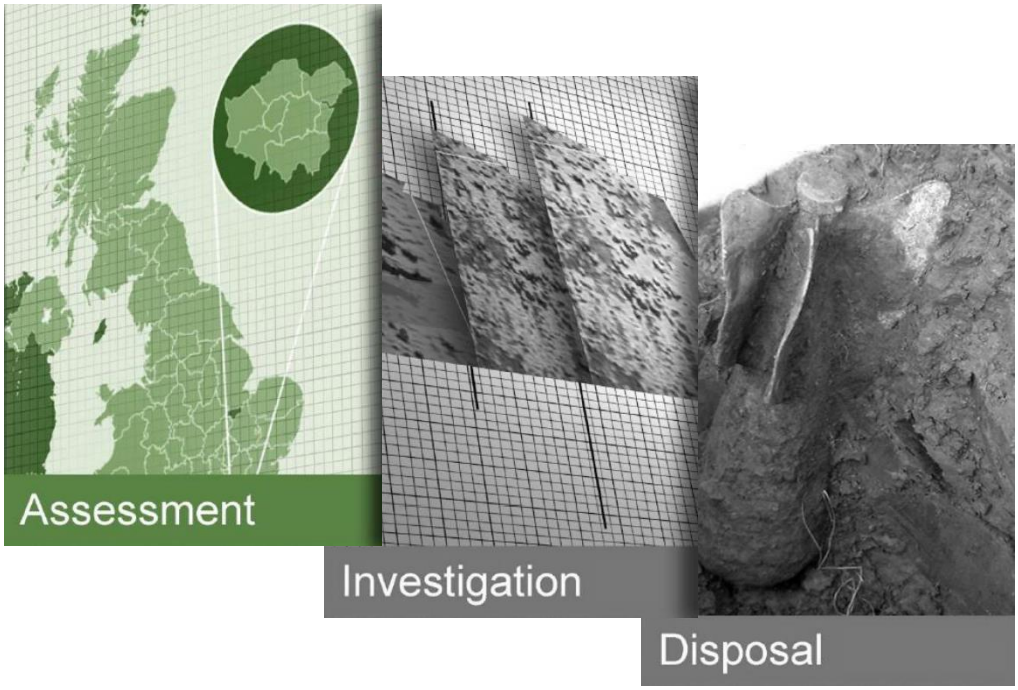
zeticaUXO



Sandy Bay, Porthcawl - UXO Desk Study & Risk Assessment

Drafted by Maciej Wencel
Checked by Lucy Warwick
Authorised by Stefan Lang

Document Title	**UXO Desk Study & Risk Assessment**
Document Ref.	**P8784-19-R1**
Revision	**A**
Project Location	**Sandy Bay, Porthcawl**
Client	**Arup**
Date	**14th August 2019**

UXO DESK STUDY & RISK ASSESSMENT

EXECUTIVE SUMMARY

Key findings: Potential hazard from close combat munitions, artillery shells and Small Arms Ammunition (SAA) on the eastern part of the Site.

Key actions: Non-intrusive Unexploded Ordnance (UXO) detection survey on the eastern part of the Site to identify and remove shallow-buried UXO.

UXO Hazard Assessment

The eastern part of the Site is encompassed by Newton Burrows, which is recorded as having been used for military training between the early 20th century and the end of World War Two (WWII). This including infantry and field artillery practice.

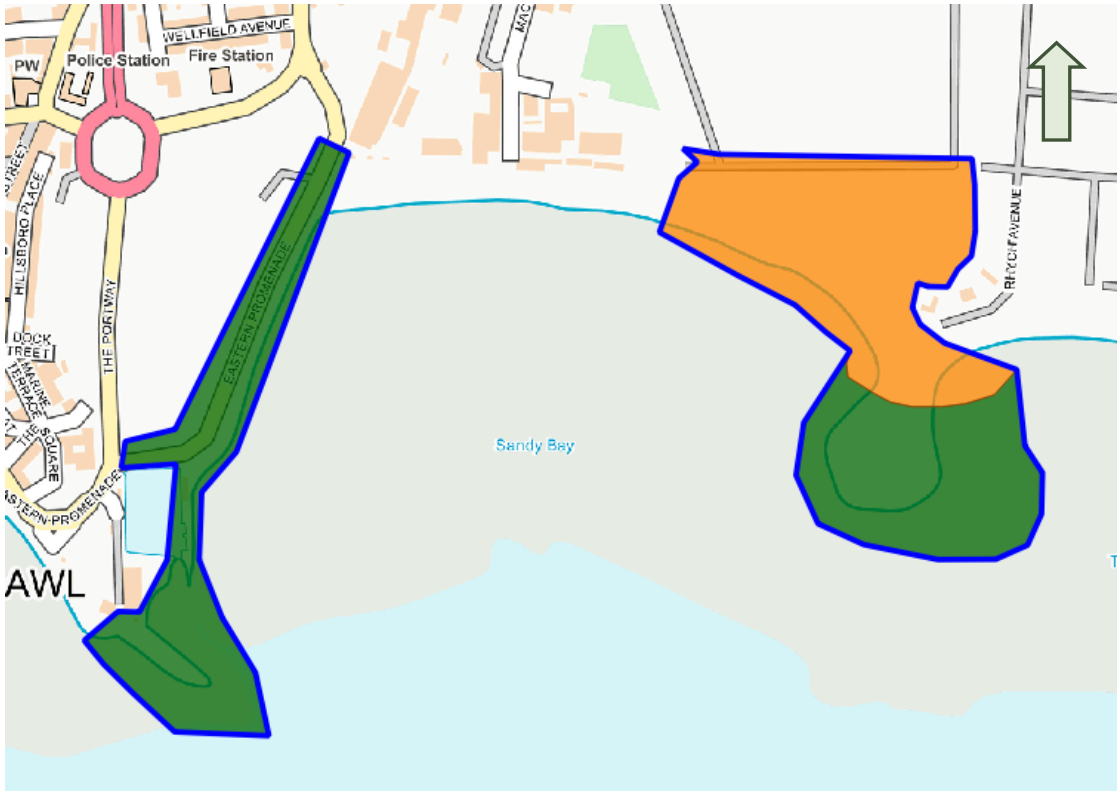
It is considered prudent to assign this part of the Site a moderate UXO hazard level due to the potential presence of shallow-buried close combat munitions, artillery shells and SAA.

No significant military activity or bombing has been identified on the remainder of the Site, which is assigned a low UXO hazard level.

It is considered that the UXO hazard level on the Site can be zoned from low to moderate, as shown in the following Figure, reproduced as Figure 6 in the main report.

This figure is also given in the accompanying Zetica P8784-19-MAP01-A Sandy Bay Porthcawl (UXO Hazard Zone Plan).

Figure	UXO hazard zone plan of the Site



Source: Zetica *Not to Scale*

Legend					
	Very Low		Low	Moderate	
	High		Very High	Site boundary	

The main findings of the report are summarised below.

- Records have been found indicating that extensive military training using live munitions took place on Newton Burrows, encompassing the eastern part of the Site, before and during World War One (WWI). Newton Burrows continued to be used for military training during the inter-war period and WWII.
- During WWII the only strategic target in the vicinity of the Site was Royal Air Force (RAF) Stormy Down.
- No records have been found indicating that bombs fell on or in close proximity to the Site during WWII.
- No records of any significant post-WWII military activity on the Site have been found.

Data Confidence Level

The findings of this report were based on good corroborative evidence of the military activity and bombing on the Site.

Proposed Works

It is understood that works on the Site will comprise excavations up to 2.0m in depth, in addition sinking Cintec anchors to approximately 5.0m, associated with a coastal defence maintenance scheme.

Risk Assessment

The Table below, reproduced as Table 4 in the main report, provides a UXO risk assessment for the proposed works on the Site.

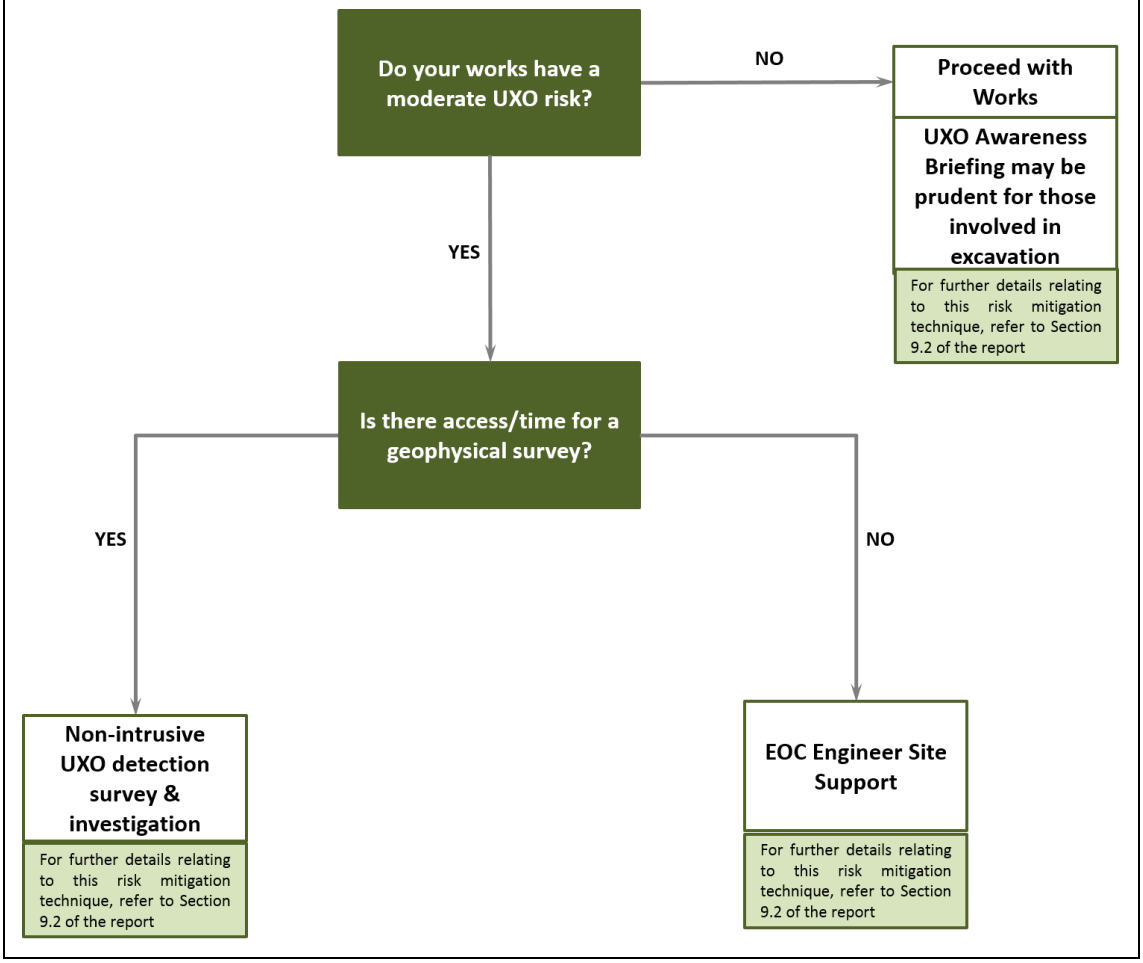
Further details on the methodology for the risk assessment are provided in Section 8.2 of the main report.

Table	UXO risk assessment for the Site								
Hazard Zone	**Potential UXO Hazard**	**Anticipated Works**	**PE**	**PD**	**P = PE x PD**	**Likelihood**	**Severity**	**Risk Rating**	**UXO Risk**
Moderate	UXB	Shallow Excavations	1	1	1	1	5	5	**Low**
		Deep Excavations	1	1	1	1	5	5	**Low**
		Anchors	1	1	1	1	4	4	**Low**
	SAA	Shallow Excavations	3	1	3	2	2	4	**Low**
		Deep Excavations	3	1	3	2	2	4	**Low**
		Anchors	2	1	2	2	2	4	**Low**
	Close Combat Munitions	Shallow Excavations	3	2	6	3	4	12	**Moderate**
		Deep Excavations	3	2	6	3	4	12	**Moderate**
		Anchors	2	3	6	3	3	12	**Moderate**
	Artillery Shells	Shallow Excavations	3	2	6	3	4	12	**Moderate**
		Deep Excavations	3	2	6	3	4	12	**Moderate**
		Anchors	2	3	6	3	3	12	**Moderate**
Low	UXB	Shallow Excavations	1	1	1	1	5	5	**Low**
		Deep Excavations	1	1	1	1	5	5	**Low**
		Anchors	1	1	1	1	4	4	**Low**
	SAA	Shallow Excavations	1	1	1	1	2	2	**Low**
		Deep Excavations	1	1	1	1	2	2	**Low**
		Anchors	1	1	1	1	2	2	**Low**
	Close Combat	Shallow Excavations	1	1	1	1	4	4	**Low**
		Deep Excavations	1	1	1	1	4	4	**Low**
		Anchors	1	1	1	1	3	3	**Low**
	Artillery Shells	Shallow Excavations	1	1	1	1	4	4	**Low**
		Deep Excavations	1	1	1	1	4	4	**Low**
		Anchors	1	1	1	1	3	3	**Low**
PE (Probability of Encounter), PD (Probability of Detonation), P (Overall Probability)									
Shallow Excavations defined as <1.0m bgl.									

Risk Mitigation Plan

The Figure below, reproduced as Figure 7 in the main report, provides a risk mitigation plan to ensure that the UXO risk for the proposed works is reduced to As Low As Reasonably Practicable (ALARP).

Figure	Recommended risk mitigation plan for the Site



Further details on the recommended risk mitigation techniques are given in Section 9.2 of this report.

The Table below, reproduced as Table 5 in the main report, summarises the UXO risk for proposed works on the Site and recommended techniques to mitigate the risk.

Table	Summary of UXO risk and mitigation recommendations

Proposed Works	UXO Risk	Recommended Mitigation
Excavations		**Proceed with works** – if additional comfort is required to address the residual UXO hazard, a formal UXO awareness briefing can be provided.
Anchors		**Proceed with works**
Excavations		**Non-intrusive survey** – a non-intrusive UXO detection survey should be undertaken in advance of excavations to detect shallow-buried UXO. Potential UXO targets detected can either be avoided or intrusively investigated and removed.
Anchors		**Non-intrusive survey** – a non-intrusive UXO detection survey (as above) is recommended in advance of anchor installation.

In summary, it is recommended that a non-intrusive UXO detection survey (if practical) is undertaken in advance of works with a moderate UXO risk.

What Do I Do Next?

If you wish to proceed with UXO risk mitigation, Zetica would be happy to assist. Just contact us via phone (01993 886682) or email (uxo@zetica.com) and we can provide a proposal with options and prices.

