found within it.

11.7. Ministry of Home Security Intelligence Summaries

Regional Situation Reports compiled by the Ministry of Home Security were consulted for the purpose of this report. These records discuss incidents in the north-west region, damage, and responses from the emergency services.

Those records describing incidents in proximity to the site are presented below and in **Annex L**.

Ministry of Home Security Intelligence Summaries – Annex L	
Date Range	Comments
9 th October 1940 – 10 th October 1940	<u>MANCHESTER AREA</u> Manchester. At 20:40 hours incendiary bombs (IBs) in Claude Road and St. Anne's Road, CHORLTON-CUM-HARDY. Fires quickly extinguished by wardens. IBs in Newlorne Street, Platt Street, Copeland Street and Carlton Street (Moss Side area). All fires under control by 23:30 hours. Four high explosive (HE) bombs damaged houses in Zeta Street and Ashley Lane, MOSTON. At 21:15 hours IBs fell in Denmark Road, Derby Street, Bath Street, Piggot Street, (Greenheys Lane), Acomb Street and Lincroft Street. Casualties: one dead, one seriously injured, one slightly injured. <i>[Piggot Street located approximately 15m west of the site. Greenheys Lane binds the site to the west].</i>

⁵ <https://www.manchestereveningnews.co.uk/news/greater-manchester-news/manchester-blitz-bomb-sites-map-10465447>

11 th October 1940	<u>MANCHESTER</u> Was raided at 22:00 hours 11/10/40. Most of the bombs fell in the South Central part of the city which is largely residential. 28 HE, 67 IB and two oil IBs caused widespread damage to dwelling houses. At least nine houses have been demolished. A considerable number of fires were caused, all of which have been dealt with. There was much damage to gas mains. Casualties so far reported: three dead, nine seriously injured, 17 slightly injured. The more serious cases are: • Carter Terrace, CHORLTON-ON-MEDLOCK, (four houses demolished). • Rose Street, GREENHEYS, (houses demolished). • Physical Training Centre and Officers' Training Corps (OTC) HQ. Manchester. • University damaged by HE believed to be unexploded. • Eliza Street, HULME, (five cottages demolished). • York Place, (Nurses Home partly demolished). • Unexploded bombs (UXBs) caused evacuation at Dudley Street and Grafton Street. • Brook's Bar and at 25 Alston Gardens, Shawbrook Road, BURNAGE (21 houses). <i>[Rose Street located approximately 75m south of the site].</i>
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11.8. War Damage to Property Cards

Written records were obtained from the Manchester Central Library. A transcript of the relevant written records are presented in the table below. Example imagery of these entries are presented in **Annex M**.

War Damage to Property Cards		
Date (Incident/Inspection)	Location	Comments
22 nd December 1940 N/A Annex M1	7 Park Street, Greenheys	Type of Bomb: High Explosive (HE). Description of Property: Social Club. Full Address and Locality: South Manchester Transport Workers' Club & Institute, 7 Park Street, Greenheys. Indication of Extent of Damage (Roof/Generally): Slight damage due to blast/Glass windows. Type of Damage: D <i>[Park Street located on site (east)].</i>
N/A 10 th April 1942 Annex M2	60, 62, 64, 66, 68, 70, 72 Burlington Street, Chorlton-on-Medlock	Tenant: D. (S.C). <i>[Located between 95m and 170m north/north-east of the site].</i>

11.9. 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 N**).

WWII-Era Aerial Photography	
Date	Description
7 th May 1946 – Annex N1	This photograph shows the site in the immediate post-war era. The site footprint appears to be largely unchanged when compared to pre-war oblique photography from 1937. However, the residential property previously situated in the south-west corner of the site has been cleared. Areas of clearance are indicative of wartime damage. Further clearance can be observed approximately 80m to the north and north-west on Burlington Street. Areas of clearance are highlighted in Annex N2 .

11.10. 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.

11.11. 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, Bruntwood SciTech will be advised.

11.12. Evaluation of German Air Delivered UXO Records

Factors	Conclusion
Density of Bombing <i>It is important to consider the bombing density when assessing the possibility that UXBs remain in an area. High bombing density could allow for error in record keeping due to extreme damage caused to the area.</i>	During WWII the site was situated in the County Borough of Manchester. According to official Home Office bombing statistics, this borough sustained an overall low density of bombing, with 738 items of ordnance recorded to have fallen within the 27,255 acre borough, or an average of 27.1 items per 1,000 acres. This was mainly due to the significant number of targets in the city, including the docks (shown on Luftwaffe reconnaissance imagery in Annex I), stations and utilities. Manchester Bomb and Damage mapping shows that seven incendiary bombs struck the large industrial structures within the centre of the site. An unexploded HE bomb fell on the adjoining Drill Hall north of the site. It was the only military installation in Manchester to be hit during the Manchester Blitz; the UXB passed through the commanding officers' office and the unit swimming pool without exploding.⁶ Immediately west of the hall a fire bomb is plotted. Furthermore, the Ministry of Home Security Intelligence Summaries note IBs at Piggot Street and Greenheys Lane, located 15m west and immediately west of the site respectively. Manchester Damage Cards note that an HE fell near the South Manchester Transport Workers' Club & Institute on 22nd December 1940, approximately 40m north-east of the site on Park Street. This may correspond with the bomb strike recorded by the Interactive Manchester 'Christmas Blitz' Map on Burlington Street. There appears to be an increased density of bombing in the Greenheys area. Ministry of Home Security North-West Intelligence Summaries indicate bombing on Greenheys Lane and at the Physical Training Centre and OTC HQ Manchester – known to be where the unexploded HE fell on the Drill Hall immediately north of the site.
Damage <i>If buildings or structures on a site sustained bomb or fire damage, any resulting rubble and debris could have obscured the entry holes of unexploded bombs dropped during the same or later raids. Similarly, a high explosive bomb strike in an area of open agricultural land will have caused soil disturbance, increasing the risk that a UXB entry hole would be overlooked.</i>	Given the site was developed, damage would have likely taken the form of rubble, debris, discoloured roofing or cleared ground. Aerial imagery – dated 1946 – shows no major signs of damage across the majority of the site. However, an area of the south-west of the site where a residential property stood pre-war has since been cleared. Such areas of clearance are indicative of wartime damage.

⁶ <https://manchesterhistory.net/manchester/tours/tour10/area10page9.html>



Ground Cover <i>The nature of the ground cover present during WWII would have a substantial influence on any visual indication that may indicate UXO being present.</i>	At the start of WWII, the site was occupied by industrial premises and some residential properties. As a consequence, the ground cover across the site is believed to have been conducive to the detection of UXO, as any incidents would have likely resulted in a highly visible trail of rubble and debris. It is thought likely that evidence of UXO, such as bomb entry holes, are more likely to have been noted and reported under these conditions. However, the detection of UXO indicators within the premises and houses would have been dependent upon the vigilance of individual staff and residents. Had the properties in the south-west been damaged and subsequently cleared, it is anticipated that the ground cover in this area would have become less conducive to the detection of evidence of UXO. Areas of damage and debris could obscure signs of UXO, such as entry holes, which could have been as small as 20cm in diameter.
Access Frequency <i>UXO in locations where access was irregular would have a greater chance of passing unnoticed than at those that were regularly occupied. The importance of a site to the war effort is also an important consideration as such sites are likely to have been both frequently visited and subject to post-raid checks for evidence of UXO.</i>	Access and monitor to all commercial and residential properties located on and adjacent to the site is considered to have been frequent at the outbreak of WWII, given, their urbanised situation in close proximity to other industrial buildings and roadways. Due to the recorded incendiary bombing across the site, and the UXB to the immediate north of the site, it is possible that it may have been evacuated for a period of time. Reduced access decreases the likelihood that evidence of UXO would have been spotted, reported and dealt with, particularly areas which were subsequently cleared. A degree of monitor would have likely persisted on Park Street and its adjoining terraced properties. However, this would have been dependent on the vigilance of individual residents.
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	1 st Line Defence holds no records of abandoned bombs at or within the site vicinity.
Bombing Decoy sites	1 st Line Defence could find no evidence of bombing decoy sites within the site vicinity.
Bomb Disposal Tasks	1 st Line Defence could find no evidence of bomb disposal tasks within the site boundary and immediate area.

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.

The Burlington Street Drill Hall, located immediately north of the site, was originally built in 1885 and was subsequently rebuilt in 1938 and then used as the headquarters of the 61st City of Manchester Battalion of the Home Guard during WWII.⁷

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.

