Report type:	Remediation Method Statement
Site:	Marsh Lane, New Mills
Client:	HT Forrest Ltd
Ref:	GRM/P7434/RMS
Date:	November 2016

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MARSH LANE, NEW MILLS

REMEDIATION METHOD STATEMENT FOR HT FORREST LTD

Project Ref:
P7434

Date:
November 2016

Prepared for:
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This report has been prepared in accordance with GRM's Accredited Quality Procedures

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		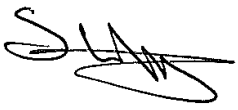

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APPENDICES

1 INTRODUCTION

1.1 PREAMBLE

GRM Development Solutions Limited (GRM) has been appointed by appointed by the HT Forrest Ltd (Client) to produce a Remediation Method Statement for the re-development of the former quarry and landfill located off of Mash lane, New Mills.

The following reports have been used in the preparation of this document:

- CL Associates, 'Site Investigation and Contamination Assessment for Land Behind the Old Vicarage, Off Marsh Lane, New Mills, Derbyshire.' (Report Ref: 42062/1), dated September 2004.
- ESG, Review of 2004 Site Investigation and Recommendations For Further Work, (Ref: LO.002/39017/clr/RGC), dated March 2011.
- GRM, 'Phase II Site Appraisal – Marsh Lane, New Mills'. (Letter report Ref: P7434-PhII-Let.1), dated May 2016.
- GRM, 'Phase I Site Appraisal (Desk Study)'. (Report Ref: P7434/GRM/DS.1), dated October 2016.
- GRM, 'Phase II Site Appraisal'. (Report Ref: P7434/GRM/F.1) dated November 2016.

GRM Standard Limitations of Reporting are provided in Appendix A of this report.

The Client proposes to develop the site with residential properties with associated infrastructure, gardens and areas of soft landscaping. The outline development proposals provided by the Client are presented in Appendix B.

1.2 OBJECTIVES OF THIS ASSESSMENT

The principal aims of the Remediation Method Statement were as follows:

a) Assess the existing information relating to the soil and groundwater conditions within the area of the site.

b) Determine a cost and time effective and sustainable remedial strategy.

c) Set out the remediation and validation processes to be followed on site to ensure the site developed does not pose a risk to human health and controlled waters.

Whilst every effort has been made to pre-empt the likely requirements of the Local Authority and the Environment Agency, they are likely to have specific requirements that will need to be discussed and addressed at a later date.

2 SUMMARY OF PHASE I DESK STUDY

The site is approximately 1ha and is 1km east of the centre of New Mills. A site location and boundary plan is presented in Appendix C. The topography is flat but the ground is relatively uneven and covered by grass. Eastern embankment comprises 2m wide stockpile against the Quarry high wall which trends approximately north south. An embankment is noted adjacent the southern boundary sloping (3-4m) down to the Marsh Lane Trading Estate.

The site currently vacant and has historically been used as a quarry and an unlicensed landfill (anecdotally accepting asbestos type wastes) located towards the northern part of the site.

Earliest map extract available (1888-1890) shows the site as “Brownbrow” Quarry with an associated tank located on the northern part of the site. By 1938 the quarry had been backfilled and the tank to the north was no longer recorded. The map extract dated 1968 shows the northern and northwestern parts of the site as a ‘refuse tip’. The latest map dated 1987 no longer noted the landfill on-site.

Made ground locally exceeds 5.4m begl. Solid geology is the Woodhead Hill Rock – Sandstone encountered between 0.9m and 5.4m begl. No superficial deposits were recorded overlying the solid geology beneath the site; however, Glacial Till deposits are noted surrounding the site. The underlying bedrock is classified as a Secondary A Aquifer whilst the surrounding Superficial strata is designated a Secondary (undifferentiated) Aquifer.

The nearest sensitive water receptor is considered to be a stream located approximately 100m to the northeast of the site.

The former landfill was not registered and is most likely unlicensed. Contaminants of concern associated with landfill are heavy metals, PAHs and asbestos.

3 SUMMARY OF GRM PHASE II INVESTIGATION

The GRM ground investigation fieldwork was conducted over two phases, the initial on the 21st April 2016 and second phase over 17th - 18th and 24th – 25th October 2016.

A total of 52 exploratory holes (Thirty six trial pits, nine windowless sample boreholes and six rotary boreholes) were progressed, to a maximum depth of 10.5m below existing ground level (begl). Nine gas and water monitoring standpipes were installed during the site works.

Topsoil
Topsoil was encountered within the window sample holes undertaken within the garden areas of 11 Marsh Lane (WS101 to WS103A) as dark brown sandy clay to brown clayey sand with gravel of quartzite.

Made Ground
Made ground was recorded from the surface of majority of the exploratory locations with the exception of WS101 to WS103A, extending to depths of between 0.90m to 7.0m begl. Three types of Made Ground were recorded;

- Made Ground A with a high proportion of anthropogenic materials was assumed to be associated with the former landfill.
- Made Ground B was reworked natural materials and was assumed to be associated with the backfill of the former quarry.
- Made Ground C represents disturbed material from surface and from the four stockpiles located within the central and eastern areas.

Presumed asbestos fragments were identified within the near surface Made Ground and predominantly associated with the landfill type materials. The asbestos fragments were provisionally identified as broken cement based sheets.

Glacial Till (Superficial Deposits)
Glacial Deposits were locally recorded beneath the near surface soils within the northwestern part of the site (WS101-WS103A) recorded to depths between 0.4m begl and 5.0m begl recorded as stiff to very stiff brown mottled grey sandy gravelly clay to sand and gravel. Gravels comprised quartzite, sandstone, mudstone and siltstone.

Woodhead Hill Rock (Sandstone)
Natural SAND weathered sandstone was recorded beneath made ground materials in some exploratory holes located to the northeast.

Depths to the rockhead ranged from between 0.4m and 6.0m begl in the northeastern part of the site and between 3.4m and 7m begl in the southern and central area. The rock was described as medium to very strong, grey stained locally light orangish brown, medium grained SANDSTONE with some containing joints.

Groundwater
The ground water monitoring to date has recorded perched water levels within the made ground between 4.03m and 5.2m begl in WS101 and WS107, respectively.

Groundwater levels within the Woodhead Hill Rock measured between 4.65m and 7.85m begl. The water monitoring within the sandstone indicate a groundwater flow in a northerly direction.

Ground Gas Assessment
The ground gas monitoring confirmed that the made ground within the former landfill and backfilled quarry is considered a potential source of ground gases. The previous ground gas data and recent GRM gas monitoring results recorded concentrations of ground gases present in the made ground as;

- Methane has not been detected above the instruments level of detection.
- Carbon dioxide concentrations of between 0.0%v/v and 2.7%v/v.
- Oxygen levels of between 10.7%v/v and 21.0%v/v.
- Maximum flow rate of 15.3l/hr.

The GRM gas monitoring programme is currently ongoing and therefore, a separate gas addendum letter report including a revised ground gas assessment will be issued following the completion of the full monitoring program.