If you have other requirements (such as utility services mapping or identifying buried structures) we can also provide these surveys, often saving costs if combined with a UXO survey.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

CONTENTS

Figures, Plates, Tables & Maps

Accompanying map

P8784-19-MAP01-A Sandy Bay Porthcawl (UXO Hazard Zone Plan)

ABBREVIATIONS

AA	Anti-Aircraft
ACPO	Association of Chief Police Officers
AGS	Air Gunnery School
ALARP	As Low As Reasonably Practicable
ARP	Air Raid Precaution
ASR	Air-Sea Rescue
ATS	Armament Training Station
AXO	Abandoned Explosive Ordnance
BD	Bomb Disposal
BDO	Bomb Disposal Officer
BDU	Bomb Disposal Unit
CMD	Conventional Munitions Disposal
DCLG	Department of Communities and Local Government
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOR	Explosive Ordnance Reconnaissance
ERW	Explosive Remnants of War
ESA	Explosive Substances and Articles
FFE	Free From Explosives
HAA	Heavy Anti-Aircraft
HE	High Explosive
HSE	Health and Safety Executive
JSEODOC	Joint Services EOD Operations Centre
IB	Incendiary Bomb
IED	Improvised Explosive Device
IEDD	Improvised Explosive Device Disposal
LAA	Light Anti-Aircraft
MoD	Ministry of Defence
PUCA	Pick Up and Carry Away
RAF	Royal Air Force
RE	Royal Engineers
SAA	Small Arms Ammunition
TEP	Time Expired Pyrotechnics
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
WWI	World War One
WWII	World War Two

UXO DESK STUDY & RISK ASSESSMENT

Please read: Zetica has colour coded each paragraph. Paragraphs with black text on a white background are paragraphs that provide site-specific information or information specifically researched as part of this project.

Boxed paragraphs in a dark green text with a green background are paragraphs providing general information and, where appropriate, links to online resources giving further detail. These are all available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

1 INTRODUCTION

1.1 Project Outline

Zetica Ltd was commissioned by Arup to carry out a detailed Unexploded Ordnance (UXO) Desk Study and Risk Assessment for 2No. areas totalling approximately 16 hectares (ha) at Sandy Bay, Porthcawl, Bridgend ('the Site').

The aim of this report is to gain a fair and representative view of the UXO hazard for the Site and its immediate surrounding area in accordance with the Construction Industry Research and Information Association (CIRIA) C681 'Unexploded Ordnance (UXO), a Guide for the Construction Industry' and C754 'Assessment and Management of Unexploded Ordnance (UXO) Risk in the Marine Environment'.

Where appropriate, this hazard assessment includes:

- Likelihood of ordnance being present.
- Type of ordnance (size, filling, fuze mechanisms).
- Quantity of ordnance.
- Potential for live ordnance.
- Probable location.
- Ordnance condition.

It should be noted that some military activity providing a source of UXO hazard may not be recorded and therefore there cannot be any guarantee that all UXO hazards affecting the Site have been identified in this report.

1.2 Sources of Information

Zetica Ltd researched the military history of the Site and its surrounding area using a range of information sources. The main sources of information are detailed in the following sections and referenced at the end of this report.

1.2.1 Zetica Ltd Defence Related Site Records

Zetica Ltd's in-house records were consulted, including reference books and archived materials from past work in the region. Relevant documents have been cited within the bibliography of this report.

1.2.2 Zetica Ltd Bombing Density Records and Maps

Reference has been made to the Zetica Ltd bomb risk maps located on Zetica's website (http://zeticauxo.com/downloads-and-resources/risk-maps/)

1.2.3 Ministry of Defence and Government Records

Government departments and units within the Ministry of Defence (MoD) were approached for information of past and present military activity in the area. These included the Department of Communities and Local Government (DCLG) records of abandoned bombs.

1.2.4 Other Historical Records, Maps and Drawings

Numerous reference documents including historical maps, aerial photographs and drawings have been consulted from sources such as the National Archives, the US National Archives & Records Administration (NARA), the Imperial War Museum (IWM), the Welsh Government and the Defence of Britain Project.

The British Geological Survey (BGS) was consulted for borehole information.

1.2.5 Local Authority Records

Information has been obtained from Bridgend County Borough Council.

1.2.6 Local Record Offices and Libraries

The Glamorgan Archives were consulted for information.

1.2.7 Local Historical and Other Groups

Local history groups and archaeological societies were consulted.

1.3 Data Confidence Level

In general, there is a high level of confidence in the researched information sources used for this report. Exceptions to this are specifically detailed in the text of the report.

2 THE SITE

2.1 Site Location

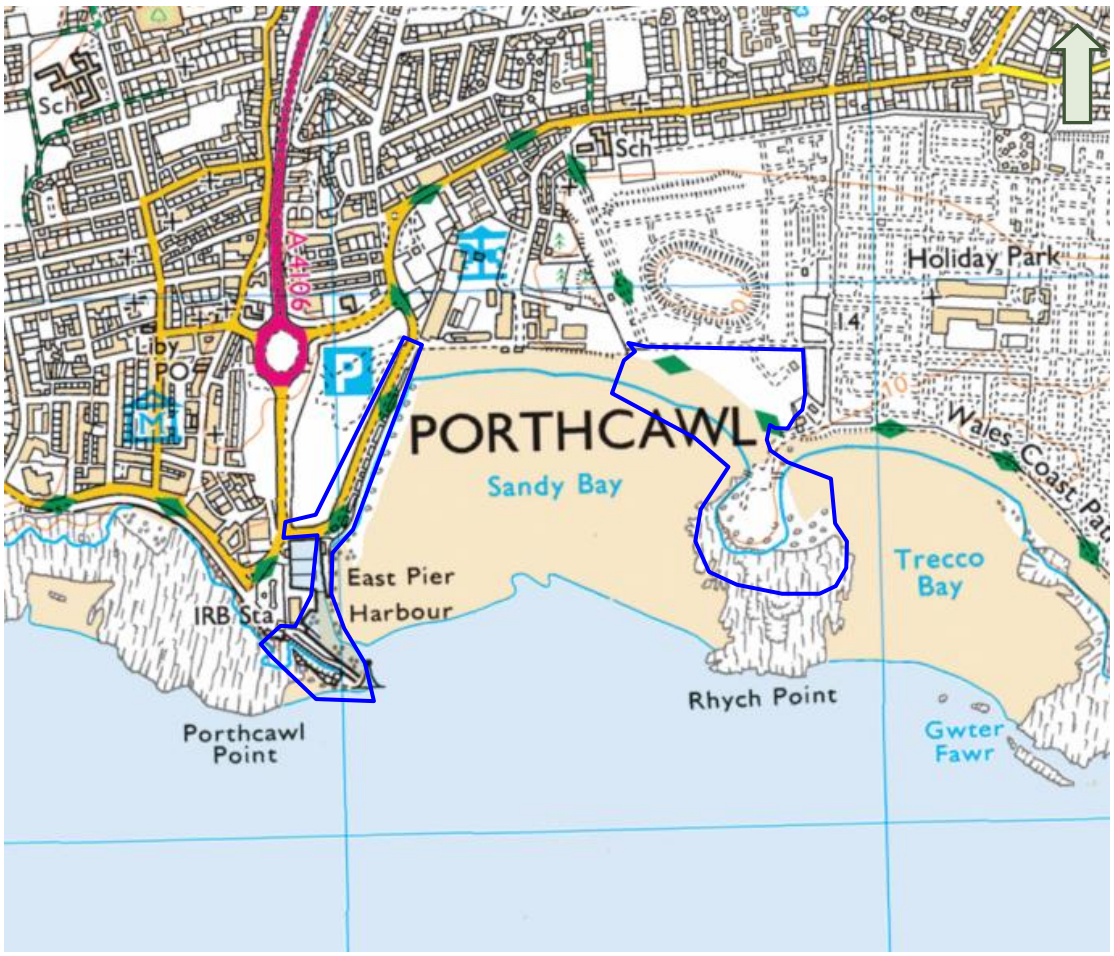
The Site is centred on Ordnance Survey National Grid Reference (OSNGR) SS 823769. It is located in Porthcawl, approximately 8.2km southwest of Bridgend town centre.

The Site comprises beaches, cliffs, shoreline defences, and hardstanding.

The Site is bounded to the south by Sandy Bay beach, to the west by open ground, to the north by open ground and Eastern Promenade, and to the east by Trecco Bay Holiday Camp.

Figure 1 is a Site location map and Plate 1 is a recent aerial photograph of the Site.

Figure 1	Site location map



Source: © Crown Copyright 2019. Reproduced by permission of Ordnance Survey *Not to Scale*

Legend	Site boundary

Plate 1	Recent aerial photograph of the Site

Source: Google Earth *Not to Scale*

Legend	Site boundary

3 MILITARY ACTIVITY

The following sections outline the recorded military activity in the vicinity of the Site. The potential UXO hazard from WWI and WWII bombing is detailed in Section 4.

Each sub-section provides hyperlinks to further information on potential sources of UXO hazard. These are also available at www.zeticauxo.com. If you cannot gain access to these resources, Zetica can forward them on request.

3.1 Defences

For further information on military defences, and the potential UXO hazards associated with them, follow the links below:

- Anti-Aircraft Guns
- Anti-Invasion Defences
- Barrage Balloons
- Bombing Decoys
- Home Guard
- Mortar & Gun Emplacements
- Pillboxes
- Pipe Mines

No military defences have been identified on the Site.

3.1.1 Anti-Aircraft Guns

Records indicate that there were no Anti-Aircraft (AA) gun batteries within 10km of the Site during WWI and 1No. Heavy AA (HAA) battery within 10km of the Site during WWII.

This was located at Morfa Mawr (SS 779843), approximately 8.4km northwest of the Site.

AA gun batteries are not considered to provide a source of UXO hazard to the Site.

3.1.2 Pipe Mines

Records have been found indicating that the beaches between Porthcawl and Ogmore-by-Sea were equipped with anti-tank defences, including pipe mines and steel traps.

In 1942 the 179th (Tunnelling) Company Royal Engineers (RE) was recorded installing 2No. pipe mine lines comprising 40No. obstacles each.

1No. was located in Trecco Bay, adjacent to the eastern boundary of the Site, the other on the beach west of Black Rock, approximately 0.8km east of the Site (see Figure 2).

No evidence has been identified to indicate that pipe mines encroached upon the Site and such defences were typically removed at the end of WWII.

Pipe mines are not considered to provide a source of UXO hazard to the Site.

3.1.3 Home Guard

During WWII No. 1 Platoon "A" Company, 24th Glamorgan (Kenfig) Battalion Home Guard was active in and around Porthcawl. For a brief period, the Home Guard headquarters was located at Coney Beach, adjacent to the northern boundary of the Site.

The main responsibility of the Home Guard was to patrol the coastline between Kenfig and Ogmore-by-Sea, encompassing the Site.

Potential UXO Hazard

There is no positive evidence to indicate that the Home Guard undertook any military training or stored munitions on the Site.

Given the irregular nature of their activity, the possibility of items of UXO being discovered at any locations patrolled by the Home Guard can never be totally discounted.

3.2 Military Airfields

For further information on military airfields, and the potential UXO hazards associated with them, follow the links below:

- Military Airfields

No records of any military airfields on or in close proximity to the Site have been found.

During WWII the nearest military airfield was Royal Air Force (RAF) Stormy Down (also known as RAF Porthcawl, RAF Newton Down, and RAF Pyle), located approximately 2.7km north-northeast of the Site (see Plate 2).

The airfield opened in 1939 and functioned as a training base throughout WWII. Units stationed at RAF Stormy Down included No. 9 Armament Training Station (ATS) and No. 7 Air Gunnery School (AGS).

The squadrons based at RAF Stormy Down made extensive use of offshore and gunnery ranges near Porthcawl (see Figure 2) and trained British, Canadian, New Zealand, South African, Czech, and Polish airmen.

Troops stationed at RAF Stormy Down were accommodated in temporary camps and billets across Porthcawl and the neighbouring villages.

Records have been found indicating that huts on Coney Beach, adjacent to the northern boundary of the Site, were requisitioned for billeting.

In 1944 RAF Stormy Down ceased operations and the airfield closed in 1945. After a brief period as a gliding school, the land was sold in 1947.

Military airfields are not considered to provide a source of UXO hazard to the Site.

3.3 Aircraft Crashes

For further information on military aircraft crashes, and the potential UXO hazards associated with them, follow the links below:

- Aircraft Crashes

No records of any aircraft crashes on or in close proximity to the Site have been found. The nearest crashes are described below.

11th February 1940

1No. Hawker Henley tug aircraft (Serial No. L3339) crashed at Rest Bay, approximately 2km northwest of the Site.

8th February 1942

1No. Boulton Paul Defiant I fighter aircraft (Serial No. N1761) crashed in fields south of RAF Stormy Down, approximately 2km north-northeast of the Site.

8th May 1944

2No. Avro Anson multipurpose aircraft (Serial Nos. LV300 and MG131) collided off Porthcawl Point, within approximately 1km south of the Site.

Aircraft crashes are not considered to provide a source of UXO hazard to the Site.

3.4 Explosives Factories, Munitions Depots and Disposal Areas

For further information on explosives factories, munitions depots and disposal areas, and the potential UXO hazards associated with them, follow the links below:

- Explosives Factories
- Munitions Depots
- Munitions Disposal Areas

No records of any explosives factories, munitions depots or munitions disposal areas on or in close proximity to the Site have been found.

Anecdotal evidence has been found indicating that unofficial munitions and shell disposal took place in the vicinity of Caeau Llaprau ranges, approximately 1.8km east-northeast of the Site.

This is not considered to provide a source of UXO hazard to the Site.

3.5 Firing Ranges and Military Training Areas

For further information on firing ranges and military training areas, and the potential UXO hazard associated with them, see Appendix 2. Alternatively, use the following links:

- Artillery Ranges
- Bombing Ranges
- Military Training Areas
- Small Arms Ranges

The eastern part of the Site was encompassed by Newton Burrows, a large sandy area with a long history of military use. Further details are provided below.

3.5.1 Newton Burrows

Since the early 20th century, numerous Volunteer and Territorial Army brigades participated in yearly summer training camps at Porthcawl. Temporary camps and billets were established in Porthcawl and the surrounding villages.

The troops would routinely use the dunes of Newton Burrows, encompassing the Site, for a variety of training activities. In 1905 a 600-yard (yd) rifle range was established at Caeau Llaprau, approximately 1.9km east-northeast of the Site.

In 1914 a permanent army camp for the Welsh Army Corps was established at West Farm, Nottage, approximately 1.1km north-northwest of the Site, including an additional rifle range.

During WWI new training facilities were constructed on Newton Burrows, including a network of practice trenches and a designated training area, located within approximately 1.3km east-northeast of the Site.

During the inter-war period, Caeau Llaprau range continued to be used for rifle practice.

During WWII, temporary camps were established at Dan-y-Graig and Wigfach, approximately 1.3km northeast and 2.2km east of the Site respectively. These camps housed several different army units, including the 15th Battalion Welch Regiment, the 5th Battalion West Yorkshire Regiment, as well as French, Belgian, and Dutch troops.

Troops stationed at the camps used Newton Burrows for military practice, including beach landing and desert warfare training.

An additional rifle range was established at Caeau Llaprau, approximately 1.9km east of the Site. Anecdotal accounts indicate that the range was used for rifle and machine gun training, as well as testing early applications of radar technology to AA gunnery.

After 1943 a number of American divisions were stationed at Porthcawl in preparation for Operation Overlord.