⁷ <https://manchesterhistory.net/manchester/tours/tour10/area10page9.html>

12.2.1. Anti-Aircraft Artillery (AAA)

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

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

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

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

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. Burlington Street Drill Hall

Located immediately north of the site, the hall was built in 1885 as the headquarters of the 4th Volunteer Battalion, the Manchester Regiment. In 1908 this unit became the 7th Battalion, the Manchester Regiment (Territorial Force). It mobilised at the hall in August 1914 before deploying to the eastern Mediterranean.

From 1922 to 1932 the hall was the headquarters of 42nd (East Lancashire) Divisional Signals, Royal Corps of Signals (TA). Thereafter, it was used by the Manchester University Officer Training Corps. The hall was substantially rebuilt in 1938 and then used as the headquarters of the 61st City of Manchester Battalion of the Home Guard. It was seriously damaged by an unexploded bomb in December 1940. It was subsequently decommissioned and acquired by the Victoria University of Manchester who used it as a Physical Education Centre and Islamic Prayer Hall. It was used by the Senior Training Corps and had a swimming bath, gymnasium, and squash courts. During this time it was known as the McDougall Centre. Since 2004 it has been predominantly unoccupied.

13.3. Evaluation of Contamination Risk from Allied UXO

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

Sources of Allied UXO Contamination	Conclusion
Military Camps <i>Military camps present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training.</i>	Although the Burlington Street Drill Hall is located in close proximity to the northern boundary of the site, this is not thought to increase the risk of contamination from Allied UXO given the structures that divide the two sites.
Anti-Aircraft Defences <i>Anti-Aircraft defences were employed across the country. Proximity to anti-aircraft defences increases the chance of encountering AA projectiles.</i>	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 2.15km south-east of the site, in the vicinity of Birchfields Park. 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 <i>The Home Guard regularly undertook training and ordnance practice in open areas, as well as burying ordnance as part of anti-invasion defences.</i>	The headquarters of the 61st City of Manchester Battalion of the Home Guard were located in the Burlington Street Drill Hall, immediately north of the site. This was predominantly an administrative location, however, as the name suggests, it is likely the hall was used for drill practice. It seems unlikely, given the structures between the two sites, that there is an increased risk from Allied UXO contamination on site because of the adjoining Drill Hall.
Defensive Positions <i>Defensive positions suggest the presence of military activity, which is often indicative of ordnance storage, usage or disposal.</i>	There is no evidence of any pillbox, emplacement or other defensive features formerly located on or bordering the site footprint.
Training or firing ranges <i>Areas of ordnance training saw historical ordnance usage in large numbers, often with inadequate disposal of expended and live items. The presence of these ranges significantly impact on the risk of encountering items of ordnance in their vicinity.</i>	No evidence of training or firing ranges could be found within the site or surrounding area.
Defensive Minefields <i>Minefields were placed in strategic areas to defend the country in the event of a German invasion. Minefields were not always cleared with an appropriate level of vigilance.</i>	There is no evidence of defensive minefields affecting the site.
Ordnance Manufacture <i>Ordnance manufacture indicates an increased chance that items of ordnance were stored, or disposed of, within a location.</i>	No information of ordnance being stored, produced, or disposed of within the proposed site could be found.
Military Related Airfields <i>Military airfields present an elevated risk from ordnance simply due to the large military presence and likelihood of associated live ordnance training or bombing practice.</i>	The site was not situated within the perimeters or vicinity of a military airfield.

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 photography, Luftwaffe reconnaissance imagery, bomb and damage mapping, an interactive bomb plot map, written records, published sources, and post-war aerial photography. The record set is of generally good quality, with most record sets corroborating the locations of bomb strikes on/around the site boundary. Furthermore, the availability of pre-and post-war aerial imagery has aided in the assessment of wartime and post-war conditions on site.
German Air Delivered Ordnance	- During WWII the site was situated in the County Borough of Manchester. According to official Home Office bombing statistics, this borough sustained an overall low density of bombing, with 738 items of ordnance recorded to have fallen within the 27,255 acre borough, or an average of 27.1 items per 1,000 acres. - During WWII the site was occupied predominantly by industrial premises. A series of terraced properties were located at the eastern and western edges of the site, adjoining Park Street and Greenheys Lane, while a small section of Park Street ran through the eastern extent of the site. - Manchester Bomb and Damage mapping shows that seven incendiary bombs struck the large industrial structures within the centre of the site, with written records indicating Piggot Street (15m west of the site) and Greenheys Lane (bordering the west of the site) were also subject to incendiary bombing. - An unexploded HE bomb is plotted on the adjoining Drill Hall north of the site. It was the only military installation in Manchester to be hit during the Manchester Blitz, where the UXB passed through the commanding officers' office and the unit swimming pool without exploding.⁸ Immediately west of the hall (north of the site) a fire bomb is plotted. - Given the site was developed, damage would have likely taken the form of rubble, debris, discoloured roofing or cleared ground. Aerial imagery – dated 1946 – shows no major signs of damage across the majority of the site. However, an area of the south-west of the site where a residential property stood pre-war has since been cleared. Such areas of clearance are indicative of wartime damage and are highlighted in Annex N2. - At the start of WWII, the site was occupied by industrial premises and some residential properties. As a consequence, the ground cover across the site is believed to have been conducive to the detection of UXO, as any incidents would have likely resulted in a highly visible trail of rubble and debris. It is thought likely that evidence of UXO, such as bomb entry holes, are more likely to have been noted and reported under these conditions. Likewise, access across the site is likely to have been frequent, with built-up, developed areas more likely to have been subject to regular access by workers/residents. - However, the detection of UXO indicators within the premises and houses would have been dependent upon the vigilance of individual staff and residents. Had the properties in the south-west been damaged and subsequently cleared, it is anticipated that the ground cover in this area would have become less conducive to the detection of evidence of UXO. Similarly, access may have decreased following bombing in the area, particularly if properties were evacuated after bombing incidents. Reduced access and cleared ground decreases the likelihood that evidence of UXO would have been spotted, reported and dealt with.

⁸ <https://manchesterhistory.net/manchester/tours/tour10/area10page9.html>



	• In summary, the risk of German UXO contamination across the site is not considered to be homogenous, with much of the site designated Low Risk and the remainder of the site assessed as Medium Risk. • Post-war OS mapping (1951) and aerial imagery – dated 1946 – shows an area of clearance in the south-west of the site where residential properties previously stood. As there are no bomb strikes recorded in this section of the site besides incendiaries which likely affected the whole site, it is possible that an unreported incident occurred here, thus causing damage. Such areas of clearance are often indicative of bomb damage and cannot be considered conducive towards the observation of UXO, owing to the rubble and debris that typically resulted amongst such conditions. UXO entry holes could be as small as 20cm in diameter, and obscured within areas of clearance due to rubble/debris. A combination of these factors means that the possibility of UXO contamination in this section of the site cannot be confidently reduced. As such, risk mitigation measures are considered a prudent precautionary measure across this area which has been deemed Medium Risk as a result. A 10m 'buffer zone' has been applied to the area immediately surrounding site to account for J-curve, whereby an item of UXO would come to rest at a lateral offset from point of entry (see Annex F). • The remainder of the site has been assessed as Low Risk based on the following factors: the incendiary bombs which fell across the site are not considered to have caused significant structural damage to the industrial buildings in this area, with 1946 aerial imagery showing no obvious indicators of damage, such as roof repairs. Given the lack of damage, ground conditions in this sector of the site are considered to have remained favourable towards the detection of UXO for the duration of the war. Additionally, this area would have benefitted with access from workers and monitor from residential properties on Park Street and the roadway itself. As a result, proactive risk mitigation measures are not considered necessary within these areas. A 'risk map' showing the extent of the above discussed risk zones is presented in Annex O.
Allied Ordnance	• The Burlington Street Drill Hall was located immediately north of the site. Built in 1885 it was subsequently used by local regiments. During WWII it was used as the headquarters of the 61st City of Manchester Battalion of the Home Guard. Given the nature of the site, it was likely used for practice – potentially with items of SAA and LAA brought onto site for demonstrative purposes – and administrative purposes. However, given the structures that divide the Drill Hall from the site, it is not considered to increase the risk of contamination from Allied UXO to any significant extent. • There is no evidence 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.

