



Geo-Environmental

VERIFICATION REPORT

for the site at

PLOTS 1-15, CORNFIELD CLOSE,

LITTLEHAMPTON,

WEST SUSSEX, BN17 6LD

on behalf of

THAKEHAM CLIENT LTD



Report:	VERIFICATION REPORT
Site:	PLOTS 1-15, CORNFIELD CLOSE, LITTLEHAM, WEST SUSSEX, BN17 6LG
Client:	THAKEHAM CLIENT LTD
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**AMENDMENT RECORD**

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1.0 INTRODUCTION

1.1 General

Following several phases of investigation and assessment for the site, as reported in the Phase I desk study (ref. GE16903-DSR-DEC17) baseline ground investigation (ref. GE16903-BGIR-JAN18) and further Phase II intrusive investigation (ref. GE17106- GAR/AP01/231018) undertaken and reported by Geo-Environmental Services Limited, together with subsequent development of a Remediation Strategy and Verification Plan (RSVP), referenced GE17106-RSVPv1.2-GE-NOV19 and Water Quarterly Monitoring Plan (WQMP), referenced GE18103/WQMP/NOV19 Geo-Environmental was instructed by Thakeham Client Ltd to prepare a Verification Report to compile the relevant information in relation to the residential development for Plots 1-15, Cornfield Close, Littlehampton, West Sussex, BN17 6LG, herein referred to as 'the site' (see Figure 1).

This report sets out the works undertaken to date to provide independent verification of the risk mitigation measures incorporated into the development to protect the development and end users thereof. This report provides final validation for works undertaken and independent inspection in relation to Plots 1-15 only with respect to ground gases and land contamination and for the whole site in relation to groundwater analysis and controlled water. At the time of reporting other plots within the development were not ready for final validation inspections therefore remedial works related to these remaining plots will be validated within a separate verification (or updated) report in due course.

1.2 Objectives

A desk study and ground investigation undertaken by Geo-Environmental identified the presence of potential hazards and through a risk assessment process a series of pollutant linkages were identified which require action to mitigate or otherwise reduce the risk. The Remediation Strategy and Verification Plan (RSVP) sets out the proposed remedial works to be undertaken on the subject site to support its development for a proposed residential end use. The Water Quality Monitoring Plan presents the monitoring works that would be undertaken prior to, during and following the intrusive element of development works (cut and fill and piling works).

This Verification Report (VR) presents the details and findings of inspection visits undertaken throughout the construction period by Geo-Environmental and/or to compile data provided by the Client with respect for Plots 1-15 in order to demonstrate that the risk mitigation measures were implemented, within these Plots only. The verification report also presents the details of the groundwater monitoring and analysis completed under the Water Quality Management Plan for the wider site following completion of the intrusive element of works on the site.

1.3 Planning Permission

It is understood that a planning application has been approved for the site by Arun District Council under Planning Reference LU/330/18/PL. The following pre-occupation planning conditions have been attached to the application which relate to the validation of land contamination in relation the development. Where conditions required the submission and agreement of works pre-commencement it is understood that those elements of the conditions have been completed and agreed.

Condition 9:

Within 3 months of the start of the development, the Developer shall agree a timetable for submission of periodic verification reports to demonstrate the completion of works set out in the approved remediation strategy and the effectiveness of the remediation. The reports shall include a maintenance plan in respect of contamination, including a timetable of monitoring and shall be submitted to, and approved in writing, by the local planning



authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. The development shall proceed in accordance with approved details.

Reason: To ensure that the site does not pose any further risk to human health or the water environment by demonstrating that the requirements of the approved verification plan have been met and that remediation of the site is complete in accordance with Arun Local Plan policies QE SP1 and QE DM4

Condition 10:

If during development, contamination not previously identified, is found to be present at the site then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until a remediation strategy detailing how this contamination will be dealt with has been submitted to and approved in writing by the Local Planning Authority. The remediation strategy shall be implemented as approved.

Reason: To ensure that the development complies with approved details in the interests of protection of the environment and prevention of harm to human health in accordance with Arun Local Plan policies QE SP1 and QE DM4.

Condition 11:

Piling & investigation boreholes using penetrative methods shall not be carried out other than with the written consent of the Local Planning Authority. The development shall be carried out and completed in accordance with details so approved.

Reason: To prevent pollution of groundwater in accordance with Arun Local Plan policy W DM1.



