



**Mineral Stability & Coal Mining Risk Assessment
Braefoot Road, Bo'ness EH51 9TX.**

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1. INTRODUCTION

McGregor Moore Environmental Consultants Ltd (MMEC) was commissioned by Hardie Associates Ltd on behalf of their client SJSJ Property Investments Ltd to undertake a Mineral Stability and Coal Mining Risk Assessment (CMRA) for a site located at Braefoot Road in the Borrowstoun area of Bo'ness.

It is the understanding of MMEC that the site is designated for residential redevelopment.

The scope of work included the preparation of an initial desk-based site investigation based on a review of relevant geological mapping, local archive information, site reconnaissance and interpretative reporting. In addition several trenches were excavated across the site in order to uncover the location of known historical mine entries on the site.

This report has been prepared for SJSJ Property Investments Ltd and their advisors for the purpose of assisting them in evaluating the potential risk associated with mine workings beneath the site.

1.1 Terms of Reference

The aforementioned Desk Study investigation was generally undertaken in accordance with:

- The Coal Authority – Model Report Template – January 2011

1.2 Scope

The objectives of this coal mining risk assessment are as follows:

- Present a desk-based review of all available archive information on the site geology, mineral stability and coal mining issues relevant to the application site.
- Review of available information to assess / determine current risks to the development.
- Set-out requirements for further work / appropriate mitigation where necessary.
- Demonstrate to the Local Planning Authority that the application site is or can be made stable to meet the requirements of national planning policy.

1.3 Methodology & Information Sources

The information presented within this CMRA is based on observations made on site, a review of available geological and hydrogeological information published by the following parties listed in Table 1.1.

Table 1.1: List of Parties Consulted

Organisation
British Geological Survey (BGS) Visitor Services – The Lyell Centre, Research Avenue South, Riccarton, Edinburgh EH14 4AP.
Coal Authority Report, Report Ref. No: 51001461955001, May 31 st , 2017.
Coal Authority Shaft Plan & Data Sheets Report Ref. No: 51001461955002, May 31 st , 2017.

1.4 Limitations

This report and its findings should be considered in relation to the terms of reference and objectives agreed between MMEC and the Client as previously stated.

For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

The conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full. MMEC cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared.

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2. SITE LOCATION & SURROUNDINGS

2.1 Site Location

The site was centred at National Grid Reference E300270, N680160 between ~85.00-92.50m AOD to the east of Braefoot Road in the Borrowstoun area of Bo'ness. The site is currently undeveloped, irregular in shape and 2,070m² in size and sloped down to the north. A site location plan is provided as Figure 1, Appendix A, while a plan showing the site boundary is provided as Figure 2, Appendix A.

2.2 Site Surroundings

A summary of the surrounding land uses at the site is shown in Table 2.1.

Table 2.1 Summary of Surrounding Land Uses

Location	Description
North	Residential development.
East	New residential development currently under construction.
South	Undeveloped agricultural land.
West	Residential development.

2.3 Site Description & Current Site Use

The site was essentially level and sloped down to the north.

At the time of the current investigation the site was undeveloped and comprised of rough grass with a scattering of shrubs and immature trees.

The site was described by existing detached and semi-detached residential dwellings to the north, a new large residential development under construction to the east, undeveloped agricultural land to the south and by existing detached residential dwellings to the west.

The site boundary was defined by a wooden garden boundary fence and hedgerow to the north, temporary Heras fencing to the east, a mature hedgerow to the south and by wooden garden boundary fencing to the west.

An initial visual inspection of the site revealed no obvious evidence of settlement issues.

Existing buried electricity, gas, water supply, waste water and telecommunications and street lightening services were noted on and in close proximity to the north-west portion of the site.

3. GEOLOGY

3.1 General Geology & Ground Conditions

The geology and likely geological conditions present beneath site were established following a review of relevant geological mapping for the area at the British Geological Survey (BGS) Visitor Services and supplementary information provided in the Coal Authority Reports. The following sources were therefore consulted.

- Sheet NT 08 SW, Solid & Drift 1:10,000 scale (1993)
- Coal Authority Report, 51001461955001, May 31st, 2017.
- Coal Authority Shaft Plan & Data Sheets Report Ref. No: 51001461955002, May 31st, 2017.
- Hydrogeological Map of Scotland, 1:625,000 scale (1988)

3.1.1 Solid Geology

The eastern portion of the site was shown on the mapping reviewed to be underlain by sedimentary strata belonging to the Limestone Coal Formation which typically comprise of a cyclical sequence of sandstones, siltstones, mudstones, seatearths and numerous coal seams. The western portion of the site was shown on the mapping reviewed to be underlain by sedimentary strata belonging to the Upper Limestone Formation which typically comprise of sandstones and mudstones with subordinate siltstones, limestones and thin coal seams. The aforementioned sedimentary strata was shown on the mapping reviewed to dip to the west at an estimated angle of up to ~12° in the vicinity of the site.

Specifically the north to south trending Splint Coal (~0.20-1.00m thick) was shown on the mapping reviewed to outcrop at or close to rockhead across the middle of the site. To the west of the Splint Coal outcrop the site was underlain by sedimentary strata belonging to the Upper Limestone Formation, while to the east of the Splint Coal outcrop, the site was shown to be underlain by sedimentary strata belonging to the Limestone Coal Formation.

In addition the north to south trending Index Limestone (~1.00-1.60m thick) which lies within the Upper Limestone Formation was shown on the mapping reviewed to outcrop at or close to rockhead some ~65m to the west of the site.

Finally, the north to south trending Corbiehall Coal (~0.10-0.80m thick), Upper Ironstone (~0.30-0.80m thick) and the Seven Foot Coal (~0.80-1.60m thick) which belong within the Limestone Coal Formation were shown on the mapping reviewed to outcrop at or close to rockhead some ~125m, ~200m and ~315m to the east of the site respectively.

Therefore with respect to the aforementioned, the Splint Coal (~0.20-1.00m thick) was anticipated to underlie the western portion of the site at rockhead to a depth of 4.0m below rockhead. In addition the Corbiehall Coal (~0.10-0.80m thick) and Seven Foot Coal (~0.80-1.60m thick) were anticipated to underlie the site at depths which varied between some ~14-35m below rockhead.

Specifically the Corbiehall Coal (~0.10-0.80m thick) was anticipated to underlie the site at depths which varied between some ~14.0m below rockhead on the eastern site boundary and ~22.0m below rockhead on the western site boundary, while the Seven Foot Coal (~0.80-1.60m thick) was anticipated to underlie the site at depths which varied between some ~30.0m below rockhead on the eastern site boundary and ~35.0m below rockhead on the western site boundary.

