OMEGA ZONE 8, ST HELENS

Omega St Helens Ltd / T. J. Morris Limited

Document Title
ES Vol. 2 Appendix 1.1
EIA Scoping Report
Document No. OPP DOC.11.18e

Appendix E

BGS BOREHOLE LOG AND COAL AUTHORITY REPORT

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Site	Number
M62 Package 5 [A569 to J8]	WS/M62/5/08

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Drive-in Window Sampler	101mm to 0.00m	24.32	AmeyMouchel	1304
	Location	**Dates**	**Engineer**	**Sheet**
	355339.57 E 390925.19 N	03/07/2006	ATKINS	1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
0.00-0.50	B27434				(0.50)	MADE GROUND: Grass over brown slightly clayey sandy slightly gravelly topsoil. Gravel is angular and subangular medium to coarse of limestone and concrete.		
0.50-1.20	B27434			23.82	0.50	MADE GROUND: Red very clayey/silty very gravelly fine to coarse sand with occasional angular and subangular sandstone cobbles. Gravel is angular and subangular fine to coarse of sandstone and limestone.		
1.20-2.00	L27434				(1.20)			
2.00 2.00-3.00	D27434 L27434			22.62	1.70	MADE GROUND: Stiff dark brown slightly sandy slightly gravelly clay. Gravel is subangular fine of coal, mudstone and sandstone.		
					(1.30)			
3.00 3.00-4.00	D27434 L27435			21.32	3.00	Stiff grey/brown slightly sandy gravelly CLAY. Gravel is subrounded and subangular fine to coarse of mudstone, coal and sandstone [Possible Embankment fill].		
					(1.10)			
4.00 4.00-5.00	D27435 L27435			20.22	4.10	Stiff grey/brown slightly sandy gravelly CLAY. Gravel is subrounded and subangular fine to coarse of mudstone, coal and sandstone.		
5.00 5.00-6.00	D27435 L27435							
6.00 6.00-7.00	D27435 L27435				(3.90)			
7.00 7.00-8.00	D27435 L27435							
8.00	D27435		03/07/2006:	16.32	8.00	Complete at 8.00m		

Remarks

Scale (approx)	Logged By
1:50	PH

Figure No.

The Coal Authority

Resolving the impacts of mining

CON29M Non-Residential Mining Report

OMGEA WEST
WARRINGTON
WA5 3UZ

Date of enquiry:	03 January 2019
Date enquiry received:	03 January 2019
Issue date:	03 January 2019
Our reference:	51001980112001
Your reference:	

CON29M Non-Residential Mining Report

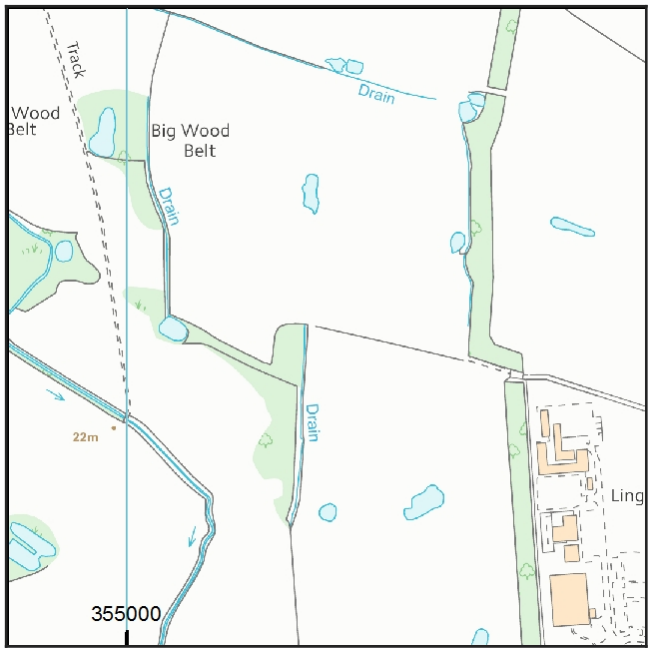
This report is based on, and limited to, the records held by the Coal Authority, at the time we answer the search.

Client name

Jessica Kinchington

Enquiry address

OMGEA WEST, WARRINGTON, WA5 3UZ



Approximate position of property

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

/company/the-coal-authority
/thecoalauthority
/coalauthority

Summary

Has the search report highlighted evidence or potential of		
1	Past underground coal mining	Yes
2	Present underground coal mining	No
3	Future underground coal mining	Yes
4	Mine entries	No
5	Coal mining geology	No
6	Past opencast coal mining	No
7	Present opencast coal mining	No
8	Future opencast coal mining	No
9	Coal mining subsidence	Yes
10	Mine gas	No
11	Hazards related to coal mining	No
12	Withdrawal of support	Yes
13	Working facilities order	No
14	Payments to owners of former copyhold land	No

Further recommended reports
Coal mining subsidence claims 50m buffer report
Coal mining subsidence claims history

For detailed findings, please go to page 4.

Detailed findings

1. Past underground coal mining

The property is in a surface area that could be affected by underground mining in 7 seams of coal at 630m to 960m depth, and last worked in 1984.

Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.

2. Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3. Future underground coal mining

The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

5. Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6. Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7. Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8. Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9. Coal mining subsidence

A damage notice or claim for alleged subsidence damage was made in July 2002 for ARABLE LAND AT MOATHOUSE FARM, BURTONWOOD, WARRINGTON, CHESHIRE. However, the claim was rejected.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

There are a further 2 claim(s) within 50 metres of the property boundary that do not match the property address. These are shown on the enquiry boundary plot.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.
If further subsidence damage claims information is required, please visit www.groundstability.com.

10. Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11. Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Coal Authority, under its Emergency Surface Hazard Call Out procedures.

12. Withdrawal of support

The property is in an area where notices to withdraw support were given in 1976.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13. Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14. Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Additional remarks

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Disclaimer

Alternative formats

If you would like this report in an alternative format, please contact our communications team.

Enquiry boundary

The map image is too large for this page and will be sent in a separate document

How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

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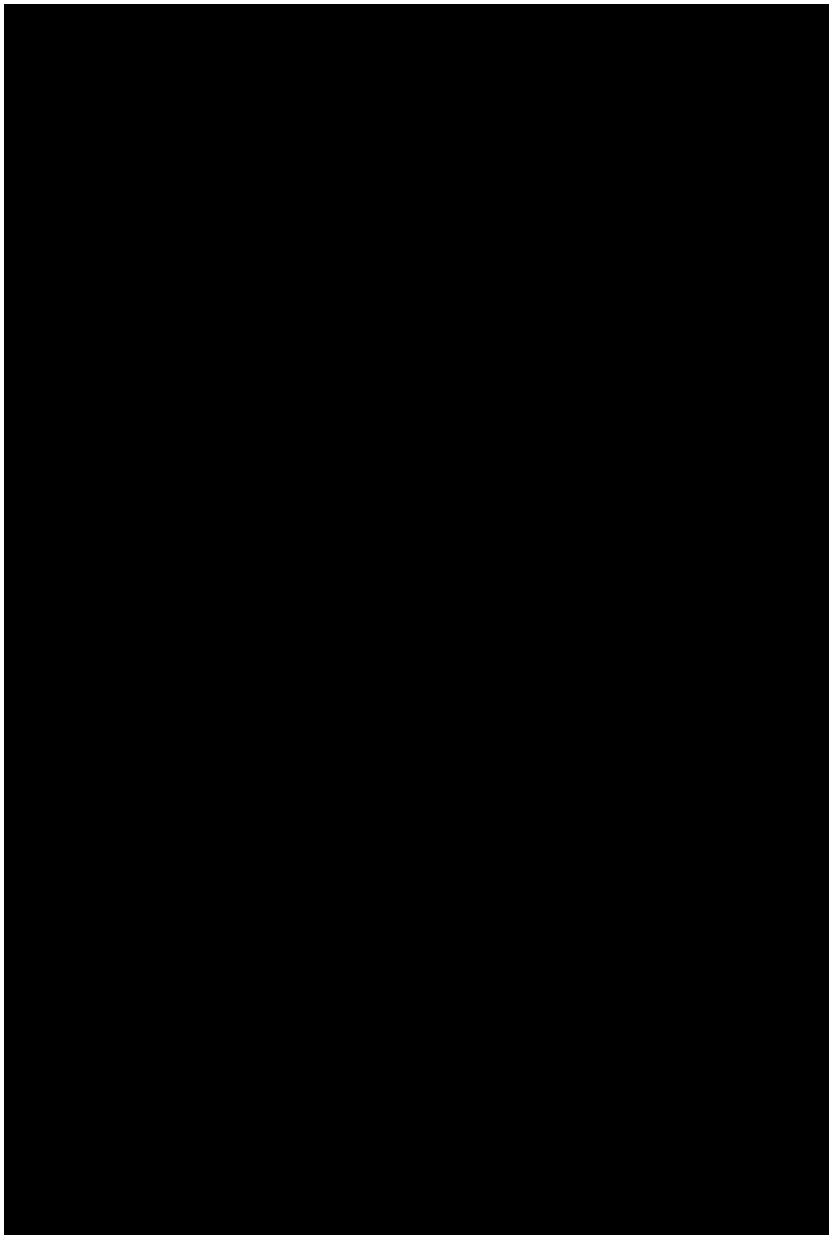
/coalauthority

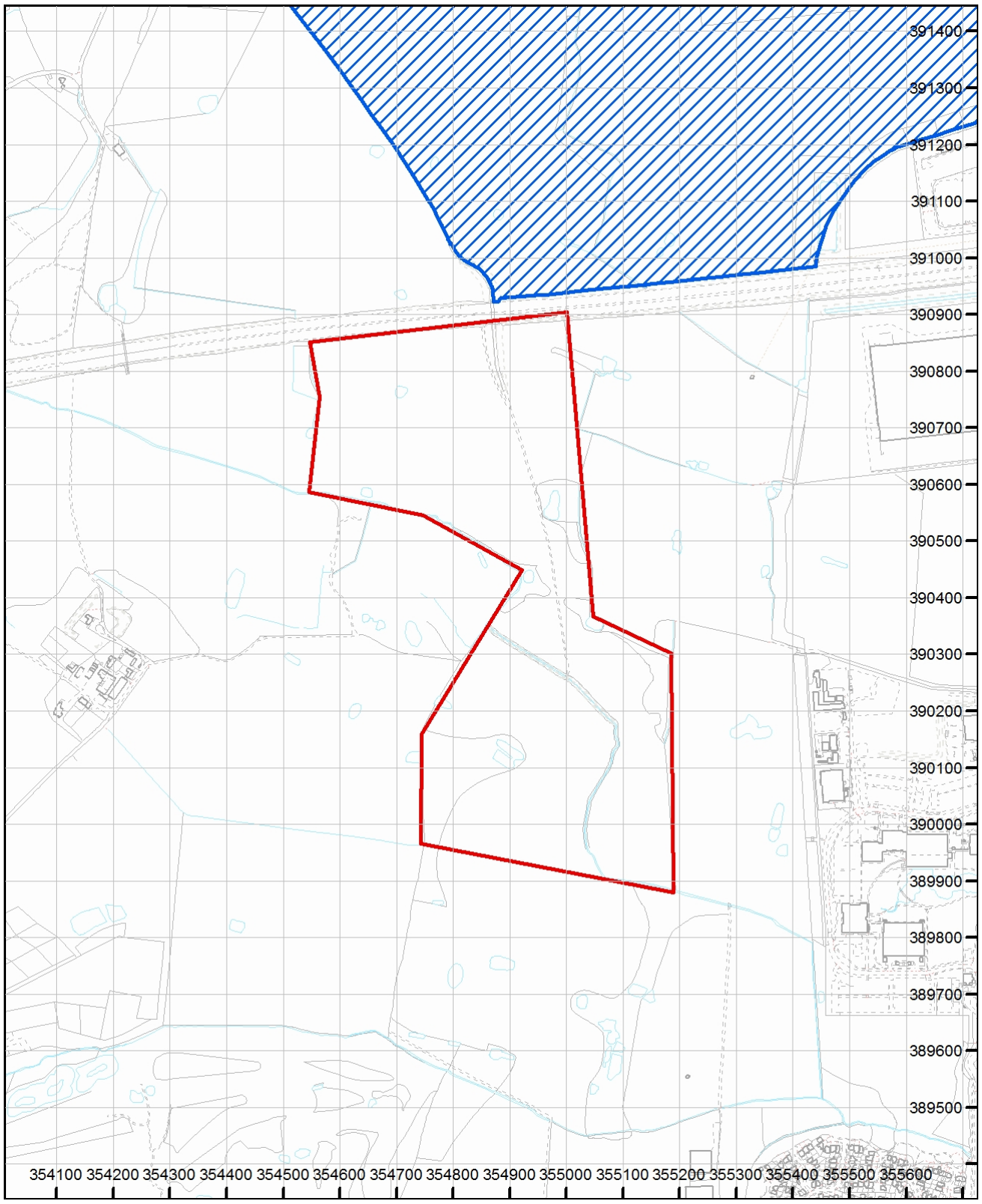


Enquiry boundary

Key

Approximate position of enquiry boundary shown

Coal claims



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www.groundstability.com

@coalauthority
/company/the-coal-authority
/thecoalauthority
/thecoalauthority

CON29M Non-Residential Mining Report, reference 51002108134001

The Coal Authority

CON29M
coal mining report

OMEGA WEST , WARRINGTON , CHESHIRE, WA5 3UZ

Known or potential coal mining risks

Further action

These additional reports can give further detail on the risks identified:

- Subsidence claims 50m buffer report

For more information please see our Further action reports on page 8

Professional opinion

According to the official mining information records held by the Coal Authority at the time of this search, evidence of, or the potential for, coal mining related features have been identified. It is unlikely that these features will impact on the stability of the enquiry boundary.

Enquiry boundary

The map image is too large for this page and will be sent in a separate document

We can confirm that the location is
on the coalfield

This report is prepared in accordance with the latest Law Society's Guidance Notes 2018, the User Guide 2018 and the Coal Authority's Terms and Conditions applicable at the time the report was produced.

Accessibility

If you would like this information in an alternative format, please contact our communications team on 0345 762 6848 or email communications@coal.gov.uk.

Detailed findings

Information provided by the Coal Authority in this report is compiled in response to the Law Society's CON29M Coal Mining enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL.

1 Past underground coal mining

The property is in a surface area that could be affected by underground mining in 8 seams of coal at 630m to 960m depth, and last worked in 1984.

Any movement in the ground due to coal mining activity associated with these workings should have stopped by now.

2 Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3 Future underground coal mining

The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods.

The property is not in an area where a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area likely to be affected from any planned future underground coal mining.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4 Mine entries

There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.

5 Coal mining geology

The Coal Authority is not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.

6 Past opencast coal mining

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

7 Present opencast coal mining

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

8 Future opencast coal mining

There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

9 Coal mining subsidence

There is a claim within 50 metres of the property boundary that does not match the property address. This is shown on the enquiry boundary plot.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Coal Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

If further subsidence damage claims information is required, please visit www.groundstability.com.

10 Mine gas

The Coal Authority has no record of a mine gas emission requiring action.

11 Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Coal Authority, under its Emergency Surface Hazard Call Out procedures.

12 Withdrawal of support

The property is in an area where notices to withdraw support were given in 1976.

The property is not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.

13 Working facilities order

The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14 Payments to owners of former copyhold land

The property is not in an area where a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Statutory cover

Coal mining subsidence

In the unlikely event of any coal mining related subsidence damage, the Coal Authority or the mine operator has a duty to take remedial action in respect of subsidence caused by the withdrawal of support from land or property in connection with lawful coal mining operations.

When the works are the responsibility of the Coal Authority, our dedicated public safety and subsidence team will manage the claim. The house or land owner ("the owner") is covered for these works under the terms of the Coal Mining Subsidence Act 1991 (as amended by the Coal Industry Act 1994). Please note, this Act does not apply where coal was worked or gotten by virtue of the grant of a gale in the Forest of Dean, or any other part of the Hundred of St. Briavels in the county of Gloucester.

The owner therefore shouldn't incur cost or liability from repairs caused by the withdrawal of support from land and/or property in connection with lawful coal mining operations. Usually these actions will not need to involve your insurance company or mortgage lender.

Coal mining hazards

Our public safety and subsidence team provide a 24 hour a day, 7 days a week hazard reporting service, to help protect the public from hazards caused by past coal workings, such as a mine shaft or shallow working collapse. To report any hazards please call 01623 646 333. Further information can be found on our website: www.gov.uk/coalauthority.