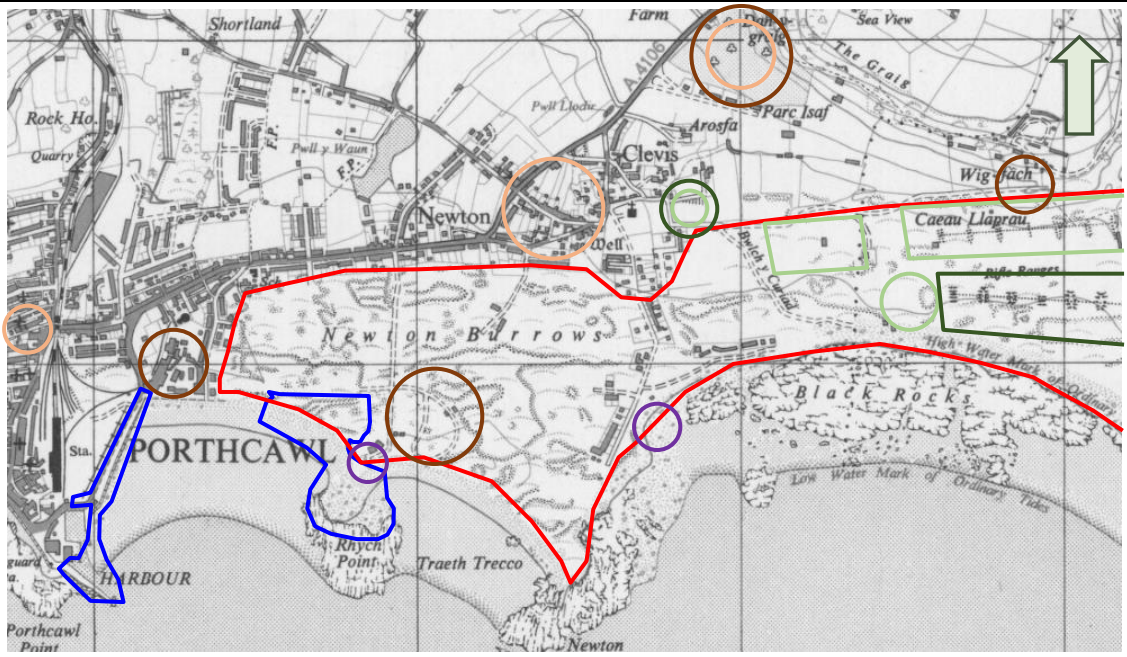
Between 1943 and 1944 the 107th Field Artillery Battalion (US 28th Infantry Division) was billeted at Mary Street, approximately 0.3km west of the Site.

Records have been found indicating that the battalion conducted artillery practice on Newton Burrows, exact locations unspecified, potentially in the vicinity of the Site. The Burrows were also used for military training by the 290th Regiment (US 7th Infantry Division).

A military camp for the 342nd US Engineers Regiment was established at Plovers Plain, within approximately 0.1km east of the eastern boundary of the Site.

Figure 2 is map showing the approximate locations of military accommodation, training areas, and recorded anti-invasion defences in the vicinity of the Site.

Figure 2	Map of Newton Burrows showing the approximate locations of military training



Source: © Crown Copyright 2019. Reproduced by permission of Ordnance Survey *Not to Scale*

Legend		
	Site boundary	Newton Burrows
	WWI ranges and training areas	WWII ranges and training areas
	WWI camps and billets	WWII camps and billets
	Pipe mines	

Potential UXO Hazard

The eastern part of the Site was encompassed by Newton Burrows, an area of dunes used for military training since the early 20th century.

This included live and practice firing involving Small Arms Ammunition (SAA), close combat munitions (such as grenades and mortars), in addition to artillery shells.

Records of training were poorly recorded and it is considered possible that some training, especially beach-landing exercises and artillery practice, may have occurred on the Site.

Given this, it is considered that there is an elevated probability of encountering SAA, close combat munitions and artillery shells at shallow depths on the eastern part of the Site.

3.6 Other Military Establishments

No other military establishments have been identified on the Site. The nearest is described below.

3.6.1 Porthcawl Harbour

During WWI captured German submarines were transported to Porthcawl Harbour for disassembly.

Between 1941 and 1946, No. 46 Air-Sea Rescue (ASR) Marine Craft Unit used Porthcawl Harbour as its base. The unit comprised 37No. marine vessels and 2No. flying boats.

Jennings Warehouse, adjacent to the western boundary of the Site, was used for accommodation and storage by No. 46 ASR. The warehouse was also briefly used as accommodation for No. 7 AGS personnel.

Porthcawl Harbour is not considered to provide a source of UXO hazard to the Site.

4 BOMBING

4.1 WWI Bombing

For further information on WWI bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.7. Alternatively, use the following link.

- WWI Bombing

No records have been found indicating that the Site was bombed during WWI.

4.2 WWII Bombing

For further information on WWII bombing in the UK, and the potential UXO hazard associated with it, see Appendix 2.8. Alternatively, use the following link.

- WWII Bombing

4.2.1 Bombing in Wales and Bridgend

From 1939 South Wales was subjected to reconnaissance flights by the Luftwaffe which was building up a photographic record of potential targets.

The most significant strategic targets in South Wales were concentrated on the coast, and included Cardiff, Swansea and Pembroke Dock, all over 20km from the Site. These cities received multiple air raids between 1940 and 1943.

The rural areas around Bridgend recorded no Luftwaffe raids except one attack against RAF Stormy Down.

4.2.2 Strategic Targets

The Site was located in a rural area with few strategic targets in the area. The main target in the vicinity was RAF Stormy Down, identified by the Luftwaffe as Pyle (Target No. GB 10 292).

Plate 2 is a Luftwaffe target photograph of RAF Stormy Down, dated the 3rd May 1941.

Plate 2	Luftwaffe target photograph of RAF Stormy Down, 3rd May 1941

Source: NARA *Not to Scale*

4.2.3 Bombing Densities and Incidents

Table 1 gives details of the overall bombing statistics recorded for the Local Authority Districts of the Site and surrounding districts. These were categorised as Rural Districts (RD), Urban Districts (UD), Municipal or Metropolitan Boroughs (MB) and County Boroughs (CB). WWII bomb density levels are defined below:

<5 bombs per 405ha is a Very Low regional bombing density.

5-15 bombs per 405ha is Low.

15-50 bombs per 405ha is Moderate.

50-250 bombs per 405ha is High.

>250 bombs per 405ha is Very High.

Table 1	Bombing statistics				
Area	Bombs Recorded				
	High Explosive	Parachute Mines	Other	Total	Bombs per 405ha (1000 acres)
Porthcawl UD	**0**	**0**	**0**	**0**	**0.0**
Penybont RD	128	4	0	132	3.2

Note that Table 1 excludes the figures for Incendiary Bombs (IBs), as well as bombs that fell on airfields and other military establishments. Discrepancies between this list and other records, such as bomb clearance records, demonstrate that this data is likely to under-represent actual bombing.

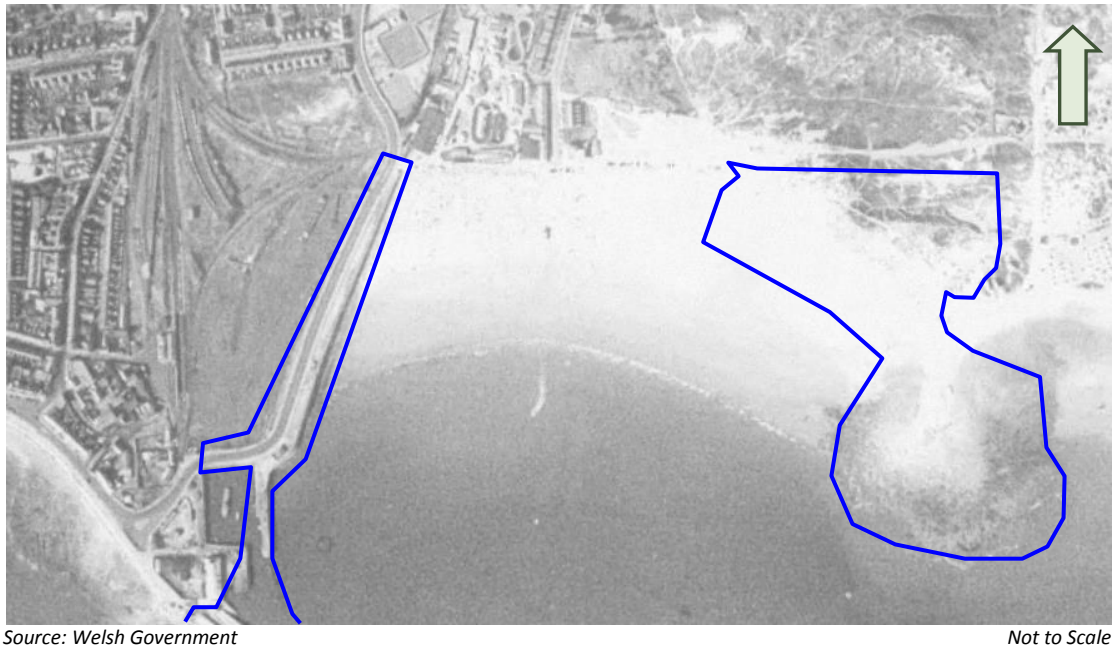
Details of the nearest recorded bombing incident to the Site are given in the following section.

21st August 1940

4No. HE bombs fell on the instructional section of RAF Stormy Down, approximately 3.1km northeast of the Site.

Plate 3 is an aerial photograph dated the 1947. No bomb damage has been identified on or in the vicinity of the Site.

Plate 3 Aerial photograph, 1947



Source: Welsh Government *Not to Scale*

Legend Site boundary

Potential UXO Hazard

No records have been found indicating that the Site was bombed and no bomb damage or cratering has been identified on the Site on historical aerial photography.

WWII bombing is not considered to provide a source of UXO hazard to the Site.

4.2.4 Geology and Bomb Penetration Depths

It is important to consider the geological materials present at the time that a bomb was dropped in order to establish its maximum penetration depth.

Client-provided ground investigation data has been consulted, in addition to British Geological Survey (BGS) 1:50,000 Sheet 251 Bridgend (Solid & Drift) and BGS borehole records from nearby investigations.

Part of the Site comprised harbour walls and sea defences during WWII. The geology in this area is understood to consist of Made Ground, over sandy Beach Deposits, overlying the Oxwich Head Limestone.

Table 2 provides an estimate of average maximum bomb penetration depths for this part of the Site, assuming ground conditions during WWII of 4m of Made Ground, over 4.5m of sand, overlying weak rock.

Table 2	Estimated average maximum bomb penetration depths (harbour walls)	
Estimated average bomb penetration depths for anticipated geology		
Bomb Weight	50kg	2.5m
	250kg	6.0m
	500kg	7.0m

The geology of the remainder of the Site during WWII comprised sandy Beach Deposits and marine clay overlying the Oxwich Head Limestone.

Table 3 provides an estimate of average maximum bomb penetration depths for this part of the Site, assuming ground conditions during WWII of 5m of sand, over 2m of firm to stiff clay, overlying weak rock.

Table 3	Estimated average maximum bomb penetration depths (beach and dunes)	
Estimated average bomb penetration depths for anticipated geology		
Bomb Weight	50kg	2.5m
	250kg	7.5m
	500kg	8.5m

The estimated bomb penetration depths given in Tables 2 and 3 are from the WWII ground level and are based on the following assumptions:

a) High level release of the bomb resulting in an impact velocity of 260m/s (>5,000m altitude).

b) A strike angle of 10 to 15 degrees to the vertical.

c) That the bomb is stable, both in flight and on penetration.

d) That no retarding units are fitted to the bomb.

e) That the soil type is homogenous.

A high altitude release of a bomb will result in ground entry at between 10° and 15° to the vertical with the bomb travelling on this trajectory until momentum is nearly lost. The bomb will then turn abruptly to the horizontal before coming to rest. The distance between the centre of the entry hole and the centre of the bomb at rest is known as the 'offset'. A marked lateral movement from the original line of entry is common.

Low-level attacks may have an impact angle of 45° or more, which will frequently lead to a much greater amount of offset movement during soil penetration.

The average offset is one third of the penetration depth, i.e. an offset of 2m may be expected for a 50kg bomb in dry silts and clays. If hard standings or Made Ground were present during WWII, bomb penetration depths would have been significantly reduced but offset distances may have been up to four times greater.

5 UXO IN THE MARINE ENVIRONMENT

Both wartime and peace time military and naval activities provide numerous sources of UXO within the marine environment. The principal sources of UXO hazards are from ordnance disposal at sea, WWII aerial laid mines, mines laid as beach defences, crashed aircraft and wrecks containing ordnance.

Clearance certification for UXO within a marine environment may be valid only for a limited period as storms, tides and general current movement can cause UXO to migrate into an area that may have been cleared of UXO only hours before. This also makes it very difficult to accurately predict where UXO may be found.

UXO is most likely to be concentrated on and immediately around the principal sources of the UXO hazard. These are typically ordnance disposal sites at sea, WWII mines, marine ranges and wrecks containing ordnance.

5.1 Marine Ranges and Coastal Defences

The Site was located in the vicinity of 2No. RAF offshore ranges. These are described below.

5.1.1 Porthcawl Offshore Ranges

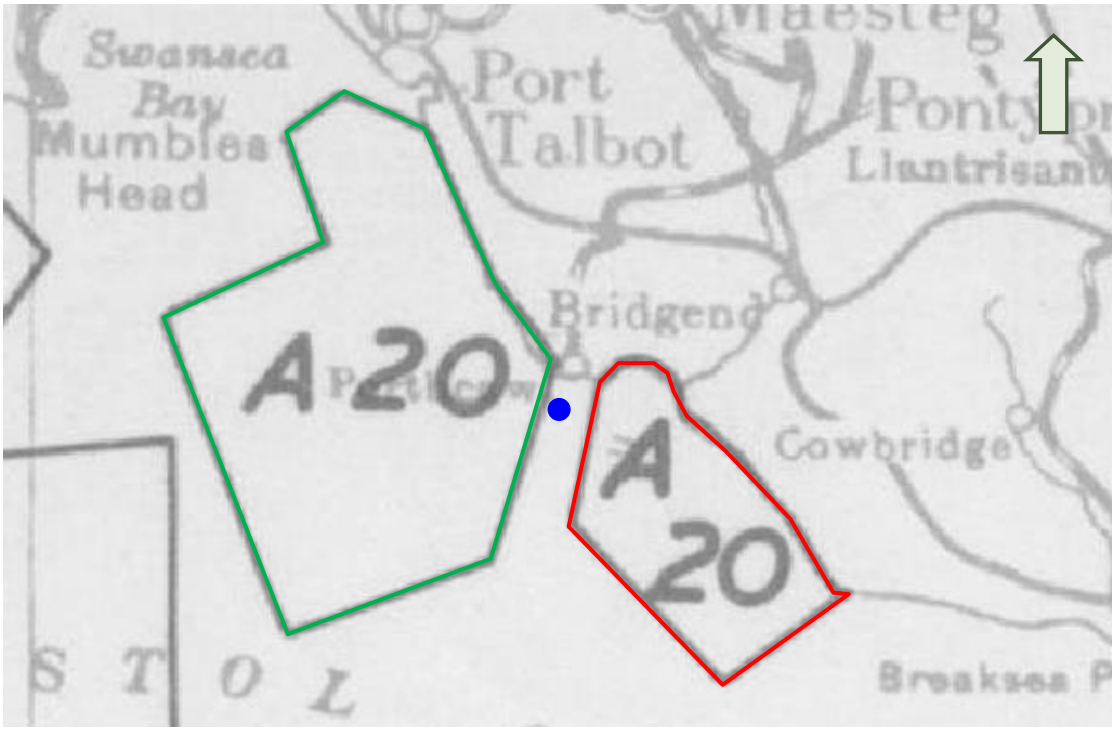
Records have been found indicating that 2No. RAF offshore bombing and gunnery ranges were located near Porthcawl. These ranges were used by the bombing and gunnery training squadrons based at RAF Stormy Down and other Welsh airfields.

Porthcawl West, also known as Margam Sands (Serial No. 1033), was located approximately 2km northwest of the Site. The range was used throughout WWII and training activities continued until at least 1955.