3.1.2 Drift Geology

The majority of the site was shown on the mapping reviewed to be covered by a surface horizon of made ground referred to as a spoil heap / fill of an unknown thickness and composition. In

addition, the former Borrowstoun Reservoir which has since been drained and infilled was shown immediate to the north of the site and may encroach on to the northern site boundary.

Undisturbed soils on the site and immediate surroundings were shown on the mapping reviewed to comprise of Glacial Till and specifically grey / brown, firm to stiff, gravelly, sandy clay with cobbles and boulders (Boulder Clay).

The thickness of the superficial drift deposits on the site was not shown on the mapping reviewed. Reference to the logs of 4No: historical boreholes (BGS BH 15637683 NT08SW221, BGS BH 15637684 NT08SW222, BGS BH 15637685 NT08SW223 & BGS BH 15637686 NT08SW224) previously sunk across the site between July 6th, and July 8th, 2004 by others reported drift thickness to depths which varied between 7.50m (BGS BH 15637685 NT08SW223) and 11.90m (BGS BH 15637684 NT08SW222) bgl.

Reference to the aforementioned logs of the 4No: historical boreholes previously sunk across the site reported made ground as clay fill to depths which varied between 0.80m (BGS BH 15637684 NT08SW222) and 3.00m (BGS BH 15637686 NT08SW224). The made ground was in turn reported to be underlain by brown sandy clay, which in turn was underlain by Glacial Till (Boulder Clay).

A plan indicating the locations of the aforementioned boreholes BGS BH 15637683 NT08SW221, BGS BH 15637684 NT08SW222, BGS BH 15637685 NT08SW223 and BGS BH 15637686 NT08SW224 is provided as Figure 3, Appendix A.

3.2 Mining & Quarrying

The site is situated within a Development High Risk Area with respect to historical coal mine workings as classified by the Coal Authority.

With reference to the geological mapping and the aforementioned (Section 3.1.1), the Splint Coal (~0.20-1.00m thick) was anticipated to underlie the western portion of the site at rockhead to a depth of 4.0m below rockhead on the western site boundary. In addition the Corbiehall Coal (~0.10-0.80m thick) was anticipated to underlie the site at depths which varied between some ~14.0m below rockhead on the eastern site boundary and ~22.0m below rockhead on the western site boundary, while the Seven Foot Coal (~0.80-1.60m thick) was anticipated to underlie the site at depths which varied between some ~30.0m below rockhead on the eastern site boundary and ~35.0m below rockhead on the western site boundary.

Reference to the logs of 4No: historical boreholes (BGS BH 15637683 NT08SW221, BGS BH 15637684 NT08SW222, BGS BH 15637685 NT08SW223 & BGS BH 15637686 NT08SW224) previously sunk across the site between July 6th, and July 8th, 2004 by others reported a number of shallow (within 20m of rockhead) intact coal seams along with waste and drilling air loss.

The generalised vertical sections of the aforementioned strata and coal seams previously encountered in boreholes sunk on the site are summarised in the following tables. Copies of the available logs are provided in Appendix B while a borehole location plan is provided in Figure 3, Appendix A.

Table 3.1: BGS BH NT08SW211 15637683 (R1), Summary of Vertical Sections, Seam Thickness & Separation Depth

Strata Type	Reported Depth (bgl)	Reported Depth (below rockhead)	Thickness
Topsoil	0.00-0.10m	N/A	0.10m
Made Ground (Clay Fill)	0.10-0.80m	N/A	0.70m
Superficial Deposits (Sandy / Boulder Clay)	0.80-8.20m	N/A	7.40m
Coal	8.20-8.35m	0.00-0.15m	0.15m
Siltstone / Mudstone	8.35-12.75m	0.15-4.55m	4.40m
Coal	12.75-13.00m	4.55-4.80m	0.25m
Sandstone / Siltstone	13.00-15.80m	4.80-7.60m	2.80m
Waste (Air Loss)	15.80-17.20m	7.60-9.00m	1.40m
Siltstone / Sandstone	17.20->30.10m	9.00->21.90m	>12.90m

Table 3.2: BH NT08SW222 15637684 (R2), Summary of Vertical Sections, Seam Thickness & Separation Depth

Strata Type	Reported Depth (bgl)	Reported Depth (below rockhead)	Thickness
Topsoil	0.00-0.20m	N/A	0.20m
Made Ground (Clay Fill)	0.20-1.10m	N/A	0.90m
Superficial Deposits (Sandy / Boulder Clay)	1.10-11.90m	N/A	10.80m
Mudstone / Sandstone	11.90-16.40m	0.00-4.50m	4.50m
Coal	16.40-16.70m	4.50-4.80m	0.30m
Mudstone / Sandstone	16.70-21.00m	4.80-9.10m	4.30m
Waste (Packed)	21.00-22.40m	9.10-10.50m	1.40m
Hard (Unknown strata)	22.40->23.00m	10.50->11.10m	>0.60m

Table 3.3: BH NT08SW223 15637685 (R3), Summary of Vertical Sections, Seam Thickness & Separation Depth

Strata Type	Reported Depth (bgl)	Reported Depth (below rockhead)	Thickness
Topsoil	0.00-0.10m	N/A	0.10m
Made Ground (Clay Fill)	0.10-1.10m	N/A	1.00m
Superficial Deposits (Sandy / Boulder Clay)	1.10-7.50m	N/A	6.40m
Sandstone	7.50-11.70m	0.00-4.20m	4.20m
Coal	11.70-11.90m	4.20-4.40m	0.20m
Mudstone / Sandstone	11.90-17.50m	4.40-10.00m	5.60m
Coal	17.50-17.75m	10.00-10.25m	0.25m
Mudstone / Sandstone	17.75-20.30m	10.25-12.80m	2.55m
Waste (Packed)	20.30-21.50m	12.80-14.00m	1.20m
Hard (Unknown strata)	21.50->22.00m	14.00->14.50m	>0.50m

Table 3.4: BH NT08SW224 15637686 (R4), Summary of Vertical Sections, Seam Thickness & Separation Depth

Strata Type	Reported Depth (bgl)	Reported Depth (below rockhead)	Thickness
Topsoil	0.00-0.10m	N/A	0.10m
Made Ground (Clay Fill)	0.10-3.00m	N/A	2.90m
Superficial Deposits (Sandy / Boulder Clay)	3.00-9.90m	N/A	6.90m
Sandstone	9.90-13.25m	0.00-3.35m	3.35m
Coal	13.25-13.45m	3.35-3.55m	0.20m
Mudstone / Siltstone / Sandstone	13.45-19.30m	3.55-9.40m	5.85m
Coal	19.30-19.75m	9.40-10.85m	0.45m
Siltstone / Sandstone / Mudstone	19.75-23.40m	10.85-13.50m	3.65m
Coal	23.40-23.80m	13.50-13.90m	0.40m
Hard (Unknown strata)	23.80->24.00m	13.90->14.10m	>0.20m

Therefore suspected shallow workings which were recorded as waste or packed waste with air loss were reported in BGS BH 15637683 NT08SW221(R1), BGS BH 15637684 NT08SW222(R2), BGS BH 15637685 NT08SW223(R3) at depths which varied between 15.80-17.20m (R1), 21.00-22.40m (R2) and 20.30-21.50m (R3) of ground surface.

