

24/08/1940	HEs (number unspecified)	Aluminium and Copper Works and docks at Port Talbot. <i>Precise location unknown, the affected copper works may be located partially within the north-west of Site A. Bombs on the docks could conceivably be on near Site A.</i>
25/08/1940	HEs (number unspecified)	Port Talbot. <i>Precise location unknown.</i>
26/09/1940	HEs (number unspecified)	Port Talbot. <i>Precise location unknown.</i>
09/10/1940	HEs (number unspecified)	Swansea and Port Talbot bombed. <i>Precise location unknown.</i>
17/01/1941	HEs (number unspecified)	Port Talbot Docks. <i>Precise location unknown, potentially on/near Site A.</i>

5.2.6 Secondary Source / Anecdotal Evidence

A search of online resources, as well as a review of local history publications was carried out with the intention of locating any eyewitness accounts of local bombing incidents.

An online source detailing the WWII history of the Port Talbot docks provides useful information pertaining to bombing during the period. See below for relevant excerpts.²

- 'The docks at Port Talbot were exceedingly fortunate in that they experience very few attacks from the air, and consequently suffered relatively little air-raid damage.'
- 'The first of the air raids occurred in the early hours of 29th June and 1st July 1940, when a number of bombs were dropped on the **docks**, some falling close to Messrs. Guest Keen & **Baldwins' Margam Works**, but fortunately there was not significant damage.'
- 'One lone raider appeared over the docks at 9.52 a.m. on 20th August 1940 and dropped a number of bombs on the **south side of the docks**, causing damage to dock railway lines, electricity cables and wagons of coal, etc.'
- 'Four days later, incendiary bombs and high explosive time bombs were dropped on No. 2 Grid. All traffic working on the **south side of the dock** was held up for two days until the unexploded bombs were recovered.'

5.2.7 Abandoned Bomb Register

Due to the overstretched bomb disposal units during WW2, many bombs were intentionally left undisturbed. UXBs were triaged based on where they were and how big they were. If they didn't pose a significant risk they were 'abandoned'. The locations of these bombs were recorded on the abandoned bomb register.

The abandoned bomb register is a public record document held at the Parliamentary Archives of the House of Commons, from which Brimstone has obtained a copy. The register should not be relied on for completeness or accuracy. The closest abandoned bomb is recorded approximately 11.4km north-west of the Site.

² <http://www.swanseadocks.co.uk/docksnewsite/ptwar.html>

5.3 Likelihood of UXB Contamination

Where detailed bombing records exist, it is possible to predict whether any UXBs could be found on a site. This likelihood is discussed in the following table:

Density of Bombing	
Number of Air Raids in the Vicinity:	A comparison of the bombing incident records confirms that at least eight air raids affected the study area. This number may be higher as no comprehensive official bombing records for Port Talbot have been uncovered.
Intensity of these Air Raids:	All bombs dropped locally were likely part of so called “tip and run” raids; aircraft jettisoning their remaining ordnance loads before the return journey to continental Europe. Small-scale targeted raids may also have taken place.
Bomb Strike Positions	
Closest Bomb Strikes	HE bombs: potentially on Site A/B. 1kg / 2kg IBs: unknown.
Alignment of recorded Bomb Strikes:	For areas with no bomb plot mapping or comprehensive written records, accurate analysis for the alignment of bomb strikes is not always possible. However, evidence obtained within an online source indicates that a stick of delayed-action HE bombs were dropped on the south side of the docks, potentially referring to Sites A and B. Additional attacks on the docks and the Margam steelworks are also referred to. This indicates that multiple aircraft may have flown over each of the Sites, elevating the possibility for a UXB to have been dropped overhead.
Bomb Failure Rate	
Evidence to suggest that the generally accepted failure rate of 10% differs in the vicinity of the site:	None.
UXBs recorded in close proximity to the site:	None.

5.4 Likelihood of Subsequent UXB Detection

A range of circumstances determine whether a UXB strike location would have been identified, during and after the war. This is discussed in the following table.

Historic Access
A UXB falling on a site which was frequently accessed would have had a better chance of being found. ARP Wardens actively searched for UXBs in heavily bombed residential areas. The importance of a site or nearby buildings and infrastructure was also a factor. Many industrial facilities had fire watchers tasked with extinguishing incendiary bombs and reporting UXBs. As all air raids in the immediate vicinity are thought to have occurred during the hours of darkness, there is a greater probability that any UXB strike to the Site could have occurred unobserved as residents/employees were inside. However, fire watchers were likely present at the industries located within each of the Sites, while the railway infrastructure located within/adjacent to each of the Sites was likely subject to post-raid checks for evidence of UXO. Indeed, given the lack of identified damage in Site C within high-resolution 1946 aerial imagery, as well as to the copper works in the north-west of Site A and briquetting works in Site B, access is likely to have remained frequent in these areas. These factors increase the likelihood of bombing and subsequent evidence of UXO being observed in these areas. However, visual evidence of repair works to the metal refinery in Site A (white/brighter roofing) suggests that bomb damage may have occurred at this location. It is conceivable that access may have been reduced for a time, depending on the extent of the damage. Furthermore, it is unlikely that the undeveloped open ground which comprised the majority of Sites A and B will have been accessed to a significant degree; these areas appear largely unused and unmaintained in 1940s aerial imagery. Evidence of a UXB strike in these areas may not have been observed, becoming obscured over time.
Bomb Damage
As the bombing campaign continued, damaged areas became vulnerable to unreported UXBs. Bomb site wreckage or soil disturbance at a bomb crater could obscure evidence of a subsequent UXB strike. No evidence of bomb damage to the copper works in Site A, the structure in Site B, nor the section of the steelworks in Site C has been identified within historical aerial imagery and OS mapping, i.e. areas of clearance, missing roofs, repair works. Similarly, no obvious evidence of bomb damage was evident in the areas of open/undeveloped ground on Site; however, such evidence is typically less easily identifiable amongst open ground. Evidence of repair works to the metal refinery in Site A has been observed within 1940 and 1946 aerial imagery, suggesting that bomb damage may have occurred early during WWII. The extent of this possible damage cannot be accurately discerned, although the whole roof appears to have been replaced. The coal briquette works, located within the north of Site B, may have sustained serious damage as identified within aerial vertical imagery (see FIGURE 5.2). However, given the homogenous nature of this potential damage, as seen within FIGURE 5.4, it may be that the structure itself is incomplete or the intended design. A possible bomb crater has been identified approximately 30m south-west of Site A.

Ground Cover Type
A UXB which falls on open field could easily go unnoticed, whereas a UXB dropped on a hard-surfaced car park would have been easily observed.
Any UXB strike to the undamaged structures on each of the Sites would have caused incontrovertible evidence of its incidence as it passed the structures and into the ground beneath. Similarly, a UXB strike to the railway sidings on/adjacent to each of the Sites is likely to have been identifiable at the time. Evidence of a UXB strike amongst the metal refinery in Site A, which may have been damaged early during WWII, could conceivably have been obscured amongst existing damage and debris. The majority of both Site A and Site B also comprised undeveloped open ground during WWII. Subsequently, any potential evidence of UXO which may have fallen at this time is thought likely to have been less noticeable, with a UXB's descent into open land less obvious than through a structure or roadway, for example. Indeed, the entry hole of a 50kg UXB may be as little as 20cm in diameter and can therefore become easily obscured by growing vegetation.

5.5 Bombing During WWI

During WWI, an estimated 9,000 German bombs were dropped on London, Eastern England and South-Eastern England during some 51 Zeppelin airship raids and 52 fixed-wing aircraft raids. London suffered the worst of the bombing with an estimated 250 tonnes of HE and incendiary bombs recorded across the Capital, over half of which fell on the City of London district.

The WWI bombing campaign waged by Germany was on a far smaller scale than the WWII campaign, in terms of the number of raids, the weight of ordnance dropped during each attack and the size of the bombs used. When coupled with the fact that most WWI bombed locations have since been redeveloped, German WWI UXB finds are extremely rare. Furthermore, most air raids took place during daylight hours and as it was the first time Britain had experienced strategic aerial bombardment, the raids often attracted public interest and even spectators, increasing the chances of any UXBs being reported.

A collection of written reports describing each air raid in the region was reviewed.³ The wider Site area, however, did not experience any air raids during WWI. As such, the associated UXO risk is considered negligible and will not be further addressed.

6 WWII GERMAN BOMBS

6.1 Bombs Dropped on the UK

Nazi Germany used different types of ordnance against the UK for different effects. Some types were designed to cause fires, others for their destructive blast effect and other for their penetration capability. Each type of ordnance was fitted with at least one fuze. For some bombs multiple fuzes were used. Many different types of fuzes were available for use – each with its own set of associated hazards.

Data sheets on those bombs most likely to be encountered today are included at **APPENDIX 2**.

- **HE bombs – moderate NEQ (net explosive quantity):** the most common types of HE bombs dropped were the SC (general purpose - GP) and SD (semi-armour piercing - SAP) series of bombs. The NEQ is between 30-50%. SAP bombs are engineered to attack light fortifications, whereas GP bombs are used in a mixed destructive blast and anti-personnel fragmentation role. 70% of bombs dropped on the UK were the 50kg type.
- **HE bombs – high NEQ:** blast bombs and parachute mines have bodies made of thin steel, allowing for larger HE charges. These were designed to detonate above ground, maximising the blast effect. Parachute mines were weapons slowed by parachutes and designed to detonate without penetrating the ground. Although, in some marshland areas, partially buried parachute mines have been observed. Consequently, it is highly unlikely that any unexploded blast bombs remain buried in the UK today.

³ <https://www.iancastlezeppelin.co.uk/>

- **HE bombs – low NEQ:** The PC series were armour piercing bombs used against heavy fortifications and reinforced bunkers. They were not commonly used over the UK.
- **Small incendiary bombs:** The 1kg and 2kg incendiaries were the most dropped bomb. Up to 620 x 1kg incendiaries could be packed into the largest container unit, which opened at a pre-determined height scattering its payload over a wide area. These small bombs could fully penetrate soft ground due to their small diameter. Variants of the 1kg and 2kg incendiary bombs contained a small HE charge designed for an anti-personnel role, and to increase its incendiary effect.
- **Large incendiary bombs - Thick skinned:** The C50 has a thick body and contained a mixture of incendiary liquids and white phosphorus. Another version of the C50 had a white phosphorus fill. The C50 'firepot' contained thermite incendiary containers (aka firepots) and a small HE charge.
- **Large incendiary bombs - Thin skinned:** The Flam 250 and Flam 500 models had thin steel bodies designed to break up on impact, spreading their oil-incendiary mixture, which was ignited by a small HE charge. Consequently, it is highly unlikely that any unexploded Flam bombs remain buried in the UK today. Their unreliability meant withdrawal from frontline use by January 1941.
- **Submunitions:** The SD2 'butterfly' bomb was a 2kg submunition dropped on several British cities and towns. It contained a 225gram HE charge. SD2s had no ground penetration ability so the vast majority were recovered at the time. However, SD2s are still found across Britain today.
- **V1 flying bombs and V2 rockets:** In the final year of WWII Germany began using pilotless weapons against England. Both V Weapons had 1,000kg HE warheads. Due to their light-body construction, they had no penetration ability and any impact left a noticeable debris field. As such, there is negligible risk from unexploded V weapons today.

6.2 Bomb Failures

Records from September 1940 to July 1941 show that an average of 84 UXBs were dropped on civilian targets each day. Around 8% of these were time delay bombs – designed to strike the ground and start a predetermined countdown which could last days.

There is a generally accepted 10% failure rate for WWII German HE bombs. This is estimated from records gathered by bomb disposal units. These statistics do not account for UXBs that went by unnoticed.

Failures can happen for different reasons, including:

- Equipment or human error in arming the bombs before release,
- Failure of a mechanism within the fuze (out of tolerance),
- Jettisoning payloads if the bomber was under attack or crashing, or
- Partially functioned bombs (e.g. cracks in the cast TNT)

6.3 Bomb Ground Penetration

6.3.1 Introduction

Using data gathered during WWII by the Ministry of Home Security, estimations can be made about how deep a bomb is likely to penetrate the ground. Over one thousand incidents were reported by the bomb disposal units to support this research. Further tests were carried out, dropping bombs of different sizes into chalk and measuring the depths they reached. This research is held at the National Archives. The estimates are:

Bomb weight (kg)	Ground Type (m)							
	Sand		Gravel		Chalk		Clay	
	Average	Max.	Average	Max.	Average	Max.	Average	Max.
50	2.8	7.8	2.8	7.8	3.5	7.7	4.0	9.1
250	4.8	13.7	4.8	13.7	6.0	13.1	6.8	15.8
500	6.0	17.3	6.0	17.3	7.6	16.4	8.7	19.8
1,000	7.6	21.9	7.6	21.9	9.6	20.7	10.9	24.9

Different layers of geology affect penetration depths. For example, 1m of made ground, then 1m of gravel before reaching clay – as is many areas of London – is not easily calculated from the data above.

When calculating how deep a bomb could have reached, we must make three assumptions:

- **Impact velocity:** German bombing raids were carried out at altitudes in excess of 5,000m. The velocity of impact is roughly 313ms^{-1} (not accounting for resistance). It is the same velocity regardless of mass.
- **Impact angle:** strike angles of 10 to 15 degrees to the vertical. It must be assumed that the bomb was stable at the moment of ground penetration.
- **Bomb design:** Some larger German bombs were occasionally fitted with 'kopfrings' - a metal ring, triangular in cross section, fitted around the nose of the bomb to help prevent penetration. It must be assumed that no 'kopfrings' were fitted.