Porthcawl East, near Tusker Rock (Serial No. 1046), was located approximately 2.6km southeast of the Site. The range operated throughout WWII and officially closed in 1946.

Figure 3 is a map showing the location of the RAF practice ranges in the vicinity of the Site.

Figure 3	Map of RAF practice ranges in the vicinity of the Site



Source: National Archives *Not to Scale*

Legend	Site boundary	Porthcawl West	Porthcawl East

Training activities recorded on the ranges included bombing practice, air-sea firing, AA practice, and rocket projectile practice. Most of the targets would be towed by small aircrafts or placed on barges. Some natural features, such as Tusker Rock, were also used as targets.

Records have been found indicating that MoD was planning to continuing using the ranges around Porthcawl for bombing and gunnery practice post-WWII, but these plans were cancelled following the fears of the local authorities over posing danger to the nearby popular tourist locations, including the beaches encompassing the eastern part of the Site.

Potential UXO Hazard

No records have been found to indicate that the Site was located within the danger area of either of the Porthcawl ranges.

Firing was typically away from the coastline and the Site.

The ranges will have contributed UXO to the marine environment in the vicinity of the Site, including practice bombs, shells, SAA and other projectiles. The potential for such ordnance to migrate onto the beach parts of the Site due to tidal action, whilst unlikely, cannot be totally discounted (see Section 5.4).

5.2 Marine Mines

For further information on marine mines in the UK, and the potential UXO hazard associated with it, see Appendix 2.5. Alternatively, use the following link.

- Marine Mines

5.2.1 WWI Minefields

No records of offshore British marine mines laid in the vicinity of the Site during WWI have been found.

During WWI (date unspecified), 1No. marine mine was recorded washing up on Rest Bay, within approximately 2km northwest of the Site.

5.2.2 WWII Minefields

No records of offshore British marine mines laid in the vicinity of the Site during WWII have been found.

Potential UXO Hazard

WWII minefields are not considered to provide a source of UXO hazard to the Site.

The potential for a buoyant marine mine to wash up on the beach part of the Site due to storms and tidal action, whilst unlikely, cannot be totally discounted.

This considered to present a low background risk as with any similar Site in the UK.

5.3 Wrecks Containing UXO

No records of wrecks containing UXO on or in the proximity to the Site have been found.

Wrecks containing UXO are not considered to provide a source of UXO hazard to the Site.

5.4 UXO Migration in the Marine Environment

There are several potential sources of UXO hazard in the marine environment in the vicinity of the Site, including marine ranges, air dropped bombs, AA, and shells.

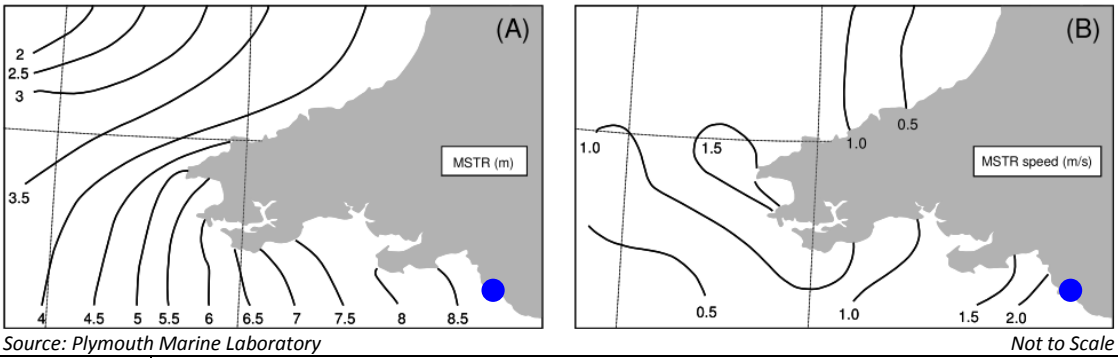
The factors controlling UXO migration in the marine environment surrounding the Site are discussed below.

Tidal Currents

Bristol Channel has one of the greatest tidal ranges in the world, with the mean spring tidal range in the vicinity of Porthcawl reaching 9m. Maximum tidal currents during spring time reach 2 ms^{-1}.

Figure 4 is a chart showing the tidal ranges and current velocities in the Bristol Channel.

Figure 4	Chart showing tidal ranges and streams in the vicinity of the Site



Source: Plymouth Marine Laboratory *Not to Scale*

Legend	Site boundary

Wave Action

Wave data demonstrates that the wave environment in the Bristol Channel is influenced by both Atlantic swell waves and locally-generated wind, with the maximum fetch to the southwest being approximately 6,000km.

No long-term measured wave data is available for the waters in the vicinity of the Site. Records indicate that in the nearby Swansea Bay, waves in excess of 6m are not uncommon during storms.

The combination of wave and tide-generated nearshore and offshore currents effects the overall sediment transport in the vicinity of the Site.

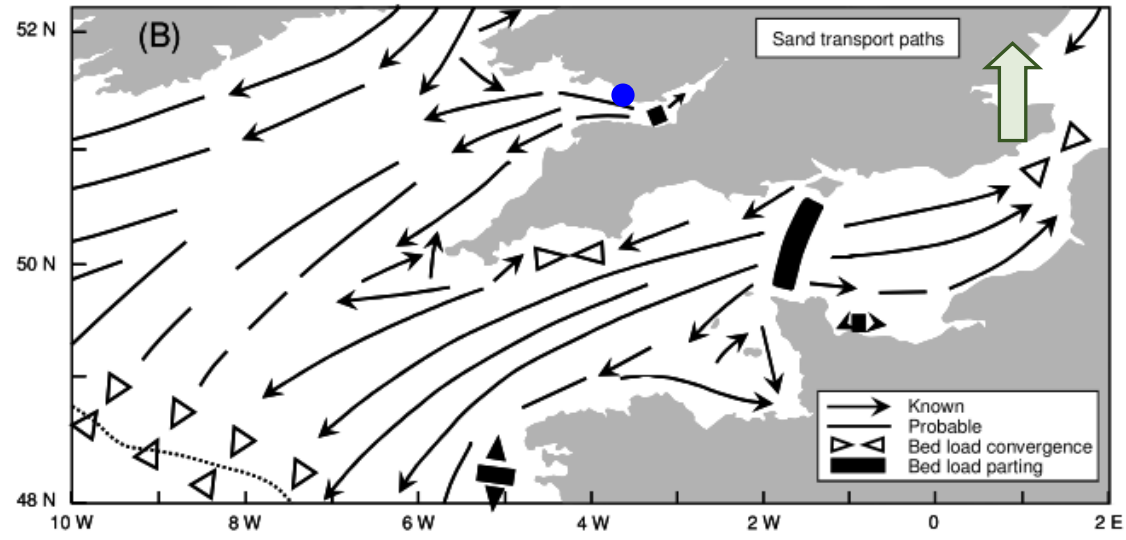
Sediment Pathways

Longshore sediment movement on the northwestern coast of Bristol Channel is predominantly to the east. Owing to the strong tidal currents, suspended sediment concentrations remain high, equivalent to approximately 3-4 years of annual river sediment supply.

According to the available records, an estimated 888 tons of sand were deposited on the beach on the eastern part of the Site since WWII. The main material deposited on the Site by the water would be sand and sandy gravel.

Typical sand transport vectors in the vicinity of the Site are shown in Figure 5.

Figure 5	Sediment pathways in the vicinity of the Site



Source: Plymouth Marine Laboratory *Not to Scale*

Legend	Site boundary

UXO Migration onto the Site

Given the tidal currents, wave action and pattern of sediment movement in the vicinity of the Site, it is considered that larger UXO, too heavy for the lower energy waves and near shore currents to move, are unlikely to be transported far but rather would be exposed by scour around them and then be left proud of the sediments.

In such cases, the UXO are unlikely to move from source unless fishing activities disturb the exposed UXO.

Buoyant and semi-buoyant UXO (as may be the case with some marine mines or degrading ordnance), smaller, lighter items of UXO (such as SAA and small or medium calibre shells) and

UXO with neutral buoyancy or rounded shapes could move by saltation or roll as bed load particles during spring tides and high wave energy storm conditions.

Given this, the possibility that such UXO may migrate onto the beach areas of the Site cannot be totally discounted.

6 EXPLOSIVE ORDNANCE CLEARANCE ACTIVITIES

Official UK bombing statistics have been compiled from both British and German sources. There were differences in the way the figures were originally reported and collated which has led to discrepancies in the summary data.

Based on data from 1939 to 1945, War Office statistics indicate that 200,195No. HE bombs exploded within Great Britain. Additionally, 25,195No. HE bombs (representing 11%) were recorded as UXBs. However, records from the Royal Engineers who were responsible for bomb disposal at the time indicate that as of 27th February 1946 upwards of 45,000No. UXBs were disposed of.

On average 8.5% of UXBs later self-exploded. In some cases the bombs had delayed action fuzes or were never intended to explode, their purpose being to cause inconvenience and fear. Given the discrepancy in records and the fact that UXBs are still being found unexpectedly, it is clear that the original figures are understated and provide only an approximation of the number of potential UXBs in the UK.

War Office statistics also show that between October 1940 and May 1941 most of the UXBs (93%) were either 50kg or 250kg. It should be noted that details of the recovery and the size of the UXB were not always accurately reported.

The larger WWII UXBs are often difficult to recover due to both penetration depths and the presence of two or more fuzes, combined with more sensitive fillings of explosive mixtures including Amatol and Trialen.

6.1 Abandoned Bombs

For further information on abandoned bombs, and the potential UXO hazard associated with them, follow the link below:

- Abandoned Bombs

No records have been found indicating that any officially abandoned bombs are located on the Site.

6.2 EOC Tasks

Records held by Zetica Ltd show that the following post-WWII EOC tasks have taken place in the vicinity of the Site.

13th April 2006

1No. mortar shell was found on New Road, Newton, approximately 0.4km north of the Site.

May 2009

Large numbers of .303 bullets and boxed shells were found near the abandoned ranges at Caeau Llaprau, Newton Burrows, approximately 1.8km east-northeast of the Site.

21st February 2014

Anti-tank traps were discovered along the Porthcawl shoreline, within approximately 0.4km south of the Site.

The MoD has provided no additional information on official EOC tasks on the Site.

7 UXO HAZARD ASSESSMENT

7.1 UXO Hazard Level

The definitions for the levels of UXO hazard are provided below.

Definitions of UXO Hazard Level for a Site	
Hazard Level	**Definition**
Very Low	There is positive evidence that UXO is not present, e.g. through physical constraints or removal.
Low	There is no positive evidence that UXO is present, but its occurrence cannot be totally discounted.
Moderate	There is positive evidence that ordnance was present or that other uncharted ordnance may be present as UXO.
High	There is positive evidence that UXO is present.
Very High	As high, but requires immediate or special attention due to the potential hazard.

The eastern part of the Site is encompassed by Newton Burrows, which is recorded as having been used for military training between the early 20th century and the end of WWII. This including infantry and field artillery practice.

It is considered prudent to assign this part of the Site a moderate UXO hazard level due to the potential presence of shallow-buried close combat munitions, artillery shells and SAA.

No significant military activity or bombing has been identified on the remainder of the Site, which is assigned a low UXO hazard level.

It is considered that the UXO hazard level on the Site can be zoned from low to moderate, as shown in Figure 6 below.

This figure is also given in the accompanying Zetica P8784-19-MAP01-A Sandy Bay Porthcawl (UXO Hazard Zone Plan).

Figure 6	UXO hazard zone plan of the Site

Source: Zetica *Not to Scale*

Legend					
	Very Low		Low		Moderate
	High		Very High		Site boundary

8 UXO RISK ASSESSMENT

8.1 Proposed Works

It is understood that works on the Site will comprise excavations up to 2.0m in depth, in addition sinking Cintec anchors to approximately 5.0m, associated with a coastal defence maintenance scheme.

8.2 Risk Assessment Methodology

A UXO risk assessment has been undertaken for the proposed works, taking into consideration the identified UXO hazard.

Firstly, the probability of encountering UXO (PE) has been considered and rated for the different construction techniques, as detailed below.

Probability of Encounter (PE)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Secondly, the probability of detonating a UXO (PD) has been considered and rated for the different construction techniques, as detailed below.

Probability of Detonation (PD)	Rating
Frequent, highly likely, almost certain.	5
Probable, more likely to happen than not.	4
Occasional, increased chance or probability.	3
Remote, unlikely to happen but could.	2
Improbable, highly unlikely.	1
Impossible	0

Next, the probability of encountering and detonating the UXO (PE x PD) have been used to generate an overall likelihood rating (P).

P = PE x PD	LIKELIHOOD of Encounter and Detonation	Rating
21 to 25	Frequent, highly likely, almost certain.	5
16 to 20	Probable, more likely to happen than not.	4
6 to 15	Occasional, increased chance or probability.	3
2 to 5	Remote, unlikely to happen but could.	2
1	Improbable, highly unlikely.	1
0	Impossible	0
P ranges from 25, a certainty of UXO being encountered and detonated on the Site by engineering activity, to 0, a certainty that UXO does not occur on the Site and will not be detonated by engineering activity.		

The likelihood of encountering and detonating UXO during site works is multiplied by the severity of such an event occurring (P x S), in order to provide a risk level using the following matrix.

Severity (S)	Rating
Multiple fatalities	5
Major injury, long term health issues, single fatality.	4
Minor injury, short term health issues, no fatalities.	3
First aid case but no lost time or ill health.	2
Minor injuries, no first aid.	1
No injuries.	0

UXO Risk Matrix							
	SEVERITY (S)						
LIKELIHOOD (P)		5	4	3	2	1	0
	5	25	20	15	10	5	0
	4	20	16	12	8	4	0
	3	15	12	9	6	3	0
	2	10	8	6	4	2	0
	1	5	4	3	2	1	0
	0	0	0	0	0	0	0

8.3 UXO Risk Level

The UXO risk assessment for proposed works on the Site is given in Table 4.

Table 4 UXO risk assessment for the Site

Hazard Zone	Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
Moderate	UXB	Shallow Excavations	1	1	1	1	5	5	Low
		Deep Excavations	1	1	1	1	5	5	Low
		Anchors	1	1	1	1	4	4	Low
	SAA	Shallow Excavations	3	1	3	2	2	4	Low
		Deep Excavations	3	1	3	2	2	4	Low
		Anchors	2	1	2	2	2	4	Low
	Close Combat Munitions	Shallow Excavations	3	2	6	3	4	12	Moderate
		Deep Excavations	3	2	6	3	4	12	Moderate
		Anchors	2	3	6	3	3	12	Moderate
	Artillery Shells	Shallow Excavations	3	2	6	3	4	12	Moderate
		Deep Excavations	3	2	6	3	4	12	Moderate
		Anchors	2	3	6	3	3	12	Moderate
Low	UXB	Shallow Excavations	1	1	1	1	5	5	Low
		Deep Excavations	1	1	1	1	5	5	Low
		Anchors	1	1	1	1	4	4	Low
	SAA	Shallow Excavations	1	1	1	1	2	2	Low
		Deep Excavations	1	1	1	1	2	2	Low
		Anchors	1	1	1	1	2	2	Low
	Close Combat	Shallow Excavations	1	1	1	1	4	4	Low
		Deep Excavations	1	1	1	1	4	4	Low
		Anchors	1	1	1	1	3	3	Low
	Artillery Shells	Shallow Excavations	1	1	1	1	4	4	Low
		Deep Excavations	1	1	1	1	4	4	Low
		Anchors	1	1	1	1	3	3	Low

PE (Probability of Encounter), PD (Probability of Detonation), P (Overall Probability)

Shallow Excavations defined as <1.0m bgl.