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

The site does not appear to have undergone significant structural development since WWII, the warehouses seem largely unchanged. These structures have been used for multiple purposes since 1945. By 1975 they were occupied by Sunvene's venetian blinds store.⁹ In the east of the site the terraced properties on either side of Park Street have since been removed. Park Street itself has been significantly altered and re-diverted slightly to the east and has been renamed Pencroft Way. Currently, the Greenheys Building provides office space as part of the wider Manchester Science Park, thought to have been redeveloped in the 1990s.

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.

⁹ <https://www.gracesguide.co.uk/Sunvene>

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.

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.

18. Consequences of Initiation/Encounter

18.1. Introduction

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

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

18.2. Consequences of Detonation

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

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

19. 1st Line Defence Risk Assessment

19.1. Risk Assessment Stages

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

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

19.2. Assessed Risk Level

1st Line Defence has assessed that the risk of German UXO contamination on site is not homogenous, with the south-western section of the site assessed as **Medium Risk** from German and anti-aircraft unexploded ordnance, and the remainder assessed as **Low Risk**. There is also an assessed **Low Risk** from Allied unexploded ordnance.

Medium Risk Areas:

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		✓		

Low Risk Areas:

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		✓		

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

It should however be stressed that if any suspect items are encountered during the proposed works, 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.

20. Proposed Risk Mitigation Methodology

20.1. General

The following risk mitigation measures are recommended to support the proposed works at Greenheys Business Centre:

Type of Work	Recommended 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.
Shallow Intrusive Works/Open Excavations (in Medium Risk area)	• 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/Piles (in Medium Risk area)	• 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.

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04/04/23

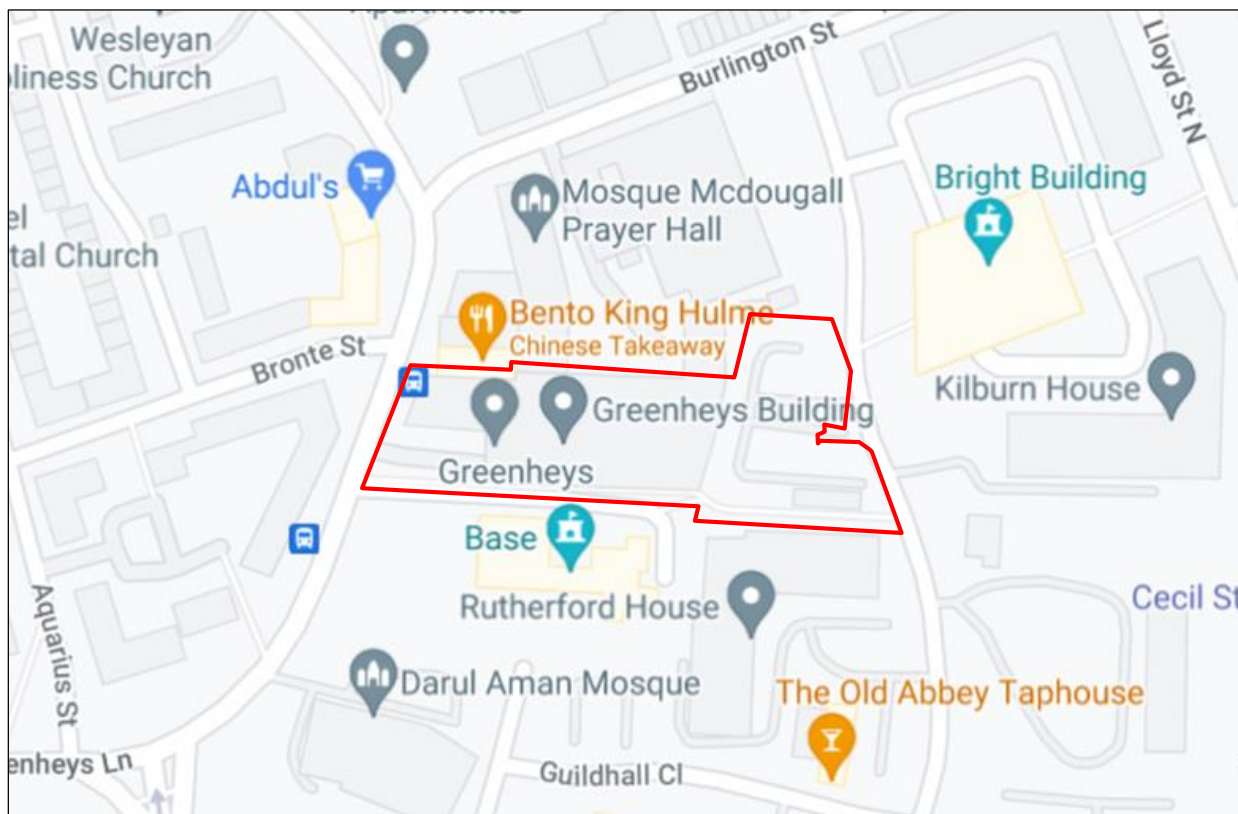
This Report has been produced in compliance with the Construction Industry Research and Information Association (CIRIA) C681 guidelines for the writing of Detailed UXO Risk Assessments.

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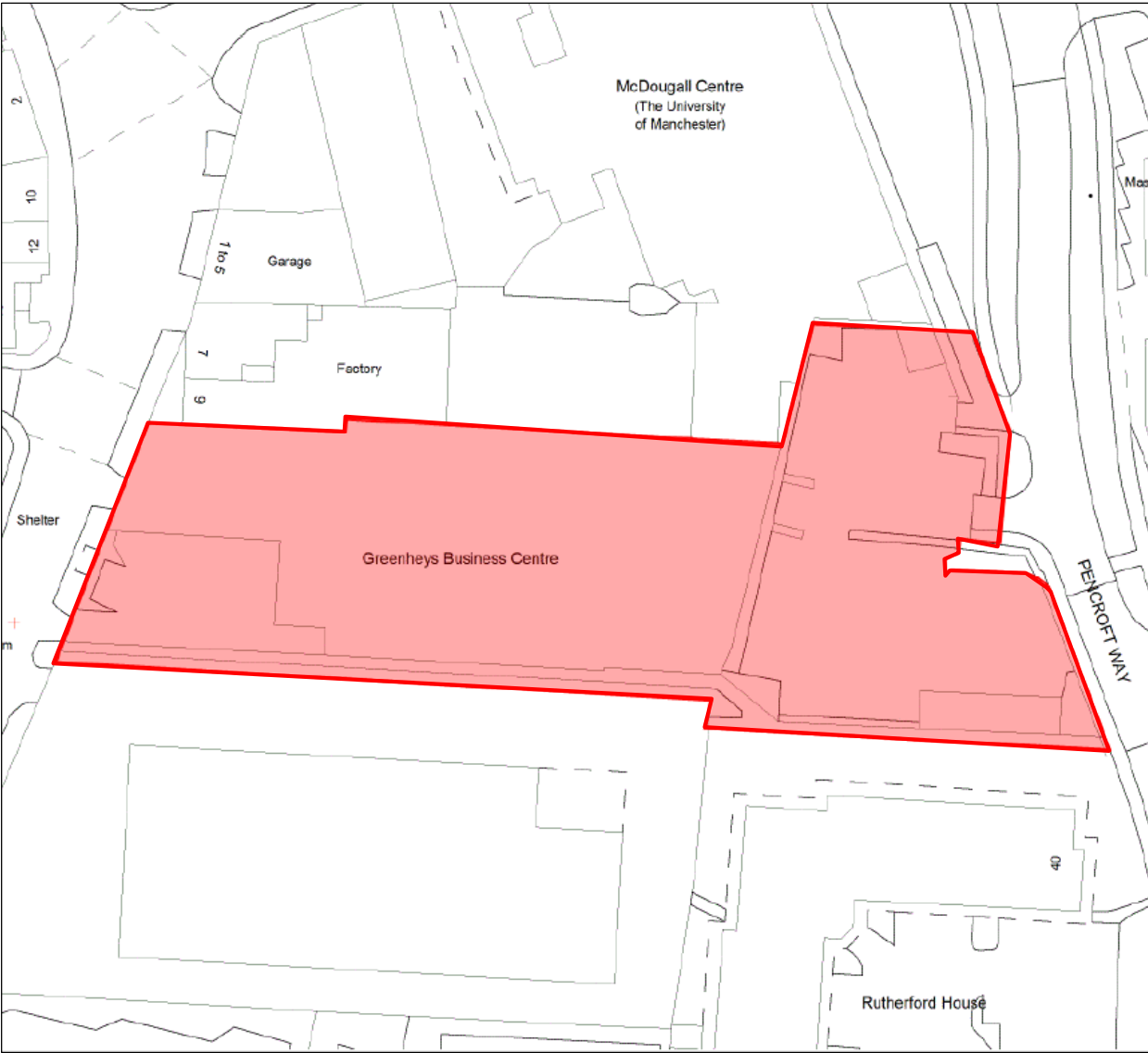
Project: **Greenheys Business Centre**