2.0 BACKGROUND

This Validation Report has been produced in order to demonstrate that the works required and presented within the Remediation Strategy and Verification Plan (RSVP) and Water Quality Management Plan (WQMP) have been carried out. The RSVP and WQMP for the site were developed following several phases of investigation works for the site, including a Phase I desk study (ref. 16903-DSR-DEC17) baseline ground investigation (ref. 16903-BGIR-JAN18) and further Phase II intrusive investigation (ref. GE17106- GAR/AP01/231018) undertaken and reported by Geo-Environmental Services Limited. Whilst a summary of these reports is presented below, reference should be made to the full reports for further details.

2.1 Proposed Site Use

The proposed development comprised the construction of 77No. residential units with private gardens, soft landscaping, amenity space, parking, roadways and associated infrastructure.

2.2 Investigation and Assessment

A summary of the findings of previous investigations and reports is presented below:

- The site was most recently utilised as a caravan park comprising caravan plots and hardstanding from a former wash block. The northern most portion of the site comprised accommodation with the southern portion of the site recreational space;
- The ground conditions beneath the site generally comprised a thickness of Made Ground (depths up to 2.90m bgl) overlying the River Terrace Deposits over the Lewes Nodular Chalk Formation at depth;
- The encountered Made Ground materials were found to generally comprise landfill type material of mixed composition comprising sandy clay and silty sand with brick, glass, plastics, metal, china, ash, coal, concrete, black organic matter, shoes, fabric, timber and flint gravel;
- River Terraced Deposits were found to underlie the Made Ground and was generally found to comprise medium dense orange-brown sandy clay becoming orange brown sand with flint gravel with slight traces of chalk at depth.
- Groundwater was encountered within boreholes between depths of 7.50m and 9.00m bgl during the intrusive investigation works. Return monitoring between 28th August 2018 and 19th October 2018 encountered groundwater between depths of 6.00m and 7.10m bgl.
- Thirty-four soil samples were submitted for analysis of a comprehensive suite of commonly occurring contaminants augmented with speciated hydrocarbon analysis and asbestos screening. Nine of these samples were used for leachate testing. Ten additional samples were analysed for VOCs, SVOCs, PCBs and ammoniacal nitrogen. A further ten samples were analysed for Waste Acceptance Criteria tests.
- The testing showed that near surface soils were impacted by Arsenic, Lead, PCBs, VOCs, SVOCs and Asbestos.
- Remediation, or risk mitigation measures were recommended to be required to protect end users from the contaminants identified in the Made Ground within private gardens and areas of soft landscaping.
- Groundwater samples were analysed during the monitoring visits and were tested for a comprehensive suite of commonly occurring contaminants, VOCs, SVOCs, BOD, COD, electrical conductivity, suspended solids and PCBs.
- Groundwater testing showed isolated elevated concentrations of Selenium, PAHs and Boron within the groundwater.
- Based on the testing results and the development proposals to include the introduction of 50% hardcover (houses/roads etc.), together with the excavation of significant volumes of the Made Ground material to accommodate the development, it was considered that the proposed development would improve the site status in respect of the leaching of contaminants from the Made Ground/Landfill materials, and the development would provide a betterment in terms of groundwater contamination.



- It was considered that no specific measures with respect to protection of groundwater are required on the site. A Qualitative Piling Risk Assessment (QPRA), reference GE18103/QPRA/JUL19, dated 10th July 2019 and Water Quality Management Plan (WQMP), reference GE18103/WQMP/NOV19, dated 15th November 2019 were also undertaken for the site in relation to the proposed foundation solution to be utilised on the site.
- Ten cable percussive boreholes were installed with two monitoring standpipes within each location (BH101-BH110) during the intrusive investigation works. Spot monitoring was undertaken on a single occasion within each location. Continuous gas monitoring was undertaken within ten gas monitoring standpipes (BH101-BH110) for a period of 3 weeks. The monitoring locations were sited within the former landfill area.
- Spot monitoring detected methane at concentrations in the range 0-8.5%, carbon dioxide in the range 0-19.4% and oxygen in the range 0-19.4%. VOCs were detected up to 3.2ppm. Borehole flow rates were only detected within two monitoring standpipes, BH101d and BH102s, and ranged from 0.9l/hr to 3.0l/hr.
- The continuous gas monitoring identified methane in the range 0-6.53%, carbon dioxide in the range 0.52-25.2% and oxygen in the range 0.06-18.53%. Carbon monoxide was detected in the range 0-19.43ppm, hydrogen sulphide in the range 0-3.89ppm and VOCs in the range 0-1.7ppm.
- The gas assessment based on the monitoring data indicated that the sites gassing regime was representative of Characteristic Situation 2/ Amber 2, for which remediation measures were considered necessary.
- A discovery strategy was also developed for the site. Where unexpected conditions or contamination are encountered as part of the works these were to be addressed under the discovery strategy in place for the site.