6.3.2 The J-Curve Effect

During WWII BDUs reported that most buried UXBs were found horizontal or upturned. This observation confirmed the 'J-curve effect'. As an HE bomb penetrates the ground, slightly offset from the vertical, its passage underground creates a 'J' shape.

This is relevant because the J-curve effect results in a horizontal offset between the buried UXB and its point of entry. This distance is estimated to be one third of the theoretical penetration depth. A low altitude attack, meaning a low impact angle, could produce an even greater offset, of up to 15m.

6.3.3 Site Specific Geology

BGS Mapping	Superficial Deposits: Tidal Flat Deposits – Clay, Silt and Sand	Bedrock Deposits: South Wales Middle Coal Measures Formation - Mudstone
SI Data	Recent SI data was provided by the Client. One of the boreholes on Site (BH01 – April 2022) encountered the following ground conditions: - 0.20m of very gravelly sand. Gravel of slag and concrete (made ground). - 1.00m of gravelly, silty sand with occasional silt. Gravel of slag, mudstone and rare brick fragments (made ground). - 1.00m of gravelly silty sand. Gravel of mudstone. - 2.00m of sandy silt. - 1.00m of sandy gravelly silt with low cobble content. - 0.80m of silt with low cobble content and frequent pockets of peat. - 3.30m of sandy silt. - 0.20m of peat. - 10.10m of sand with medium cobble content.	

6.3.4 Site Specific Maximum Bomb Penetration Depth

During WWII the Luftwaffe dropped many different types of HE bomb. The SC (general purpose) series was by far the most numerous and of this series, the SC 500 model (weighing 500kg) was the largest of the most commonly deployed and therefore this will be used as the benchmark weapon for the Site-specific bomb penetration depth calculations.

To calculate an accurate maximum bomb penetration depth, Brimstone would normally take the average of the averages of the figure for the predominant Site-specific geologies (silt, sand, gravel), in the table above. However, given the lack of BPD data for silt, as well as for mudstone and sandstone, this has not proved possible on this occasion. While dense gravel presents at depths of 10-14m bgl, a UXB will first have travelled through clay, silt or sand beforehand, indicating that the dampening effect of the dense gravel on the descent of a UXB will be marginal and near the tail-end. As a result of the variance of the geological conditions on Site, with areas of predominantly clay, silt and sand identified, the maximum penetration depth could be up to 14.25m.

NB: theoretically penetration depths could be greater if the UXB was larger, however, War Office statistics confirm that between October 1940 and May 1941 the majority of HE UXBs (>90%) were either 50kg or 250kg, with the 500kg bombs making up most of the remaining 10%.

7 UXO RISK - BRITISH/ALLIED ACTIVITY

7.1 Introduction

The table below lists potential sources of UXO (excluding enemy action). Those which are potentially relevant to the Site are discussed in the subsequent section(s).

Potential UXO Source	Potentially Significant
Army or RAF training areas / ranges	✗
Military bases and other installations	✗
Munitions and explosives factories	✗/✓
Military storage depots	✗
Defensive fortifications	✗
Wartime site requisitions	✗
WWII defensive mining (landmines)	✗
WWII Home Guard activity	✗
Wartime anti-aircraft fire	✓

7.2 Potential Sources of UXO

7.2.1 Introduction

Research has not located any evidence of significant British or Allied army, RAF or Royal Navy activity specifically on Site and none is likely to have occurred historically. However, evidence indicates that the Margam Steelworks, within which Site C was located during WWI and WWII, was purpose built during WWI for war production. The potential sources of British UXO contamination are therefore munitions factories and WWII AA artillery fire.

7.2.2 Margam Steelworks

Evidence indicates that the Margam Steelworks, within which Site C was located during WWI and WWII, was purpose built during WWI for war production. Further research suggests that the steelworks produced steel utilised for munitions, tanks, ships and other war materials. Three WWII-era bombs/shells have been uncovered at Tata Steel in the 21st century. The first, referred to as a 'bomb' within an in-house geo dataset, was encountered approximately 1.8km to the south-east of Site A in 2008 during excavation works; the area was

cordoned off and an EOD squad attended the scene, although the device was found to be inert. A ‘shell’ was discovered near the main railway line in 2011, which is located approximately 170m to the east of Site C at its closest point, although was likely encountered further to the south. It is unclear whether the shell was filled and fuzed and bomb disposal personnel carried out a controlled detonation.⁴ Another ‘shell’ was uncovered in 2020 (precise location unknown) and was declared without a fuze and therefore inert by Army personnel; however, it is unknown whether it was filled with high explosives.⁵

No evidence has been found to suggest that shells were filled at the steelworks in Port Talbot. It is likely that each of the aforementioned shells consisted solely of the outer casing, produced by the Margam Steelworks, given that each of them was certified inert.

7.2.3 WWII Anti-Aircraft Fire

Anti-Aircraft (AA) Command was a British Army command established in 1939 to defend the UK during the anticipated German bombing campaign. It controlled the Territorial Army AA artillery and searchlight units. From 1940 to 1945 BDUs dealt with 7,000 unexploded AA shells in Britain. There were three main types of AA battery used for home defence (see below). Data sheets on these AA defences are included at **APPENDIX 3**.

- **Heavy Anti-Aircraft (HAA):** large calibre guns (3.7” and 4.5”) for engaging high altitude bomber formations. Hundreds of permanent batteries were constructed in and around major cities and military bases during the 1930s. Some 2,000 of these guns were available during the Blitz. Each gun could fire between 10 and 20 rounds per minute and consequently HAA batteries could expend large quantities of shells during each engagement.

British time fuses were poorly manufactured during WWII and this led to high failure rate for HAA shells, up to 30%. Unexploded HAA shells had the potential to land up to 27km from their battery, although more typically landed within a 15km radius.

- **Light Anti-Aircraft (LAA):** smaller calibre guns for engaging dive bombers and low altitude intruders. As such they were mostly used to defend specific industrial and military targets which were subject to precision bomber attack. LAA guns were either .303” calibre machine guns or 20mm and 40mm calibre cannon. The latter were fitted with simply impact fuses and small incendiary or HE bursting charges.

The 40mm Bofors gun could fire 120 x HE shells / minute to a ceiling of 1,800m. Each shell was designed to self-destruct if it didn’t strike an aircraft, however, inevitably some failed and fell back to earth.

- **Z (Rocket) Batteries:** a Z-Battery comprised a grid formation of 64 rocket projectors which fired 2” and later 3” Unrotated Projectile (UP) rockets to a maximum altitude of 5,800m; a ground range of some 9,000m. They were deployed in cities all around the UK from 1941 and proved to be an effective addition to the existing AA guns.

The rockets measured 0.9m (2”) and 1.8m (3”) in length with four stabilising fins at the base and were fitted with 3.5kg or 8.2kg HE warheads. The larger warhead had an effective airborne blast radius of up to 20m. Some variants deployed a form of aerial mine described as a “small yellow bomb” which was designed to detach from the rocket at height and descend on a parachute with the objective of becoming snagged on target aircraft and then detonating.

Unlike bombs which were designed to strike the ground, AA projectiles and rockets were designed to function in the air. Due to their shape, and centre of gravity they would often not strike the ground nose first. This coupled with the lower mass of AA UXO resulted in shallower ground penetration depths, compared to UXBs. Although, in very soft conditions, unexploded AA projectiles have been found deeper than 1.5m bgl.

16 permanent HAA batteries were active within range of the Site during WWII. LAA guns likely defended Port Talbot, within which the Site was located. Luftwaffe activity in the region was relatively infrequent. It is possible that an unexploded AA shell struck the open areas of the Site.

⁴ <https://www.bbc.co.uk/news/uk-wales-south-west-wales-13877272>

⁵ <https://www.walesonline.co.uk/news/local-news/port-talbot-tata-steel-bomb-17621716>

8 UXO RISK MITIGATING CIRCUMSTANCES

8.1 Introduction

Works on a UXO contaminated site could result in the partial or complete removal of UXO risk. Construction or earthworks may have uncovered any UXO contamination, which would then have been reported and removed by the authorities. A site may have been subject to an explosive ordnance clearance (EOC) task conducted by the armed forces. EOC tasks involve surveying, subsequent target investigation and removal of UXO. Although the effectiveness of historic EOC tasks will have often been unsatisfactory.

8.2 Explosive Ordnance Clearance Tasks

The division of EOD tasks has been complex throughout British military history. It used to be the case that anything under the water level would be dealt with by navy units, and anything on land would be dealt with by army units. In recent years RAF EOD capability has been discontinued, and now only the Royal Navy and the British Army have EOD units. In the army, the Royal Logistics Corps and Royal Engineer EOD units have been amalgamated to form 29 EOD & Search Group. Often taskings are assigned to either the naval or army elements based on where in the country the threat is and the nature of the threat.

Brimstone has access to a database of historic EOC tasks. This database is only complete up until the early 2000s and therefore does not include recent EOC tasks. No such database for the RAF and Royal Navy EOD units is easily accessible. A search of this database has not resulted in any Army EOC tasks in the vicinity of the Site.

UXO encounters on civilian land are often reported in the media and therefore a web search of local media outlets was also carried out. Three inert bombs/shells have been encountered at Tata Steel in the 21st century, see **Section 7.2.2** above for additional information.

8.3 Ground Works

Post-conflicts ground works for all three Sites have comprised the clearance of all WWII-era structures and railway lines. This would have consisted of grubbing out the foundations of the former structures, likely mitigating the risk in these areas to shallow depths (1-2m bgl). It is possible that the clearing of some structures may have required deep (>2m) intrusions, although this has not been possible to confirm. The open areas of the Site are likely to have received minimal post-WWII ground works, which will likely have been to very shallow depths (<1m bgl). Site B has seen the construction of various low-rise structures, infrastructure and the addition of hardstanding across large areas in the north and west. The depths associated with these ground works likely range from very shallow to shallow.

8.4 Deductions

The risk associated with (any) very shallow and shallow buried UXO will have been partially mitigated in areas of WWII-era structures and infrastructure, as well as post-WWII ground works. The risk associated with (any) deep buried UXO likely remains unmitigated.

9 CONCLUSION

9.1 Accuracy of Historical Records

Occasionally, the accuracy of some historical records can prove to be poor when compared with other sources of information. One significant consequence of this can be the possibility of unrecorded German bomb strikes in the study area. No comprehensive bombing records nor bomb plot mapping was available for the WWII-era Municipal Borough of Port Talbot during the production of this report from national and local archives. While anecdotal accounts provide the locations of various bombing incidents, 87 HE bombs are recorded as falling within the borough during WWII and therefore the locations of the vast majority of these are unknown. While an accurate risk level can be determined without the need for comprehensive records, their unavailability leads to uncertainty regarding whether bombs fell on/near the Site, resulting in an additional risk factor to consider.

9.2 The Risk of UXO Contamination on Site

9.2.1 Key Findings – German UXO Risk

- Port Talbot was a key industrial hub during World War II, with its steelworks and coal production facilities playing a vital role in supporting the British war effort. The Margam Steelworks, within which Site C was located, were involved in the production of steel for munitions, tanks, ships, and other war materials. Consequently, the town and its industries became targets for German air raids carried out by the Luftwaffe. Indeed, Luftwaffe target photography indicates industries on Site and nearby were identified as primary bombing targets. A railway yard/storage station was recorded on target photography (Site B) and a steel works which made up Site C. This is further recorded within Luftwaffe target mapping, which highlights the copper works (Kupferwerke) and hard coal briquettes (Steinkohlenbrikettebrik) within Site A as bombing targets, as well as the iron foundry (Eisengießerei) within which Site C was located.
- The majority of the official records obtained for Port Talbot did not specifically state the location of the incidents occurring, with many entries merely referring to bombing occurring over the town as a whole. It is of note, however, that one of the records reports an incident occurring at a copper works, a facility which consulted OS mapping confirms was present on and immediately adjacent to the north of Site A, as well as waste ground and railway sidings in the vicinity (partially included within / adjacent to Sites A and B), suggesting that bombing may have occurred on Site or in the immediate surrounds. Furthermore, bombing at the docks appears to have occurred on several occasions, with the south side referenced as sustaining a number of bombs, some of which were delayed action. A failure with the clockwork mechanism within the fuze of the delayed-action bombs is one cause of UXBs remaining in-situ. Sites A and B were located on the south side of the docks. The Margam Steelworks and/or its surrounding area is also stated to have been bombed on several occasions.
- No evidence of bomb damage to the copper works in Site A, the structure in the south-east of Site B, nor the section of the steelworks in Site C has been identified within historical aerial imagery and OS mapping, i.e. areas of clearance, missing roofs, repair works. Similarly, no obvious evidence of bomb damage was evident in the areas of open/undeveloped ground on Site; however, such evidence is typically less easily identifiable amongst open ground.
- However, evidence of repair works to the metal refinery in Site A has been observed within 1940 and 1946 aerial imagery, suggesting that bomb damage may have occurred early during WWII. The extent of this possible damage cannot be accurately discerned, although the whole roof appears to have been replaced. The coal briquette works, located within the north of Site B, may have sustained serious damage as identified within aerial vertical imagery. However, given the homogenous nature of this potential damage, as seen within **FIGURE 5.4**, it may be that the structure itself is incomplete or the intended design. A possible bomb crater has been identified approximately 30m south-west of Site A.
- Wartime conditions across the Site varied during WWII. Site A comprised a metal refinery, a section of a copper works, railway infrastructure and undeveloped open ground. Site B comprised a briquetting works in the north, small structure in the south-east, railway infrastructure and undeveloped open ground. Site C comprised a section of the Margam Steelworks. Any UXB strike to the undamaged structures on each of the Sites would have caused incontrovertible evidence of its incidence as it passed the structures and into the ground beneath. Similarly, a UXB strike to the railway sidings on/adjacent to each of the Sites is likely to have been identifiable at the time. Fire watchers were likely present at the industries located within each of the Sites, while the railway infrastructure located within/adjacent to each was likely subject to post-raid checks for evidence of UXO. Indeed, given the lack of identified damage in Site C within high-resolution 1946 aerial imagery, as well as to the copper works in the north-west of Site A and briquetting works in Site B, access is likely to have remained frequent in these areas. These factors increase the likelihood of bombing and subsequent evidence of UXO being observed in these areas.