Ref: **DA17581-00**

Source: Google Earth™ Mapping Services

 **Approximate site boundary**





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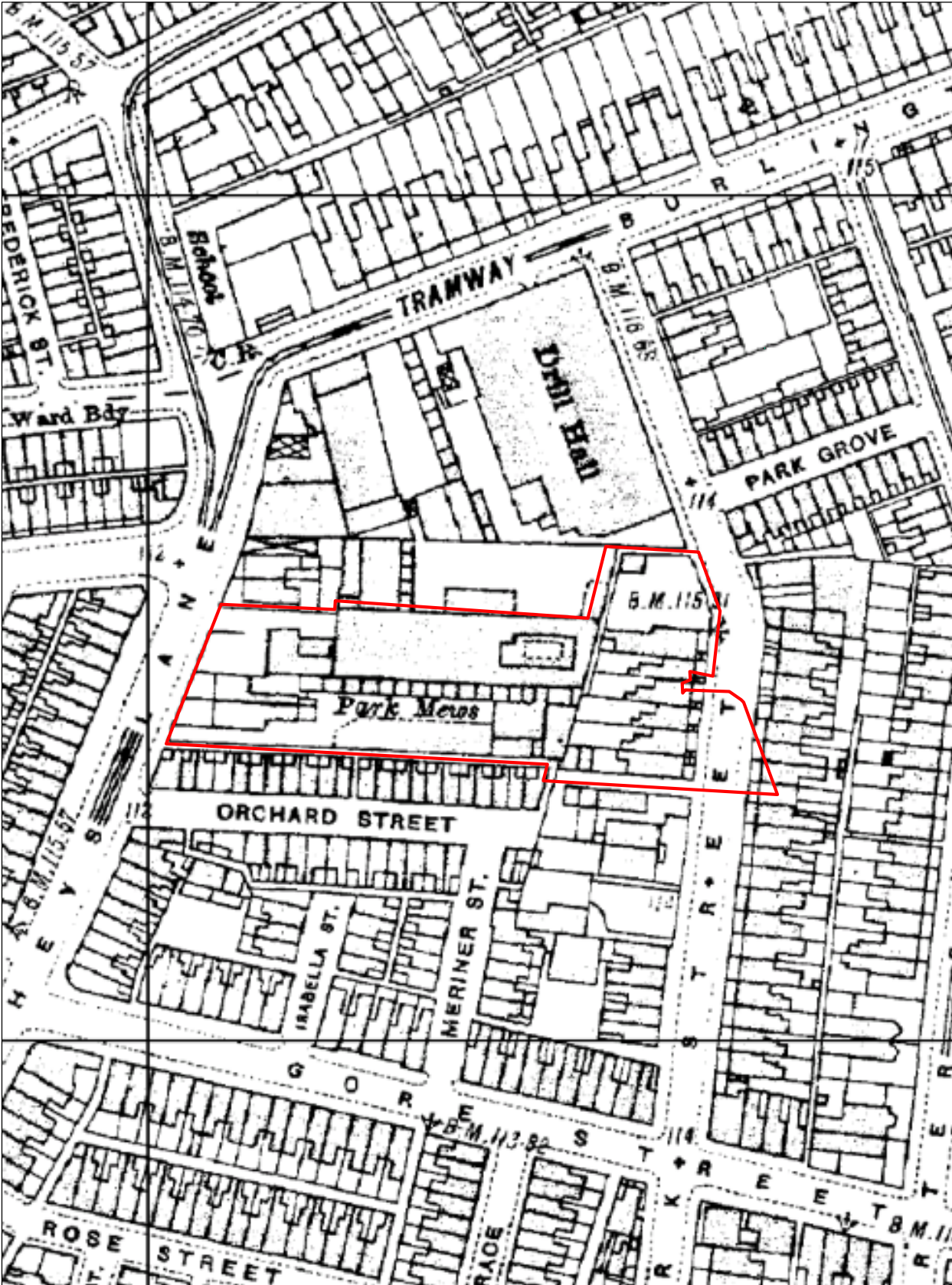
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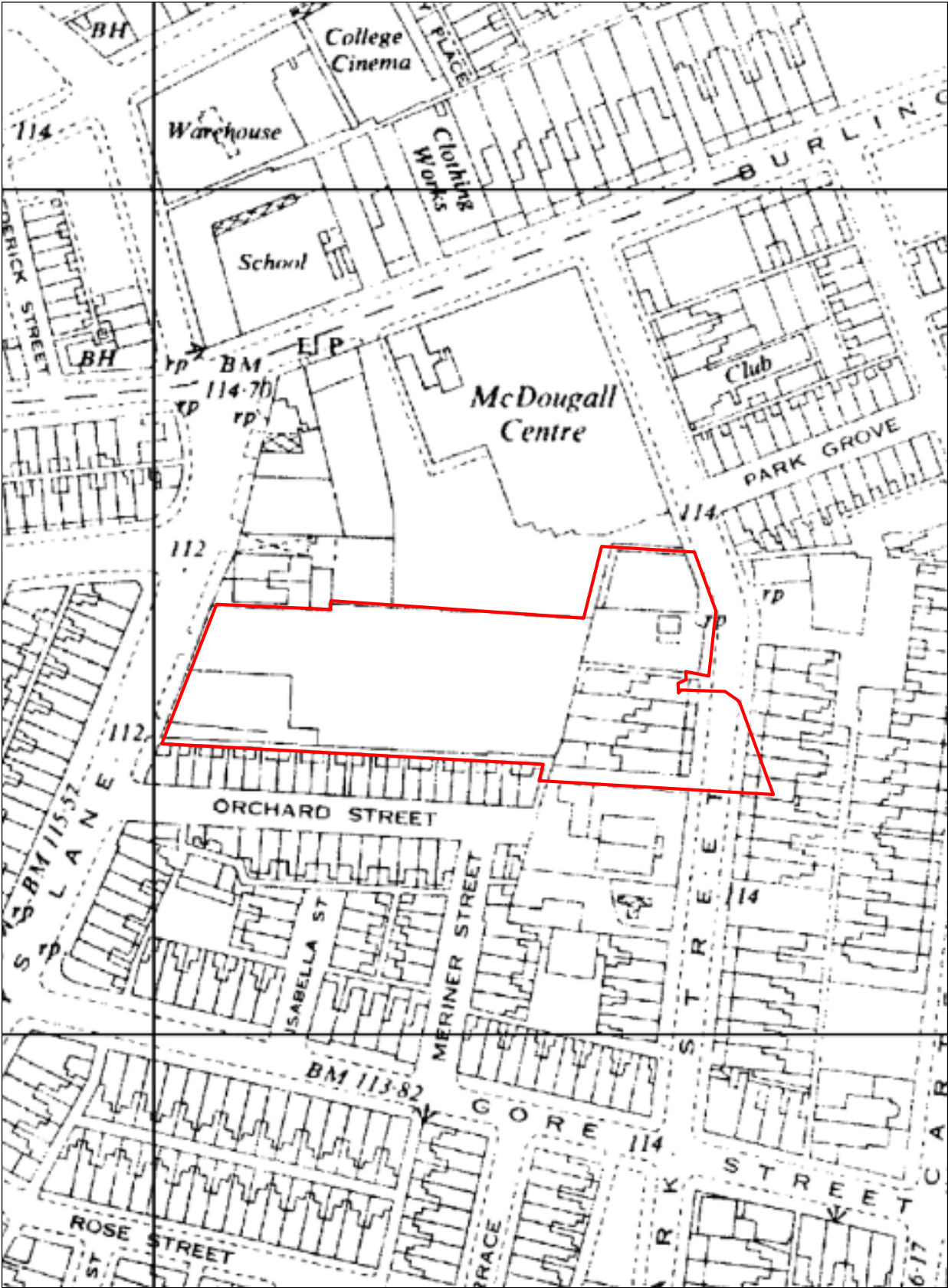
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Source: **Landmark Maps**