2.3 Conceptual Site Model

The conceptual site model (CSM) developed as part of the risk assessment identified particular hazards, or potential hazards which were considered to require intervention (remediation) to mitigate the risk of harm.

2.4 Approach for Remediation, Monitoring and Validation

Remediation works were proposed to break the pathways of identified sources of contamination to receptors. The aim of the remediation was not necessarily to remove all contamination from the site but to provide betterment and to reduce the identified risk to an acceptable level with respect to relevant receptors, e.g. human health, the built environment and controlled waters.



3.0 GROUND GAS

3.1 Ground Gas Assessment

A ground gas assessment was undertaken as part of the further Phase II intrusive investigation undertaken by Geo-Environmental. The monitoring undertaken as part of the 2018 investigation comprised one 'spot' monitoring visit alongside continuous monitoring undertaken over a 3 week period from 26th September 2018 to 17th October 2018. Spot monitoring detected methane at concentrations in the range 0-8.5%, carbon dioxide in the range 0-19.4% and oxygen in the range 0-19.4%. VOCs were detected up to 3.2ppm. Borehole flow rates were only detected within two monitoring standpipes, BH101d and BH102s, and ranged from 0.9l/hr to 3.0l/hr.

The continuous gas monitoring identified methane in the range 0-6.53%, carbon dioxide in the range 0.52-25.2% and oxygen in the range 0.06-18.53%. Carbon monoxide was detected in the range 0-19.43ppm, hydrogen sulphide in the range 0-3.89ppm and VOCs in the range 0-1.7ppm. Positive gas flow rates and marginally negative gas flow rates were identified within all monitoring locations during the continuous monitoring. A maximum flow rate of 1.24l/hr was detected within BH108.

On the basis of both the spot and continuous monitoring undertaken, the site's gassing regime, based on both hazardous gas flow and limiting concentrations, was assessed to be Characteristic Situation 2 (CIRIA and BS) and Amber 2 (NHBC).

3.2 Gas Protection Design Measures

The following gas protection measures were considered to be required to protect the development and end users thereof:

- Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with sufficient reinforcement to mitigate/control cracking;
- Minimum penetration of the slab by services and sealing of all penetrations and joints using 'top hats' or bespoke/site formed top hat seals;
- Installation of a vapour and gas resistant membrane laid across the floor with all joints and service penetrations sealed to form a single integral membrane with welded joints. All joints should comprise a minimum 150mm overlap. The membrane installation is to be undertaken by a suitability competent (e.g. NVQ qualified) installer;
- Use of an appropriate gas resistant DPC across the cavity with lap on the inner skin wall to facilitate joining to the floor membrane;
- Inspection and verification of installed measures.

Gas protection measures on site have been installed by Keytec Membrane Limited. Independent verification of gas protection measures at various stages of development with respect to Plots 1-15 were undertaken by Geo-Environmental on behalf of Thakeham Client Ltd, and included several inspection visits undertaken between August 2019 and January 2020, details of which are presented below:

- 11th June 2020 (Plots 1-2 perimeter);
- 2nd July 2020 (Plots 2-15 perimeter);
- 29th July 2020 (Plot 1-3 whole floor area);
- 10th August 2020 (Plots 4-5 whole floor area);
- 13th August 2020 (Plots 6-7 whole floor area);
- 25th August 2020 (Plots 8-10 whole floor area – Plot 11 in progress);
- 10th September 2020 (Plots 12-13 whole floor area – Plots 14-15 in progress);

Plots 1-15

Plots 1-15 comprised semi-detached and terraced houses. Floor construction within all the plots comprised a piled foundation with 225mm reinforced concrete slab above. A gas resistant membrane was installed directly on top of the reinforced concrete slab. The membrane was installed around the perimeter of the plots so as to go directly over external walls to ensure the cavity was sealed. Where plots were semi-detached or terrace the membrane was taken across adjoining wall cavities to ensure a continuous seal. Celotex Rigid insulation (or similar) was to be installed directly on top of the gas resistant membrane with floor screed above.