Glossary

Key terms

adit - horizontal or sloped entrance to a mine

coal mining subsidence - ground movement caused by the removal of coal by underground mining

Coal Mining Subsidence Act 1991 - the Act setting out the duties of the Coal Authority to repair damage caused by coal mining subsidence

coal mining subsidence damage - damage to land, buildings or structures caused by the removal of coal by underground mining

coal seams - bed of coal of varying thickness

future opencast coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal from the surface

future underground coal mining - a licence granted, or licence application received, by the Coal Authority to excavate coal underground. Although it is unlikely, remaining coal reserves could create a possibility for future mining, which would be licensed by the Coal Authority

mine entries - collective name for shafts and adits

payments to owners of former copyhold land - historically, copyhold land gave rights to coal to the copyholder. Legislation was set up to allow others to work this coal, but they had to issue a notice and pay compensation if a copyholder came forward

shaft - vertical entry into a mine

site investigation - investigations of coal mining risks carried out with the Coal Authority's permission

stop notice - a delay to repairs because further coal mining subsidence damage may occur and it would be unwise to carry out permanent repairs

subsidence claim - a formal notice of subsidence damage to the Coal Authority since it was established on 31 October 1994

withdrawal of support - a historic notice informing landowners that the coal beneath their property was going to be worked

working facilities orders - a court order which gave permission, restricted or prevented coal mine workings

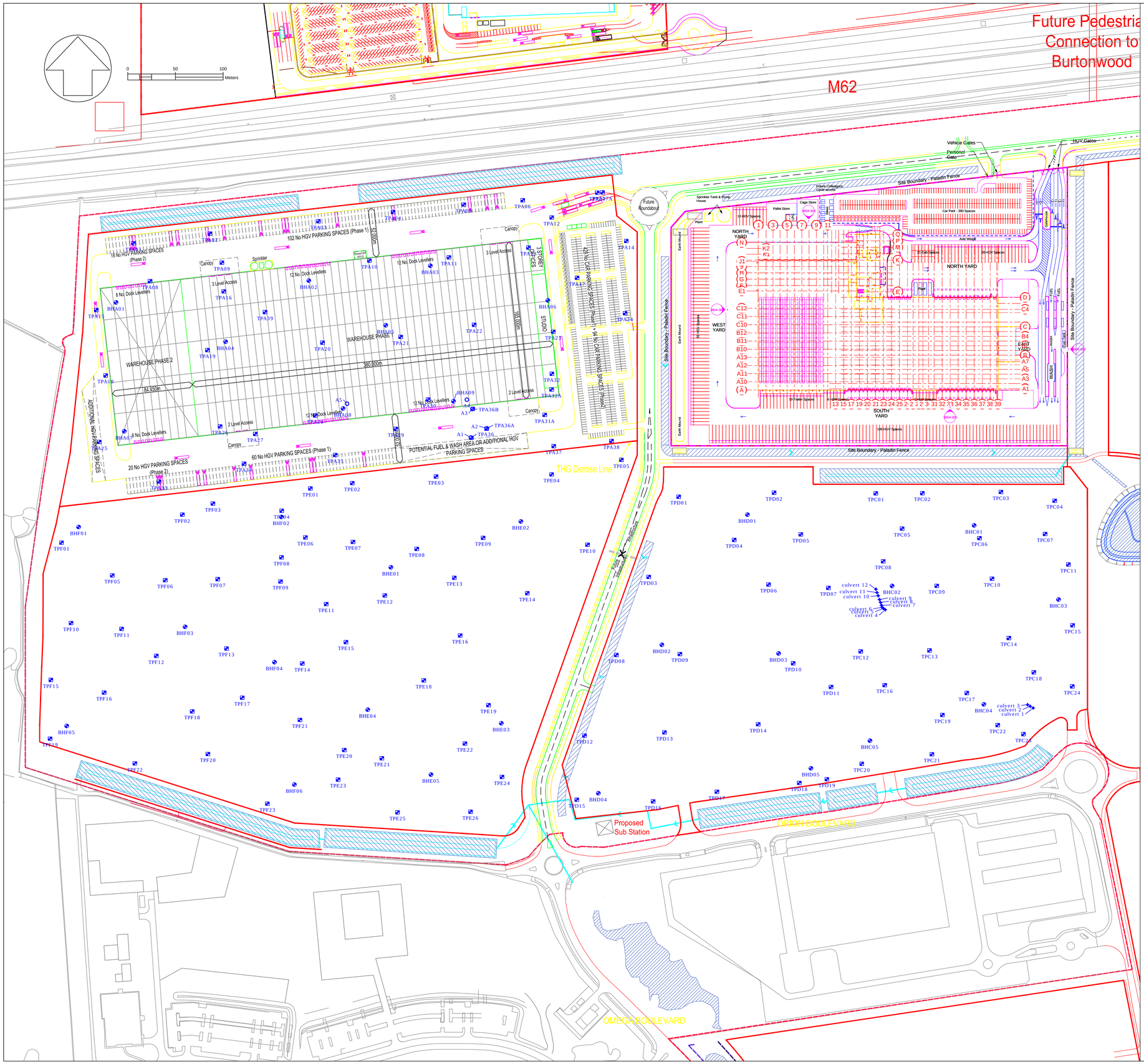
Further action reports

Subsidence claims 50m buffer report - gives information on coal mining subsidence claims within 50 metres of the property boundary. To order this report, use the same boundary as the CON29M mining report.

For more information and to order this report please visit:
https://www2.groundstability.com/subsidence-50m-buffer

Appendix F

EXCERPTS FROM GROUND INVESTIGATIONS REPORT ADJACENT TO SITE



Hole ID	Easting (mE)	Northing (mN)	Level (mOD)
A1	355835.382	390076.950	20.785
A2	355852.139	390086.611	20.744
A3	355837.031	390756.798	20.986
A4	355831.103	390765.570	21.044
A5	355705.653	390712.381	21.288
BHA01	355463.767	390818.371	21.528
BHA02	355665.647	390841.238	20.815
BHA03	355792.918	390856.783	20.558
BHA04	355578.530	390777.258	21.383
BHA05	355746.279	390794.424	20.766
BHA06	355916.038	390820.491	20.393
BHA07	355472.414	390683.411	21.888
BHA08	355751.486	390707.355	21.102
BHA09	355817.181	390714.860	21.220
BHC01	354361.457	390584.866	21.550
BHC02	354276.549	390521.460	20.208
BHC03	354650.847	390507.238	20.060
BHC04	354317.591	390387.448	20.068
BHC05	354253.340	390359.897	20.248
BHD01	354125.046	390596.098	18.909
BHD02	354035.400	390453.788	20.610
BHD03	354157.686	390450.789	20.434
BHD04	353968.911	390304.353	20.486
BHD05	354181.514	390380.463	20.486
BHE01	357751.598	390540.960	20.663
BHE02	358867.786	390589.019	20.381
BHE03	358867.296	390377.624	20.629
BHE04	357727.390	390381.845	21.073
BHE05	357769.628	390321.889	20.640
BHF01	355424.575	390583.161	21.659
BHF02	355636.929	390593.692	21.483
BHF03	355536.081	390478.653	21.025
BHF04	355629.703	390441.623	21.061
BHF05	354412.104	390374.762	20.800
BHF06	355650.578	390313.423	20.614
culvert 1	354424.241	390393.596	18.697
culvert 2	354421.203	390395.371	20.287
culvert 3	354418.439	390397.064	20.360
culvert 4	354269.312	390486.548	19.179
culvert 5	354267.330	390487.597	19.314
culvert 6	354266.151	390489.100	19.271
culvert 7	354265.474	390501.153	19.104
culvert 8	354264.422	390504.172	19.119
culvert 9	354263.239	390507.258	19.169
culvert 10	354262.006	390511.191	19.201
culvert 11	354260.724	390514.509	19.199
culvert 12	354259.525	390518.079	19.212
TPA01	355481.934	390880.347	20.992
TPA02	355561.915	390890.464	20.743
TPA03	355675.751	390903.480	19.992
TPA04	355713.883	390913.156	19.968
TPA05	355827.932	390920.909	20.162
TPA06	355889.688	390925.426	20.471
TPA07	355967.796	390931.305	20.680
TPA07A	355973.211	390933.635	20.651
TPA08	355499.405	390840.083	21.052
TPA09	355574.611	390850.063	20.983
TPA10	355729.070	390862.253	20.259
TPA11	355812.400	390871.611	20.026
TPA12	355920.036	390907.349	20.372
TPA13	355895.646	390875.859	20.686
TPA14	355998.139	390882.730	20.842
TPA15	355443.045	390820.454	21.757
TPA16	355576.565	390829.964	21.143
TPA17	355946.563	390944.186	20.334
TPA18	355452.917	390741.890	22.034
TPA19	355539.477	390758.466	21.466
TPA20	355679.982	390776.275	21.229
TPA21	355761.835	390782.313	20.562
TPA22	355838.797	390794.970	20.576
TPA23	355921.690	390787.714	20.351
TPA24	355996.875	390807.101	20.075
TPA25	355446.236	390672.399	21.724
TPA26	355717.678	390698.570	21.353
TPA27	355609.608	390680.659	21.410
TPA28	355672.533	390699.988	21.356
TPA29	355756.894	390681.993	20.988
TPA30	355790.543	390756.728	21.457
TPA31A	355921.699	390701.623	20.317
TPA32	355920.188	390761.649	20.259
TPA32A	355919.871	390737.254	20.343
TPA33	355558.846	390630.766	21.440
TPA34	355597.814	390669.573	21.369
TPA35	355693.351	390658.626	21.153
TPA36	355835.818	390675.597	20.688
TPA36A	355851.878	390686.168	20.693
TPA36B	355837.304	390706.905	20.925
TPA37	355922.176	390667.831	20.427
TPA38	355982.643	390673.354	20.372
TPA39	355619.775	390808.249	21.062
TPC01	354259.432	390618.497	19.776
TPC02	354304.181	390618.680	20.914
TPC03	354390.493	390618.909	21.466
TPC04	354446.800	390610.710	20.768
TPC05	354287.012	390581.537	20.897
TPC06	354368.021	390571.604	21.402
TPC07	354436.756	390575.814	20.579
TPC08	354267.175	390547.395	20.283
TPC09	354323.279	390521.554	20.850
TPC10	354381.178	390529.064	21.010
TPC11	354461.181	390543.955	20.332
TPC12	354243.630	390452.880	19.922
TPC13	354315.720	390453.937	19.502
TPC14	354398.808	390466.893	19.601
TPC15	354465.570	390480.230	19.709
TPC16	354268.759	390417.587	19.404
TPC17	354354.763	390409.320	20.110
TPC18	354424.939	390410.996	19.970
TPC19	354329.202	390386.320	20.852
TPC20	354244.710	390385.346	20.307
TPC21	354318.227	390345.178	20.606
TPC22	354387.138	390375.770	20.585
TPC23	354414.138	390366.217	20.638
TPC24	354465.197	390416.268	20.186
TPD01	354052.992	390614.902	20.138
TPD02	354132.926	390619.118	19.592
TPD03	354021.567	390530.960	20.192
TPD04	354111.128	390569.687	20.045
TPD05	354180.924	390575.484	19.576
TPD06	354147.149	390522.929	19.908
TPD07	354229.806	390519.475	20.007
TPD08	353987.745	390449.192	20.537
TPD09	354054.128	390450.159	20.709
TPD10	354172.908	390440.487	20.383
TPD11	354212.601	390415.699	19.905
TPD12	353954.347	390364.797	20.185
TPD13	354038.132	390368.047	20.277
TPD14	354136.298	390376.621	20.423
TPD15	353946.288	390297.587	20.275
TPD16	354026.230	390295.845	20.526
TPD17	354093.040	390305.968	20.483
TPD18	354179.272	390315.157	20.726
TPD19	354258.208	390319.009	20.581
TPE01	355667.242	390623.546	21.360
TPE02	355711.151	390628.145	21.081
TPE03	355798.900	390636.051	20.910
TPE04	355919.938	390638.277	20.646
TPE05	355963.991	390653.516	20.550
TPE06	355662.095	390572.246	21.375
TPE07	355711.899	390567.597	21.011
TPE08	355778.703	390560.276	20.690
TPE09	355848.162	390571.846	20.441
TPE10	355957.566	390564.622	20.177
TPE11	355618.842	390502.307	21.091
TPE12	355745.207	390511.494	20.732
TPE13	355818.005	390520.965	20.589
TPE14	355894.447	390513.889	20.589
TPE15	355704.542	390462.666	21.061
TPE16	355824.194	390469.567	20.670
TPE18	355786.075	390422.583	20.556
TPE19	355813.747	390391.627	20.732
TPE20	355702.730	390349.656	20.844
TPE21	355742.107	390341.007	20.960
TPE22	355829.190	390345.456	20.853
TPE23	355686.394	390316.666	20.822
TPE24	355867.956	390321.445	20.479
TPE25	355758.565	390284.377	20.625
TPE26	355815.037	390285.030	20.317
TPF01	355406.646	390566.822	21.558
TPF02	355533.167	390596.119	21.477
TPF03	355565.167	390607.755	21.360
TPF04	355637.251	390600.256	21.619
TPF05	355459.812	390532.476	21.523
TPF06	355513.279	390527.478	21.305
TPF07	355570.270	390528.624	21.287
TPF08	355637.046	390515.413	23.417
TPF09	355636.002	390526.111	23.400
TPF10	355416.634	390481.623	20.802
TPF11	355469.574	390470.486	20.838
TPF12	355505.908	390448.271	20.641
TPF13	355579.420	390455.927	20.875
TPF14	355618.813	390440.282	21.084
TPF15	355395.467	390421.047	20.984
TPF16	355451.291	390409.786	20.773
TPF17	355595.900	390404.491	20.885
TPF18	355543.511	390390.045	20.964
TPF19	355394.648	390361.519	20.718
TPF20	355559.896	390345.462	21.321
TPF21	355636.325	390381.153	20.718
TPF22	355483.463	390335.631	20.907
TPF23	355622.253	390293.475	20.678

Key

- Borehole
- Trial Pit
- Asbestos-Containing Material Sample Point
- Culvert

geotechnics

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www.geotechnics.co.uk

Engineer:
WSP Environmental Limited

Client:
Omega Warrington Limited

Project:
Omega South - Zone 7

Drawing Title:
Exploratory Hole Location Plan

Scale: 1:2000@A1

Date:
June 2014

Project No:
PN143109

File Name:
Geo-PN143109-001(1)

BOREHOLE RECORD – Cable Percussion

Project	OMEGA SOUTH - ZONE 7	Engineer	WSP ENVIRONMENTAL LIMITED	Borehole / Project No	BHA01 / PN143109
Client	OMEGA WARRINGTON LIMITED	National Grid Coordinates	355463.8 E, 390818.4 N	Ground Level	21.53 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Level m OD
							G.L.	21.53
0.00- 0.50	B					Grass over TOPSOIL: Dark brown slightly gravelly clayey fine to coarse sand with some rootlets.		
0.10- 0.50	B							
0.10	ES					Gravel is fine to coarse angular to subangular of various lithologies.	0.30	21.23
0.50- 1.20	B						0.50	21.03
1.00	ES					Grey slightly gravelly clayey fine to coarse SAND. Gravel is fine to coarse angular of various lithologies.		
1.20- 1.65	B					Firm becoming stiff brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subangular of various lithologies. Between 0.50-2.70m, Traces of coal fragments.		
1.20- 1.65	D	(DRY)			S17			
1.80	D			17		Occasional bands of sand.		
2.00- 2.45	U63	1.80 (DRY)				At 1.20m, Band of sand. Below 2.00, Brown. Grey mottling absent. At 2.20m, Band of sand.		
2.50	D							
2.50	ES							
2.80	D			14				
3.00- 3.45	B					Below 3.00m, Stiff.		
3.00- 3.45	D	3.00 (DRY)			S20			
3.50	ES							
3.80	D							
4.00- 4.45	U64	4.00 (DRY)	102	13		At 4.00m, high strength		
4.50	D							
4.80	D			17				
5.00- 5.45	B							
5.00- 5.45	D	4.80 (DRY)			S15			
6.00	D					At 6.10m, Medium cobble and boulder content.		
6.50- 6.95	U100	6.00 (DRY)	210	9.8		Below 6.50m, Very stiff. At 6.50m, very high strength		
7.00	D			10				
7.50	D							
8.00- 8.45	B							
8.00- 8.40		7.50 (DRY)			C49/ 248			
8.80- 8.85		8.80 (DRY)			C50/18	At 8.80, Obstruction - Probable cobble/boulder. End of Borehole	8.85	12.68

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/AR
8.80	0.15	Cable Percussion	SL/AR

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			20/03/14	08:00
7.00	6.00	DRY	20/03/14	18:00
7.00	6.00	DRY	21/03/14	08:00
8.85	8.80	DRY	21/03/14	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20		1.10	20	1.50	Seepage.
2.20	2.00	1.90	20	2.60	Seepage.

Remarks

Inspection pit hand excavated to 1.20m depth.
ES Sample = 1 x 1kg plastic tub, 1 x 258ml amber glass jar and 1 x 60ml VOC vial.
Borehole terminated at 8.85m depth on encountering obstruction - Probable cobble/boulder.

A 50mm gas monitoring pipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: bentonite grout up to 5.00m, gravel filter up to 1.00m, bentonite grout up to ground level.
Chiselling: 8.80m for 60 minutes.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:1999 + A2:2010

Logged by KF
Checked by JK
Figure 1 of 1
10/06/2014

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DATA SHEET - Symbols and Abbreviations used on Records

Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecone Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content

(All other strengths from undrained triaxial testing)

S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/- (mm)	Total blows/penetration
( )	Extrapolated value

Groundwater

Water Strike

Depth Water Rose To

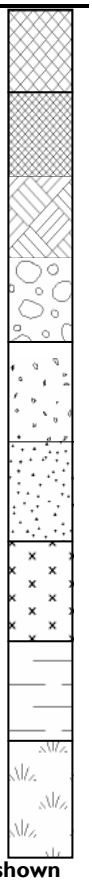
Instrumentation

Seal

Filter

Seal

Strata



Made Ground Granular

Made Ground Cohesive

Topsoil

Cobbles and Boulders

Gravel

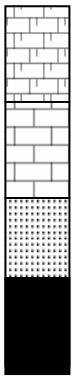
Sand

Silt

Clay

Peat

Note: Composite soil types shown by combined symbols



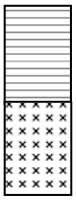
Chalk

Limestone

Sandstone

Coal

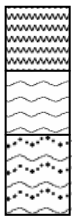
Strata, Continued



Mudstone

Siltstone

Metamorphic Rock

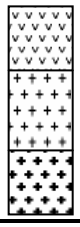


Fine Grained

Medium Grained

Coarse Grained

Igneous Rock



Fine Grained

Medium Grained

Coarse Grained

Backfill Materials

Arisings

Bentonite Seal

Concrete

Fine Gravel Filter

General Fill

Gravel Filter

Grout

Sand Filter

Tarmacadam

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	Fractures/metre
FRACTURE SPACING (mm)	Maximum Minimum
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss

(where core recovery is unknown it is assumed to be at the base of the run)

BOREHOLE RECORD - Cable Percussion

Project	OMEGA SOUTH - ZONE 7	Engineer	WSP ENVIRONMENTAL LIMITED	Borehole	BHA07
				Project No	PN143109
Client	OMEGA WARRINGTON LIMITED	National Grid Coordinates	355472.4 E 390683.4 N	Ground Level	21.89 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.89
0.00- 0.60	B					Grass over TOPSOIL: Dark brown slightly gravelly very clayey fine to coarse sand with some rootlets. Gravel is fine to coarse angular to subangular of various lithologies.			
0.10	ES								
0.50	B								
0.60- 1.20	B						0.60		21.29
0.60	ES					Firm becoming stiff orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to rounded of various lithologies.			
1.20- 1.65	UT42	(DRY)		17					
						Below 1.50m, Brown mottled grey. Medium cobble and boulder content.			
1.70	D								
1.70	ES								
1.80	D					Below 2.00m, Brown. Grey mottling absent.			
2.00- 2.45	B								
2.00- 2.45	D	1.80 (DRY)		16	S12				
						Between 2.80-3.00m, Firm.			
2.80	D			18					
3.00- 3.45	B			20		Below 3.00m, Stiff.			
3.00	ES								
3.00- 3.45	UF100	3.00 (DRY)							
3.50- 3.95	#	3.00			S42				
3.50- 3.95	B	(DRY)							
4.00- 4.45	U47	4.45 (3.70)							
4.50	D								
4.50	ES								
4.80	D			15					
5.00- 5.45	B								
5.00- 5.45	D	4.50 (DRY)			S16				
6.00	D			13					
6.50- 6.95	B								
6.50- 6.95	U86	6.00 (DRY)							
7.00	D								
7.50	D			11			7.50		14.39
						Extremely weak to very weak reddish brown fine to coarse grained micaceous SANDSTONE.			
7.80	D								
8.00- 8.45	B								
8.00- 8.33		7.50 (7.10)			C50/ 177				
8.60	D			14					
8.60- 8.72		7.50 (7.70)			C50/54		8.72		13.17
						End of Borehole			