Reference to the available mapping indicated that there were 2No: known former mine entries on the site, located towards the centre and south-western portions of the site respectively.

Up to a further 7No: abandoned mine shafts / entries were shown at locations some ~35m to the east, ~75m to the north, north-west, ~95m to north, ~140m to the south-west (Baillie's Pit), ~300m to the north (Burn Pit), ~320m to the east, and ~380m to the north-east (Mingle Pit) of the site.

In addition, the mapping reviewed indicated that the Wester Main Coal (~1.20-3.00m thick) was recorded up to 1.15m thick in 3No: leaves at a depth of 112.20m bgl in Baillie's Pit, some ~140m to the south-west of the site.

The Easter Main Coal (~0.70-2.40m thick) and the Smithy Coal (~0.60-1.20m thick) were reported in the Burn Pit some ~300m to the north of the site at respective depths of 126.20m and 150.0m bgl.

Finally, the Wester Main Coal (~1.20-3.00m thick), Red Coal (at 0.90m thick), Parrot / Six Foot Coal (at 2.00m thick), Easter Main Coal (at 1.25m thick) and the Smithy Coal (~0.60-1.20m thick) were all reported in the Mingle Pit some ~380m to the north-east of the site at respective depths of 43.90m, 85.0m, 116.10m, 138.70m and 165.50m bgl.

Reference to relevant Mine Abandonment Plans (S2326, S2338, S2349, S3231, S3239, S3242, S4322, S4577, S4578 & S4589)) which were reviewed at the BGS confirmed the presence of recorded historical workings beneath and in close proximity to the site within the Red Coal (~0.50-1.80m thick), Parrot / Six Foot Coal (~0.80-2.10m thick) and the Easter Main Coal (~0.70-2.40m thick).

Based on a review of available information at the time of writing there are no known former or current quarry sites within 250m of the site. As previously stated the former Borrowstoun Reservoir which has now been drained and infilled was shown immediate to the north and may encroach on to the northern site boundary.

3.3 Coal Authority Mining Report & Shaft Plan and Data Sheets

Following a review of the Coal Authority Report and Shaft Plan and Data Sheets for the site the following relevant points were noted. A copy of the aforementioned Coal Authority Report (CAR) and Shaft Plan and Data Sheets are provided in Appendix C.

- The site was situated in an area which could be affected by historical mine workings in up to 4No: coal seams at depths which varied between 130-200m bgl and which were last worked in 1900. It is noted that the Coal Authority (CA) indicated that any ground movement associated with these workings should have since ceased.
- The site was situated in a locality where the Coal Authority understands that there are shallow coal seams present at or close to the surface, which may have been historically worked.
- The site is not located in the likely zone of influence at the surface from any present underground coal workings.
- The property is not in an area where the Coal Authority is considering to grant a license for future coal removal using underground methods.
- There are no notices under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.
- The CA are not aware of any damage due to geological faults or other lines of weakness that have been affected by coal mining.
- There are 2No: known coal mine entries on the site. The locations of the aforementioned mine entries are given as E300273, N680160 (CA Ref. No: 300680-018) on the central portion of the site and E300253, N680127 (CA Ref. No: 300680-034) on the south-western portion of the site. It is noted that the CA state that there are no records of what, if any, actions have been taken to treat the aforementioned mine entries.
- The CA has not received a damage notice or claim for the site or other properties within 50m of the site since October 31st, 1994.
- There are no records of mine gas emissions within the site boundary.

4. INTRUSIVE INVESTIGATIONS

Given that there are known recorded former mine entries situated on the central portion of the site (CA Ref. No: 300680-018, E300273, N680160) and on the south-western portion of the site (CA Ref. No: 300680-034, E300253, N680127) a number of trenches were excavated in the vicinity of the aforementioned former mine entries in order to attempt to further locate the position of these features. The locations of the aforementioned mine entries are given in the CAR (Appendix C).

A total of 6No: trenches (number TT01-TT06 inclusive) were excavated at selected locations on the site in the vicinity of the former mine entries on June 14th, 2017, where access and ground conditions allowed. The trenches were excavated using a tracked excavator fitted with a 0.60m wide bucket to depths which varied between 0.50m (TT01) and 1.50m (TT06) bgl and varied in length between 8.0m (TT02) and 10.70m (TT04). A plan showing the locations and orientation of the trenches excavated across the site are provided in Figure 4, Appendix A, while profile sketches of the strata encountered are given as Figure 5, Appendix A.

The trenches encountered strata which typically comprised of a surface horizon of gravelly, sandy, clayey topsoil to depths which varied between 0.20-0.35m bgl.

Towards the central section of each trench, a horizon of brown, soft to firm*, reworked, gravelly, sandy clay with varying quantities of bricks, blaes, cobbles, boulders and fragments of timber which extended to depths which varied between 0.40m (TT01) and more than 1.40m (TT03) bgl was encountered.

With the exception of a 3.90m section of TT03, the surface topsoil and / or made ground was in turn underlain by firm*, undisturbed grey / brown, gravelly, SANDY CLAY with cobbles and boulders (Glacial Till / Boulder Clay).

With the exception of a general thickening of the reworked clay made ground encountered in TT03 and TT06, no obvious evidence of abandoned mine entries were noted in the trenches excavated across the site.

5. RISK ASSESSMENT

The identification of potential mining risks associated with the site was based on the information reviewed as part of this (Desk Study) investigation. The following table provides a summary of the potential risks associated with mining legacy for the proposed development site.