- However, visual evidence of repair works to the metal refinery in Site A (white/brighter roofing) suggests that bomb damage may have occurred at this location. Evidence of a subsequent UXB strike at this location, which may have been damaged early during WWII, could conceivably have been obscured amongst existing damage and debris. It is conceivable that access may have been reduced for a time, depending on the extent of the damage. The majority of both Site A and Site B also comprised undeveloped open ground during WWII. Subsequently, any potential evidence of UXO is thought likely to have been less noticeable, with a UXB's descent into open land less obvious than through a structure or roadway, for example. Indeed, the entry hole of a 50kg UXB may be as little as 20cm in diameter and can therefore become easily obscured by growing vegetation. Furthermore, it is unlikely that the undeveloped open ground which comprised the majority of Sites A and B will have been accessed to a significant degree; these areas appear largely unused and unmaintained in 1940s aerial imagery. Evidence of a UXB strike in these areas may not have been observed, becoming obscured over time.
- In summary, factors pertinent to the risk of UXO contamination vary across each Site. As discussed above, the ground conditions within the majority of Sites A and B were un conducive to the detection of UXO. Bombs, including those with delayed-action fuzes, are recorded across the south of the docks, potentially on Sites A and B. Indeed, potential repair works indicative of bomb damage has been observed to the metal refinery in Site A. As a result, the majority of Site A and Site B has been assessed at a **Moderate Risk** from German UXBs. While evidence of a UXB will have been more readily observed amongst the undamaged structures and railway infrastructure within this zone, the potential for the J-Curve effect, whereby a UXB may travel laterally from its point of penetration, indicates that the risk from the open ground also presents at the footprint of the WWII structures and railway sidings. A buffer zone has therefore been added to account for this possibility.
- No evidence of damage to the copper works in Site A, railway infrastructure in both Site A and B, nor the structures in Site C, has been identified. The presence of significant and important infrastructure in these locations indicate that a UXB strike will have been observed and dealt with at the time. However, given recorded bombing to the copper works, south side of the docks and the steelworks, the risk from German UXBs is slightly elevated and has been assessed as **Low-Moderate**.
- Similar to the copper works and railway infrastructure within Site A, as well as structures in Site C, no confirmed visual evidence of damage has been observed to the briquetting works in Site B. A UXB strike is likely to have been observed at this location during WWII. Given this, a **Low Risk** has been assessed at the footprint of this structure, with the zone accounting for the possibility of J-Curve causing a UXB to come to rest beneath. As a result, this zone is smaller than the structure itself.

9.2.2 Key Findings - British UXO Risk

- Evidence indicates that the Margam Steelworks, within which Site C was located during WWI and WWII, was purpose built during WWI for war production. Further research suggests that the steelworks produced steel utilised for munitions, tanks, ships and other war materials. Three WWII-era bombs/shells have been uncovered at Tata Steel in the 21st century (none have been recorded on Site, although specific locations are unknown). No evidence has been found to suggest that shells were filled at the steelworks in Port Talbot. It is likely that the aforementioned shells consisted solely of the outer casing, given that each of them was certified inert and no mention was made of a high-explosive fill. Therefore, the risk from Allied UXO is assessed to be **Low** across the Site.
- Although all shells uncovered within the wider Tata Steel works have been found to be inert and are believed to be shell casings only, not ordnance, it cannot be assumed to be the case for any potential future items that are encountered. Any suspicious items should be assumed to be live / hazardous. If such an item is encountered on Site, the relevant authorities should be contacted in order to carry out an immediate investigation and initiate the necessary safety procedures.
- 16 permanent HAA batteries were active within range of the Site during WWII. LAA guns likely defended Port Talbot, within which the Site was located. Luftwaffe activity in the region was relatively infrequent. It is possible that an unexploded AA shell struck the open areas of the Site, and the risk is considered to be analogous to that of German UXBs.

9.3 Site-Specific UXO Hazards

Different types of UXO pose differing types of hazard, depending on their structural design, Net Explosive Quantity (NEQ), fill type and likely contamination depth. The table below lists the main types of UXO most often encountered on urban UK sites and their relative hazard levels.

UXO Type	NEQ (NEQ Range)	Likely Burial Depth	Hazard Posed
WWII German General Purpose HE Bombs	25kg - 220kg (most commonly deployed bomb weights)	Likely deep burial (>2m)	HIGH RISK
WWII British Heavy Anti-Aircraft Shells	1.1kg - 1.7kg	Shallow burial (1-2m)	MODERATE-HIGH RISK
WWII British Land Service Ammunition	<2kg	Shallow burial (1-2m)	
WWII German 2kg Incendiary / HE Bombs	680g incendiary hazard + ~500g explosive hazard	Shallow burial (1-2m)	
WWII German 1kg IBs	680g (incendiary, not explosive hazard)	Shallow burial (1-2m)	MODERATE RISK
WWII British Light Anti-Aircraft Shells	4g - 70g	Very shallow burial (<1m)	LOW-MODERATE RISK

9.4 The Likelihood of UXO Encounter

9.4.1 Introduction

This report assesses the risk of UXO in relation to the proposed works, not simply the risk that UXO remains buried on site. The likelihood of UXO encounter during intrusive ground works will vary depending on the type of UXO and the type of construction methods employed during the project. With increased soil disturbance i.e. more excavations, the likelihood of encountering UXO increases.

Within an area of elevated UXO contamination likelihood, the sub-surface volume of potential UXO contamination will comprise the natural soil / geology in between WWII ground level and the maximum bomb penetration depth. Therefore, any intrusions into this layer will be at risk of UXO encounter.

Any post-WWII fill material deposited on a site is unlikely to be contaminated with UXO and therefore the risk of encountering UXO on such a site could vary with depth.

In the wake of the initial nine-month Blitz, many cities and towns were left with vast quantities of bomb site rubble that required removal and relocation. This material was put to use for in a variety of ways, for example >750,000 tons of London's rubble was used to build runways for new RAF and USAAF airfields and much of Liverpool's rubble was used to create and maintain sea / flood defences throughout Merseyside.

It is quite possible that unexploded British AA projectiles and German 1kg incendiaries were overlooked during removal, resulting in UXO contaminated fill material ending up on otherwise low UXO risk sites, possibly many miles from any high bombing density areas.

9.4.2 German UXBs

Although most German UXBs came to rest several metres below WWII ground level, these weapons can be found at any level between just below WWII ground level and the maximum bomb penetration depth. There are a number of reasons why these heavy bombs might be found at surprisingly shallow depths.

- **Tip and run:** When enemy aircraft had to take evasive action to escape RAF fighter intercepts or AA defences, they often dropped their bomb loads from a reduced height, potentially resulting in extreme J-curve effect.

- **Deflection:** the shape of German bomb nose sections meant they were susceptible to deflection when striking surface or shallow sub-surface obstacles, occasionally resulting in shallow burial or even UXBs skidding across hardstanding.
- **Aircraft Crash Site:** if an aircraft was unable to dump its bomb load before impacting the ground, due to mechanical fault, any externally fitted bombs could have become buried on impact.

German 1kg / 2kg incendiaries were cylindrical and approximately 50mm in diameter. They had tail sections, and so landed nose first. Within soft ground this could result in full penetration of the bomb below the surface. Such UXBs are usually found close to the surface.

9.4.3 British / Allied UXO

The nature of British/Allied military activity involving LSA and SAA and the smaller size of these munitions (in relation to German HE bombs) indicates that any resulting UXO contamination on a site will be limited to shallow depths, usually within 1.5m of the surface, notwithstanding added material to raise the ground level.

Domestic military LSA and SAA contamination will either be the result of expending blinds (dud ammunition) which bury into the ground on impact or munitions purposefully buried, for a number of reasons. Either way, these types of UXO are all found at shallow depth.

9.4.4 Deductions

An elevated likelihood of UXO contamination (German) and likelihood of that UXO remaining up to the present day has been identified across the majority of Site A and Site B. Therefore, some of the proposed works are considered to be exposed to a UXO encounter.

10 OVERALL RISK RATING

Ratings for the likelihood of UXO contaminating the Site, remaining within the Site up to the present day and being encountered during the proposed works, inform the overall risk rating. The UXO risk to the proposed works varies. **Low**, **Low-Moderate** and **Moderate Risk** zones for German UXBs and unexploded HAA shells have been identified, with a **Low Risk** from Allied UXO across the Site. These are illustrated within the risk mapping displayed at **FIGURE 7**.

Risk Table: Low Risk				
UXO TYPE (ASSOCIATED HAZARD)	LIKELIHOOD OF UXO CONTAMINATION	LIKELIHOOD OF UXO REMAINING	LIKELIHOOD OF ENCOUNTER	OVERALL RISK RATING
WWII German 'Iron' Bombs	Low	n/a		Low
WWII British Heavy Anti- Aircraft Shells	Low	n/a		
WWII British Land Service Ammunition	Low	n/a		
WWII German 2kg Incendiary / HE Bombs	Low	n/a		
WWII German 1kg Incendiary Bombs	Low	n/a		
WWII British Light Anti- Aircraft Shells	Low	n/a		
WWII British Small Arms Ammunition	Low	n/a		

Risk Table: Low-Moderate Risk				
UXO TYPE (ASSOCIATED HAZARD)	LIKELIHOOD OF UXO CONTAMINATION	LIKELIHOOD OF UXO REMAINING	LIKELIHOOD OF ENCOUNTER	OVERALL RISK RATING
WWII German 'Iron' Bombs	Low-Moderate	Moderate-High	Moderate	Low-Moderate
WWII British Heavy Anti- Aircraft Shells	Low-Moderate	Moderate-High	Moderate-High	
WWII British Land Service Ammunition	Low	n/a		Low
WWII German 2kg Incendiary / HE Bombs	Low	n/a		
WWII German 1kg Incendiary Bombs	Low	n/a		
WWII British Light Anti- Aircraft Shells	Low	n/a		
WWII British Small Arms Ammunition	Low	n/a		