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/AR
8.60	0.15	Cable Percussion	SL/AR

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			31/03/14	08:00
4.00	3.00	DRY	31/03/14	18:00
4.00	3.00	DRY	01/04/14	08:00
8.72	7.50	7.70	01/04/14	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth.
ES Sample = 1 x 1kg plastic tub, 1 x 258ml amber glass jar and 1 x 60ml VOC vial.
Water added to assist boring between 7.50m and 8.60m.
Backfill details from base of hole: bentonite seal up to 7.50m, arisings up to ground level.
Chiselling: 8.20-8.60m for 60 minutes.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:1999 + A2:2010

Logged by KF
Checked by JK
Figure 1 of 1
10/06/2014

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BOREHOLE RECORD - Cable Percussion

Project	OMEGA SOUTH - ZONE 7	Engineer	WSP ENVIRONMENTAL LIMITED	Borehole	BHF01
				Project No	PN143109
Client	OMEGA WARRINGTON LIMITED	National Grid Coordinates	355424.6 E 390583.2 N	Ground Level	21.66 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		21.66
0.00- 0.30	B					Grass over TOPSOIL: Dark brown slightly gravelly clayey fine to coarse sand with some rootlets. Gravel is fine to coarse angular of various lithologies.			
0.10	ES								
0.30	B						0.30		21.36
0.50- 1.20	B					Firm orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to rounded of various lithologies.			
0.50	ES								
1.20- 1.65	U53	(DRY)		16					
1.70	D					Below 1.80m, Stiff, brown. Grey mottling absent. Medium cobble content.			
1.70	ES								
1.80	D								
2.00- 2.45	B								
2.00- 2.45	D	1.80 (DRY)			S19				
2.80	D			13					
3.00- 3.45	U72	3.00							
3.00	U	(DRY)							
3.50	D								
3.80	D								
4.00- 4.45	B								
4.00- 4.45	D	4.00 (DRY)		14	S14				
4.80	D								
5.00- 5.45	U61	4.50 (DRY)	199	11		Below 5.00m, Very stiff. At 5.00m, very high strength			
5.50	D								
6.00	D			16					
6.50- 6.94	B	6.00 (DRY)			S32				
7.50	D								
8.00- 8.45	B								
8.00- 8.31	D	7.50 (DRY)			S50/ 158				
							8.40		13.26
						Extremely weak to very weak reddish brown fine grained micaceous SANDSTONE.			
9.00	D								
9.00- 9.13		7.50 (8.10)			C50/63				
						End of Borehole	9.13		12.53

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/AR
9.00	0.15	Cable Percussion	SL/AR

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			01/04/14	08:00
9.13	7.50	8.10	01/04/14	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
					None encountered.

Remarks

Inspection pit hand excavated to 1.20m depth.
ES Sample = 1 x 1kg plastic tub, 1 x 258ml amber glass jar and 1 x 60ml VOC vial.
Water was added to assist boring between below 8.40m.
A 50mm gas monitoring pipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: arisings up to 6.00m, bentonite seal up to 5.00m, gravel filter up to 1.00m, bentonite seal up to 0.30m, concrete up to ground level.
Chiselling: 8.70-9.00m for 60 minutes.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:1999 + A2:2010

Logged by KF
Checked by JK
Figure 1 of 1
10/06/2014

geotechnics

BOREHOLE RECORD - Cable Percussion

Project	OMEGA SOUTH - ZONE 7	Engineer	WSP ENVIRONMENTAL LIMITED	Borehole	BHF05
				Project No	PN143109
Client	OMEGA WARRINGTON LIMITED	National Grid Coordinates	355412.1 E 390374.8 N	Ground Level	20.80 m OD

Scale 1:50

Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD
							G.L.		20.80
0.00- 0.30	B					Grass over TOPSOIL: Dark brown slightly gravelly very clayey fine to coarse sand with some rootlets. Gravel is fine to coarse angular of various lithologies.	0.20		20.60
0.10	ES								
0.50- 1.20	B								
0.50	ES								
						Firm orangish brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to rounded of various lithologies.			
1.20- 1.65	U47	(DRY)		14		At 1.40m, Band of sand.		▽	
1.70	D					Below 1.80m, Brown mottled grey. Medium cobble content and low boulder content.			
1.80	D								
2.00- 2.45	B								
2.00- 2.45	D	1.80			S14				
2.00	ES	(DRY)							
						Below 2.80m, Stiff, brown. Grey mottling absent.			
2.80	D			15					
3.00- 3.45	B								
3.00- 3.45		3.00 (DRY)			C32				
3.50	ES								
3.80	D								
4.00- 4.45	U92	4.00 (DRY)	188	12		Below 4.00m, Stiff to very stiff. At 4.00m, very high strength			
4.50	D								
4.80	D								
5.00- 5.45	D	4.70			S17				
5.05- 5.45	B	(DRY)							
6.00	D			11					
6.50- 6.95	U100	6.00 (DRY)							
7.00	D			10					
7.50	D					At 7.50m, Obstruction - Probable cobble/boulder.			
7.60- 7.69		6.00 (DRY)			C50/41				
						End of Borehole	7.69		13.11

Boring

Depth	Hole Dia	Technique	Crew
1.20	0.40	Inspection Pit	SL/AR
8.05	0.15	Cable Percussion	SL/AR

Progress

Depth of Hole	Depth Cased	Depth to Water	Date	Time
G.L.			02/04/14	08:00
8.05	6.00	DRY	02/04/14	18:00

Groundwater

Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.40				1.50	Seepage - no rise.

Remarks

Inspection pit hand excavated to 1.20m depth.
ES Sample = 1 x 1kg plastic tub, 1 x 258ml amber glass jar and 1 x 60ml VOC vial.
Borehole terminated at 7.69m depth on encountering obstruction - Probable cobble/boulder.
A 50mm gas monitoring pipe was installed to 5.00m with a geowrapped slotted section from 1.00m to 5.00m with upright lockable protective cover. Backfill details from base of hole: arisings up to 6.00m, bentonite seal up to 5.00m, gravel filter up to 1.00m, bentonite seal up to 0.30m, concrete up to ground level.
Chiselling: 7.50-7.60m for 60 minutes.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:1999 + A2:2010

Logged by KF
Checked by JK
Figure 1 of 1
10/06/2014

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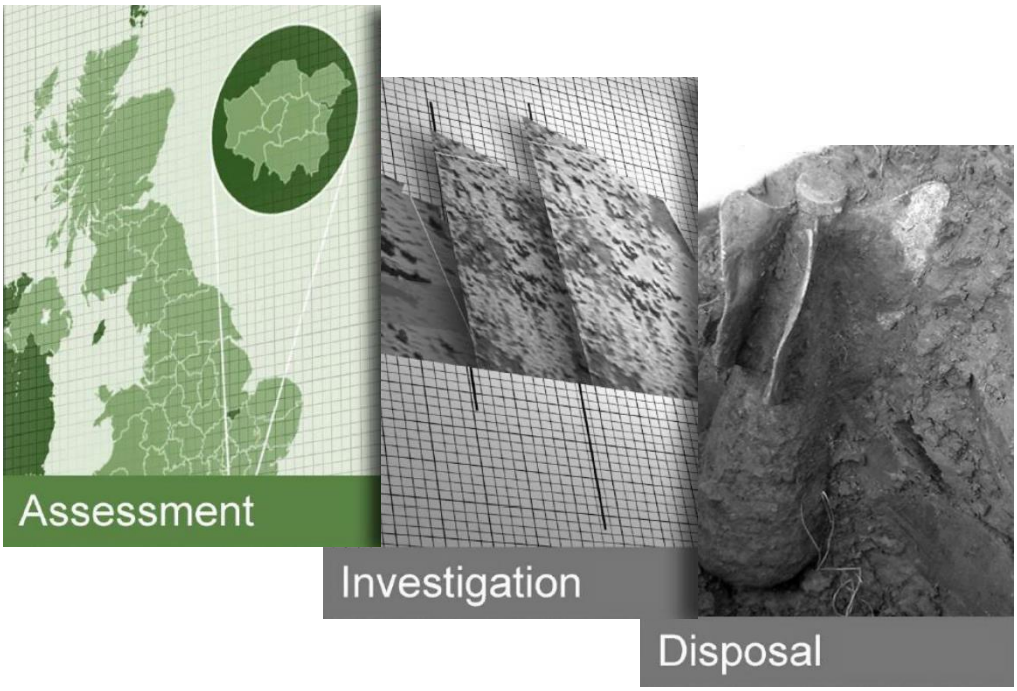
Appendix G

UXO DESK STUDY REPORT



Omega West, Warrington – UXO Desk Study & Risk Assessment

Drafted by Corinne Harrison
Checked by Stefan Lang
Authorised by Mike Sainsbury

Document Title	**UXO Desk Study & Risk Assessment**
Document Ref.	**P7831-18-R1**
Revision	**A**
Project Location	**Omega West, Warrington**
Client	**WSP**
Date	**11th September 2018**

UXO DESK STUDY & RISK ASSESSMENT

Omega West, Warrington

EXECUTIVE SUMMARY

Zetica Ltd was commissioned by WSP to carry out an Unexploded Ordnance (UXO) Desk Study and Risk Assessment for an area of approximately 30.5 hectares (ha) to the south of the M62 at Burtonwood, Warrington, Cheshire (the 'Site').

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

No records have been found indicating that the Site was bombed and no other significant sources of UXO hazard have been identified on the Site.

Given this, it is considered that the Site has a low UXO hazard level, as shown in the following Figure, reproduced as Figure 6 in the main report.

Figure	UXO hazard zone plan of the Site

Source: Google Earth *Not to Scale*

Legend					
	Very Low		Low		Moderate
	High		Very High		Site boundary

The main findings of the report are summarised below.

- No records of bombing or other significant military activity on the Site during World War One (WWI) have been found.
- During World War Two (WWII), the north-eastern corner of the Site encroached upon the perimeter track and accommodation facilities of Burtonwood Airfield. The airfield was used by the Royal Air Force (RAF) and United States Army Air Forces (USAAF) as a major aircraft depot, with extensive maintenance and repair facilities.
- No records of bombs falling on the Site during WWII have been found. Incendiary Bombs (IBs) are recorded falling approximately 0.3km east of the Site.
- In 1967 the US Army took over Burtonwood Airfield as its main European supply depot, known as Burtonwood Army Depot. This remained in use until 1994.

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

Further details on the methodology for the risk assessment are provided in Section 10.1 of the main report.

Table UXO risk assessment for the Site

Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
UXB	Shallow Excavations	1	1	1	1	5	5	**Low**
	Deep Excavations	1	1	1	1	5	5	**Low**
	Piling/Boreholes	1	1	1	1	4	4	**Low**
Other UXO	Shallow Excavations	1	1	1	1	4	4	**Low**
	Deep Excavations	1	1	1	1	4	4	**Low**
	Piling/Boreholes	1	1	1	1	3	3	**Low**

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

Shallow Excavations defined as <1.0m below ground level (bgl.)

Risk Mitigation Recommendations

To ensure that the UXO risk is reduced to As Low As Reasonably Practicable (ALARP) the following mitigation is advised:

Where a low risk of UXO encounter is anticipated, industry good practice is to raise the awareness of those involved in excavations so that in the unlikely event that a suspect item is discovered, appropriate action is taken. This can be achieved through UXO awareness briefings to site staff.

Clearance certification for borehole or pile locations is considered prudent only if a zero tolerance to risk is adopted. Zero tolerance is commonly adopted for sites that have safety critical infrastructure such as nuclear establishments and oil refineries.

Table 5 in the main report gives recommended actions in relation to the potential UXO risk level and the anticipated Site activity.

Further advice on the mitigation methods can be provided by Zetica on request.

CONTENTS

Figures, Plates, Tables & Drawings

Appendices

UXO DESK STUDY & RISK ASSESSMENT

Omega West, Warrington

Note: To aid the reader of this report, Zetica has colour coded each paragraph. Paragraphs with black text on a white background are paragraphs that provide site-specific information or information specifically researched as part of this project.

Paragraphs in a dark green text with a green background are paragraphs providing general information and, where appropriate, links to online resources giving further detail on particular sources of UXO.

1 INTRODUCTION

1.1 Project Outline

Zetica Ltd was commissioned by WSP to carry out an Unexploded Ordnance (UXO) Desk Study and Risk Assessment for an area of approximately 30.5 hectares (ha) to the south of the M62 at Burtonwood, Warrington, Cheshire (the 'Site').

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

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

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

1.2 Historical Information

With most locations, the potential presence of UXO as a result of enemy action, unauthorised disposal or unrecorded military activity can never be totally discounted.

Detailed records of military activity are rarely released into the public domain. Even when military information is made public there may be gaps in the records because files have been lost or destroyed.

Records for periods such as WWII are only as detailed and accurate as the resources and working conditions would allow at the time. Densely populated areas tend to have a greater number of records than rural areas. Such records may be inaccurate due to the confusion surrounding continuous air raids.

Press records can supplement local information, although this source of information must be treated with caution, as inaccuracies do exist, either inadvertently or intentionally in order to confuse enemy intelligence. Classified official records can sometimes be considered inaccurate for the same reason.

Recent research indicates that England alone had 17,434No. recorded defence sites, of which 12,464No. were classified as defensive anti-invasion sites. The precise locations of many of these sites are still to be identified, illustrating the scale of the problem when establishing potential risks from limited historical data.

1.3 Sources of Information

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

1.3.1 Zetica Ltd Defence Related Site Records

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

1.3.2 Zetica Ltd Bombing Density Records and Maps

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

1.3.3 Ministry of Defence and Government Records

Various government departments and units within the Ministry of Defence (MoD) were approached for information of past and present military activity in the area. These included the Home Office records of abandoned bombs.

1.3.4 Other Historical Records, Maps and Drawings

Numerous reference documents including historical maps, aerial photographs and drawings have been consulted from sources such as the National Archives, the Royal Air Force (RAF) Museum, the Imperial War Museum (IWM), Historic England and the Defence of Britain Project.

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

1.3.5 Local Authority Records

Information was obtained from Warrington Borough Council and Lancashire County Council.

1.3.6 Local Record Offices and Libraries

Information was obtained from the Lancashire Record Office.

1.3.7 Local Historical and Other Groups

Local history groups and archaeological societies were consulted, including the Lancashire Historic Environment Record (HER).

1.4 Data Confidence Level

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

2 THE SITE

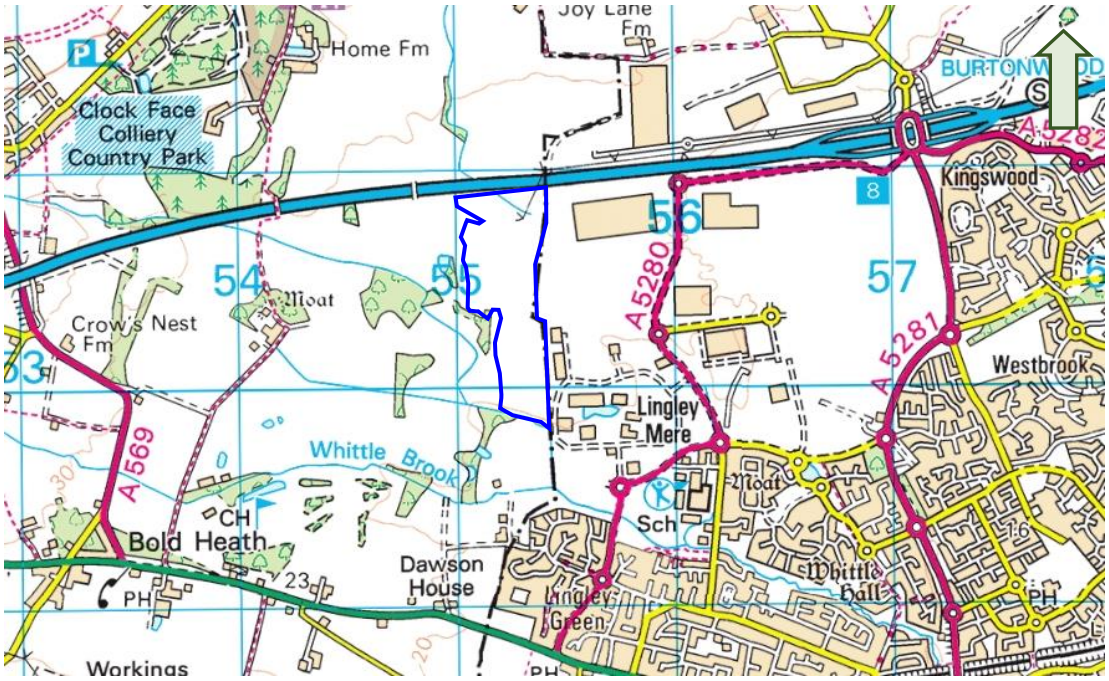
2.1 Site Location

The Site is centred on Ordnance Survey National Grid Reference (OSNGR) SJ 552904. It is located to the south of the M62 at Lingley Mere, Burtonwood, approximately 5km northeast of Warrington town centre.

The Site comprises an area of open farmland. It is bounded to the north by the M62, to the west and south by farmland, and to the east by Lingely Mere Business Park.

