City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

January 2017

CONTENTS

1 Introduction

1. The City Airport Development Programme 1 (CADP1) planning application (13/01228/FUL) was granted planning permission by the Secretaries of State for Communities and Local Government and Transport in July 2016 following an appeal and public inquiry which was held in March/April 2016. Condition 81of the CADP1 permission is as follows:

   "The Development shall not commence until an Unexploded Ordnance (UXO) site safety and emergency procedures plan has been submitted to and approved in writing by the local planning authority. The Development shall only be carried out in accordance with the approved UXO site safety and emergency procedures plan.

   Reason: To reduce risk from Unexploded Ordnance to an acceptable level, as the site lies within an area of the London Borough of Newham that has been identified as being at potential risk from buried explosive ordnance due to wartime bombing."

2. The document shall focus on LCA's responsibility to ensure UXO risks are managed compliant to CIRIA industry guidance, and HSE endorsed, UXO risk management procedures and also LCA's obligations as client under the Construction Design Management (CDM) regulations.

3. The document refers to guidance documents created and maintained by the Construction Industry Research and Information Association (CIRIA), specifically:
   - Assessment and management of unexploded ordnance (UXO) risk in the marine environment (C754);
   - Unexploded ordnance (UXO) a guide for the construction industry (C681).

4. LCA has already commenced the process of undertaking UXO surveys and have engaged with a number of licenced Explosive Ordnance Disposal (EOD) specialists; this document refers to processes and procedures briefed to LCA by the specialist suppliers.

5. This document is the site safety and emergency procedures plan required under Condition 81 and references documents:
   - **Appendix 1:** CIRIA four stage UXO mitigation workflow
   - **Appendix 2:** 160919 DTS Report 16417 London City Airport CONCEPT
   - **Appendix 3:** 162900 - LCA - PAP Issue 01
   - **Appendix 4:** Site Supervisor Emergency Procedure 2016
   - **Appendix 5:** UXO Safety Procedure 2016

2 Industry Guidance

6. CIRIA describe four stages for managing UXO risks (see below) which are depicted in a workflow (see **Appendix 1**):

    1. **Preliminary Risk Assessment**: The purpose of the preliminary risk assessment is to inform the non-UXO specialist to place a site in context with the potential risk from UXO and to identify whether more detailed assessment is required. The assessment is based on data obtained from a desktop review of historic information regarding site location, previous site development and wartime bombing;
    2. **Detailed Risk Assessment**: This assessment enables an estimate to be made of the likelihood of encountering a UXO, giving due consideration to the size of development, development type and construction methods employed;
    3. **Risk Mitigation**: The purpose is to either eliminate the risk or reduce it to an acceptable level. The risk mitigation process provides a framework that identifies appropriate mitigation methods for the various risk scenarios that may have been identified in the detailed risk assessment;
    4. **Implementation**: The final phase of the process is to ensure that the selected risk management plan is carried out correctly and efficiently during the construction works and that works are verified/certified as having been completed to a satisfactory level.

7. Guidance from CIRIA also requires for sites where there is the possibility of a UXO hazard there shall be an emergency response plan in place. The plan should provide clear and precise guidance on what to do in the event a UXO is discovered. This should include emergency management team roles and responsibilities, health & safety plan for the proposed works, communication methods including tool-box talks.

3 Preliminary Risk Assessment

3.1 Explosive Ordnance Desktop Study

8. As part of the survey works carried out by LCA a UXO desktop study covering airport campus was commissioned and completed by EOD Contracts Limited. EOD Contracts is an international company that specialises in the field of Unexploded Ordnance clearance and disposal (UXO/ UXB) risk mitigation, desk top studies, intrusive and non-intrusive surveys and is a member the Institute of Explosive Engineers. EOD engineers are NATO qualified and conform to both ISO 9001:2008 and ISO 14001:2004 and subscribe to the Contractors Health and Safety Assessment Scheme (CHAS).

   Further information on EOD can be found on their website at: http://eodcontractsltd.com/

The desktop report can be found in **Appendix 2**.

3.2 Summary of Findings

9. The survey and report concludes that:
   - The area suffered bomb strikes and multiple bomb incidents were noted in the area with bomb damage evidenced.
   - The risk level on site for UXO is deemed as **HIGH** and given that some UXO retains the potential to detonate if disturbed with possible severe consequences, it is concluded that it would be prudent to ensure that basic precautions are taken to ensure that the CADP1 proceeds in the safest possible manner and that any residual risk posed by UXO is as low as it is reasonably practical to achieve (ALARP).

10. The report recommends:
    - Communicating the risks such that all stakeholders should be made aware of the UXO situation on the site and the possible impact it may have on the project works and day to day running of the district. Clients have a legal duty under the Construction Design & Management Regulations (CDM) and Health & Safety at Work legislation to provide Designers and Contractors with project specific information shall identify hazards and risks associated with the design and construction work. The possibility that UXO may be encountered on site falls within the category of a significant risk and as such it should be addressed as early as possible in the lifecycle of the project.
    - The risks posed by UXO should be brought to the attention of the project Principal Designer (CDM regulations 2015), Project Team (via the Project Manager) and Airport Operations and other individuals with a responsibility for project safety and operations at the site. The matter of UXO should be considered critical to project safety and one requiring high priority action.
    - UXO safety awareness training should be given at all levels of site personnel and selected individuals on the project staff with relevant responsibilities. The training should be provided by a competent person as part of the project safety induction course. It should be reinforced with specific safety briefings and tool box talks to individuals involved in conducting intrusive earthworks. The training should cover the following topics to a level commensurate with the audience's responsibilities and duties:
      - Project overview and the responsibilities of those working on site with regard to duty of care and public safety.
      - UXO recognition and safety procedures to be followed on discovery of a suspicious object or the alarm being sounded.

- Emergency procedures to be followed in the event of an explosion. Evacuation routes, muster stations and accounting for personnel.
- Work permits, works methodology and specific UXO risk mitigation methods. Post incident inspections and returning to normal works.

- Prior to and during any intrusive piling or drilling UXO safety testing shall be undertaken. This can be done using a progressive drilling process or (where large numbers of piles are to be placed and ground permitting) using a vehicle borne hydraulic system to push a magnetometer into the ground to test for the presence of UXO prior to piling.
- UXO safety monitoring of all "at risk" excavations, including geotechnical or archaeological trial pits to be conducted during the project. This should be provided by a UK Home Office Authorised EOD/UXO Contractor using qualified EOD Engineer with specialist locators and detectors to scan the ground ahead of the excavation wherever possible.

4 Detailed Risk Assessment

4.1 Borehole Investigations

11. In order to progress the design ground investigations shall be carried out using rotary and/or percussion boreholes. The works shall be carried out by a licenced supplier with experience undertaking ground investigations both on land and in a marine environment (for dock piling works).

    Recognising the HIGH risk of UXO's, as described in the desk top study by EOD Contracts, the following detailed risk assessment shall be carried out:

4.1.1 Ground Investigations (landside)

12. Due to the nature of the ground where development is due to take place, in that it is made/developed ground with numerous services below ground level, a non-intrusive survey is deemed to prove ineffective as any magnetometer results are likely to be affected by ferro-magnetic contamination. As such intrusive methods of risk assessment/identification will be adopted.

    Refer to example documents (Concept project action plan for dock piling):

    - 162900 - LCA - PAP Issue 01 – **Appendix 3**

13. Prior to commencing the intrusive works on site all personnel will receive an Ordnance Awareness Safety briefing by a UXO specialist technician who shall be employed through the CADP project team. These will be location/site specific and cover relevant issues as per the Unexploded Ordnance Treat Assessment (UXO TA). All briefings will be recorded in the daily works diary and attendee's names on the relevant record sheet.

14. During borehole penetration works a magnetometer probe will be dropped into the boreholes at 1m depths by a UXO engineer to check for presence of ferrous materials. In the event of ferrous material being identified the borehole rig shall be moved to an area where no ferrous material is found and the steps repeated.

15. The location of the ferrous material will be logged by the UXO engineer and will provide information to future stages of the project (piling & groundworks). During the GI phase of works ferrous material will not be investigated further and/or removed. The procedure when encountering ferrous materials within the borehole is presented in the Concept Project Action Plan **(Appendix 3)**.

4.1.2 Dock Surveys

16. As part of the CADP1 building works c.1000 piles will be installed in the dock to the south of the existing runway to support the deck construction for the additional aircraft stands; Eastern Terminal Extension (ETE); East Pier; and an additional taxi-way.

Magnetometer Survey

17. A magnetometer survey shall be conducted to locate ferrous materials (termed anomalies) on the dock bed and up to 4m below the dock bed level. The survey will determine the approximate size, position and depth of the ferrous materials.

18. LCA shall employ a registered EOD specialist company to undertake the magnetometer survey and interpret the results and have commenced engagement with four such suppliers.

19. GIS software will be employed to accurately pinpoint the location of the materials and the piling grid will be overlaid to identify clashes between the piling rig and piles and the identified ferrous materials. The information provided on the overlay will inform the next stages of risk mitigation.

5 Risk Mitigation

20. Following the ground investigation surveys and detailed risk assessment where the location of ferrous materials is identified, LCA will decide on a strategy for mitigating the risks to an acceptable level. This will be an internal process led by the CADP Project Manager with input from Airport Operations, the Emergency Planning team, Metropolitan Police – Aviation Policing and specialist EOD/UXO technician.

21. The specialist EOD supplier shall inform risk managers how they should proceed. For the dock bed works, having established what kind of individual UXO they may be dealing with, they will carry out a risk management strategy designed to reduce UXO risks to as Low As Reasonably Practicable (ALARP), a process which is legally required.

5.1 Landside Risk Mitigation

22. **Operational UXO Risk Management Plan:** Appropriate Site Management documentation will be held on site to guide and plan for the actions which should be undertaken in the event of a suspected, or real, UXO discovery. Example plans can be found in **Appendix 4 and 5.**

23. **UXO Safety Awareness Briefings:** As part of the site inductions all members of staff entering the site, whether workers or non-operational/management staff, shall be briefed on the risks and possibility of encountering UXO's. The safety induction is a mandated part of the Health & Safety plan, conforming to the rules and guidance set out in CDM 2015.

24. Staff will be briefed on the identification of UXO's, what actions they should take to keep people and equipment away from the threat and how they should alert the site management staff.

25. Information on the risk, types of explosives and pictures from historical construction sites will be displayed in common areas (welfare, mess rooms, offices..etc) and will serve as a reference and a reminder for site based staff of the threat of UXO's.

26. **Deep Excavations:** On all deep (>2m) and open excavations such as trenching for services, excavations for foundations and below ground structures an EOD specialist supervisor will be employed to supervise the works and identify any UXO finds.

5.2 Dock Bed Risk Mitigation

27. Due to the construction constraints the location of the piles for the deck construction cannot be moved. As such in the areas where a clash between the piling location and anomalies, identified through the magnetometer survey, these have to be investigated further to establish whether the anomaly is a UXO or otherwise safe.

28. The method of investigation differs between suppliers with some opting to use divers and some opting to use remote operated vehicles (ROV's). However the outcome is to visually identify whether the anomaly is a UXO or a 'safe' object. The objects will be tagged using colour coded buoys; for example UXO's will have RED buoys and safe objects BLUE buoys. Tagging the objects in this manner will aid in the safe removal of UXO's – covered in Section 6.

29. As per the investigation work LCA will employ a specialist supplier who has the capability and all associated licences to undertake the risk mitigation stage. In the event of a UXO being identified the EOD specialist company will advise of the type and size of UXO and the method for safe removal.

30. The risk mitigation strategy for the dock bed will be to eliminate the risk by removing all UXO's within 5m of the location of a pile.

6 Implementation

31. The final phase of the Emergency Plan process is to ensure that the selected risk management plan is carried out correctly and efficiently during the construction works and that works are verified/certified as having been completed to a satisfactory level.

6.1 Landside Implementation

32. The landside risk mitigation (Section 5) and implementation phase (Section 6) will likely occur in parallel.

33. Following the identification of ferrous metals during the bore-hole ground investigations (as described in Section 4) localised excavation will commence under the guidance of the EOD specialist to the depth where the magnetometer encountered the ferrous metal.

34. The table below indicates the typical depths of bombs in differing types of soil; typical soil type found on the site is highlighted in yellow:

	50kg bomb	250kg bomb	500kg bomb	1000kg bomb
Soft rock	2.4m	5.0m	6.0m	7.0m
Gravel	2.4m	5.0m	6.0m	7.0m
Sand	2.4m	5.0m	6.0m	7.0m
Chalk	3.7m	7.6m	9.1m	10.7m
Dry clay	3.7m	7.6m	9.1m	10.7m
Wet clay	5.5m	11.4m	13.65m	16.05m

35. The ferrous metal will be identified as either a UXO, or, inert material which can be removed without the requirement for either military intervention or the UXO specialist on site.

36. For identified UXO's the UXO specialist will contact the local police, military and Airport Operations, the process is described later in Section 6.3. As part of the clearance activity the military (or delegated specialist) will advise the airport (via the Airport Duty Manager) and local police force on the requirement for implementing exclusion zones as this is dependent on the type of EOD identified. Once the UXO threat has been made safe or disposed of, the consultant team will give the developers a sign-off certificate which affirms that the site has had its UXO risk reduced to ALARP.

6.2 Dock Bed Implementation

37. Due to the construction constraints with the location of the piles for the deck construction specified the implementation strategy will be to remove all objects that clash with the pile locations. The strategy adopted for UXO clearance will be to clear a 5m radius from the centre of the pile locations; however the piles will be installed at 10m centres therefore rendering the need to clear the whole of the dock bed (in the area of construction) of UXO's.

38. Following from the risk mitigation phase (as described in Section 5) where all UXO's are tagged with coloured buoys the specialist supplier will contact the military to undertake the clearance/removal of the UXO. Only the military bomb disposal experts are permitted to undertake such works UNLESS the military delegate this responsibility to a specialist contractor.

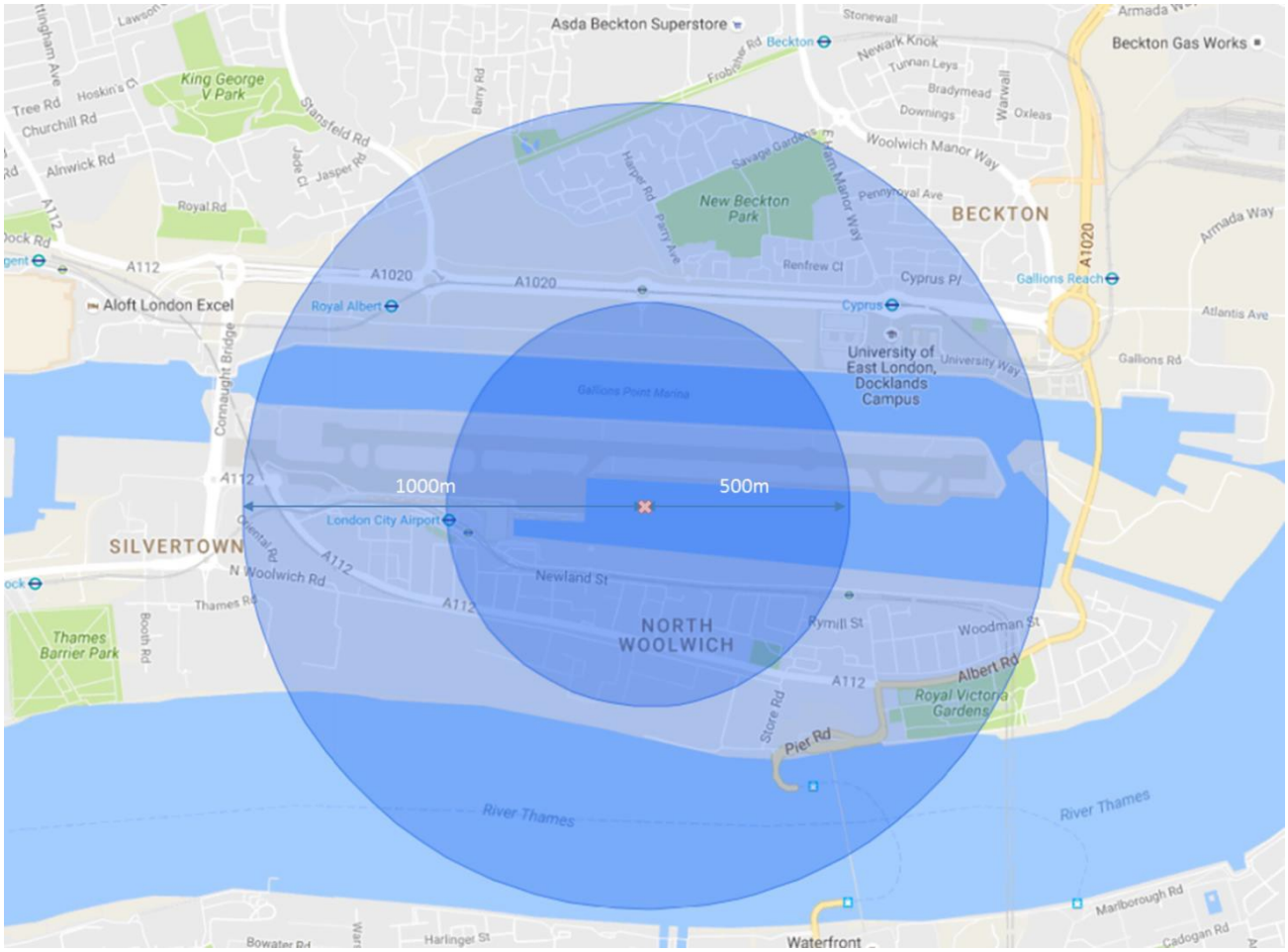
6.3 Removal of UXO's

39. Removal and/or controlled detonation can only be undertaken by the military bomb squad(s) unless they delegate this responsibility to a specialist contractor.

40. If the UXO threat is likely to explode, then it will be safely detonated on site. If it is likely to cause direct damage to on-site equipment it will likely be detonated, then carefully removed to a safe location for disposal.

41. When an UXO object is detonated in situ, an exclusion zone of between 500m and 1km is usually established around it, this is dependent on the type of explosive device found. This ensures that neither infrastructure nor maritime wildlife is affected by the shockwaves from the detonation.

42. The figure below shows the extent of a 500m and 1km exclusion zone:



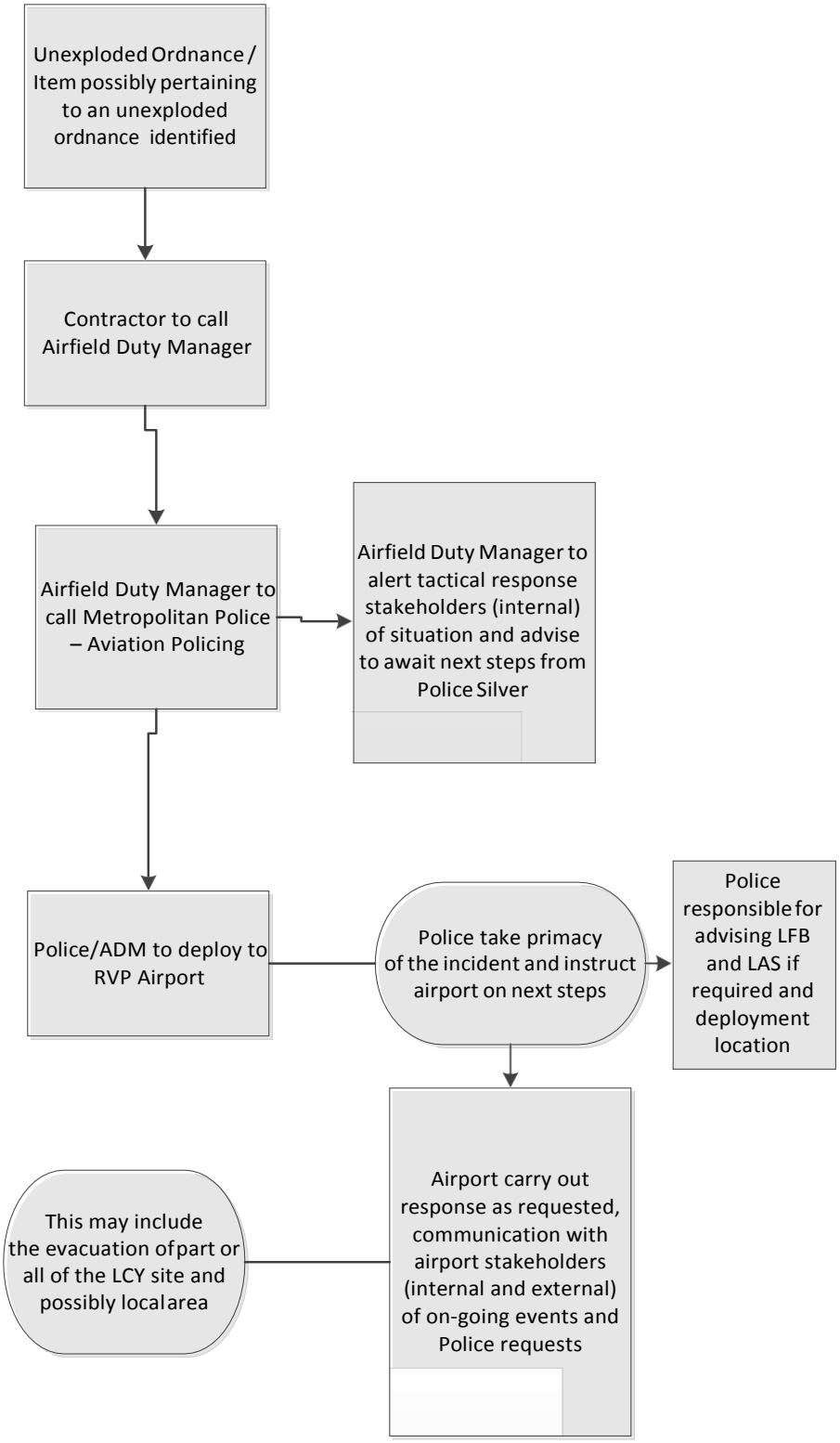
43. Regardless of whether the identified UXO's are to be removed and disposed of off-site, OR, detonated on site this will be undertaken during the times when the airport is closed.

44. London City Airport Ltd adheres to European Aviation Safety Agency (EASA) and the UK Civil Contingencies Act (CCA) 2014 legislation which includes ensuring comprehensive emergency plans are in place. The Civil Aviation Authority is LCA's regulator for works relating to EASA regulations. In the event that unexploded ordnance is either found, or suspected, there is a process describing the roles and responsibilities and the communication lines which are outlined in the flow chart below. These processes align with the processes employed by the EOD specialists and in summary include:

- EOD specialist/Client representative contacts the Airfield Duty Manager;
- EOD specialist contacts the local police;

- The police shall be deployed and take primacy of the scene with the EOD specialist providing advice on the type & nature of UXO;
- The airport will await instructions from the police;

LCA unexploded ordnance emergency response activation



7 Appendices

7.1 Appendix 1 – CIRIA four stage UXO mitigation workflow

7.2 Appendix 2 – 160919 DTS Report 16417 London City Airport CONCEPT 162900

7.3 Appendix 3 – LCA - PAP Issue 01

7.4 Appendix 4 – Site Supervisor Emergency Procedure 2016

7.5 Appendix 5 – UXO Safety Procedure 2016

City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

Appendix 1 – CIRIA Four Stage UXO Mitigation Workflow

Can be undertaken by non-UXO specialist

Must be undertaken by UXO specialist

PRELIMINARY RISK ASSESSMENT

Gather basic site data

Does site have a history of previous military use?

No

Has the Preliminary Risk Assessment identified a requirement for a Detailed Risk Assessment to be undertaken?

No

NO FURTHER ASSESSMENT REQUIRED

DETAILED RISK ASSESSMENT

Review data

Is the data adequate to enable detailed risk assessment?

No → Gather additional data

Yes

Carry out detailed risk assessment *(See Section 6)*

Has detailed risk assessment identified any potential UXO risks?

No

Yes

NO FURTHER ASSESSMENT REQUIRED

Is risk acceptable?

No

RISK MITIGATION

Identify UXO specific mitigation works to address unacceptable risk

Is the data sufficient to allow design of detailed risk mitigation plan?

No

Yes

No feasible risk mitigation options identified

DEVELOPMENT NOT VIABLE

NO FURTHER ASSESSMENT REQUIRED

IMPLEMENTATION

Is a UXO encountered during site works?

No

Yes

Implement Emergency Response Plan

Coordinate safe removal of UXO

Complete and issue Verification Report

NO FURTHER ASSESSMENT REQUIRED

City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

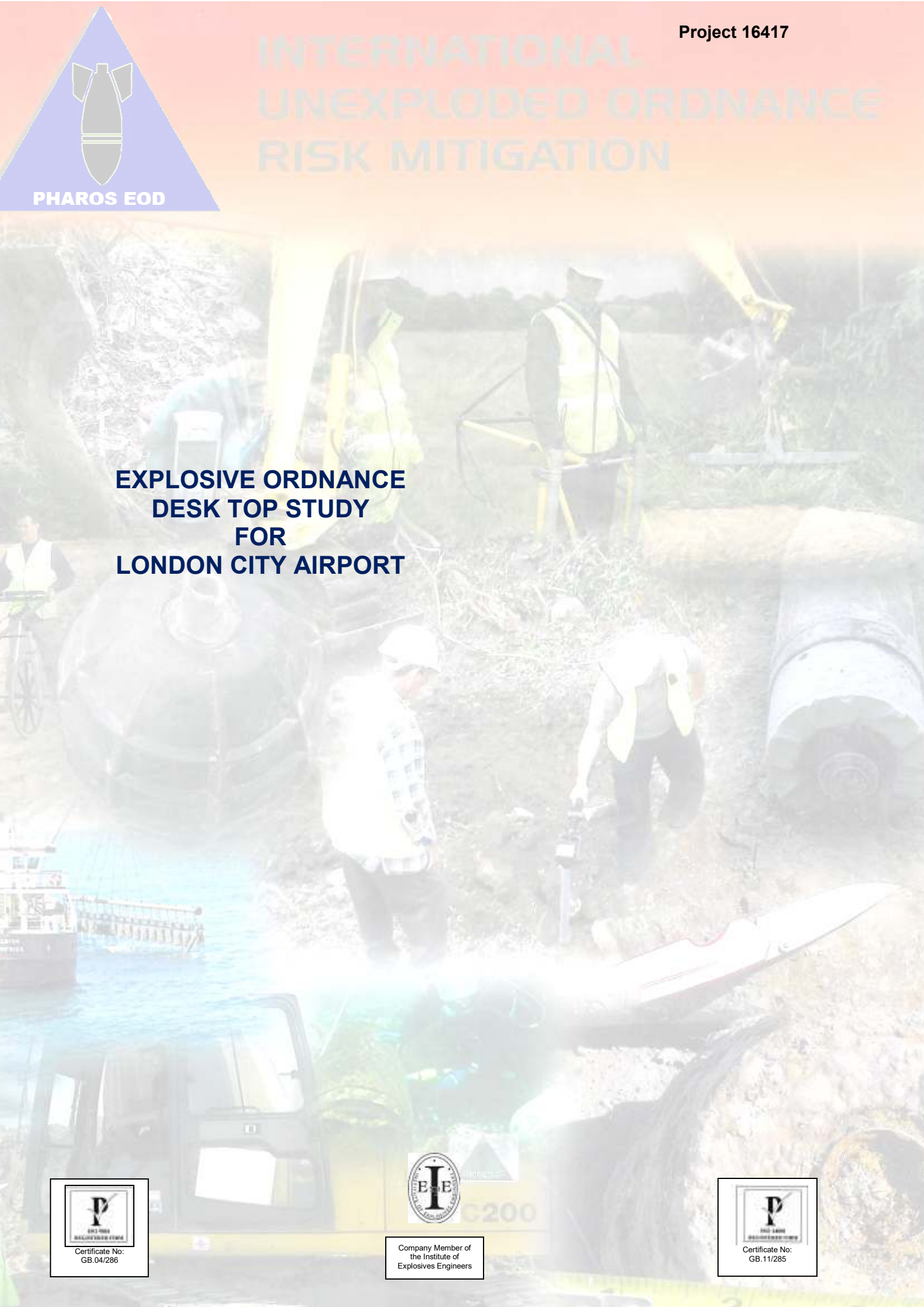
Appendix 2 – Explosive Ordnance Desk Top Study

PHAROS EOD

Project 16417

INTERNATIONAL
UNEXPLODED ORDNANCE
RISK MITIGATION

EXPLOSIVE ORDNANCE DESK TOP STUDY FOR LONDON CITY AIRPORT



Certificate No:
GB.04/286

Company Member of
the Institute of
Explosives Engineers

Certificate No:
GB.11/285

EXPLOSIVE ORDNANCE DESK TOP STUDY

Of

London City Airport

Conducted by EOD Contracts Limited

On behalf of

Concept

PREFACE

Conditions of Release

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CONTENTS

Annexes

TERMS AND DEFINITIONS

Anti Aircraft Shells (AA)
Small HE shells ranging up to 100mm in diameter.

Battlefield Area Clearance (BAC)
The systematic clearance of munitions from military property or old battle sites e.g. ranges, airfields etc.

Borehole Search
The placing of boreholes in a set pattern, then using a magnetometer to take readings at specific depths along each borehole. When used with a geophysical survey system this will give a magnetic signature of the area. The depth of the borehole and the pattern will depend upon the type of UXB and the geology of the ground.

Doodle Bug (See Pilotless Aircraft)

Explosive Ordnance (EO)
All munitions containing **explosives**, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads; guided and ballistic missiles; artillery, mortar, rocket and **small arms ammunition**; all mines, torpedoes and depth charges; pyrotechnics; clusters and dispensers; cartridge and propellant actuated devices; electro-explosive devices; clandestine and improvised explosive devices; and all similar or related items or components explosive in nature.

Explosive Ordnance Clearance (EOC)
See BAC.

Explosive Ordnance Disposal (EOD)
The detection, identification, field evaluation, render safe, recovery and disposal of **UXO**.

Geophysical Survey
The survey of an area using a Magnetometer and geophysical gathering device, after interpretation, this will produce a geophysical map and an object list for any metallic hotspots.

High Explosive (HE)
High explosives burn/detonate at rates of up to 9,000 m/per second.

Incendiary Bomb (IB)
Incendiary bombs ranged from 1kg in size to 500kg the larger sizes were sometimes called Oil Bombs. Fills range from thermite mixtures, phosphorus to kerosene.