Using the maximum flow rate of 15.3l/hr recorded previously by ESG and the default methane concentration of 0.1%v/v a Qhg of 0.0153l/hr has been calculated for methane. Using the maximum flow rate of 15.3l/hr and the maximum carbon dioxide concentration recorded by GRM of 2.7%v/v, a Qhg of 0.4131l/hr has been calculated for carbon dioxide. On this basis the Qhg GSV for the site is determined as 0.4131l/hr.

Therefore as the GSV is >0.07l/hr, the site has been characterised as 'Characteristic Situation 2' as outlined in table 2 of BS8485:2015, for which gas protection measures are required.

The requirements for ground gas protection measures will be revised once the gas monitoring programme is complete.

Chemical Analysis
Soils
The chemical results revealed lead to be pervasively contaminated within the made ground materials across the site. Localised hotspots of nickel, naphthalene and benzo[a]pyrene were also identified at depths greater than 1m below existing ground levels.

Although asbestos containing materials (ACMs) have been identified onsite predominantly associated with the materials within the former landfill, evidence of free-fibres present within the Made Ground is limited.

A plan showing the approximate extent of contamination is presented in Appendix D.

Therefore, the risk from release of free fibres during the construction phase can be considered to be low with the correct management of asbestos (removal of visible fragments, dust suppression measures and reassurance air monitoring).

Groundwater

The nearest sensitive controlled waters receptor for this site has been identified as the stream 100m to the northeast. The underlying Secondary A Aquifer has been considered to be the pathway to the stream via infiltration and lateral migration.

Copper and phenol were found to be leachable within made ground associated with the former landfill and at concentrations which exceed the EQS values.

However, copper was recorded as a slight exceedance and phenol was also not detected above the laboratory limit of detection within the groundwater in RB101 also located within the former landfill. Therefore, contamination present within the made ground materials are not considered to significantly impact upon the underlying aquifer.

Given sufficient volume of groundwater was not available from the downstream rotary boreholes (RB106) the pathway to the stream via the groundwater table is limited

Based upon quality of the groundwater and limited pathway, the overall risk to controlled waters is very low and remediation for the protection of controlled water receptors is not required

4 CONCEPTUAL SITE MODEL

4.1 HUMAN HEALTH RISK ASSESSMENT

The chemical analysis revealed elevated concentrations of lead across the site with localised hotspots of nickel, naphthalene and benzo[a]pyrene. ACMs are present within the made ground.

It is considered the risk to end users from soil contamination is considered to be moderate from metals, PAHs and asbestos.

Therefore, it is considered that remediation is required to protect end users from the recorded contamination.

The risk posed to construction workers can been mitigated by utilising PPE/RPE during the construction phase. The risk from asbestos can be lowered to within acceptable limits with removal of visible ACM fragments, dust suppression and reassurance air monitoring should be undertaken which would limit the risk of fibre release from the site and the risk posed from asbestos can be classed as low.

4.2 CONTROLLED WATERS RISK ASSESSMENT

The most sensitive receptor from the site has been identified as the stream noted 100m northeast of the site and the underlying Secondary A Aquifer is considered to be solely a pathway to the stream.

The made ground has been identified as a potential source for controlled waters and, accordingly, soil leachate and groundwater testing has been conducted to determine whether it poses risk.

Contaminants copper and phenol were found to be leachable at concentrations which exceed the EQS values.

However the impact upon the groundwater from these contaminants was limited with copper present slightly elevated above the EQS value from a single borehole located within the former landfill area.

Therefore, it is considered that the Made Ground materials do not pose a significant risk to the nearby stream and the overall risk to controlled waters is very low.

4.3 CONSTRUCTION MATERIALS RISK ASSESSMENT

It is considered that, based on the UKWIR guidance, the concentration of contaminants are such that standard PE pipes can be used within a clean backfill. However, it is recommended that the local water supply company for the site be contacted to confirm their requirements with regard to pipe materials.

The recorded water soluble sulphate results were between 11mg/l and 74mg/l and a single isolated result of 3,300mg/l. pH levels range from 5.4 and 8.8 in the soils below the site.

Based upon the majority of the water soluble sulphate concentrations and assuming mobile groundwater conditions, in accordance with requirements of BRE Special Digest 1 (2005), 'Concrete in Aggressive Ground', the Design Sulphate Class for buried concrete at the site should be assumed as DS-1 and the ACEC Class as AC-1.

However the single sample observed in the southeastern area of the site in (TP101), recorded maximum water soluble sulphate concentration of 3,300mg/l that the buried concrete is assessed as DS-4 and the ACEC Class as AC-4 for which upgraded concrete is required.

For unreinforced trench-fill foundations with a width of greater than 450mm, the classifications above equate to a concrete designated as GEN1 in BS8500 and RC35 for reinforced foundations.

Phase II Conceptual Model (pre-remediation)

HUMAN HEALTH			
Source	**Pathway**	**Receptor**	**Remedial Solution**
Elevated levels of lead and asbestos present in made ground.	Indoor and outdoor inhalation of soil/soil dust and asbestos fibres, ingestion of, and dermal contact with contaminated soil and soil dust, ingestion of vegetables that have taken up contamination and contaminated soil attached to vegetables.	End users.	Soil capping and localised removal of asbestos pieces.
Elevated levels of lead and asbestos present in made ground.	Indoor and outdoor inhalation of soil/soil dust, and asbestos fibres ingestion of, and dermal contact with contaminated soil and soil dust.	Construction workers.	Appropriate PPE/RPE. Localised removal of asbestos pieces, dust suppression and air monitoring during the construction phase.
Deep made ground and former landfill.	Inhalation of carbon dioxide.	End users.	Gas protection measures are required (Scope to be confirmed following completion of the gas monitoring).

CONTROLLED WATERS			
Leachable copper and phenol present in made ground. Copper present within groundwater in marginal concentrations.	Leaching of contaminants and vertical migration to the groundwater.	Stream, 100m NE.	No remediation required.

5 REMEDIATION STRATEGY

The works outlined below are those considered necessary to commence the development of the site. Remediation plan has been presented in the Appendix E.

Based upon the proposed development plan, and current topographic survey existing site levels are to be raised by an average 1m to meet finished site levels.

5.1 REMEDIAL STRATEGY FOR HUMAN HEALTH

Soil Contamination

The northwestern part of the site does not appear to be underlain by deep made ground and no contamination was identified within the shallow soils. Based upon this information no remediation is required within this area and the existing (limited) topsoil has been shown be uncontaminated and can be used as a growing medium in private gardens and soft landscaping within this area.

However, an existing building occupied part of this area, which following demolition of the structure, a limited investigation with chemical testing will be required to confirm the quality of the underlying soils. The limited investigation will aim to determine the whether a clean capping layer is required within the affected plots.

Elsewhere on-site, a clean capping system within gardens and soft landscaping areas is considered the most suitable method to mitigate the potential risk posed to end-users by severing the pathway across the majority of the site.

A plan showing the extent of capping is presented in Appendix E.

It is understood that site levels are to be raised by an average of 1m. Therefore, it is considered that a clean capping thickness of 750mm placed in gardens with the inclusion of an anti-dig layer will be sufficient. The capping layer should comprise minimum 150mm imported topsoil, underlain by 450mm of imported subsoil proven suitable for use and 150mm anti-dig layer at the base.