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

Figure 1	Site location map



Source: © Crown Copyright 2018. Reproduced by permission of Ordnance Survey *Not to Scale*

Legend	Site boundary

Plate 1	Recent aerial photograph of the Site

Source: Google Earth *Not to Scale*

Legend	Site boundary

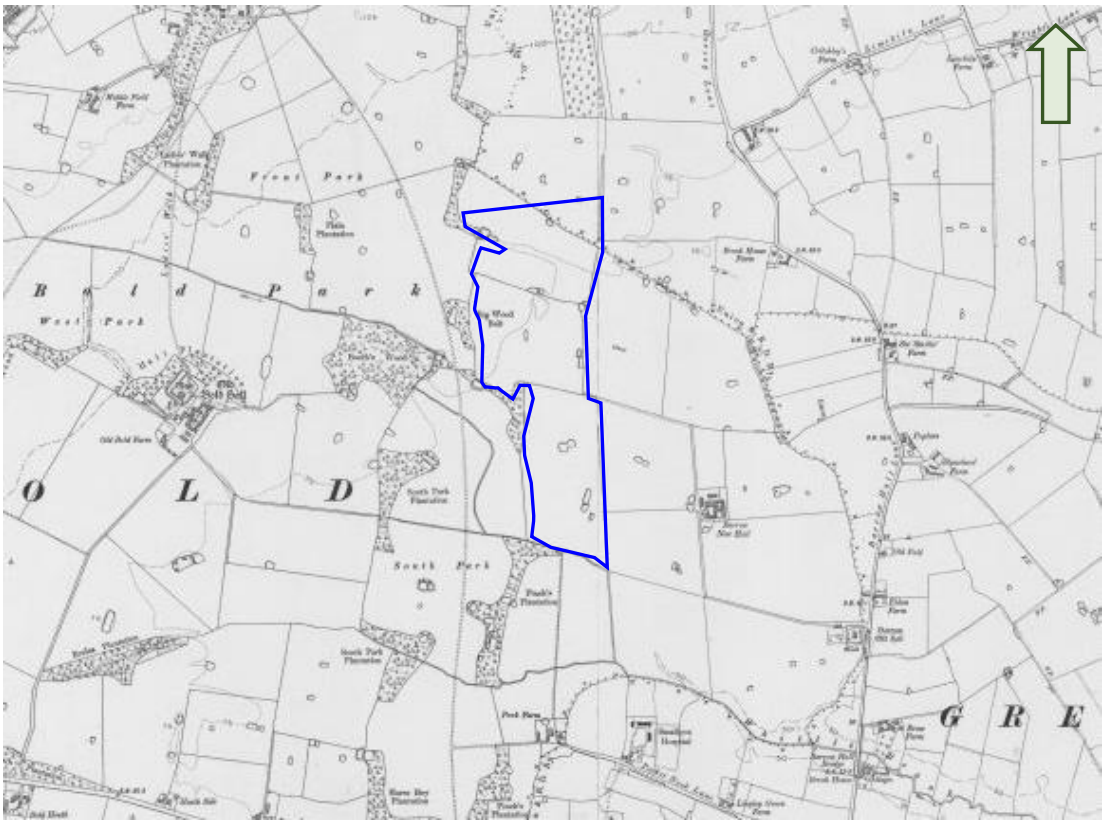
2.2 Proposed Works

It is understood that proposed works on the Site may include intrusive ground investigations, excavations and piling.

2.3 Site History

The historical map of 1905 (Figure 2) shows that at the beginning of the 20th century the Site comprised open farmland in a predominantly rural area.

Figure 2	Historical map, 1905



Source: © Crown Copyright 2018. Reproduced by permission of Ordnance Survey *Not to Scale*

Legend	Site boundary

No development occurred on or in close proximity to the Site during World War One (WWI).

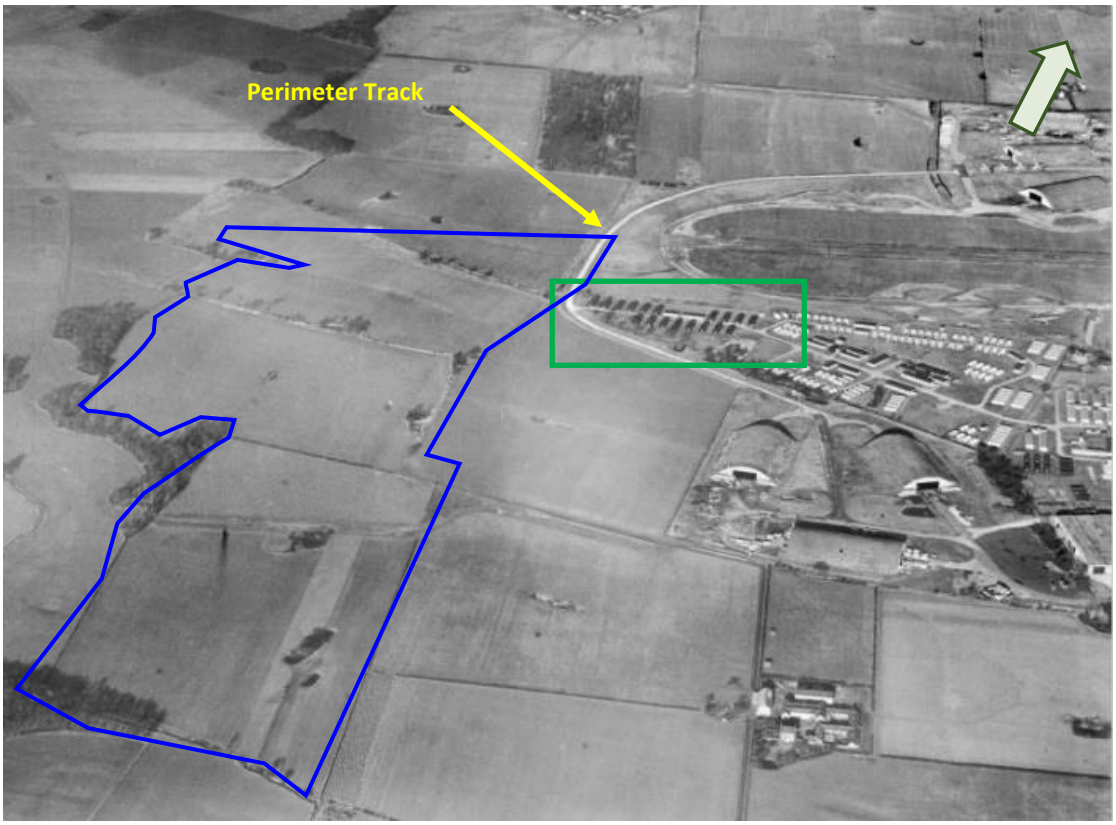
In 1940 Burtonwood Airfield was constructed on land within approximately 1.5km east-southeast of the Site (see Section 5).

In 1942, after the United States Army Air Forces (USAAF) occupied Burtonwood, the airfield underwent considerable expansion. A third runway was constructed, the perimeter track encroaching onto the north-eastern part of the Site.

The expansion of facilities at Burtonwood Airfield included the construction of an accommodation camp, known as site-6 Lythgoe, adjacent to the Site.

Plate 2, an aerial photograph dating from 1947, shows these developments.

Plate 2	Aerial photograph, 1947



Source: Britain from Above *Not to Scale*

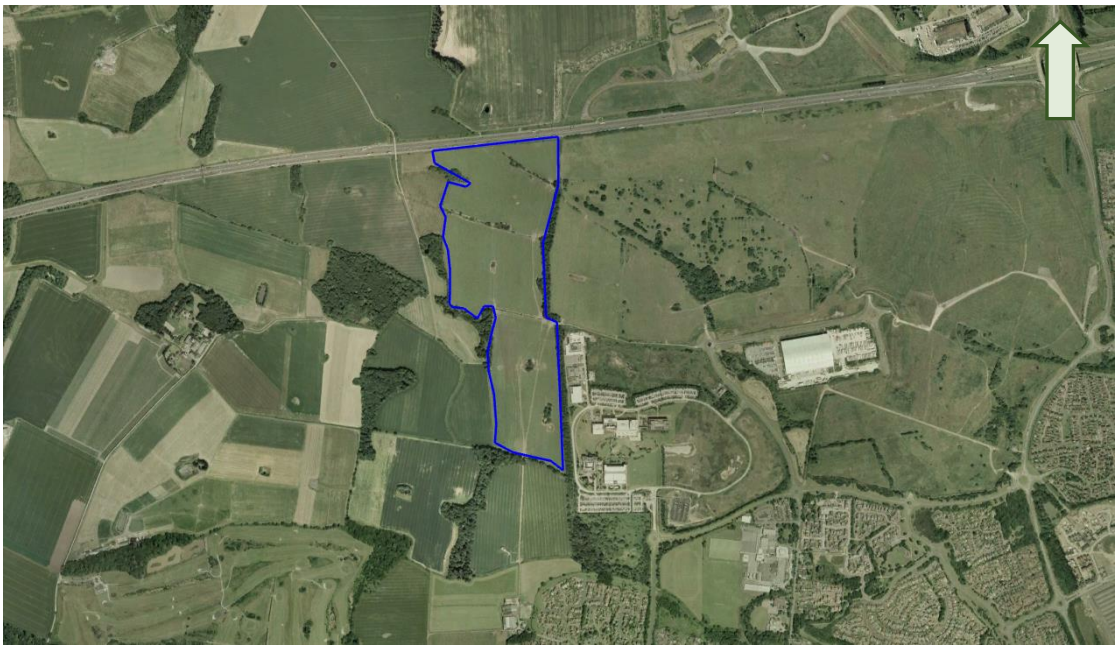
Legend	Site boundary	Site 6-Lythgoe

The United States Air Force (USAF) left Burtonwood at the end of the 1950s and the facilities were handed over the US Army as a supply depot, which operated into the 1990s.

Plate 3, an aerial photograph dating from 2005, shows that the Site remained open farmland.

The majority of the former airfield and depot facilities had been demolished, with the M62 constructed along the line of the former main runway, adjacent to the northern boundary of the Site.

Plate 3	Aerial photograph, 2005



Source: Google Earth *Not to Scale*

Legend	Site boundary

There has been no significant development on the Site since 2005. Several new commercial units have been built to the east of the Site as part of the Lingley Mere Business Park (see Plate 1).

2.4 Pre-WWI Military Activity

No records of any significant pre-WWI military activity on or in close proximity to the Site have been found.

2.5 WWI Military Activity

No records of any significant WWI military activity on the Site have been found.

During WWI an estimated 9,000No. German bombs were dropped over Britain. It was the first time that strategic aerial bombing had been used.

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

In response to regional air raids, Anti-Aircraft (AA) guns were established. These were potential sources of Unexploded AA (UXAA) shells which could land up to 13km from the firing point, although more typically fell within 10km during WWI.

No records have been found indicating that there were any static AA guns within 10km of the Site during WWII.

2.6 WWII Military Activity

Burtonwood Airfield opened in 1940 and in 1942 expanded to encroach upon the Site. Various associated facilities were established in the surrounding area, including an accommodation camp adjacent to the Site, and hangars and a repair depot. The operational history of the airfield is outlined in Section 5.

The region surrounding the Site was predominantly rural and recorded few significant air raids. Details of recorded air raid incidents in the vicinity of the Site are provided in Section 3.

Defensive and offensive military structures were built in the vicinity of the Site. These included lines of defences (Stop Lines), pillboxes, bombing decoys and AA guns. Further details are given in Section 4.

Other military establishments in the vicinity of the Site are described in Sections 6 and 7.

2.7 Post-WWII Military Activity

Burtonwood Airfield remained in use after WWII, first by the RAF and subsequently by the USAF, continuing its role as a major assembly, repair and modification depot.

In the 1950s the USAF constructed a major supply depot on land approximately 1.5km from the Site which was used by the US Army between 1967 and 1994 (see Section 5.1 for further details).

Post-WWII military activity is not considered to provide a source of UXO hazard to the Site.

3 WWII BOMBING

Bombing raids began in the summer of 1940 and continued until the end of WWII. Bombing densities generally increased towards major cities or strategic targets such as docks, industrial premises, power stations and airfields.

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

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

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

Anti-Personnel (AP) bombs and Parachute Mines (PMs) were also deployed. 2No. types of anti-personnel bombs were in common use, the 2kg and the 12kg bomb. The 2kg bomb could inflict injury across an area up to 150m away from the impact, within 25m of this, death or fatal injury could occur.

PMs (which were up to 4m in length) could be detonated either magnetically or by noise/vibration. Anti-shipping parachute mines were commonly dropped over navigable rivers, dockland areas and coastlines. The Royal Navy was responsible for ensuring that the bombs were made safe. Removal and disposal was still the responsibility of the Bomb Disposal Unit of the Royal Engineers.

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

It is understood that the local Civil Defence authorities in urban areas had a comprehensive system for reporting bomb incidents and dealing with any UXO. In more rural areas, fewer bombing raids occurred. It is known that ARP records under-represent the number and frequency of bombs falling in rural and coastal areas.

Bombs were either released over targets or as part of 'tip and run' raids where bomber crews would drop their bombs to avoid Anti-Aircraft fire or Allied fighter aircraft on the route to and from other strategic targets. Bombs dropped as a result of poor targeting or 'tip and run' raids on rural, river, marsh or coastal areas were often unrecorded or entered as 'fell in open country', 'fell in the sea' or 'fell in the river' and left little evidence of the fall.

3.1 Bombing in Lancashire

From prior to the declaration of war in 1939, Britain was subjected to reconnaissance flights by the Luftwaffe which was building up a photographic record of potential targets. As early as 1937, German airships and aircraft were flying over the northwest of England to photograph defences, docks and factories.

Military establishments in the region such as airfields and radar stations were specifically targeted. Burtonwood Airfield was photographed and target details had been prepared. Records for heavy raids on many of the region's airfields were suppressed until after WWII.

Bombing raids in the region began in the summer of 1940 and continued until 1944. Most of the bombing raids in Lancashire were aimed at the large industrial centres of Liverpool and Manchester and their surrounding towns.

Bombing densities in the Warrington region were low and raids were typically carried out by single aircraft. These included some 'tip and run' bombing raids in which aircraft jettisoned bombs, either before reaching or on their return flights from strategically important targets in the region such as Liverpool.

3.2 Strategic Targets

The presence of strategic targets significantly increased the likelihood of bombing within the local area. Airfields, docks, industrial facilities, transport infrastructure and anti-invasion defences were all targeted by Luftwaffe bombers. The inherent bombing inaccuracies at the time meant that areas surrounding the targets were often subjected to bombing.

The main strategic targets in the vicinity of the Site are outlined below.

3.2.1 Military Targets

Burtonwood Airfield, within approximately 1.5km east-southeast of the Site, was the main strategic target in the vicinity of the Site.

Plate 4 is a Luftwaffe target photograph of Burtonwood, dated the 17th September 1940. It identifies Burtonwood Airfield (GB 10 297), associated aircraft warehouses (Teil I, Teil II and Teil III) and manufacturing and repair depots (GB 74 73).

Plate 4	Luftwaffe target photograph of Burtonwood, 17th September 1940

Source: IWM *Not to Scale*

Legend	Site boundary

3.2.2 Industrial Targets

The Burtonwood Repair Depot (BRD), within approximately 2.7km southeast of the Site, was a major facility for the manufacture, repair and modification of aircraft engines.

Other factories in Warrington undertook war production. Industrial works at Bank Quay, approximately 5km southeast of the Site, included an oil depot, engineering works, the Mersey Tube Works and grain wharves.

3.2.3 Transport Infrastructure

Transport infrastructure was targeted by the Luftwaffe to disrupt logistical supply lines and troop movements.

The main Central London Railway (CLR) mainline between Warrington and Liverpool ran approximately 1.7km south of the Site.

3.2.4 Public Utilities

Public utilities were targeted by the Luftwaffe to disrupt power and water supplies.

Bold Power Station was located approximately 5km southeast of the Site.

Longford Gas Works was located approximately 5.1km east of the Site.

3.3 Bombing Density and Incidents

Table 1 gives details of the overall bombing statistics recorded for the Local Authority Districts of the Site and surrounding districts. These were categorised as Country Boroughs (CB), Municipal or Metropolitan Boroughs (MB), Urban Districts (UD) and Rural Districts (RD).

WWII bomb density levels are defined below:

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

5-15 bombs per 405ha is a Low regional bombing density.

15-50 bombs per 405ha is a Moderate regional bombing density.

50-250 bombs per 405ha is a High regional bombing density.

>250 per 405ha is a Very High regional bombing density.

The Site straddled the boundary of the Rural District (RD) of Whiston and Warrington RD.

Table 1 Bombing statistics

Area	Bombs Recorded				
	High Explosive	Parachute Mines	Other	Total	Bombs per 405ha (1,000 acres)
Whiston RD	**274**	**3**	**3**	**280**	**9.5**
Warrington RD	**100**	**4**	**2**	**106**	**4.7**
St Helens CB	116	0	6	122	15.3
Widnes MB	70	2	1	73	12.7

Note that Table 1 excludes the figures for IBs. Discrepancies between this list and other records, such as bomb clearance records, demonstrate that this data is likely to under-represent actual bombing.

The nearest recorded incidents to the Site are described below.

30th August 1940

HE bombs (number unspecified) fell on Cow Lane, Great Sankey, approximately 1.7km southeast of the Site. Some of these were recorded as Unexploded Bombs (UXB).

4th September 1940

1No. HE bomb fell on Park Road, Great Sankey, approximately 0.6km southeast of the Site. This was recorded as a UXB.

5th September 1940

2No. IBs fell on Clock Face colliery, approximately 1.2km northwest of the Site. These were recorded as Unexploded IBs (UXIBs).

1No. HE bomb fell between Great Sankey Church and the CLR mainline, approximately 1.7km southeast of the Site. This was recorded as a UXB.

6th September 1940

IBs fell near to the runways at Burtonwood Airfield, within approximately 1.5km east-northeast of the Site.

6No. HE bombs fell between Burtonwood Airfield, approximately 1.7km north of the Site, and Sankey Viaduct, approximately 3.2km southeast of the Site.

7th September 1940

1No. HE bomb fell on Gorsey Lane, Bold, approximately 1.4km northwest of the Site. This was recorded as a UXB.

9th September 1940

2No. HE bombs fell on North Lodge, Bold, approximately 1.5km northwest of the Site. These were recorded as UXB.

19th September 1940

2No. HE bombs fell on Great Sankey, approximately 2.2km south of the Site. These were recorded as UXB.

27th September 1940

IBs fell on G-site at Burtonwood Airfield, approximately 0.3km east of the Site.

IBs fell near the runways at Burtonwood Airfield, within approximately 1.5km east-northeast of the Site.