Intrusive Survey
The use of a cone penetrometer (MagCone) or drilled boreholes (MagDrill) to take magnetometer test in a set pattern (see borehole search) or to prove pile positions.

Land Service Ammunition (LSA)
LSA is defined as “All items containing explosives or pyrotechnic compounds which are placed, thrown or projected so as to cause damage to men and equipment during land warfare.

Long Range Rocket (LRR)
The long range rocket sometimes codenamed Big Ben is the V2 rocket designed to deliver an approximate payload of 1000 kg.

Oil Bomb (OB)

A bomb containing a flammable liquid normally the KC 250 Flam or the C 500 flam.

Pilot less Aircraft (PAC)

A flying bomb (Fly) or doodlebug is the V1 rocket or predecessors designed to deliver an explosive payload of approximately 500kg - 800kg.

Parachute Mine (PM)

Air dropped mine may have been used as a blast effect bomb maximum explosive content 1600lb always fitted with anti-handling and anti-stripping equipment.

Unexploded Bomb (UXB)

Any air dropped bomb that has failed to operate.

Unexploded Ordnance (UXO)

Explosive ordnance that has been primed, fused, armed or otherwise prepared for use or used. It may have been fired, dropped, launched or projected yet remains unexploded either through malfunction or design or for any other cause.

Vengeance Weapons (V)

V1 see Pilot less Aircraft.
V2 see Long Range Rocket.

WWI

World War 1.

WWII

World War 2.

EXECUTIVE SUMMARY

1 Instruction

EOD Contracts Ltd, have been commissioned by Concept to undertake a desktop study for potential historic Unexploded Ordnance (UXO) contamination on a site at the environs of London City Airport.

2 Scope of Work

The scope of this EO Risk Assessment/Desk Study is to assess the likelihood of buried EO/UXO within the environs of London City Airport, a further aim was to evaluate the implication from UXO contamination during any future intrusive land use.

2.1 Location

The site is located in the Royal Docks, in the London Borough of Newham, the general area appears to be mixed residential, commercial and some light industry.

Title	Description (Centre of Site)
Address	Hartmann Rd, London, E16 2PX
Post Code	E16 2PX
Grid Reference	TQ429803 / TQ4293880375
OS (X)	542938
OS (Y)	180375

Annex A shows a site location map.

4 Sources of UXO Contamination

4.1 The two main sources of UXO contamination are:

4.1.1 Air delivered ordnance bombs and sub munitions/incendiaries.
4.1.2 Anti Aircraft Ammunition(AA)

5 Key Findings

5.1 Based on the information researched by EOD Contracts Ltd for the site, in that the site:

5.1.1 Suffered with 5 to 12 bomb strikes.

5.1.2 Suffered with IBs across site

5.1.3 Multiple bomb incidents were noted in the area.

5.1.4 Bomb Damage occurred to some of the buildings.

5.1.5 The expected bomb depth is 12m below 1939 ground levels and 3m below 1939 dock bed level.

5.2 Although the site has had some reconstruction this would have been in the early 1980s and the majority of the site would have been the removal of buildings.

5.3 The risk level on site is **HIGH** and given that some UXO retains the potential to detonate if disturbed with possible severe consequences, it is concluded that it would

be prudent to ensure that basic precautions are taken to ensure that the project can proceed in the safest possible manner and that any residual risk posed by UXO is as low as it is reasonably practical to achieve (ALARP).

5.4 The footprints of the buildings across the site are deemed **MEDIUM**.

6 RECOMMENDATIONS

6.1 It is recommended that the following risk mitigation strategy is executed during the project:

6.1.1 Communicating the risks, all stakeholders should be made aware of the UXO situation on the site and the possible impact it may have on the project works and day to day running of the district. Clients have a legal duty under the Construction Design & Management Regulations (CDM) and Health & Safety at Work legislation to provide Designers and Contractors with project specific information needed to identify hazards and risks associated with the design and construction work. The possibility that UXO may be encountered on site falls within the category of a significant risk and as such it should be addressed as early as possible in the lifecycle of the project.

6.1.2 Further Planning; the risks posed by UXO should be brought to the attention of the Project Principal Designers and other individuals with a responsibility for project safety and operations at the site. The matter of UXO should be considered critical to project safety and one requiring high priority action.

6.1.3 Safety Training; UXO safety awareness training should be given at all levels of site personnel and selected individuals on the project staff with relevant responsibilities. The training should be provided by a competent person as part of the project safety induction course. It should be reinforced with specific safety briefings and tool box talks to individuals involved in conducting intrusive earthworks. The training should cover the following topics to a level commensurate with the audience's responsibilities and duties:

6.1.3.1 Project overview and the responsibilities of those working on site with regard to duty of care and public safety.

6.1.3.2 UXO recognition and safety procedures to be followed on discovery of a suspicious object or the alarm being sounded.

6.1.3.3 Emergency procedures to be followed in the event of an explosion. Evacuation routes, muster stations and accounting for personnel.

6.1.3.4 Work permits, works methodology and specific UXO risk mitigation methods. Post incident inspections and returning to normal works.

6.1.4 Prior to any intrusive piling or drilling commencing, UXO safety testing and appropriate clearance certification into the ground to sufficient depth to provide clearance from UXO. This can be done using a progressive drilling process or (where large numbers of piles are to be placed and ground permitting) using a vehicle borne hydraulic system to push a magnetometer into the ground to test for the presence of UXO prior to piling.

6.1.5 UXO safety monitoring of all "at risk" excavations, including geotechnical or archaeological trial pits to be conducted during the project. This should be provided by a UK Home Office Authorised EOD/UXO Contractor using qualified EOD Engineer with specialist locators and detectors to scan the ground ahead of the excavation wherever possible.

6.2 **Specifically**:

6.2.1 Geotechnical investigations, percussive drilling/trial pits/window/samples, require an EOD Engineer over watch.

1 INTRODUCTION

1.1 Instruction

EOD Contracts Ltd, have been commissioned by Concept to undertake a desktop study for potential historic Unexploded Ordnance (UXO) contamination on a site at the environs of London City Airport.

1.2 Scope of Work

The scope of this EO Risk Assessment/Desk Study is to assess the likelihood of buried EO/UXO within the environs of London City Airport, a further aim was to evaluate the implication from UXO contamination during any future intrusive land use.

1.3 Restrictions

It must be emphasized that a desk study can only indicate the potential for UXO to be present on the site. A geophysical survey and intrusive investigation is fundamentally important to provide proof that the site is free of the UXO threat.

This study was written with the site conditions prevailing at the time of the study and no liability can be accepted for any change in the condition of the area.

Please note that our appraisal relies on the accuracy of the information contained in the documents consulted and that EOD Contacts Ltd will in no circumstances be held responsible for the accuracy of such information or data supplied.

1.4 Sensitive Documentation

Information may be classified, restricted or deemed to be confidential in nature to EOD Contracts Limited, where such material has been gained a summary of the documentation has been approved.

1.5 Objective

The objective of this document is to define the UXO contamination routes as defined in Unexploded ordnance (UXO) A guide for the construction industry (C681) dated July 2009 formulate a risk based on the available information and offer remediation methodologies if required.

2 SOURCES OF INFORMATION

2.1 Research of the site's history, with regard to military usage, bombing raids and bomb impacts has been undertaken to establish the following:

- Frequency and intensity of enemy bombing raids for the site and immediate vicinity up to 500m.
- Bomb impacts and associated damage on the Site and in the immediate vicinity.
- The potential for UXO to remain on the Site and in the vicinity.
- Records of UXO removal activities for the Site and immediate vicinity.

2.2 The main sources of information consulted include:

- EOD Contracts Ltd company records
- Ministry of Defence records
- Central and Local Government Records
- Public Records Office (Kew)
- Historic Maps and Air Photography
- Open Source information (Internet)

2.3 **Ministry of Defence (MOD) Records**. 33 Engineer Regiment (Explosive Ordnance Disposal) Royal Engineers is the unit responsible for maintaining the records concerning conventional Bomb incidents, reports, clearances and related UXO matters. These records are known to be incomplete and are no longer supplied. Based on in-house information released by the MOD previously, it is considered unlikely that any information released will have any significant impact on the findings of this study.

2.4 **Attack Record Keeping**. In general, the quality and accuracy of bombing and shelling records prior to 1939 varied greatly from one region to another. Records relating to the limited air attacks on the United Kingdom are considered to be sufficiently accurate in urban areas to provide a reasonable level of confidence in determining the likelihood that an area was or was not bombed during this period. Wartime records, maps etc held within the civil archives are considerably more comprehensive than those still in existence within the MOD, where it is acknowledged that large numbers of records have been disposed of since 1945. Records from some areas, particularly rural districts or near large bodies of water should still be regarded as an incomplete picture of the extent and effect of the bombing campaign.

2.5 **Attack Record Accuracy**. While an Air Raid was in progress it was inevitable that mistakes would be made in the transcription of rushed verbal reports into the written records. Discrepancies did occur between the total of bombs dropped against detonations witnessed. In some cases records were made several hours after the event and mistakes were inevitable. Some reports were drafted before the full extent of the raid had been determined which has led to significant omissions in the records. Reports of raids on rural areas were often witnessed and submitted by untrained individuals and passed through third parties before being recorded. Suspect UXBs occasionally went unreported by local farmers and freeholders who saw the event as insignificant, or were reluctant to report their findings for fear of valuable land or crops

being destroyed by the authorities in their attempts to find the UXB. It should also be noted that bomb strikes in water were notoriously difficult to spot, particularly if the bomb had failed to detonate. As a result bomb record accuracy in areas containing large bodies of water or marshland is considered to be questionable.

2.6 **Errors and Omissions**. The accuracy of bombing records has been shown to vary greatly; this may have been a result of the individual record keeper's expertise. Additionally, in some cases, errors occurred as a result of poor or incomplete transcription and copying. Some "errors and omissions" were intentional, designed to serve as dis-information to confuse German intelligence. So long after the event, official verification of such incidents has often proven to be impossible to obtain. At present, UXBs are found on construction sites and other locations where there had been no documentary evidence to suggest their presence. These events, although infrequent, do serve as confirmation that records cannot be considered definitive.

2.7 **Bibliography**

The significant published documents referred to during this study are listed below:

- HO 193 series from National Archives
- HO 198 series from National Archives
- The Blitz Then and Now Volumes 1 to 3
- The Little Blitz John Conen
- Map 56/18 NE Provisional Edition Aug 1940 GSGS 3906, 1 to 25,000
- AA Command Colin Dobinson
- German Air Raids on Britain 1914-1918
- Osprey - Campaign 193 - London 1914-17 - The Zeppelin Menace
- Osprey- Campaign 227 -London 1917–18 - The Bomber Blitz
- Bomb Sight Mapping the WW2 Census during 7th October 1940 to 6th June 1941

3 SITE DESCRIPTION AND DETAILS

3.1 Location

The site is located in the Royal Docks, in the London Borough of Newham, the general area appears to be mixed residential, commercial and some light industry.

Title	Description (Centre of Site)
Address	Hartmann Rd, London, E16 2PX
Post Code	E16 2PX
Grid Reference	TQ429803 / TQ4293880375
OS (X)	542938
OS (Y)	180375

Annex A shows a site location map.

3.2 Description

The site is located on the south side of the main runway, for London City Airport, the eastern boundary is prior to the entrance of Royal Albert Dock, the southern boundary is in King George V Dock and the western boundary is the main terminal building. During WWII the site was in Region 5, Group 7 West Ham.

3.3 Geology

Assumed Geological Model from Below Ground Level

Geological Unit Description	Anticipated Thickness (m)	Anticipated Depth Below river bed
Clay	3.4	3.4
Peat	3	6.4
Sand (Wet)	0.6	7
Gravel	3.7	10.7
Fine Sand	2.7	13.4

Assumed Geological Model from Below Silt Level (7 to 10m bgl)

Geological Unit Description	Anticipated Thickness (m)	Anticipated Depth Below river bed
Clay	1	1
Gravel and Sand BALLAST	7.8	8.8

3.4 Previous Use

The site prior to, during and post WWII was one of London's major docks, built in 1921.

3.5 Current Site Use

The subject site is at London City Airport a commercial airport, constructed in 1987, the port finally closed in 1981.

3.6 **Future Works**

At the time of writing this report it is understood that the site will be redeveloped, the outline specification is unknown. Therefore, it is assumed that the following intrusive construction works will be carried out:

- Geotechnical investigations, percussive drilling/trial pits/window/samples
- Demolition of buildings to ground level
- Removal of old foundations
- Possible new foundations with piling

4 HISTORICAL REVIEW

4.1 Historical Mapping and Aerial Photography

4.1.1 The air photograph in Annex B detailing the land usage is attached. The aerial photography indicates possible heavy bomb damage on the land side of the site. The site being a dock with water, which will not show bomb damage.

4.1.2 Perusal of historical mapping indicates the wharves and buildings around the site, vary in their usage, repairs seem to have completed during WWII, the pre and post war maps are in Annex B.

4.2 WWI

4.2.1 Although many people associate wartime bombing with The Blitz during World War II, the first airborne terror campaign in Britain took place during the First World War. Air raids in World War One caused significant damage and took many lives. German raids on Britain, for example, caused 1,413 deaths and 3,409 injuries. Air raids provided an unprecedented means of striking at resources vital to an enemy's war effort. Many of the novel features of the war in the air between 1914 and 1918—the lighting restrictions and blackouts, the air raid warnings and the improvised shelters—became central aspects of the Second World War less than 30 years later. The East End of London was one of the most heavily targeted places. Poplar, in particular, was struck badly by some of the air raids during the First World War. Initially these were at night by Zeppelins which bombed the area indiscriminately, leading to the death of innocent civilians.

4.2.2 The first daylight bombing attack on London by a fixed-wing aircraft took place on 13 June 1917. Fourteen German Gotha G bombers led by Squadron Commander Hauptmann Ernst Brandenberg flew over Essex and began dropping their bombs. It was a hot day and the sky was hazy; nevertheless, onlookers in London's East End were able to see 'a dozen or so big aeroplanes scintillating like so many huge silver dragonflies'. These three-seater bombers were carrying shrapnel bombs which were dropped just before noon. Numerous bombs fell in rapid succession in various districts. In the East End alone 104 people were killed, 154 seriously injured and 269 slightly injured.

4.2.3 The gravest incident that day was a direct hit on a primary school in Poplar. In the Upper North Street School at the time were a girls' class on the top floor, a boys' class on the middle floor and an infant class of about 50 students on the ground floor. The bomb fell through the roof into the girls' class; it then proceeded to fall through the boys' classroom before finally exploding in the infant class. Eighteen students were killed, of whom sixteen were aged from 4 to 6 years old. The tragedy shocked the British public at the time.

4.2.4 No bombs were noted on or in close proximity of the site. Annex C is a map of the bomb incidents for central London.

4.3 WW II

4.3.1 The Blitz on London started on Saturday 7 September 1940 when 348 German bombers escorted by 617 fighters attacked London in the late afternoon, formed a 20-mile-wide block of aircraft filling 800 square miles of sky. 448 people were killed. London was bombed every day or night from 7 September until 2 November. The Blitz finished in May 1941, when Germany was embroiled with its invasion of the Soviet Union and so raids on London stopped.

4.3.2 The London Blitz:

- 10 May 1941 was the worst night of the Blitz (and the last). 3000 people were killed in London that night
- 3000 unexploded Bombs (UXBs) were dealt with during the Blitz
- 1,400,000 people were made homeless due to the Blitz
- Just over 20,000 people were killed in the London Blitz

4.3.3 Sporadic single small groups of aircraft bombing incidents continued throughout 1942 and 1943.

4.3.4 **Operation Steinbock** (*Unternehmen Steinbock*) was a late Second World War Luftwaffe night-time strategic bombing campaign against southern England that took place from January—May 1944. It was the last strategic air offensive by the German bomber arm during the conflict. Germans assembled 474 bomber aircraft for the offensive. The attacks were mainly aimed at and around the Greater London area. In Britain, it was known as the 'Baby Blitz' due to the much smaller scale of operations compared to The Blitz, the Luftwaffe's campaign against the United Kingdom in 1940–41. Air raid casualties in Britain during the first five months of 1944 totaled some 1,556 killed, with 2,916 seriously injured.

4.3.5 West Ham in the Blitz

- The bomb density for West ham was 300-399 bombs per 404 hectares, a copy of the London Bomb Density Map is attached in Annex D
- The first bomb to land in West ham was on the 28th of August 1940, by the end of WWII, West Ham had a total of 194 air raids resulting in:

High explosive bombs (exploded):	1,286
High explosive bombs (unexploded):	207
Parachute mines (exploded):	28
Parachute mines (unexploded):	4
Incendiary bombs 1 kilo type that caused fires:	1,130
Incendiary bombs 1 kilo type which were dealt with and caused no fires, including those that did not ignite:	Many thousands
Oil bombs (ignited):	49
Oil bombs (unignited):	16
Anti aircraft shells (exploded):	106
Anti aircraft shells (unexploded):	95
Crashed aircraft:	1

4.4 **Bombing Details of Air Raids**

4.4.1 Record of air raids on and in the vicinity of the site have been scrutinized, bomb impact maps HO193 series are attached in Annex E, 8 bomb impacts on the site have been assessed as relevant.

4.4.1.1 Map **HO-193-1 7 to 21 Oct 1940** indicates 3 bombs on the site.

4.4.1.2 Map **HO-193-2 21 to 28 Oct 1940** indicates a bomb on the site.

4.4.1.3 Map **HO-193-4 4 to 11 Nov 1940** indicates a bomb on the site.

4.4.1.4 Map **HO-193-12 Accumulative day and night bombing up to 7 Oct 1940** indicates 3 bombs within 50m of the site.

4.4.1.5 Map **HO-193-13 Night bombing only between 7 Oct 1940 and 6 June 1941** indicates 17 bombs on the site.

4.4.1.6 Map **HO-193-24 10 to 17 Mar 1941** indicates incendiaries across the site.

4.4.1.7 Map **HO-193-25 17 to 24 Mar 1941** indicates incendiaries across the site.

4.4.1.8 Map **HO-193-27 14 to 21 Apr 1941** indicates 2 bombs and incendiaries across the site.

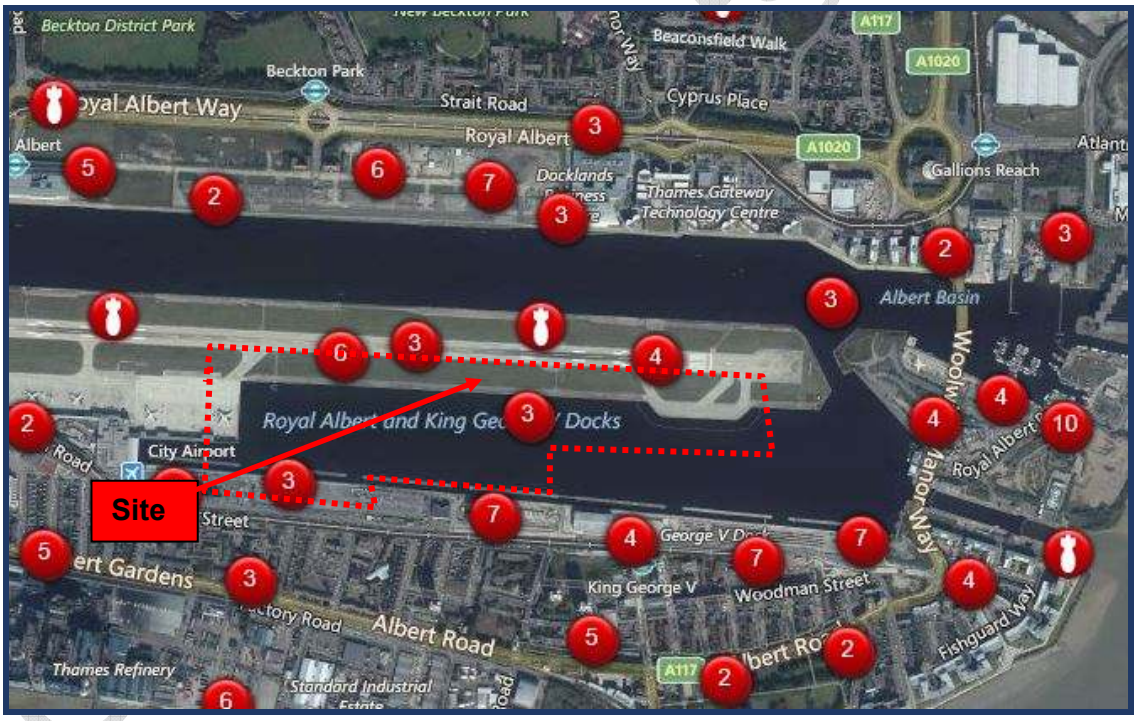
4.4.1.9 Map **28 5 to 12 May 1941** indicates incendiaries across the site.

4.4.1.10 Map **HO-193-31 11 Jan to 14 Feb 1943** indicates a bomb on the site.

4.4.2 The area has been assessed for damage using the Aerial Photograph in Annex B. The site surrounds have suffered serious damage.

4.4.3 The site is a waterway and bomb impacts would leave no evidence, bomb entry holes are unlikely to have been noted.

4.4.4 Bomb Sight indicates 12 recorded bombs on the site.



4.4.5 The West Ham Borough Council Bomb Map indicates 5 bombs on the site.

Bomb Impact Map

4.5 **Abandoned Bombs**

4.5.1 EOD Contracts records indicate no abandoned bombs in the area.

4.6 **Anti-Aircraft Artillery**

4.6.1 The nearest location of heavy AAA position is over 3km from the site.

4.7 **Prior Clearance Operations**

4.7.1 No Prior Clearance Operations have been documented for this site. Dredging has been noted at the lock gates, not across the main dock area.

5 SOURCES OF UXO CONTAMINATION

5.1 The main sources of UXO contamination are:

5.1.1 Air delivered ordnance bombs and sub-munitions/incendiaries.

5.1.2 Anti-Aircraft Ammunition (AA), to a lesser degree.

5.2 GENERAL

5.2.1 The area suffered bombing during the period of WWII, with between 8 and 12 recorded bombs dropped the site.

5.2.2 UXOs are essentially dangerous; therefore, further information on UXO and Safety is detailed in Annex F.

5.3 BOMB PENETRATION DEPTHS

5.3.1 **Weapon Sub-Surface Penetration**. Weapons penetrate a significant depth into the ground and other types of ammunition are designed to permit the weapon time to penetrate deeply into the target before detonating a short time after coming to rest or a considerable number of hours afterwards. The second reason is where the weapon has failed to function as designed becoming a UXB. A number of studies have been carried out into weapon penetration and it is an inevitable consequence of a number of variable factors acting on the bombs trajectory that figures can and do differ significantly. Careful consideration must be given to the weapon's velocity, trajectory and shape. Also surface conditions and subsurface geology. The largest of the common German bombs, (500kg) can penetrate to significant depths given favourable conditions for penetration. In the case of projectiles and shells, the potential for deep penetration is significantly less.

5.3.2 **Penetration Assumptions**. A number of assumptions were used in determining the maximum threat depth within the project footprint, which were.

5.3.3 **Factors Affecting Penetration.** The penetration of sub-surface bombs will be affected by the following:

- Height of release
- Weight, shape and design of bomb
- Aerodynamic qualities
- Angle of flight and impact
- Nature of impact surface
- Nature of sub soil

5.3.4 The expected bomb depths for the site assuming the following criteria:

- 15,000 ft the vast majority of bombs were dropped from height to avoid AA fire and balloons
- General Purpose Bombs of 50kg to 1000kg
- Near Vertical impact 80 to 90 degrees
- Surface geotechnical conditions are made ground
- Subsurface geotechnical conditions are generally clays see Paragraph 3.3

5.3.5 Therefore, the expected depths for Air dropped UXBs on site are indicated in **red** in the following table:

TABLE 1 Bomb Penetration Depths

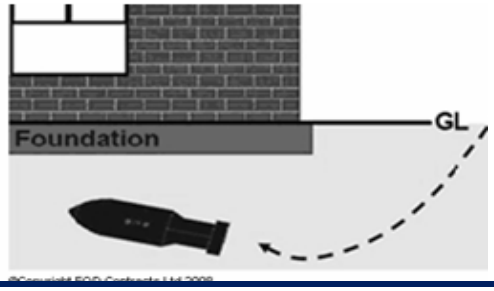
	Bomb Weights			
Sub Soil Type	50kg	250kg	500kg	1000kg
Soft Rock	2.442	5.016	6.006	7.062
Gravel	2.442	5.016	6.006	7.062
Sand	2.442	5.016	6.006	7.062
Chalk	3.7	7.6	9.1	10.7
Shingle	3.7	7.6	9.1	10.7
Dry Clay	3.7	7.6	9.1	10.7
Wet Sand	5.55	11.4	13.65	16.05
Wet Clay	5.55	11.4	13.65	16.05
Average Offset (m)	0.8-1.6	1.6-3.7	3-4.5	3.4-5.3

5.4 Bombs on penetration of the surface do not follow a straight line trajectory they can and do curve; this is called a “J” curve where the bomb’s path bends back towards the surface. This gives what is known as the Offset, which may place a bomb under a structure and at a shallow depth.

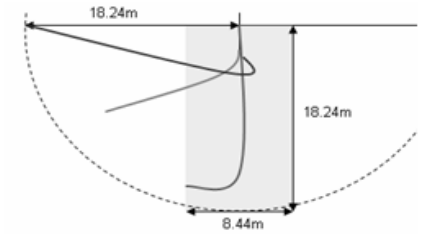
FIGURE 2 Sub-Surface Trajectories & Safety Buffers

Sub Surface Trajectory.

Common Sub-Surface Trajectory [6]

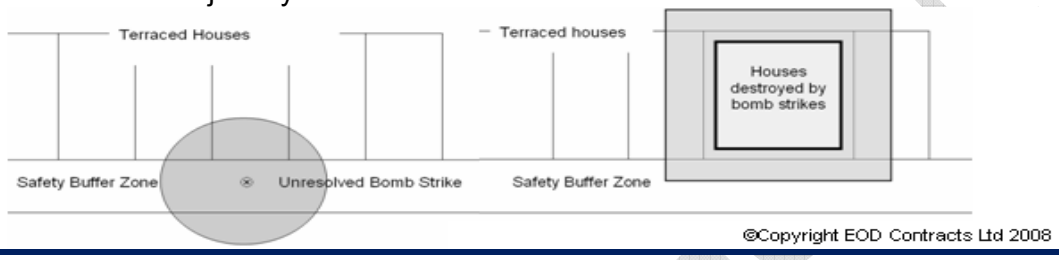


Anomalous Sub-Surface Trajectory [7]



Distances shown are for example only.

Sub-surface Trajectory Incursion [8]



[6] *Note; the common sub-surface trajectory will follow a path best described as a 'J' curve. The curve can result in a weapon coming to rest some distance from its impact point. The distance from impact point to resting place is referred to as the "Off set Distance and is normally considered to be 1/3 of the depth. This mechanism can permit a weapon to strike outside a building and travel below ground finally coming to rest within the building footprint. Where a strike is known to have occurred close to a building or structure such as a dock wall, a danger zone should be considered to exist around the area of the strike of sufficient size to accommodate the likely sub-surface travel distance for the weapon.*

[7] *Note; the typical offset distance is shown as the shaded area, on rare occasions a near surface deflection of the weapon can occur and the offset distance can be substantially increased up to 5/4 of the penetration depth. This mechanism does however reduce the penetration depth considerably with the net result that while the offset is increased the overall travel distance is for the most part unaffected.*

[8] *Note; scenario 1 shown top left shows a hypothetical bomb strike outside a structure or building. The strike location has been accurately identified and as a consequence; a potential danger zone (circular shaded area) can be placed around the point of impact. Scenario 2 shown top right; depicts a direct HE bomb or Incendiary strike within a building which totally destroyed the building. In circumstances such as this another UXB entry hole may have been concealed by the building rubble and the weapon may still be present within the building footprint or it may have travelled sub-surface and come to rest outside the footprint. Here the danger zone (square shaded Area) extends outwards on all sides of the original building footprint.*

6 RISK ASSESSMENT

6.1 **Risk Assessment**. The overall risk for the site from unexploded ordnance has been derived by assessing both the likelihood of occurrence and the consequences of the encounter. Review of the site's history and geographic location can provide an overall likelihood of encounter factor which is used in the subsequent determination of a risk level when a Figure can be determined for the consequence.

6.2 **Likelihood of Encounter**. Given the study findings and other criteria (See Annex G Tables) it is considered that there is a **HIGH** risk of encountering UXO within the site footprint. This finding is based on assessment of all of the available information and taking account of the following factors:

6.2.1 It is a matter of historic record that the area was subjected to enemy attack. For the most part, the records provide relatively accurate numbers of strikes however are limited in their precise locations.

6.2.2 The area has been developed since WW2, in that the removal of the dock infrastructure and the subsequent building of a runway with aprons and the associated buildings, no records of dredging the waterways on site was noted.

6.2.3 The site is a dock with 7 to 11m of water and evidence of bomb entries would not have been apparent.

6.2.4 **Consequence of Encounter**. The consequence (See Annex F) of an uncontrolled encounter with UXO, given its lethal design and its unpredictable nature could be catastrophic and warrants a high severity factor. With regards to the consequences, the following factors were considered:

6.2.5 The project works may make use of a number of common ground investigation and construction techniques in its methodology during the project. Any intrusive groundwork has the potential to encounter UXO.

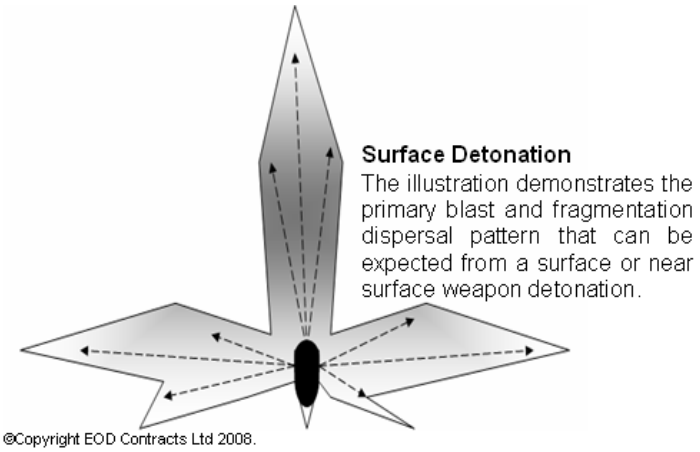
6.2.6 Intrusive earthwork, piling driving and dynamic ground compaction are by nature, aggressive, significant force (kN) is often required to achieve the desired results. As a precaution it is prudent to assume that any external stimulus, no matter how slight, may result in an unstable weapon detonating.