The thickness of capping will be sufficient to protect end-users and aim to also minimise the amount of potentially asbestos impacted made ground, removed to facilitate the capping layer which would reduce the potential release of asbestos fibres.

A clean capping thickness of 600mm is recommended for all other soft landscaped areas which should be sufficient for the protection to end-users and maintenance workers. The capping layer should comprise minimum 150mm imported topsoil, underlain by 450mm of imported subsoil, proven suitable for use.

No capping would be required below areas of hard standing, such as roads, drives and houses as the hard cover will remove the possibility of a plausible linkage being present by removing the pathway.

Unexpected Contamination

Should any material suspected of being significantly contaminated be encountered during the redevelopment of the site, GRM shall be contacted to undertake additional investigation if necessary. The local Environmental Health Officer will be contacted by GRM and informed of any additional remedial work required.

5.2 REMEDIAL STRATEGY FOR CONSTRUCTION WORKERS

Given the nature of the identified contaminants of concern, it is considered that the soils encountered potentially pose a risk to construction workers without mitigation measures for dust generation and inhalation pathways.

Therefore, removal any visible fragments of ACMs (by a suitably qualified licenced contractor) dust suppression measures and appropriate Health and Safety measures (PPE/RPE) are adopted during these works to protect site workers.

Any arisings from these works should be stockpiled separately and covered to prevent dust generation, and the decision as to whether or not the material will be reused on-site will be made by GRM, following receipt of the chemical analysis results.

5.3 MATERIAL MANAGEMENT

It is considered the stockpiled soils are suitable for use below the capping layer either on-site or as a useful commodity on similar projects. A plan showing the stockpile locations and types of material is presented in Appendix F.

The majority of the stockpiled materials analysed are classified as not hazardous for off-site disposal. The existing made ground is also classified as non-hazardous, possibly Inert and natural strata is likely to be classified as Inert for disposal purposes.

However, visible ACMs have been identified during site investigation within soils and therefore will result in any associated soils being classified as Hazardous Waste. It may also be present in areas not previously investigated, such as below stockpiles.

It is recommended a watching brief is maintained and any visible ACMs encountered removed.

Prior to disposal or re-use of soils on site, visible ACMs are to be removed, employing appropriate health and safety protocols and licensed asbestos removal specialist.

Careful segregation of the existing stockpiles and arisings from site works will minimise the potential for cross-contamination and soils being classified as Hazardous Wastes.

Stockpiles should be covered and sealed and dust suppression measures should be implemented as required during excavation, transport and stockpiling.

5.4 REMEDIAL STRATEGY FOR HUMAN HEALTH (GROUND GASES)

Based on current monitoring data, gas protection measures are required for the proposed development.

The gas protection measures are to comprise the provision of a gas resistant membrane (such as Monarflex Reflex Super), fully sealed at joints and service penetrations, and a cast in-situ suspended floor slab.

The risk from ground gases will be re-assessed following completion of the ground gas monitoring programme and discussed in the Gas Addendum Letter.

Details of the protection and validation for ground gases will be included within a Gas Protection Measures Design and Verification Plan (GPMDVP), if required.

5.5 REMEDIAL STRATEGY FOR CONTROLLED WATERS

Remedial measures are not required.

5.6 REMEDIAL STRATEGY FOR CONSTRUCTION MATERIALS

Standard PE water supply pipes placed in clean backfill should be acceptable. Consultation with the local water supply company is recommended to confirm their requirements with regard to pipe materials.

Based upon the majority of the water soluble sulphate the site should be assumed as DS-1 and the ACEC Class as AC-1.

Upgraded concrete specification (DS-4, AC-4) is required where elevate sulphate was recorded (3,300mg/l) towards the southern end of the site. Further investigation is recommended around the isolated area within the southern part of the site to determine the extent where upgraded concrete is required. The location of the elevated sulphate is presented is Appendix D.

6 VALIDATION – POST REMEDIATION

The recommended remedial methods will avoid the need for monitoring after validation; however, validation of any remedial measures will be required. The proposed remedial works will be validated as outlined below.

Impacted Topsoil and Made Ground (Metals and PAHs)
The limited existing topsoil on-site in the north east area (Appendix E) has been proven suitable for use and providing good site management is carried out to prevent cross-contamination these soils can be used within the clean topsoil medium.

In the event that soils will need to be imported, it is advised that an existing test certificate is forwarded to GRM, if available, to ensure that the material is suitable for use. The test certificate should be for the same suite of contaminants as the validation testing suite and compared against the Remedial Targets.

Chemical analysis should be carried out once imported to site based upon a minimum of three samples per type (topsoil/subsoil) and source (greenfield/generated) to the specification outlined below;

Source	Imported Material Type	Chemical Validation Rate	Chemical Validation Suite		
			General Screening Suite	TPHCWG	Asbestos
Greenfield	Topsoil	1 per 250m^3	✓	✓	✓
	Subsoil	1 per 250m^3	✓	✓	✓
Brownfield / Recycled	Topsoil	1 per 50m^3	✓	✓	✓
	Subsoil	1 per 50m^3	✓	✓	✓

The above table assumes that it will be possible to stockpile the imported capping material on-site prior to placement.

If this is not possible then the materials will be tested once placed in the gardens.

The results of the chemical validation will be compared against the appropriate GRM TACs (presented in Appendix G). Any material that fails the chemical validation process will be removed from site.

Details of the validation testing of the imported soil material will be required by the local Environmental Health officer.

Depth Validation
The validation of the capping layer will include confirmation that it is of sufficient thickness. This will take the form of hand dug trial pits to determine the exact thickness of the soil capping layer; test pits will be excavated and photographic evidence of the layer thickness and nature of the capping material will be collected for inclusion in the validation report. The depth validations will be carried out on every plot.

Ground Gas
The validation of ground gas protective measures will be included within the GPMDVP, if required.

7 FURTHER WORKS

Further works have been identified,

- Limited investigation within the northwestern area, following demolition of the existing building.
- Further investigation around the area where elevated sulphate was detected to the south of the site, to determine the extent of upgraded concrete required.
- Completion of the ground gas monitoring programme including re-assessment and GPMDVP, if required.

8 VALIDATION REPORTING

Validation letters will be produced for the clean capping and gas protection measures on a plot by plot basis as the development progresses. These will be incorporated into the final validation report.

The final validation report should include:

- Confirmation of the removal of the identified ACMs.
- Photographs confirming placement of capping materials to the required depth.
- Confirmation of the suitability of imported soils for use in gardens/landscaped areas, including chemical analysis results.
- Copies of site waste consignment notes, volumes for materials disposed off-site.

The validation report confirming that all of the above measures have been undertaken should be submitted to Local Authority and the NHBC.

9 CONSLUSIONS

Providing the recommendations contained within this report are followed and validated in accordance with the procedures suggested, it is considered that after development the site will not pose a potential risk to human health for the proposed end use and controlled waters.