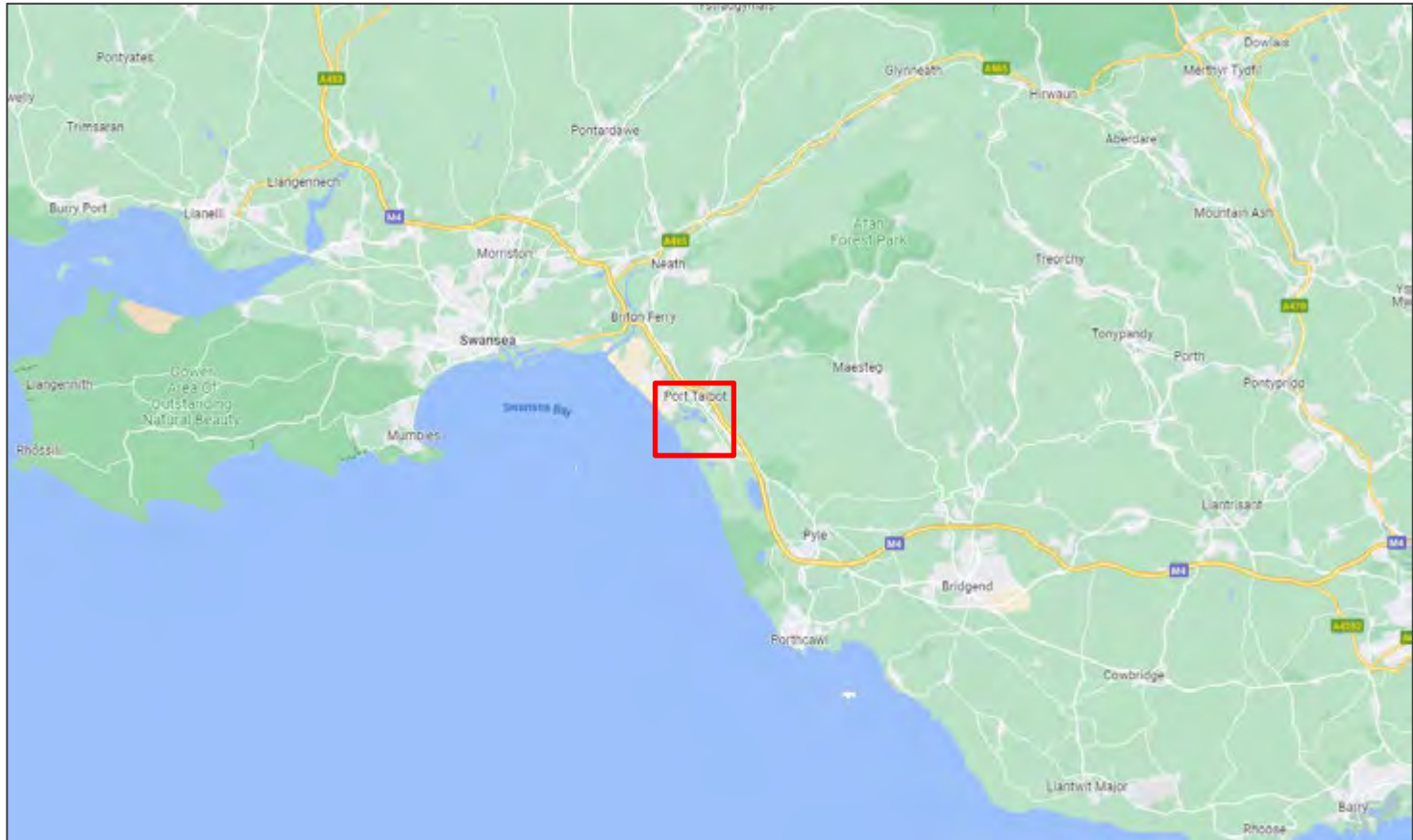
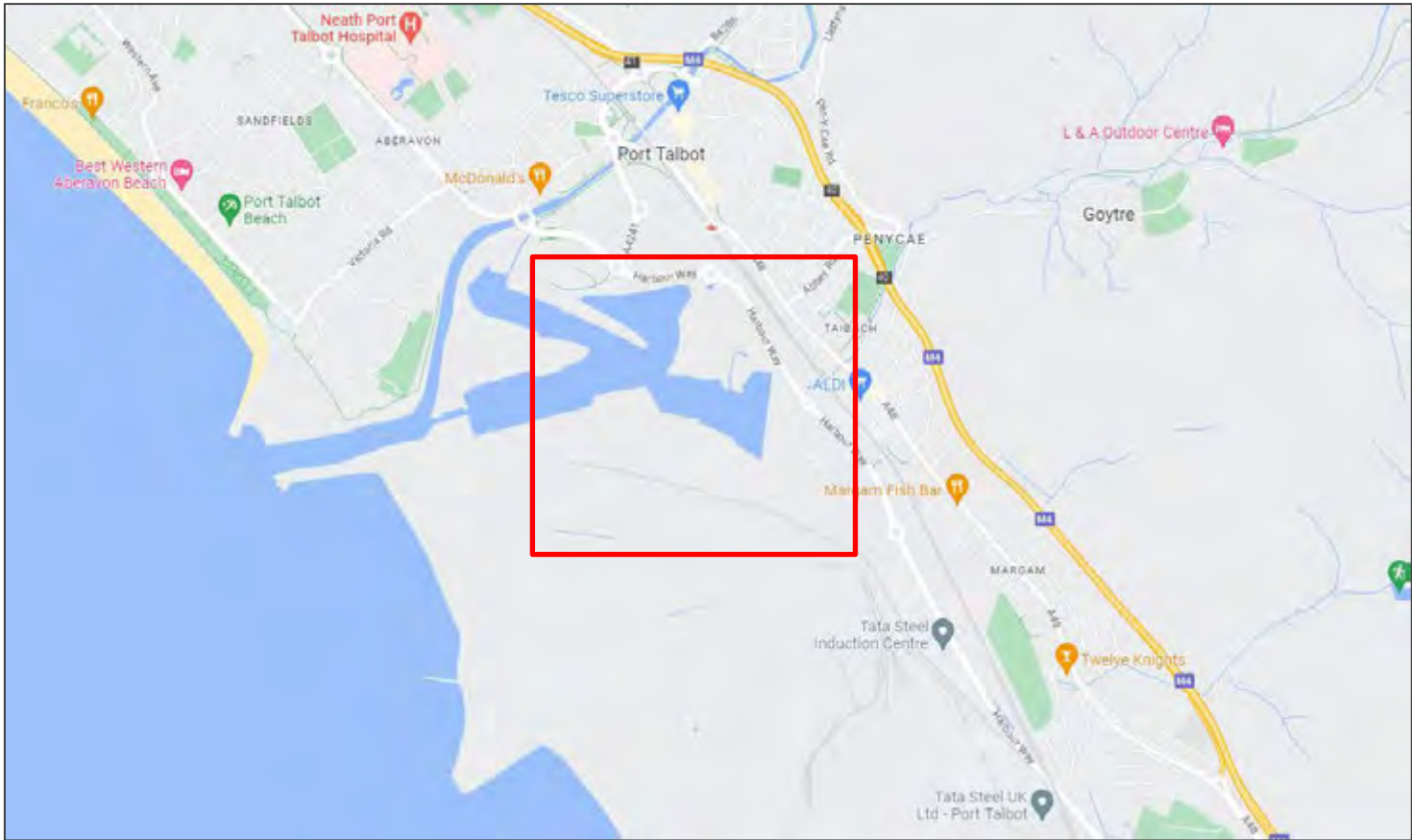
Risk Table: Moderate Risk				
UXO TYPE (ASSOCIATED HAZARD)	LIKELIHOOD OF UXO CONTAMINATION	LIKELIHOOD OF UXO REMAINING	LIKELIHOOD OF ENCOUNTER	OVERALL RISK RATING
WWII German 'Iron' Bombs	Moderate	Moderate-High	Moderate	Moderate
WWII British Heavy Anti- Aircraft Shells	Moderate	Moderate-High	Moderate-High	
WWII British Land Service Ammunition	Low	n/a		Low
WWII German 2kg Incendiary / HE Bombs	Low	n/a		
WWII German 1kg Incendiary Bombs	Low	n/a		
WWII British Light Anti- Aircraft Shells	Low	n/a		
WWII British Small Arms Ammunition	Low	n/a		

11 RISK MITIGATION RECOMMENDATIONS

Brimstone has identified an elevated UXO risk to some of the proposed works. The measures detailed below are recommended to mitigate the risk to ALARP level.

Risk Mitigation Measure	Recommendation
UXO Safety Awareness Briefings: To all personnel conducting intrusive works on Site. An essential part of the Health & Safety Plan for a site. Conforms to the requirements of CDM2015.	Prior to all intrusive works commencing.
EOD Engineer - On Site Supervision: Watching brief for open excavations below WWII ground level. Portable magnetometer instruments for clearing ground ahead of borehole positions and shallow excavations (where / when appropriate). Positive identification of suspicious (non UXO) objects. Liaison during confirmed UXO incidents. Provision of additional UXO Safety Awareness Briefings.	Watching brief of all open excavations and magnetometer survey of borehole locations within the Moderate Risk zone.
Intrusive Magnetometer Probe Survey: A range of intrusive magnetometer methodologies can be deployed to survey the ground (down to the maximum bomb penetration depth) prior to deep intrusive works; pile foundations. The appropriate technique is governed by a number of factors, the most important being the site-specific ground conditions.	Of any pile positions within the Moderate Risk zone.
Non-Intrusive Magnetometer Survey: A range of non-intrusive magnetometer methodologies can be deployed to survey large areas of land to a limited depth. Such surveys can typically detect a 50kg WWII bomb at a depth of 4.5m, in “clean” ground. This survey is only appropriate for greenfield land where “magnetic noise” is negligible. To extend survey range, a reduced dig and secondary survey can be carried out.	Open excavations on greenfield land within the Moderate Risk zone.

Figures: 1 - 7



Project

Project Dragon, Port Talbot

Client:

TEC Ltd

Report Ref:

DRA-23-1532

General Site Location

Info Source:

Google (open-source)



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Laser Quay, Culpeper Close
Rochester, Kent
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Project

Project Dragon, Port Talbot

Client:

TEC Ltd

Report Ref:

DRA-23-1532

 Approx. Site Boundary

Info Source:

Google (open-source)



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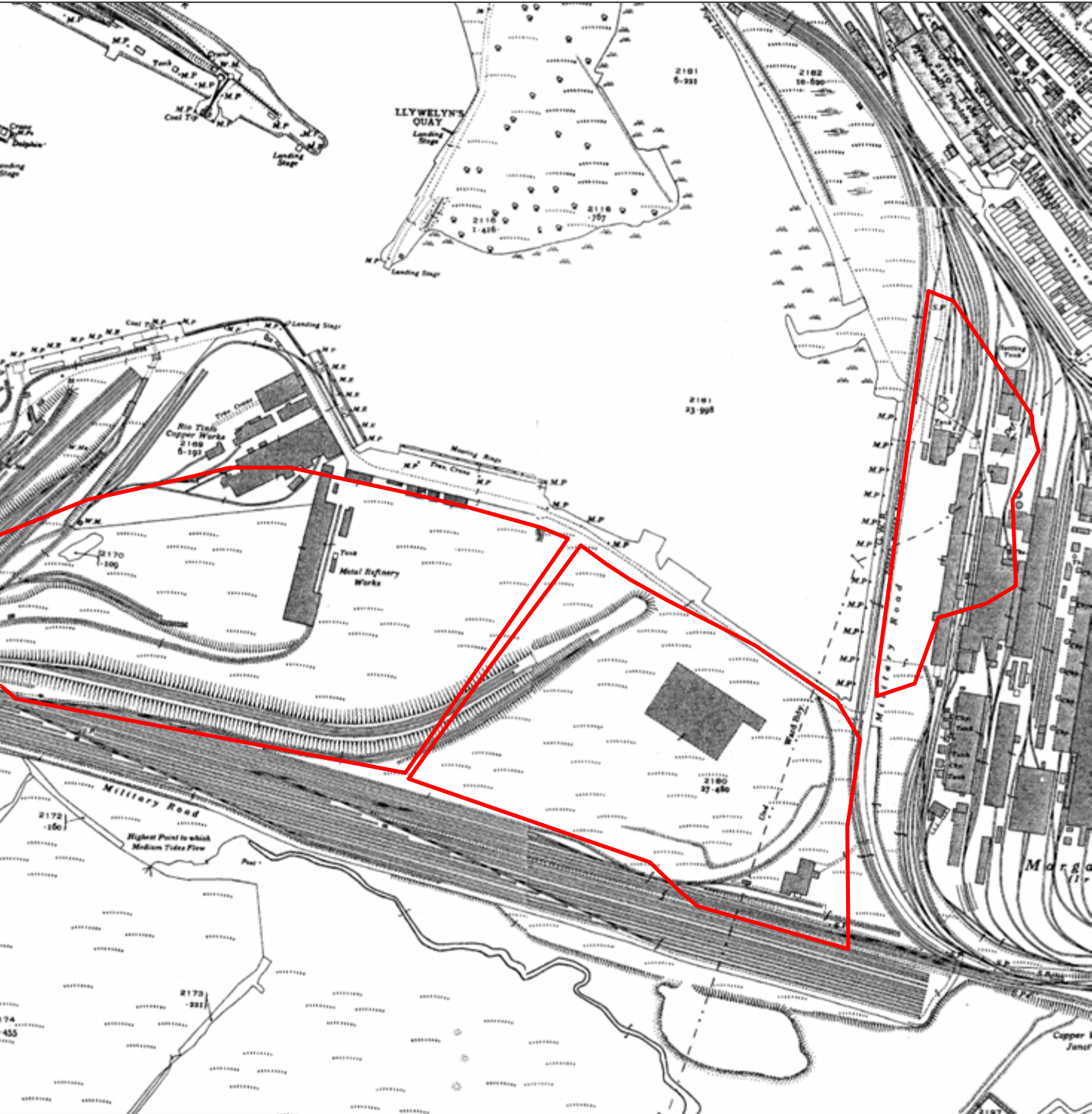