6.2.7 Records of encounters with UXO, particularly where plant machinery has been involved have resulted in detonations of the items with varying degrees of consequence; ranging from slight injuries sustained to piling contractors when a bomb detonated at 6.0m bgl to fatal injuries sustained to a construction worker while conducting near surface machine works on a motorway.

6.2.8 Detonation on land. The effects of a detonation at depth will be more localised and less destructive than one occurring on the surface. Figure 3 shows an illustration of the primary blast and fragmentation dispersal from explosive ordnance when it detonates on the surface. The size and effects of a blast will be determined by the weapon's design, and other key factors such as the ratio of explosive charge weight to total weapon weight (CWR) and the Net Explosive Quantity (NEQ). The effects will also be enhanced or reduced by a number of factors including, the presence of other energetic materials in close proximity to the blast or if the weapon is buried or exposed on the surface. As a guide Annex F Table 1 gives an indication of the likely blast radius for common types of UXO.

FIGURE 3 Primary Blast & Fragmentation on Land

Blast and fragmentation dispersal.



6.2.9 In addition to the dangers of explosion, many common chemicals used in the manufacture of explosive ordnance fillings are; in sufficient quantity, and level of exposure, toxic or poisonous. Although it is unlikely that such chemicals would be encountered in significant quantity to represent a significant risk to personnel, leakage or venting could pose a risk to the local marine environment. In addition to heavy metals; copper, lead, zinc etc used in the weapon body and fuze, hydrocarbon propellants such as Kerosene may also be present.

6.3 **Risk Level**. The overall risk has been determined to apply to all of the ground within the site footprint. The prevailing risk level has been determined to be **HIGH**. The risk from UXO is considered to exist to a maximum depth of 12 metres below the 1939 ground levels and 3 below the dock bed levels.

6.4 **Encounter Consequences**. it is acknowledged that when viewed from a "likelihood versus consequence" scenario; the consequences of an explosion may have the potential to include:

6.4.1 Multiple casualties or fatalities.

6.4.2 Extensive damage to high value private and public assets and property.

6.4.3 Significant delays to the construction project.

6.5 **Those at Risk**. The risk is considered to have the potential to pose a direct and indirect threat to a wide range of individuals and facilities. While the impact on fixed assets can be estimated based on the asset's proximity to the seat of the explosion. The impact to transient assets and people will, for the most part, be the result of both; proximity to the explosion and the time at which the event occurs. The overall impact therefore has the potential to range from little more than a minor localised event to a level which may be considered to be a more widespread major incident involving some or all of the following:

6.5.1 Construction and other specialist personnel carrying out the work.

6.5.2 General public in open spaces, at their places of work and transient population on foot or road users in proximity to the construction work.

6.5.3 Public services including; transport, water, gas and electricity supplies.

6.5.4 Public facilities, including; buildings, vehicles, other high value assets and equipment.

6.5.5 Private business property including construction equipment.

6.5.6 Private residential property in proximity to the work.

6.6 **At Risk Activities**. Based on our understanding of the scope of the most common construction projects, it is considered that a wide range of intrusive processes may be required to complete the project. Any intrusive groundworks have the potential to encounter UXO and each activity therefore has a degree of risk attached to it. The severity or level of the risk is derived as a consequence of activity's; location, methodology and volume or quantity of risk material to be worked, at risk activities are considered to include:

6.6.1 Site preparation and levelling.

6.6.2 Intrusive geotechnical and archaeological investigations including drilling and pitting.

6.6.3 Foundation construction, trenching and other excavations.

6.6.4 Intrusive construction works which may include piling.

7 CONCLUSIONS

7.1 Based on the information researched by EOD Contracts Ltd for the site, in that the site:

7.1.1 Suffered with 5 to 12 bomb strikes.

7.1.2 Suffered with IBs across the site.

7.1.3 Multiple bomb incidents were noted in the area.

7.1.4 Bomb Damage occurred to some of the buildings.

7.1.5 The expected bomb depth is 12m below 1939 ground levels and 3m below 1939 dock bed level.

7.1.6 The site is a waterway and as such evidence of bomb entries are highly unlikely to be discovered.

7.2 Although the site has had some reconstruction this would have been in the early 1980s and the majority of the site would have been the removal of buildings.

7.3 Therefore, the risk level on site for UXO is deemed as **HIGH** and given that some UXO retains the potential to detonate if disturbed with possible severe consequences, it is concluded that it would be prudent to ensure that basic precautions are taken to ensure that the project can proceed in the safest possible manner and that any residual risk posed by UXO is as low as it is reasonably practical to achieve (ALARP).

7.4 The footprints of the buildings across the site are deemed **MEDIUM**.

8 RECOMMENDATIONS

8.1 It is recommended that the following risk mitigation strategy is executed during the project:

8.1.1 Communicating the risks, all stakeholders should be made aware of the UXO situation on the site and the possible impact it may have on the project works and day to day running of the district. Clients have a legal duty under the Construction Design & Management Regulations (CDM) and Health & Safety at Work legislation to provide Designers and Contractors with project specific information needed to identify hazards and risks associated with the design and construction work. The possibility that UXO may be encountered on site falls within the category of a significant risk and as such it should be addressed as early as possible in the lifecycle of the project.

8.1.2 Further Planning; the risks posed by UXO should be brought to the attention of the Project Principal Designers and other individuals with a responsibility for project safety and operations at the site. The matter of UXO should be considered critical to project safety and one requiring high priority action.

8.1.3 Safety Training; UXO safety awareness training should be given at all levels of site personnel and selected individuals on the project staff with relevant responsibilities. The training should be provided by a competent person as part of the project safety induction course. It should be reinforced with specific safety briefings and tool box talks to individuals involved in conducting intrusive earthworks. The training should cover the following topics to a level commensurate with the audience's responsibilities and duties:

8.1.3.1 Project overview and the responsibilities of those working on site with regard to duty of care and public safety.

8.1.3.2 UXO recognition and safety procedures to be followed on discovery of a suspicious object or the alarm being sounded.

8.1.3.3 Emergency procedures to be followed in the event of an explosion. Evacuation routes, muster stations and accounting for personnel.

8.1.3.4 Work permits, works methodology and specific UXO risk mitigation methods. Post incident inspections and returning to normal works.

8.1.4 Prior to any intrusive piling or drilling commencing, UXO safety testing and appropriate clearance certification into the ground to sufficient depth to provide clearance from UXO. This can be done using a progressive drilling process or (where large numbers of piles are to be placed and ground permitting) using a vehicle borne hydraulic system to push a magnetometer into the ground to test for the presence of UXO prior to piling.

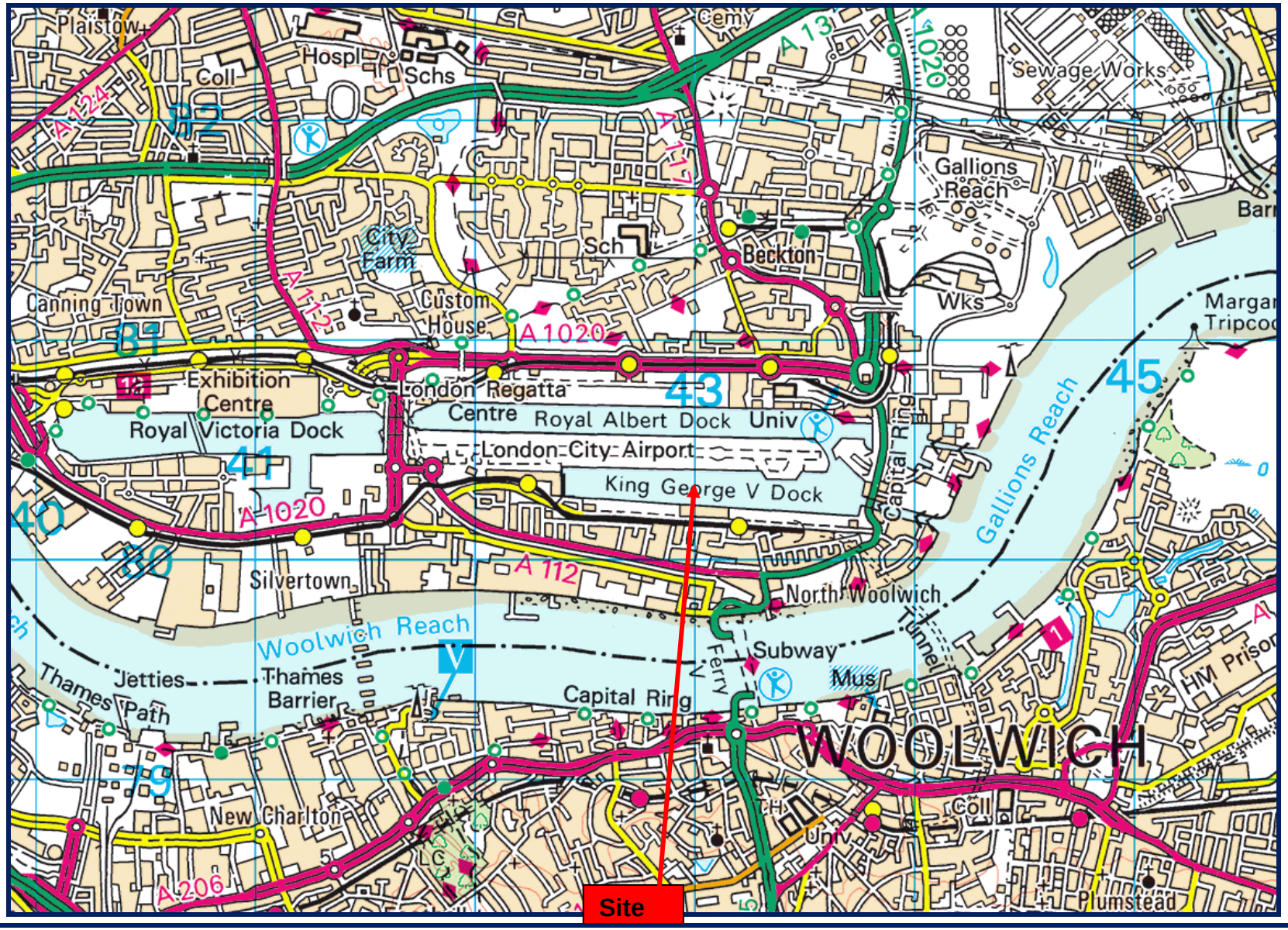
8.1.5 UXO safety monitoring of all "at risk" excavations, including geotechnical or archaeological trial pits to be conducted during the project. This should be provided by a UK Home Office Authorised EOD/UXO Contractor using qualified EOD Engineer with specialist locators and detectors to scan the ground ahead of the excavation wherever possible.

8.2 **Specifically**

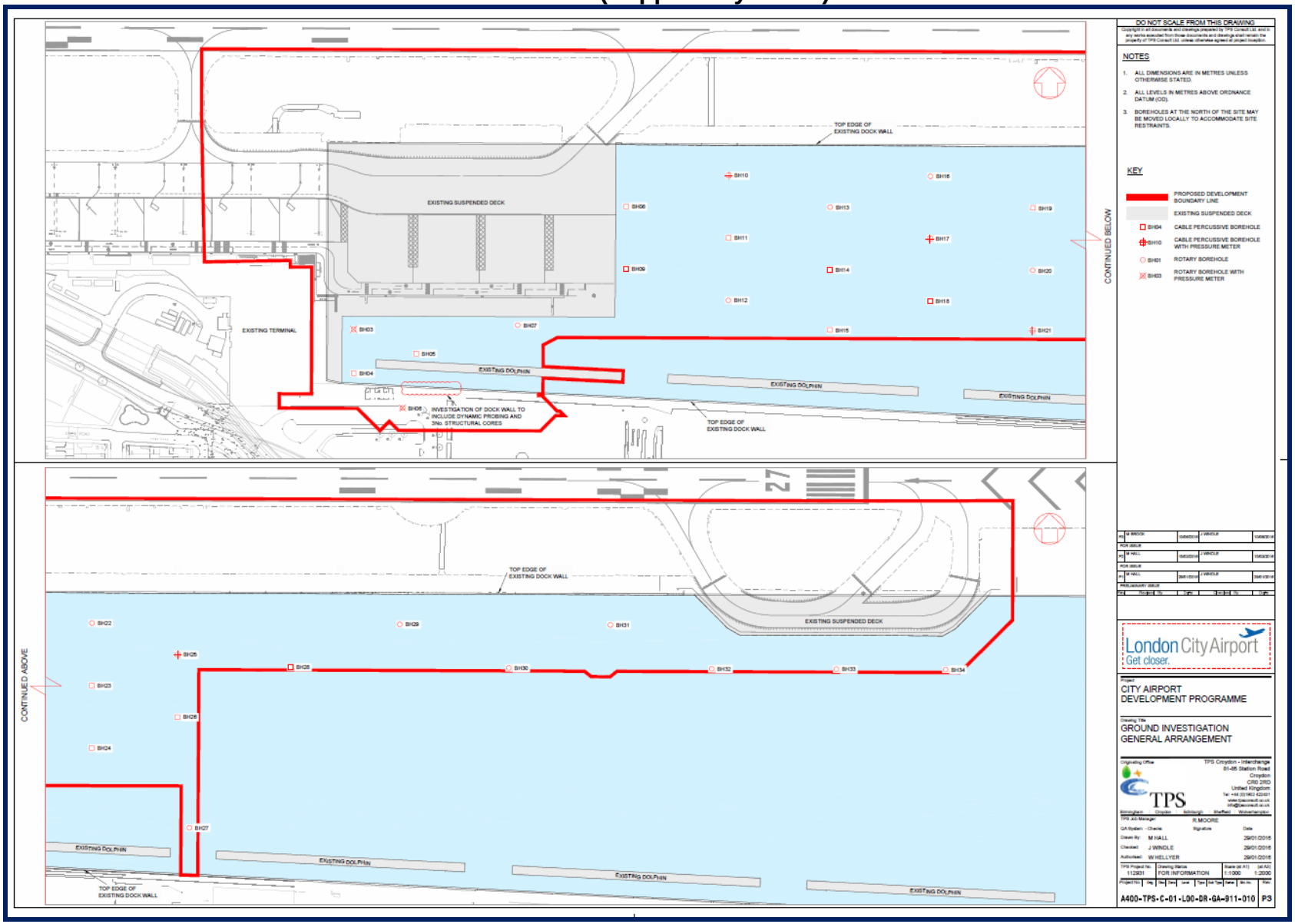
8.2.1 Geotechnical investigations, percussive drilling/trial pits/window/samples, require an EOD Engineer over watch.

Annex A

SITE LOCATION

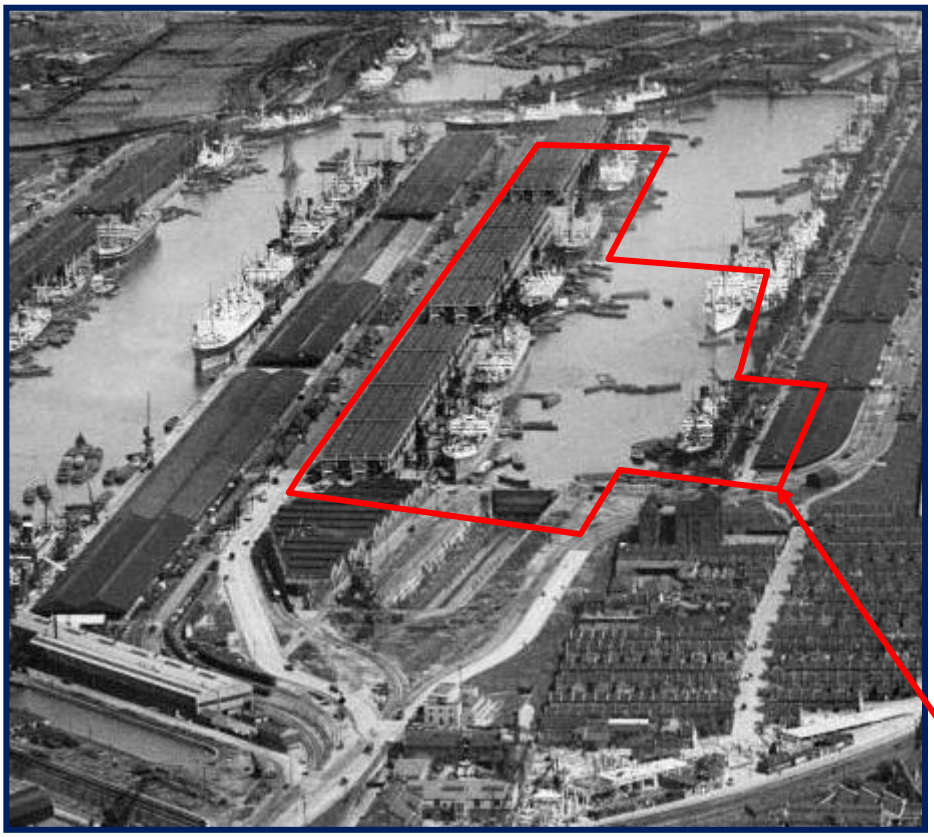


SITE PLAN (Supplied by Client)