The houses are of timber frame construction, with the frames secured to the foundation blockwork/external wall and floor slabs. Hammer screw type fixings were used to secure the frames, self-sealing tape was laid beneath the soleplate fixing points so that where hammer screws breached the membrane to secure the timber frame the breach was sealed with the tape product, thereby creating a continuous seal of the installed membrane.

The gas membranes installed on these plots were installed by specialist membrane installers from Keytec Geomembranes Limited. The membranes utilised were self-branded Keytec 400 HP membranes. All joints were heat welded with at least a 150mm overlap. Corner details and threshold details were sealed using heat welded joins. Site-formed service seals were used to seal services, and were formed of foil band tape that was heat sealed. Where necessary any damage or defects were sealed using foil band tape product patch repairs.

The gas resistant products installed within the development of Plots 1-15 comprised:

- Keytec 400 HP – self branded purchased from Juta;
- 301483 Foil Band 150mm width/ 1.5 thickness/ 10m length – Aluminium heat weld membrane tape.

The gas membrane installation for Plots 1-15, was inspected by Geo-Environmental on several occasions to observe and record that the measures installed complied with the requirements as set out within RSVP. The proposed floor construction detail drawing including the gas membrane detail for the houses are presented in Appendix A. Visual inspection record sheets in line with the verification pro forma as set out in CIRIA C735 'Good practice on the testing and verification of protection systems for buildings against hazardous ground gases', of the gas protection measures installed are enclosed in Appendix B. The completed membrane installation was not fully completed within Plots 11 and 14-15 during the visits undertaken by Geo-Environmental. As such, the final completed membrane installation within these plots was photographed by the site manager for Thakeham (the Client), with these photos then issued to Geo-Environmental. These photographs are presented within Appendix C.



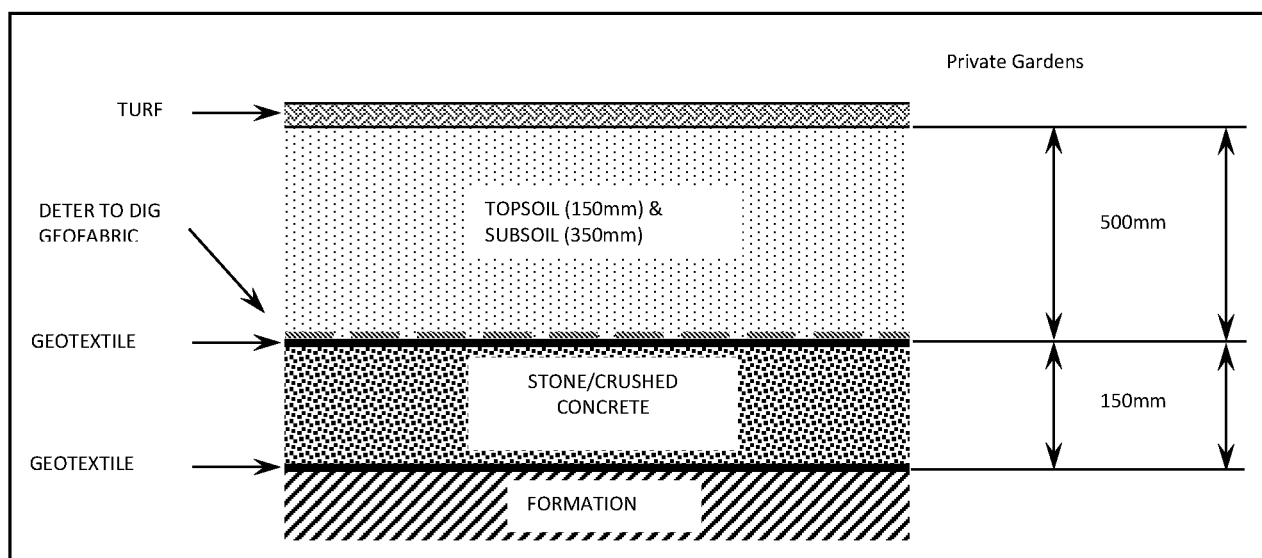
4.0 SOILS

4.1 End Users (Shallow Soils)

With reference to report Ground Appraisal Report for the site GE17106 - GAR/AP01/231018, through a process of statistical analyses on the results of chemical analyses on both deeper and near surface soil samples, it was considered that the near surface soils have been impacted by Lead, Arsenic, PCBs, SVOCs, VOCs and ACMs and remedial measures were deemed necessary to protect end users of the proposed properties from soil contamination within private garden and soft landscaped areas. Furthermore, the physical quality of all near surface soils was deemed unsuitable for inclusion in private gardens due to the presence of concrete, brick, and tarmacadam. In addition, ACMs and asbestos fibres have been identified both visually and within chemical analysis to be present within the Made Ground.