 **Approximate site boundary**





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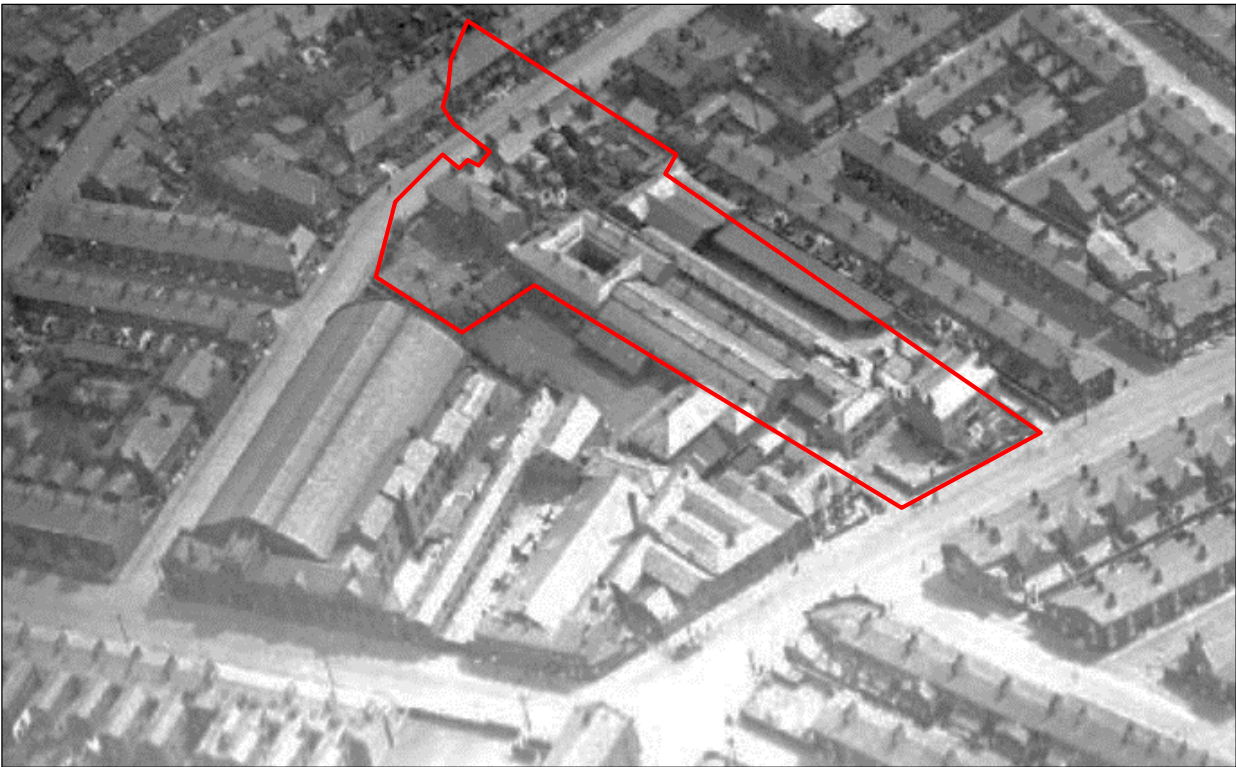
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Source: Landmark Maps

 **Approximate site boundary**



Greenheys, Chorlton-on-Medlock, General view looking south east showing also Whitworth Park, Manchester, 1924



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Source: Manchester Central Library

 **Approximate site boundary**



EPW017614 – Greenheys Lane and environs, Manchester, 1927



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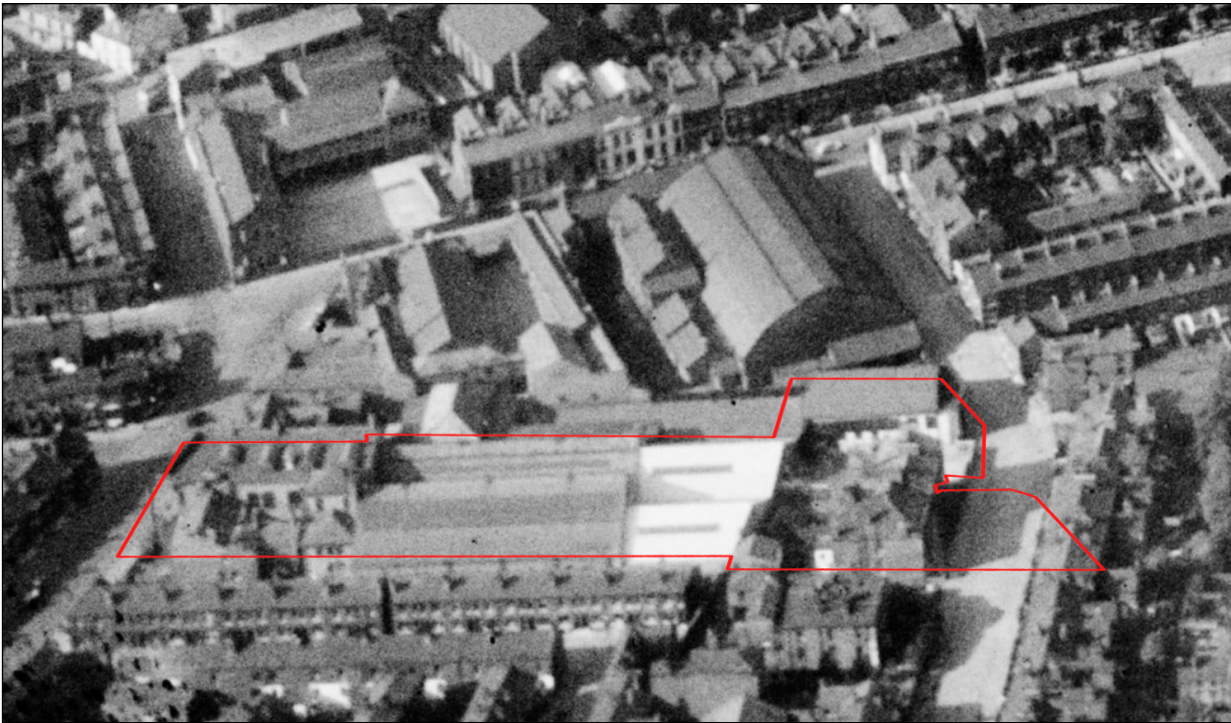
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Source: Britain from Above

 **Approximate site boundary**



EPW055077 – The Victoria University of Manchester, Oxford Road and the city, Manchester, from the south-west, 1937



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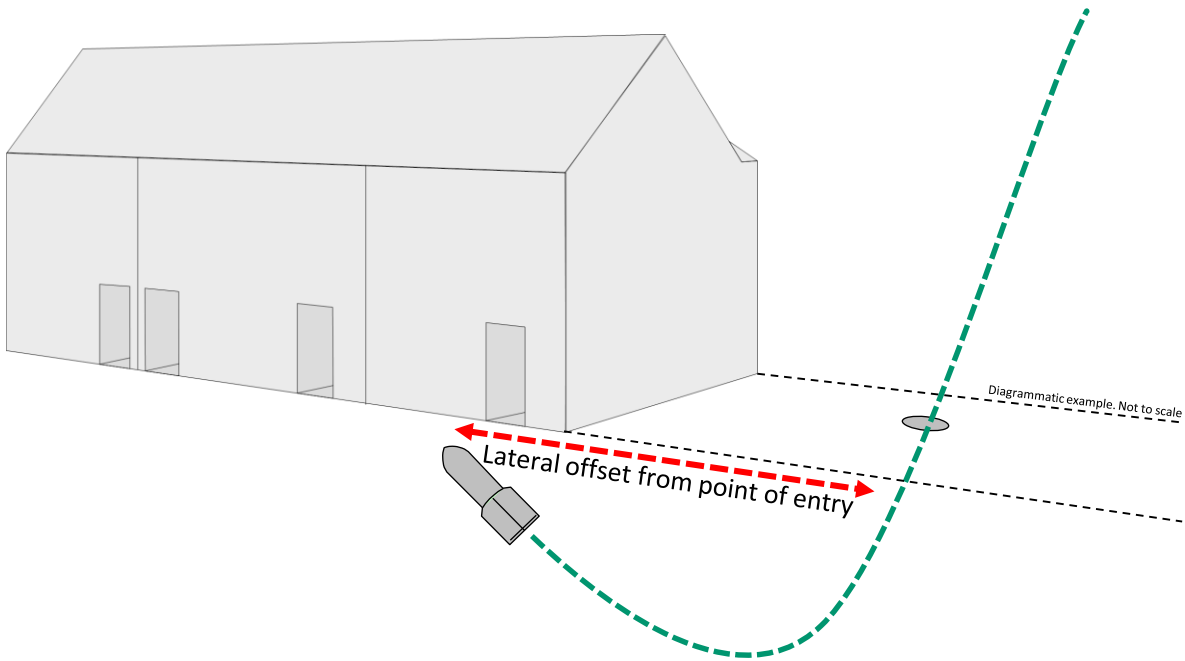
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Ref: **DA17581-00**