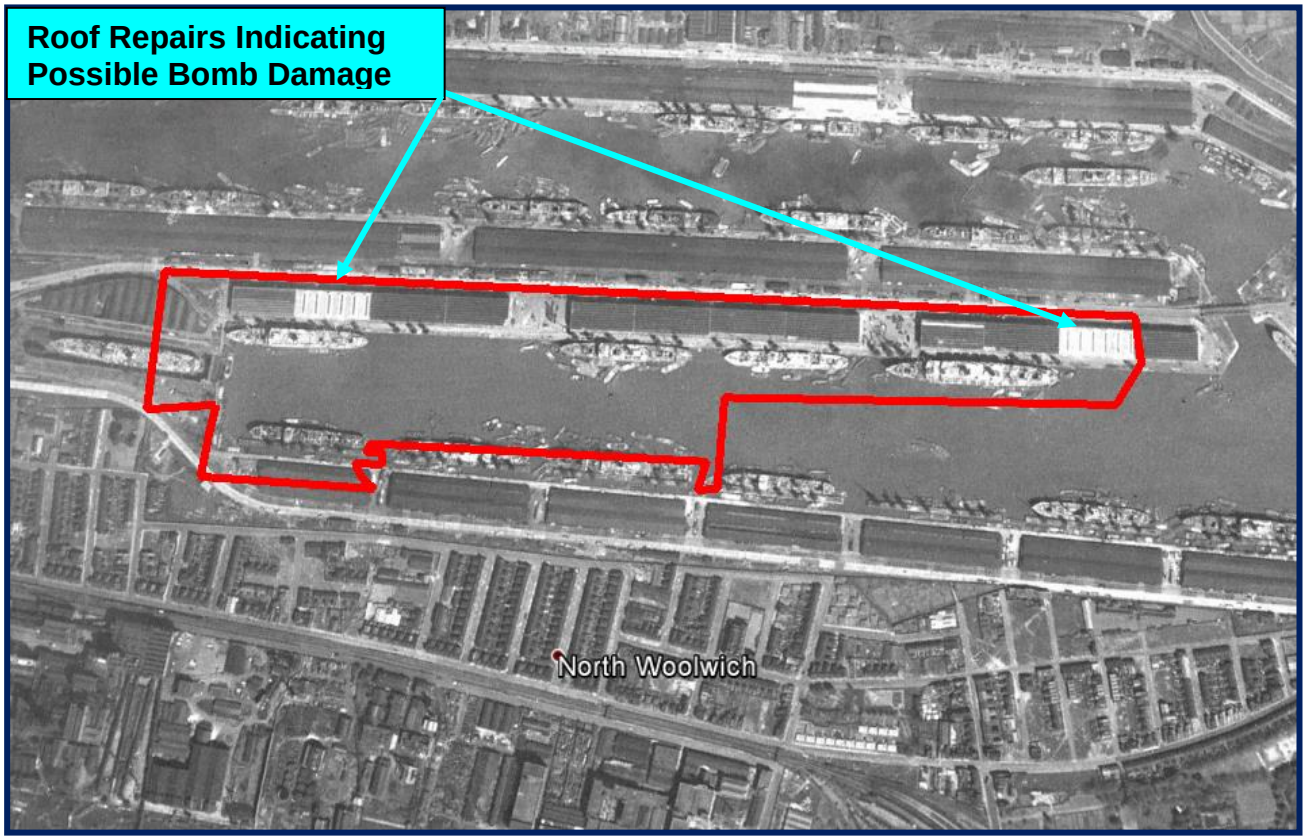


Annex B

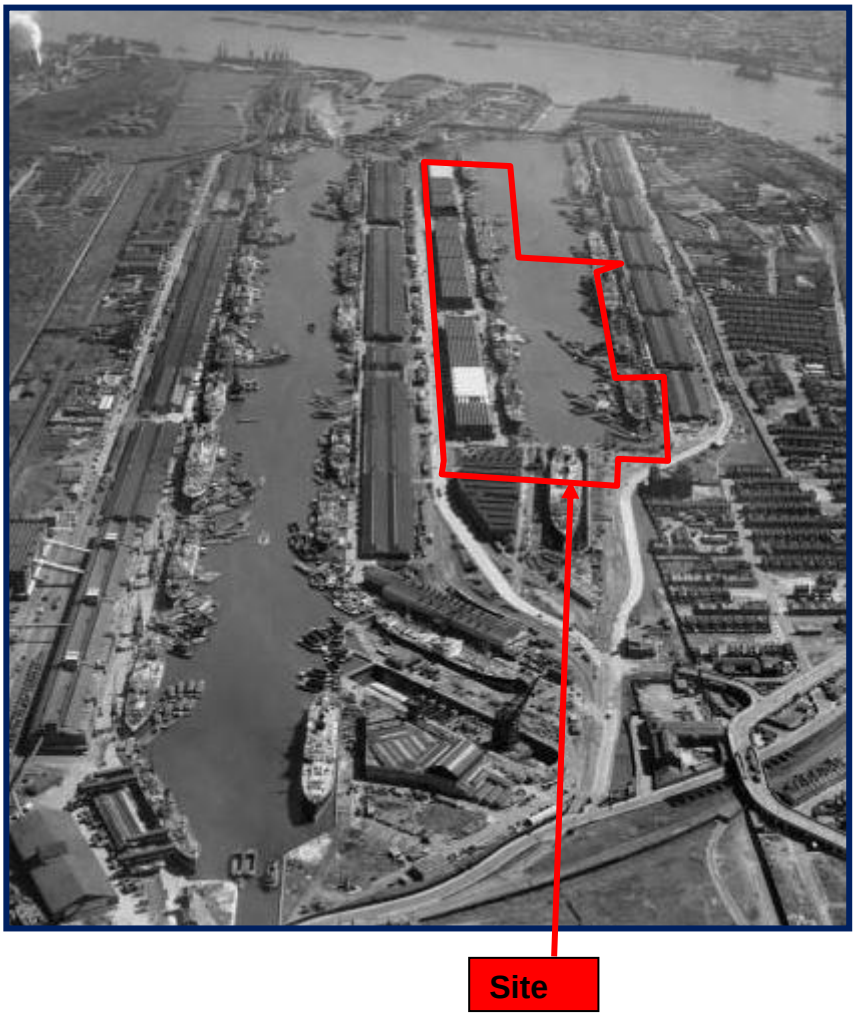
AERIAL PHOTOGRAPH CIRCA 1934



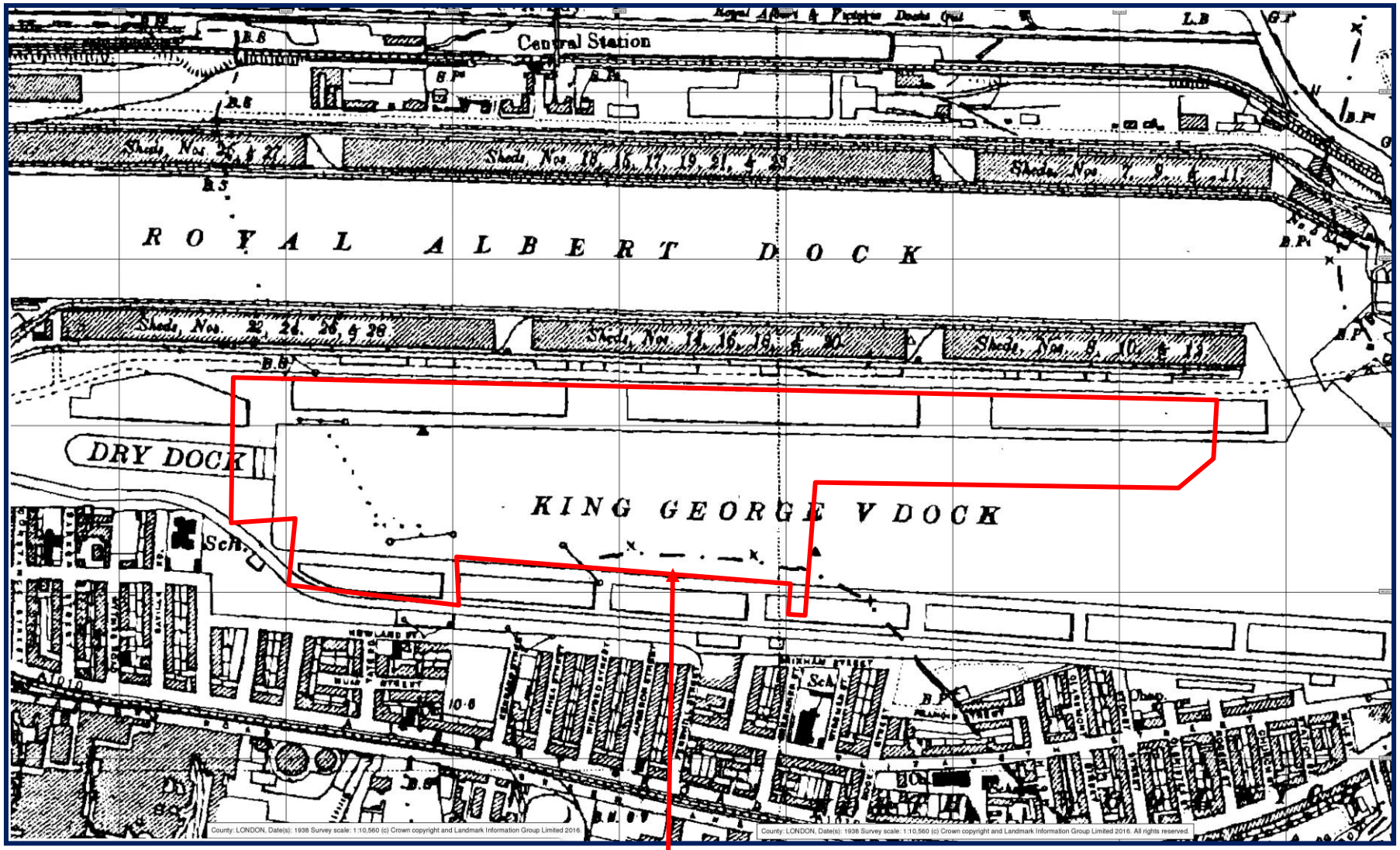
AERIAL PHOTOGRAPH CIRCA 1945



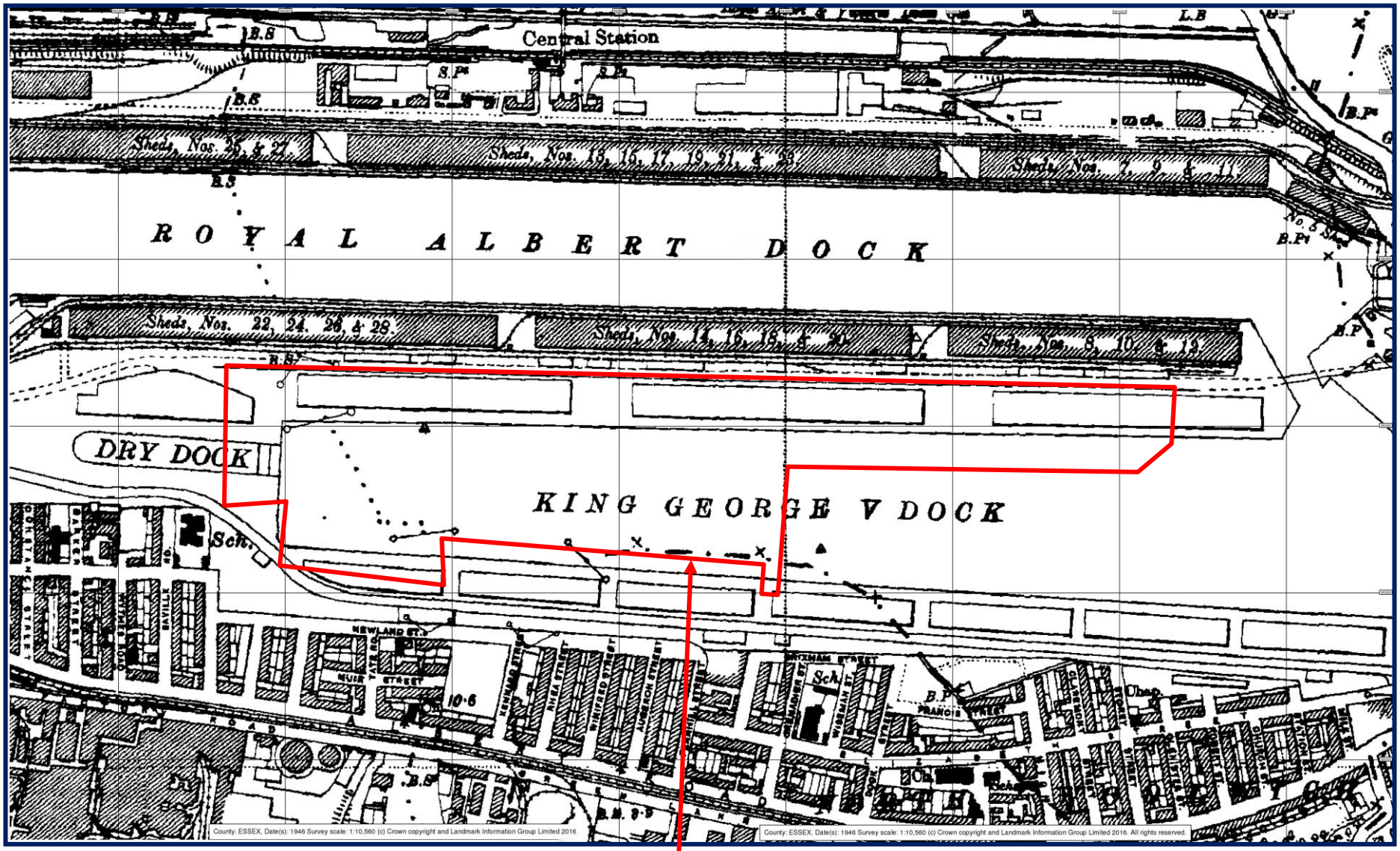
AERIAL PHOTOGRAPH CIRCA 1949



HISTORIC MAP 1938

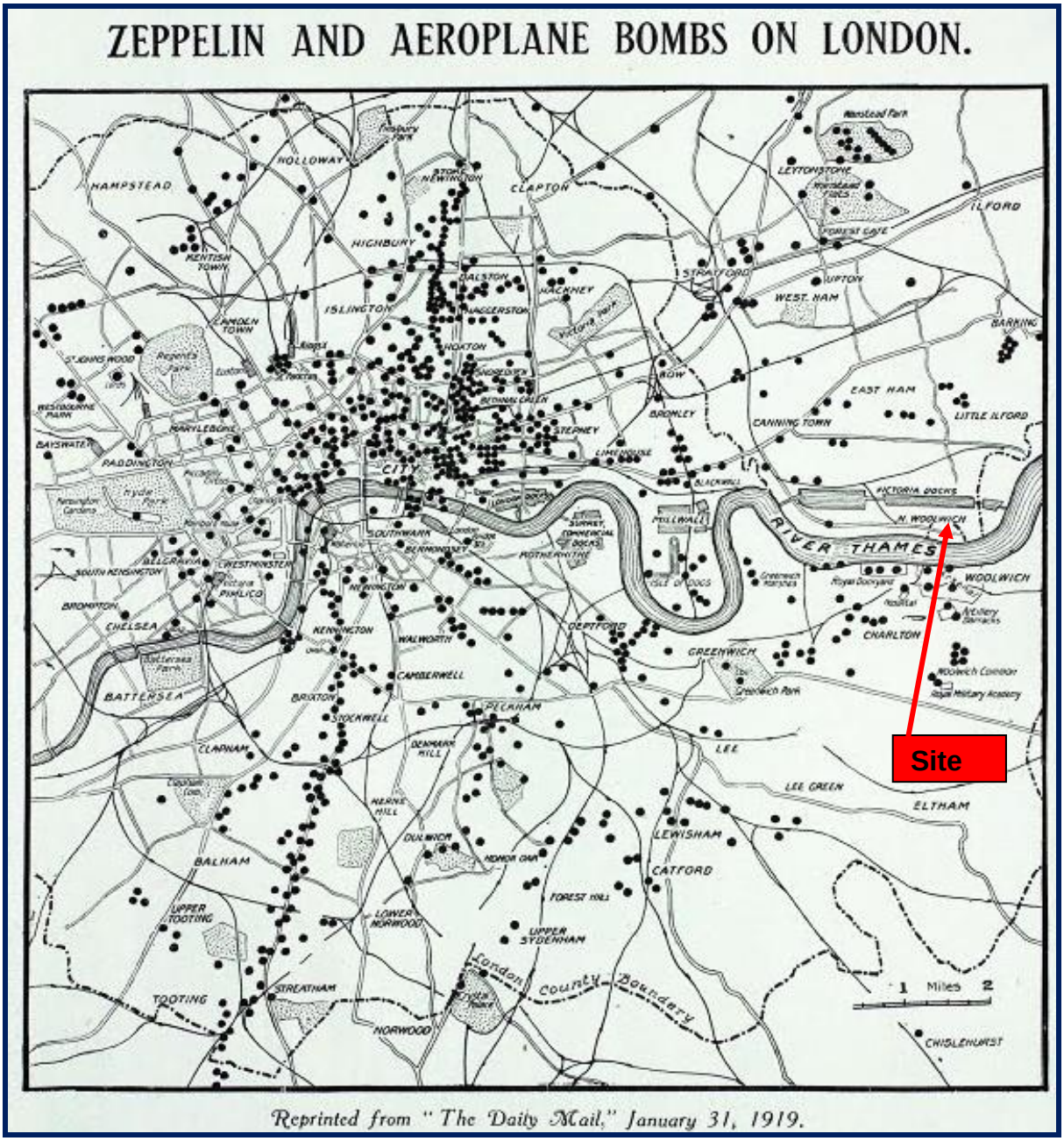


HISTORIC MAP 1946



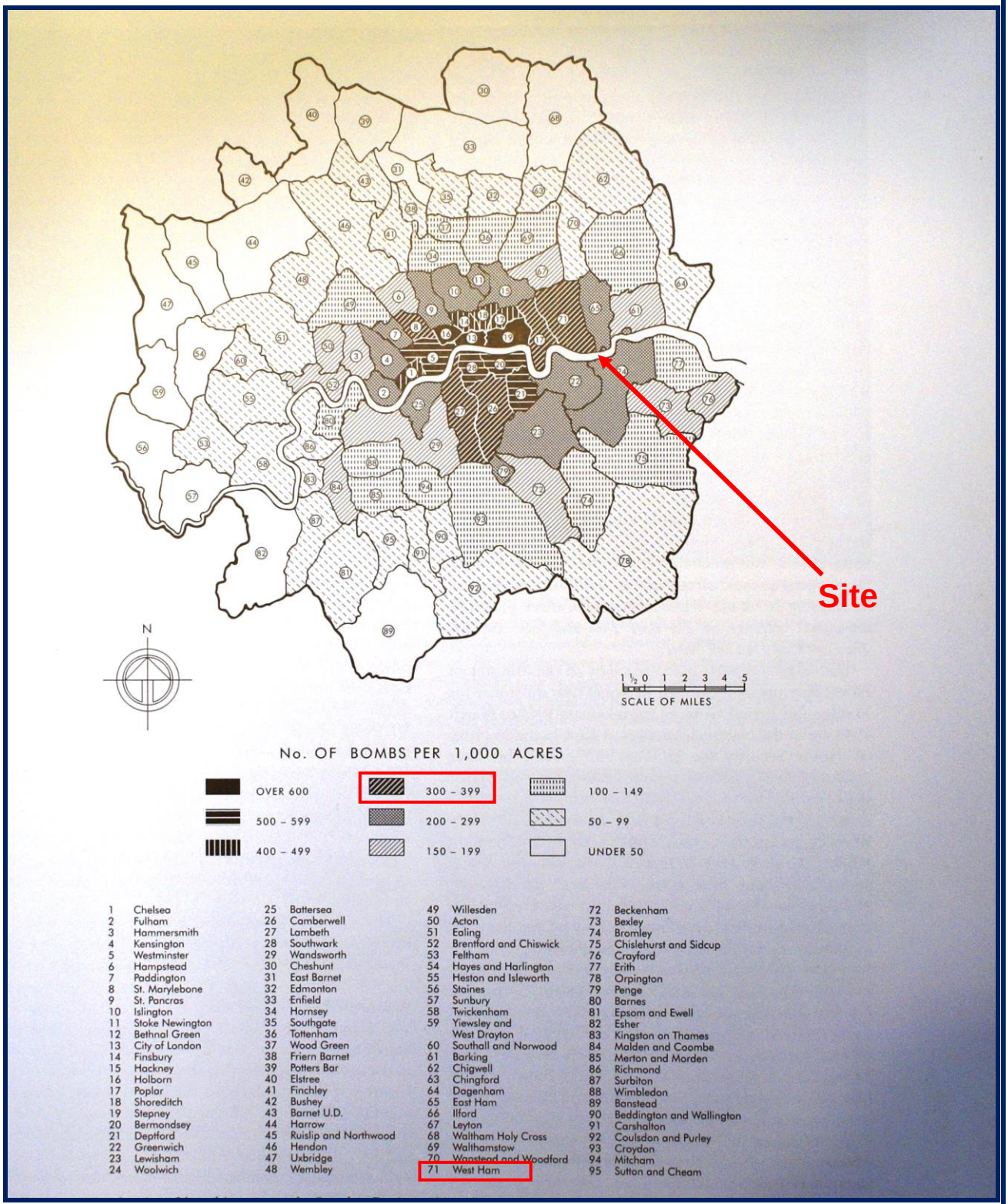
Annex C

LONDON BOMB RAIDS WWI



Annex D

LONDON BOMB DENSITY MAP



Annex E

BOMB IMPACT MAPS

Map: London 56-18 NE. Provisional Edition GSGS No. 3906 Scale: 1 to 25,000

This map was reproduced for the Home Office to compile bomb data.

Key:

A different colour denotes different dates for bombs dropped.

IBs

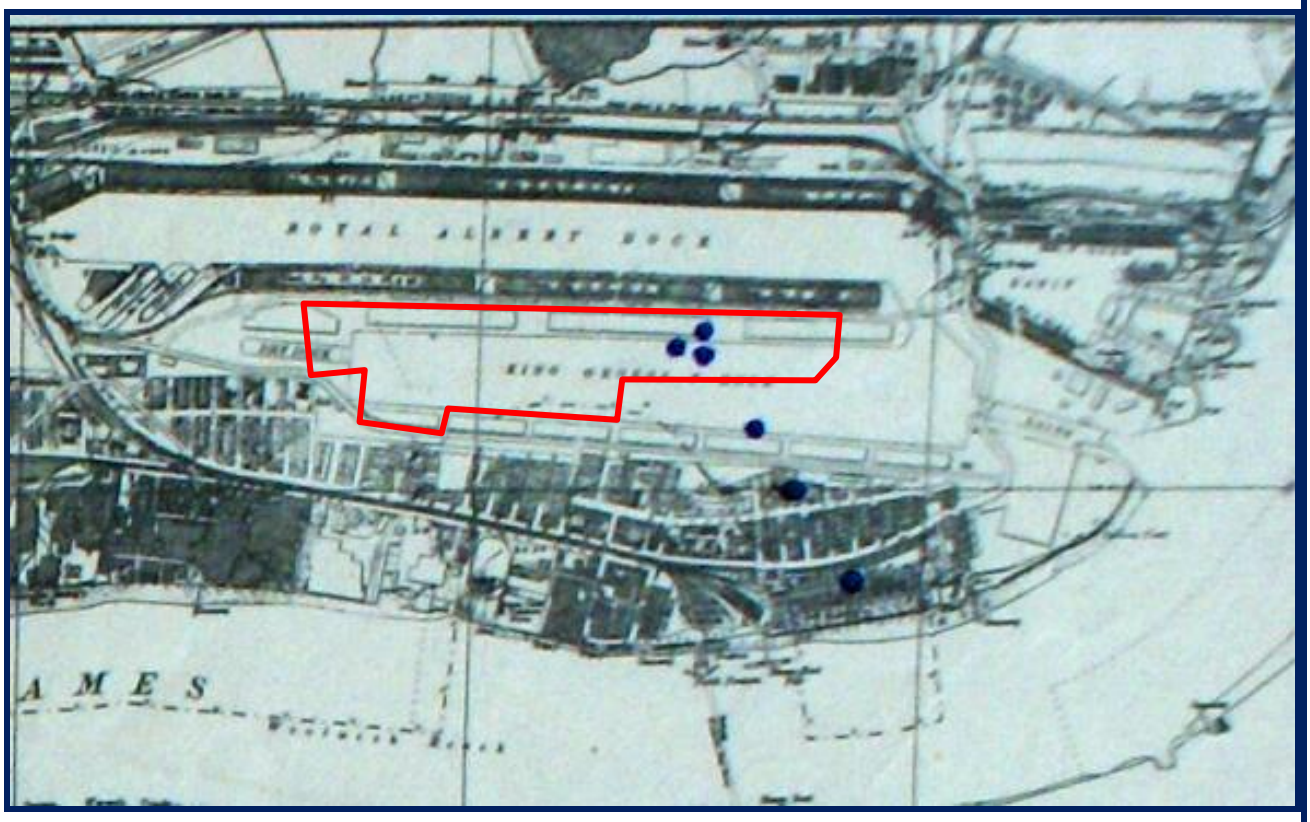
UXB

HE Bomb

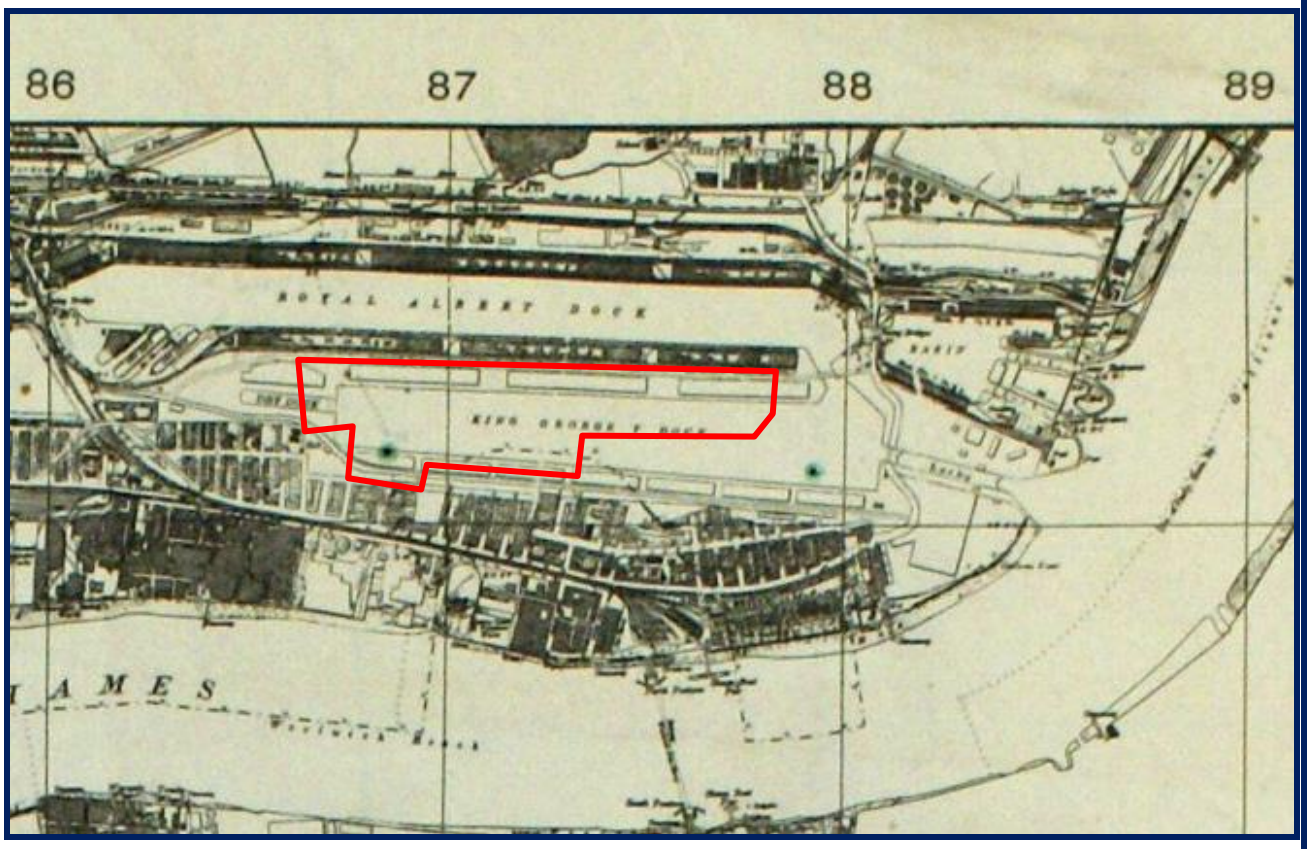
Parachute Mine

Site Position Map Reference 875993 (Centre of Site)