APPENDIX A

GRM Development Solutions provides multi-disciplinary consultancy services, UK-wide:

- Geotechnical and Geo-environmental Services
- Civil and Infrastructure Services
- Structural Engineering Services
- Construction Management
- Site Services

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GENERAL APPRAISAL COMMENTS

i INFORMATION SOURCES

Where available the following sources have been used for the identification and assessment of potential ground hazards:

- Relevant British Standards
- British Geological Survey (BGS) Geology Map Scale 1:10,000 for local area
- British Geological Survey (BGS) Geology Map Scale 1:50,000/1:63,320
- BGS Memoir
- BGS Borehole Records
- Environment Agency Groundwater Vulnerability Maps
- Historical Ordnance Survey (OS) Maps
- Environmental Data Report
- Environment Agency Website: http://www.environment-agency.gov.uk/
- Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, UKWIR, 2010.
- Coal Authority Records / Coal Mining Report
- DEFRA/Environment Agency Contaminated Land publications and DoE Industry Profiles
- BRE Guide BR211 (2007), 'Radon: Guidance on protective measures for new buildings'
- HPA-RPD-033 (2007), 'Indicative Atlas of Radon in England and Wales'
- NRPB Publication W26 (2002), 'Radon Atlas of England and Wales'
- CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings'
- Other technical references used throughout this document are detailed in the text.

ii CONTAMINANTS OF CONCERN

The DoE Industry Profiles are normally used to assess likely contaminants from past land use and potential nearby industrial sources. For land uses where no profile is available, likely contaminants of concern are selected by GRM based on past experience of similar sites, a general screening suite of contaminants covered by CLEA and common contaminants from the Industry Profiles.

- Arsenic
- Cadmium
- Chromium
- Lead
- Mercury
- Selenium
- Copper
- Nickel
- Zinc
- Phenols
- cyanide (total)
- pH
- Water soluble sulphate
- PAH (polycyclic aromatic hydrocarbons)

Asbestos and PCBs are listed in the vast majority of profiles. PCBs are listed as the profiles expect electricity substations and switch boxes on all industrial sites. There is the potential for asbestos containing material to be mixed up with made ground, following any demolition works.

iii CONCEPTUAL MODEL METHODOLOGY

The consideration of contamination is based upon the principles of risk assessment, using the 'source-pathway-receptor' model in order to establish the presence, or potential presence, of a pollutant linkage.

To create a risk, contamination must have the potential to cause harm to susceptible targets or receptors such as humans, the water environment or the built environment. The potential for harm to occur requires three conditions to be satisfied to form a pollutant linkage:

- The presence of substances that may cause harm (SOURCE).
- The presence of a target which may be harmed (RECEPTOR).
- The existence of a plausible migration route between the source and the receptor (PATHWAY).

In the absence of a plausible pollutant linkage there is no risk. Where a potential linkage is identified in order for it not to pose a risk to the identified receptor it must be broken.

iv INTRUSIVE INVESTIGATION SAMPLING METHODOLOGY

The ground investigation (including fieldwork, sampling, monitoring and laboratory analyses) has been designed to identify and assess potential ground related problems and to allow cost effective solutions to be advised. It has been planned on the basis of the desk study, site inspection and the proposed development layout (where available). All fieldwork and soil descriptions were carried out in general accordance with relevant British Standards.

The exploratory holes have been positioned and advanced to depths to determine the general ground/groundwater/gas conditions below the site. A general grid pattern has been adopted, where possible, to provide sufficient information based on the current proposed layout scheme. Some holes have been targeted at particular hazards identified in the Phase I assessment. The resultant exploratory hole density is considered to be commensurate with the complexity of the site conditions and detail of information required for this phase of the investigation.

v GROUND GAS RISK ASSESSMENT METHODOLOGY

Gas monitoring programmes undertaken by GRM are designed to broadly comply with the recommendations outlined in CIRIA Report C665 'Assessing risks posed by hazardous ground gas to buildings' (2007).

To assess the risks posed by ground gases such as radon, carbon dioxide and methane, the relevant current guidance has been used. For radon the site has been assessed following the guidelines in 'Radon: guidance on protective measures for new dwellings (BR211: 2007)'. For methane and carbon dioxide the primary guidance document used to determine if protection measures are required is CIRIA Report C665 'Assessing risks posed by hazardous ground gases to buildings' (2007). This uses Gas Screening Values (GSVs), which are gas concentrations multiplied by borehole flow rate, along with additional limiting factors (such as maximum methane concentrations) to classify the gas regime of a site.

The guidance document includes two methods of characterising a site. The main method 'Situation A' is based on work by Wilson and Card and is used for all types of development except low rise housing that meets the assumptions of 'Situation B'. The 'Situation B' method proposed by Boyle and Witherington for the NHBC assumes all properties have pre-cast suspended floors (beam and block) with ventilated underfloor voids.

Where flow is not recorded during the monitoring a default flow rate of 0.1l/hr will be used in the assessment to produce a positive result.

vi HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

Guidance contained in the Environment Agency's CLEA Report has been used to assess the risks posed to human health.

For residential developments that include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land with plant uptake' are used, i.e. a female with a start age class of one and an end age class of six. All pathways are considered including the consumption of home-grown vegetables.

For residential developments that do not include domestic gardens the default Tier 1 Assessment Criteria (TAC) for 'residential land without plant uptake' are used, i.e. a female with a start age class of

one and an end age class of six. All pathways are considered except the consumption of home-grown vegetables.

For commercial/industrial developments the default Tier 1 Assessment Criteria (TAC) for 'commercial/industrial' are used, i.e. a female with a start age class of sixteen and an end age class of eighteen. All pathways are considered except the consumption of home-grown vegetables.

The TAC used by GRM include Soil Guideline Values (SGV) published by the EA, values calculated by GRM using the CLEA v1.06 risk assessment and values and chemical data developed by LQM/CIEH. The TAC used in the assessment are selected based on the lowest site specific SOM values returned as part of the chemical analysis.

Where soil chemical analysis results are found to exceed the TAC, Site-Specific Risk Assessments may be undertaken using the CLEA v1.06 risk assessment software using the age classes and pathways described above.

vii RISK TO SITE WORKERS – GENERAL COMMENTS

The risks to site workers are similar to those posed to site end users, although likely to be less severe due to the site workers' shorter exposure to the identified contamination. However, site workers (particularly groundworkers) are more likely to come into direct contact with contaminated soils due to the nature of their work. On this basis ground and construction workers should be provided with basic Personal Protective Equipment based on the site's general health and safety risk assessment, but including as a minimum safety footwear, gloves and overalls.

A site specific risk assessment should be carried out for all hazards identified within the ground investigation in accordance with current health and safety legislation. This assessment should identify any measures required to further reduce risks i.e. providing further Personal Protective Equipment, welfare facilities and if necessary preventing access to certain areas.

Demolition and dismantling of existing structures on the site must be carried out to a safe and acceptable standard, in accordance with current UK guidance and best practice. Whilst not ground related, asbestos and hazardous substances surveys should be conducted prior to any demolition.

Any unusual colours, odours and suspicious ground should be reported immediately to site management and then GRM.

Whilst this appraisal has considered the long-term effects of contamination, GRM can also help during the formulation of Health and Safety documentation, if required.

viii CONTROLLED WATERS RISK ASSESSMENT METHODOLOGY

Where the desk study and fieldwork do not reveal a potential source of contamination no leachate or groundwater testing will be performed. Where a potential source is identified the testing will comprise leachate testing on the material considered most likely to pose a risk, groundwater testing will be undertaken if water is present at shallow depth.