9th December 1940

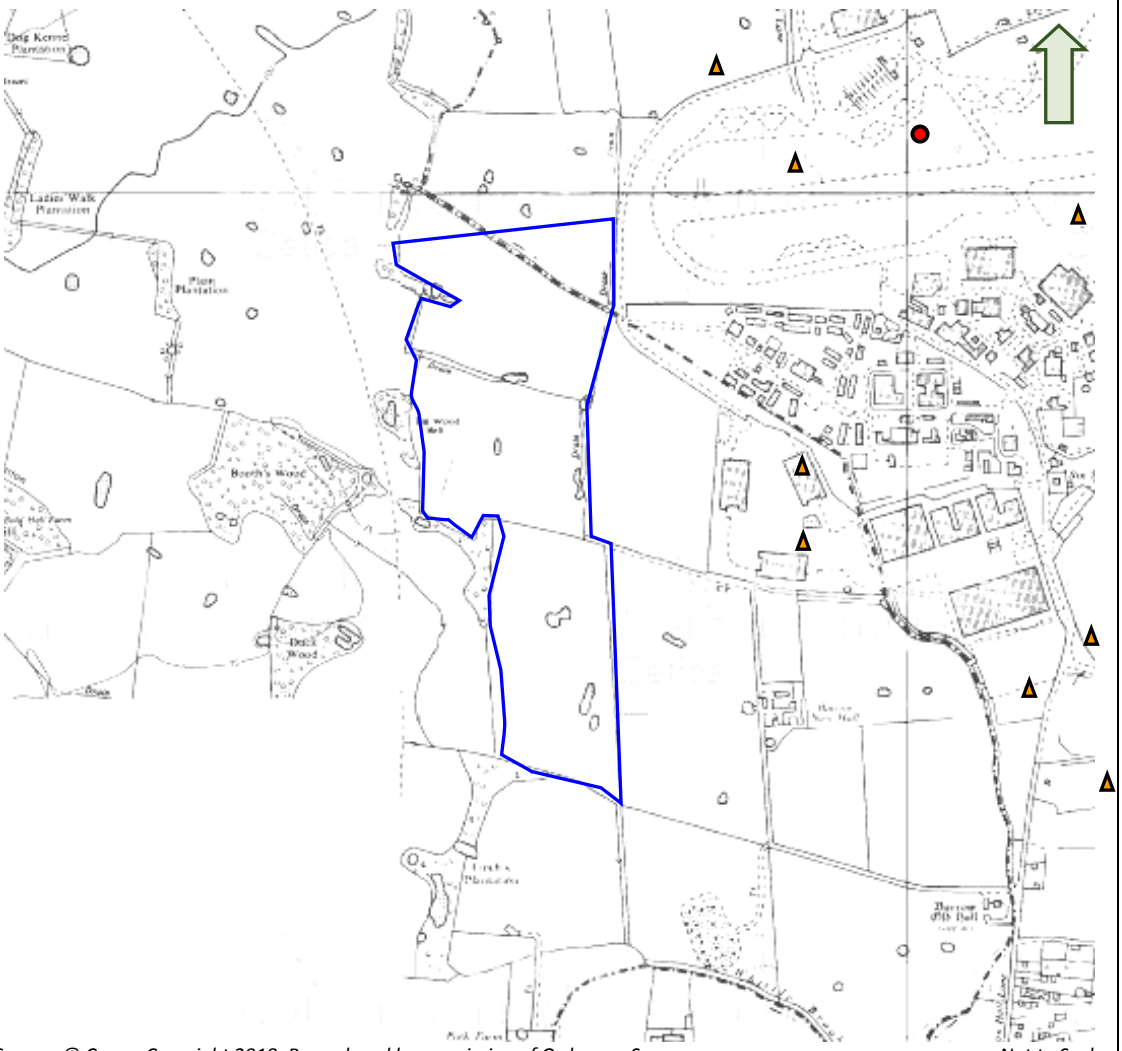
1No. HE bomb fell on Travers Farm, Bold, approximately 2km north of the Site. This was recorded as a UXB and abandoned.

It should be noted that during WWII, many UXB were mapped and subsequently removed as and when conditions and demands on Bomb Disposal teams allowed. Their removal was not always accurately recorded and sometimes records were later destroyed. In practice, most UXB were probably removed and only a much smaller number were actually registered as officially abandoned bombs.

Figure 3 is a map showing the approximate locations of bomb impacts in the vicinity of the Site. IBs shown are indicative of large numbers of these devices that fell within the given area. The map has been compiled from a number of different sources, including air raid incident reports, bomb census maps and historical aerial photographs.

Note that air raid incident reports did not always record precise locations, often only indicating on which street, area or farm a bomb fell.

Figure 3	Compiled bomb impact map for the vicinity of the Site



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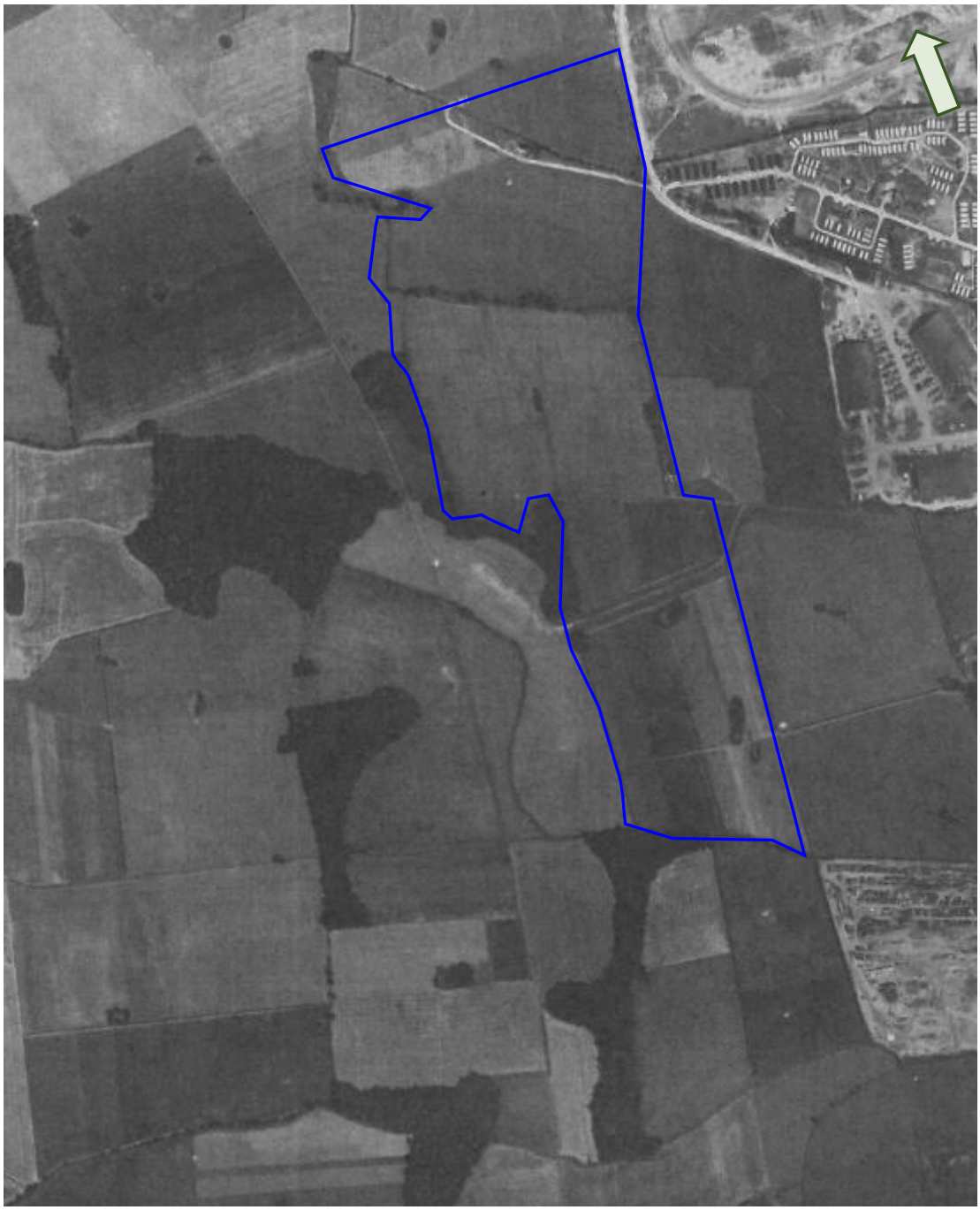
Legend	Site boundary	HE bomb	IBs

Plate 5 is an aerial photograph dated the 10th August 1945. No bomb damage has been identified on or in close proximity to the Site.

Plate 5	Aerial photograph, 10th August 1945



Source: Historic England *Not to Scale*

Legend	Site boundary

Potential UXO Hazard

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

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

3.4 Geology and Bomb Penetration Depths

It is important to consider the geological materials present at the time that a bomb was dropped in order to establish its maximum penetration depth. The British Geological Survey (BGS) 1:50,000 Sheet 97 Runcorn (Solid) and BGS borehole records were consulted.

The geology of the Site comprises Devensian Till deposits of clay and sand overlying sandstones of the Chester Pebble Bed Formation.

Table 2 provides an estimate of average maximum bomb penetration depths for the Site, assuming WWII ground conditions of 1m firm clay, over 10m of stiff to very stiff clay, overlying weak rock.

Table 2 Estimated average maximum bomb penetration depths

Estimated average bomb penetration depths for anticipated geology		
Bomb Weight	50kg	5.5m
	500kg	13.0m

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

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

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

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

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

e) That the soil type is homogenous.

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

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

4 WWII DEFENCES

4.1 Bombing Decoys

In order to draw enemy aircraft away from towns and other strategically important targets, a series of decoys were developed between 1940 and 1941.

They were estimated to have drawn at least 5% of the total weight of bombs away from their intended targets. Approximately 792No. static decoy sites were built at 593No. locations in England. In addition, numerous temporary and mobile decoys were deployed.

Several different types of decoy were devised:

- Night time dummy airfields (Q sites).
- Daytime dummy airfields (K sites).
- Diversionary fires to simulate successful bombing raids on airfields (QF sites), petroleum depots (P sites) and major towns and cities (Starfish or SF sites).
- Simulated urban lighting (QL sites).
- Dummy Heavy Anti-Aircraft (HAA) batteries, factories and buildings (C series).
- Mobile decoys representing 'hards' for troop embarkation (MQLs), tanks and other vehicles.

Machine gun emplacements and Light Anti-Aircraft (LAA) guns were used to prevent possible enemy landings at decoy airfields.

By their nature, decoy sites provide a potential risk from Unexploded Bombs (UXB), both within the decoy site boundary and in the surrounding areas.

No records of any bombing decoys on the Site have been found. The nearest is described below.

4.1.1 QF213 Bombing Decoy

Records indicate that bombing decoy No. QF213a was located northeast of Bold Heath (SJ 546897), approximately 0.3km southwest of the Site.

A series of controlled fires lit during air raids were designed to look like struck targets and deflect bombing away from Burtonwood Airfield. The bombing decoy was operational between November 1940 and November 1943. Aerial photography from 1945 shows that by the end of WWII the decoy had been given over to agricultural use.

No records have been found indicating that this decoy was successful in attracting any bombing.

Bombing decoys are not considered to provide a source of UXO hazard to the Site.

4.2 Anti-Aircraft Defences

Anti-Aircraft (AA) gun batteries were targeted by the Luftwaffe. They were also a source of Unexploded AA (UXAA) shells which could land up to 27km from the firing point during WWII, although more typically fell within 15km. These could be distributed over a wide area.

AA batteries present a potential source of UXO hazard as a result of the storage, use and disposal of ordnance associated with the armaments used. They may have a risk from small caches of ammunition buried locally to them. 3No. types of AA batteries existed:

- Heavy Anti-Aircraft (HAA) batteries of large guns designed to engage high flying bomber aircraft. These tended to be relatively permanent gun emplacements.
- Light Anti-Aircraft (LAA) weaponry, designed to counter low flying aircraft. These were often mobile and were moved periodically to new locations around strategic targets such as airfields.
- Rocket batteries (ZAA) firing 3" or 3.7" AA rockets with a maximum altitude of 5,800m and a ground range of 9km were also relatively permanent emplacements.

Many AA batteries were associated with searchlights and consequently 'visible' at night, providing clear targets to the Luftwaffe bombers and a potential for UXB.

The Site was within range of HAA guns deployed in the Mersey Gun Defended Area (GDA). Table 3 is a list of recorded HAA gun batteries within 10km of the Site.

Table 3 WWII HAA gun batteries within 10km of the Site

Grid Reference	Serial No.	Approximate Location	Armament	Approximate Distance and Direction from Site
SJ 551919	-	Joy Lane	Unknown	1.0km N
SJ 542880	Q/H17	Barrow's Green	2No. 3.7" guns	2.1km SW
SJ 577853	R/H20	Moore	2No. and 4No. 3.7" guns	5.3km SE
SJ 503866	P/H15	Ditton	Unknown	5.8km SW
SJ 570819	S/H19	Red Brow	Unknown	8.0km SSE
SJ 469864	PP/H14	Yew Tree Farm	4No 4.5" guns	9.0km SW

It should be noted that the lack of official records of HAA batteries or armaments cannot be taken to imply their absence because many units were mobile and were moved around as operational requirements dictated.

WWII AA shell incidents nearest to the Site are described below.

5th March 1941

1No. AA shell fell on a field 200 yards (yds) northwest of Tanhouse Lane, approximately 1.2km northwest of the Site. This was recorded as an Unexploded AA (UXAA) shell.

8th April 1941

2No. AA shells fell on Limerick Hotel, 10yds from Cow Lane, approximately 1.7km southeast of the Site. These were recorded as UXAA shells and removed on the 11th April 1941.

15th April 1941

1No. AA shell fell approximately 100yds east of South Lane Entry, approximately 1.7km southeast of the Site. This was recorded as a UXAA shell.

5th May 1941

1No. AA shell fell in a field approximately 200yds northwest of Tanhouse Lane, approximately 2km northwest of the Site. This was recorded as a UXAA shell.

Given the number of gun batteries in the surrounding area, the potential for a UXAA shell to have fallen unnoticed on the Site, whilst unlikely, cannot be totally discounted.

4.3 Barrage Balloons and Anti-Landing Obstacles

Balloon barrages were flown in many British towns and cities to protect against air raids. Their presence deterred low flying aircraft, making it more difficult for bombs to reach their intended targets. Barrage balloon sites can be a source of UXO as they were targeted by the Luftwaffe. They also often had a small explosive charge fitted with tilt fuzes attached approximately 50m from each end of the balloon cables and designed to detonate if the cables were hit by an aircraft.

Measures were also taken to prevent enemy aircraft landing in the event of invasion. Obstructions were constructed around airfields and on other open sites deemed fit for use as landing grounds. Solid obstructions (such as concrete blocks), posts or stakes, felled trees, haystacks, scaffolding with wire and trenching were the main measures used.

No records of any barrage balloons or anti-landing obstacles on or in close proximity to the Site have been found.

4.4 Anti-Invasion Defences

Defence structures are a potential source of UXB as they were especially targeted by low flying enemy aircraft, particularly during 'tip and run' raids which were common in industrialised regions. These defences may also be associated with small caches of UXO in the form of small arms, used by the troops manning the emplacement.

The rapid advance of German Troops into France, Holland and Belgium after the start of WWII prompted the War Office to review the vulnerability of the UK to invasion and a decision was taken to begin work on a national plan of anti-invasion defences. Static defences were built to interrupt and delay the progress of any invading force.

Coastal defences were strengthened (the 'Coastal Crust'). These defences included barbed wire entanglements and minefields, which were often combined to give defence in depth.

Inland, lines of defence structures were constructed along 'Stop Lines' in order to impede enemy progress for long enough to allow mobile defending forces to counter-attack.

Stop Lines included the fortification of key 'centres of resistance', such as river crossings and important road or rail junctions that could seriously hamper the enemy's advance across country. Bridges were mined for demolition and tank traps installed.

Stop Lines were further integrated into a network of fortified nodal points and 'Anti-Tank (AT) Islands'.

No records of any anti-invasion defences on or in close proximity to the Site have been found.

4.5 Pillboxes, Mortar and Gun Emplacements

Defences also included spigot mortar positions and gun emplacements.

Spigot mortars, also known as Blacker Bombards, were used primarily in an anti-tank role at road blocks or to defend airfields. Typically they fired a 20 pound (lb) HE mortar bomb. The fixed positions, in weapons pits with ammunition lockers, were frequently positioned near pillboxes.

Spigot mortar positions could be either fixed or mobile.

No records of any mortar or gun emplacements on or in close proximity to the Site have been found.

Pillboxes provide a potential UXO hazard both from the storage, use and disposal of ordnance associated with them and from UXB because they were targeted by enemy aircraft.

Pillboxes were common along Stop Lines, perimeters of airfields, potential land invasion sites and around important civil sites. Several different designs existed including Seagull Trenches (semi-buried structures), Alan Williams and Tett Turrets (small prefabricated pillboxes). Fortified sites, buildings or loop-holed walls also functioned as pillboxes.

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

The nearest recorded pillbox was located on the northern boundary of E-site, Burtonwood Airfield (SJ 557914), approximately 0.6km northeast of the Site.

Pillboxes and gun emplacements are not considered to provide a source of UXO hazard to the Site.

4.6 Home Guard and Auxiliary Units

Local Defence Volunteers (LDV) units, later known as the Home Guard, were located in all cities, towns and large villages. Anti-invasion defences were to be defended by the Home Guard and regular Army troops for as long as possible in the event of an invasion. The troops were issued with 'No Withdrawal' orders.

Important elements of the ordnance supply for the use of the Home Guard included substantial supplies of Mills bombs (fragmentation grenades) and Self Igniting Phosphorus (SIP) grenades as well as machine gun and small arms ammunition.

Records of Home Guard activities and related sites are rarely preserved. Storage and disposal of munitions by the Home Guard was poorly documented and surplus supplies were either buried or dumped in lakes and ponds.

Given the irregular nature of this activity, the possibility of items of UXO being discovered at any locations occupied or used for training by the Home Guard can never be totally discounted.

In addition to the regular Home Guard, Auxiliary Units existed which were made up of guerrilla troops trained in sabotage and assassination in case of invasion. Sites used by these Units were Top Secret and many locations are still unknown.

No records of any Home Guard or Auxiliary Unit activity on or in close proximity to the Site have been found.

4.7 Minefields and Mined Locations

Minefields were laid along the coast, in estuaries and along the banks of major rivers to deter infantry invasion. Strategic points such as bridges and gaps in cliffs were mined to impede enemy advance. Most of the mined locations in the UK have been cleared and the risk of finding UXO in these areas is considered to be low.

No records of any minefields or mined locations on or in close proximity to the Site have been found.