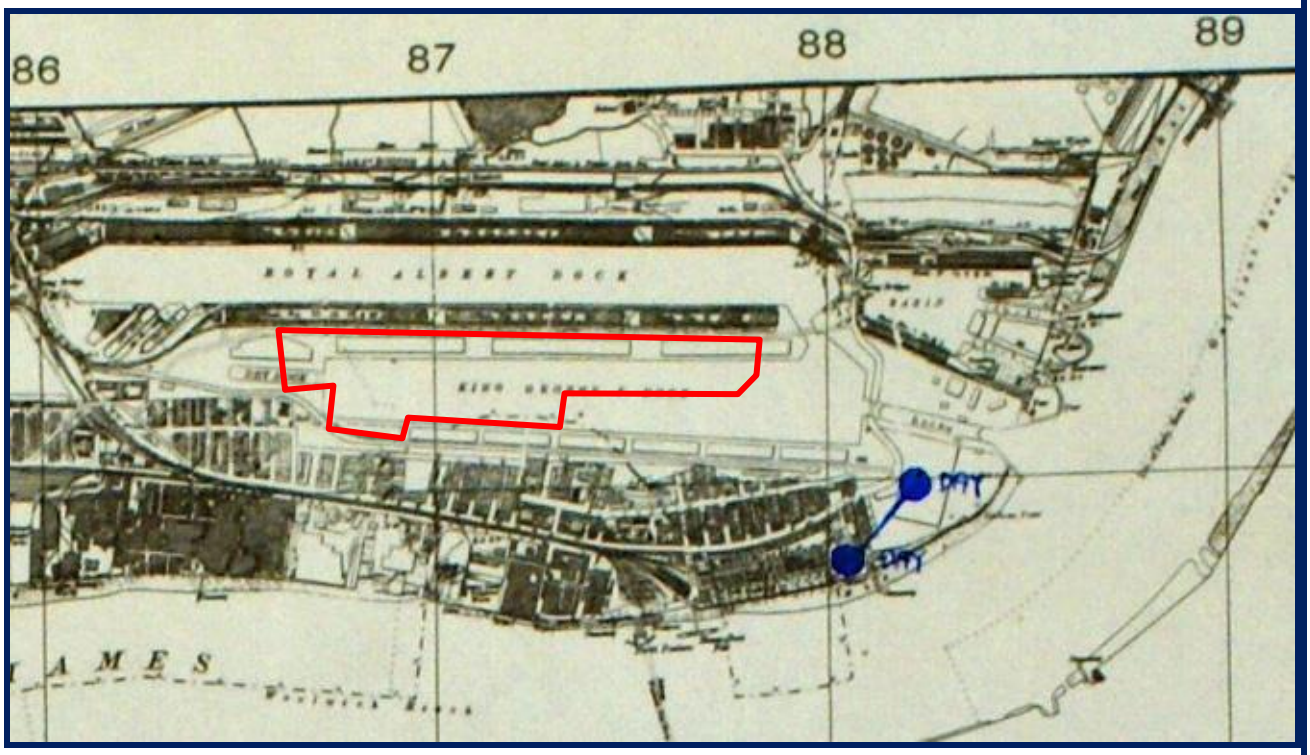
HO-193-1 7 to 21 Oct 1940



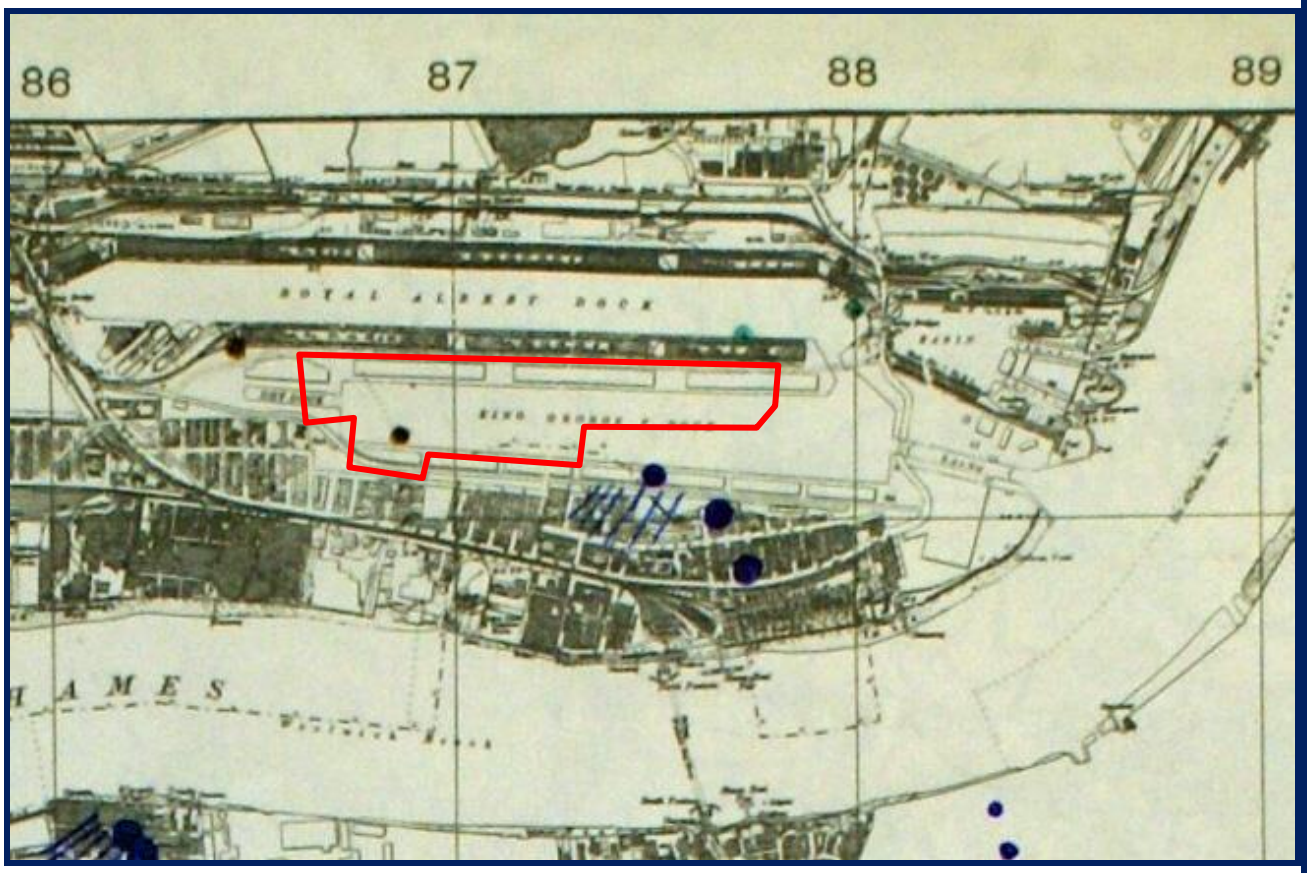
HO-193-2 21 to 28 Oct 1940



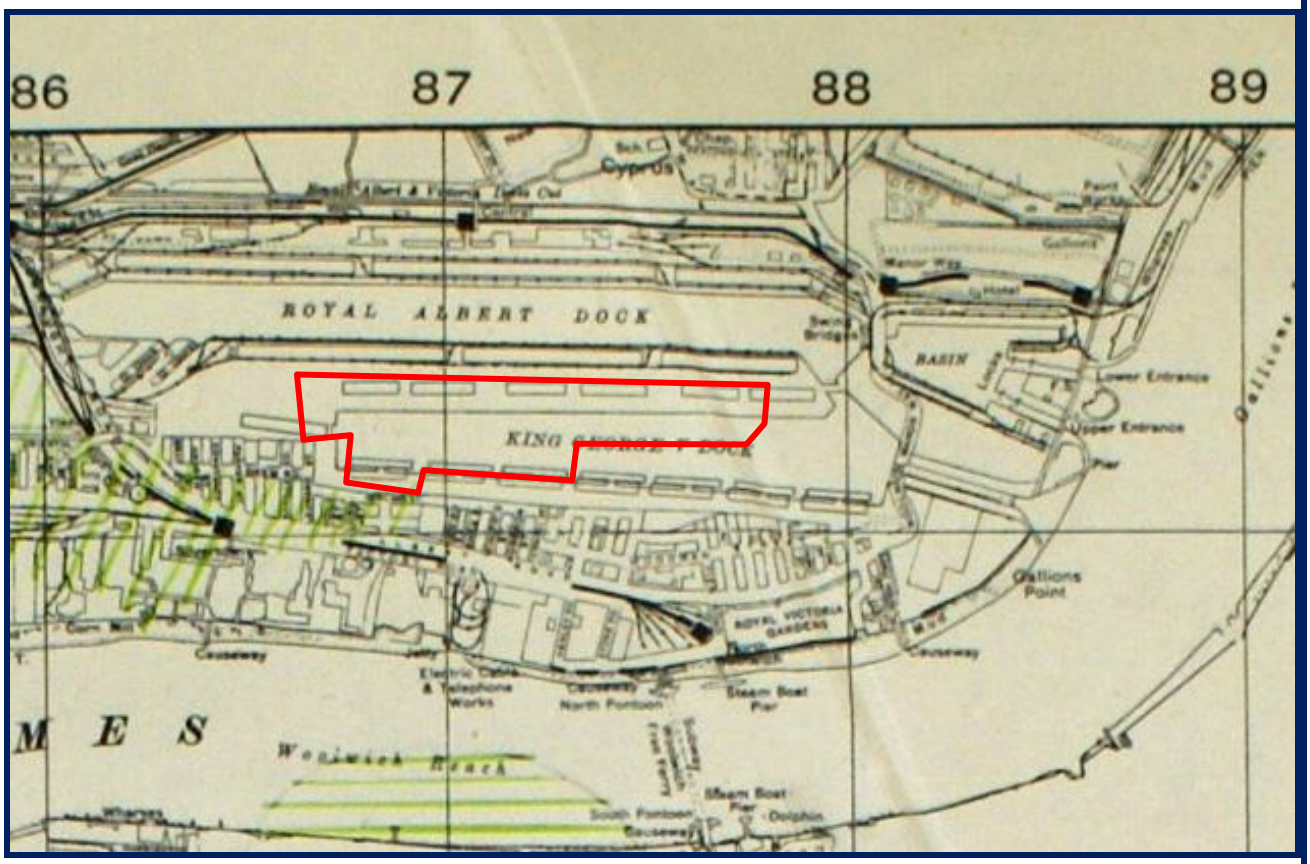
HO-193-3 28 Oct to 4 Nov 1940



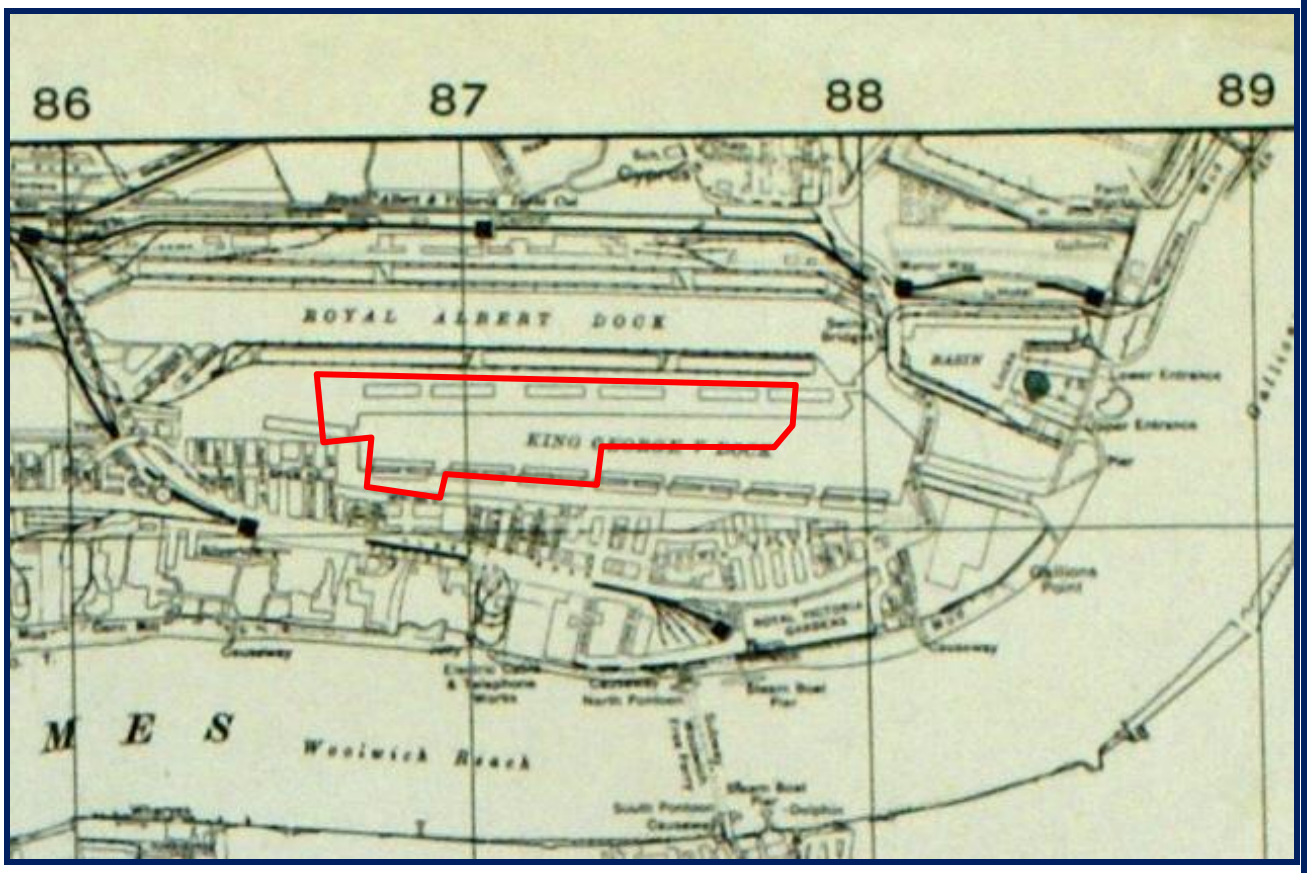
HO-193-4 4 to 11 Nov 1940



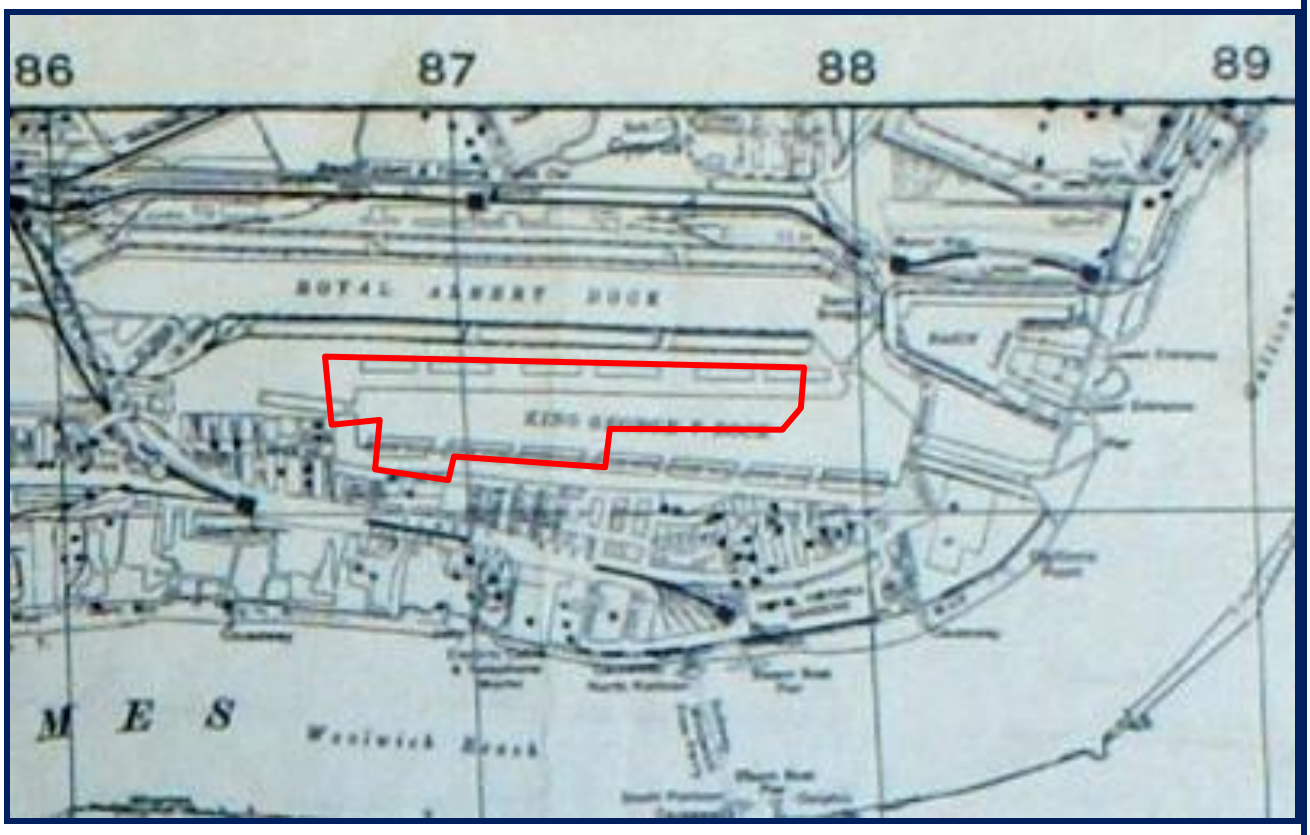
HO-193-8 2 to 9 Dec 1940



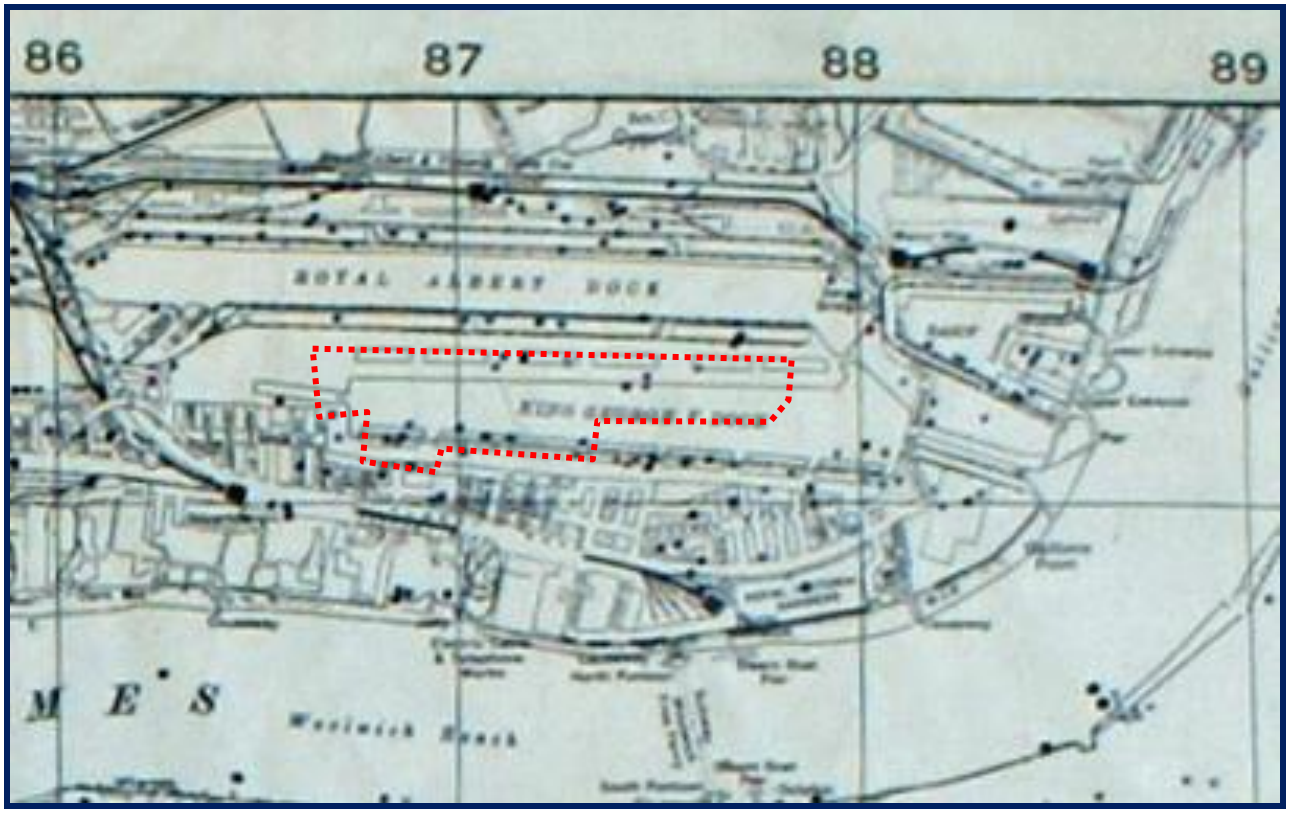
HO-193-11 23 to 30 Dec 1940



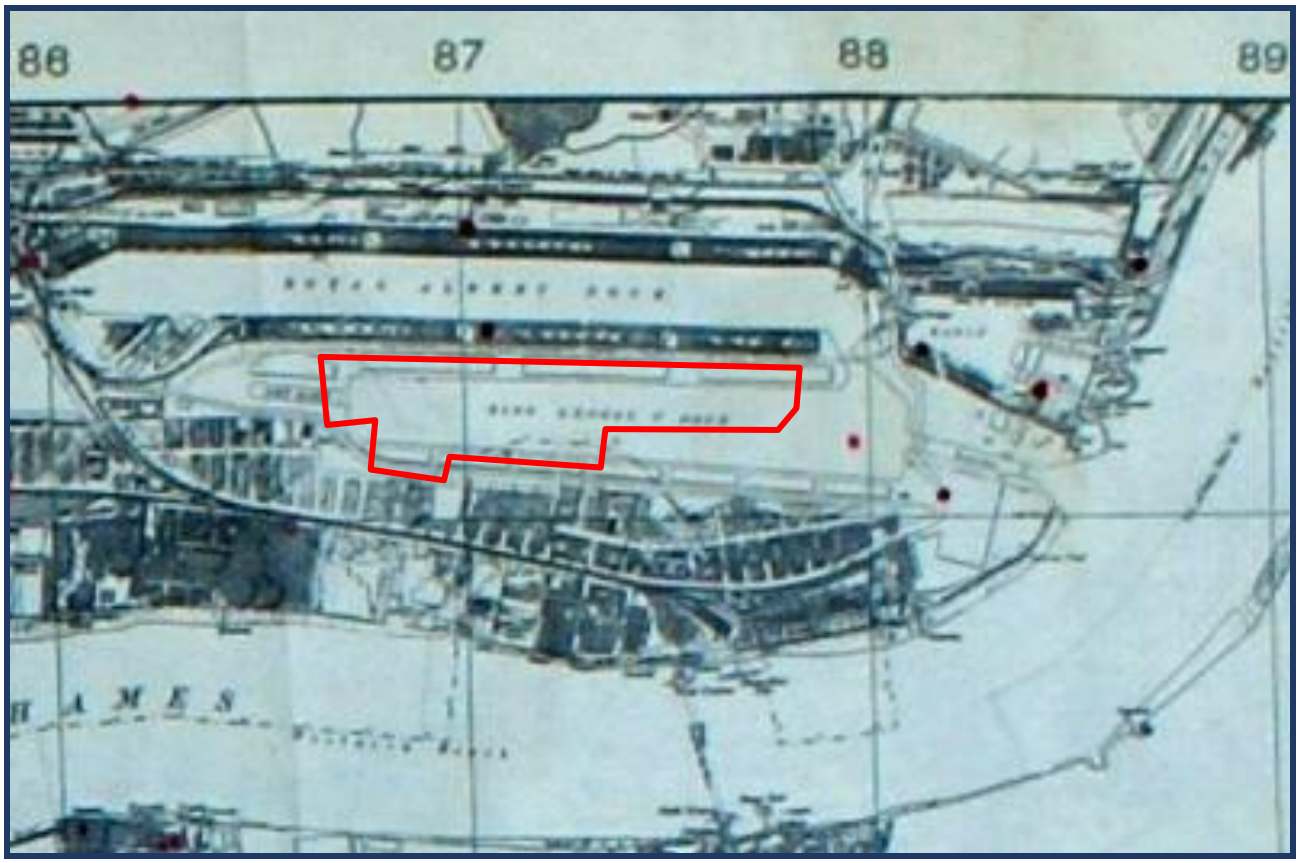
HO-193-12 Accumulative day and night bombing up to 7 Oct 1940



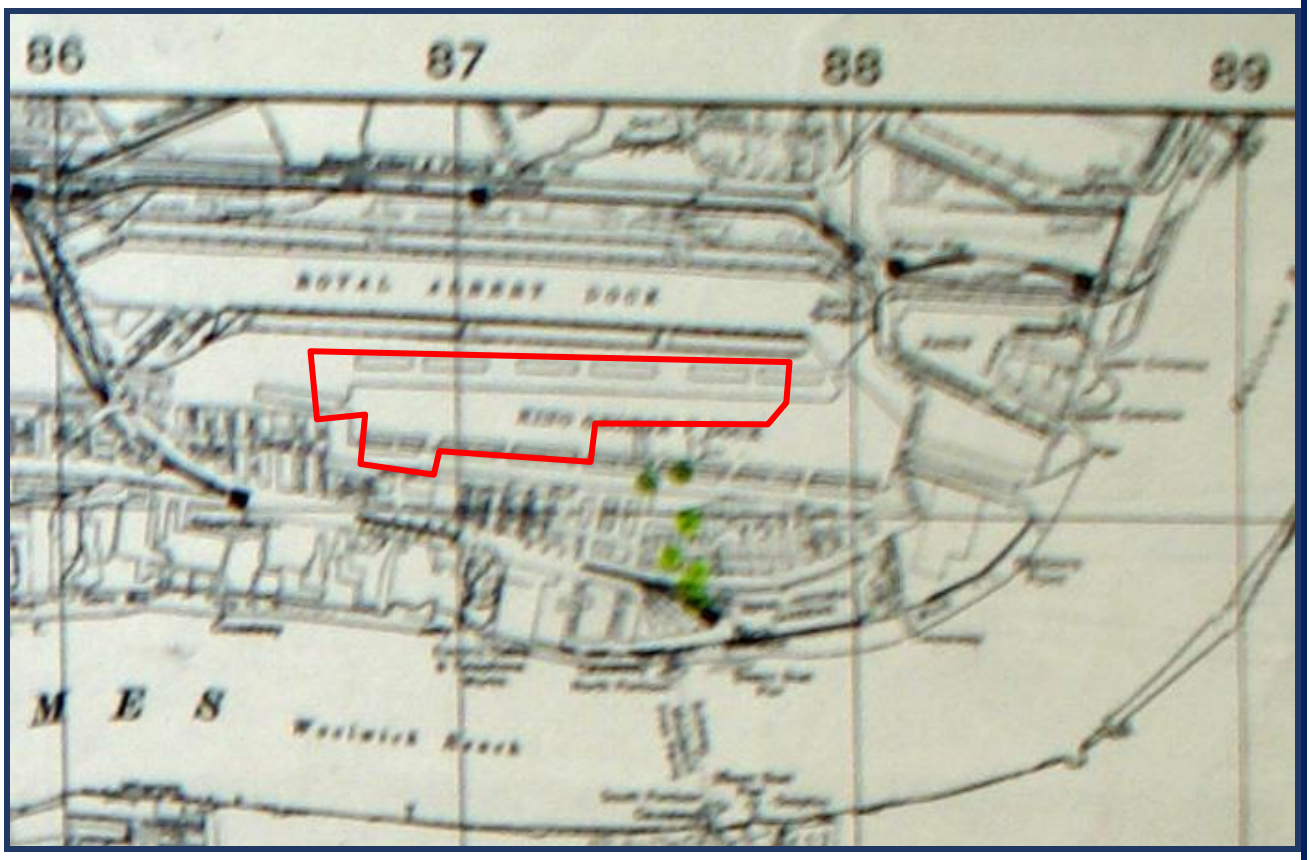
HO-193-13 Night bombing only between 7 Oct 1940 and 6 June 1941



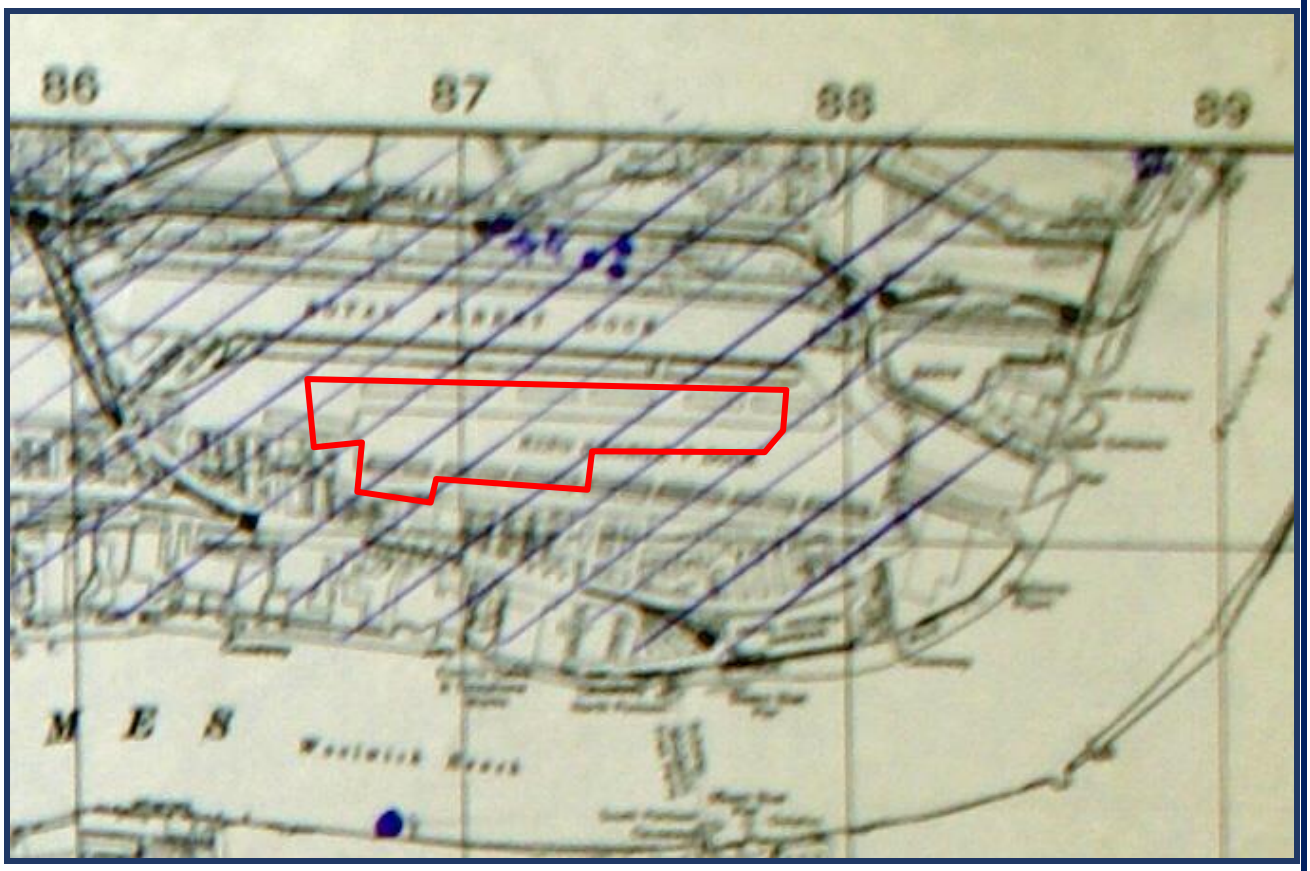
HO-193-14 Day bombing only between 8 Oct and 31 Dec 1940