The UK Drinking Water Standards (UKDWS) or Environmental Quality Standards (EQS) are usually adopted for comparison with the leachate/groundwater test results. When the most sensitive receptor is considered to be the an aquifer (groundwater) UKDWS will be adopted as the Initial Tier 1 screening values. Where the most sensitive receptor is a surface water feature the EQS values will be used as Initial Tier I Screening values.

ix CONSTRUCTION MATERIALS RISK ASSESSMENT METHODOLOGY

The 'screening levels' adopted for the assessment of risk to construction materials are taken from the following documents:

- UK Water Industry Research (UKWIR) Contamination thresholds for sub-surface water pipes, for the protection of buried pipes.
- Building Research Establishment (BRE) Special Digest SD1 (2005), 'Concrete in Aggressive Ground', for the protection of buried concrete.

x WASTE DISPOSAL AND SITE WASTE MANAGEMENT PLANS

Under current Waste Management Regulations, waste soil materials produced from the site will require characterisation to enable it to be disposed of correctly.

The chemical analysis results included in this report should be provided to the relevant landfill operators to establish the characterisation of the waste, confirm its suitability for landfill disposal and provide estimated costings. If material is classified as hazardous, then the site will need to be registered with the Environment Agency prior to the movement of the waste. Depending on the receiving landfill's current permit, further chemical analysis, incorporating Waste Acceptance Criteria (WAC) leachate analysis, may be required.

All materials removed from the site will be classified as 'waste' and therefore must be removed by a suitably licensed carrier of waste. This applies whether or not the waste is contaminated. All waste removed to landfill will attract Landfill Tax.

The developer/builder is likely to be classed as the waste producer and therefore, has a duty of care to ensure that all waste is disposed of appropriately. This includes ensuring the waste carrier is licensed and disposes of the waste to a suitably licensed landfill site. They are also required to keep a paper trail from 'cradle to grave' including copies of the waste disposal tickets.

Efficient materials management on site is recommended as it can lead to significant cost savings when compared to the traditional side casting or single stockpile of arisings. Likewise making the site as volume neutral as possible will reduce the costs of development.

Site Waste Management Plans allow better waste management practices, help to reduce the amount of waste produced and identify best environmental disposal options. Implementing a Site Waste Management Plan (SWMP) can reduce costs (increasing business profits) and maximise resource efficiency.

SWMPs are a legal requirement for all projects with an overall development cost of over £300k. GRM can assist in the production of SWMPs which comply with the Code of Practice and identify best environmental disposal options when dealing with waste.

xi GEOTECHNICAL ASSESSMENT GENERAL COMMENTS

Where finished floor levels of proposed structures have not been provided by the Client, then for the purposes of initial assessment, GRM will assume that finished levels will not vary appreciably from the existing ground levels. If the depths of any underground engineering works (i.e. sewers, pumping stations etc.) are unknown they will not be taken in to account in the assessment and it will be assumed that any such works will not compromise foundation or ground stability.

Should the development proposals or finished levels be different from these assumptions then the comments/recommendations in the Geotechnical Assessment may require revising.

It should be noted that the results of window sampling and/or cable percussive boreholes may not give a true indication of a soils actual engineering properties (i.e. stability, mass structure etc). GRM consider that that prior to development trial pitting should be undertaken to confirm the recommendations in the Geotechnical Assessment.

xii GEOTECHNICAL ASSESSMENT – ENGINEERING GROUND TREATMENT

Near surface soils have the potential to be disturbed by weathering and site traffic. Precautions should always be taken to avoid this, as excessive disturbance may leads to more onerous floor slab designs, road cap thickness and increased amounts of off site disposal etc.

Near surface soils may need treatment or reinforcing to allow safe movement of construction plant and labour. An assessment by the contractor should be undertaken once the type of machinery/plant needed to complete the development is known.

xiii GEOTECHNICAL ASSESSMENT – EXCAVATIONS

Excavation instability (over-break) can result in damage to existing services or structures (e.g. foundations, roads or boundary walls/fences) both on and off-site, as well as increased foundation concrete costs. In order to minimise this, all excavations deeper than 1.2m deep (or any excavation within 1.5m of any existing structure or service) should be supported. Full support should be provided to the full depth of all near vertically sided excavations in made ground, soft and very soft clays and granular soils. A reduction to intermediate support should be acceptable within firm and stiffer natural clays.

Wherever possible, man entry into excavations should be prevented; however, where this is not possible, entry to, and time spent in, excavations should be kept to a minimum.

The build program should be tailored to reflect the impact that deep excavations through potentially unstable strata can have on adjacent properties, so that they are not undermined.

All excavations on site should be in accordance with HSE guidelines and stability should be practically maintained at all times. Reference should be made to HSE construction information sheet No. 8 (Revision 1) 'Safety in Excavations'.

Care should be taken to ensure that falls from excavation faces do not adversely affect the integrity of foundation concrete.

If contaminated water enters excavations it should be removed and transported to an appropriate treatment facility by a suitably licensed carrier before construction begins.

xiv GEOTECHNICAL ASSESSMENT – SUBSTRUCTURES

Where practicable, existing buried construction should be fully removed; however, if this is not practicable all new foundations should be carried down to fully penetrate it and it should be broken well away from all new structures.

There may be existing structures and/or infrastructure in close proximity to the proposed development. New build foundations may be constructed next to pavements with existing underground services beneath them, or excavations may be required near existing footings associated with adjacent properties. These potential hazards need to be taken into consideration when designing foundations and the groundworker needs to be made aware of their potential impact during the redevelopment works. Foundations close to existing underground services or buildings may require alternative foundation techniques (such as piling) to protect the integrity of these structures.

The contractor for the works should carry them out in such a fashion so as to not cause excessive overbreak, concrete usage or undermine existing buildings/roads/ services that are to be retained.

xv GEOTECHNICAL ASSESSMENT – SOAKAWAYS

Soakaway testing in trial pits by GRM is broadly carried out in accordance with BRE 365 (1991). The testing comprises the excavation of a test pit to a suitable depth, and the placement of water into the pit. The level of water present is then monitored over time. For borehole installations, the permeability testing (falling head/rising head) is undertaken in accordance with BS5930.

If it is decided to proceed with the use of soakaway drainage, then the following general points should be noted:

- Soakaways should not be placed so that water can be discharged through potentially contaminated made ground.
- The Environment Agency may require soakaways to be sealed systems such that only roof run off falls to soakaway.
- Interceptors are likely to be required for soakaways for highway drainage. The adopting authority for the highways should be consulted at the earliest opportunity regarding the use of soakaways for highways drainage.
- Consideration of site levels and slopes should be taken into account during the design.

- The construction of all soakaways should be in accordance with the current building regulations.
- Soakaways should not be placed within 5m of a proposed building.
- Placement of soakaways needs to be considered so as to avoid ponding of water down slope.
- The base of a soakaway should not be below the highest recorded water level.
- The Environment Agency prefer 1m of dry soil to be present between the base of a soakaway and the water table to provide attenuation for contamination.

xvi GEOTECHNICAL ASSESSMENT – FOUNDATIONS

If soft or hard spots are encountered during foundation excavation then they should be replaced with suitably compacted material or the footings deepened to suitable strata, to avoid differential settlement.