5 MILITARY AIRFIELDS

Military airfields offer the potential for significant UXO hazards due to the use, storage and disposal of ordnance and as a result of enemy bombing during WWI and WWII.

Airfields active during WWII were targeted by the Luftwaffe, providing a potential source of UXB on the airfield. As bombing accuracy was so poor during WWII, it is likely to find UXB in the surrounding areas. Aircraft crashes are also associated with operational airfields.

Burtonwood Airfield, encroaching onto the north-eastern corner of the Site, was active from 1940 until 1994.

A brief operational history of the airfield is given in the Section below.

5.1 Burtonwood Airfield & Depot

In 1938 land to the south of Burtonwood, within approximately 1.5km east-southeast of the Site, was identified for the construction of a combined Aircraft Storage Unit (ASU) and Aircraft Repair Depot (ARD).

The ASU at Burtonwood Airfield opened on the 1st April 1940 as No. 37 Maintenance Unit (MU) RAF.

The role of the ASU was to receive new aircraft from the manufacturer and to prepare them for the RAF by fitting radio equipment and armament. Once ready, the aircraft were placed in storage prior to delivery to active squadrons.

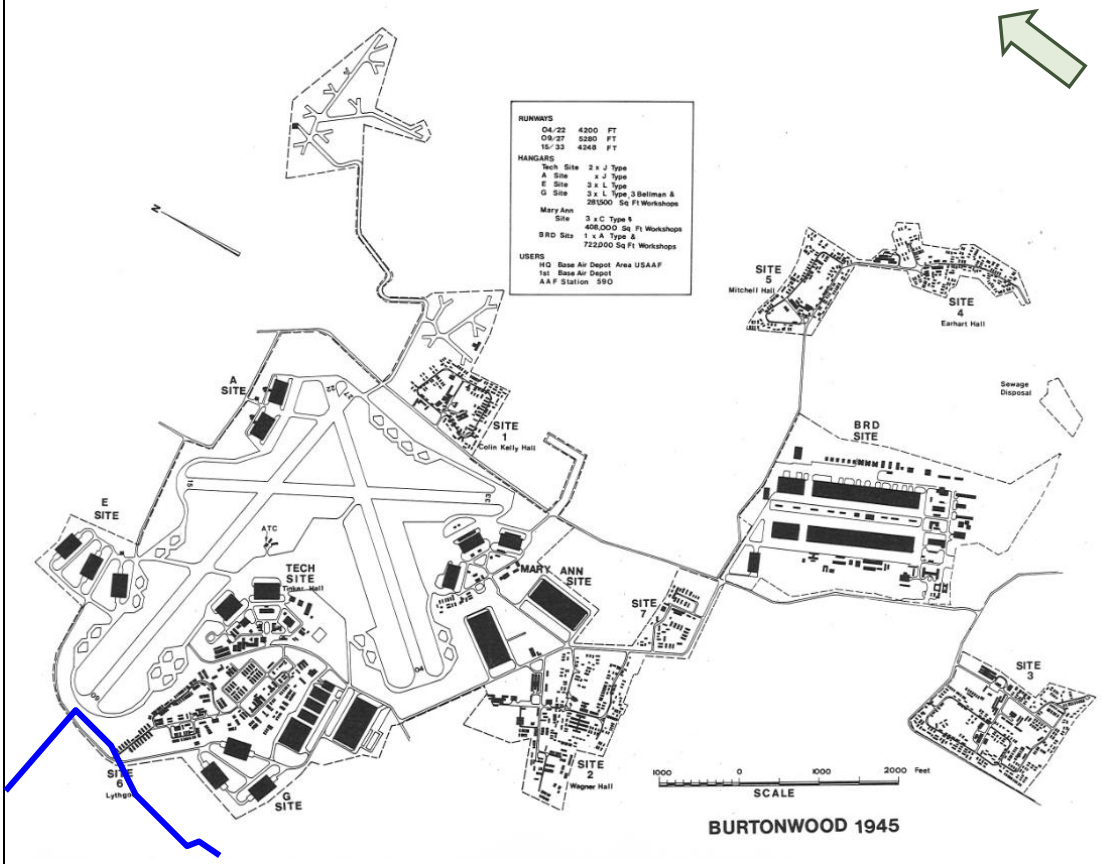
In 1940, Burtonwood Airfield initially comprised an airfield with a HQ and 3No. sub-sites for storage. During this time the airfield did not encroach onto the Site.

In 1942, following the US entry into WWII, Burtonwood Airfield became the principal supply and maintenance base for the 8th US Air Force. The facilities were officially handed over to the USAAF in October 1943, when the airfield became Base Air Depot 1 (BAD1), designated as Army Air Force (AAF) Station 590.

A large expansion programme was initiated following the USAAF takeover. This comprised the construction of a third runway, the perimeter track of which encroached onto the north-eastern corner of the Site, new storage hangars, and the provision of additional living accommodation, including site 6-Lythgoe adjacent to the Site.

Figure 4 is a 1945 layout plan of the airfield. It shows the north-eastern corner of the Site encroaching onto the perimeter track near to the main runway and the accommodation facilities at site 6-Lythgoe.

Figure 4	Plan of Burtonwood Airfield, 1945



Source: Ferguson, 1986 *Not to Scale*

Legend	Site boundary

At the end of WWII activity at the airfield decreased and in 1946 it reverted to RAF control. It was used by No. 276 MU and the reformed No. 37 MU for aircraft salvage and scrapping.

In September 1948 the airfield was handed to the United States Air Force (USAF), which used it as a support base for US troops serving in Europe.

Flying at Burtonwood Airfield ceased in 1959 and control of the airfield passed back to the RAF, although several USAF units remained there until 1965.

In 1967 the US Army took over Burtonwood Airfield as its main European supply depot, known as Burtonwood Army Depot. It included stores of US Army vehicles, mobile hospitals, bridges and equipment.

During the 1970s and 1980s, the airfield was used by Territorial Army (TA) and Cadet units for training purposes. It was also used by the MoD for civil contingency and emergency planning exercises, as well as EOD exercises for the Police and Fire & Rescue training.

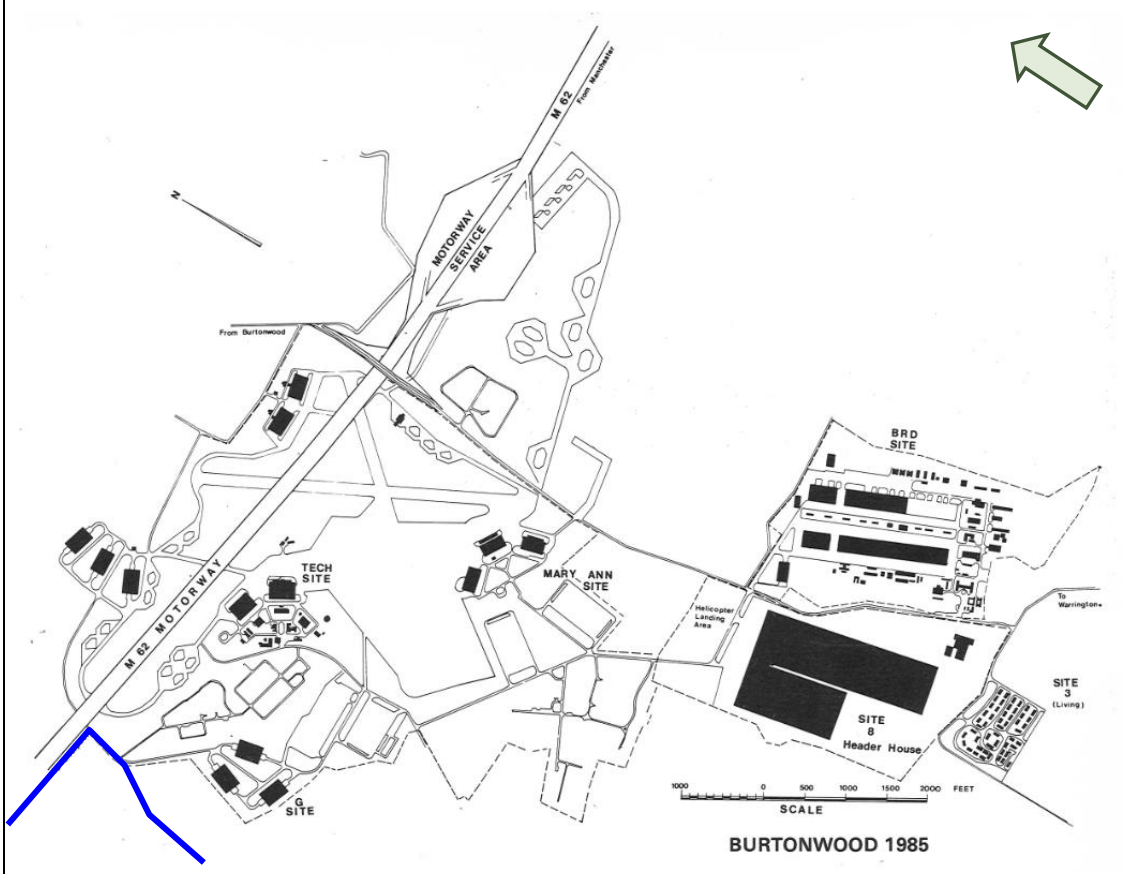
Elements of the base closed between 1973 and 1985. During this time, the M62 was established along the northern boundary of the Site, across the line of the former main runway.

In 1982 the main part of the airfield was sold to the Warrington & Runcorn Development Corporation.

Figure 5 is a 1985 plan of the airfield. It shows the construction of the M62 along the line of the former runway.

Many of the sub-sites and accommodation facilities, including site 6-Lythgoe adjacent to the Site, had been closed and demolished.

Figure 5	Plan of Burtonwood Airfield, 1985



Source: Ferguson, 1986 *Not to Scale*

Legend	Site boundary

Demolition of most of the remaining airfield infrastructure took place between 1986 and 1988.

Following the end of the Cold War, Burtonwood Army Depot officially closed in June 1994 and by 2003 most of the former depot was either undergoing redevelopment, principally for Chapelford Urban Village, or had reverted to agriculture. The last of the WWII buildings were demolished between 2008 and 2009.

Potential UXO Hazard

The north-eastern corner of the Site encroached upon the perimeter track and accommodation facilities at Burtonwood Airfield.

No airfield activity likely to provide a significant source of UXO hazard has been identified on the Site.

As with any similar establishment, the potential for finding Small Arms Ammunition (SAA) or military scrap within the former airfield boundary cannot be totally discounted, as shown by recent finds (see Section 8).

Burtonwood Airfield is not considered to provide a significant source of UXO hazard to the Site.

5.2 Aircraft Crashes

Aircraft crash sites are a known UXO hazard. The MoD advises that if crashed aircraft are found, the safest policy is to leave them alone where possible. Unless disturbed there is no statutory requirement for the MoD to clear such sites.

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

7th August 1941

1No. Handley Page Hampden bomber aircraft (P2073) crashed on landing at Burtonwood Airfield, within approximately 1.5km east-northeast of the Site.

7th November 1941

1No. Handley Page Hampden I bomber aircraft (P5396) crashed at Burtonwood Airfield, within approximately 1.5km east-northeast of the Site.

27th June 1943

1No. Republic P-47D-11-RE Thunderbolt fighter aircraft (42-75522) crashed at Burtonwood Airfield, approximately 1.1km east-northeast of the Site.

30th August 1943

1No. Consolidated B-24H-1-FO Liberator heavy bomber aircraft (42-7468) crashed at Burtonwood Airfield, on 'Cob' Northolt Farm, approximately 1.9km northwest of the Site.

1No. Lockheed YP-80A Shooting Star fighter aircraft (44-83026) crashed north of Burtonwood Airfield, approximately 1.9km northwest of the Site.

18th January 1944

1No. Lockheed P-38J Lightning fighter aircraft (42-67896) crashed at Burtonwood Airfield, within approximately 1.5km east-northeast of the Site.

14th January 1945

1No. Lockheed P-38 Lightning fighter aircraft (42-4633) crashed on approach to the main runway at Burtonwood Airfield, approximately 1.2km east of the Site, while making a forced landing.

The crashes detailed may have resulted in the scattering of SAA over a wide area, some of which may still be present. This is not considered to provide a significant UXO hazard (see Appendix A1.1).

6 EXPLOSIVES AND MUNITIONS ESTABLISHMENTS AND DEPOTS

Explosives and munitions manufacturing or storage sites offer a particularly high risk from both explosive substances and UXO. Standard procedures of explosive/ordnance disposal through burial or burning means that explosive and UXO hazards will be present in some areas of such establishments.

In addition, UXB hazards may be present as a result of enemy bombing during WWI and WWII.

6.1 Explosives and Ordnance Factories

No records of explosives or ordnance factories on or in close proximity to the Site have been found.

Crosfield and Sons Ltd manufactured glycerine for the explosives industry during WWI. They had a works in Warrington, approximately 4km southeast of the Site.

Explosives and ordnance factories are not considered to provide a source of UXO hazard to the Site.

6.2 Munitions Stores

Local ammunition caches would have been present near to defended road blocks, pillboxes, HAA and LAA sites. Most of those associated with the anti-invasion sites are understood to have been cleared.

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

There were munitions storage facilities at Burtonwood Airfield for equipping the aircraft processed at the depot before they were sent to operational units. This would have predominantly consisted of the storage of canon and machine-gun ammunition.

No evidence has been found to indicate that any such stores were located on the Site.

Munitions stores are not considered to provide a source of UXO hazard to the Site.

6.3 Informal Munitions Depots

Informal munitions depots, often made by requisitioning roadside lay-bys or parks. Other informal munitions depots were commonly located in areas of woodland or on train wagons along sidings in marshalling yards.

No records of any informal munitions depots on or in close proximity to the Site have been found.

6.4 Munitions Disposal Areas and Bomb Cemeteries

Munitions disposal areas were often made by requisitioning open areas of land, usually away from habitation. Marshland, beaches or sand dunes were frequently used for this purpose. Disposal of munitions was carried out in many different ways, ranging from destruction to burial. Full records were not necessarily maintained for these locations, and so they can potentially be a source of UXO.

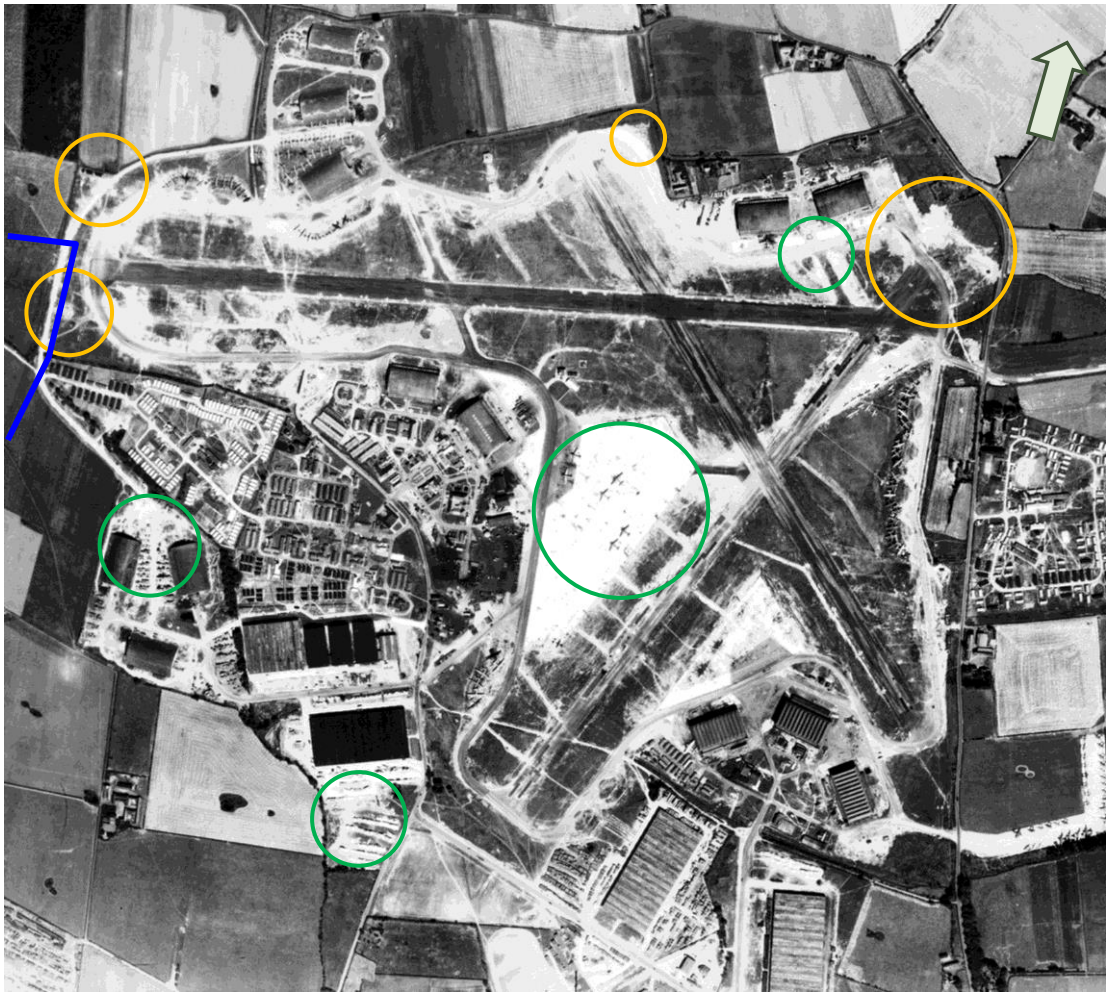
No records of any official munitions disposal areas on or in close proximity to the Site have been found.

There is anecdotal evidence that during and post-WWII, large pits were dug at the end of runways at Burtonwood Airfield to dispose of waste that had built up at the airfield.

Plate 6 is an aerial photograph, dated the 10th August 1945, showing large areas of disturbed ground around the airfield, typical of waste burial. The nearest of these was located adjacent to the north-eastern corner of the Site.

A variety of aircraft, many awaiting scrapping, are also evident around the airfield. There is evidence of possible aircraft breaking near the G-site hangars, approximately 0.3km east of the Site.

Plate 6	Aerial photograph showing disturbed ground at Burtonwood Airfield, 1945



Source: Historic England *Not to Scale*

Legend	Site boundary	Disturbed ground	Possible aircraft breaking

Given its location at the end of the main runway, it is considered unlikely that the disturbed ground adjacent to the Site would have been due to munitions disposal. It more likely relates to general waste disposal.