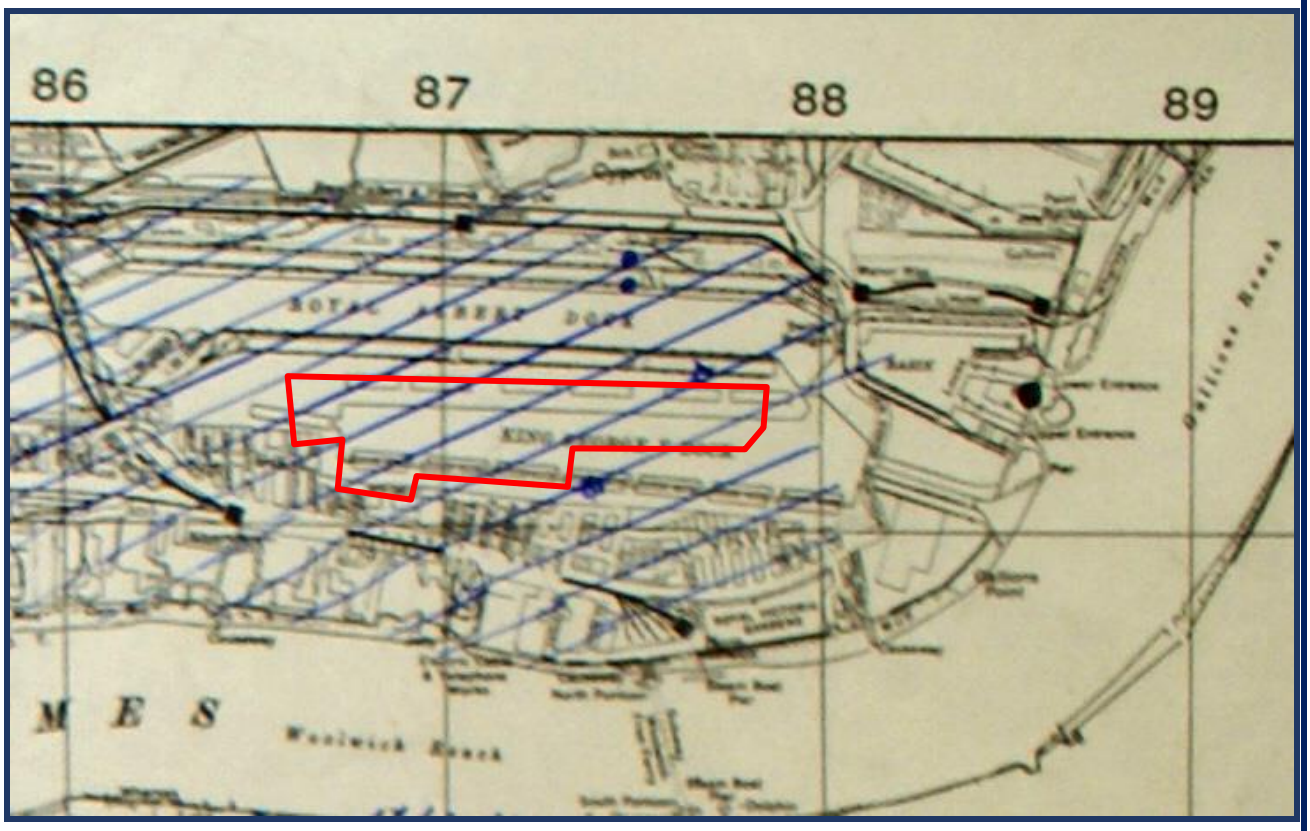
HO-193-23 3 to 10 Mar 1941



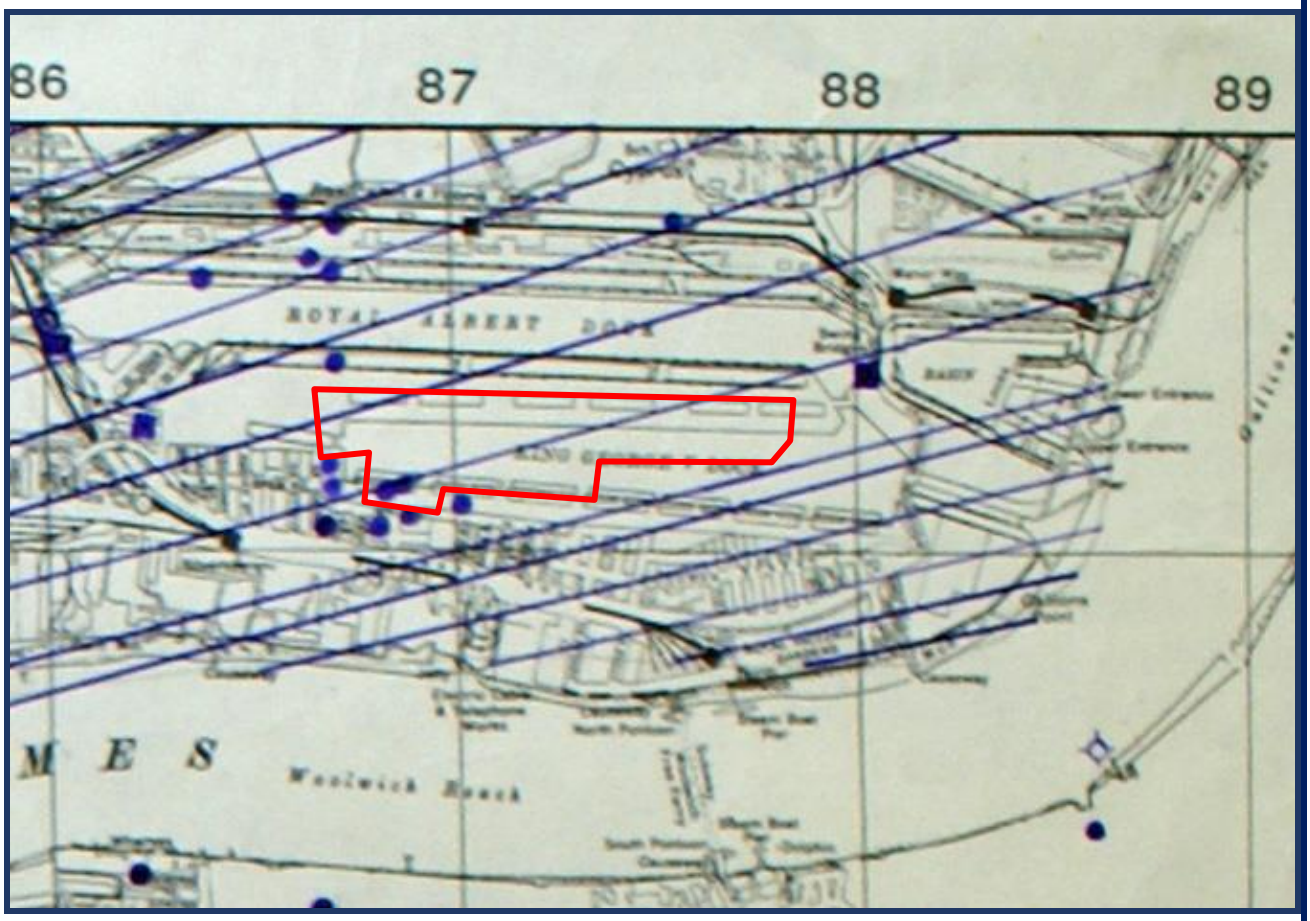
HO-193-24 10 to 17 Mar 1941



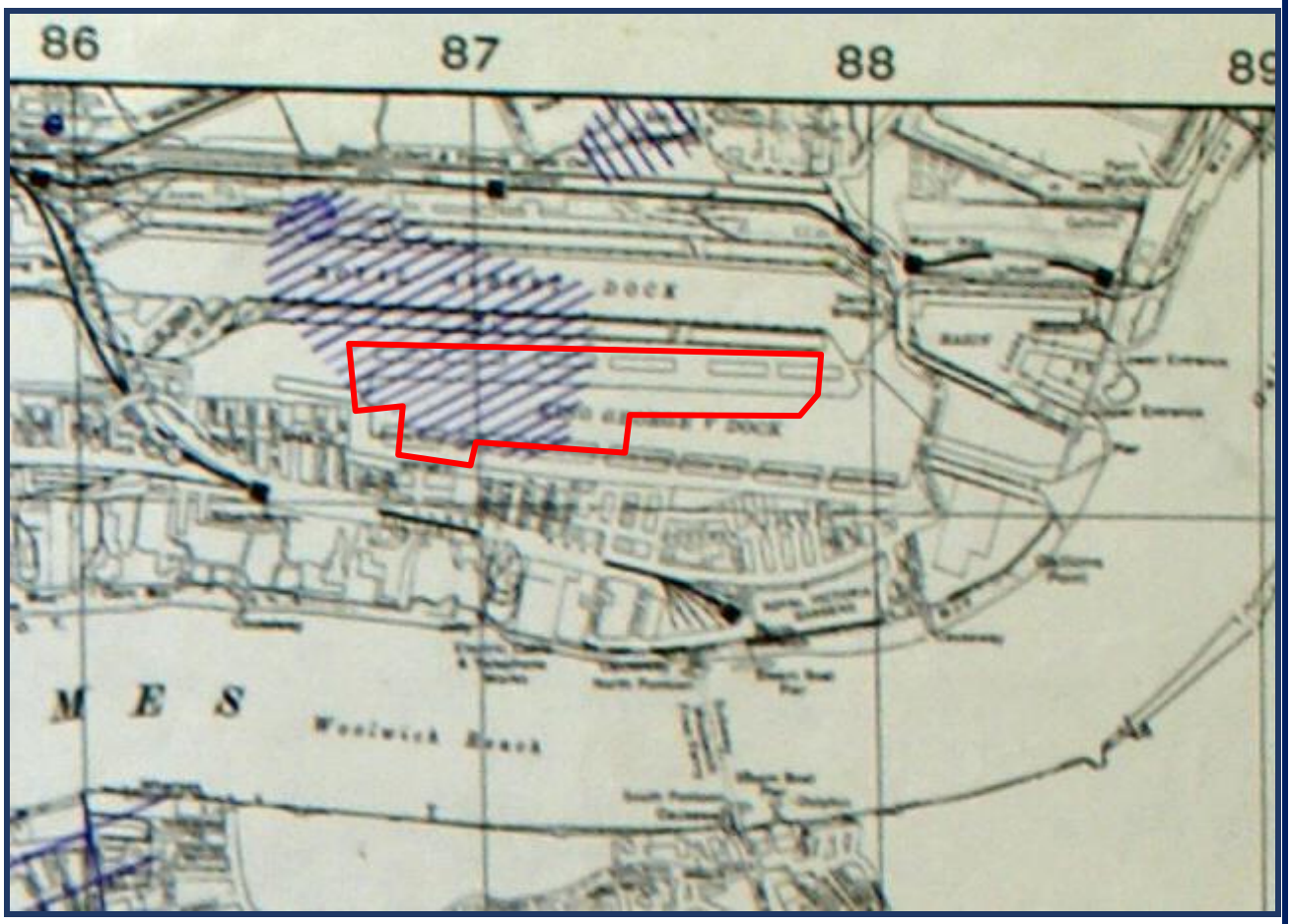
HO-193-25 17 to 24 Mar 1941



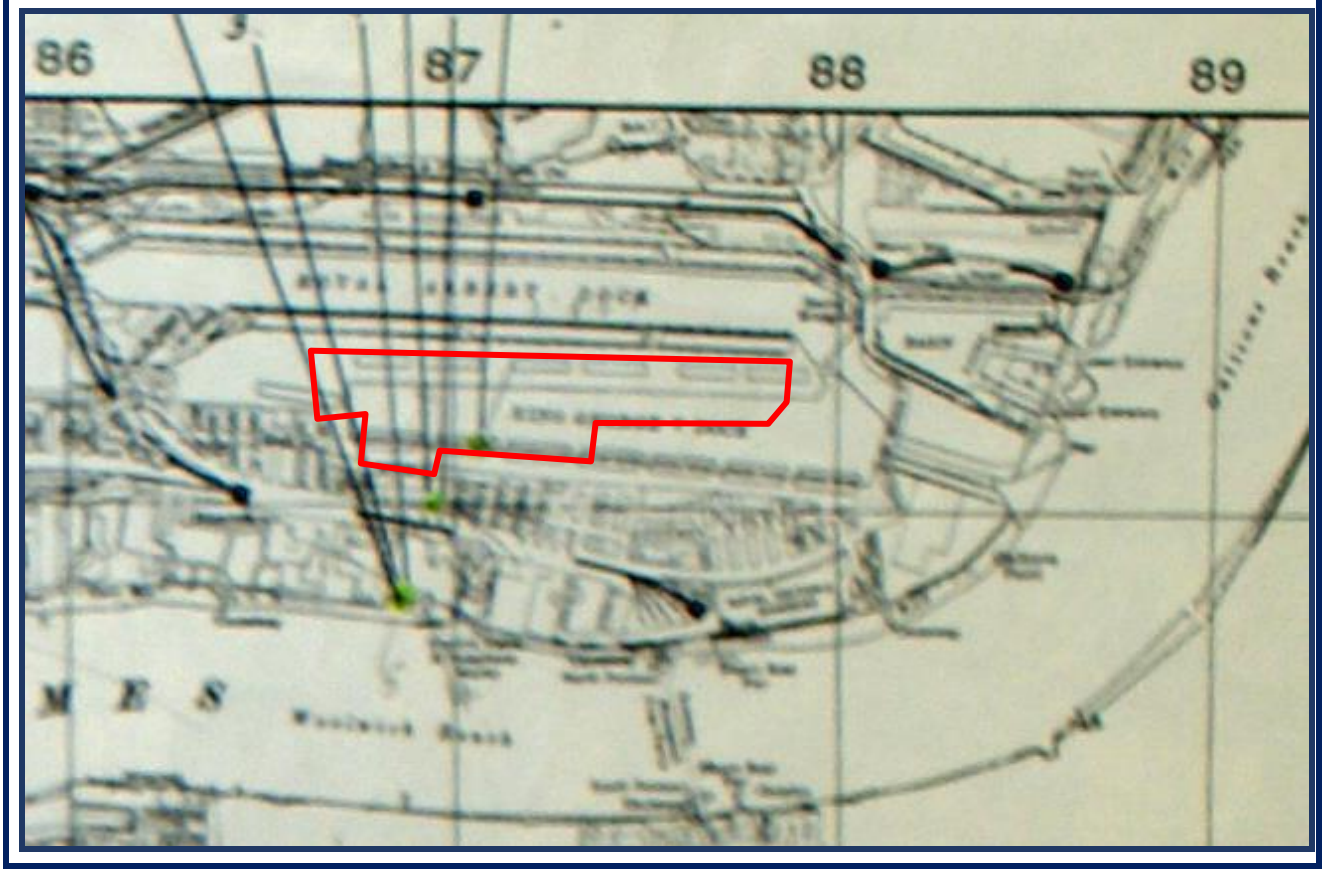
HO-193-27 14 to 21 Apr 1941



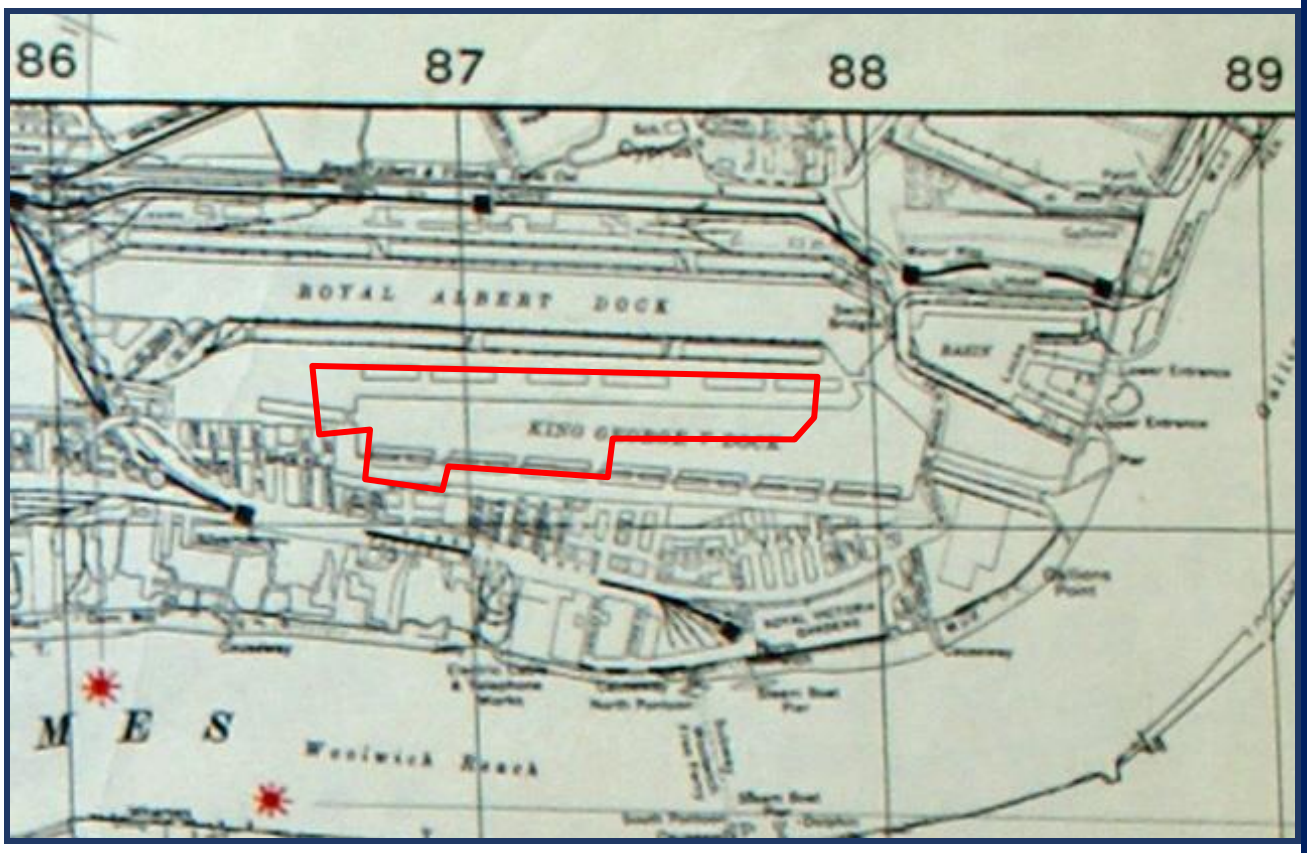
HO-193-28 5 to 12 May 1941



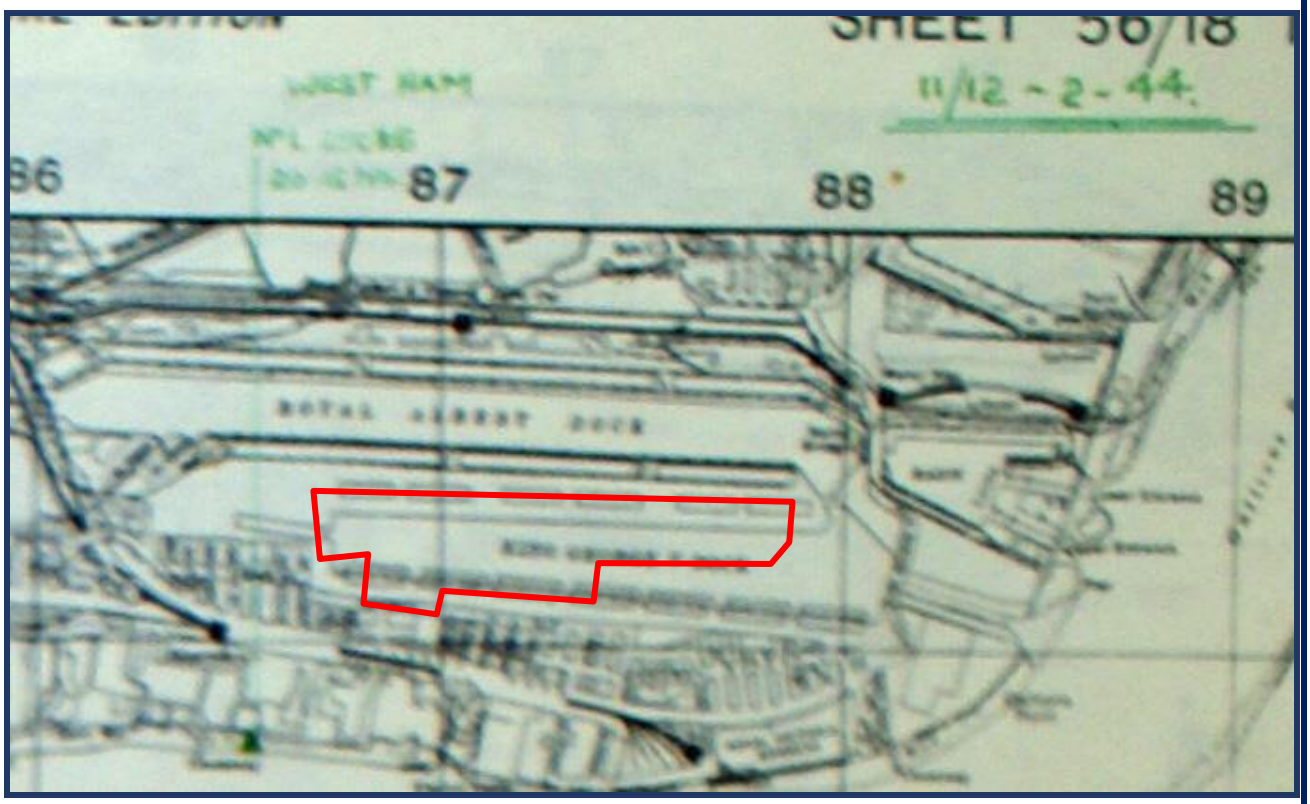
HO-193-31 11 Jan to 14 Feb 1943



HO-193-33 31 May to 27 June 1943



HO-193-37 31 Jan to 20 Feb 1944



Annex F

EXPLOSIVE ORDNANCE SAFETY AND INFORMATION

1 UNEXPLODED ORDNANCE

Since the end of WWII, there have been a limited number of recorded incidents in the UK where bombs have detonated during engineering works, though a significant number of bombs have been discovered.

The threat to any proposed investigation or development on the site may arise from the effects of a partial or full detonation of a bomb or ordnance item. The major effects usually being shock, blast, heat and shrapnel damage. It should be noted that the detonation of a 50kg buried bomb could damage brick/concrete structures up to 16m away and unprotected personnel on the surface up to 70m away from the blast. Larger ordnance is obviously more destructive. Table 1 denotes recommended safe distance for UXO.

Table 1 Safety Distances for Personnel

UXO (Kg)	Safety Distances (m)			
	Surface UXO		Buried UXO	
	Protected	Unprotected	Protected	Unprotected
2	2O	200	10	20
10	50	400	20	50
50	70	900	40	70
250	185	1100	120	185
500	200	1250	140	200
1000	275	1375	185	275
3000	450	1750	300	450
5000	575	1850	400	575

Explosives rarely become inert or lose effectiveness with age. Over time, fuzing mechanisms can become more sensitive and therefore more prone to detonation.

This applies equally to items that have been submersed in water or embedded in silt, clay, peat or similar materials.

Once initiated, the effects of the detonation of the explosive ordnance such as shells or bombs are usually extremely fast, often catastrophic and invariably traumatic to the personnel involved.

The degradation of a shell or bomb may also offer a source of explosive contamination into the underlying soils. Although this contamination may still present an explosion hazard, it is not generally recognised that explosives offer a significant toxicological risk at concentrations well below that at which a detonation risk exists.

2 TYPES OF ORDNANCE

2.1 **German Air Delivered Ordnance**. Technical information on the nature and characteristics of the ordnance used by the German Air Force during both world wars has been available for a number of years. Assessment that began during the 1930's has continued to the present day. Research has been conducted in many countries by experts as part of national research programmes and as individual research projects.

Consequently, a well informed assessment of the threat posed by unexploded ordnance, and the hazards that they represent, can be made with a high degree of confidence.

3 **Terminology**. It should be noted that two terms used in bomb records can lead to some confusion as to their meaning and therefore significance. The term Unexploded Bomb (UXB) refers to a bomb that has fallen, failed to function and has been subsequently dealt with and removed from the site. The term Abandoned Bomb (A/UXB) refers to a UXB that could not be found or recovered, or the decision was taken not to pursue the matter further. Consequently the unexploded bomb remains where it came to rest when it was dropped or fell to the present day. It should also be noted the word 'bomb' can be used to describe an airdropped bomb or a shell as in some cases no differentiation was made and the term was interchangeable.

4 **Abandoned Bombs**. The records of known abandoned unexploded bomb locations in the London area were released in response to a written Parliamentary Question from Simon Hughes. (Hansard: Volume; 282. Dated 15th October 1996). The information was provided by the Ministry of Defence (MOD) and supplied under an indemnity.

5 **Explosive Ordnance Failure Rates**. Over the course of both World Wars a considerable quantity of ordnance dropped on UK targets failed to function as designed and subsequently penetrated the ground without exploding. Information gathered during the war by the MOD and its research partners provide typical failure rates for different types of ordnance. Figures significant to this study are:

5.1 10% of all German airdropped bombs failed to function as intended.

5.2 30% of all anti-aircraft and other types of shells failed to function as intended.

6 **Deductions & Considerations**. The following points were considered as part of the assessment and have been given due consideration:

6.1 Records were found that indicated that the general area was subjected to heavy bombing.

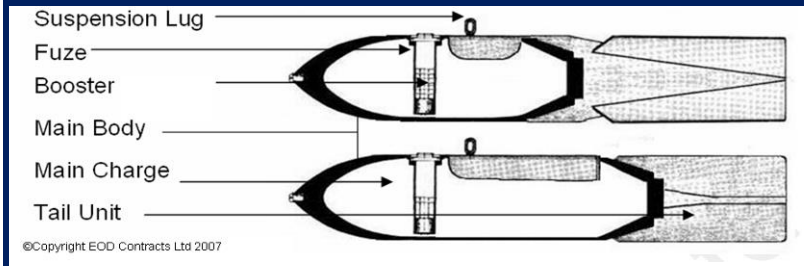
6.2 Bombs which struck previously hit or burned out targets and did not function; consequently their impact was unseen and therefore no report was ever made.

6.3 In all likelihood, the local anti-aircraft battery would have fired a far higher number of shells than the bombers dropped HE bombs. Contamination by anti aircraft shells can not be rules out.

7 **Generic German Bomb Types**. The majority of German bombs dropped were 50kg in weight, accounting for approximately 16% of the total bombs dropped. The range of common bombs increased in weight to a maximum of 1700kg. Regardless of size, German bombs were fitted with one or more Electrical Condenser Resistance (ECR) fuzes many of which included a mechanical component. The fuzes were mounted transversely in the bomb body with the booster directly below, and in contact with, the fuze. The booster; sometimes referred to as the Gaine, is composed of a sensitive explosive material (Picric Acid). Picric Acid is known to deteriorate over time becoming increasingly unstable. The internal layout of two common German bombs and a German fuze is shown in Figures 6.1 & 6.2.

FIGURE 6.1 Generic German Bomb Design.

Graphic Cross Section through the most common German bombs (50kg)



Note; the diagram shows that there can be a significant difference in the quantity of High Explosive contained within bombs of similar size and shape; the Grade 1 bomb on the bottom having 30% more HE than the Grade 2 shown at the top. This serves to demonstrate the importance of an accurate identification of any item of UXO.

FIGURE 6.2 Generic German Bomb Fuze Design.

Graphic Cross Section through a typical German fuze (ECR)

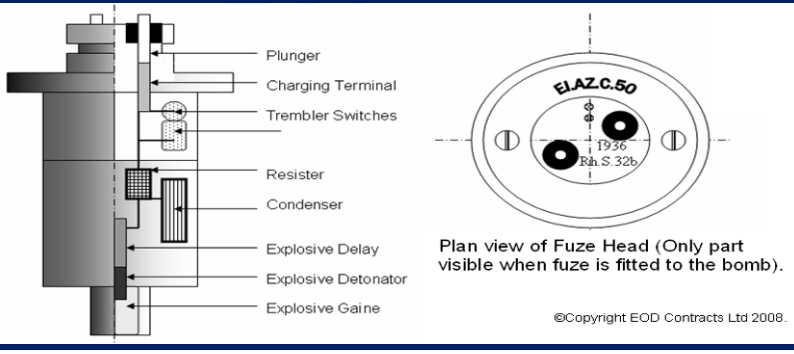


FIGURE 6.3 Range of HE bombs dropped on the United Kingdom.

German bombs

The smaller sub-munitions (Bomblets) seen to the right, ranged in size between 1 and 3kg, were dropped in large numbers and were intended as incendiary bombs, anti-personnel bombs or as bombs filling both roles. The smaller bomblets were dropped in larger container bombs designed to hold between 360 and 620 of the bomblets. The containers were designed to burst open at a predetermined height above ground level, dispersing the bomblets over a wide area. Air raid damage was far greater by using both incendiary, and HE bombs on a single raid. The fires started by the incendiaries being rapidly spread by the blast waves from the HE bomb. This scenario was shown to devastating effect on the 14th February 1945 in the German city of Dresden. Where fires started and spread by the bombing increased to a point where the oxygen was being sucked into the flames at such a high speed that the fire became a "Fire Storm". At the time the city's population had increased due to a high number of refugees fleeing the Russian advance to the east, the exact civilian death toll from fire and suffocation will never be known, but is considered to be somewhere between 25,000 and 100,000.

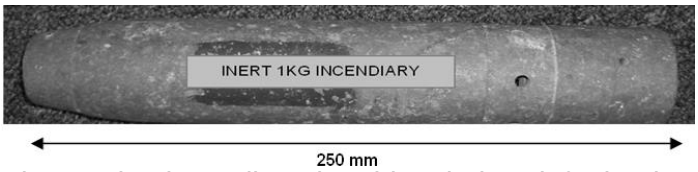
7.1 High Explosive (HE) Bomb. Some of the most common type of ordnance to be dropped on the United Kingdom, HE bombs are often the type encountered as UXBs. Relatively thick cased, they are still recovered in remarkably good condition. Ranging in size from 50 to 1700 kg, their typical release height (1,500m) allowed them to penetrate deep into the ground as a result of design or flaw. Towards the end of the bombing campaign, as steel became scarce the German Engineers produced a range of bombs that used steel reinforced concrete as the bomb body. Figure 6.3 shows the range of steel HE bombs dropped on the UK.

7.2 Incendiary Bomb. The larger incendiary bombs, containing bottles of white phosphorus and an incendiary mixture contained within a thin steel case were designed to burst on contact with the ground. The smaller type of bomb or 'Bomblet' was delivered to the target area in container bombs or by a fixed dispenser on the aircraft; both types of container would open dispersing the smaller Incendiary bombs. Relatively small and light they were unlikely to penetrate the ground to any significant depth. However, once concealed in bomb damage rubble or below water they were easily missed and are still unearthed today from in-fill and drained land. Later

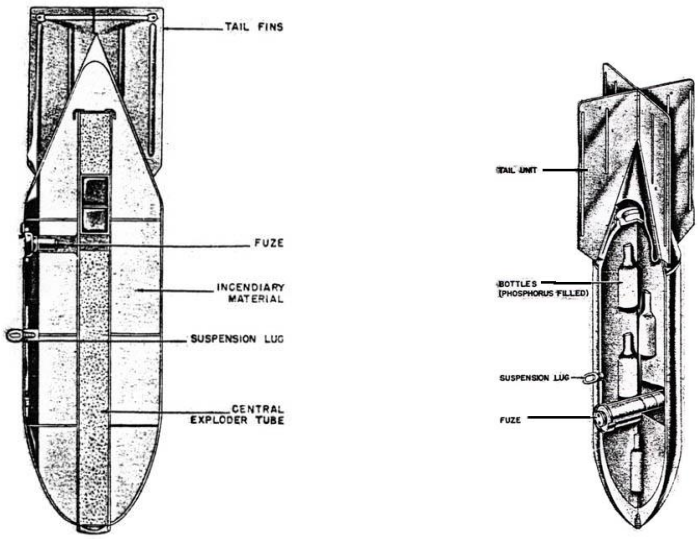
versions of the incendiary bomb contained an additional explosive charge used as a short delay “Booby Trap” device that contained a significant amount of high explosive. The Booby Trap component was designed to kill or injure fire fighters and hinder the damage control. See Figure 6.4.

FIGURE 6.4 Incendiary Bombs.

Common German Incendiary Bombs



Above 1kg incendiary bomblet, below left the larger 500kg incendiary bomb Below right a 50kg incendiary bomb containing bottles of white phosphorus.

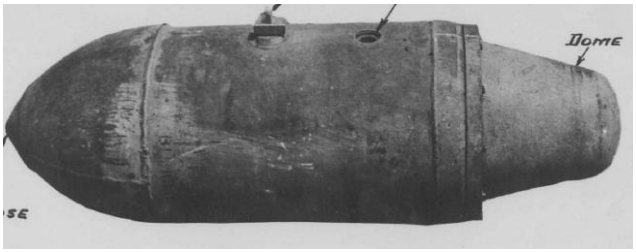


Note; Incendiary bomblets were made of a flammable alloy similar in appearance to aluminium, which resists corrosion well. The tail unit was made of thin tin-plate steel and is more prone to have rusted away. Some Incendiary models were fitted with a High Explosive (HE) steel nose. With the tail and explosive nose attached the bomb was 480mm long.

7.3 Blast Bomb / Parachute Mine. The parachute mine was extensively used on land and at sea and was fitted with specialist fuzes designed to trigger the weapon at a predetermined altitude, water depth or to switch on other magnetic influence mechanisms to trigger the weapon when a ship approached (Magnetic or Acoustic influence). While early versions were based on the standard 1000kg SD Bomb case others were specially designed and manufactured with an aluminium body, making them extremely difficult to detect using magnetometers. The thin cased versions would normally disintegrate on impact on land and are normally considered to pose little threat to work on land based projects, but the risk increases significantly on projects over water or in marshland. Thicker cased versions however will survive impact and pose a significant risk regardless of the local ground conditions. (See Figure 6.5)

FIGURE 6.5 Common Airdropped Mines.

Parachute & Ground Mines



Note; all mine fuzes were designed to arm after deployment from the ship, submarine or aircraft, some fuze designs incorporated anti-removal booby traps. Unexploded mines found today are the result of a failure within the arming mechanism or procedure whereby the mine never fully armed. Sudden shock or jarring of a weapon in this state has the potential to complete the arming sequence and could result in the mine detonating with lethal consequences.

7.4 Non Steel Cased Bombs. Used primarily in the construction of training or practice bombs, some high explosive variants were introduced towards the end of the war. With resources running scarce, German Engineers produced a small number of blast bombs with a concrete body. The design utilised a steel framework onto which concrete was cast. The explosive filling was also contained within a thin steel container within the bomb body. Very few “concrete” bombs were dropped on the UK. In common with standard steel cased weapons, this type of bomb can be detected using standard magnetometer detection techniques (albeit; providing a smaller ferromagnetic signature than its all steel counterparts). This type of bomb represents a very small percentage of the total number of bombs dropped worldwide and are not considered a significant threat, particularly when viewed from an overall bomb threat in the UK.

7.5 Anti-Personnel Bomb. Generally these were small weapons of 1-3 kilograms in weight and are often referred to as ‘Bomblets’ and possessing similar ground penetration ability as the Incendiary Bomblets. They were often located during the post-raid searches. This type of bomb has been recovered within the bomb rubble being cleared or used as in-fill on construction projects and poses the same potential to function as the Incendiary bomb with a greater potential to cause localised casualties.

7.6 Specialist Bomb. These types of bombs were designed to meet a specific mission requirement. Typically, this would be a design modification or special fusing to enable

the bomb to destroy hardened/armoured targets or deep buried and sub-marine targets. Similar to the more common HE bombs, they differ in that they rarely contain large amounts of high explosive. Therefore the consequence of a detonation is reduced but remains a significant risk, particularly when the detonation occurs on or near the surface.

7.7 Depth Bombs & Depth Charges. These types of weapons were designed to meet a specific mission requirement. Typically, the modifications would include the type of explosive filling and special fusing to enable the bomb to penetrate to a significant depth into the ground or water before detonating. Depth bombs intended for maritime attack and sub-marine targets would be fitted with one or more fuzes, one of which would be a hydrostatic fuze designed to detonate the bomb at a predetermined depth. The bomb would be fitted with an anti skip ring to reduce the deflection of the bomb as it entered the water. Similar in many ways to Depth Bombs, Depth Charges were exclusively designed to detonate at a predetermined depth. This was achieved by fitting the Charge with a short time delay or hydrostatic fuze. Depth bombs; having a similar configuration to general purpose bombs had the potential to penetrate deeply into the sea bed where an attack occurred in the relatively shallower water of a dock.

7.8 Unmanned Rocket Bombs & Missiles. The most famous in this category of weapons were the V1 (Fi103 flying bomb) commonly known as the Doodlebug and the Larger V2 (A4 missile). Both V1 & V2 with high explosive warheads containing 850kg & 1000kg (respectively) represent some of the largest weapons to land in the United Kingdom. Both types were built in a similar manner to an aircraft and would generally disintegrate on impact even if the warhead failed to detonate. The impact would spread debris over a wide area which was difficult to miss and any resulting unexploded 'V' weapons were comprehensively dealt with at the time. For this reason they are rarely encountered on land. However, where a 'V' weapon landed in water the opportunity for the event to have been missed and/or follow-up action abandoned was greater and they continue to pose a significant risk. Other, less well known rocket bombs were also produced by the Luftwaffe to attack maritime targets. Some were equipped with TV/Radio guidance from the parent bomber. Two of the most common were the Fritz X which consisted of an adapted SD1400kg bomb and the Henschel Hs293 which was based on a smaller 500kg bomb. No record of one having been recovered on land as a UXB can be found but these large HE bombs are considered to pose a significant risk, particularly to maritime projects. No records were found to indicate this type of bomb was ever used on targets in the area.

7.9 Photoflash Bomb. This type of bomb was dropped by specialist "Pathfinder" aircraft and although this type of bomb can be included with the category of specialist bombs, it is worthy of specific comment due to the danger it may still pose. Photoflash bombs were designed to explode with a blinding flash, rather like a camera flashbulb. They were used to enable photographs to be taken of targets at night and also served to identify ground targets for other aircraft to attack. The speed at which the highly energetic filling detonated, and energy it produced in doing so, was significant. Although these bombs were thin skinned and are prone to corrosion the functioning of one can be compared to a high explosive bomb detonation.

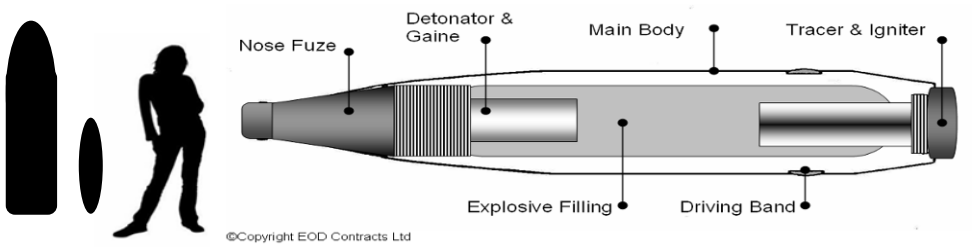
8 **High Explosive Shells & Projectiles**. As mentioned previously, one of the most common sources of UXO contamination encountered in the United Kingdom is High Explosive Shells and Projectiles. This is most commonly found to be as the result of firing practice ranges, bombardment and anti-aircraft defence, the latter often positioned to defend Major cities and Strategic installations and ports from German Bombing. Anti Aircraft Shells and projectiles are generally smaller (Up to 4.7" inch diameter) than the airdropped bombs and as a consequence were more easily missed amongst the bomb rubble. However, coastal bombardment guns could fire a shell weighing 1000kg, (larger than most common airdropped bombs) and capable of

significant ground penetration. The generic layout of a projectile can be found at Figure 6.6. It should be noted that the fatal incident on the German autobahn in 2006 was thought to be the result of a shell or projectile detonating, not an airdropped bomb as first reported.

8.1 The Fuzes used in Anti-Aircraft Ammunition were designed to ensure the projectile would detonate in contact with the target, or at a pre-set altitude, or in close proximity to the target. The fuzes employed different means to achieve this, including; direct impact, or indirect impact, Barometric, Delay and Electro-magnetic influence. Some were fitted with more than one fuze, which served to reduce the chance of the projectile falling to earth and detonating. Artillery fuzes are activated during the firing process, using the projectile's acceleration or spin within the gun barrel to switch off the safety mechanisms. For this reason fired projectiles are considered more dangerous than unfired ones.

FIGURE 6.6 Generic Shell Design

Scale & Graphic Cross Section of a typical High Explosive (HE) Shell



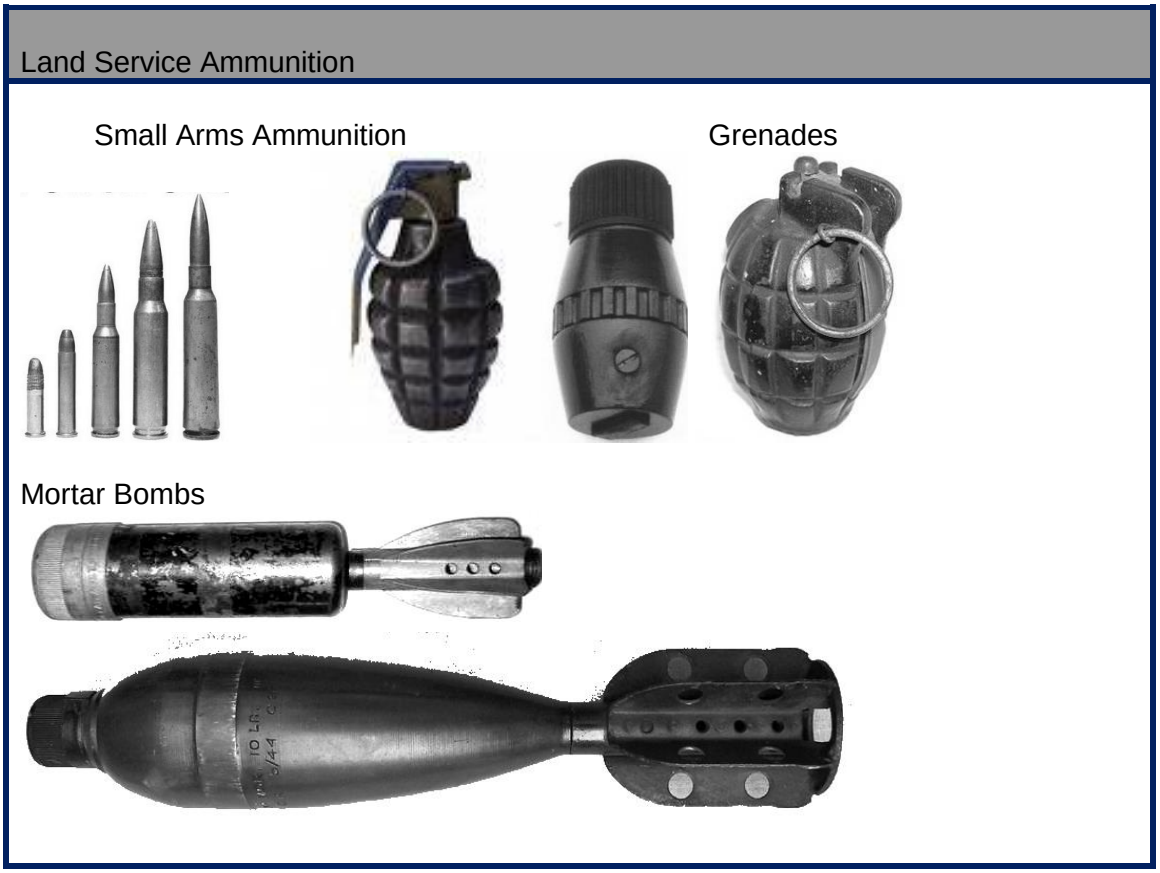
Approximate size of a large shell used by battleships and coastal bombardment guns (Left) and Anti-aircraft shell (Right)

9 **Other Types of Ordnance**. The following additional sources of ordnance types have been considered, and inherent risks taken account of:

9.1 Flares and Pyrotechnics. Flares and pyrotechnics were used for a variety of reasons throughout the war and continue to be found today in the most unlikely places. However, due to the thin casings of these weapons a high level of corrosion is likely to have occurred since manufacture. Depending on the specific nature of the weapon, this effectively renders them inert with the exception of any white phosphorous content or explosive gaine.