Mining Issues	Yes	No	Risk Assessment
Underground Coal Mining (recorded at shallow depths)	✓		Horizons of waste and air loss varying between 1.20-1.40m in thickness was recorded in boreholes previously advanced by others across the site at depths which varied between 15.80-22.40m bgl and 7.60-14.00m below rockhead. - <u>Potential Risk.</u>
Underground Coal Mining (probable at shallow depths)	✓	✓	Suspected workings within 22.40m of surface / 14.0m below rockhead. - <u>Potential Risk.</u>
Coal Mining Geology	✓		There are known workings in 4No: seams of coal at depths of between 130-200m bgl. Any movement associated with the aforementioned is anticipated to have since ceased. Based on a review of the information available. - <u>No Risk.</u>
Mine Entries (shafts & adits)	✓		There are 2No: known historical mine shafts or adits on the site. There are no records of what, if any actions have been undertaken to treat these mine entries. <u>Potential Risk</u>
Other Underground Mining (recorded at shallow depths)		✓	Based on a review of the information available. - <u>No Risk.</u>
Other Underground Mining (probable at shallow depth)		✓	Based on a review of the information available. - <u>No Risk.</u>
Record of Past Mine Gas Emissions		✓	<u>No Risk.</u>
Recorded Mining Surface Hazard		✓	<u>No Risk.</u>
Surface Mining (opencast workings)		✓	<u>No Risk.</u>

Based on a review of the information available superficial soils across the site are anticipated to comprise of a surface horizon of made / disturbed ground underlain by undisturbed superficial soils comprising of gravelly sandy clay (Glacial Till / Boulder Clay). Drift thickness has previously been proved on the site to depths which varied between 7.50-11.90m bgl.

The review of the available geological mapping indicated that the Splint Coal (~0.20-1.00m thick) was anticipated to underlie the western portion of the site at rockhead to a depth of 4.0m below rockhead on the western site boundary. In addition the Corbiehall Coal (~0.10-0.80m thick) was anticipated to underlie the site at depths which varied between some ~14.0m below rockhead on the eastern site boundary and ~22.0m below rockhead on the western site boundary, while the Seven Foot Coal (~0.80-1.60m thick) was anticipated to underlie the site at depths which varied between some ~30.0m below rockhead on the eastern site boundary and ~35.0m below rockhead on the western site boundary.

The review of the available archive information confirmed the presence of historical workings beneath the site within 4No: coal seams at depths which varied between 130-200m bgl and which were last worked in 1900. It is noted that the CA indicated that any ground movement associated with these workings should have since ceased. Review of relevant Mine Abandonment Plans indicated that there are known workings beneath and in close proximity to the site within the Red Coal (~0.50-1.80m thick), Parrot / Six Foot Coal (~0.80-2.10m thick) and the Easter Main Coal (~0.70-2.40m thick).

Based on a review of previous borehole logs advanced by others across the site encountered suspected shallow workings which were recorded as waste or packed waste with air loss were reported at depths which varied between 15.80-17.20m (R1), 21.00-22.40m (R2) and 20.30-21.50m (R3) bgl.

Given the depth of the undisturbed solid strata cover encountered in BGS BH 15637685 NT08SW223(R3) which was reported as 12.80m, it is considered that there would be no adverse impact at the surface from the horizon of workings (packed waste) encountered in BGS BH 15637685 NT08SW223(R3) which was advanced on the south-eastern portion of the site.

Given the depth of the undisturbed solid strata cover encountered in BGS BH 15637683 NT08SW221(R1) and BGS BH 15637684 NT08SW222(R2) which was reported as 7.60m and 9.10m respectively, it is considered that there potentially could be an adverse impact at the surface from the horizon of air loss and workings (packed waste) encountered in BGS BH 15637683 NT08SW221(R1) and BGS BH 15637684 NT08SW222(R2) which were advanced on the north-eastern and central eastern portions of the site respectively.

There are 2No: known former mine entries recorded on the site, located towards the centre and south-western portions of the site respectively. Up to a further 7No: abandoned mine shafts / entries were shown at locations some ~35m to the east, ~75m to the north, north-west, ~95m to north, ~140m to the south-west (Baillie's Pit), ~300m to the north (Burn Pit), ~320m to the east, and ~380m to the north-east (Mingle Pit) of the site.

A total of 3No: trenches were excavated in the vicinity of each of the recorded mine entry on the site. The precise locations of the aforementioned mine entries were not able to be proved during the course of the initial trenching works.

Based on a review of the available information the greatest thickness of made ground recorded in the vicinity of the recorded mine entry located on the central portion of the site was >1.40m (TT03) bgl, while the greatest thickness of made ground recorded in the vicinity of the recorded mine entry located on the south-western portion of the site was 3.00m (BGS BH 15637686 NT08SW224) bgl.

Given the anticipated thickness of the superficial soils across the site (~7.5.0-11.90m) it is considered unlikely that any shallow coal seams present beneath the site would have been worked from the surface through bell pits which are typically limited to a maximum depth of ~8.0m bgl.

Based on a review of the available information and with respect to the nature of the proposed new development, the site can not be considered to be minerally stable.

5.1 Conclusions & Proposed Mitigation Strategy

Based on a review of the available information and with respect to the nature of the proposed new development, the site can not be considered to be minerally stable.

The presence of recorded shallow mineworkings in seams of coal at depths which varied between 15.80-22.40m bgl (7.60-14.00m below rockhead) together with the presence of up to 2No: abandoned mine shafts have been identified as the principal risks to surface stability.

Based on a review of the available information an indicative "No Build Zone" has been identified and this is shown as Figure 6, Appendix A. It is noted that this drawing indicates areas of the site which are considered unsuitable for development without further intrusive investigations and remedial works, based on a review of the available information.

It is noted that areas affected by shallow underground mineworkings may require stabilisation by grout injection or the adoption of special foundation measures.

The depth and condition of the mineworkings, particularly on the western and north-western portion of the site and the location of the recorded mine shafts on the central and south-western portions of the site remains uncertain and therefore further intrusive site investigation works are recommended in order to further assess the potential risks.

At the time of writing the following scope of additional intrusive work are considered appropriate.

- Up to 3No: additional rotary boreholes should be advanced on the western and north-western portion of the site within the highlighted "No Build Zone" (Figure 6, Appendix A). The rotary boreholes should be advanced to depths in the order of 30.0m bgl. A Coal Authority permit will be required before any drilling work commences.
- The initial exploratory trenching for mine entries undertaken as part of the this investigation has proved inconclusive, therefore as part of any further intrusive investigations, further trenching is recommended within the "No Build Zone" in the vicinity of the recorded former mine entries. It is noted that if suspected mine entries are encountered, follow-on rotary drilling may be required in order to establish depth and condition. A Coal Authority permit will be required before any drilling work commences.

In areas of past mining activity the possible presence of unrecorded mine entries cannot be completely discounted. It is therefore recommended that all formations exposed during site preparatory and construction work are examined by suitably experienced personnel such that anomalous ground conditions, possibly representing an abandoned mine entry or local subsidence, can be identified, assessed and subject to further investigation if deemed necessary.

With respect to the aforementioned and given the potential for uncharted shallow workings to be present on and in close proximity to the site, it is recommended that vigilance should be maintained during any future redevelopment works to ensure that any evidence of unrecorded mine entries or local subsidence is highlighted immediately and appropriately investigated.