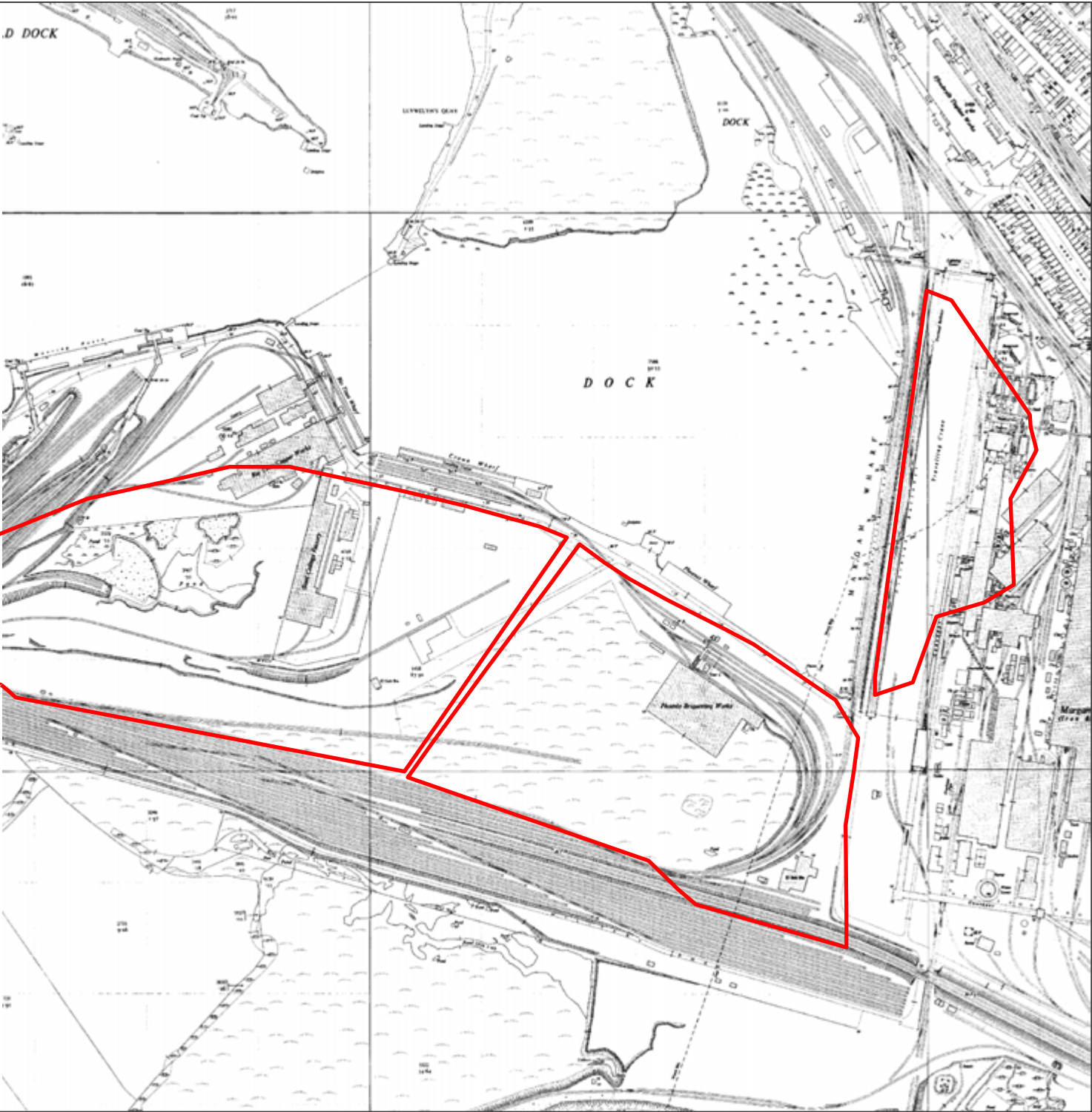
Project	Project Dragon, Port Talbot	
Client:	TEC Ltd	
Report Ref:	DRA-23-1532	
 Site Boundary	Info Source:	TEC Ltd



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Project	Project Dragon, Port Talbot	
Client:	TEC Ltd	
Report Ref:	DRA-23-1532	
Approx. Site Boundary	Info Source:	NCAP

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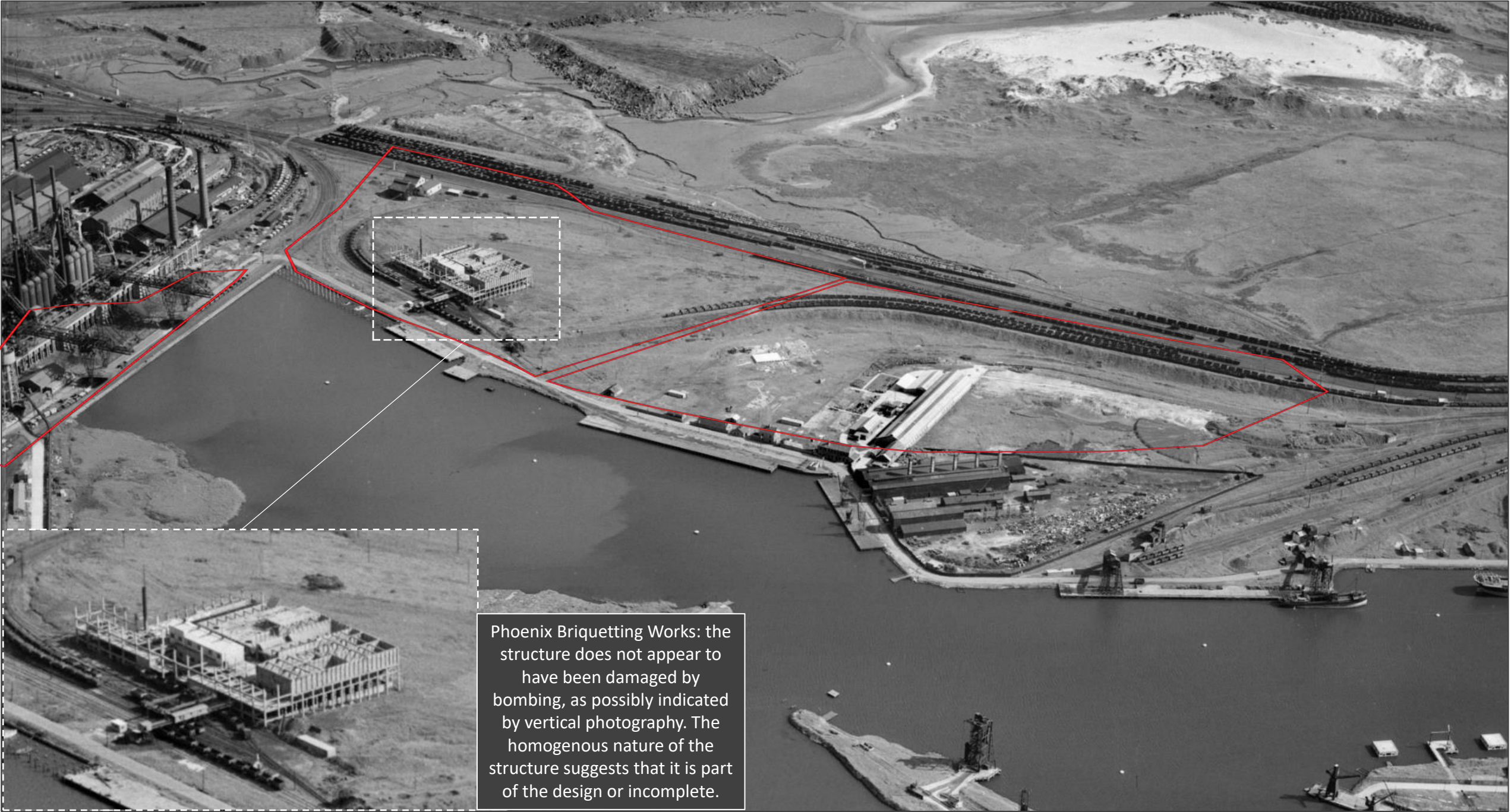


Project	Project Dragon, Port Talbot	
Client:	TEC Ltd	
Report Ref:	DRA-23-1532	
 Approx. Site Boundary	Info Source:	Historic England



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 Hafenanlagen

 Gaswerk

 Umspannwerk

 Eisengießerei

 Steinkohlenbrikettfabrik

 Kupferwerke

 Wasserwerk, Hochbehälter

 Eisenbahnbrücke

 Straßenbrücke

 Fußgängerbrücke, Steg

 Schleuse



Project	Project Dragon, Port Talbot	
Client:	TEC Ltd	
Report Ref:	DRA-23-1532	
 Approx. Site Boundary	Info Source:	Historic England

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Low Risk from German UXBs & HAA Shells

Low-Moderate Risk from German UXBs & HAA Shells

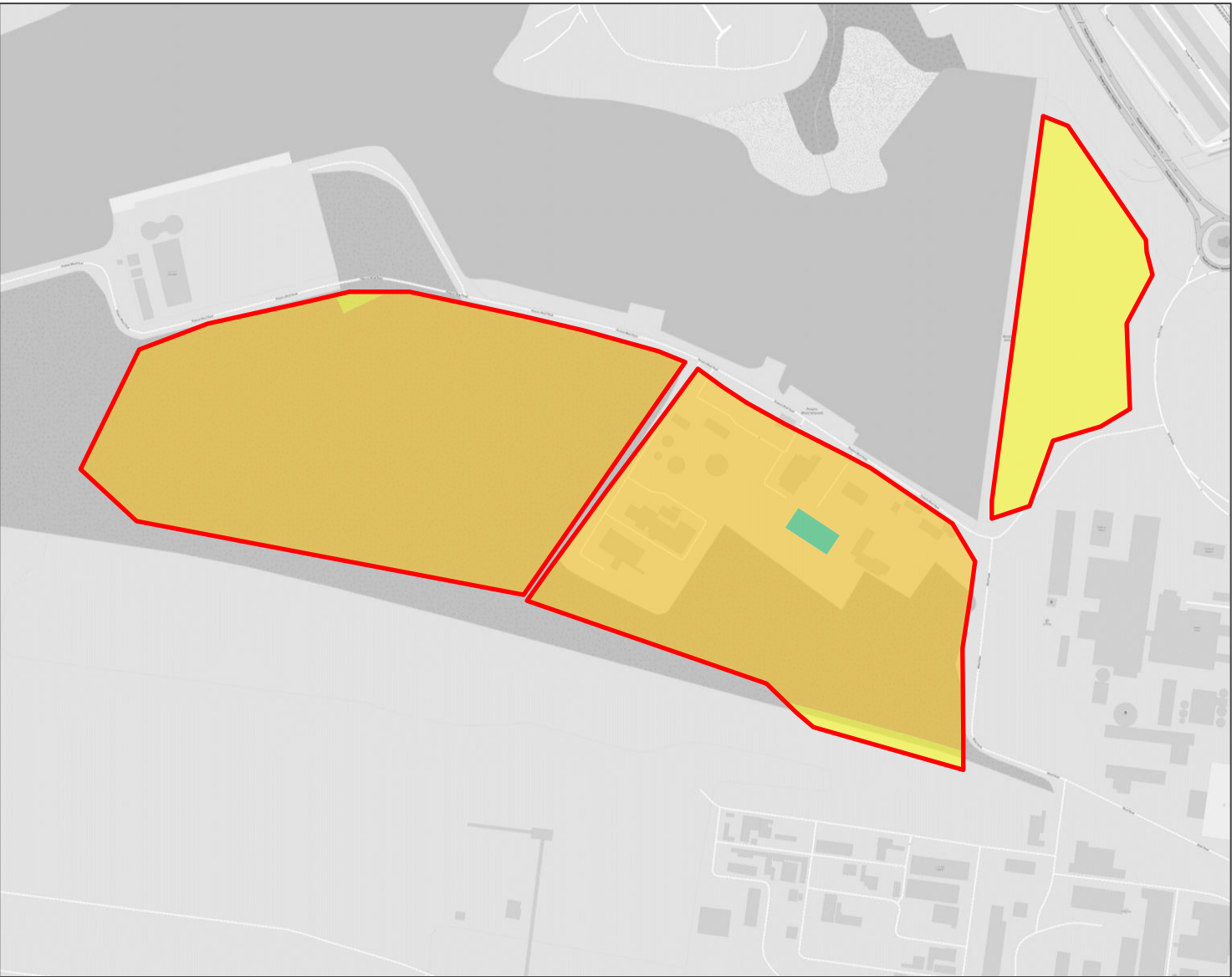
Moderate Risk from German UXBs & HAA Shells

	Project	Project Dragon, Port Talbot	
	Client:	TEC Ltd	
	Report Ref:	DRA-23-1532	
	 Approx. Site Boundary	Info Source:	Google (open-source)

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Appendices: 1 - 5



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Recent German UXB Finds in the UK + Historical Analysis

- **23rd May 2019** - An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Kingston upon Thames, London. *Historical Analysis: The UXB landed in a small residential back garden belonging to an undamaged terraced house. It came to rest approximately 3 to 4m bgl.*
- **15th May 2017** - An SC250 (standard 250kg HE bomb) was found during shallow excavations at a building site in Aston, Birmingham. *Historical Analysis: The UXB landed in a small back garden belonging to a terraced house, part of a row. It J-Curved under a neighbouring garden and came to rest at just 1.4m bgl. NB: These houses had not sustained bomb damage.*
- **2nd March 2017** - A 250kg HE bomb was found during deep excavations at a building site in Brondesbury Park, London. *Historical Analysis: UXB landed in a large residential back garden. A single storey building was built on top of the UXB post-WWII.*
- **19th January 2017** - An SD50 (semi-armour piercing 50kg HE bomb) was dredged from the Thames during barge dredging works near Westminster Bridge, London.
- **12th May 2016** - A 500kg HE bomb was found buried just 1m below the playground of the former Royal High Junior School in Bath. *Historical Analysis: The UXB landed in a plot of neglected, unmaintained vegetation in between the school gym and main school building.*
- **23rd September 2015** - A 1,000kg HE bomb was encountered by a mechanical excavator on a building site in Paradise Street, Coventry. *Historical Analysis: the UXB landed in a large residential back garden occupied by dense vegetation. A two storey building was built on top of the UXB post-WWII.*
- **10th August 2015** - A 250kg HE bomb was found immediately beneath a basement floor during refurbishment works in Temple Street, Bethnal Green (London). *Historical Analysis: The UXB struck a house that had been damaged beyond repair during a previous air raid. The existing house was then built on top of UXB post-WWII.*
- **21st May 2015** - An SC50 (general purpose 50kg HE bomb) was found during deep excavations at a construction site in Wembley, London. *Historical Analysis: UXB landed in a large residential back garden.*
- **23rd March 2015** - A 250kg HE bomb was found during deep excavations at a building site in Grange Walk, Bermondsey (London). *Historical Analysis: inconclusive - reported UXB position is likely inaccurate.*

NB: Domestic UXO finds in the UK are too numerous to list. Between 2006 and 2009, over 15,000 items of British / Allied UXO (excluding small arms ammunition) were found on UK construction sites (CIRIA).