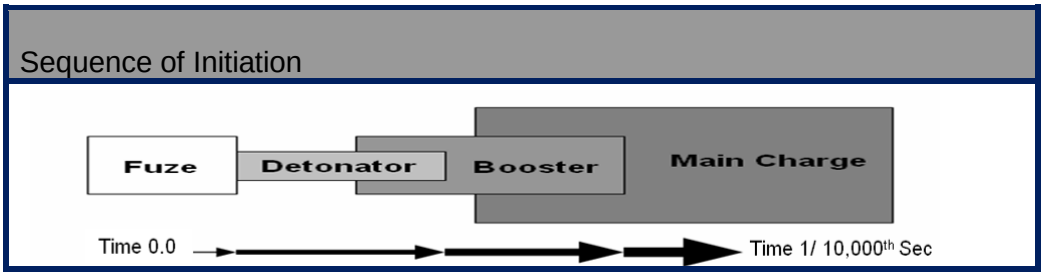
9.2 Land Service Ammunition (LSA). While as the name implies this type of ammunition was designed for use on land, it was also issued to naval personnel for close protection of vessels and their crew and to provide a limited offensive capability even to relatively small craft. This type of ammunition includes some shells and projectiles such as those covered previously. Other natures of LSA range from Small Arms Ammunition (SAA), having little or no high explosive content to Grenades, Mortars and Rockets which may pose a risk of detonation due to their explosive content and the design of their fuzes (impact) which; if subjected to sufficient shock or friction may result in the weapon functioning. (See Figure 6.7)

FIGURE 6.7 Common Categories of Land Service Ammunition



10 **Initiation of Unexploded Ordnance**. Explosive Ordnance is highly unlikely to spontaneously explode. The energetic chemical compounds, (Explosives) used in weapon manufacture are chosen to be as stable as possible and they all require a significant application of additional energy to create the right conditions for detonation to occur. If stored correctly, most explosive materials are designed to remain stable for the duration of their expected lifespan (typically 20 years). During this time, the correct functioning of the weapon is achieved by means of the 'Initiation Train' (See Figure 6.8).

FIGURE 6.8 Explosive Ordnance Initiation Train.



11 **Initiation Train**. This is a means by which, once the safety features have been switched off or removed, a chain reaction occurs through the weapon. Starting within the fusing system as a small ignition or spark, causing a detonator to explode, which in turn causes the booster charge to detonate with a greater energy and ending in the full detonation of the main explosive filling. Each part of the process has in-built safety features to prevent an unintended detonation. A failure in any of the components within the Initiation Train can result in a UXO. In the case of a UXB; the chain reaction has broken down and the Initiation Train is brought to a halt, albeit, a temporary one. There are a number of ways that sufficient energy could be introduced to the otherwise stable UXB / UXO that may allow the Initiation Train to set off once more, overcoming the initial reason for failure. In addition to subjecting the weapon to excessive heat, such as a fire, the most common methods to bring about an explosive detonation in such items are considered to be:

11.1 Direct impact onto the main body of the bomb by mechanical excavation or pile driving: Such an occurrence can cause the bomb to detonate, should the point of impact be on the bomb fuze; less force would be required to bring about a full or partial explosive detonation.

11.2 Re-starting the clock timer in the bomb fuze. Only a small percentage of bombs were fitted with clockwork fuzes. It is likely that corrosion has taken place within the fuze that may prevent the clockwork mechanism from functioning. However, the restarting of the clock is by no means a scenario that can be completely ruled out. This is considered to be one of the two most credible mechanisms by which sufficient energy could be introduced to the bomb and result in a detonation.

11.3 Induction of a static charge or exposure to an external power source (Electrical Services), causing a current in an electrical fuze. The majority of German bombs employed an electrical component within the fuzes, it is likely that corrosion would have taken place within the fuze mechanism and that it would no longer contain, or conduct sufficient electrical charge to initiate the bomb.

11.4 Friction initiating the sensitive fuze explosive. Some chemical constituents may have deteriorated, due to oxidisation. Components designed with a high degree of stability at the time of manufacture may no longer be as safe. **This is considered to be the most likely mechanism by which sufficient energy could be introduced to the bomb and result in a detonation.**

Annex G

Risk Assessment Tables

Table 1 Summary of Potential Contamination Sources

Source	Applicable	Not Applicable
Enemy Attack & Counter Measures		
Bombing WW1		☒
Manned Aircraft Bombing WW2	☒	
Unmanned V1 & V2 Rocket Attack		☒
Shelling		☒
Anti-Shipping Mines & Depth Charges		☒
Anti-Aircraft Shells & Rockets		☒
Beach Mines & Coastal Defences.		☒
Airfield/Key Point Defensive Mines/Charges		☒
Abandoned Unexploded Bomb (A/UXB)		☒
Migration of UXO		
UXO Migration in Rubble & Infill		☒
UXO Migration by Tide & River Current		☒
UXO Migration by Marine Dredging		☒
Ship Wrecks		☒
Dispersal by Explosion, Fire & Accident		☒
Aeroplane Crash		☒
Private Collections		☒
MOD Facilities		
Bombing Range		☒
Artillery, Mortar & Tank Range		☒
Grenade Range		☒
Small Arms Firing Range		☒
Weapon Research & Development Facilities		☒
Ammunition Burial Grounds		☒
Docks & Harbour Facilities		☒
Offshore Ammunition Dumping Grounds		☒
Ammunition Storage & Manufacture Sites		☒
Airfields & Air Stations		☒
Bombing Decoy Site		☒
Army Barracks & Camps		☒
MOD Training / Concentration Areas		☒
Home Guard & SOE Weapon Caches		☒

Table 2 Baseline Bomb Penetration Assessment

	Bomb Weights			
Sub Soil Type	50kg	250kg	500kg	1000kg
Soft Rock	2.442	5.016	6.006	7.062
Gravel	2.442	5.016	6.006	7.062
Sand	2.442	5.016	6.006	7.062
Chalk	3.7	7.6	9.1	10.7
Shingle	3.7	7.6	9.1	10.7
Dry Clay	3.7	7.6	9.1	10.7
Wet Sand	5.55	11.4	13.65	16.05
Wet Clay	5.55	11.4	13.65	16.05
Average Offset (m)	0.8-1.6	1.6-3.7	3-4.5	3.4-5.3

Table 3 Site Specific Bomb Penetration Assessment

Input Figures			
Bomb Weight	Release Height	Velocity on Impact	Angle of Strike
500 kg	5000 m	340 $m.s^{-1}$	10º to vertical
Geology	**Ground Made-Clay-Peat-Gravel-Sand(Wet) Water sub-sediment 3m dock not tidal**		

Output Figures	
Maximum Penetration Depth	Maximum Offset
12 m	**5.3 m**

The maximum threat depth from airdropped weapons is considered to be: **Bombs 12 m**

The maximum threat depth for smaller shells is considered to be: **AA Shells 3.0m**

Input figures based on the most common bombing methods and largest common bomb type
Figures derived from computer simulation. All depths based on 1939 levels.

Table 4 Airdropped Weapon Strike Indicators (UK)

Item	Increasing Potential level ⇨			
Site Location	Rural	Small Town	Brown Field Large Towns	Cities
Site Description and Use	Greenfield or Agricultural Land	Near Strategic Target	Adjacent to Strategic Target	Strategic Target
Site History	No history of Attack	Near area of Attack	Immediate Area Attacked	Direct Attack

Strategic Target: Military Installation, Industrial or Munitions Manufacturer, Power Station, Gas or Water Works, Port, Dock, Railway Yard, Decoy Site.

Table 5 Weapon Strike Records (UK)

Source	Availability			
Archive	None	Non specific	Specific	Extensive
In-house	None	Non specific	Specific	Extensive
Anecdotal	None	Non specific	Specific	Confirmed

Table 6 Anti-Aircraft Weapon Strike Indicators (UK)

Item	Increasing Potential level ⇨			
Site Location	Rural	Town	City	Military Site
Fixed Battery Location	None	General Area	Nearby	Onsite
Mobile Battery	Rural	Town	City	Military Site

Military Site: Airfield, Port, Radar, Barracks, Depots, Arsenal or Similar.

Table 7 Abandoned Bomb Records (UK)

Item	Increasing Potential level ⇨			
In-house	None	Yes	On-site	
Other	None	Yes	On-site	

Table 8 Bomb Strike Density Assessment

Bombs & Mines	**LCC bomb density placed at 300 to 399 per 405 hectares.**

Table 9 Opportunity to have detected Bomb or Shell Strikes (UK)

	Increasing Potential level ⇨
	No recorded bomb damage Good ARP cover Significant development No significant ground cover
	Light bomb damage Moderate ARP cover Moderate development Frequent public access Little ground cover
	Significant bomb damage Poor ARP cover Minimal development limited to shallow excavations Infrequent public access Moderate ground cover
	Heavy bomb damage No ARP cover No development Controlled private access Heavy ground cover, vegetation, ploughing or body of water

Table 10 Post Contamination Development Indicators (UK)

	Increasing Potential level ⇨
Nature of post contamination development	100% excavations of the entire site to below contamination depth.
	Significant development
	Moderate development
	Minimal development
	No development

Table 11 Construction Activities Encounter Indicators

	Increasing Potential level ⇨
Activities	**Borehole Drilling** **Dynamic Sampling**
	Shallow Trial Pit **Services Trenching** **Bored (CFA) Piling**
	Sheet Piling
	Shallow Excavations over extended area **Deep Excavations over a limited area**
	High Density Piles **Deep Excavations over extended area** **Bulk Excavations**

City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

Appendix 3 – Project Action Plan

Revision 01			Date: 19/10/2016	
	Title	Name	Signature	Date
Originator:	Project Coordinator	Ivo Penchev		19/10/2016
Checked	H&S Manager	Wesley Wray		
Checked	H&S Director	Anastasia Savidu		

Client:	Contractor:
London City Airport	CONCEPT Geotechnical & Environmental Investigations Unit 8 Warple Mews Warple Way London W3 0RF Tel 0208 811 2880

Project:

London City Airport
CADP Surveys – Ground Investigation (Dock) – Phase 2

Title:

Project Action Plan

Ref:

162900-LCA- PEP Issue 00

Format	Date	Revision	Issue To	Comments
A4	19.10.16	01	LCY	Addressing comments from LCY and EOD Contracts

When this Cover Sheet is applied to a Method Statement prepared by a Sub-contractor for his activity it indicates that Concept Engineering Consultants Ltd has checked and approved the content. This does not relieve the contractor / sub-contractor carrying out the task of any of his responsibilities for Health & Safety and the Environment.

The master version of this document is retained on the Document Management System. Copies produced from the master are deemed uncontrolled. Please confirm that you hold the latest version before using this document.

The Site Project Manager will be responsible to ensure that all staff and sub-contractors are familiarised with the appropriate sections of the Project Emergency Plan.

Staff and Sub-contractors must sign off on the following:

1. That they have read and understand the appropriate sections of the Project Emergency Plan.
2. That any additions or corrections have been put in writing to the Project Manager.

Name	Company	Signature	Date

CONTENTS

1.0 Action Plan Overview

1.1. Project Profile and Emergency Contacts / Liaison

Concept Project Reference:	162900
Project Name:	London City Airport CADP Surveys – Ground Investigation (Dock) – Phase 2
Principal Contractor Details	
Company Name:	Concept Engineering Consultants Ltd
Address:	8 Warple Mews, Warple Way, London, W3 0RF
Telephone Number:	02088 112880
Concept Project Manager:	Mike Kerr
Mobile Number:	07825 784681
Email:	Mike.kerr@conceptconsultants.co.uk
Concept Project Coordinator:	Ivo Penchev
Mobile Number:	07984226815
Email:	ivo@conceptconsultants.co.uk
Concept EH&S Manager:	Wesley Wray
Mobile Number:	07557 478130
Email:	Wesley.wray@conceptconsultants.co.uk
Investigation Supervisor:	Daniel Freeland
Mobile Number:	01902 91 2617
Email:	freeland.daniel@tpsconsult.co.uk
LCA H&S Manager:	Barrie Woodley
Mobile Number:	07703 754058
Email:	
LCY Airfield Duty Manager	07767 293831

1.2. Description of Site

The 'site' is defined as the required working area(s) within which each of the working areas, compound and access routes are located. Concept will only be responsible for the working areas under their control which will be delineated either by a physical barrier, such as Heras type fencing, or a virtual boundary when working over water. The virtual barrier for each location when working over water is presented on drawings.

The working areas are located within and adjacent to the operational areas of London City Airport. Exploratory holes are located on land adjacent to the main pedestrian entrance into the airport terminal and within the dock basin to the south of the existing runway.

The compound / lay down area are located on the quay side located to the south of the end of the runway as shown on drawing 162900/MS01 and 162900/MS02. Access to the compound is via the main route to the airport and long stay carpark.

The site is an operational airport with associated infrastructure (such as access roads, car hire and car parks), dock basin and a semi – derelict quayside which is for office space, temporary over spill taxi rank and for the storage of vehicles such as HGV's and cars.

1.3. Overview of the Scope of Works

The scope of work for this project mainly comprises of the completion of intrusive works as outlined below;

- 15 No. cable percussion holes
- 16 No. rotary holes
- 1 No. observation pit

It should be noted that the large proportion of the exploratory holes are located within the dock basin, therefore working over water is required in order to complete the exploratory holes.

1.4. Action Procedure Overview

The Action Plan outlines the following arrangements and emergency procedures to be implemented in the event of an emergency incident on site. This includes, but not necessarily limited to the following:

- Event of Injury (Section 2.1)
- Environmental Incident, spill, discharge (Section 2.2)
- Event of Fire (Section 2.3)
- Security Incident, organized / opportunistic crime / activist protest (Section 2.4)
- Striking potential Unexploded Ordnance (UXO) (Section 2.5)
- Water Rescue (Section 2.6)
- Breakdown (Section 2.7)

Any emergency incidents shall be reported immediately to Concepts Project Manager who will escalate as outlined within the attached Incident Reporting Procedure. This is presented in Appendix 1 whilst the emergency contact numbers are outlined in Section 2.

2.0 Action Procedures

The project action response plan outlines how Concept will manage incidents and emergencies and detail the training and operating procedures in case of an emergency. Taking into consideration sufficient capacity and provision of first aid kits, variety and appropriate usage of spill kit types and capacity and category of fire extinguishers, as well as training in their use.

First aid kits, eye wash stations, fire extinguishers and spill kits can be accessed in the site compound and on the pontoons.

In the event of any first aid emergency the concept engineer will check for danger to any party before proceeding to assist.

In case of injury, Concept has trained 20% of our field staff to a minimum of Emergency First Aid at Work level. Adequate first aid facilities shall be made available in relation to the risks posed by the work and number of personnel on site.

In case of fire, individual work locations will be self-supporting in terms of fire safety and will comprise a means of raising the alarm (typically verbal command "fire, fire, fire") and fire pit at the drilling rig or local welfare unit. Every drill rig / crew carries a suitable fire extinguisher, 6litre foam or 2kg powder, and only trained and competent operatives will use fire extinguishers if safe to do so.

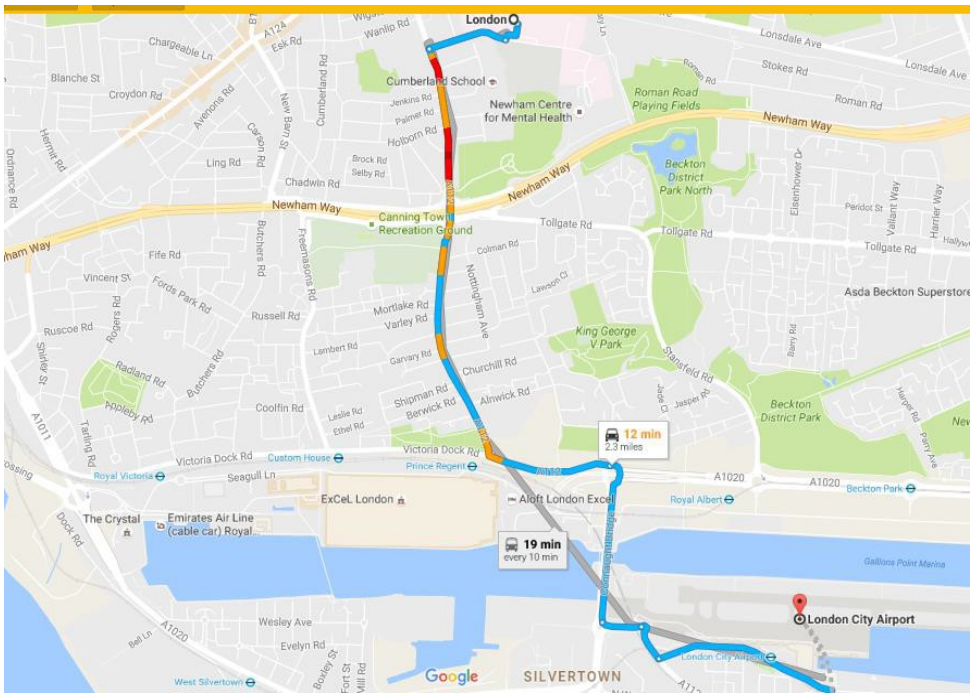
In case of a spillage, individual work locations will have a spill kit, typically chemical 'yellow' which has the capacity to absorb all types of spills encountered within our works including water, oil, chemicals and corrosives (yellow products). Typically something similar to: Lubetech Performance Spill Response Kit – Chemical or Lubetech Performance Spill Response Kit – Oil. In cases where greater or differing spill kit capacity is required additional resources will be made available.

Table1: Emergency Procedure Summary

In case of Injury: • Give Emergency First Aid • If serious summons ambulance • In minor but medical treatment required take casualty to nearest A&E department • Report the incident	**In case of fire:** • Alert all local personnel and evacuate vicinity • Call emergency services • Fight fire with extinguisher – ONLY if trained and safe to do so • Report the incident – alert the Airfield Duty Manager and Project Manager
In case of spillage: • Contain and prevent further spillage • Use spill kit to clean up • Remove contaminated materials / ground • Correctly dispose of contaminated material • Report incident	**In case of damage to buried services:** • Vacate and isolate working area • Contact relevant utility provider • Inform local utility end user (if known and practicable) • Report incident
In case of ferrous anomaly strike: • Remove drilling tools and casing • Relocate to secondary borehole position • Report Incident	**In case of security incident:** • Establish severity – vandalism, protesters etc • Contact police if required • Contact / inform London City Airport if required • Report the incident – alert the Airfield Duty Manager and Project Manager
In case of finding UXO in trial pit: • If UXO is positively identified by specialist, stop work and evacuate 100m • Contact Airfield Duty Manager and Project Manager	
Nearest A&E Hospital	Main Compound Address
Newham General Hospital Glen Road Plaistow London E13 8SL Phone: 020 74764000	Hartmann Road London E16 2PB

Distance from site: 1.8 miles Estimated response time: 15 minutes	
Emergency Contact Details	
LCY Airfield Duty Manager	07767 293 831
Environment Agency	Environment Incident Hotline (24 Hour) 0800 80 70 60
Gas (National Grid)	0800 111999
Electricity (National Grid)	0800 404090
UK Power Networks	0800 31 63 105
Water (Thames Water)	0800 714614
Telephone (BT)	0800 0232023 (Option 1)
Emergency Services	999

Figure 1: Directions to nearest A&E Hospital



2.1.Injury and First Aid Arrangements

Welfare facilities for both male and females will be provided during the setting up of the main compound by using a mobile welfare unit. First aid kits are available at the main site compound welfare facilities, on the pontoon located within the dock and at all land based work locations.

At the work location first aid provisions will be covered by the supervising engineer and the Lead Driller. Any necessary deviation will be outlined and identified within the pre-work briefings.

All injuries, no matter how minor, shall be reported to a designated first aider. The first aiders for the site are outlined below:

Mike Kerr – Project Manager – 07825 784 681

Details of the designated first aiders are displayed on the site notice board and on the pontoon. All injuries shall be recorded in the accident book, no matter how minor.

If injury is minor but requires medical attention the injured party shall attend the local A&E department as identified in Section 2.0. The injured party shall be accompanied at all times whilst attending A&E.

If a major injury is sustained the relevant emergency services shall be contacted by dialing 999 and the main site address given as given in Section 2.0.

All injuries shall be reported immediately to the Concept Project Manager who will escalate within Concept and with the Client to ensue all relevant stakeholders are aware.

2.2. Pollution Incident Control Plan (Including Environmental Procedures)

All employees and sub-contractors working on the site shall ensure that their work plan makes suitable provision for emergencies commensurate with the nature of the site, the operations being carried out and people who could be affected. All such provisions shall be communicated site personnel and other relevant persons as part of their site induction.

It is the responsibility of all employees and sub-contractors to ensure that all accidents, environmental incidents and near misses are reported by informing the project manager. The Project Manager will escalate within Concept, with the Client and other third parties if required to ensue all relevant stakeholders are aware.

The engines and hydraulic systems of all plant shall be location over a plant nappy, or similar. This requirement is particularly relevant for the plant operating on the pontoon within the dock basin.

All chemicals and fuels shall be stored in a bunded or double skinned storage containment to avoid spillage and subsequent environmental pollution / damage.

Should a pollution incident occur the immediate response shall be to isolate the cause of the spillage and contain the spill to prevent it spreading further. In the event of a fuel or chemical spillage which is potentially flammable all plant operating in the area shall be turned off and made safe until the spillage has been cleared up.

The spill kit at the work location shall be used to clean the spill. All personnel involved in the cleaning up of any spillage shall consult the COSHH assessment for the material(s) prior to ensure all the relevant PPE and / or RPE required is available on site and should be used as outlined.

All waste materials produced from cleaning up the spillage shall be disposed using the relevant waste disposal route. All 'contaminated' materials shall be doubled bag in bulk bags and stored separately from all other waste until collected for disposal.

2.3. Fire

A fire risk assessment of the compound will be undertaken by the project manager and / or the Health and Safety Manager immediately on completion of mobilization and setting up the main compound. This will include the confirmation of the muster point for any emergencies such as fire and / or possible UXO strike.

Individual work locations, including the pontoon, and the compound shall be self-supporting in terms of fire safety and will comprise a means of raising the alarm (typically verbal command "fire, fire, fire") and fire point at the drilling rig / plant. The fire shall be equipped with a suitable fire extinguisher, either a 6lts foam or a 2kg powder.

There is a good mobile phone signal / network across the site. Communications will be maintained across the whole site area by means of mobile phone.

Details of the appointed fire marshal(s) will be displayed on the site notice board, including the arrangments for raising the alarm and location of the fire muster point.

Only trained and competent operatives are to use fire extinguishers; and only when safe to do so. Periodic checks of the site compound will be undertaken by the site team to ensure compliance with fire regulations.

An on-going programme of tool box talks will be initiated to highlight the awareness of fire, importance of good housekeeping, storage of combustible materials and why the importance of having an emergency plan.

2.3.1. Fire on Pontoon

Should a fire occur on the pontoon all employees shall evacuate the pontoon via the safety boat which will bring them to a safe location on shore. The supervisor / engineer shall inform the project manager when it is safe to do so. The storage flammable materials on the pontoon, such as fuel, shall be strictly limited to minimum quantities. In addition no naked flames shall be allowed on the pontoon.

The following procedure shall be followed:

- Shout “FIRE, FIRE” to alert fellow crew members.
- Operatives evacuate from the platform via a safety boat.
- When safe, call the emergency services, Airfield Duty Manager and Project Manager.
- Following a fire onboard the pontoon, the affected areas will be inspected for damage by the Site Supervisor. Signs of structural deformations are to be reported to Volkers immediately and the pontoon quarantined in order to facilitate a full investigation.
- The pontoon will remain inoperable until a representative of Volkers has given instruction to start operating on the pontoon following the results of a detailed investigation.

2.4. Security

Security Threat Level

The Security threat level will be provided / indicated weekly, or when deemed necessary, by London City Airport. The project manager will assess the information with the Client based on the following criteria:

- Have any incidents occurred on site or within the surrounding area
- Intelligence on any incidents which may have occurred on other construction sites in the area and / or other land owned by the Client
- Information and intelligence communicated to Concept by London City Airport Security and / or local police force
- Observations made on site by personnel working on the project

The security threat level shall be communicated to Concept weekly, as minimum, by London City Airport. Concept’s project manager will provide the relevant updates to the project team as and when required.

The current security threat level is considered to be low.

All personnel working on the project have the responsibility to report any unusual or suspicious behavior to the project manager. The project manager will inform the relevant third party depending on the severity of the observation, perceived threat level and urgency.

All personnel working on the project shall ensure their actions do not comprise the security of the project or London City Airport.

During the fieldwork period Concept will have a security guard on site located at the compound during all out of hours periods. Out of hours is defined as 18:00 to 07:00 Monday to Friday and 24 / 7 on weekends (Saturday and Sunday).

2.4.1. Pontoon, support vessel security

At the end of each shift the pontoon, safety boat and support tug shall be made safe and if it is a powered water craft is should be immobilised by removing all keys and locking the wheel house where applicable.

At the end of each working day when all personnel are on shore the safety support boat shall be moored at a safe location to prevent unauthorized access. This should be either at the pontoon, buoy within the dock or a secure jetty. The supporting tug boat shall be made safe and secured at the quayside adjacent to the main compound.

2.4.2. Management / Controls

Only personnel who are authorised by Concept will be allowed to access the compound and working areas. The will be granted by the Project Manager and explained during the site induction, this opportunity will also be used to explain restrictions with regards to access to certain areas. In the event of a security emergency incident the police and the Airfield Duty Manager shall be informed as soon as possible. All non-emergency security incidents shall be reported to the Project Manager who will ensure the relevant third parties are informed, such as London City Airport's security team.

2.5. Unexploded Ordnance

Prior to commencing the intrusive works on site all personnel will receive an Ordnance Awareness Safety briefing by the UXO technician. These will be site specific and cover relevant issues as per the unexploded ordnance treat assessment (UXO TA). All briefings are to be recorded in the daily works diary and attendee's names on the relevant record sheet.

UXO findings can be categorised as outlined below:

- Category 1: Live UXO (found during excavations)
- Category 2: Expended UXO or free from explosive UXO (found during excavations)
- Category 3: Ferro-magnetic anomaly (detected at depth below ground during borehole checks)

The majority of the intrusive works on this project comprise boreholes which have a relatively small diameter (typically 200mm), therefore Category 3 will mainly apply. It will not be possible to visually inspect any anomaly detected or struck during drilling to confirm whether or not it is a UXO.

In order to prevent a ferrous object being struck the mitigation measures outline within the Risk Assessment and Method statement shall be adhered to at all times. A summary of these are outlined below:

- Designers position exploratory holes away from known anomalies within the dock basin

- The position for the spud legs on the pontoon shall be checked for ferrous anomalies using the hand held magnetometer before lowering the legs
- Position of proposed exploratory holes checked for ferrous anomalies before commencing borehole
- Borehole to be checked using down hole magnetometer every 1.0m during drilling. This shall be completed until 'natural' strata such as the River Terrace Gravels is encountered (not alluvium).

2.5.1. Obstruction Strike in Borehole

If an obstruction is encountered / struck within the alluvium at the base of the dock basin it shall be checked whether or not it is ferrous by using the downhole / hand held magnetometer. If it is not metal the situation will be assessed and the borehole continued or abandoned.

If the obstruction is confirmed to be metal all work on the pontoon shall stop immediately, the drilling equipment shall be removed, the borehole abandoned and relocated to the secondary position.

2.5.2. UXO Uncovered in Trial Pit

If a suspected UXO is found in the trial pit, all work shall cease immediately. The on-site UXO specialist and Project Manager shall be alerted. The UXO specialist shall determine the course of action to be taken, and shall identify the suspect object. If there is a positive identification, area shall be evacuated and the emergency services and LCY Airfield Duty Manager shall immediately be alerted.

Once the emergency services are on site the situation is then within their control. They will advise on further evacuation measures if required.

The Project Manager from Concept will stay in direct contact with the incident controller / commander of the emergency services and provide the conduit for information between all parties whilst providing updates as and when necessary.

2.6. Water Rescue

The following actions must be adhered to if a member of personnel falls overboard during the completion of the works:

Raise the alarm by:

- Shouting 'man over board'
- Sounding of a boat horn or air horn located on each barge/quayside.
- Summon the safety boat
- Keep the person in view

- Do as advised by a member of the Jenkins Marine (tug and safety boat and crew suppliers) site team. All safety boat operators will be qualified to National Powerboat Level 2, with adequate training for immediate first aid. At least 1 member of the Jenkins Marine management team present on site will also be fully first aid trained.
- A boat will remain adjacent to the area of works at all times ready to assist in case of an emergency, whilst the safety boat is to be single manned, should the boatman require assistance the operative is to collect a co-worker from the nearest barge.

- Should a person fall into the water, nearby parties will shout 'man over board' followed by 3 firm blasts on the air horn, this is to be repeated until the safety boat is at the scene: do not assume that the safety boatman has heard the first call. The boat operator will immediately assess the situation, his priority being to keep the person in the water afloat by grabbing / hooking the person or throwing a lifebuoy or floating line to them.

- If the person in the water is conscious they will be helped into the boat either at the rear via the propulsion system once the motor has been switched off, hauled over the side by two boatmen or moved to the nearest access point where they will be assisted by the work crew.