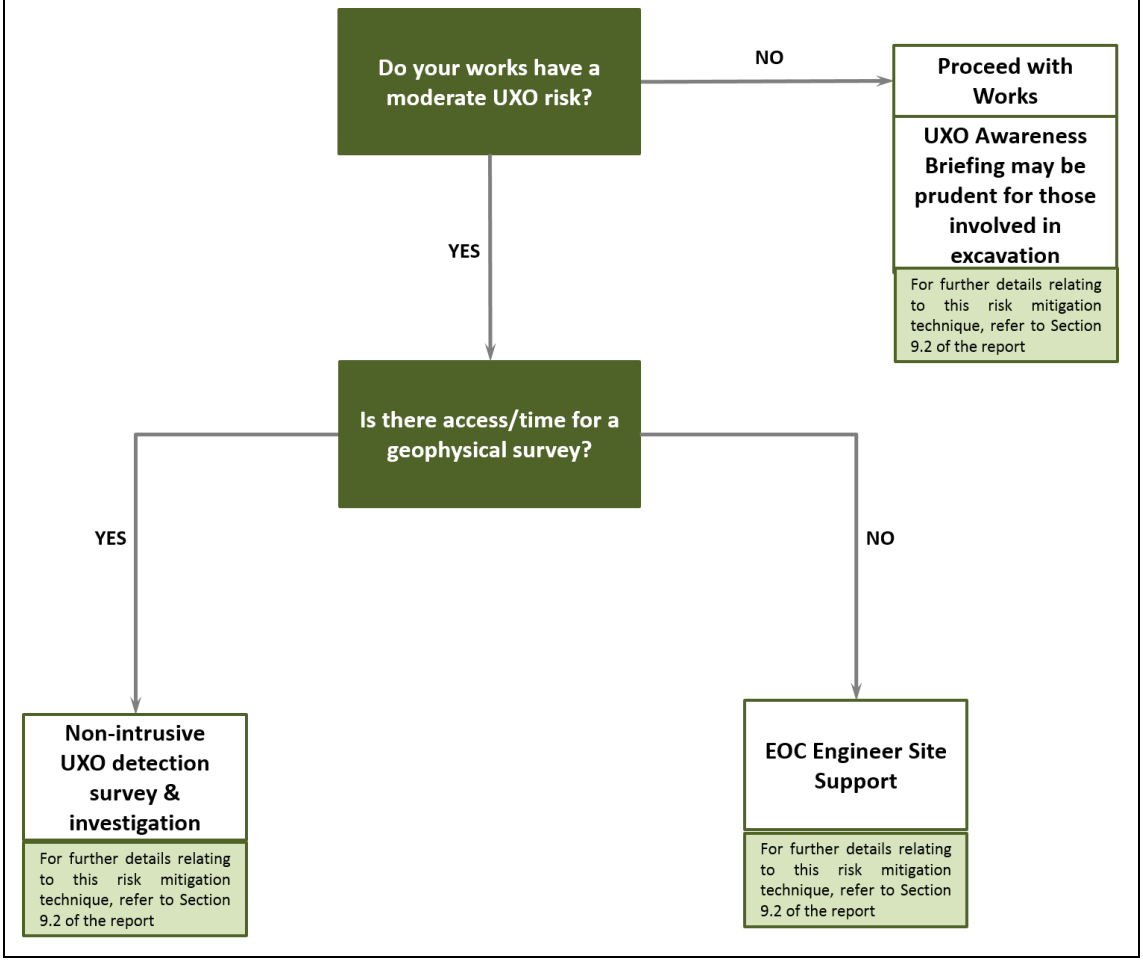
9 RISK MITIGATION PLAN

Key findings: Potential hazard from close combat munitions, artillery shells and SAA on the eastern part of the Site.

Key actions: Non-intrusive UXO detection survey on the eastern part of the Site to identify and remove shallow-buried UXO.

Figure 7 outlines the recommended steps to reduce the UXO risk to ALARP.

Figure 7 Recommended risk mitigation plan for the Site



9.1 UXO Risk Summary

Table 5 summarises the most appropriate risk mitigation recommendations for the proposed works on the Site.

Table 5	Summary of UXO risk and mitigation recommendations

Proposed Works	UXO Risk	Recommended Mitigation
Excavations		**Proceed with works** – if additional comfort is required to address the residual UXO hazard, a formal UXO awareness briefing can be provided.
Anchors		**Proceed with works**
Excavations		**Non-intrusive survey** – a non-intrusive UXO detection survey should be undertaken in advance of excavations to detect shallow-buried UXO. Potential UXO targets detected can either be avoided or intrusively investigated and removed.
Anchors		**Non-intrusive survey** – a non-intrusive UXO detection survey (as above) is recommended in advance of anchor installation.

In summary, it is recommended that a non-intrusive UXO detection survey (if practical) is undertaken in advance of works with a moderate UXO risk.

9.2 Risk Mitigation Techniques

The section below provides further details of the recommended techniques for mitigating the UXO risk on the Site.

9.2.1 UXO Awareness Briefing

Typically ~1hour in duration, these briefings will be expected to provide site workers with:-

- Background to the potential UXO hazards that could be encountered.
- Awareness of how the UXO hazard could present a risk.
- Knowledge of what to do in the event that a suspect item is encountered.

The briefing is to be provided along with back-up materials such as UXO awareness posters, emergency contact numbers and other background information to assist site workers in becoming familiar with what potential UXO can look like.

The materials can also be used by key staff to pass on the relevant points of the induction to others who visit or work on the Site.

By providing the UXO awareness briefing, it ensures that in the unlikely event that UXO is encountered:-

- All site staff take appropriate action.
- A support mechanism and points of contact are established.
- The likelihood of harm to people or property is reduced.
- Significant delays to site work are prevented.

9.2.2 Non-intrusive Survey

To proactively mitigate the risk prior to works in the moderate hazard area, it is recommended that a non-intrusive UXO detection survey is undertaken.

The primary technique should be a magnetometer survey to identify ferrous ordnance. To detect SAA and non-ferrous and low ferrous ordnance (such as with some practice munitions), a complimentary electromagnetic technique can be deployed.

Analysis of the survey data should be undertaken in the office by a suitably trained and qualified geophysics specialist to determine the limits of detection and enable effective target selection. From this, a priority ranking can be established for those targets most likely to be UXO.

On completion of the survey, potential UXO targets can be avoided (where practical) or investigated and removed by an Explosive Ordnance Clearance (EOC) team.

Where hazardous UXO is identified, an Explosive Ordnance Disposal (EOD) task may be required.

In areas where there has been an increase in dune sediments post-WWII, the shallow layer would first need to be excavated before undertaking the survey to increase the probability of detecting the anticipated ordnance types.

Further details of a suitable survey design can be provided on request.

9.2.3 EOC Engineer Site Support

If a non-intrusive survey is not practical due to restricted access or programme, an EOC Engineer can provide support during intrusive works.

For excavations, the Engineer will carry out a visual assessment on any suspect items uncovered during the works and classify them as potential UXO or other material.

Prior to anchor installation, the Engineer can undertake a sweep of the area using a handheld detector in order to try and detect shallow-buried UXO. It should be noted that this does not offer the same level of detection as a mapped survey (see Section 8.2.2 above).

If an item of UXO is uncovered, the EOC Engineer will arrange for its disposal as appropriate.

9.2.4 Quality Control & Processing

All works, in particular UXO detection surveys, must be conducted under a strict quality control protocol. For a geophysical survey, procedures must address issues of data quality thoroughly throughout the data acquisition phase. It is important that all data collected is assessed onsite and any issues addressed immediately whenever feasible.

The achieved detectability is to be measured and clearly quantified. This is to include a measure of geophysical noise. The assessment of an instrument's performance over a known target (seed) is also required to be assessed and recorded throughout the field works.

Within the final report, the quality of data and any issues must be stated and any implications clearly addressed. Statement of detectability should also be included along with depths of detection achieved wherever possible.

It is imperative that such assessments are undertaken by an experienced and competent geophysics specialist.

9.3 What Do I Do Next?

If you wish to proceed with UXO risk mitigation, Zetica would be happy to assist. Just contact us via phone (01993 886682) or email (uxo@zetica.com) and we can provide a proposal with options and prices.

If you have other requirements (such as utility services mapping or identifying buried structures) we can also provide these surveys, often saving costs if combined with a UXO survey.

If proposed works on the Site change, or additional works are planned, contact Zetica for a re-assessment of the UXO risk and the risk mitigation requirements.

APPENDICES

Appendix 1 Anticipated Ordnance Types

The most likely ordnance types to be encountered on the Site are detailed below. For a more comprehensive set of ordnance data sheets, see http://zeticauxo.com/downloads-and-resources/ordnance-data-sheets/.

Information Data Sheet

Category Small Arms Ammunition
Type Various

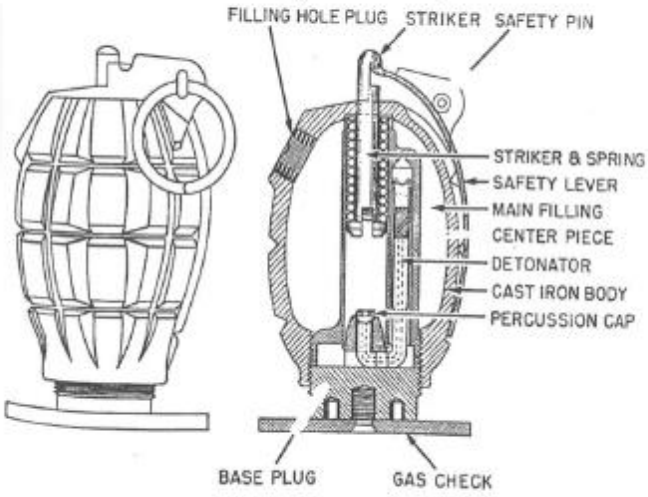
Description: Small Arms Ammunition (SAA) is one of the more recognisable categories of ordnance which is primarily designed for anti-personnel use. SAA include items such as bullets, generally up to a calibre (diameter) of 20mm.

Generally small arms ordnance has a relatively low risk as UXO, although the larger calibre categories may have the same detonation risk as larger high explosive ordnance.

SAA is often associated with discarded ammunition boxes around firing practice ranges and training areas and is often found scattered across former military airfields as a result of aircraft crashes and localised disposal.

Information Data Sheet

Category Grenades (British)
Type No. 36 Hand Grenade ('Mills Bomb')



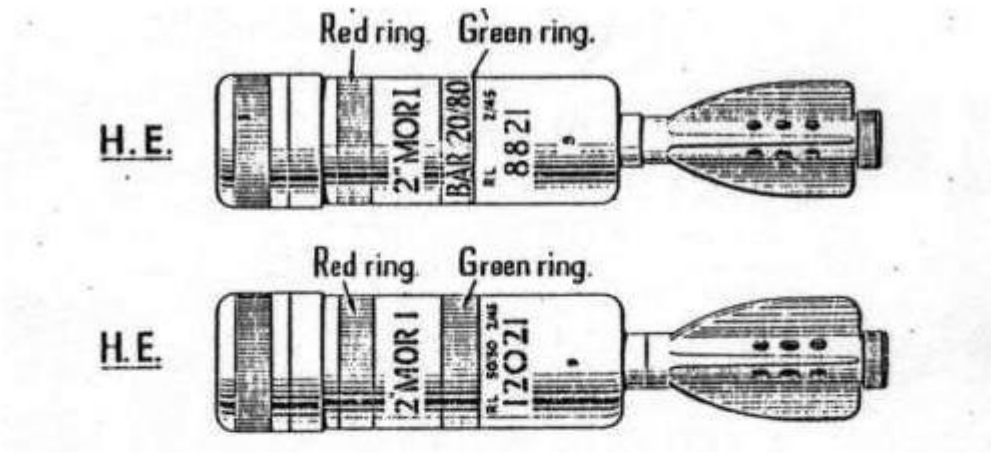
Variants	-	**Dimensions**	101.6mm x 61mm (4" x 2.4")
Weight	2 lbs	**Delay**	4 seconds
Filling	Baratol	**Material**	Cast Iron

Description Lemon-shaped, cast-iron body filled with high explosive. Three holes in the body; one in the base for priming, one near the top for filling; one on the top holding striker.

Function Used as a defence against enemy personnel.

Information Data Sheet

Category Mortar (British)
Type 2-Inch Mortar Bomb



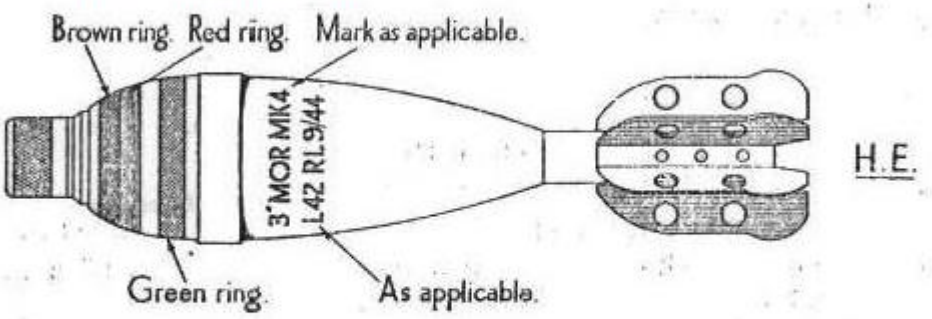
Variants	14	**Length**	11.4" x 2"
Weight	2.5lbs	**Firing Mechanism**	Trip (small trigger)
Calibre	50.8mm (2.0 inches)	**Rate of Fire**	8 rounds per minute

Description Pear-shaped steel body with 6 or 8 vanes. Originally painted buff yellow or dark grey. Filled with c TNT, granular TNT or powdered Amatol. Also smoke, illumination and practice versions.

Function Small enough to be carried by one man, with a range limited to 500 yards, the 2" mortar was usec an anti-personnel role.

Information Data Sheet

Category Mortar (British)
Type 3-Inch Mortar Bomb



Variants	2	**Dimensions**	19.3" x 3"
Weight	10lbs	**Firing Mechanism**	Trip (small trigger)
Calibre	76.2mm (3.0 inches)	**Rate of Fire**	12 rounds per minute

Description Pear-shaped steel body with vaned tail fin for stability in flight. Typically filled with high explosive or white phosphorus, the latter dispersing on detonation.

Function Range of up to 1,600 yards, the 3" mortar was used in an anti-personnel role.