Appendices

Appendix A	Figures 1-5 Site Location Plan (Fig. 1) Site Boundary Plan (Fig. 2) BGS Borehole Location Plan (Fig. 3) Trial Trench Location Plan (Fig. 4) Trial Trench Profile Sketches (Fig. 5) Indicative "No Build Zone" (Fig. 6)
Appendix B	BGS Borehole Logs
Appendix C	Coal Authority Report & Shaft Plans & Data Sheets

Appendix A

Figures 1-6

Site Location Plan (Fig. 1)

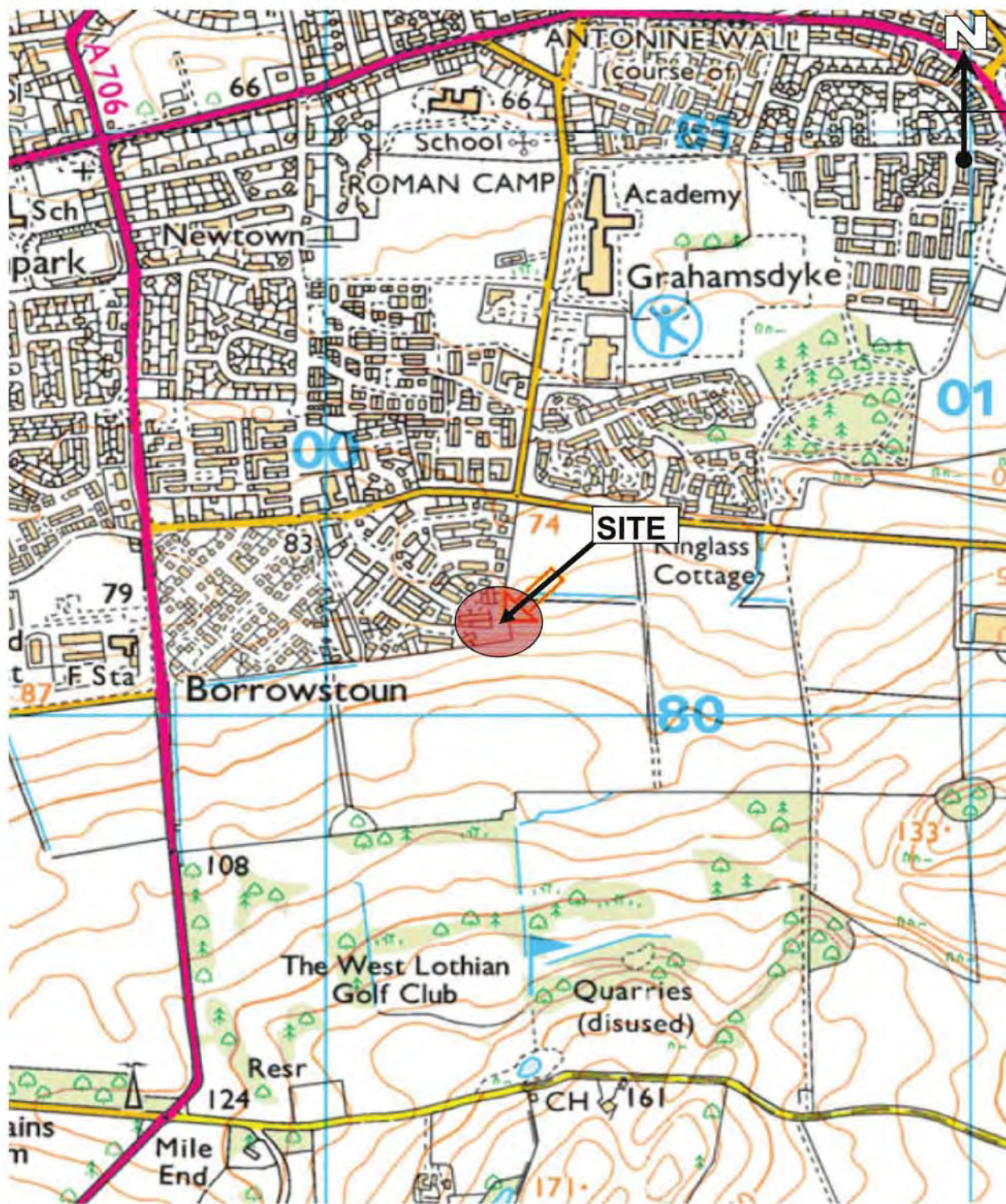
Site Boundary Plan (Fig. 2)

BGS Borehole Location Plan (Fig. 3)

Trial Trench Location Plan (Fig. 4)

Trial Trench Profile Sketches (Fig. 5)

Indicative “No Build Zone” (Fig. 6)