Munitions disposal areas are not considered to provide a source of UXO hazard to the Site.

7 FIRING RANGES AND MILITARY TRAINING AREAS

By their nature, firing ranges and military training areas represent a potential source of UXO due to associated training activities. The training will involve both practice and live munitions and will offer a significant risk from a very wide range of potential UXO.

7.1 Small Arms Ranges

Small arms ranges (such as rifle ranges) and close combat ranges (such as mortar and grenade ranges) are likely to provide a significant source of UXO. It should be noted that even on small arms ranges, larger munitions such as mortars or grenades cannot be discounted.

No records of any small arms ranges on or in close proximity to the Site have been found.

A 400yd rifle range and test butts located on the northern part of Burtonwood Airfield, approximately 0.8km from the Site.

A miniature rifle range was situated to the north of the gas works in Warrington, approximately 4.9km southeast of the Site.

Small arms ranges are not considered to provide a source of UXO hazard to the Site.

7.2 Artillery Ranges

Artillery ranges will have utilised a wide range of munitions, predominantly shells, although close combat munitions such as mortars, or larger munitions such as bombs, cannot be discounted.

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

7.3 Bombing Ranges

Bombing ranges will have primarily used bombs, although other munitions such as shells and close combat munitions such as mortars cannot be totally discounted.

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

7.4 Training Areas

Training areas will have primarily used blank ammunition or practice shells in ‘dry’ areas, although live munitions such as shells and close combat munitions such as mortars cannot be discounted in any training area.

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

There would have been training activities at Burtonwood Airfield throughout WWII, consisting of basic military drills and simulated ‘invasions’ to test the airfield’s defences. It is unlikely that these would have included the use of live munitions.

Training areas are not considered to provide a source of UXO hazard to the Site.

8 EXPLOSIVE ORDNANCE CLEARANCE ACTIVITIES

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

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

On average 8.5% UXBs later self-exploded. In some cases the bombs had delayed action fuzes or were never intended to explode, their purpose being to cause inconvenience and fear.

Given the discrepancy in records and the fact that UXBs are still being found unexpectedly, it is clear that the original figures are understated and provide only an approximation of the number of potential UXBs in the UK.

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

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

8.1 Abandoned Bombs

No records of any officially abandoned bombs on the Site have been found.

8.2 EOC Tasks

Zetica Ltd holds records of the following post-WWII EOC tasks being undertaken in the vicinity of the Site.

1980s

Anecdotal evidence has been found indicating that when Burtonwood Airfield was redeveloped, several cases of grease-wrapped .50 calibre guns were discovered in burial pits, approximately 1.5km from the Site, along with both spent and live .30 and .50 calibre rounds.

1983

Approximately 250No. items of expended UXO were found on Burtonwood Airfield, approximately 1.2km east of the Site. These were removed by an army Explosive Ordnance Disposal (EOD) unit.

2005

2No. spent .303 cartridge cases were found approximately 1.5km southeast of the Site.

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

9 UXO HAZARD ASSESSMENT

9.1 UXO Hazard Level

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

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

No records have been found indicating that the Site was bombed and no other significant sources of UXO hazard have been identified on the Site.

Given this, it is considered that the Site has a low UXO hazard level, as shown in Figure 6.

Figure 6 UXO hazard zone plan of the Site

Source: Google Earth *Not to Scale*

Legend	Very Low	Low	Moderate
	High	Very High	Site boundary

10 UXO RISK ASSESSMENT

10.1 UXO Risk Level

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

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

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

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

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

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

P = PE x PD	LIKELIHOOD of Encounter and Detonation	Rating
21 to 25	Frequent, highly likely, almost certain.	5
16 to 20	Probable, more likely to happen than not.	4
6 to 15	Occasional, increased chance or probability.	3
2 to 5	Remote, unlikely to happen but could.	2
1	Improbable, highly unlikely.	1
0	Impossible	0

P ranges from 25, a certainty of UXO being encountered and detonated on the Site by engineering activity, to 0, a certainty that UXO does not occur on the Site and will not be detonated by engineering activity.

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

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

UXO Risk Matrix

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

The final risk assessment for the Site is given in Table 4.

Table 4 UXO risk assessment for the Site

Potential UXO Hazard	Anticipated Works	PE	PD	P = PE x PD	Likelihood	Severity	Risk Rating	UXO Risk
UXB	Shallow Excavations	1	1	1	1	5	5	Low
	Deep Excavations	1	1	1	1	5	5	Low
	Piling/Boreholes	1	1	1	1	4	4	Low
Other UXO	Shallow Excavations	1	1	1	1	4	4	Low
	Deep Excavations	1	1	1	1	4	4	Low
	Piling/Boreholes	1	1	1	1	3	3	Low

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

Shallow Excavations defined as <1.0m below ground level (bgl.)

UXO Risk	Matrix Rating	Definition
Very Low	0-1	Little action is required by the client provided that suitable records and procedures are in place to ensure appropriate action is undertaken should the UXO risk level change.
Low	2-5	Tolerable to the client as engineering activity need not alter if UXO related procedures and controls are strictly adhered to.
Moderate	6-15	May be tolerable for the client, but it is prudent to reduce the risk where cost effective and reasonably practicable.
High	16-20	Tolerable to the client only where further risk reduction is impracticable or disproportionate to the risk involved. Essential that all practicable measures are taken to reduce the level of risk.
Very High	21-25	Unacceptable to the client except in extraordinary circumstances. Imperative that all control measures are taken.

10.2 Risk Mitigation Recommendations

To ensure that the UXO risk is reduced to As Low As Reasonably Practicable (ALARP) the following mitigation is advised:

Where a low risk of UXO encounter is anticipated, industry good practice is to raise the awareness of those involved in excavations so that in the unlikely event that a suspect item is discovered, appropriate action is taken. This can be achieved through UXO awareness briefings to site staff.

Clearance certification for borehole or pile locations is considered prudent only if a zero tolerance to risk is adopted. Zero tolerance is commonly adopted for sites that have safety critical infrastructure such as nuclear establishments and oil refineries.

Table 5 in the main report gives recommended actions in relation to the potential UXO risk level and the anticipated Site activity.

Further advice on the mitigation methods can be provided by Zetica on request.

Table 5	Risk mitigation for assumed Site activities			
Risk Level	**Typical Future Activity on the Site**			
	None	**Shallow Excavations (<1.0m)**	**Deep Excavations (>1.0m)**	**Boreholes or Pile Construction**
Very low	Ensure suitable records and procedures are in place to highlight the risk should future development be planned.	Ensure site staff, are informed as part of the site safety induction that the potential presence of UXO cannot be discounted. Appropriate action is required to be detailed within site procedures.	Ensure site staff, are informed as part of the site safety induction that the potential presence of UXO cannot be discounted. Appropriate action is required to be detailed within site procedures.	Ensure site staff, are informed as part of the site safety induction that the potential presence of UXO cannot be discounted. Appropriate action is required to be detailed within site procedures.
Low	**As very low.**	**As very low.** **+ It is considered prudent to include some UXO awareness training in site inductions.**	**As very low.** **+ It is considered prudent to include some UXO awareness training in site inductions.**	**As very low.** **+Clearance certification for borehole or pile locations would be considered prudent only if a zero tolerance to risk is adopted.** **Zero tolerance is commonly adopted for sites that have safety critical infrastructure such as nuclear establishments and oil refineries.**
Moderate	As very low.	As low. +Non-intrusive investigation methods considered prudent where practical. +Alternatively, EOC Engineer supervision is considered prudent.	As low. +Non-intrusive investigation methods considered prudent where practical. +Alternatively, EOC Engineer supervision is considered prudent.	As low. +Clearance certification for borehole or pile locations is considered essential.
High	As very low.	As moderate. +Non-intrusive investigation methods considered essential where practical. + Alternatively, EOC Engineer supervision is considered essential.	As moderate. +Non-intrusive investigation methods considered essential where practical. + Alternatively, EOC Engineer supervision is considered essential.	As moderate.
Very High	Requires immediate or special attention.	Requires immediate or special attention.	Requires immediate or special attention.	Requires immediate or special attention.
The above table is for guidance only.				

APPENDICES

Appendix 1 UXO Hazard and Ordnance Types

When assessing the risk from UXO including UXB, it is important to be aware of ordnance type and function. The following Section briefly describes the more common types of UXO. More data on these can be found at http://zeticauxo.com/downloads-and-resources/ordnance-data-sheets/.

A1.1 Small Arms Ammunition

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

Larger calibre small arms munitions can contain fuze mechanisms and high explosives or pyrotechnic fillings and may have been used for anti-aircraft or anti-vehicle purposes.

Generally small arms ordnance has a relatively low risk as UXO, although the larger calibre categories may have the same detonation risk as larger high explosive ordnance. SAA is often associated with discarded ammunition boxes around firing practice ranges. The Plate below illustrates some common SAA.

Plate	Photograph of typical WWII small arms ammunition

Source: Google Images

A1.2 Hand Grenades

Hand grenades can be filled with explosives or chemicals and have 3No. main parts, a body, a fuze with a pull ring and a safety-clip assembly. Fragmentation grenades are the most common and have a metal or plastic body filled with an explosive. Most use a burning delay fuze that functions for 3 to 5 seconds after the safety lever is released.

Some, such as smoke grenades, are activated instantly when the lever is released. The Plate below illustrates the typical character and condition of No. 36 hand grenades (Mills Bombs) that have been excavated from a site.

Plate	Photographs of a typical and an excavated WWII No. 36 hand grenades

Source: Google Images

Source: Zetica Ltd

A1.3 Projected Grenades

Projected grenades are among the most commonly found UXO items, particularly the 40mm type. These contain high explosives and use a variety of fuzes, including some of the most sensitive internal impact-fuzing systems. They are extremely dangerous and can explode if moved or handled.

A1.4 Mortars

A mortar is a short tube designed to fire a projectile at a steep angle. Mortars can range from approximately 50mm to 280mm in diameter and can be filled with explosives, toxic chemicals, white phosphorous or illumination flares. They generally have a thinner metal casing than projectiles, but use the same types of fuzing and stabilisation.

During WWII there are records that the target areas of RAF practice bombing ranges were occasionally used for mortar training.

The Plate below shows a typical 2-inch mortar bomb found (left) and a demonstration 3-inch mortar bomb (right).

Plate	Photographs of WWII 2-inch and 3-inch mortars

Source: Daily Mail

Source: Zetica Ltd

A1.5 Shells

Shells are a projectile containing an explosive charge designed to burst the casing that can contain High Explosives, pyrotechnic compounds or other chemicals.

Shells can be found in a range of sizes, from <20mm to several times this size. The most likely shells to be found on the Site are Small Arms Ammunition (SAA) or UXAA shells that have fallen back to the ground unexploded.

Most commonly used anti-aircraft shells were 2" and 3.7" HE shells.

If fired and found as UXO, shells can offer a particular hazard from accidental detonation as they can have sensitive fuze mechanisms. A fuze is a device which incorporates mechanical, electrical, chemical or hydrostatic components to initiate a train of fire or detonation.

The Plate below is a photograph of a 3.7" UXAA shell found in Camberwell, London.

Plate	Photograph of a recently excavated 3.7" AA shell

Source: Zetica Ltd

A1.6 Incendiary Bombs

Incendiary Bombs (IBs) ranged from small 1kg and 2kg thermite filled, magnesium bodied bombs to a 250kg 'Oil Bomb' (OB) and a 500kg 'C300' IB. The C300 bombs were similar in appearance to 500kg HE bombs.

In some cases the IBs were fitted with a very small High Explosive (HE) bursting charge. This exploded after the bomb had been alight for a few minutes causing burning debris to be scattered over a greater area.

By far the most common air dropped incendiary devices across the UK during WWII were small Brandbomben 1kg Elektron (B-1E) IBs.

B1-E IBs consisted of a cylinder of magnesium alloy (Elektron) with an incendiary filling of 680 grammes (g) of thermite, an incendiary mixture of 24% aluminium and 76% iron (III) oxide, occasionally with additional barium nitrate or boric acid. The thermite was ignited by a very small percussion charge in the nose which fired on impact.

Later B-1E Zusatz (B-1E Z) versions with an explosive charge in the nose or tail were introduced in the bomb loads. The explosive charge, ignited by heat (B-1E ZA) or a small delayed action device (B-1E ZB), usually consisted of small amounts, typically less than 15g, of Penta-erythritol-tetranitrate (Nitropenta or PETN).

Later, the 2.2kg steel nosed B-2E was deployed. Note that the 2kg B-2E steel nosed IB was not introduced until 1944.

In most cases the B-1E IBs, which actually weighed approximately 0.83kg and were 50mm in diameter and 350mm long, were unlikely to have penetrated more than 0.5m.

The small amount of HE and the almost negligible potential for B-1E or B-1EZ IBs to remain active after more than 70 years in the ground means that these items have very little prospect of causing damage. In the majority of cases if IBs are found in the ground, the incendiary materials have deteriorated to such an extent that they are considered to provide a low UXO hazard level.

However, since magnesium and phosphorus were common components in IBs, some localised chemical contamination may occur where the contents have leached out of the IB into the surrounding soil.

The Plate below shows a typical variety of fragmentary remains of IBs and IBs recovered by the Civil Defence during WWII, along with a photograph of 4No. spent IBs found in Hertfordshire in January 2017 (lower right).

Plate	Photographs of an intact IB and typical fragmentary remains of IBs.

Source: ZeticaUXO

A1.7 German High Explosive Bombs

Probably the most common and certainly most publicised UXOs to be found in the UK are bombs. Air dropped bombs, as a result of WWII enemy action, are found on a relatively frequent basis as UXO. They tend to be highly publicised (at least on a local basis) due to the common disruption where an evacuation of the potentially affected area is put in place.

The amount of High Explosive and the potential for a fuze to still be activated means that these devices have the prospect of causing some of the most widespread damage. WWII bombs were particularly sophisticated for their time, with anti-tamper fuzes.

Many German bombs were designed to not explode on impact and instead to cause disruption as a UXB. Some fuzes were set with a delay time of over 70 hours. During this time, an anti-tamper fuze could also be activated to detonate should it be disturbed.

The most commonly used bombs during WWII were the 50kg and 250kg sized general purpose bombs. Less frequently, the 500kg bomb was also used. Larger bombs were used, but so infrequently that any assessment of hazard is more typically based on bombs ranging up to 500kg only.

It should be noted that the June 2008 find of a 1000kg bomb in London, does demonstrate that larger bombs can be found and any risk mitigation measures should consider this.

The Plate below shows the variety of UXB recovered by the Civil Defence during WWII.

Plate	Photograph of a variety of UXB recovered by the Civil Defence during WWII

Source: Imperial War Museum

A1.8 Detonators, Gaines and Fuzes

Bomb components such as detonators, gaines and fuzes were stored at operational airfields during WWII and typically contained some type of explosive charge to initiate the detonation of a munition.

A wide variety of these components were used and examples of some common fuzes are shown in the Plate below.

Plate	Photographs showing examples of WWII fuzes

Source: Zetica Ltd

A1.9 Land Mines

Wartime activities provide numerous sources of UXO within the land environment. Whilst efforts have been made to clear the known British minefields, it was common for mines to become lost for a variety of reasons and so not recovered. Additionally, such munitions might have been disposed of on an unofficial basis and so no records were kept.

Most of the mined beaches and other land areas in the UK have been cleared by the MoD. Occasionally, wave action or activities such as bombing caused mines to become displaced and these were missed as part of any past clearance activities.

The Plate below is a photograph of a typical WWII land mine used on the land area, beaches and cliffs around Britain. This example was found at Gatwick Airport formerly RAF Gatwick.

Plate	Photographs of original and recently excavated WWII land mines

Source: Google Images

Source: Zetica Ltd

A1.10 Home Guard Weapons

Initially, the Home Guard's armoury was largely second-hand and much of it was of WWI vintage. Personal weapons (such as shotguns) and home-made devices were also employed.

By the end of WWII, some units were well equipped with a wide variety of small arms and munitions.

These included .32, .38 and .455 revolvers, .303 P14, .300 P17 and .303 Canadian Ross rifles, anti-tank rifles and a variety of Sub- Machine Guns (SMG) such as the .45 Thompson and 9mm Sten Guns.

Other heavier Machine Guns (MG) at their disposal included Browning, Hotchkiss, Lewis, Vickers and Marlin MG. Sub-artillery weapons were developed for them, including grenade throwers (the Northover Projector) and spigot mortars (the Blacker Bombard). 2-pdr anti-tank guns and Projector, Infantry Anti Tank (PIAT) weapons were in circulation amongst some units, and the Home Guard also manned AA guns later in WWII.

Explosives were available to some Home Guard units and were used and stored by all Auxiliary Unit patrols. As well as the flame fougasse and hand grenades detailed in this Appendix, the Home Guard had stocks of Molotov Cocktails, Sticky Bombs and SIP grenades.

In October 2006 a cache of 76No. SIP grenades was found in a garden at Seend, Wiltshire. In October 2008, a further 26No. SIP grenades were discovered in a garden in Wimborne, Dorset. Similar caches were discovered in October 2009 in Hove, Sussex and during May 2010 in Halesowen in the West Midlands, and a further cache of 20No. was uncovered on a construction site at Birdlip, Gloucestershire, in July 2010.

Also in July 2010, a box of 24No. SIP grenades was found on Cogden Beach, Dorset. In April 2012, more than 8No. SIP grenades were found on a construction site in Banbury and destroyed by members of the Army Royal Logistic Corps (RLC).

In March 2015, 80No. SIP grenades were found at a building site in Eastbourne, some of which exploded before they could be made safe by a Bomb Disposal unit.

Most recently, in May 2016, 1No. No. 76 SIP grenade was found during excavation at Chapel Point, Lincolnshire forcing works to be delayed. During WWII, the site was occupied by a pillbox and gun emplacement associated with the heavily-defended 'Coastal Crust', manned by Home Guard units. The device was removed safely.

In January 2017, a cache of 24No. SIP grenades was discovered at Derriford, Plymouth and made safe by a Royal Navy Bomb Disposal Unit.

Between December 2017 and February 2018, at least 194No. SIP grenades were found on a building site in Cambridgeshire.

The Plate below is a photograph of a No. 76 SIP grenade (LHS) with an explanatory leaflet produced by ZeticaUXO for site staff (RHS).