Information Data Sheet

Category Projectiles (British)
Type 2-Pounder Shell

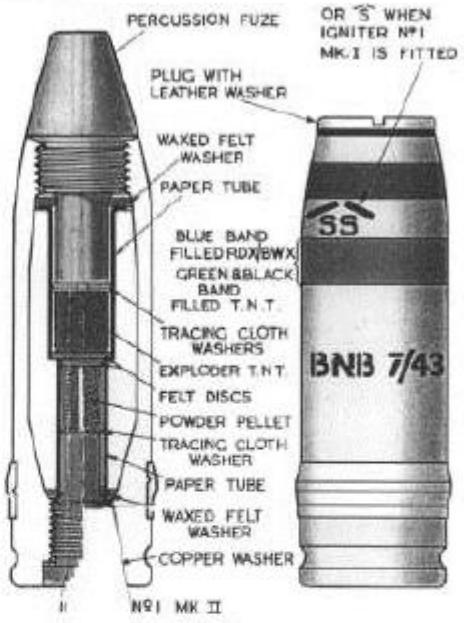
Variants Numerous

Body Dimensions 40mm x 156mm

Weight 2lbs (0.9kg)

Fuze Percussion fuze

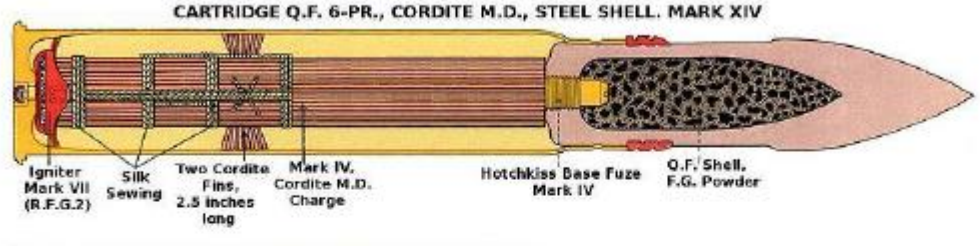
Function Used as the standard British anti-tank gun during the early part of WWII before being replaced by the 6-pounder shell.

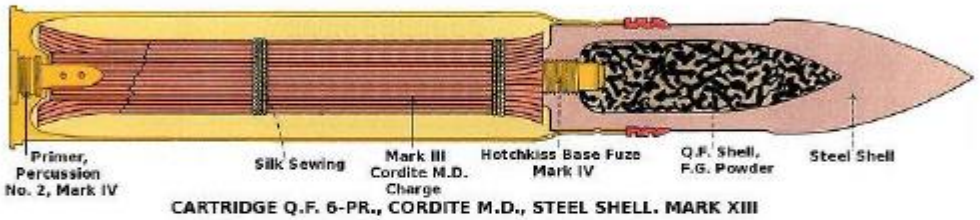


Information Data Sheet

Category Projectiles (British)
Type 6-Pounder Shell

CARTRIDGE Q.F. 6-PR., CORDITE M.D., STEEL SHELL. MARK XIV





CARTRIDGE Q.F. 6-PR., CORDITE M.D., STEEL SHELL. MARK XIII

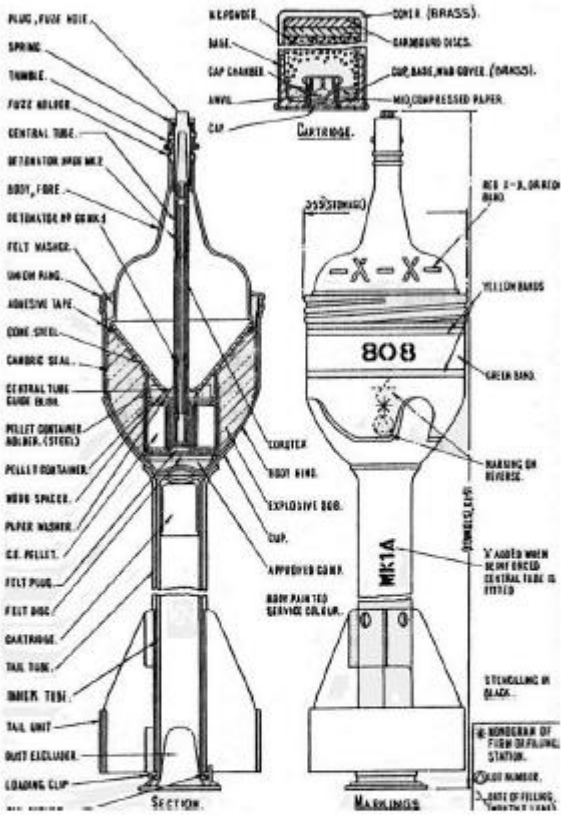
Variants	Numerous	**Body Dimensions**	57mm x 211mm
Weight	6lbs (2.7kg)	**Fuze**	Base fuze

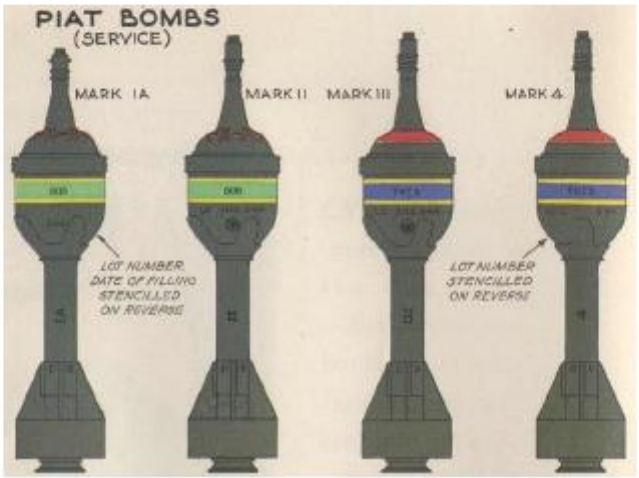
Function Primary anti-tank weapon of the British Army at the end of WWII. Used by armoured fighting vehicles both in combat and, extensively, in military training exercises.

Information Data Sheet

Category Projectiles (British)
Type Projector, Infantry, Anti-Tank (PIAT) Projectile

Variants	-
Body Dimensions	380mm x 89mm (15" x 3.5")
Weight	2.5lbs
Fuze	Impact fuze
Composition	Steel
Description	Steel cylindrical body beneath fuze chamber with drum tail unit and guide ring at base. Fin-stabilised tail.
Function	Used by the infantry as an anti-tank weapon and house breaker, with a maximum range of fire of 350yds. Also used extensively for training. High explosive, phosphorus and smoke fillings.





Information Data Sheet

Category Mine (British)
Type MK XVII Mine

Variants 1

Body Dimensions 1,020mm x 1,220mm

Weight 105-225kg (320-500lbs)

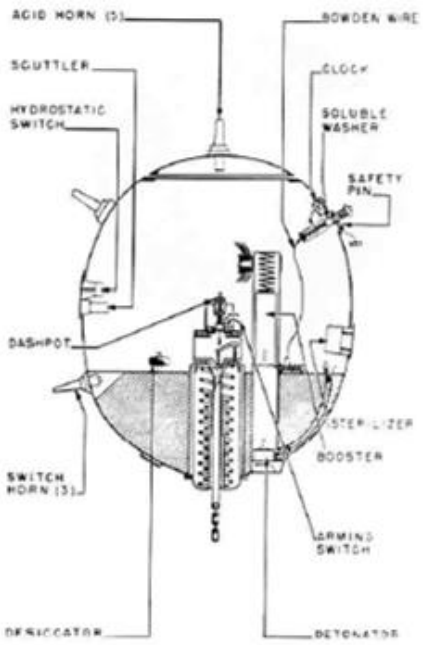
Fuze Contact

Composition Steel

Description Spherical in shape and typically painted black with a coloured band around the lower section. Could be equipped with up to 11 switch horns, protruding from the body at all angles. Top and bottom have fixtures for a detonator and mooring chain respectively.

Function The MK XVII was the most commonly used British naval mine, and could be moored in waters up to 915m depth.

It was a moored contact mine which was frequently used in defensive minefields within UK territorial waters.



Information Data Sheet

Category Mines
Type Canadian Pipe Mine / McNaughton Tube

Variants	1
Body Dimensions	2.5" / 3" / 4" x 55'
Weight	1kg per ft
Fuze	No. 3 Tube Fuze
Composition	Steel
Filling	Nitro-glycerine / Polar Blasting Gelignite
Description	Often crudely made, pipe mines were bored, drilled or placed near-horizontally beneath critical infrastructure, such as airfield runways or roads. Usually in a grid pattern. The pipes were filled with nitro-glycerine or Polar Blasting Gelignite (PBG), over time these devices can become increasingly unstable. It is estimated that some 40,000 feet of pipe mines were installed across southern England alone.
Function	Designed as an anti-tank weapon, but mainly saw use as a weapon to deny airfields to the enemy.

Information Data Sheet

Category Bomb (Luftwaffe)
Type Sprengbombe-Cylindrisch (SC) 50kg

Variants 8

Body Dimensions 762 x 200mm (30" x 7.9")

Weight 55kg (122lbs)

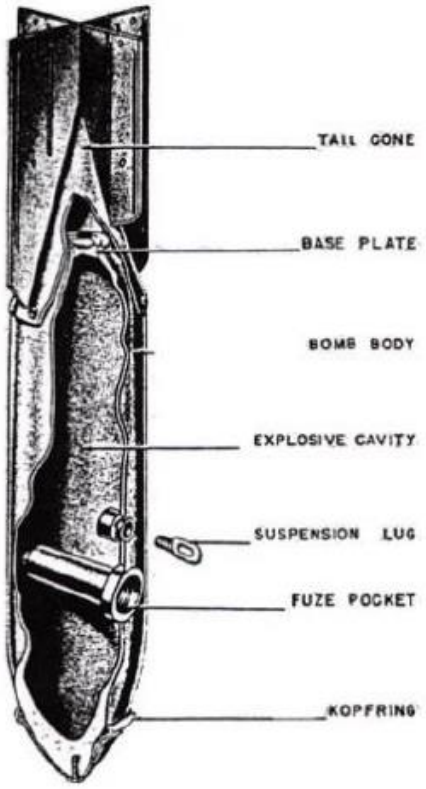
Charge Weight 25kg (54lbs)

Fuze Single electric impact fuze. Some have short time delay

Composition Sheet steel

Description Thick nose welded to a steel body. Nose may be attached to Kopfring (a triangular section steel ring) or spike. Suspension bolt in eye/body and sheet metal tail attached to body with rivets/screws. Originally painted green-grey with a yellow stripe on the tail. Cast TNT, Amatol or Trialen filling.

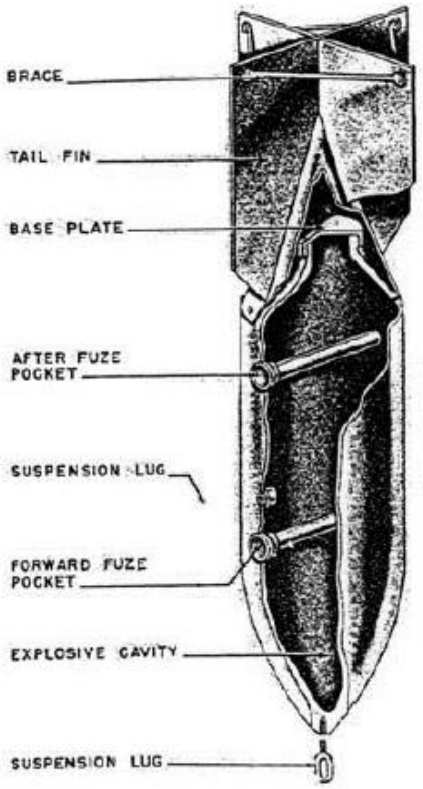
Function Designed to maximise shock waves through air, water and earth and for general demolition. Used against easily damageable targets, including roads, aircraft hangars, rolling stock and small buildings. Spike bombs/ 'Stabo' (SC 50 with spikes attached to nose) were used against rail lines and country roads, with Kopfring used against naval targets.



Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 250kg

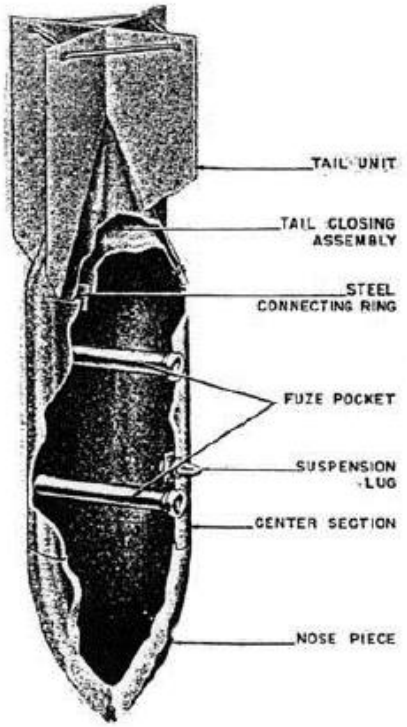
Variants	8
Body Dimensions	1194mm x 368mm (47" x 14.5")
Weight	249-264 kg (548-582lbs)
Charge Weight	130-145 kg (287-320lbs)
Fuze	Electric impact fuze/electric clockwork time fuse & electric anti-disturbance fuze
Composition	Sheet steel with stays
Description	Thick nose welded to steel body. Nose may be attached to Kopfring (triangular section steel ring) or spike. Sheet metal tail attached to body with rivets/ screws. Suspension eye bolt in the nose/body. Originally painted green-grey with a yellow stripe on the tail. TNT; amatol; TNT and aluminium powder, naphthalene, ammonium nitrate and wax/ wood meal filling.
Function	Designed to maximise shock waves through air, water and earth and general demolition. Used against railway installations, large buildings, ammunition depots and below-ground installations (to 8m). Spike bombs/ 'Stabo' (SC 50 with spikes attached to nose) used against rail lines and country roads.



Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 500kg

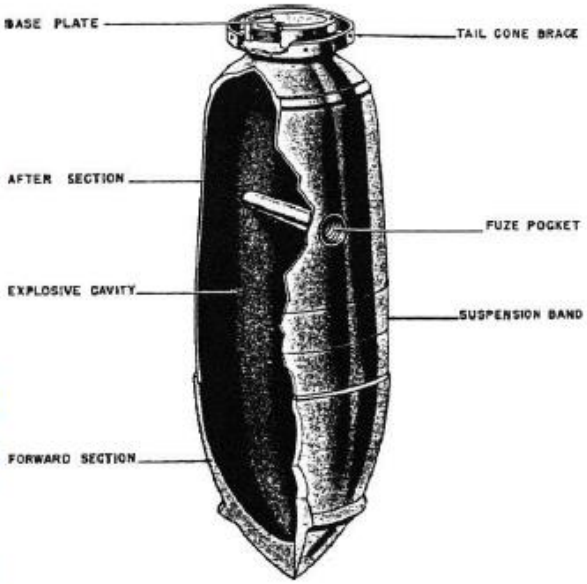
Variants	-
Body Dimensions	1414–1486mm x 470mm (55.7-58.5" x 18.5")
Weight	500kg (1,100lbs)
Charge Weight	220kg (484lbs)
Fuze	Electric impact fuze/electric clockwork time fuse & electric anti-disturbance fuze.
Composition	Sheet steel with stays or drum
Description	Thick nose welded to steel body. Nose may be attached to Kopfring (triangular section steel ring). Tail either steel sheet or drum-shaped. Suspension band. Originally painted green-grey/ buff (some later versions sky blue) with yellow stripe on tail. Filled with amatol, TNT or trialen.
Function	Designed to maximise shock waves through air, water and earth and for general demolition. Used against railway property, large buildings, shipping and below-ground installations.