- The likelihood of a person being knocked into the water when unconscious will be reduced by the appropriate precautions being taken within the relevant works method statements, however if the person in the water is unconscious or badly injured the boatman is to get as close as possible to grab the person by hand, boathook or lifebuoy. Once on board the boat, the person shall be taken immediately to the dockside.

- Summon the emergency services, ambulance, by dialling 999 and the Airfield Duty Manager – they may be able to send security boats to assist.

- Ensure the incident is reported as soon as reasonably practicable to the Project Manager who will liaise with the relevant stakeholders.

Whilst priority must be given to the rescue, a message must be sent to the main office as soon as possible to enable coordinated support.

Information to be issued to Office / Emergency services is as follows: -

- The person's location

- Likely injuries, if any.

Employees must not make a rescue attempt by diving into the water unless they have been suitably trained in life saving techniques.

All personnel will be informed of emergency arrangements in the site induction.

2.7. Vehicle Breakdown

In the event of a vehicle breakdown all Concept fleet are supported by RAC breakdown assist. Fleet breakdown assist will be contacted and the Project Manager will be informed of the breakdown. Appropriate directions to the location of the vehicle will be passed onto breakdown assist. The driver responsible for the vehicle will remain with the vehicle until breakdown assist arrive.

Breakdown assist number: 0800 828 282

If the support tug / vessel or safety boat breaks down, a distress signal of three long blasts from the vessel horn or hand held horn shall be used to attract attention of the other vessel. This shall continue until it is clear the other vessel has heard the distress signal and is responding.

The broken down vessel shall be attached to the operational vessel using a suitable tow rope and towed to the safety of the quayside. The broken down vessel shall be made secure at the quayside and arrangements made for its repair or replacement.

The vessel shall not be used again until it has been inspected and repaired by a suitably qualified and competent person. If safety requirements of the pontoons cannot be serviced by one vessel work shall stop until the vessel is repaired or a replaced provided.

3.0 Incident Reporting and Investigation

All incidents shall be reported to Concepts EH&S manager. Accidents, incidents and near misses will be investigated and reported in accordance with Concepts EH&S Management system.

4.0 Training and Awareness

All personnel working on the project or visiting the project shall be made aware of the emergency procedures and their obligations on site during the site induction process. This will be in the form of an initial site induction and activity briefing in relation to the emergency procedures in place at the site. The following topics will be covered;

- ☐ Event of injury
- ☐ Environmental incident, spill, discharge
- ☐ Event of fire
- ☐ Security incident
- ☐ Water rescue
- ☐ UXO strike
- ☐ Breakdown

Any changes to emergency plan, supporting documentation and arrangements for security procedures will be communicated at the next daily briefing.

APPENDIX A - ACCIDENT REPORTING AND INVESTIGATION PROCEDURE

ACCIDENT REPORTING AND INVESTIGATION PROCEDURE

All near misses or accidents causing injury or damage to a Concept Engineering Consultants Ltd employee or sub contractor will be reported to the principal contractor if they occur on a construction site and will be recorded in the site accident book by Concept's site manager. Additionally Concept's Health and Safety Manager will be informed and an entry will be made in Concept's accident book.

The details that must be recorded in the accident book are:

- ☐ Name of the person suffering the injury.
- ☐ Date and time of the injury.
- ☐ Name of person reporting the injury.
- ☐ Cause of the injury.
- ☐ Any action taken as a result of the injury.
- ☐ Whether the injury is reportable to the enforcing authority (health and safety executive or local authority or not).
- ☐ Nature of the injury (e.g.: part of the body affected).

In order to comply with the data protection act the accident book must be in a format so as to prevent unauthorised persons from viewing personal details of injured persons, witnesses or those reporting the incident

Following the initial report all accidents will be investigated in order to:

- ☐ Identify the root causes of the accident
- ☐ Prevent a reoccurrence
- ☐ To obtain legal advice in contemplation of criminal or civil legal proceedings

The scope and duration of the investigation will be decided by the nature of the injury and the likelihood of reoccurrence.

SERIOUS INCIDENT PROCEDURE

In the event of a serious accident or incident which has the potential to result in legal action a senior company representative must contact **Crossroad Health and Safety Systems immediately**. Upon this initial contact a Crossroad representative will seek to undertake a full accident investigation for the dominant purpose of obtaining legal advice in contemplation of legal action. The accident investigation will then be conducted at the request of the appointed solicitor.

At no time should a company employee or officer of the company make any statement to the press or undergo an interview of any kind (other than a compulsory interview under section 20 of the Health and Safety at work Act etc 1974), without first seeking advice from the management or directly from Crossroad Health and Safety Systems who may appoint a solicitor to act on behalf of the company.

In the event of an employee of this company suffering any of the following categories of injury -

- ☐ Fatal injury
- ☐ Major injury (including fractures, amputations, loss of eyesight, hospitalisation for a period of 24 hours or more, etc)
- ☐ An injury resulting in the employee being absent for three (3) days or more
- ☐ Occupational illness or disease (including dermatitis, occupational deafness, vibration white finger, etc.)
- ☐ Any other accident resulting in damage to property or injury to employees and/or members of public

Then certain procedures must be followed as described below.

Initially the accident must be reported to the site supervisor as soon as possible and be reported in the company accident book held on site or at the head office premises.

The supervisor is required to report the accident to company management, who will decide if the injury/accident is reportable or not. If the accident/injury is reportable to the enforcing authority then an appointed member of management will fill in the details required on the official reporting form (F2508, F2508A, etc.) and send it to the enforcing authority within the time period specified by law. Accidents which result in an employee being unable to undertake their normal range of duties for a period in excess of three days must be reported to the HSE office (or the local authority environmental health department) that serves the location of the accident within ten days. Serious incidents, those which are reportable immediately without waiting for three days must be reported by telephone or fax to the HSE **without delay.**

Management will take the appropriate steps to ensure that the accident/injury is investigated as soon as is reasonably practicable, that the results of that investigation are recorded on the company's internal accident investigation form, and that remedial measures are put into place to prevent a reoccurrence of the injury/accident.

Major Injuries and fatal accidents should be the subject of a full formal investigation carried out by the appropriate company representative or Crossroad health and Safety Systems Ltd on behalf of the company.

If there is no supervisor in the area at the time of the accident/injury then the employee or person working on behalf of a Concept Engineering Consultants Ltd , suffering the accident/injury must report the accident in the accident book and to management as soon as

possible. A work colleague can undertake this responsibility if the injured person is unable to do this himself/herself.

If a member of public (or other person who is not an employee of this company) is injured as a result of a work activity by one of our company employees and that member of public is taken to hospital for treatment then the accident/injury must be reported to company management **without delay.**

Where an incident has occurred which is classified as a dangerous occurrence, then that incident must be reported to management **without delay**, even if no-one was injured.

The company will keep a record of any reportable injury, disease or dangerous occurrence. This will include the date and method of reporting; the date, time and place of the event, personal details of those involved and a brief description of the nature of the event or disease.

ALL INCIDENTS MUST BE REPORTED TO THE LOCAL OFFICE WHERE THE ACCIDENT OCCURRED; OR TO THE NATIONAL INCIDENT CONTACT CENTRE

The HSE's Incident contact centre will be available from 8.30am to 5.00pm, Monday to Friday, from 1 April 2001, on (Tel) 0845 300 9923, or (Fax) 0845 300 9924. Calls are charged at local rates.

Employers are also able to report RIDDOR incidents by e-mail or by visiting the centre's website. In addition, employers are able to send postal reports to the incident Contact Centre.

Health and Safety Executive

London HQ and Construction Division

Rose Court
2 Southwark Bridge
LONDON, SE1 9HS

Liverpool

Redgrave Court
Merton Road
Bootle
Merseyside, L20 7HS

Contact details and addresses for regional HSE offices can be found at:

http://www.hse.gov.uk/contact/maps/index.htm

RIDDOR Reports can be made using the F2508 on the previous page

or

via the RIDDOR Web site at:

http://www.riddor.gov.uk/eaview

or

By calling 0845 300 99 23

or

riddor@natbrit.com

Incident Contact Centre
Caerphilly Business Park
Caerphilly, CF83 3 GG.

EXPLANATION OF RIDDOR CATEGORIES

Death or Major Injury

If there is an accident connected with work and an employee, or a self-employed person working on company premises is killed or suffers a major injury (including as a result of physical violence), or a member of the public is killed or taken to hospital, then the company will notify the enforcing authority without delay (e.g. by telephone). Within ten days a completed accident report form (F2508) will be sent to the enforcing authority.

Reportable major injuries include:

- ☐ Fracture other than to fingers, thumbs or toes.
- ☐ Amputation.
- ☐ Dislocation of the shoulder, hip, knee or spine.
- ☐ Loss of sight (permanent or temporary).
- ☐ Chemical or hot metal burn to the eye or any penetrating injury to the eye.
- ☐ Injury resulting from an electric shock or electrical burn leading to unconsciousness or requiring resuscitation; or requiring admittance to hospital for more than 24 hours.
- ☐ Any other injury leading to hypothermia, heat induced illness or unconsciousness; or requiring resuscitation; or requiring admittance to hospital for more than 24 hours.
- ☐ Unconsciousness caused by asphyxia or exposure to harmful substances or biological agent.
- ☐ Acute illness requiring medical treatment, or loss of consciousness arising from absorption of any substance by inhalation, ingestion or through the skin.
- ☐ Acute illness requiring medical treatment where there is reason to believe that this resulted from exposure to a biological agent or its toxins or infected material.

Over Three Day Injury

If there is an accident connected with work (including an act of physical violence) and an employee, or a self-employed person working on company premises, suffers an over three-day injury a completed accident report form (F2508) will be sent to the enforcing authority within ten days. An over three-day injury is one which is not a major injury but results in the injured person being away from work or unable to do their normal work for more than three days (including non-work days).

Occupational Disease

If a doctor notifies an employee that he/she suffers from a reportable work-related disease then a completed disease report form (F2508A) will be sent to the enforcing authority. A full list is included with the pad of report forms and in the guide to the regulations, or the local health and safety executive will be contacted to confirm if the disease is reportable.

Reportable diseases include:

- ☐ Certain poisonings
- ☐ Some skin diseases such as occupational dermatitis, skin cancer, chrome ulcer, oil folliculitis/acne.
- Lung diseases including; occupational asthma, farmer's lung, pneumoconiosis, asbestosis, mesothelioma.
- ☐ Infections such as leptospirosis, hepatitis, tuberculosis, anthrax, legionellosis and tetanus.
- ☐ Other conditions such as occupational cancer, certain musculoskeletal disorders; decompression illness and hand-arm vibration syndrome.

Dangerous Occurrence
If something happens which does not result in a reportable injury, but which clearly could have done, then it may be a dangerous occurrence which must be reported immediately (e.g. by telephone) to the enforcing authority. A full list is included with the pad of report forms and in the guide to the regulations, or the local health and safety executive will be contacted to confirm if the event/incident is reportable.

Reportable dangerous occurrences include:

- ☐ Collapse, overturning or failure of load-bearing parts of lifts and lifting equipment.
- ☐ Explosion, collapse or bursting of any closed vessel or associated pipe-work.
- ☐ Failure of any freight container in any of its load bearing parts.
- ☐ Plant or equipment coming into contact with overhead power lines.
- ☐ Electrical short circuit or overload causing fire or explosion.
- ☐ Any unintentional explosion, misfire, failure of demolition to cause the intended collapse, projection of material beyond a site boundary, injury caused by an explosion.
- ☐ Accidental release of a biological agent likely to cause severe human illness.
- ☐ Failure of industrial radiography or irradiation equipment to de-energise or return to its safe position after the intended exposure period.
- ☐ Malfunction of breathing apparatus while in use or during testing immediately before use.
- ☐ Failure or endangering of diving equipment, the trapping of a diver, an explosion near a diver, or an uncontrolled ascent.
- ☐ Collapse or partial collapse of a scaffold over five meters high, or erected near water where there could be a risk of drowning after a fall.
- ☐ Unintended collision of a train with any vehicle.
- ☐ Dangerous occurrence at a well (other than a water well).
- ☐ Dangerous occurrence at a pipeline.
- ☐ Failure of any load bearing fairground equipment, or derailment or unintended collision of cars or trains.
- ☐ A road tanker carrying a dangerous substance overturns, suffers serious damage, catches fire or the substance is released.
- ☐ A dangerous substance being conveyed by road is involved in a fire or released.

The following forms should be used to record and review accidents occurring to company employees and those affected by the company's undertaken

- The accident register – for use in tracking accident trends
- The accident report – for the recording of all incidents including near misses
- The investigation report – for the further investigation of all RIDDOR reportable incidents
- The Form 2508 for reporting to RIDDOR – for reporting of incidents

INCIDENT REGISTER

All incidents/accidents/near misses/ dangerous occurrences should be recorded on this register

Time & Date of Accident	Serial Number of Accident Report (if applicable)	Site / Location	Description of Incident (include hospital visits, time off work etc)	Is the incident reportable under RIDDOR

_Tables_and_Forms

ACCIDENT/NEAR MISS RECORD

To be used to record all incidents including near misses

Serial Number _____

(Records must be kept for 3 years) (Private and confidential Data Protection Act 1998)

About the person who had the accident:

Name:
Address:

Postcode:

Occupation:

About you, the person completing this record:

Name:
Address:

Postcode:

Occupation:

About the Incident: ***(Continue on a separate sheet if necessary)***

When did the accident take place: Date: / / Time:

Accident Location:

Accident Details:

Were any injuries sustained?

Was first-aid treatment was given?

Was a safe system of work (procedure/method statement) and risk assessment written for the task being performed? Yes/No (attach)

What Management action has been taken to prevent a reoccurrence?

Signature: Date:

Complete this box only if the accident was reportable under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR).

How was it reported to RIDDOR: By Whom:

Date Reported: / / Report number: Signature:

For official user only

COMPANY ACCIDENT/INCIDENT INVESTIGATION FORM

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS
(Records must be kept for 3 years) (Private and confidential Data Protection Act 1998)

To be completed immediately an employee is unable to continue, or commence work following an injury on the premises or on site

1. TYPE OF INCIDENT (Please tick applicable box/s)

Fatality		Under "3" day injury		No time lost	
Major Injury		In hospital more than 24 hours		Member of public/other contractor injured	
Over "3" day injury		Dangerous occurrence		Became unconscious	
Reportable disease		Damage incident		Needed resuscitation	

2. THE INJURED PERSON

Name of Injured Person's Company:

Name:

Age: Sex: M/F

Status**:** Employee ☐ Self Employed ☐ Trainee ☐ Contractor ☐ Other ☐

Home address:

Telephone Number:

Work being undertaken when injured:

Normal Occupation:

Occupational Experience:

Nature of injury or condition and the part of the body affected:

3. THE ACCIDENT

Exact Location of Accident:

Time of Accident: Date:

Normal Activity carried on there:

What job was being done:

What step of the job was in progress:

Describe what happened and how. In the case of an accident state what the injured person was doing at the time. Include any facts necessary to clarify what happened, e.g. weights and lengths being carried or lifted, distances of falls, etc.

Name of the direct supervisor or manager:

Was the level of supervision or management sufficient for the work being undertaken:

Names of witnesses:

What factors may have contributed to the accident *(Continue on a separate sheet if necessary)?*

Immediate Factors:

Underlying Factors:

Root Factors:

4. TRAINING AND RECOMMENDATIONS

What job instruction had injured person received relating to the incident, and when *(induction, toolbox talk formal and informal training*)?

What actions have already been taken to prevent a recurrence?

Further Recommendations for action if required to prevent a reoccurrence?

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

Was there a Risk Assessment performed for this task and had it been communicated effectively?

Had the recommendations been followed?

Does the Risk Assessment need amending?

SIGNATURE OF INVESTIGATOR:

DATE:

INJURED PERSONS STATEMENT

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

To be completed immediately an employee is unable to continue, or commence work following an injury on the premises or on site

Statement of *(Print Full Name):*……..

Age if under 18 *(if Over 18 insert "***Over 18"**):……

Occupation: ……

Contact number:……..

This statement consisting of ……. pages each signed by me, is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I shall be liable to prosecution if I have wilfully stated in it anything which I know to be false or do not believe to be true.

Signed.....

Date.....

WITNESS STATEMENT

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

Statement of *(Print Full Name):……*

Age if under 18 *(if Over 18 insert "***Over 18"**):……..

Occupation: ……

Contact number:……..

This statement consisting of ……. pages each signed by me, is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I shall be liable to prosecution if I have wilfully stated in it anything which I know to be false or do not believe to be true.

Signed.....

Date.....

WITNESS STATEMENT

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

Statement of *(Print Full Name):*……

Age if under 18 *(if Over 18 insert "***Over 18"**):……

Occupation: ……

Contact number:……..

This statement consisting of ……. pages each signed by me, is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I shall be liable to prosecution if I have wilfully stated in it anything which I know to be false or do not believe to be true.

Signed.....

Date.....

SCENE OF ACCIDENT - SKETCH

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

Below is a sketch of the location where the incident occurred.

(Sketches should be labelled, clear and relevant. Sketches are provided to give basic information and are not drawn to scale. Where they existA3 or A1 drawings can be attached to the accident investigation to provide exact information if required)

PHOTOGRAPHIC EVIDENCE

PRIVILAGED – PREPARED IN CONTEMPLATION OF LEGAL PROCEEDINGS

(Photographs are to be date and time stamped and should be labelled where necessary with a brief explanation of the contents and relevant to the incident if applicable).

HSE Health & Safety Executive

Health and Safety at Work etc Act 1974 ?

The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995

Click here for report guidance

Report of an injury or dangerous occurrence

Filling in this form

This form must be filled in by an employer or other responsible person.

Part A

About you

1 What is your full name?

2 What is your job title?

3 What is your telephone number?

About your organisation

4 What is the name of your organisation?

5 What is its address and postcode?

6 What type of work does the organisation do?

Part B

About the incident

1 On what date did the incident happen?

2 At what time did the incident happen?

(Please use the 24-hour clock eg 0600)

3 Did the incident happen at the above address?

Yes ☐ Go to question 4

No ☐ Where did the incident happen?

- ☐ elsewhere in your organisation – give the name, address and postcode
- ☐ at someone else's premises – give the name, address and postcode
- ☐ in a public place – give details of where it happened

If you do not know the postcode, what is the name of the local authority?

4 In which department, or where on the premises, did the incident happen?

Part C

About the injured person

If you are reporting a dangerous occurrence, go to Part F. If more than one person was injured in the same incident, please attach the details asked for in Part C and Part D for each injured person.

1 What is their full name?

2 What is their home address and postcode?

3 What is their home phone number?

4 How old are they?

5 Are they

- ☐ male?
- ☐ female?

6 What is their job title?

7 Was the injured person (tick only one box)

- ☐ one of your employees?
- ☐ on a training scheme? Give details:
- ☐ on work experience?
- ☐ employed by someone else? Give details of the employer:
- ☐ self-employed and at work?
- ☐ a member of the public?

Part D

About the injury

1 What was the injury? (eg fracture, laceration)

2 What part of the body was injured?

3 Was the injury (tick the one box that applies)

- ☐ a fatality?
- ☐ a major injury or condition? (see accompanying notes)
- ☐ an injury to an employee or self-employed person which prevented them doing their normal work for more than 3 days?
- ☐ an injury to a member of the public which meant they had to be taken from the scene of the accident to a hospital for treatment?

4 Did the injured person (tick all the boxes that apply)

- ☐ become unconscious?
- ☐ need resuscitation?
- ☐ remain in hospital for more than 24 hours?
- ☐ none of the above.

Part E

About the kind of accident

Please tick the one box that best describes what happened, then go to Part G.

- ☐ Contact with moving machinery or material being machined
- ☐ Hit by a moving, flying or falling object
- ☐ Hit by a moving vehicle
- ☐ Hit something fixed or stationary

- ☐ Injured while handling, lifting or carrying
- ☐ Slipped, tripped or fell on the same level
- ☐ Fell from a height

How high was the fall?

metres

- ☐ Trapped by something collapsing

- ☐ Drowned or asphyxiated
- ☐ Exposed to, or in contact with, a harmful substance
- ☐ Exposed to fire
- ☐ Exposed to an explosion

- ☐ Contact with electricity or an electrical discharge
- ☐ Injured by an animal
- ☐ Physically assaulted by a person

- ☐ Another kind of accident (describe it in Part G)

Part F

Dangerous occurrences

Enter the number of the dangerous occurrence you are reporting. (The numbers are given in the Regulations and in the notes which accompany this form)

Part G

Describing what happened

Give as much detail as you can. For instance

- the name of any substance involved
- the name and type of any machine involved
- the events that led to the incident
- the part played by any people.

If it was a personal injury, give details of what the person was doing. Describe any action that has since been taken to prevent a similar incident. Use a separate piece of paper if you need to.

Part H

Your signature

Signature

Date

If returning by post/fax, please ensure this form is signed, alternatively, if returning by E-Mail, please type your name in the signature box

Where to send the form

Incident Contact Centre, Caerphilly Business Centre, Caerphilly Business Park, Caerphilly, CF83 3GG.
or email to riddor@natbrit.com or fax to 0845 300 99 24

Continue

For official use

Client number | Location number | Event number | ☐ INV REP ☐ Y ☐ N

ALL INCIDENTS MUST BE REPORTED TO THE LOCAL OFFICE WHERE THE ACCIDENT OCCURRED; OR TO THE NATIONAL INCIDENT CONTACT CENTRE

Health and Safety Executive Head Quarters

London HQ and Construction Division

Rose Court
2 Southwark Bridge
LONDON
SE1 9HS

Liverpool

Redgrave Court
Merton Road
Bootle
Merseyside, L20 7HS

Contact details and addresses for regional HSE offices can be found at:

http://www.hse.gov.uk/contact/maps/index.htm

RIDDOR Reports can be made using the F2508 on the previous page

or

via the RIDDOR Web site at:

http://www.riddor.gov.uk/eaview

or

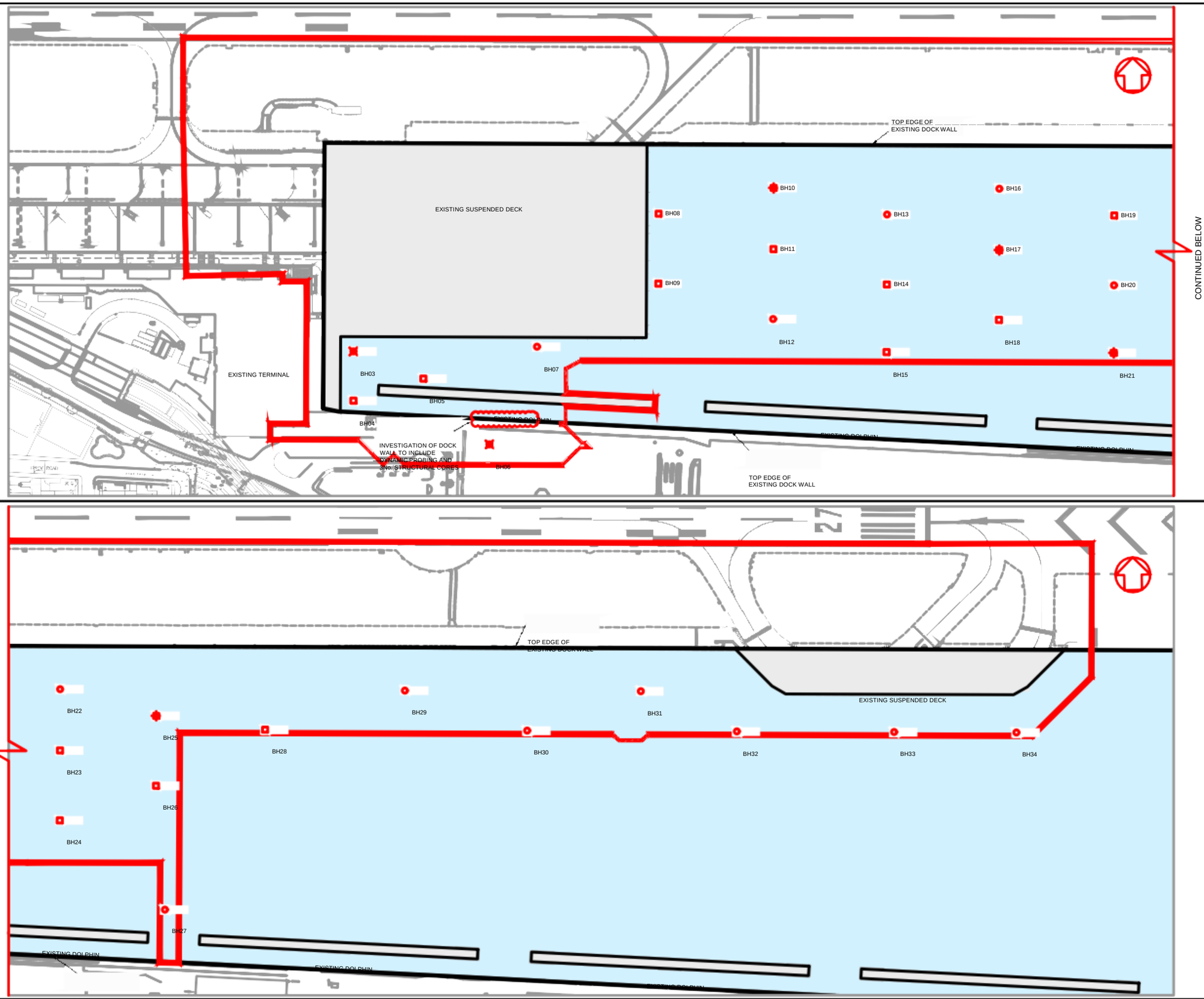
By calling 0845 300 99 23

or

riddor@natbrit.com

Incident Contact Centre
Caerphilly Business Park
Caerphilly, CF83 3 GG.

APPENDIX B - DRAWINGS



DO NOT SCALE FROM THIS DRAWING

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. ALL LEVELS IN METRES ABOVE ORDNANCE DATUM (OD).
3. BOREHOLES AT THE NORTH OF THE SITE MAY BE MOVED LOCALLY TO ACCOMMODATE SITE RESTRAINTS.

KEY

- PROPOSED DEVELOPMENT BOUNDARY LINE
- EXISTING SUSPENDED DECK
- BH04 — CABLE PERCUSSIVE
- BH10 — BOREHOLE
- BH01 — CABLE PERCUSSIVE BOREHOLE WITH PRESSURE METER
- BH03 — ROTARY BOREHOLE
- ROTARY BOREHOLE WITH PRESSURE METER

P4	M HALL	10/10/2016	D FREELAND	10/10/2016
FOR ISSUE				
P3	M BROCK	10/06/2016	J WINDLE	10/06/2016
FOR ISSUE				
P2	M HALL	15/03/2016	J WINDLE	15/03/2016
FOR ISSUE				
P1	M HALL		J WINDLE	
PRELIMINARY ISSUE				

London City Airport
Get closer.

Project
CITY AIRPORT
DEVELOPMENT PROGRAMME

Drawing Title
GROUND INVESTIGATION
PRIMARY LOCATION PLAN
SHEET 1 OF 4

Originating Office
TPS
TPS Croydon - Interchange
81-85 Station Road
Croydon
CR0 2RD
United Kingdom
Tel: +44 (0)1883 622351
www.tpsconsult.co.uk
info@tpsconsult.co.uk
Birmingham : Croydon : Edinburgh : Sheffield : Wolverhampton

TPS Job Manager	W.HELLYER	
QA System - Checks	Signature	Date
Drawn By:	M HALL	29/01/2016
Checked:	J WINDLE	29/01/2016
Authorised:	W.HELLYER	29/01/2016

TPS Project No.	Drawing Status	Scale (at A1)	(at A3)
112931	FOR INFORMATION	1:1000	1:2000

Project No. A400 Org. TPS Doc. C-O Zone LDO Level SI Type GA Sub Type 91 Series 010 Sht. No. Rev. P4

A4 PLOT SCALE
ACAD A4

City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

Appendix 4 – Site Supervisor Emergency Procedure

SUPERVISORS EMERGENCY PROCEDURE ON THE DISCOVERY OF AN ITEM SUSPECTED OF BEING EXPLOSIVE ORDNANCE (EO)
(EO ENGINEER NOT IN ATTENDANCE)

When an item that is suspected of being EO (Explosive Ordnance) is discovered on site the supervisor is to:

1 CHECK ITEM

1.1 This is carried out visually. The Supervisor is to make sure they are safe, if the item is venting smoke etc, do not approach.

2 If confirmed as an EO item phone the emergency services (999).

3 If unsure then:

3.1 TAKE DIGITAL PHOTOGRAPH

3.2 When taking a photograph ensure a size comparison is put as close to the item as possible e.g. a ruler/ telephone/pencil.

3.3 Do not disturb the item

3.4 INFORM EOD CONTRACTS LTD

3.5 During working hours 0800hrs to 1700hrs.

3.5.1 Send picture with any other information about the item. The email address is info@eodcontractsltd.com

3.5.2 Phone EOD on 01926 485 708 to inform them that an item has been found and talk to the standby EOD Engineer.

EOD CONTRACTS Ltd WILL:

1 On receipt of the picture make an assessment as to the status of the item.

STATUS 1: Not an item of EO, no further action will be carried out

STATUS 2: Definitely an item of EO

STATUS 3: The item can not be identified as EO or not.

2 The standby EOD Engineer will then advise on any initial safety distances and then depart for your Site Offices.

City Airport Development Programme (CADP1)

Condition 81: Unexploded Ordnance

Appendix 5 – UXO Safety Procedure

UXO SUSPECT ITEM SAFETY PROCEDURE

CAUTION

IF YOU FIND A SUSPICIOUS POTENTIAL UXO ITEM :

- **ASSUME THE ITEM IS DANGEROUS.**
- **DO NOT TOUCH OR INTERFERE WITH IT.**
- **MARK LOCATION OF THE SUSPECT ITEM AND WARN OTHERS OF ITS PRESENCE.**
- **STOP WORKS AND VIBRATION SOURCES -*SWITCH OFF ENGINE - LEAVE KEYS IN IGNITION*.**
- **NOTIFY SITE MANAGER.**
- **EVACUATE IMMEDIATELY TO DESIGNATED MUSTER POINT.**
  - ***EVACUATE UPWIND SHOULD ANY SUBSTANCE DISCHARGE / EMINATE FROM THE ITEM*.**
- **ENSURE YOU KNOW THE LOCATION OF FIRST AID FACILITIES.**

NO SUSPECT ITEM SHOULD BE REMOVED FROM SITE.