If strata of differing bearing character (e.g. sand and clay) are encountered at foundation levels within the excavations for a single plot then the excavation depths should be altered as appropriate to ensure the foundations rest on a single stratum, or strata that will not induce differential settlement. Where this is impractical then GRM should be contacted to assess a reinforced concrete detail or an alternative foundation solution (e.g. piles or vibro-replacement).

NOTES ON LIMITATIONS

General

GRM Development Solutions Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement had been executed, or with whom an assignment had been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from GRM Development Solutions Limited; a charge may be levied against such approval.

GRM Development Solutions Limited accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) the consequences of this document being used by any third party with whom an agreement has not been executed.

Phase I Environmental Audits/ Desk Studies

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, GRM Development Solutions Limited reserves the right to review such information and as considered necessary and appropriate to modify the opinions accordingly. It should be noted that any risks identified in a Phase 1 report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental Audits (Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, ground and groundwater conditions to allow a reasonable risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated with potential human targets, building materials, and controlled waters.

The amount of exploratory work and chemical testing undertaken has necessarily been restricted by the short timescale available, and the locations of exploratory holes have been restricted to the areas unoccupied by the building(s) on the site and by buried services. A more comprehensive investigation may be required if the site is to be redeveloped as, in addition to risk assessment, a number of important engineering and environmental issues need to be resolved.

For these reasons if costs have been included in relation to site remediation these must be considered as provisional only and must, in any event, be confirmed by a commercial adviser.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. Whilst exploratory testing is intended to gain an accurate representation of the site, the very nature of sampling and testing is such that it cannot ensure that all localised conditions are detected

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

Phase II Geo-environmental Investigations (Combined Geotechnical and Contamination Investigations)

The investigation of the site has been carried out to provide sufficient information concerning the type and degree of contamination, geotechnical characteristics, and ground and groundwater conditions to provide a reasonable assessment of the environment risks together with engineering and development implications. If costs have been included in relation to site development a commercial adviser must confirm these.

The exploratory holes undertaken, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site for each of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time the site work was conducted. It should be noted that groundwater levels will vary owing to seasonal, tidal and weather related effects.

The scope of the investigation was selected on the basis of the specific development proposed by the Client and may be inappropriate to another form of development or scheme.

The risk assessment and opinions provided take in to consideration, inter alia, currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

APPENDIX B

GRM Development Solutions provides multi-disciplinary consultancy services, UK-wide:

- Geotechnical and Geo-environmental Services
- Civil and Infrastructure Services
- Structural Engineering Services
- Construction Management
- Site Services

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DO NOT SCALE

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CLIENT:

HT Forrest Ltd

PROJECT:

Marsh Lane,
New Mills

TITLE:

Proposed Development Plan

SCALE@SIZE :	ISSUE:
NTS	FINAL
DESIGN/DRAWN by :	DATE:
CT	May 2016
PROJECT No:	DRAWING No:
P7434	

APPENDIX C

GRM Development Solutions provides multi-disciplinary consultancy services, UK-wide:

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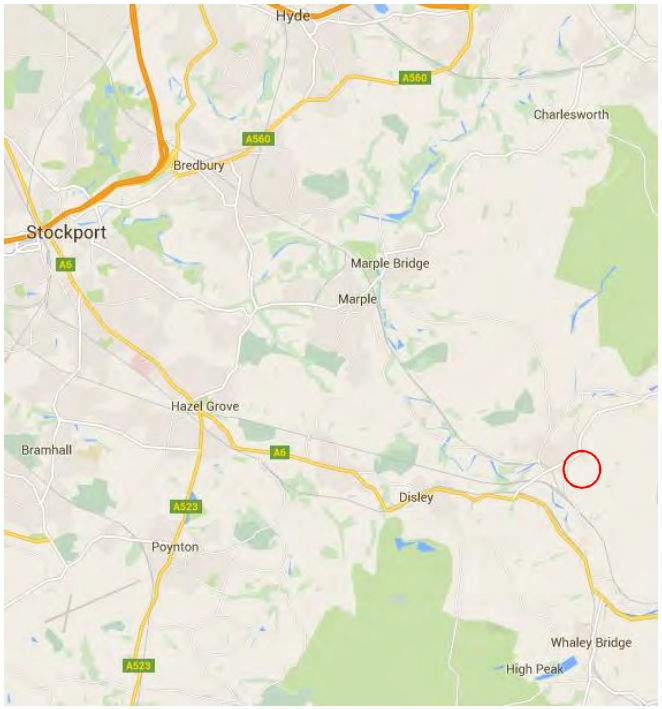

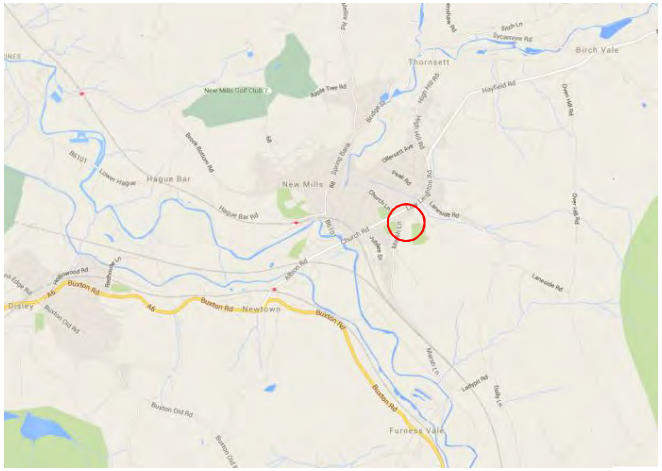

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DO NOT SCALE

NOTES:

Approximate Site Location

Approximate Site Boundary

Nearest postcode – SK22 4PH

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CLIENT:

HT Forrest Ltd

PROJECT:

**Marsh Lane,
New Mills**

TITLE:

Site Location Plan and Boundary Plan

SCALE@SIZE :	ISSUE:
NTS	FINAL
DESIGN/DRAWN by :	DATE:
CT	May 2016
PROJECT No:	DRAWING No:
P7434	

APPENDIX D

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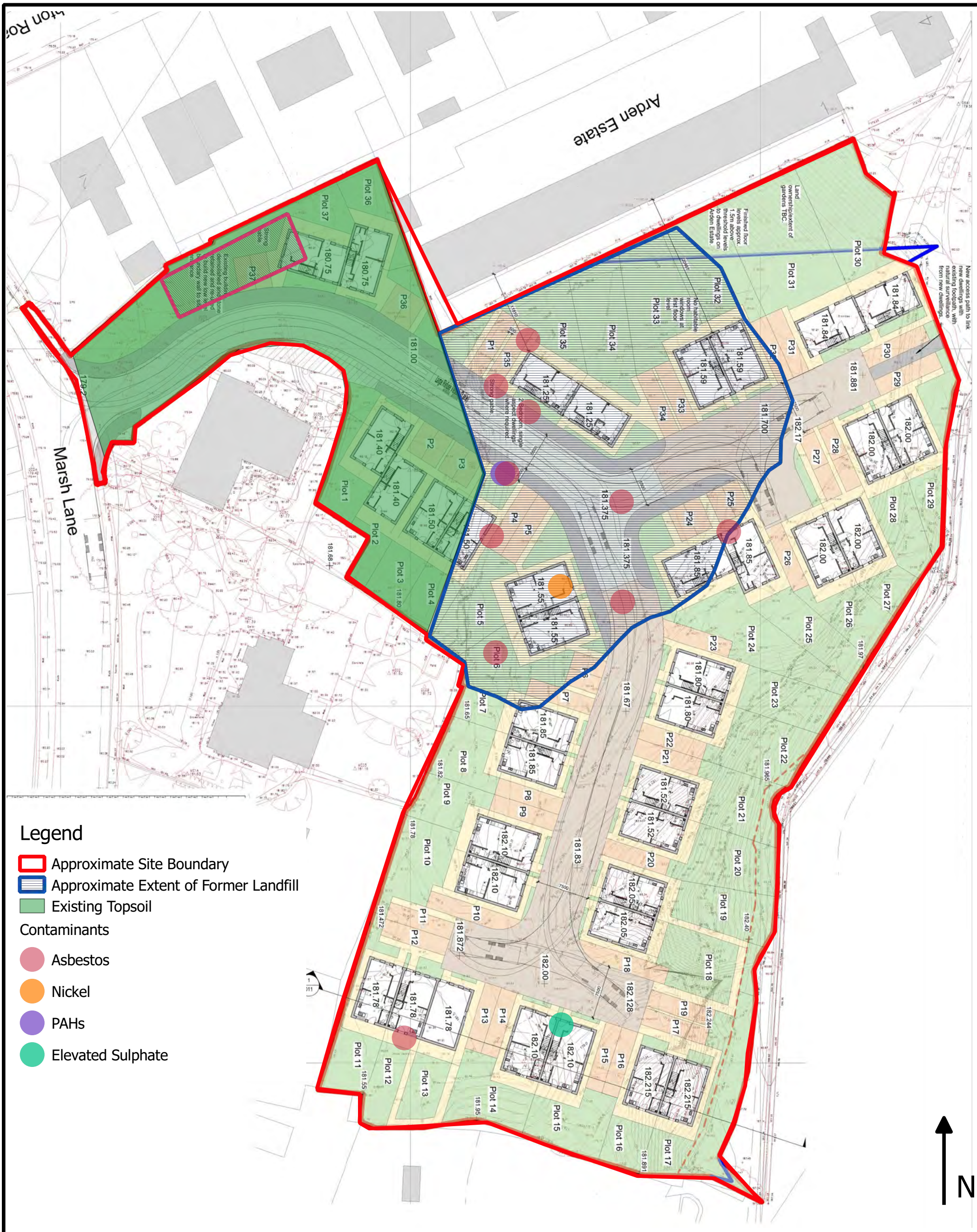

NOTES:
Elevated lead recorded within Made Ground materials across the site.

CLIENT: **HT Forrest Ltd**	TITLE: **Contamination Plan**	PROJECT No: **P7434**	DATE: 11/2016
PROJECT: **Land off Marsh Lane, New Mills**		DESIGN/DRAWN: SS	ISSUE: FINAL
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APPENDIX E

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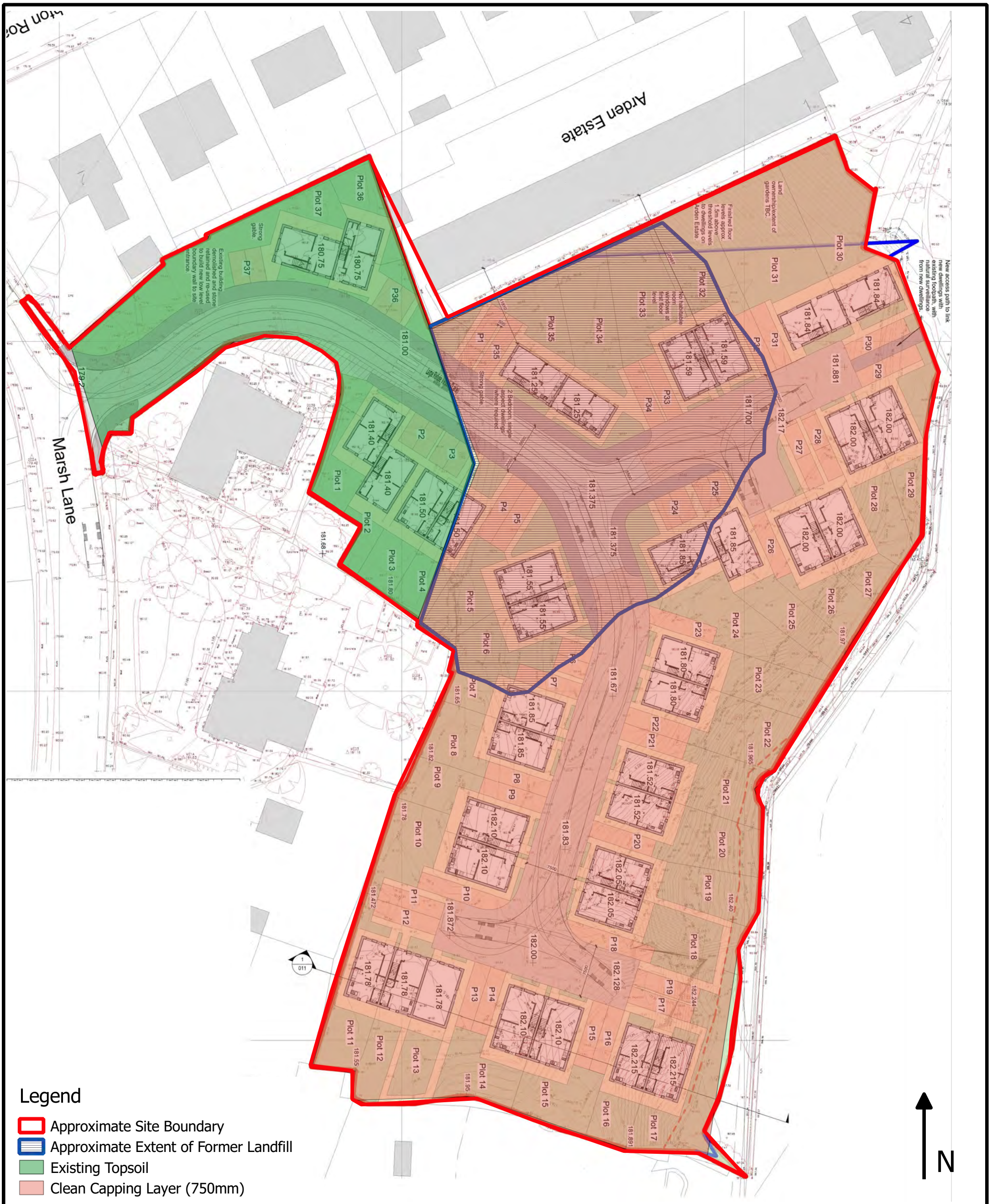