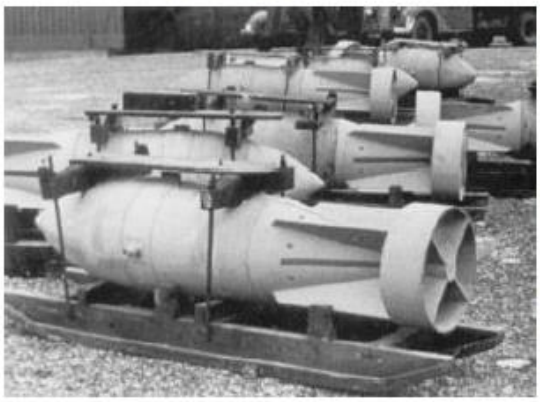


Information Data Sheet

Category Bomb
Type Sprengbombe-Cylindrisch (SC) 1,000kg (HERMANN)

Variants	3
Body Dimensions	1742-1905mm x 648–660mm (68.6-75" x 25.5-26")
Weight	1,000-1,088kg (2,204-2,398lbs)
Charge Weight	529-619kg (1,166-1,364lbs)
Fuze	Electric impact fuze/ electric clockwork time fuze & electric anti-disturbance fuze
Composition	Magnesium alloy with drum
Description	Thick nose welded to steel body. Nose attached to Kopfring (triangular section steel ring). Drum-shaped tail made of magnesium alloy. Suspension band. Originally painted sky-blue. Filled with amatol, TNT/aluminium/wood meal or trialen.
Function	Designed to maximise shock waves through air, water and earth and for general demolition.





Appendix 2 Sources of UXO Hazard

The sections below provide background information on the potential sources of UXO hazard affecting the Site. For a more comprehensive set of UXO information sheets, see http://zeticauxo.com/downloads-and-resources/uxo-information-sheets/.

Appendix 2.1 Military Training Areas

Military training has taken place on available open land across the UK for centuries. Initially this typically involved temporarily requisitioning any suitable open space for training activities, which often used live munitions.

Designated training areas began to be established by the late 19th century and during WWI additional land was taken over by the military for training.

At the beginning of WWII the area of land occupied by the army for all purposes, including training, was 235,000 acres. By February 1944, this had risen to 9,800,000 acres for training alone. Land was required for infantry and tank training, for beach assault, and for weapon practice.

Coastal sites involved not only use of the land but also the seabed designated by navigational exclusion zones. Where the land was selected, often requiring the civilian population to leave, camps for the incoming troops had then to be built.

Official training areas tend to have clearly delineated boundaries within which training is to take place. During wartime, however, many areas of open fields and woodland were requisitioned under Defence Regulation 52 by military units stationed in the area. Training in these areas was often not subject to any official rules and regulations, or detailed records.

Some training areas had associated firing ranges and others had provisions for armoured vehicle and tank training. In addition to the surrounding camps, the training areas required firing points, stop butts and observation and range control bunkers.

In the build-up to D-Day, marshalling areas for British and American troops were established in park and woodland near to the coast and these areas were commonly used for training exercises using live munitions.

The types of UXO that could be present at former military training areas varies depending on their operational history. Ordnance used during exercises ranged from small arms ammunition to grenades, defensive mines, mortars and shells, and unconventional weapons such as flamethrowers.

'Dry' training areas will have primarily used blank ammunition, although even these are likely to have used live munitions at some stage.

Appendix 2.2 Artillery Ranges

Artillery ranges mainly involve the firing of projectiles such as shells. Close combat munitions, such as mortars, and larger ordnance, including bombs, are also occasionally used on such ranges.

Historically, the majority of artillery ranges have been situated along the coast, allowing the test-firing of shells out to sea. As early as the 16th century, coastal gun batteries test-fired their weapons into the adjacent sea.

The 18 pounder (pdr) gun was the most commonly used field gun in the British Army during WWI. Their advantage over earlier forms of artillery was its light frame, cheap manufacturing costs and the speed with which it could be reloaded.

The 18 pdr gun, like other light field pieces in the British arsenal (such as the 5" and 6" howitzers) was light and mobile, allowing a well-trained crew to manoeuvre the gun during battle to great effect.

The ordnance fired by these guns ranged significantly. In 1914, the 18pdr gun fired "fixed charges" (i.e. the cartridge and shell were loaded as a single unit) with a fitted nose fuze, filled exclusively with shrapnel. War-time developments led to the adoption of High Explosive shells filled initially with Lyddite and then later with TNT or Amatol.

The 5" and 6" howitzers typically fired heavy HE shells packed with Lyddite or Amatol. Lighter shells were produced to allow gun crews greater range.

As the 20th century progressed, several inland artillery ranges were established on areas of moorland and open plains, well away from habitation. This allowed the testing of a variety of shells and rocket projectiles, and was often carried out in collaboration with RAF aircraft.

Field artillery pieces during WWII ranged from the 4.5" and 5.5" Medium field guns to large bore howitzers and the Ordnance Breach Loading (BL) 60 pdr heavy field gun.

The ordnance used ranged from light 25kg to 100kg HE shells which could be fitted with a variety of fuzes depending on their intended tactical use.

War-time developments resulted in progressively larger ordnance with a greater range.

Most artillery ranges still in use are under MoD control and access is carefully managed.

Artillery ranges provide a potential UXO hazard from shells and other projectiles that may have failed to detonate during training. In the marine environment, in particular, there would often be no requirement to remove any unexploded projectiles.

Typically, the greatest concentration of ordnance at an artillery range will be around any target/impact area, which are often recorded on range templates or evident from aerial photographs.

Whilst efforts would have been made to clear artillery ranges of UXO after training exercises, the potential something was missed can never be discounted. Simultaneously, the sometimes unpredictable nature of firing shells and other projectiles could result in poor accuracy and there are records of UXO resulting from such activity being found outside designated range areas.

Today, there is a much more rigid protocol for clearing artillery ranges of UXO and, with improved equipment and techniques, clearance is far more thorough than on wartime ranges.

Appendix 2.3 Bombing Ranges

Bombing ranges primarily use practice and live bombs, although other munitions such as shells and rocket projectiles are also commonly used.

Bombing ranges have been established since WWI, when aerial strategic bombing was first used. Many practice bombing targets were located at airfields, allowing resident squadrons to practice close to their base.

During WWII, a significant number of new bombing ranges were established. This included live ranges (often along the coast), practice ranges and air-to-ground ranges which also involved the firing of projectiles from aircraft.

Despite being designated for practice bombs, many ranges also used live bombs, particularly during wartime.

Bombing ranges provide a potential UXO hazard from live and practice bombs, in addition to other projectiles that may have failed to detonate during training. In the marine environment, in particular, the removal of unexploded bombs is less likely to have taken place.

Practice bombs contain a small explosive charge and produce a coloured powder plume for daylight operations and a light flash for night operations.

Typically, the greatest concentration of ordnance at an artillery range will be around any target/impact area, which are often recorded on range templates or evident from aerial photographs.

The inherent inaccuracy of practice bombing and inexperience of crews in training means that bombs can be found in areas surrounding designated bombing ranges.

Today, there is a much more rigid protocol for clearing bombing ranges of UXO and, with improved equipment and techniques, clearance is far more thorough than on wartime ranges.

Appendix 2.4 Small Arms Ranges

Small arms ranges (such as rifle ranges) can provide a source of UXO, explosive and metallic contamination, depending on their operational history and length of use.

Rifle ranges were a common feature in the open countryside during the 19th century, with local volunteer and militia forces using them extensively for practice.

By the beginning of the 20th century, many of the rifle ranges had fallen into disuse, although some were retained for training purposes by the regular army.

Small arms ranges vary considerably in length, from 25yd machine gun ranges (typically found at airfields, barracks and in urban areas) to 1,000yd shooting galleries. On the larger ranges, medium-calibre and close combat munitions, such as grenades and mortars, were occasionally used, particularly during wartime.

Most of the larger small arms ranges still in use are under MoD control and access is carefully managed. They often have extensive danger areas within which live firing may occur.

Generally, small arms ammunition does not provide a significant UXO hazard and, whilst some live ammunition is likely to be found at former small arms ranges, it does not typically have a high explosive charge.

It should be noted that some larger calibre smalls arms ammunition does have high explosive filling and, at airfield sites, machine gun ranges were used to test cannon shells in addition to small arms. The possibility that some of the larger rifle ranges were used for close combat practice, using grenades and mortars, can also not be discounted.

A significant hazard arising from small arms ranges is metallic contamination associated with spent ammunition. This contamination is usually from lead, although antimony and zinc may also be present. These substances are potentially toxic to humans and the environment.

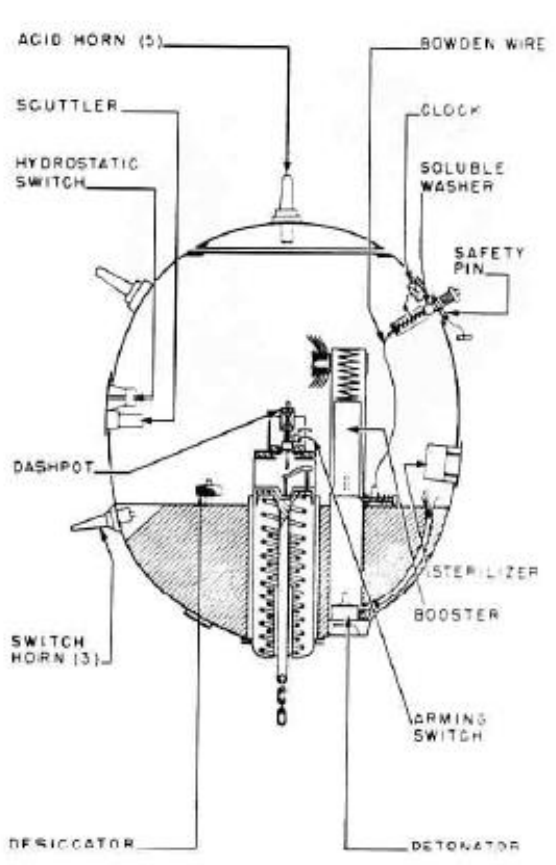
Appendix 2.5 Marine Mines

During WWI, approximately 128,000No. mines were laid in the sea around the coast of the UK. At the beginning of WWII, the Admiralty ordered the laying of further extensive minefields around the coast of England. This included both defensive mines on beaches in order to prevent enemy landings, as well as approximately 100,000No. marine mines laid at sea to destroy enemy ships.

Known marine minefields were cleared at the end of WWII using the original layout plans, although less than 30% of the total number of sea mines were cleared as many were moved from their original positions by tidal currents and wave action. As a result there is a possibility that some remain in the marine environment and a mine can be washed up on a beach or found drifting in the water around any part of the UK's coastline.

Buoyant mines, designed to float or sit just below the surface, were the most commonly deployed marine mines. They were typically moored, or tethered to the seabed with an anchor or wire. Generally spherical in shape, the mines were comprised of 2No. hemispheres connected with a cylindrical mid-section.

Marine mines typically carried 100 to 500lbs (50 to 250kg) of explosive. They were detonated by contact (being struck) or by influence (a vessel interfering with the mine's electromagnetic field).



German ground mines (Luftmine) were air-deployed naval mines which were also modified for deployment from submarines and surface craft. Although primarily designed to lie on the seabed, many were also moored or buoyant. Designed as an anti-shipping weapon, the WWII Luftmine was also often used on land based targets.

Luftmines typically comprised a cylindrical body with a hemispherical nose and tapered tail, with charges weighing between 675lbs and 1,500lbs (305 to 680kg).

Some German marine mines were composed of aluminium or manganese steel depending on the variant, whereas British mines were typically made of steel.

The initiating mechanisms in these mines have often deteriorated but the explosive charges will not have significantly altered unless the mine has split and the explosives have migrated and dispersed in the marine environment.

Appendix 2.6 Pipe Mines

Often crudely made, pipe mines were pipes approximately 100mm in diameter and up to 55m long bored roughly horizontal beneath critical infrastructure such as airfield run ways, or angled between ten and thirty degrees into river banks in places were invasion forces may land.

The pipes were filled with explosives and usually a sensitive fuzing mechanism. With nitro-glycerine or Polar Blasting Gelignite (PBG) being the primary component, over time, these devices can become increasingly unstable.

Pipe mines were not usually installed individually. The preferred method was to overlap them, usually in a grid pattern at intervals, at different depths of anything up to 5m below ground level (bgl), or to insert several parallel, closely spaced tubes.

By the 31st May 1941, Southern Command had installed a total of 12,200' (approximately 3,800m) length of Canadian pipe 'obstacles' using approximately 26,880' (approximately 8,300m) of pipes and 33 tons of Blasting Gelatine.

In mid-1941, it was discovered that the in some cases the conditions of burial caused early deterioration of the explosive charge due to moisture and alike. A maintenance cycle was put in place to initially inspect the pipe mine cartridges every 12 months.

Thereafter, the inspection was carried out every 3 months for the Blasting Gelatin but every month for the other explosives.

The Nitroglycerine within the charge was also potentially very hazardous due to its instability when it becomes frozen at temperatures of <14oC. As such removal of pipe mines is undertaken with extreme caution.

Where pipe mines needed replacing, typically new pipe mines were installed to avoid the hazards when removing an existing mine.

Towards the end of 1941, if deterioration of the original explosives was discovered, they were removed by a specially designed pronged spear or corkscrew rod and a water flush technique and then burnt. In most cases the pipe mines were recharged with a new explosive mix. This was undertaken during 1941-42.

The fuze was usually a length of cordtex, capped with a No. 3 tube fuze, in a vertical drain pipe fitted with a cover flush with the ground. The initiator was a half-hour time pencil fitted with a No. 27 detonator and covered with a primer. A glass ampoule was broken to initiate the time pencil.

After WWII, most remaining Canadian pipe mine installations were removed. Due to the method and speed of placement of many of them during 1940-41, detailed plans and maps were sometimes not available and a small number were missed.

For example, in April 2006, 20No. unexploded pipe mines were discovered at the former Royal Navy air base HMS Daedulus in Hampshire. The original 265No. pipe mines were each approximately 18m long. The 20No. unexploded pipe mines contained approximately 1,100kg of HE. The mines were destroyed by controlled explosion.

Left undisturbed, it is unlikely that these devices will detonate and in this case, the road has been used for in excess of 70 years without incident.

Today, disposal of pipe mines is taken with extreme caution due to the probability of accidental detonation as a result of the instability of its Nitroglycerine content. The process typically involves identifying the extent of the pipe mines, where possible using non-intrusive geophysical techniques

Significant blast protection is placed over the suspected pipe mine location. Careful excavation by hand is used to expose one end of the pipe mine allowing a donor charge to be placed on the pipe. The blast protection then permits a safe detonation of the pipe mine in situ.

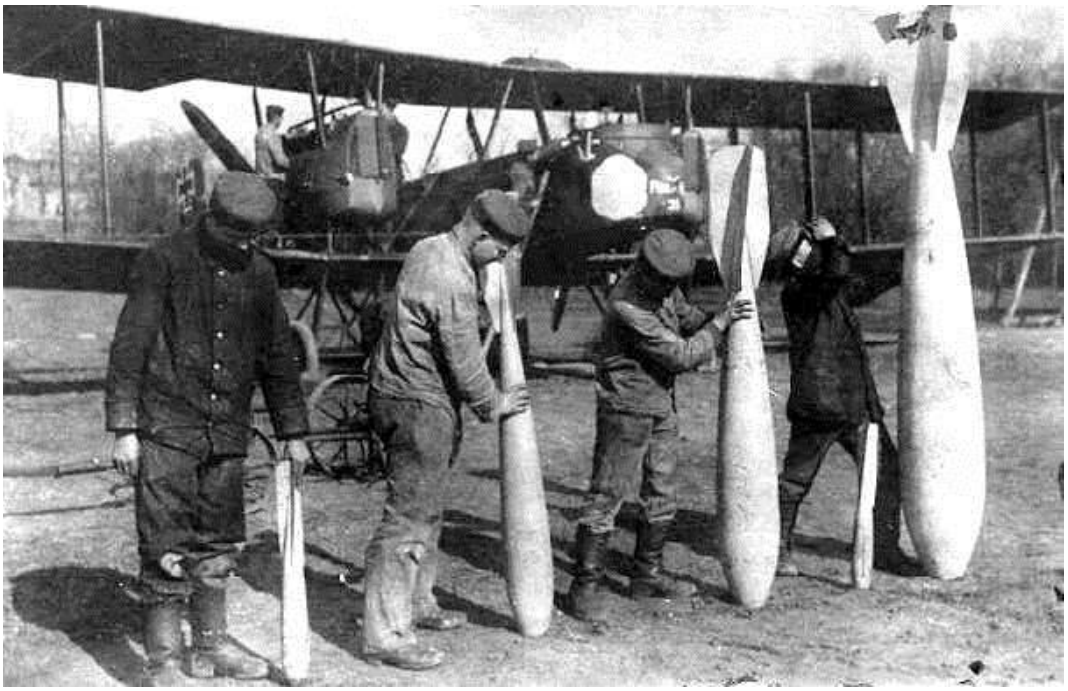
Appendix 2.7 WWI Bombing

It is not generally realised that during World War One (WWI) significant bombing took place across some areas of the UK. An estimated 9,000No. German bombs were dropped on Britain during the course of 51No. airship and 52No. aircraft raids. It was the first time that strategic aerial bombardment had been used. More than 1,400No. people were killed during these raids.