Title

**Site Location Plan,
Braefoot Road, Bo'ness EH51 9TX**

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MM11356

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NTS

Drawn By

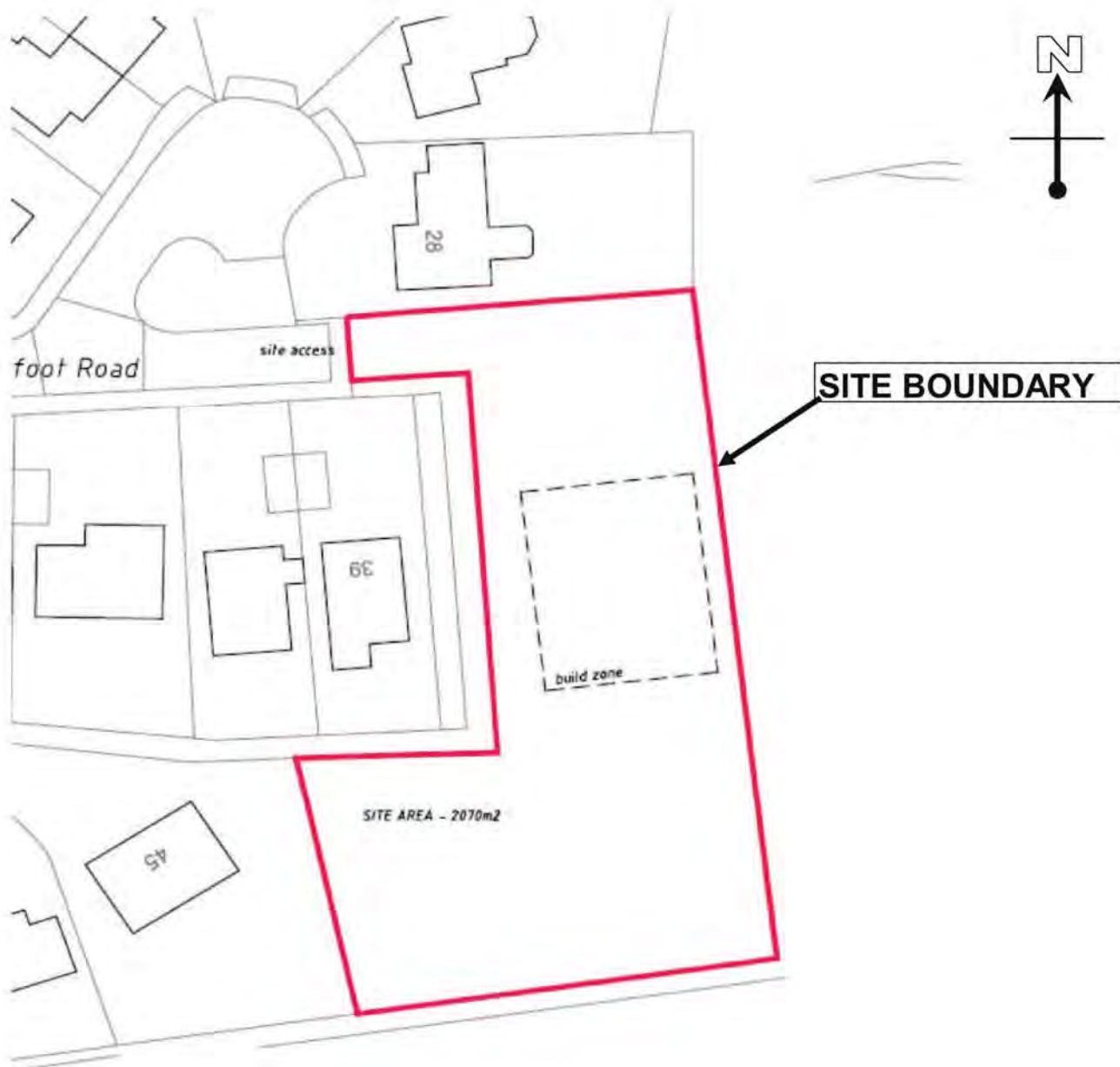
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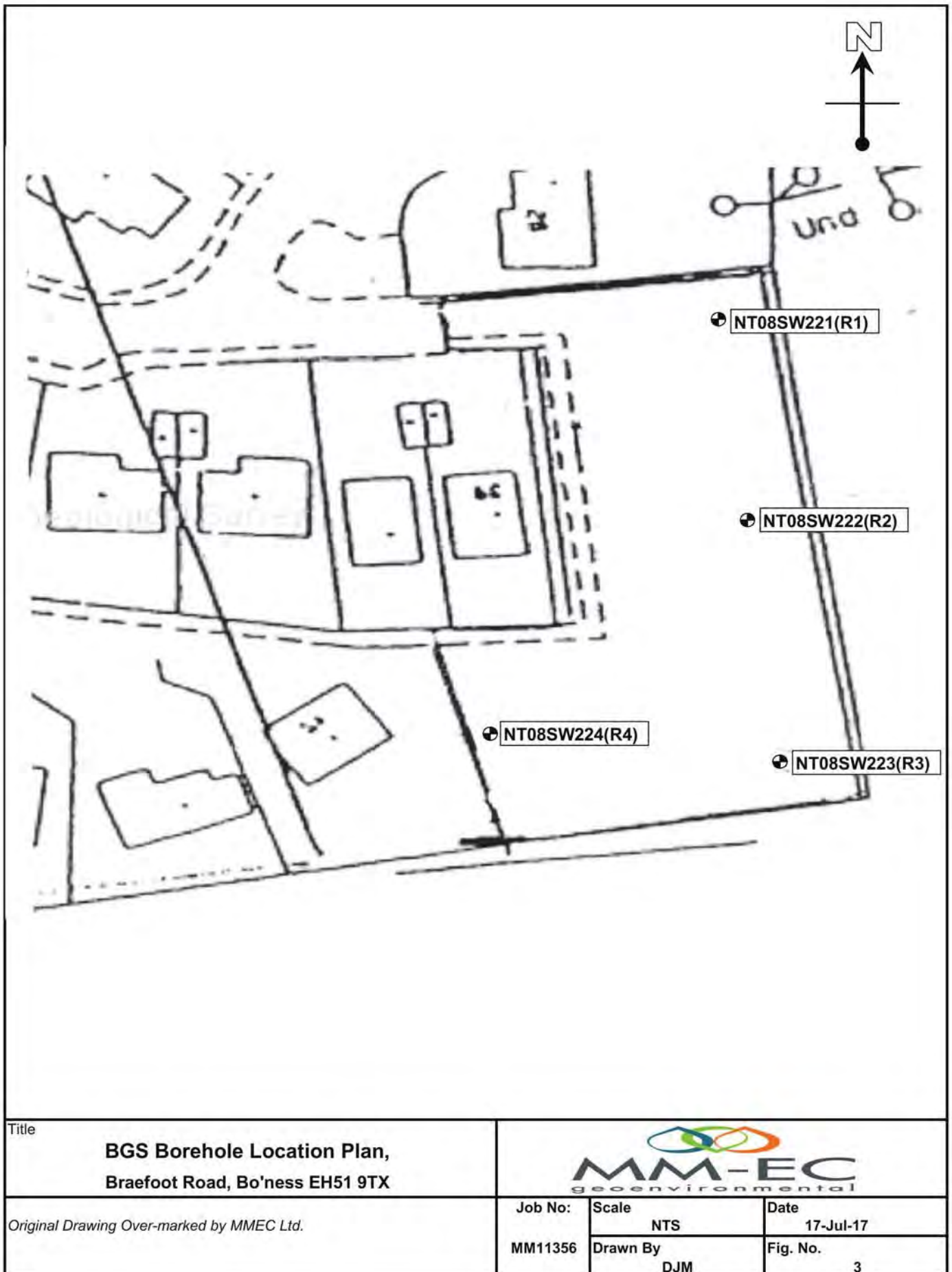
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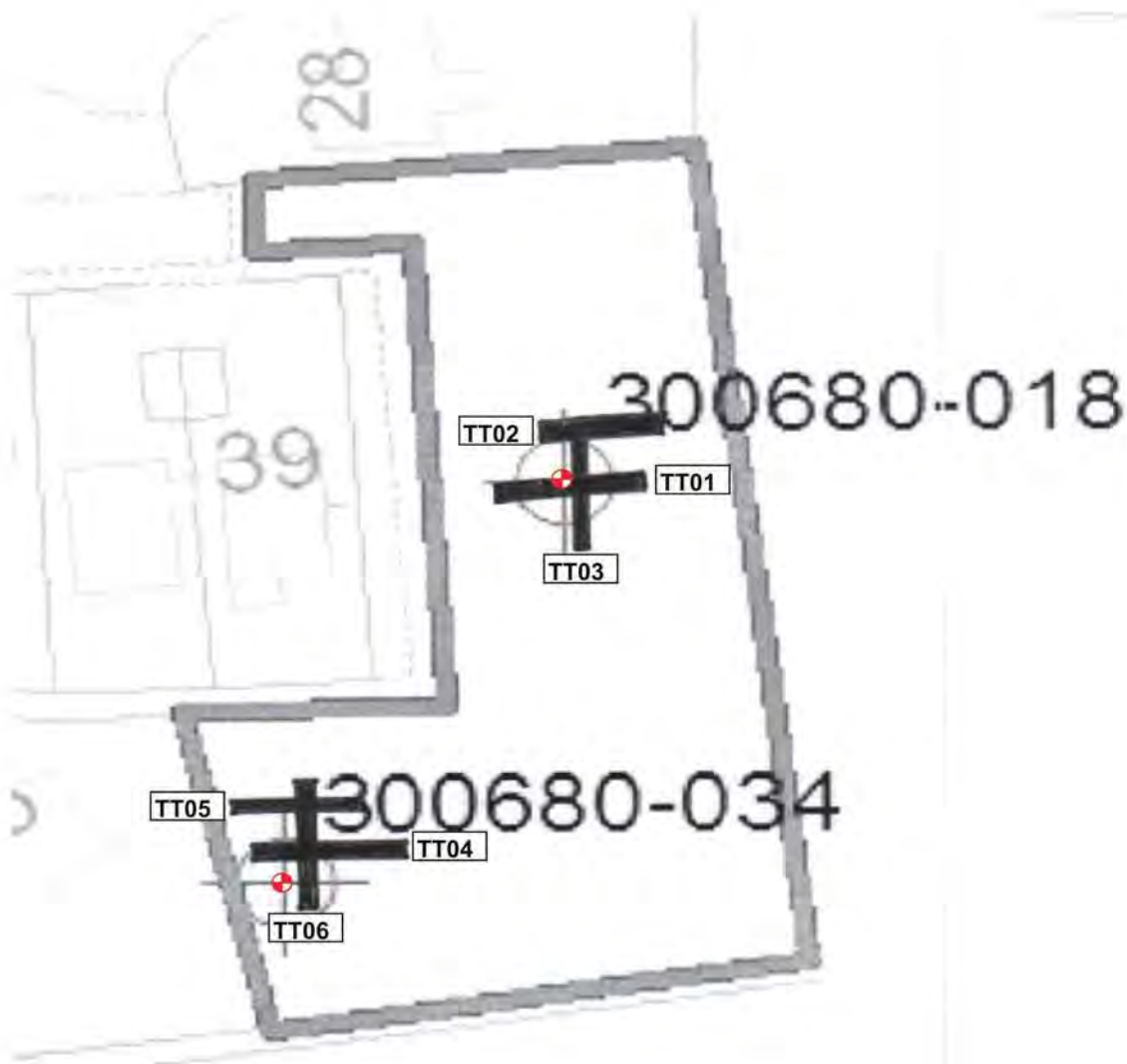
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Title Site Boundary Plan, Braefoot Road, Bo'ness EH51 9TX			
<i>Original Drawing Over-marked by MMEC Ltd.</i>	Job No: MM11356	Scale NTS	Date 15-May-17
		Drawn By DJM	Fig. No. 2