Plate	Photographs of No. 76 SIP grenades

zeticaUXO

Information Data Sheet

Category Grenades
Type No. 76 Self-Igniting Phosphorus Grenade

Variants -

Dimensions 152.4mm x 63.5mm (6" x 2.5")

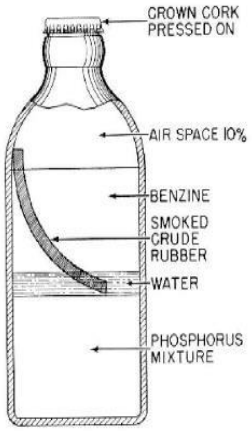
Weight 1lb

Fuze Self-igniting upon breakage

Material Glass

Description Glass bottle filled with white phosphorus, benzene, water and crude rubber.

Function Introduced as an emergency anti-tank measure for the Home Guard early in WWII. Intended to ignite the engine compartment of advancing tanks.



Source: Zetica Ltd

Given the irregular nature of Home Guard activity, the possibility of items of UXO or weapons being discovered at any locations occupied or used for training by them can never be totally discounted.

A1.11 UXO Migration

It is possible for explosive material, UXO or ordnance scrap to migrate to a site during landfill or dredging operations or other ground works which import Made Ground or natural materials already containing UXO. It is important to understand the nature and age of such landfill or dredging operations when assessing the potential UXO hazard level on the site.

A1.12 Effects and Consequences

There have been a limited number of recorded incidents in the UK since WWII where bombs have detonated during engineering works, though a significant number of bombs have been discovered. Incidents involving smaller ordnance are, however, relatively common in the UK.

In the UK, there are no recorded incidents since the decade after WWII, of a UXB accidentally detonating. In recent years, bombs have been found that have fuze mechanisms that have started to operate indicating that given the right conditions a UXB may still function.

In June 2008 the UXB uncovered in the Lea Valley caused difficulty to No. 33 Regiment (Explosive Ordnance Disposal) Royal Engineers because the fuze mechanism started to operate.

The 1,000kg 'Hermann' bomb, the first of this size to be found in over 30 years, took 5 days to deactivate. This demonstrates that larger bombs can be found and any risk mitigation measures should provide the option to deal with this size of device. Since WWII, UXBs have been found on a regular basis in London.

Since WWII, UXBs have been found on a regular basis throughout Britain. Some of the most recent cases are described below.

In May 2009 1No. 50kg WWII bomb was found on a building site in Bexhill-on-Sea, Sussex, and on the 16th August 2009, 1No. 250kg WWII bomb was found near Ebberston, North Yorkshire. Both of these were destroyed in controlled explosions by Bomb Disposal Units.

On the 8th March 2010 1No. 500kg WWII bomb was found at Bowers Marsh in Essex by Zetica EOC operatives following a Zetica desk study concluding a high risk of UXB on the site. The bomb was demolished in situ by members of the Army Royal Logistics Corps (RLC).

The Plate below is a photograph of the bomb in situ.

Plate	Photograph of the 500kg WWII UXB at Bowers Marsh, 8th March 2010

Source: Zetica Ltd

On the 23rd February 2011, 1No. WWII UXB was found on a building site in Notte Street in Plymouth City centre. The bomb was removed by EOD personnel and demolished at sea.

On the 22nd July 2012, a landslip in the cliffs at Mappleton in the East Riding of Yorkshire exposed over 1,000No. UXO items, including practice bombs, mortars, rockets, shells and grenades. The cliff was part of a former bombing and artillery range, used during WWII and until the 1970s.

UXO items were removed by Explosive Ordnance Disposal (EOD) officers from Catterick and MoD staff from Leconfield. 15No. controlled explosions were undertaken by the Royal Engineers (RE) to detonate the more volatile items in situ, while other less hazardous UXO devices were left in place to be dealt with at a later date.

1No. WWI bomb (shown in the Plate below) was found on the Isle of Sheppey on the 2nd August 2012 during a geophysical survey following desk study research by Zetica Ltd which had established that a previously unknown WWI bombing range existed on the site. A further WWI bomb was found in the same location in August 2015.

Plate	Photograph of WWI bomb, Isle of Sheppey, 2nd August 2012

Source: Zetica Ltd

On the 23rd March 2015, 1No. WWII 500kg UXB was found on a building site in The Grange, Bermondsey. The bomb was made safe by EOD personnel and removed for demolition.

On the 21st May 2015, 1No. 50kg UXB was found on a building site near Wembley Stadium, London Borough of Brent. The bomb was made safe by EOD personnel and removed for demolition.

On the 10th August 2015, 1No. 250kg UXB was found under the basement of a building site at Bethnal Green, London Borough of Tower Hamlets. It was made safe and removed by an EOD team from the RLC.

On the 21st September 2015, 1No. UXB was uncovered on a construction site in Cheylesmore, Coventry, by the operator of a mechanical digger. It was destroyed in situ by an EOD team from the RLC.

In January 2016, Zetica discovered 3No. 500lb British UXB at a former airfield in Cambridgeshire. These were destroyed in controlled explosions. The Plate below is a photograph of one of the bombs.

Plate	Photograph of a recently excavated WWII British 500lb GP bomb

Source: Zetica Ltd

On the 12th May 2016, 1No. 250kg UXB was found on a building site in Bath. It was made safe and then taken to a local quarry for demolition.

In September 2016 1No. 500kg UXB and 1No. torpedo were discovered during dredging works in Portsmouth Harbour. An additional 250kg HE bomb was discovered on the 16th November 2016. These devices were towed out to sea and destroyed in controlled explosions.

On the 19th January 2017, 1No. 50kg UXB was found during dredging works along the River Thames Victoria Embankment in Central London. The device was towed to Tilbury in Essex where it was destroyed in a controlled explosion.

On the 25th January 2017, 1No. 500lb British UXB and 1No. mortar shell were found in King's Forest, Thetford. They were destroyed in a controlled explosion.

On the 2nd March 2017, 1No. 250kg German UXB was found on a building site in Brondesbury Park in the London Borough of Brent. It was defuzed by an EOD team and removed to a safe location where it was destroyed in a controlled explosion.

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

On the 31st August 2017, 1No. 50kg German UXB was found in a quarry in Kings Hill, West Malling, Kent. It was destroyed in a controlled explosion.

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

During October and November 2017, approximately 150No. canisters of Mustard Gas were found in a lake and adjacent woodland near the former WWII military airfield RAF Woodhall Spa, Lincolnshire. The canisters were removed to the DSTL at Porton Down for safe disposal.

On the 11th February 2018, 1No. 500kg UXB was found in King George V Dock in London, resulting in the temporary closure of the adjacent London City Airport. The UXB was freed from a silt bed and towed along the River Thames to Shoeburyness where it was destroyed in a controlled explosion on the 14th February 2018.

On the 26th February 2018, an EOD team destroyed numerous items of ordnance including shells and 20mm ammunition which had been exposed by storms on Selsey Beach.

On the 3rd April 2018, 1No. WWI shell was found in Steeton near Bradford. It was destroyed in a controlled explosion after being made safe and moved to a nearby field.

Overseas

There is a long list of incidents during construction work in Europe (particularly Germany) that in some cases have led to casualties.

On the 4th September 2017, 1No. 4,000lb High Capacity UXB was discovered during construction work in Frankfurt. Following the evacuation of more than 60,000No. people from inside a 1.5km exclusion zone the bomb was defuzed by an EOD team. A similar evacuation took place in Koblenz the following day after the discovery of an American UXB.

In June 2010, 3No. members of a bomb disposal team were killed, and 6No. others injured, whilst attempting to defuze an unexploded WWII bomb in Goettingen, Central Germany.

The bomb, the second found in Goettingen in the space of a few days, was unearthed at a depth of 7.5m during excavations for a sports stadium.

In September 2008, 17No. people were injured and considerable damage occurred to adjacent buildings when a bomb exploded on a construction site in Hattingen, Germany.

In October 2006 during road works on a motorway near Aschaffenburg in Bavaria, southern Germany, a bomb was struck by a machine and detonated. The plant driver was killed and 5No. others injured, including passing motorists.

In a similar incident in October 2004 in Linz, Austria a bomb exploded injuring 3No. workers and causing considerable damage to plant. In the same month, a WWII bomb under a back garden in Vienna, Austria, was detonated without warning by a minor earth tremor, after remaining undiscovered for over 60 years.

Incidents involving UXO are also reported from the marine areas around the North Sea. For example, on 6th April 2005, 3No. Dutch fishermen were killed when they accidentally trawled up a WWII UX bomb which exploded when it hit the deck.

Further details of similar finds can be found at http://zeticauxo.com/news/.

The effects of a partial or full detonation of ordnance are usually shock, blast, heat and shrapnel damage. A 50kg buried bomb can damage brick / concrete structures up to a distance of approximately 16m away. Unprotected personnel on the surface up to 70m away from the blast could also be seriously injured. Larger ordnance would obviously be more destructive.

Explosives rarely lose effectiveness with age, although over time mechanisms such as fuzes and gaines can become more sensitive and therefore more prone to detonation, regardless of whether the device has been submersed in water or embedded in silt, clay or similar materials.

The effects of a detonation of explosive ordnance are usually extremely fast, often catastrophic and invariably traumatic to any personnel involved.

Appendix 2 Abbreviations	
AA	Anti-Aircraft
AAF	Army Air Force
ACPO	Association of Chief Police Officers
AFDU	Air Fighting Development Unit
ALARP	As Low As Reasonably Practicable
ARD	Aircraft Repair Depot
ARP	Air Raid Precaution
ASACS	Air Surveillance and Control System
ASU	Aircraft Storage Unit
AXO	Abandoned Explosive Ordnance
BAD1	Base Air Depot 1
BD	Bomb Disposal
BDO	Bomb Disposal Officer
BDU	Bomb Disposal Unit
BRD	Burtonwood Repair Depot
CLR	Central London Railway
CBRN	Chemical, Biological, Radiological and Nuclear
CLE	Central Landing Establishment
CMD	Conventional Munitions Disposal
DAB	Delayed Action Bomb
DCLG	Department of Communities and Local Government
EO	Explosive Ordnance
EOC	Explosive Ordnance Clearance
EOR	Explosive Ordnance Reconnaissance

ERW	Explosive Remnants of War
ESA	Explosive Substances and Articles
FFE	Free From Explosives
FTS	Flying Training School
HAA	Heavy Anti-Aircraft
HE	High Explosive
HSE	Health and Safety Executive
JSEODOC	Joint Services EOD Operations Centre
IB	Incendiary Bomb
IED	Improvised Explosive Device
IEDD	Improvised Explosive Device Disposal
LAA	Light Anti-Aircraft
MoD	Ministry of Defence
MU	Maintenance Unit
ORB	Operational Record Book
OTU	Operational Training Unit
PRU	Photographic Reconnaissance Unit
PTS	Parachute Training School
PUCA	Pick Up and Carry Away
RAF	Royal Air Force
SAA	Small Arms Ammunition
SIP	Self-Igniting Phosphorous
TA	Territorial Army
TEP	Time Expired Pyrotechnics
USAAF	United States Army Air Forces

USAF	United States Air Force
UXAA	Unexploded AA
UXB	Unexploded Bomb
UXIB	Unexploded Incendiary bombs
UXO	Unexploded Ordnance

Appendix 3 Glossary & Definitions	
Abandoned Explosive Ordnance (AXO)	Abandoned Explosive Ordnance is explosive ordnance that has not been used during an armed conflict, that has been left behind or disposed of by a party to an armed conflict, and which is no longer under control of that party. Abandoned explosive ordnance may or may not have been primed, fuzed, armed or otherwise prepared for use.
Camouflet	The type of cavity produced when a charge explodes underground without breaking the surface of the earth to form a crater.
Demil	Derived from the term 'Demilitarisation', it refers to the break down and the recycling or disposal of ordnance components.
Detonation	The high-speed chemical breakdown of an energetic material producing heat, pressure, flame and a shock wave.
Device	This term is used for any component, sub-assembly or completed ordnance, which may or may not have an explosive risk. It can apply to detonators, primers, gaines, fuzes, shells or bombs.
Explosive	The term explosive refers to compounds forming energetic materials that under certain conditions chemically react, rapidly producing gas, heat and pressure. Obviously, these are extremely dangerous and should only be handled by qualified professionals.
Explosive Ordnance (EO)	Explosive Ordnance is all munitions containing explosives, nuclear fission or fusion materials and biological and chemical agents. This includes bombs and warheads, guided and ballistic missiles, artillery, mortar, rocket, small arms ammunition, mines, torpedoes, depth charges, pyrotechnics, cluster bombs & dispensers, cartridge & propellant actuated devices, electro-explosive devices, clandestine & improvised explosive devices, and all similar or related items or components explosive in nature.
Explosive Ordnance Clearance (EOC)	Explosive Ordnance Clearance is a term used to describe the operation of ordnance detection, investigation, identification and removal, with EOD being a separate operation.
Explosive Ordnance Disposal (EOD)	Explosive Ordnance Disposal is the detection, identification, on-site evaluation, rendering safe, recovery and final disposal of unexploded explosive ordnance.
Explosive Ordnance Reconnaissance (EOR)	Explosive Ordnance Reconnaissance is the detection, identification and on-site evaluation of unexploded explosive ordnance before Explosive Ordnance Disposal.
Explosive Remnants of War (ERW)	Explosive Remnants of War are Unexploded Ordnance (UXO) and Abandoned Explosive Ordnance (AXO), excluding landmines.

Explosive Substances and Articles (ESA)	Explosive substance are solid or liquid substance (or a mixture of substances), which is either: • capable by chemical reaction in itself of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. • designed to produce an effect by heat, light, sound, gas or smoke, or a combination of these as a result of a non-detonative, self-sustaining, exothermic reaction. Explosive article is an article containing one or more explosive substances.
Fuze	A fuze is the part of an explosive device that initiates the main explosive charge to function. In common usage, the word fuze is used indiscriminately, but when being specific (and in particular in a military context), fuze is used to mean a more complicated device, such as a device within military ordnance.
Gaine	Small explosive charge that is sometimes placed between the detonator and the main charge to ensure ignition.
High Explosive	Secondary explosives (commonly known as High Explosives (HE)) make up the main charge or filling of an ordnance device. They are usually less sensitive than primary explosives. Examples of secondary explosives are: Nitro glycerine (NG), Trinitrotoluene (TNT), AMATOL (Ammonia nitrate + TNT), Gunpowder (GP), and Cyclotrimethylenetrinitramine (RDX).
Munition	Munition is the complete device charged with explosives, propellants, pyrotechnics, initiating composition, or nuclear, biological or chemical material for use in military operations, including demolitions. This includes those munitions that have been suitably modified for use in training, ceremonial or non-operational purposes. These fall into three distinct categories:- • inert - contain no explosives whatsoever. • live - contain explosives and have not been fired. • blind - have fired but failed to function as intended.
Primary Explosive	Primary explosives are usually extremely sensitive to friction, heat, and pressure. These are used to initiate less sensitive explosives. Examples of primary explosives are: Lead Azide, Lead Styphnate, and Mercury Fulminate. Primary explosive are commonly found in detonators.
Propellants	Propellants provide ordnance with the ability to travel in a controlled manner and deliver the ordnance to a predetermined target. Propellants burn rapidly producing gas, pressure and flame. Although usually in solid form they can be produced in liquid form. Examples of propellants are: Ballistite often found in a flake form and Cordite used in small arms ammunition.
Pyrotechnic	A pyrotechnic is an explosive article or substance designed to produce an effect by heat, light, sound, gas or smoke, or a combination of any of these, as a result of non-detonative, self-sustaining, exothermic chemical reactions.

Small Arms Ammunition (SAA)	SAA includes projectiles around 12mm or less in calibre and no longer than approximately 100mm. They are fired from a variety of weapons, including rifles, pistols, shotguns and machine guns.
Unexploded Anti-Aircraft (UXAA) Shell	UXAA shells are army ordnance commonly containing HE, though they can also contain pyrotechnic compounds that produce smoke. Most commonly, these were 3.7" and 4.5" HE shells, although they ranged from 2" to 5.25" calibre.
Unexploded Bomb (UXB)	UXB is a common term for unexploded air-dropped munitions.
Unexploded Ordnance (UXO)	UXO is explosive ordnance that has been either primed, fuzed, armed or prepared for use and has been subsequently fired, dropped, launched, projected or placed in such a manner as to present a hazard to operations, persons or objects and remains unexploded either by malfunction or design.
V1	The Vergeltungswaffe-1, V-1, also designated Fieseler Fi 103/FZG-76, known colloquially in English as the Flying Bomb, Buzz Bomb or Doodlebug, was the first guided missile used in WWII and the forerunner of today's cruise missile.
V2	The Vergeltungswaffe 2 (V-2) ('Reprisal Weapon 2') was the first ballistic missile. It was used by the German Army primarily against Belgian and British targets during the later stages of WWII. The V-2 was the first manmade object launched into space, during test flights that reached an altitude of 189km (117 miles) in 1944.

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- ☑ Intrusive ground investigations

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Kinchington, Jess

From: Robert Lea <Robert.Lea@zetica.com>
Sent: 13 May 2019 10:50
To: Kinchington, Jess
Cc: Research
Subject: RE: UXO Desk Study Omega West site (ref: P7831-18-R1

Hi Jess

Yes, we can confirm that the conclusions remain valid for the additional search area.

Kind regards

Robert

Robert Lea
Risk Assessor
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From: Kinchington, Jess [mailto:Jess.Kinchington@wsp.com]
Sent: 13 May 2019 10:43
To: Robert Lea
Subject: RE: UXO Desk Study Omega West site (ref: P7831-18-R1

Great thanks Robert – are you in a position to provide an update on the below?

Kind regards

Jess Kinchington
Senior Consultant | Ground Risk & Remediation

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From: Robert Lea [mailto:Robert.Lea@zetica.com]
Sent: 08 May 2019 16:40
To: Kinchington, Jess <Jess.Kinchington@wsp.com>
Cc: Research <Research@zetica.com>
Subject: RE: UXO Desk Study Omega West site (ref: P7831-18-R1

Hi Jess

We'll review the expanded area and get back to you shortly.

Kind regards

Robert

Robert Lea
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From: Kinchington, Jess [mailto:Jess.Kinchington@wsp.com]
Sent: 08 May 2019 16:33
To: Research
Subject: UXO Desk Study Omega West site (ref: P7831-18-R1

Hello

We have currently made a recent purchase of a UXO Desk Study for the Omega West site (ref: P7831-18-R1). We have recently been informed by our client that the boundary has changed to the following (shown in green): Are you able to confirm if the findings from the original UXO report are still valid for the additional search area?

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