Initiation of WWII Allied Bombs

- **6th January 2014** - Mechanical excavator stuck a WWII bomb in Euskirchen (Germany) causing it to explode, killing the operator and injuring 13 more, two critically. The explosion was so large it damaged buildings 400m away.
- **1st March 2013** - During piling at a construction site in Ludwigshafen (Germany) a small buried WWII bomb exploded, injuring one worker.
- **2nd June 2010** - A British 500kg bomb detonated whilst being defused, killing three EOD engineers in Goettingen, Germany. The bomb was found as builders dug the foundations for a new sports hall. Several houses had their fronts blown off by the blast.
- **19th September 2008** - Seventeen people were injured and buildings were damaged when an excavator apparently drove over and set off a 250kg American bomb at a construction site in Hattingen, Germany.
- **23rd October 2006** - A construction worker breaking up tarmac at the side of a highway near the south-western German town of Aschaffenburg was killed when his machine struck and detonated a WWII bomb. In addition, the blast injured several motorists who were driving past.
- **2006** - A piling rig and dump truck were destroyed when a piling rig struck an Allied bomb on a construction site in Austria.
- **2003** - In the Austrian city of Salzburg, two people were killed while attempting to defuse a 250kg Allied bomb.
- **1994** - At a central Berlin construction site a piling rig struck a large WWII Allied bomb. 3 were killed and 14 more were injured. Dozens of cars in a 250m radius were wrecked, the top 10 floors of neighbouring office building collapsed and human remains were found 100m away.
- **1990** - In Wetzlar (Germany) two EOD engineers were blown up as they removed the detonator of an allied WWII UXB.

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	Client:		TEC Ltd		
	Report Ref:		DRA-23-1532		
		Info Source:	Various		

SC 50

Bomb Weight:

40-54kg (110-119lb)

Explosive Weight:

25kg (55lb)

Filling:

TNT, Amatol or Trialen

Charge/Weight Ratio:

46%

Fuse Type:

Electrical impact fuse or mechanical delayed action fuse

Body Dimensions:

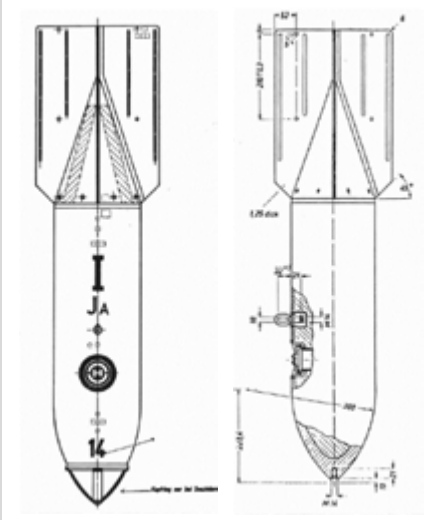
1,100mm length x 200mm diameter

Appearance:

Bomb body and tail painted grey/green with a yellow stripe on the tail unit. Steel construction.

Variants:

8 x variants. Additional fittings: Kopfring nose for limited penetration and Stabbo nose for dive-bombing.





SC 250

Bomb Weight:

245-256kg (540-564lb)

Explosive Weight:

125-130kg (276-287lb)

Filling:

TNT, Amatol and Trialen mix

Charge/Weight Ratio:

44%

Fuse Type:

1 or 2 electrical impact fuse(s) or mechanical delayed action fuse(s)

Body Dimensions:

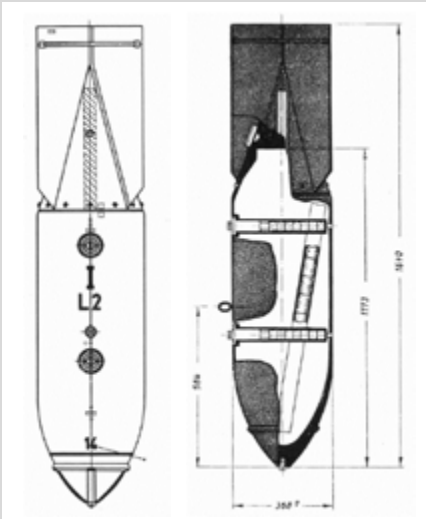
1,173mm length x 368mm diameter

Appearance:

Bomb body and tail painted grey/green with a yellow stripe on the tail unit. Steel construction.

Variants:

8 x variants. Kopfring nose for limited penetration. Stabbo nose for dive-bombing.





SC 500

Bomb Weight:

480-520kg (1,058-1,146lb)

Explosive Weight:

220kg (485lb)

Filling:

TNT, Amatol and Trialen mix

Charge/Weight Ratio:

44%

Fuse Type:

2 electrical impact fuses or mechanical delayed action fuses

Body Dimensions:

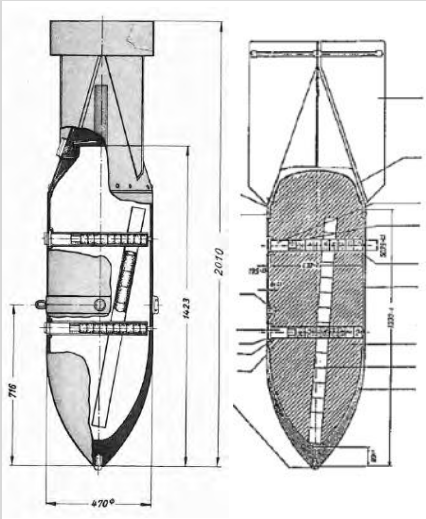
1,423mm length x 470mm diameter

Appearance:

Bomb body and tail painted grey/green or buff with a yellow stripe on the tail unit. Steel construction.

Variants:

3 x variants. Kopfring nose for limited penetration.





Project	Project Dragon, Port Talbot	
Client:	TEC Ltd	
Report Ref:	DRA-23-1532	
	Info Source:	W, Ramsey.1988 / various news sources

B-1E Sub-Munition

Bomb Weight: 1-1.3kg (2.2-2.87lb)

Incendiary Weight: 680g (1.4lb)

Filling: Thermite

Fuse Type: Simple impact fuse

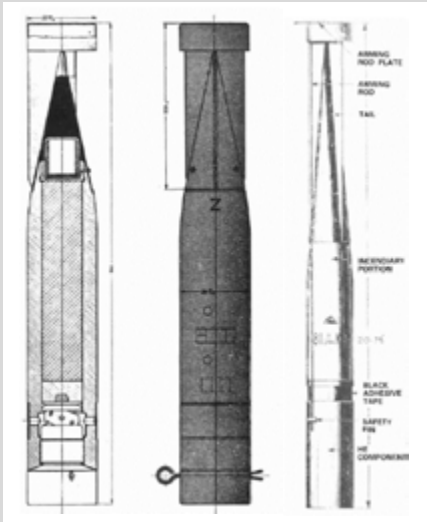
Body Dimensions: 247mm length x 50mm diameter

Appearance: Grey body and dark green painted tail unit. Magnesium alloy case.

Operation: Small percussion charge ignites Thermite (>1,000°C burn).

Variants: Most common variant: B 2EZ (2kg) included a small HE charge

Remarks: Drop containers varied in size. The smallest cluster bomb held 36 x B-1Es and the largest 620 x B-1Es.



Brand C50

Bomb Weight: 41kg (90.4lb)

Incendiary Weight: 13kg (30lb)

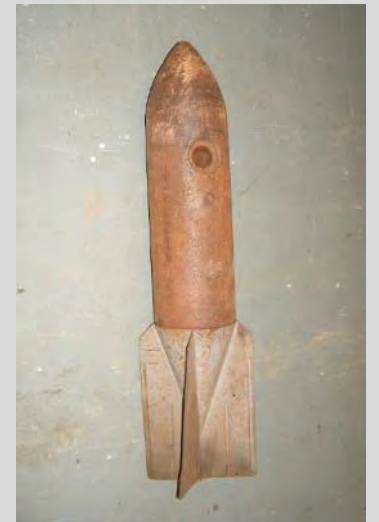
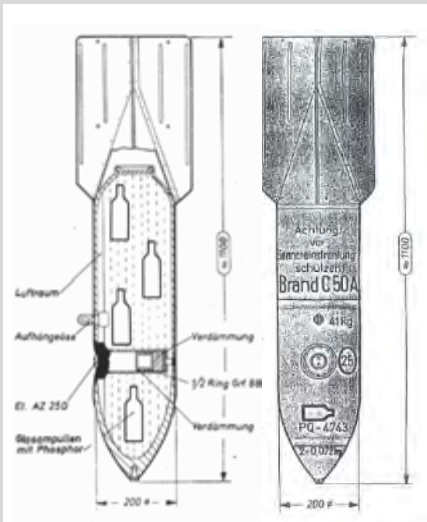
Filling: Main fill (86% Benzine, 10% Rubber) plus 4% Phosphorus in glass bottles

Fuse Type: 1 x electrical impact fuse

Bomb Dimensions: 762mm length x 203mm diameter

Appearance: bomb body and tail painted grey or green with the rear of the bomb painted red and a red band around the centre of the body.

Variants: C 50 B: 77% White Phos fill
C 250 A: 87.7% Petroleum, 11.7% Polystyrene, 0.5% White Phos (185kg version)



Spreng-Brand C50 - Fire Pot

Bomb Weight: 34kg (75lb)

Explosive Weight: 9kg (20lb)

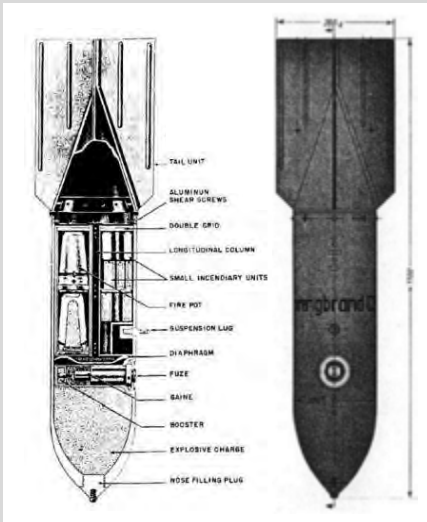
Filling: TNT burster charge, 6 x Thermite containers (fire pots) and 67 x small triangular incendiary elements.

Fuse Type: 1 x electrical impact fuses or aerial burst fuse

Bomb Dimensions: 711mm length x 203mm diameter

Appearance: Bomb body and tail painted grey/green or pale blue with red base plug and red or green incendiary markings. Steel construction.

Operation: A charge blows off the base plate, firing a plume of incendiary mixture 100 yds. Approx 1 second later the HE charge detonates.



Project	Project Dragon, Port Talbot
Client:	TEC Ltd
Report Ref:	DRA-23-1532
Info Source:	W, Ramsey.1988 / various news sources

HAA Battery - 3.7” QF Shell

Shell Weight: 12.7kg

Shell Dimensions: 94mm x 438mm

Fill Weight: 1.1kg

Fill Type: TNT

Fuse Type: Mechanical Time Delay fuse

Appearance: Grey body, copper driving bands, brass neck

Rate of Fire: 10 - 20 rpm

Ceiling: 9,000 - 18,000m

Variants: HE or shrapnel shells.

Note, the 4.5” gun was also used in an HAA role throughout the UK.



LAA Battery - 40mm Bofors Shell

Shell Weight: 0.84kg

Shell Dimensions: 40mm x 180mm

Fill Weight: 70g

Fill Type: TNT

Fuse Type: Impact fuse

Appearance: Grey body, copper driving bands, brass neck

Rate of Fire: 120 rpm

Ceiling: 7,000m

Variants: HE or AP shells. Both with rear tracer compartment



Z Battery - 3” U.P Rocket

Rocket Weight: 24.5kg

Warhead Weight: 1.94kg

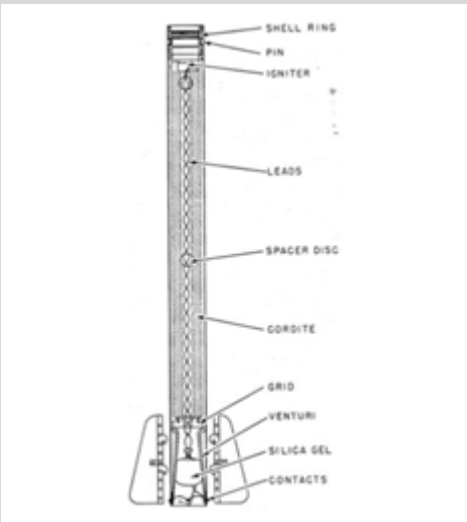
Filling: TNT warhead. Black Powder solid fuel rocket motor.