LEGEND:

TT01

Trial Trench



Recorded Mine Shaft

Title

**Trial Trench Location Plan,
Braefoot Road, Bo'ness EH51 9TX**



Original Drawing Over-marked by MMEC Ltd.

Job No:

MM11356

Scale

NTS

Drawn By

DJM

Date

17-Jul-17

Fig. No.

4

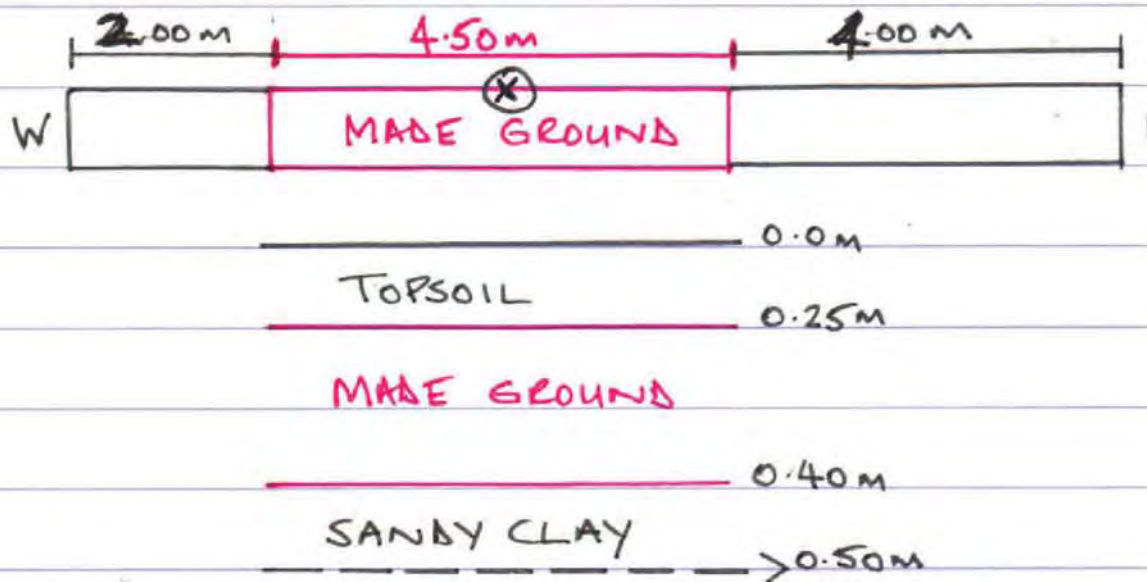
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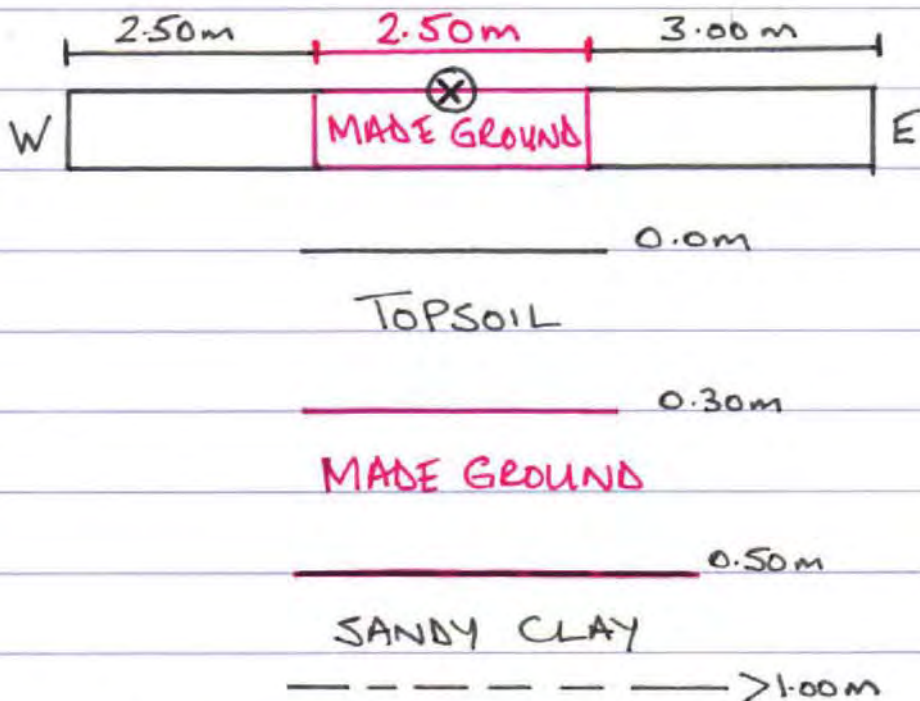