Source: Britain from Above

 **Approximate site boundary**





Diagrammatic example. Not to scale

Lateral offset from point of entry



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

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





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C

NEWS

Bermondsey bomb: World War Two device safely removed



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

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

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

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

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

250kg German HE Bomb, March 2015

B

B

C

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 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

B

B

C

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

B

B

C

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



1ST LINE DEFENCE

Unit 3, Maple Park
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Client:	Bruntwood SciTech		
Project:	Greenheys Business Centre		
Ref:	DA17581-00	Source:	BBC News
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BASF has confirmed that an explosive device, most likely a World War II-era bomb, caused the blast that left one person injured Tuesday at a plant construction site in Germany.

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



BASF Provides Some Details

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

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

1st March 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

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



World War II bomb kills three in Germany



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

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

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

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

2nd June 2010



June 2006



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Salford WW2-era bomb find in garden prompts evacuation

31 October 2021



People were told to leave their homes on Moss Lane in Swinton

Residents have been moved out of their homes after an unexploded bomb believed to be from World War Two was found in a garden.

The device was discovered at the home on Moss Lane in Swinton, Salford, shortly before 11:30 GMT.

A cordon was put in place and nearby houses were evacuated, Greater Manchester Police said.

The force said an Explosive Ordnance Disposal team was brought in to assess the device before declaring it safe.

Greater Manchester Fire and Rescue Service said at about 16:00 GMT they were leaving the scene and people were returning home.

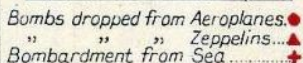
They said all previous advice for residents further from the device, who had been told stay inside and away from windows, was lifted.



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Ref: DA17581-00	Source: BBC News	



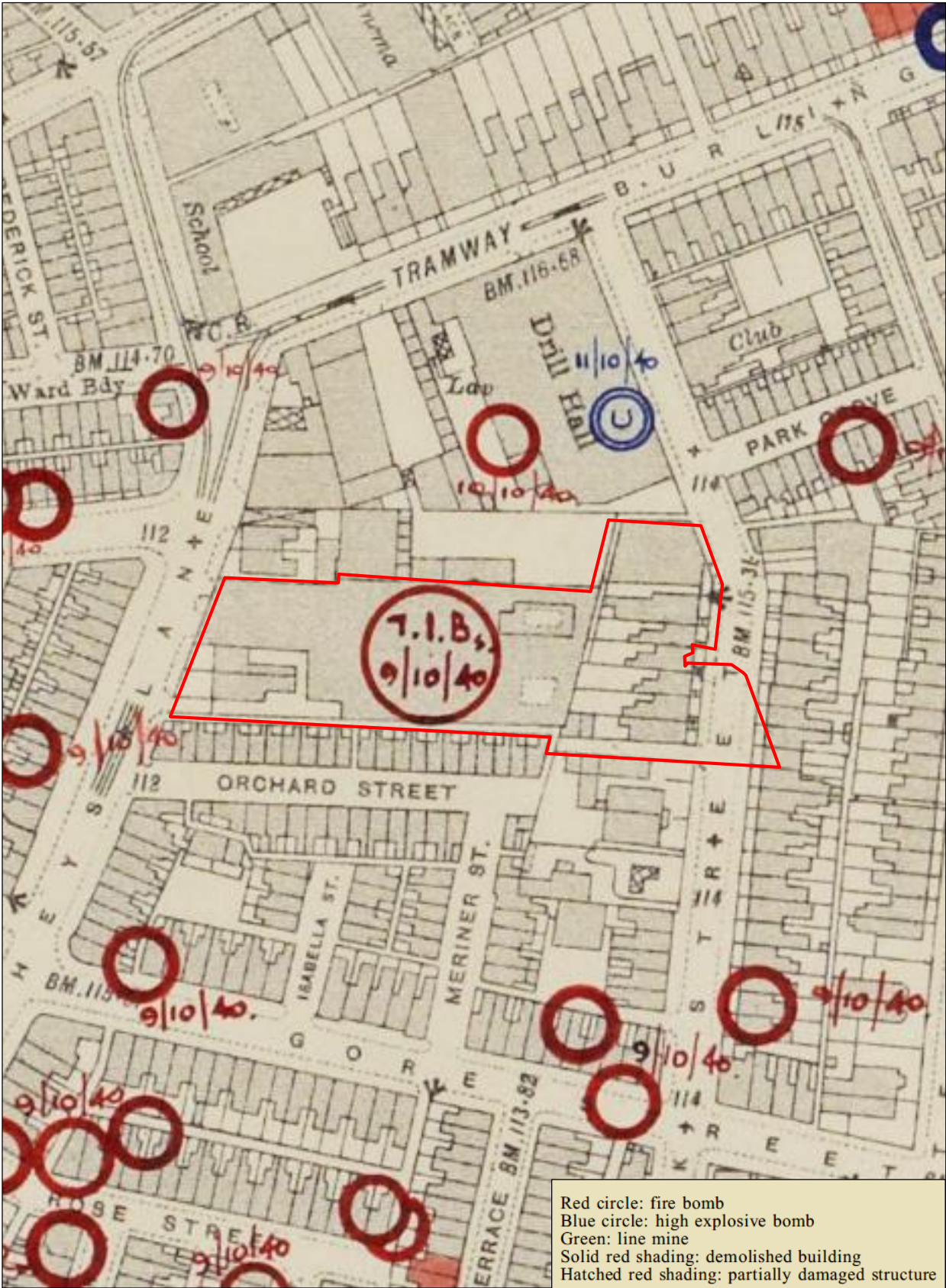
Luftwaffe Photograph, 1st November 1940



Manchester– Salford

Manchester Ship Canal and North Bay docks

The site is located approximately 3.4km south-east of the docks.



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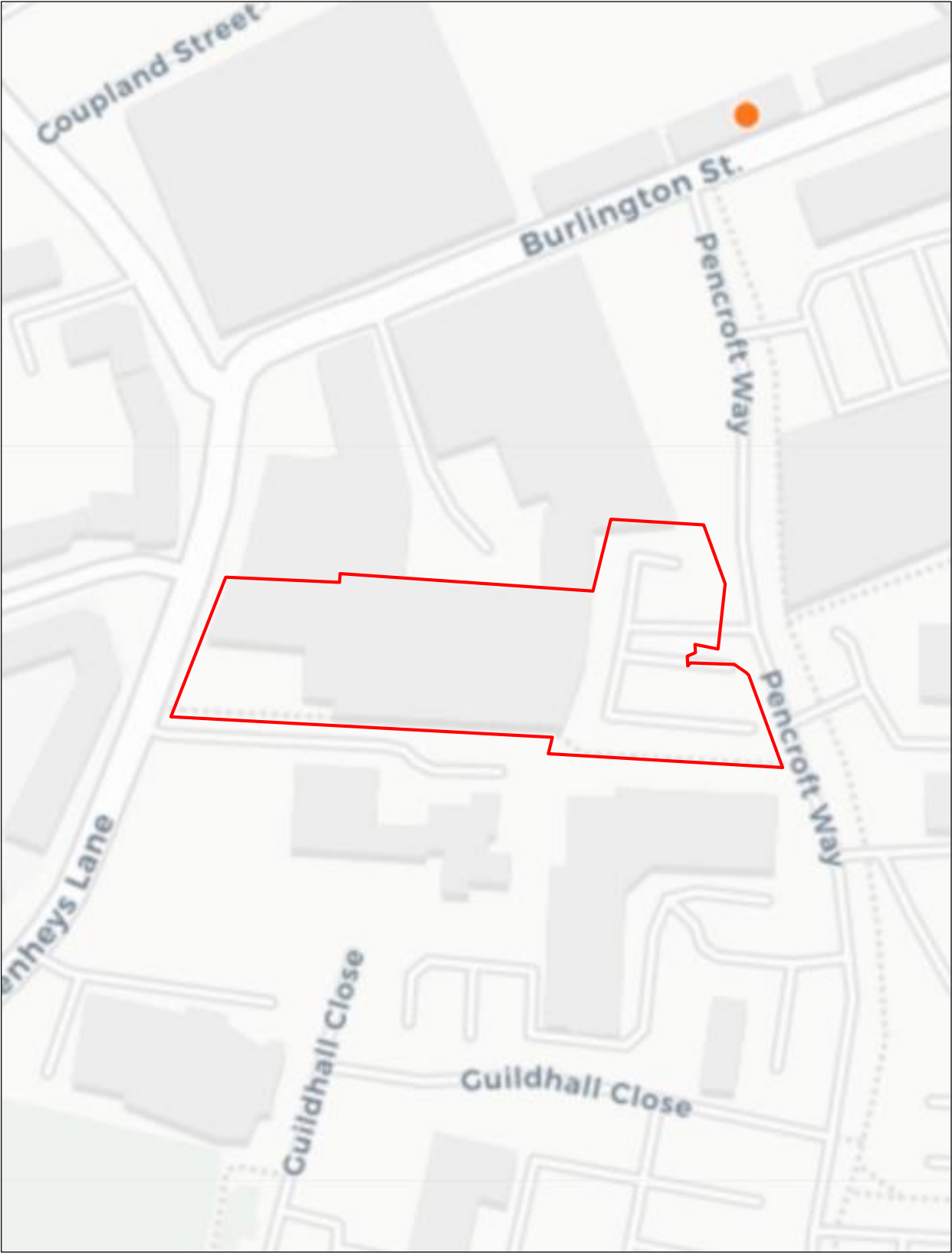
Ref: DA17581-00