Fuse Type: Mechanical Time Delay fuse

Rocket Dimensions: 1,930mm x 76mm

Ceiling: 6,770m

Operation: Fired from single, tandem and (later) 36 x rail launchers (Z Batteries). Limited use throughout the UK.



Project

Project Dragon, Port Talbot

Client:

TEC Ltd

Report Ref:

DRA-23-1532

Info Source:

W, Ramsey.1988 / various news sources

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AA	Anti-Aircraft (defences)
AFS	Auxiliary Fire Service
AP	Anti-Personnel
ARP	Air Raid Precautions
ASW	Anti-Submarine Warfare
BDU	Bomb Disposal Unit (historic term for EOD)
Bgl	Below Ground Level
EOC	Explosive Ordnance Clearance
EOD	Explosive Ordnance Disposal
FP	Fire Pot (German bomb)
GI	Ground Investigation
HAA	Heavy Anti-Air (gun battery)
Ha	Hectare (10,000m2)
HE	High Explosive
IB	Incendiary Bomb
Kg	Kilogram
LAA	Light Anti Air (gun battery)
LCC	London County Council
LRRB	Long Range Rocket Bomb (V2)
LSA	Land Service Ammunition
Luftwaffe	German Air Force
OB	Oil Bomb (German bomb)
PM	Parachute Mine (German bomb)
RAF	Royal Air Force
RFC	Royal Flying Corps
RN	Royal Navy (British)
RNAS	Royal Naval Air Service
ROF	Royal Ordnance Factory
SAA	Small Arms Ammunition
SD2	2kg AP bomb (German bomb)
SI	Site Investigation
U/C	Unclassified (German) bomb
UP	Unrotating Projectile (British 3” AA rocket)
USAAF	United States Army Air Force
UX	Unexploded
UXB	Unexploded Bomb
UXO	Unexploded Ordnance
V1	German Flying (pilotless) bomb - “Doodlebug”
V2	German LRRB - “Big Ben”
WAAF	Women’s Auxiliary Air Force
WWI	World War One
WWII	World War Two

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Appendix C

Risk Methodologies and Evaluation

Risk Evaluation

The qualitative assessment methodology presented in CIRIA publication C552 (2001) titled '*Contaminated Land Risk Assessment: A Guide to Good Practice*' has been used by TEC for the basis of evaluating potential risk.

The method requires an assessment of the:

- magnitude of the probability or likelihood of the risk occurring (Table 1); and
- magnitude of the potential consequence or severity of the risk occurring (Table 2)

Table 1. Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the short-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 2. Classification of Consequence

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. (Note: Water Resources Act contains no scope for considering significance of pollution). Catastrophic damage to buildings/property. A short-term risk to a particular ecosystem, or organisation forming part of such ecosystem (note: the definitions of ecological systems within the draft circular on Contaminated Land, DETR, 2000).	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to human health ("significant harm" as defined in DETR, 2000). Pollution of sensitive water resources. (Note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem, (note: the definitions of ecological systems within draft circular on Contaminated Land, DETR, 2000).	Concentration of a contaminant from site exceeding the generic or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ("significant harm" as defined in the draft circular on Contaminated Land, DETR, 2000). Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc), easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discolouration of concrete.

The combination of the two factors is determined using Table 3 and the resulting level of risk is described in Table 4. The evaluation can be applied to each of the scenarios identified in the risk model and the overall risk assessed.

Table 3. Combination of Consequence with Probability

		Consequence			
		Severe	Medium	Mild	Minor
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

Table 4. Description of risks and likely action required

Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the long-term.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Using the risk model the pollutant linkages are identified and a preliminary estimate of risk undertaken. If there is no pollutant linkage identified, then there is no risk. If the estimate of risk for all the linkages and exposure scenarios is very low at this stage then it is likely that no further assessment will be required.

Appendix D

Exploratory Hole Logs



Borehole Log

Borehole No.

BH201

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 15/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277057.00 N188831.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
					0.20	7.40		MADE GROUND: Brown and light grey gravelly silty sand with rare rootlets. Gravel of concrete, sandstone and brick. CONCRETE SLAB.		
					0.40	7.20				End of Borehole at 0.40m
									1	
									2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
				0.20	0.30	01:00				
				0.30	0.40	01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH201A

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 15/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277050.00 N188825.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20	7.40		MADE GROUND: Brown and light grey gravelly silty sand with rare rootlets. Gravel of concrete, sandstone and brick.	1
					0.40	7.20		CONCRETE SLAB.	
								End of Borehole at 0.40m	2
									3
									4

Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
				0.20	0.30	01:00				

Remarks:
No groundwater encountered. Terminated due to refusal.





Borehole Log

Borehole No.

BH201B

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 16/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277037.00 N188820.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		0.00 - 0.50	B	N=14 (1,3/3,3,5,3)	1.00	6.60		MADE GROUND: Brown and light grey gravelly silty sand with rare rootlets. Gravel of concrete, sandstone and brick.	1			
		0.50 - 1.00	B					MADE GROUND: Dark brown slightly sandy gravelly silt with rare rootlets and low cobble content. Gravel of slag and brick. Cobbles of brick and concrete.				
		0.60 - 0.80	ES									
		1.00	D					N=19 (1,1/4,5,5,5)		1.50	6.10	MADE GROUND: Dark grey to greyish brown slightly sandy silty gravel with low cobble content. Gravel of sandstone, concrete and brick. Cobbles of brick.
		1.00 - 3.00	B									
		1.00	SPT									
		2.00	D	N=50 (6,9/50 for 225mm)	3.10	4.50	MADE GROUND: Dark brown and grey gravel with low cobble content. Gravel and cobbles of vesicular slag.	3				
		2.00	SPT									
		2.50 - 2.80	ES									
		3.00	D									
		3.00 - 4.00	B	50 (25 for 75mm/50 for 50mm)	4.00	3.60	End of Borehole at 4.00m	4				
		3.00	SPT									
		3.50 - 3.80	ES									
		4.00	SPT									
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation					
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation		
		4.00	200	3.60	4.00	01:00						
				4.00	4.00	01:00						
Remarks: Groundwater strike at 3.1m. Groundwater resting at 1.7m after 20minutes .Terminated due to refusal.												



Borehole Log

Borehole No.

BH201C

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 16/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277029.00 N188819.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.00	B		0.30	7.30		MADE GROUND: Dark greyish brown slightly sandy gravelly silt. Gravel of concrete and vesicular slag.	1	
								MADE GROUND: Light brown to brownish grey slightly sandy gravelly silt with rare rootlets. Gravel of concrete.		
								MADE GROUND: Dark brown slightly sandy gravelly silt with rare rootlets and low cobble content. Gravel of slag and brick. Cobbles of brick and concrete.		
		1.00 1.00 - 2.00 1.00	D B SPT	N=21 (2,4/5,4,6,6)	1.00	6.60		MADE GROUND: Dark reddish brown slightly sandy silty gravel with low cobble content. Gravel and cobbles of concrete.		
					1.50	6.10				
		2.00 2.00 - 2.50 2.00	D B SPT	50 (25 for 20mm/50 for 0mm)	2.00	5.60		MADE GROUND: Multi-coloured (reddish brown, red, yellowish brown and black) sandy gravel. Gravel of slag, brick, concrete and lime.	2	
		2.50	SPT	50 (25 for 75mm/50 for 0mm)	2.50	5.10		End of Borehole at 2.50m	3	
										4
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		2.50	200	2.00 2.20	2.20 2.50	01:00 01:00				
Remarks:										
No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH201D

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 17/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277024.00 N188819.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.00	B	N=42 (9,8/9,9,11,13)	0.30	7.30		MADE GROUND: Brown and light grey gravelly silty sand with rare rootlets. Gravel of concrete, sandstone and brick.	1	
							MADE GROUND: Dark brown slightly sandy silty gravel with low cobble content. Gravel of concrete and brick. Cobbles of concrete.			
		1.00 1.00 - 2.00 1.00	D B SPT		1.00	6.60		MADE GROUND: Dark brown slightly silty sandy gravel. Gravel of metal ore, vesicular and rounded slag.		
		2.00 2.00	D SPT	50 (25 for 75mm/50 for 0mm)	2.00	5.60		End of Borehole at 2.00m	2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
				2.00 2.50	2.50 2.50	01:00 01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH201E

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 17/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277010.00 N188819.00

Project No. 2111006.006

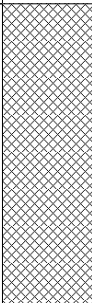
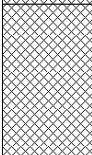
Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.00	B					MADE GROUND: Dark greyish brown slightly sandy gravelly silt. Gravel of concrete and vesicular slag.		
		1.00 1.00 - 1.50 1.00	D B SPT	50 (25 for 35mm/50 for 75mm)	1.00	6.60		MADE GROUND: Dark brown and dark grey slightly sandy gravel. Gravel of slag, concrete and metal piping.	1	
		1.50	SPT	50 (25 for 0mm/50 for 0mm)	1.50	6.10		End of Borehole at 1.50m		
									2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		1.50	200	1.00 1.50	1.30 1.50	01:00 01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH202

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 18/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E277036.00 N188687.00

Project No. 2111006.006

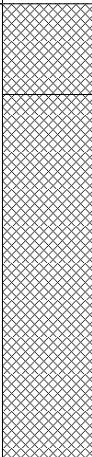
Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.50	B	50 (8,12/50 for 0mm)	0.30	7.30		MADE GROUND: Dark greyish brown slightly sandy gravelly silt. Gravel of concrete and vesicular slag.	1	
		1.00 1.00	D SPT					MADE GROUND: Dark brown slightly sandy gravelly silt with rare rootlets and roots up to 20mm and low cobble content. Gravel of slag and brick. Cobbles of brick and concrete.		
		1.50	SPT		50 (25 for 10mm/50 for 0mm)	1.50	6.10			End of Borehole at 1.50m
									2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		1.50	200	0.00 1.60	0.30 1.70	00:30 01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH202A

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 18/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E276993.00 N188689.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		1.00 1.00 - 1.20 1.00 - 2.00 1.00	D ES B SPT	50 (19,6/50 for 75mm)	0.20	7.40		MADE GROUND: Brown and light grey gravelly silty sand with rare rootlets. Gravel of concrete, sandstone, wood fragments and brick. MADE GROUND: Dark greyish brown slightly sandy gravelly silt. Gravel of concrete and vesicular slag. CONCRETE SLAB. MADE GROUND: Dark brown slightly sandy gravelly silt with rare rootlets. Gravel of slag and brick.	1	
					0.40	7.20				
					0.50	7.10				
		2.00	SPT	50 (25 for 75mm/50 for 0mm)	2.00	5.60		End of Borehole at 2.00m	2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		2.00	200	0.00	0.40	01:00				
				2.00	2.00	01:00				
				1.70	2.00	01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH202B

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 19/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E276990.00 N188690.00

Project No. 2111006.006

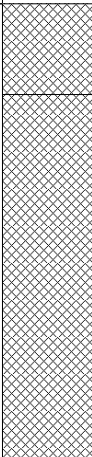
Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.50	B	16 (45 for 115mm/16 for 100mm)	0.30	7.30		MADE GROUND: Dark greyish brown slightly sandy gravelly silt. Gravel of concrete and vesicular slag.	1	
		1.00 1.00	D SPT					MADE GROUND: Dark brown slightly sandy silty gravel with low cobble content. Gravel of concrete, slag and brick. Cobbles of concrete.		
		1.50	SPT		50 (25 for 75mm/50 for 70mm)	1.50	6.10		End of Borehole at 1.50m	2
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		1.50	200	0.00 1.50	0.30 1.60	00:45 02:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Borehole Log

Borehole No.

BH202C

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 19/05/2023

Location: Port Talbot

Contractor: Apex Drilling Services

Co-ords: E276985.00 N188692.00

Project No. 2111006.006

Drilling Equipment: Dando 2000

Level: 7.60m AOD

Hole Type: CP

Logged By: RK

Scale: 1:25

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.00 - 1.50	B	50 (11,14/50 for 75mm)	0.30	7.30		MADE GROUND: Dark brown slightly sandy silty gravel with low cobble content and rare rootlets. Gravel of concrete and brick. Cobbles of concrete.	1	
		1.00 1.00	D SPT					MADE GROUND: Dark brown slightly sandy silty gravel with low cobble content. Gravel of concrete, slag and brick. Cobbles of concrete.		
		1.50	SPT		50 (25 for 15mm/50 for 50mm)	1.50	6.10	End of Borehole at 1.50m		
									2	
									3	
									4	
Hole Diameter		Casing Diameter		Chiselling			Inclination & Orientation			
Depth Base (m)	Diameter (mm)	Depth Base (m)	Diameter (mm)	Depth Top (m)	Depth Base (m)	Duration (hh:mm)	Depth Top (m)	Depth Base (m)	Inclination	Orientation
		1.00	200	0.00 1.40 1.50	0.30 1.40 1.50	00:30 01:00 01:00				
Remarks: No groundwater encountered. Terminated due to refusal.										



Trial Pit Log

Trial Pit No.