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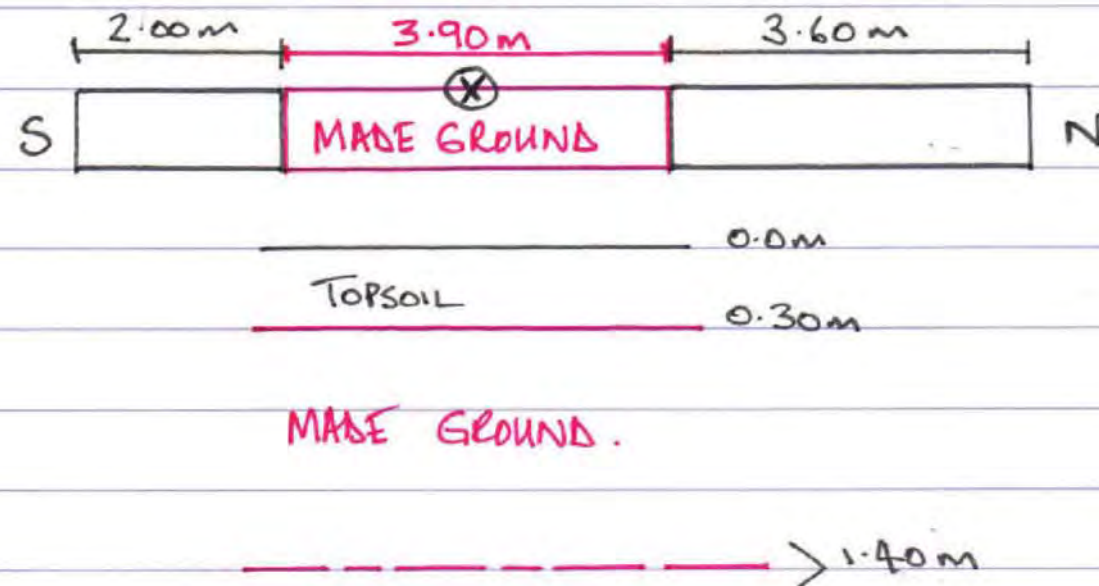


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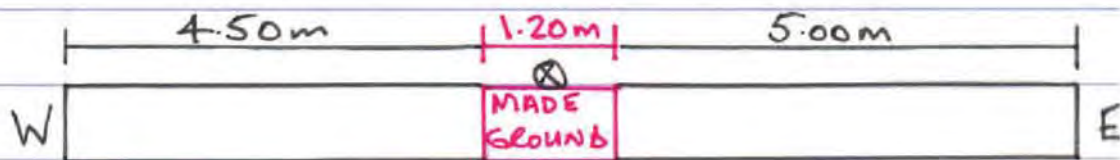
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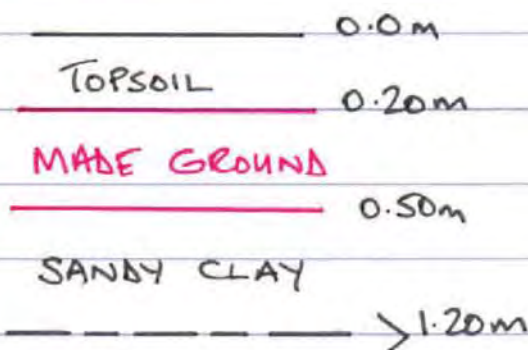
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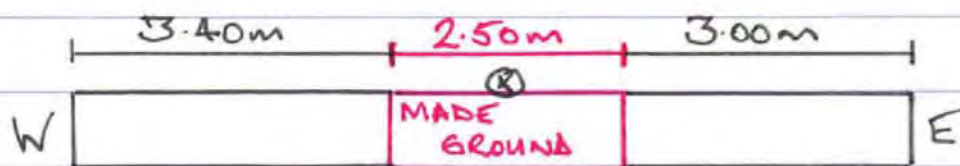
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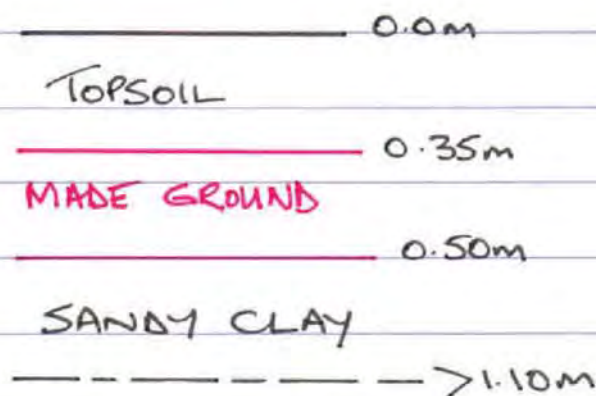
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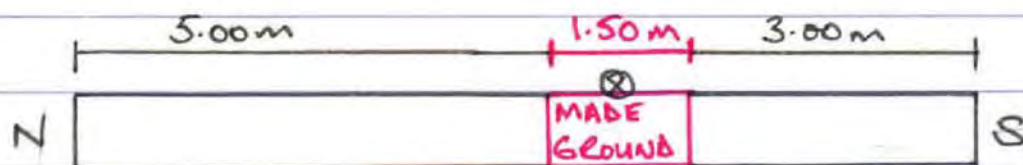
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