Source: Manchester Central Library

Approximate site boundary



22nd – 24th December 1940



Recorded Fatal Bomb Strike



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Project: Greenheys Business Centre

Ref: DA17581-00

Source: <http://www.manchestereveningnews.co.uk>

Approximate site boundary



Regional Situation Report 1800/9/10/40 to 0600/10/10/40.

MANCHESTER AREA.

MANCHESTER. At 2040 hours I.B's in Claude Road and St. Anne's Road, CHORLTON-CUM-HARDY. Fires quickly extinguished by Wardens. I.B's in Newlorne Street, Platt Street, Copeland Street and Carlton Street (Moss Side Area): All fires under control by 2330 hours. 4 H.E. damaged houses in Zeta Street and Ashley Lane, MOSTON. At 2115 hours I.B's fell in Denmark Road, Derby Street, Bath Street, Piggot Street, (Greenheys Lane), Acomb Street and Lincroft Street. Casualties 1 dead 1 seriously injured, 1 slightly injured.

MANCHESTER.

Was raided at 2200 hours 11/10/40.
Most of the bombs fell in the South Central part of the City which is largely residential. 28 H.E., 67 I.B. and 2 oil I.B. caused wide spread damage to dwelling houses. At least 9 houses have been demolished. A considerable number of fires were caused, all of which have been dealt with. There was much damage to gas mains. Casualties so far reported: 3 Dead, 9 seriously injured, 17 slightly injured.
The more serious cases are:-
Carter Terrace, CHORLTON-ON-MEDLOCK, (4 houses demolished).
Rose Street, GREENHEYS, (houses demolished).
Physical Training Centre and O.T.C. H.Q. Manchester University damaged by H.E. believed to be ux.
Eliza Street, HULME, (5 cottages demolished.)
York Place, (Nurses Home partly demolished).
Uxb's caused evacuation at Dudley Street and Grafton Street. Brook's Bar, and at 25 Alston Gardens, Shawbrook Road, BURNAGE (21 houses).



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Project: Greenheys Business Centre

Ref: DA17581-00

Source: Manchester Central Library

11103 [4578]				FOR OFFICE USE ONLY	
CITY OF MANCHESTER CITY ARCHITECT'S DEPARTMENT RETURN OF WAR DAMAGE TO PROPERTY				PART 3	SHEET No 687
LOCATION 7 Park Street. Greenheys.	DIST. C.W.	DATE 22/12/40	TYPE BOMB H.E.	IF ESSENTIAL BLDG. STATE TYPE	
GRID No.					
* DESCRIPTION OF PROPERTY Social Club.		FULL ADDRESS AND LOCALITY South Manchester Transport Workers' Club & Institute 7 Park Street. Greenheys.			
INDICATION OF EXTENT OF DAMAGE					
ROOF Slight damage. due to blast.	WALLS —	FLOORS —	* GENERALLY Glass windows.		
DAMAGE TO CONTENTS —		INDICATION OF DANGEROUS STATE IF ANY —			
* TYPE OF DAMAGE D.	DATE 12/12/41	TIME	INSPECTOR C.W. Peers.		

Transcription:
Date: 22nd December 1940.
Location: 7 Park Street, Greenheys.
Type of Bomb: High Explosive (HE).
Description of Property: Social Club.
Full Address and Locality: South Manchester Transport Workers' Club & Institute, 7 Park Street, Greenheys.
Indication of Extent of Damage (Roof/Generally): Slight damage due to blast/Glass windows.
Type of Damage: D



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Project: Greenheys Business Centre	
Ref: DA17581-00	Source: Manchester Central Library

District CW		Burlington Street						Incident Date						
Sector 12		Con M						Date Inspected 10/4/42						
Card No.		Continued on Card No.						Inspector SBT						
No.	H. H. & S. F.	Classification	TENANT	EXTENT OF DAMAGE								Re-Classification		
				Roofs	Chimneys	Walls	Floors	Ceilings	Doors	Windows	Frames	Class	Date	
60		B✓	D. (s.c)											(C6)
62		B✓	Ditto											
64		B✓	Ditto											
66		B	Ditto											A 10/4/42
68		B✓	Ditto											
70		B✓	Ditto											
72		B✓	Ditto											

Transcription:
Incident Date: N/A
Date Inspected: 10th April 1942
District/Sector: CW/12
Location: 60, 62, 64, 66, 68, 70, 72 Burlington Street, Chorlton-on-Medlock
Tenant: D (SC)



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Project: **Greenheys Business Centre**

Ref: **DA17581-00**

Source: National Monuments Record Office (Historic England)

 **Approximate site boundary**







Cleared Ground



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

- Low Risk
- Medium Risk

- All Risk Areas:**
- Site Specific Unexploded Ordnance Awareness Briefings to all personnel conducting intrusive works
 - UXO Risk Management Plan
- Medium Risk Area:**
- Non-Intrusive UXO Magnetometer Survey and Target Investigation (where appropriate.)
 - Unexploded Ordnance (UXO) Specialist Presence on Site to support shallow intrusive works
 - Intrusive Magnetometer Survey of all Borehole and pile locations down to a maximum bomb penetration depth



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Client: Bruntwood SciTech		 Approximate site boundary
Project: Greenheys Business Centre		
Ref: DA17581-00	Source: 1 st Line Defence	



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

- Low Risk
- Medium Risk

All Risk Areas:

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

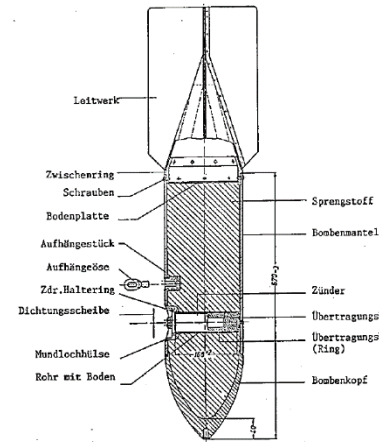
Medium Risk Area:

- Unexploded Ordnance (UXO) Specialist Presence on Site to support open excavation works
- Intrusive Magnetometer Survey of all Borehole and pile locations down to a maximum bomb penetration depth

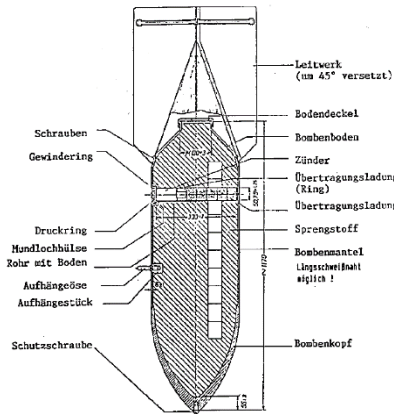
Please note that UXO Support/Survey would not be deemed necessary in areas of and down to the depth of any post-war fill or significantly worked post-war Made Ground.