TP204

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 27/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E277030.00 N188802.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.20 - 0.40	B					MADE GROUND: (Very dense) brown to light grey slightly clayey slightly silty very sandy gravel with low cobble content and rare fine rootlets. Gravel of concrete, brick, wood fragments and metal wire. Cobbles of concrete.	
	0.40	PID	0.30 ppmv					
	0.50	ES		0.60	7.00			
	0.80	PID	0.20 ppmv				MADE GROUND: Brownish grey silty very sandy gravel with low cobble content. Gravel of concrete, brick, slag and tile fragments.	1
	1.30	ES						
	1.50 - 1.80	B						
				2.10	5.50		End of Trial Pit at 2.10m	2
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
3.20	0.60	Stable						

Remarks:

No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.







Trial Pit Log

Trial Pit No.

TP208A

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 27/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276988.00 N188725.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.30	PID	0.20 ppmv	0.35	7.25		MADE GROUND: (Very dense) greyish brown and grey slightly sandy gravel with low cobble content and rare fine rootlets. Gravel of coke, concrete and brick. Cobbles of concrete.	1
	0.70 0.70 0.80 - 1.00	ES PID B	0.80 ppmv	1.40	6.20		MADE GROUND: Greyish brown silty very sandy gravel with low cobble and boulder content. Gravel of concrete, brick, coke, metal fragments, metal rebar, cloth (fabric) and plastic. Cobbles and boulders of concrete.	2
							End of Trial Pit at 1.40m	3
								4

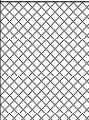
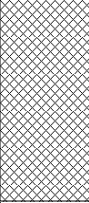
Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
2.30	0.70	Stable						

Remarks:

No groundwater encountered. Terminated due to encountered concrete slab at both eastern and western end of trial pit. All comments made on densities are based on field observations only.



		Trial Pit Log					Trial Pit No. TP209 Sheet 1 of 1	
Project Name: Project Dragon - Temporary Construction Area at Margam Wharf			Client: LanzaTech UK Limited			Date: 27/06/2023		
Location: Port Talbot			Contractor: Tom Prichards Ltd			Co-ords: E277004.00 N188727.00		
Project No. 2111006.006			Drilling Equipment: Volvo ECR880			Level: 7.60m AOD		
Hole Type: TP			Logged By: RK			Scale: 1:25		

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.20 0.20	ES PID	0.30 ppmv	0.40	7.20		MADE GROUND: (Very dense) brownish grey to grey slightly silty sandy gravel rare occasional rootlets. Gravel of concrete, brick and slag.	1
	0.70 0.70 0.80 - 1.00	ES PID B	0.10 ppmv				MADE GROUND: Dark brown and greyish brown silty very sandy, gravel. Gravel of concrete, brick, coke, cloth (fabric) and tiles.	
	1.60			6.00			MADE GROUND: Brown to yellowish brown slightly clayey sandy gravel. Gravel of brick and porcelain fragments.	2
	1.75			5.85			MADE GROUND: Greyish brown and grey mottled slightly gravelly sandy silty silty clay. Gravel of slag.	
	2.00 2.00 2.20 - 2.40	ES PID B	0.10 ppmv	2.50	5.10		End of Trial Pit at 2.50m	3
	2.40 2.40	PP HV	1.9 kg/cm2 77 kPa					
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
2.50	0.55	Stable						

Remarks:
 No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.





Trial Pit Log

Trial Pit No.

TP211

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 27/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276997.00 N188688.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.40 0.40 0.60 - 0.80	ES PID B	0.10 ppmv				MADE GROUND: (Very dense) grey to brownish grey silty very sandy gravel with rare fine rootlets. Gravel of concrete, coke, brick, metal wire, metal fragments, plastic and metal rebar.	1
	1.30 1.30 1.40 - 1.50	ES PID B	0.20 ppmv	1.50 1.80	6.10 5.80		MADE GROUND: (Very dense) brown to purplish brown slightly silty gravel. Gravel of slag, concrete and brick.	
							End of Trial Pit at 1.80m	2
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	Remarks
2.10	0.60	Stable						

Remarks:

No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.





Trial Pit Log

Trial Pit No.

TP213

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 27/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276975.00 N188662.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
				0.15	7.45		MADE GROUND: (Very dense/strongly cemented) purplish brown silty sandy gravel of subrounded to rounded slag.	1
				0.45	7.15		MADE GROUND: (Very dense) grey silty sandy gravel with rare fine rootlets. Gravel of concrete, brick, metal fragments and concrete.	
							End of Trial Pit at 0.45m	2
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
2.50	0.55	Stable						

Remarks:
No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.





Trial Pit Log

Trial Pit No.

TP214

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 18/05/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276967.00 N188611.00

Project No. 2111006.006

Drilling Equipment: JCB 3CX

Level: 7.60m AOD

Hole Type: TP

Logged By: MT

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.20 - 0.60	ES					Brownish grey gravelly silty SAND with low cobble content. Gravel of concrete, slag and metal fragments. Cobbles of slag. (MADE GROUND)	1
	2.10 - 2.40	ES		2.00	5.60		Reinforced concrete slab with 150mm diameter rebar encountered at 1.6mbgl within northern half of trial pit.	2
				2.60	5.00		Dark brown, dark grey and brown mottled sandy GRAVEL of brick, concrete and slag. (MADE GROUND)	
							End of Trial Pit at 2.60m	3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
2.70	0.80	Stable	None					

Remarks:
Groundwater strike at 2.1m. Groundwater resting at 2.0m after 15 minutes.





Trial Pit Log

Trial Pit No.

TP215

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 30/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276963.00 N188593.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.30	PID	0.10 ppmv	0.40	7.20		MADE GOUND: Brownish grey silty sandy gravel with low cobble content and boulder content and occasional fine rootlets. Gravel of concrete, metal wire, metal rebar, rubber, coke and wood fragments. Cobbles and boulders of concrete.	1
	0.60 0.60	ES PID	0.10 ppmv				MADE GROUND: Dark brown to brown slightly silty very sandy gravel with low cobble and boulder content. Gravel of coke, slag, concrete, plastic, cloth (fabric), brick and metal rebar. Cobbles and boulders of concrete and relicts of brick walls.	
	1.00 - 1.20	B		1.50	6.10		End of Trial Pit at 1.50m	2
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
3.50	1.20	Stable						

Remarks:

No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.







Trial Pit Log

Trial Pit No.

TP217

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 30/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E276982.00 N188710.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.10	PID	0.10 ppmv	0.15	7.45		MADE GROUND: (Very dense) grey brownish and grey slightly silty sandy gravel with rare fine rootlets. Gravel of concrete, brick, coke, metal fragments and metal rebar. MADE GROUND: Grey to dark grey, slightly silty sandy gravel with low cobble content. Gravel of coke, slag, concrete, brick, tile, porcelain fragments, plastic, metal wire, metal fragments and rubber matting. Cobbles of coke.	1
	0.80 0.80	ES PID	0.10 ppmv					
	1.20 - 1.40	B		1.60	6.00			
							End of Trial Pit at 1.60m	2
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
3.20	1.00	Stable						

Remarks:

No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.





Trial Pit Log

Trial Pit No.

TP218

Sheet 1 of 1

Project Name: Project Dragon - Temporary Construction Area at Margam Wharf

Client: LanzaTech UK Limited

Date: 30/06/2023

Location: Port Talbot

Contractor: Tom Prichards Ltd

Co-ords: E277016.00 N188742.00

Project No. 2111006.006

Drilling Equipment: Volvo ECR880

Level: 7.60m AOD

Hole Type: TP

Logged By: RK

Scale: 1:25

Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth (m)	Type	Results					
	0.20	PID	0.20 ppmv	0.30	7.30		MADE GROUND: (Very dense) brownish grey to grey slightly silty sandy gravel with rare fine rootlets. Gravel of concrete and coke.	1
	0.40 - 0.60	B					MADE GROUND: Brownish grey, brown and dark brown silty very sandy gravel with low cobble content. Gravel of concrete, slag, metal wire, metal fragments, plastic, iron ore. Cobbles of iron ore.	
	0.60	ES	0.10 ppmv	1.50	6.10		End of Trial Pit at 1.50m	2
	0.60	PID						
								3
								4

Dimensions		Trial Pit Support		Soakage Testing				Remarks
Pit Length (m)	Pit Width (m)	Pit Stability	Shoring Used	Test No.	Date Test	Duration (hh:mm)	Soil Infiltration Rate (m/s)	
2.90	1.00	Stable						

Remarks:

No groundwater encountered. Terminated due to difficulty digging. All comments made on densities are based on field observations only.



Appendix E

Geochemical Certificates of Analysis



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The Old Chapel
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Wells
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i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 23-34973

Project / Site name:	Margam Wharf Port Talbot	Samples received on:	22/05/2023
Your job number:	2111006-006	Samples instructed on / Analysis started on:	22/05/2023
Your order number:		Analysis completed by:	05/06/2023
Report Issue Number:	1	Report issued on:	05/06/2023
Samples Analysed:	2 leachate samples - 4 soil samples		

Signed: _____

Joanna Wawrzeczko
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-34973
Project / Site name: Margam Wharf Port Talbot

Lab Sample Number				2686383	2686384	2686385	2686386
Sample Reference				TP214	TP214	BH201B	BH201B
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.20-0.60	2.10-2.40	0.60-0.80	2.50-2.80
Date Sampled				18/05/2023	18/05/2023	18/05/2023	18/05/2023
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	8.6	22	7.9	12
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	0.3

Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	JBH	JBH	JBH	JBH

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	11.3	10.4	11.3	8.9
Electrical Conductivity	µS/cm	10	ISO 17025	680	310	730	280
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	2.4	150
Complex Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	2.4	120
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	31
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2900	1300	2500	830
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.19	0.17	0.12	0.11
Sulphide	mg/kg	1	NONE	41	13	81	3.2
Water Soluble Chloride (2:1)	mg/kg	1	MCERTS	32	20	100	37
Ammoniacal Nitrogen as NH ₄	mg/kg	0.5	MCERTS	< 0.5	< 0.5	1.2	< 0.5
Fraction Organic Carbon (FOC) Automated	N/A	0.001	MCERTS	0.01	0.023	0.0088	0.018
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1	2.3	0.9	1.8

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
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Speciated PAHs

Naphthalene	mg/kg	0.05	NONE	0.47	1.2	0.14	0.3
Acenaphthylene	mg/kg	0.05	NONE	0.09	< 0.05	0.11	0.12
Acenaphthene	mg/kg	0.05	NONE	0.66	5.5	0.19	0.24
Fluorene	mg/kg	0.05	NONE	0.63	5.7	0.27	0.24
Phenanthrene	mg/kg	0.05	NONE	7.2	63	1.6	2.3
Anthracene	mg/kg	0.05	NONE	1.7	17	0.31	0.57
Fluoranthene	mg/kg	0.05	NONE	9.9	70	2.5	3.5
Pyrene	mg/kg	0.05	NONE	8.7	61	1.9	3
Benzo(a)anthracene	mg/kg	0.05	NONE	5	30	1.2	2.3
Chrysene	mg/kg	0.05	NONE	4.7	29	1.1	2
Benzo(b)fluoranthene	mg/kg	0.05	NONE	5.9	30	1.6	3
Benzo(k)fluoranthene	mg/kg	0.05	NONE	1.7	11	0.46	0.82
Benzo(a)pyrene	mg/kg	0.05	NONE	4.1	25	0.93	1.8
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	2.2	13	0.62	1.2
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	0.58	3.3	0.21	0.35
Benzo(ghi)perylene	mg/kg	0.05	NONE	2.3	14	0.67	1.2

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	NONE	56	379	13.7	22.8
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Analytical Report Number: 23-34973
Project / Site name: Margam Wharf Port Talbot

Lab Sample Number	2686383	2686384	2686385	2686386
Sample Reference	TP214	TP214	BH201B	BH201B
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.20-0.60	2.10-2.40	0.60-0.80	2.50-2.80
Date Sampled	18/05/2023	18/05/2023	18/05/2023	18/05/2023
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

Heavy Metals / Metalloids

Antimony (aqua regia extractable)	mg/kg	1	ISO 17025	< 1.0	6.5	< 1.0	14
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	10	30	8	31
Barium (aqua regia extractable)	mg/kg	1	MCERTS	160	230	170	330
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.8	1.3	0.83	1.5
Boron (water soluble)	mg/kg	0.2	MCERTS	5.4	6.5	3.4	1.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.5	< 0.2	0.4	3.1
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	300	89	290	70
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	12	14	5.2	14
Copper (aqua regia extractable)	mg/kg	1	MCERTS	120	760	28	210
Iron (aqua regia extractable)	mg/kg	40	MCERTS	180000	91000	86000	160000
Lead (aqua regia extractable)	mg/kg	1	MCERTS	85	190	87	1300
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	17000	4600	11000	3300
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	3.4
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	2.2	3.5	1.4	3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	30	33	14	32
Phosphorus (aqua regia extractable)	mg/kg	20	ISO 17025	2600	1100	2500	2000
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Tin (aqua regia extractable)	mg/kg	1	MCERTS	23	110	6.2	33
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	350	100	230	150
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	270	530	200	3800

Calcium (aqua regia extractable)	mg/kg	20	ISO 17025	170000	88000	280000	120000
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	21000	7800	31000	5600
Potassium (aqua regia extractable)	mg/kg	20	ISO 17025	770	1400	1100	1400
Sodium (aqua regia extractable)	mg/kg	20	ISO 17025	640	730	790	520

Monoaromatics & Oxygenates###

Benzene	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Toluene	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Ethylbenzene	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
p & m-xylene	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
o-xylene	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0