Most air raids were carried out on London and Southeast England. Areas along the East Coast were also targeted regularly due to their proximity to the European continent. Bombing raids further inland were rare and West England and Wales were out of reach for German aircraft of the time.

Aerial bombing during WWI initially relied on visual aiming, with bombsights not developed until later in the war. The inaccuracy inherent in this method meant that bombs often fell some way from their intended targets.

The first recorded raid against England occurred on the 21st December 1914 when 2No. high explosive bombs fell near the Admiralty Pier at Dover. Zeppelin raids intensified during 1915 and 1916, with aircraft raids becoming more frequent after 1917. The last raid of WWI took place on the 19th May 1918, when 38 Gotha and 3 Giant aircraft bombed London and surrounding districts, dropping a total of more than 2,500lbs of bombs.



The potential of coming across an Unexploded Bomb (UXB) from WWI is far less likely than a WWII UXB given the lower bombing densities during raids in the Great War.

Some areas which were subjected to sustained bombing raids, such as parts of London and coastal towns, recorded a higher number of UXB. In these areas, where there has been no significant development for the last century, the potential of a UXB remaining from WWI cannot be totally discounted.

Appendix 2.8 WWII Bombing

Bombing raids began in the summer of 1940 and continued until the end of WWII. Bombing densities generally increased towards major cities or strategic targets such as docks, harbours, industrial premises, power stations and airfields. In addition to London, industrial cities and ports, including Birmingham, Coventry, Southampton, Liverpool, Hull and Glasgow, were heavily targeted, as well as seaside towns such as Eastbourne and cathedral cities such as Canterbury.

The German bombing campaign saw the extensive use of both High Explosive (HE) bombs and Incendiary Bombs (IBs). The most common HE bombs were the 50kg and 250kg bombs, although 500kg were also used to a lesser extent. More rarely 1,000kg, 1,400kg and 1,800kg bombs were dropped.

The HE bombs tended to contain about half of their weight in explosives and were fitted with one or sometimes two fuzes. Not all HE bombs were intended to explode on impact. Some contained timing mechanisms where detonation could occur more than 70 hours after impact.

Incendiary devices ranged from small 1kg thermite filled, magnesium bodied Incendiary Bombs (IBs) to a 250kg 'Oil Bomb' (OB) and a 500kg 'C300' IB. In some cases the IBs were fitted with a bursting charge. This exploded after the bomb had been alight for a few minutes causing burning debris to be scattered over a greater area. The C300 bombs were similar in appearance to 500kg HE bombs, although their design was sufficiently different to warrant a specially trained unit of the Royal Engineers to deal with their disposal.

Anti-Personnel (AP) bombs and Parachute Mines (PMs) were also deployed. 2No. types of anti-personnel bombs were in common use, the 2kg and the 12kg bomb. The 2kg bomb could inflict injury across an area up to 150m away from the impact. PMs (which were up to 4m in length) could be detonated either magnetically or by noise/vibration.

Anti-shipping parachute mines were commonly dropped over navigable rivers, dockland areas and coastlines. The Royal Navy was responsible for ensuring that the bombs were made safe. Removal and disposal was still the responsibility of the Bomb Disposal Unit of the Royal Engineers.

In 1944, the Germans introduced new weapons; the V1, a 'flying bomb' and guided missile, and the V2, a ballistic missile rocket that travelled at such speed that no one could see or hear its approach. London was the main target for these attacks.

WWII bomb targeting was inaccurate, especially in the first year of the war. A typical bomb load of 50kg HE bombs mixed with IBs which was aimed at a specific location might not just miss the intended target but fall some considerable distance away.

It is understood that the local Civil Defence authorities in urban areas had a comprehensive system for reporting bomb incidents and dealing with any Unexploded Bombs (UXB) or other UXO. In more rural areas, fewer bombing raids occurred. It is known that Air Raid Precaution (ARP) records under-represent the number and frequency of bombs falling in rural and coastal areas. Bombs were either released over targets or as part of 'tip and run' raids where bomber crews would drop their bombs to avoid anti-aircraft fire or Allied fighter aircraft on the route to and from other strategic targets. Bombs dropped as a result of poor targeting or 'tip and run' raids on rural and coastal areas often went unrecorded or entered as 'fell in open country' or 'fell in the sea'. The Luftwaffe are thought to have dropped approximately 75,000 tons of bombs on Britain throughout the Second World War and an estimated 11% of all bombs dropped during the war failed to detonate.

The potential for a UXB hazard to exist on a site depends on a variety of factors. Were there strategic targets in the surrounding area? Was the site bombed? Could a UXB impact have been missed? Even in rural areas, the potential for UXB cannot be totally discounted and therefore it is essential that detailed local bombing records are obtained when assessing the UXB hazard on any site.

Appendix 3 Recent UXO Finds

UXO finds in the UK are a regular occurrence, although they almost never result in an accidental detonation.

It is still important to note that explosives rarely lose effectiveness with age. In some instances, mechanisms such as fuzes and gaines can become more sensitive and more prone to detonation, regardless of whether the device has been submersed in water or embedded in silt, clay or similar materials.

The effects of an accidental UXO detonation are usually extremely fast, often catastrophic and invariably traumatic to any personnel involved. Such occurrences are largely restricted to current theatres of war and overseas minefields, with occasional events in mainland Europe.

The sections below provide a brief summary of recent significant UXO finds in the UK. To keep up to date with the latest UXO finds, visit http://zeticauxo.com/news/.

On the 15th May 2017, 1No. suspected 250kg German UXB was found on a building site in Aston, Birmingham. Due to the corrosion of the fuzes, the UXB was destroyed in situ on the 17th May 2017.

On the 4th September 2017, 1No. 50kg UXB was found in a ragstone quarry at Kings Hill near West Malling in Kent. It was destroyed in situ in a controlled explosion by an EOD team.

On the 11th February 2018, 1No. 500kg UXB was found in King George V Dock in London, resulting in the temporary closure of the adjacent London City Airport. The UXB was freed from a silt bed and towed along the River Thames to Shoeburyness where it was destroyed in a controlled explosion.

On the 26th February 2018, an EOD team destroyed numerous items of ordnance including shells and 20mm ammunition which had been exposed by storms on Selsey beach. A similar operation was required after more UXO finds on the beach in April 2018.

On the 31st March 2018, 2No. 870lb British PMs were found in waters off Guernsey. They were destroyed in controlled explosions.

On the 20th May 2018, a 1,000kg German sea mine washed ashore at Elmer beach near Bognor Regis, West Sussex. A 1 mile exclusion zone was enforced before an EOD team towed the device out to sea for a controlled explosion.

On the 24th May 2018, numerous ordnance-related items were found on a proposed residential development in Burntwood, Staffordshire.

On the 10th July 2018, a suspected 1,000kg German UXB was found by scuba divers near Teignmouth Pier in Devon. The UXB was towed out into open sea by a RN EOD team for a controlled explosion.

On the 30th August 2018, a 2,000lb German PM was trawled up by a fishing vessel off Mersea in Essex. The PM was moved to an area of open sea where it was destroyed in a controlled explosion by a RN EOD team.

On the 29th November 2018 a large naval projectile was found at Wembury Point, Plymouth. It was destroyed in a controlled explosion.

During January and February 2019 a military EOD was called out to deal with several items of UXO washed up at Medmerry Beach in Selsey. The site of a former gunnery range, it followed on from several similar incidents in 2018.

On the 21st January 2019 a suspected 1,000lb torpedo was brought into Brixham Harbour by a fishing trawler. It was towed back out to sea and destroyed by a Naval EOD team.

On the 6th February 2019 3No. WWII projectiles were found on Chalkwell Beach near Southend-on-Sea, Essex. They were destroyed in a controlled explosion.

On the 19th February 2019 6No. projectiles were found on the beach at Lilstock, Somerset.

On the 14th March 2019 an unexploded pipe mine was found at the former RAF Manston airfield near Ramsgate, Kent. It was destroyed in a controlled explosion.

On the 21st March 2019 2No. unexploded shells were found on a building site in Brighton. They were removed by an EOD team.

On the 25th March 2019 an unexploded shell was found in Stechford, Birmingham. It was removed to a field and destroyed in a controlled explosion.

On the 22nd May 2019 70No. Self-Igniting Phosphorus (SIP) grenades were found during development works at Tongland Dam in Dumfries & Galloway, Scotland. They were destroyed in a controlled explosion.

On the 23rd May 2019 a 250kg German UXB was found by workers on a building site at Kingston University in London (see plate below). The UXB could not be safely removed and was consequently destroyed in situ by an EOD team.

On the 27th May 2019 24No. SIP grenades were found in a field near Sibton in Suffolk. An EOD team constructed a 2ft deep trench into which the grenades were placed before being destroyed in a controlled explosion.

On the 7th June 2019 a 50kg German fragmentation UXB was found at a building site in Kings Hill at the former RAF West Malling airfield. It was destroyed in a controlled explosion by an EOD team the following day.

Appendix 4 Glossary and Definitions

Abandoned Explosive Ordnance (AXO)	Abandoned Explosive Ordnance is explosive ordnance that has not been used during an armed conflict, that has been left behind or disposed of by a party to an armed conflict, and which is no longer under control of that party. Abandoned explosive ordnance may or may not have been primed, fuzed, armed or otherwise prepared for use.
Close Combat Munitions	Items of ordnance thrown, propelled or placed during land warfare, to include grenades, mortars, projectiles, rockets and land mines.
Demil	Derived from the term 'Demilitarisation', it refers to the break down and the recycling or disposal of ordnance components.
Detonation	The high-speed chemical breakdown of an energetic material producing heat, pressure, flame and a shock wave.
Device	This term is used for any component, sub-assembly or completed ordnance, which may or may not have an explosive risk. It can apply to detonators, primers, gaines, fuzes, shells or bombs.
Explosive	The term explosive refers to compounds forming energetic materials that under certain conditions chemically react, rapidly producing gas, heat and pressure. Obviously, these are extremely dangerous and should only be handled by qualified professionals.
Explosive Ordnance (EO)	Explosive Ordnance is 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, small arms ammunition, mines, torpedoes, depth charges, pyrotechnics, cluster bombs & dispensers, cartridge & propellant actuated devices, electro-explosive devices, clandestine & improvised explosive devices, and all similar or related items or components explosive in nature.
Explosive Ordnance Clearance (EOC)	Explosive Ordnance Clearance is a term used to describe the operation of ordnance detection, investigation, identification and removal, with EOD being a separate operation.
Explosive Ordnance Disposal (EOD)	Explosive Ordnance Disposal is the detection, identification, on-site evaluation, rendering safe, recovery and final disposal of unexploded explosive ordnance.
Explosive Ordnance Reconnaissance (EOR)	Explosive Ordnance Reconnaissance is the detection, identification and on-site evaluation of unexploded explosive ordnance before Explosive Ordnance Disposal.
Explosive Remnants of War (ERW)	Explosive Remnants of War are Unexploded Ordnance (UXO) and Abandoned Explosive Ordnance (AXO), excluding landmines.

Explosive Substances and Articles (ESA)	Explosive substances are solid or liquid substances (or a mixture of substances), which are either: • capable by chemical reaction in itself of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. • designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these as a result of a non-detonative, self-sustaining, exothermic reaction. Explosive article is an article containing one or more explosive substances.
Fuze	A fuze is the part of an explosive device that initiates the main explosive charge to function. In common usage, the word fuze is used indiscriminately, but when being specific (and in particular in a military context), fuze is used to mean a more complicated device, such as a device within military ordnance.
Gaine	Small explosive charge that is sometimes placed between the detonator and the main charge to ensure ignition.
Geophysical survey	A geophysical survey is essentially a range of methods that can be used to detect objects or identify ground conditions without the need for intrusive methods (such as excavation or drilling). This is particularly suited to ordnance as disturbance of ordnance items is to be avoided where ever possible.
Gold line	This is the estimated limit of blast damage from an explosive storage magazine. It usually means that development within this zone is restricted.
High Explosive	Secondary explosives (commonly known as High Explosives (HE)) make up the main charge or filling of an ordnance device. They are usually less sensitive than primary explosives. Examples of secondary explosives are: Nitro glycerine (NG), Trinitrotoluene (TNT), AMATOL (Ammonia nitrate + TNT), Gunpowder (GP), and Cyclotrimethylenetrinitramine (RDX).
Munition	Munition is the complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations, including demolitions. This includes those munitions that have been suitably modified for use in training, ceremonial or non-operational purposes. These fall into three distinct categories:- • inert - contain no explosives whatsoever. • live - contain explosives and have not been fired. • blind - have fired but failed to function as intended.

Primary Explosive	Primary explosives are usually extremely sensitive to friction, heat, and pressure. These are used to initiate less sensitive explosives. Examples of primary explosives are: Lead Azide, Lead Styphnate, and Mercury Fulminate. Primary explosive are commonly found in detonators.
Propellants	Propellants provide ordnance with the ability to travel in a controlled manner and deliver the ordnance to a predetermined target. Propellants burn rapidly producing gas, pressure and flame. Although usually in solid form they can be produced in liquid form. Examples of propellants are: Ballistite often found in a flake form and Cordite used in small arms ammunition.
Pyrotechnic	A pyrotechnic is an explosive article or substance designed to produce an effect by heat, light, sound, gas or smoke, or a combination of any of these, as a result of non-detonative, self-sustaining, exothermic chemical reactions.
Small Arms Ammunition (SAA)	SAA includes projectiles around 12mm or less in calibre and no longer than approximately 100mm. They are fired from a variety of weapons, including rifles, pistols, shotguns and machine guns.
Unexploded Anti-Aircraft (UXAA) Shell	UXAA shells are army ordnance commonly containing HE, though they can also contain pyrotechnic compounds that produce smoke. Most commonly, these were 3.7” and 4.5” HE shells, although they ranged from 2” to 5.25” calibre.
Unexploded Bomb (UXB)	UXB is a common term for unexploded air-dropped munitions.
Unexploded Ordnance (UXO)	UXO is explosive ordnance that has been either primed, fuzed, armed or prepared for use and has been subsequently fired, dropped, launched, projected or placed in such a manner as to present a hazard to operations, persons or objects and remains unexploded either by malfunction or design.

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