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**

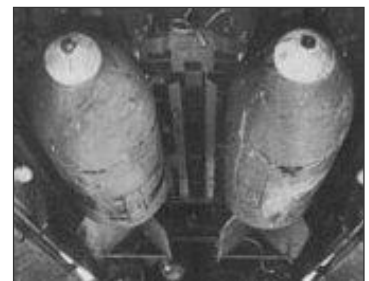
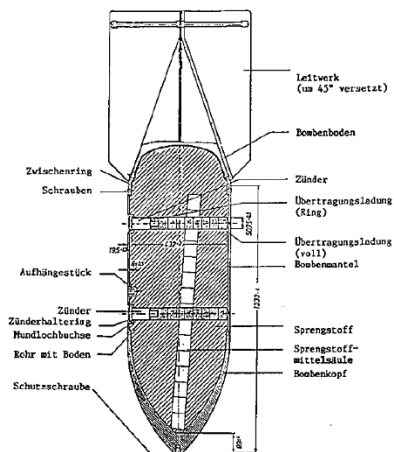
Bomb Weight	245-256kg (540-564lb)
Explosive Weight	125-130kg (276-287lb)
Fuze Type	Electrical impact/mechanical time delay fuze
Bomb Dimensions	1640 x 512mm (64.57 x 20.16in)
Body Diameter	368mm (14.5in)
Use	Against railway installations, embankments, flyovers, underpasses, large buildings and below-ground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



SC250 bomb being loaded onto German 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 Trialene filling have cylindrical paper-wrapped pellets, 1-15/16in. in length and diameter.

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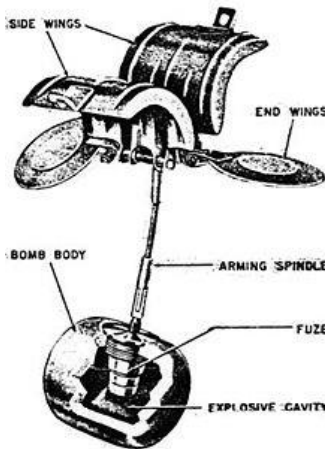
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Source: Various sources

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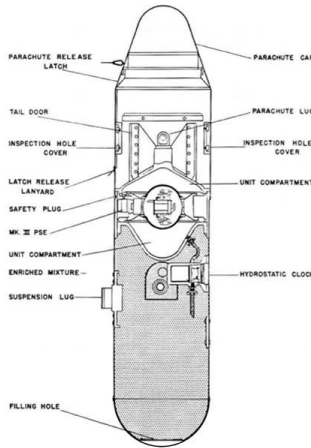
SD2 Anti-Personnel ‘Butterfly Bomb’

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.



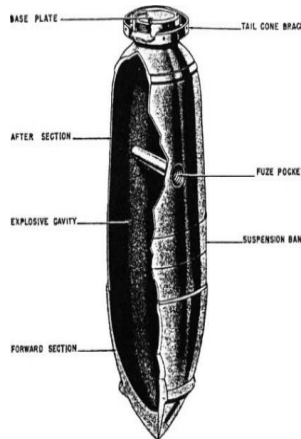
Parachute Mine (Luftmine B / LMB)

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

Bomb Weight	Approx. 993-1027kg (2,189-2,264lb)
Explosive Weight	Approx. 530-620kg (1168-1367lb)
Fuze Type	Electrical impact/mechanical time delay fuze.
Filling	Mixture of 40% amatol and 60% TNT, but when used as an anti-shipping bomb it was filled with Trialen 105, a mixture of 15% RDX, 70% TNT and 15% aluminium powder.
Bomb Dimensions	2800 x 654mm (110 x 25.8in)
Body Diameter	654mm (18.5in)
Use	SC-type bombs were General Purpose Bombs used primarily for general demolition work. Constructed of parallel walls with comparatively heavy noses, they are usually of three-piece welded construction.



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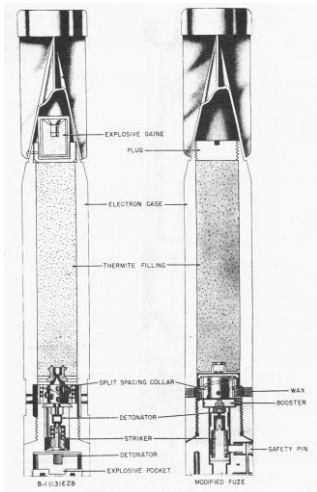
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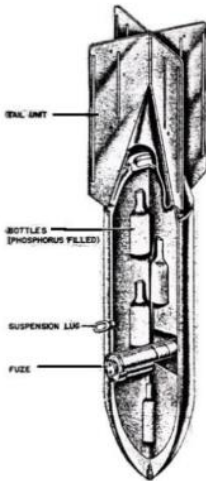
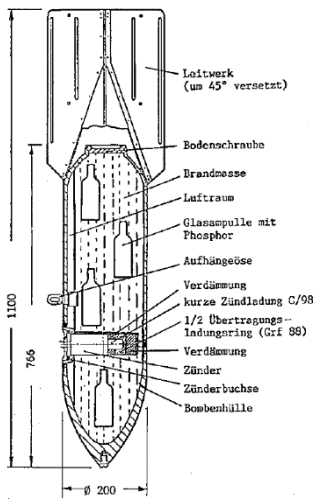
1kg Incendiary Bomb

Bomb Weight	Approx. 1.0 - 1.3kg (2.2 and 2.9lb)
Explosive Weight	Approx. 680g (1.5lb) Thermit 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.



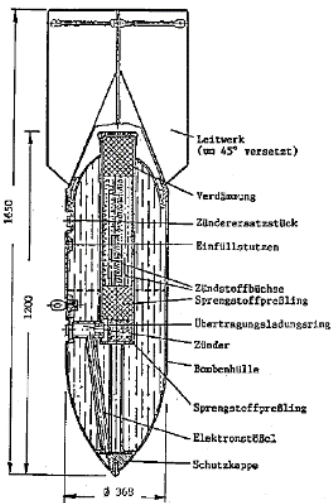
C50 A Incendiary Bomb

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



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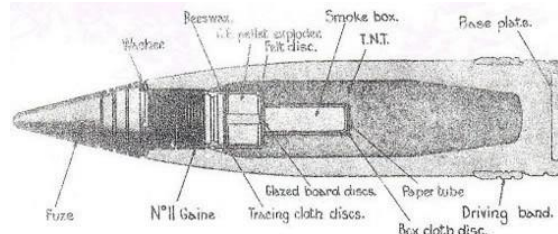
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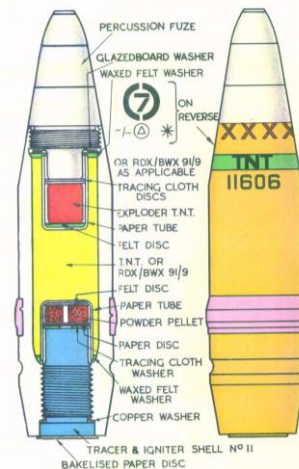
3.7 Inch QF Anti-Aircraft Projectile

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



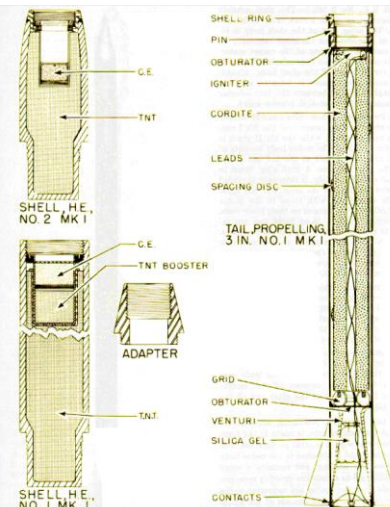
40mm Bofors Projectile

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



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

HE Projectile Weight	3.4kg (7.6lb)
Explosive Weight	0.96kg (2.13lb)
Filling	High Explosive – TNT. Fitted with aerial burst fuzing
Dimensions of projectile	236 x 83mm (9.29 x 3.25in)
Remarks	As a short range rocket-firing anti-aircraft weapon developed for the Royal Navy. It was used extensively by British ships during the early days of World War II. The UP was also used in ground-based single and 128-round launchers known as Z Batteries. Shell consists of a steel cylinder reduced in diameter at the base and threaded externally to screw into the shell ring of the rocket motor.



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