NOTES

CLIENT: **HT Forrest Ltd**	TITLE: **Remediation Plan**	PROJECT No: **P7434**	DATE: 11/2016
PROJECT: **Land off Marsh Lane, New Mills**		DESIGN/DRAWN: SS	ISSUE: FINAL

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APPENDIX F

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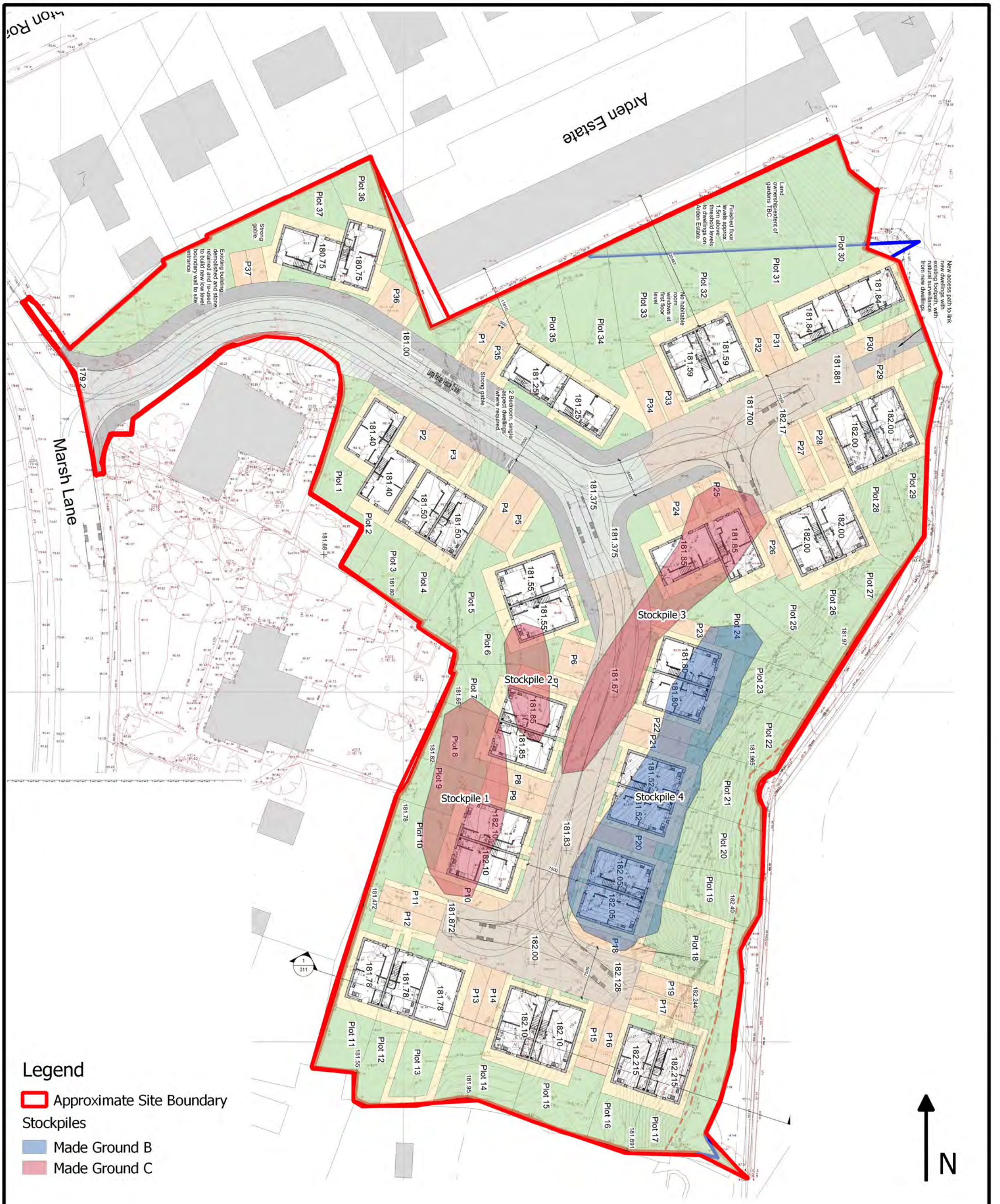

Legend

- Approximate Site Boundary

Stockpiles

- Made Ground B
- Made Ground C

NOTES:
Stockpiled materials not suitable for use in clean capping layer.

CLIENT: **HT Forrest Ltd**	TITLE: **Stockpile Plan**	PROJECT No: **P7434**	DATE: 11/2016
PROJECT: **Land off Marsh Lane, New Mills**		DESIGN/DRAWN: SS	ISSUE: FINAL

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APPENDIX G

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	GRM TIER 1 ASSESSMENT CRITERIA		
LAND USE	Residential with Plant Uptake		
CONTAMINANT	**1%**	**2.50%**	**6%**
[e] Arsenic	37	37	37
[e] Cadmium	26	26	26
[b] Chromium III	2590	2590	2590
[e] Chromium VI	21	21	21
[e] Lead	200	200	200
[c] Mercury	170	170	170
[a] Selenium	350	350	350
[a] Nickel	130	130	130
[b] Phenols	240	471	951
[b] Copper	2300	2300	2300
[b] Zinc	4590	4590	4590
[d] Cyanide	34	34	34
[e] Benzene	0.20	0.36	0.87
[b] Toluene	118	267	609
[b] Ethylbenzene	64	151	349
[b] *o* - xylene	43	101	235
[b] *m* - xylene	41	98	228
[b] *p* - xylene	40	93	217
Non Genotoxic PAHs			
[b] Acenaphthene	333	746	1450
[b] Acenaphthylene	170	407	906
[b] Anthracene	3770	7890	13700
[b] Fluoranthene	391	690	981
[b] Fluorene	166	939	849
[b] Napthalene	1.5	3.5	8.2
[b] Phenanthrene	149	316	558
[b] Pyrene	867	1560	2270
Genotoxic PAHs			
[e/f] Benzo(a)pyrene	5	5	5
ALIPHATIC HYDROCARBONS			
[b] C5-C6	28	51	105
[b] C6-C8	68	152	347
[b] C8-C10	18	43	102
[b] C10-C12	87	215	509
[b] C12-C16	709	1680	3400
[b] C16-35	128000	128000	128000
AROMATIC HYDROCARBONS			
[b] C5-7 (benzene)	64	128	271
[b] C7-8 (toluene)	118	267	609
[b] C8-C10	26	63	146
[b] C10-C12	69	165	364
[b] C12-C16	141	325	662
[b] C16-C21	264	547	938
[b] C21-C35	1120	1490	1720

Notes

a SGV (2009)

b LQM/CIEH values or derived using CLEAv1.06 with LQM/CIEH Data.

c SGV for inorganic Hg used (ref.2009 SGV, Pg5, Para.4)

d Atkins ATRISKsoil Value

e C4SL - SP1010 (2014)

f Benzo(a)pyrene is a surrogate marker for the 8 genotoxic PAHs (Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(ah)anthracene, Ideno(1,2,3-cd)pyrene)

NB Where C4SLs/SGVs have not been produced, all TACs have been revised in line with report SP1010 (2014), however, the default consumption rates in the CLEAv1.06 model have been retained.

GRM.TAC.08.14