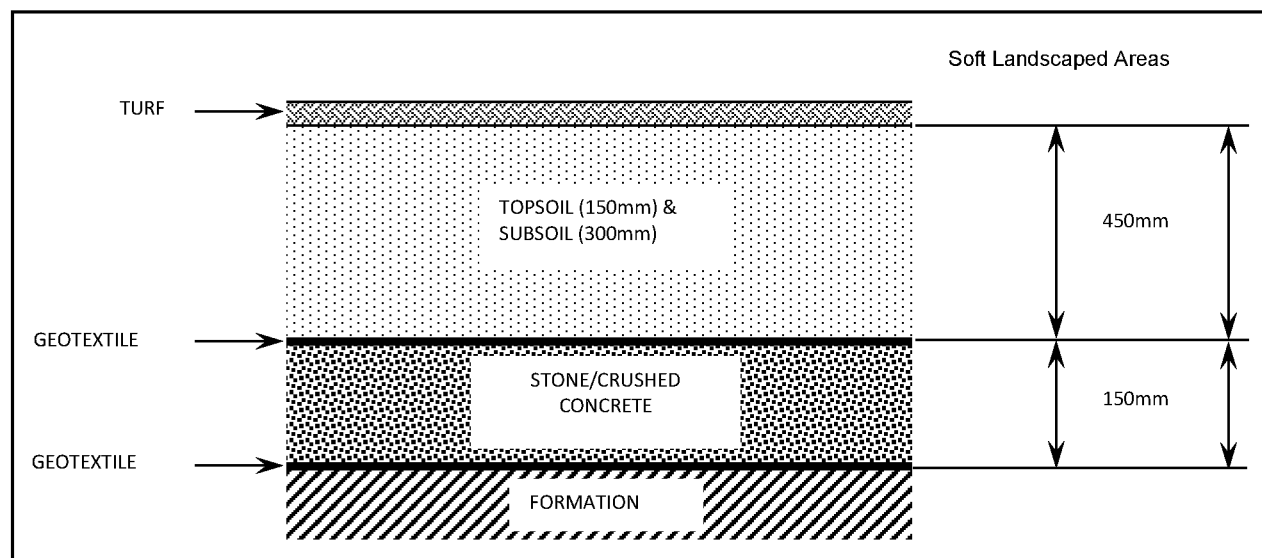
In areas remote from those designated for tree root protection it was recommended that the Made Ground beneath be removed or the site raised to a depth of 650mm and be replaced with chemically and geotechnically suitable material with a high visibility marker geotextile layer such as Terram High-Vis placed at the base between the imported soils and a capillary break layer comprising crushed stone or hardcore of 150mm and underlain by a further layer of Terram.

An example of the cover system for use in private gardens is provided below:





An example of the cover system for use in areas of soft landscaping is provided below:





5.0 IMPORTATION OF MATERIALS

5.1 Topsoil (Plots 1-15)

The chain of custody (COC) delivery certificates for Topsoil materials imported into site for use within Plots 1-15 were provided by to Geo-Environmental by Thakeham (the Client), copies of which are presented within Appendix D. Geochemical analysis was provided for the source site for the Topsoil materials prior to importation to site. A copy of this analysis is also presented in Appendix D.

Further independent sampling and analysis of this materials was undertaken by Geo-Environmental following the placement of this material with the private gardens of Plots 1-15. The results of this independent validation analysis testing are presented in Appendix F and detailed and discussed within Section 6 of this report.

5.2 Subsoil (Plots 1-15)

Thakeham have confirmed that the subsoil utilised within Plots 1-15 on site was clean material excavated from on site as part of the installation of a soakaway chamber. One composite sample of this material was analysed and tested for a suite of commonly occurring contaminants by Bells (The Groundworkers) prior to the use of this material within private garden areas, these results are presented within Appendix D.

Further independent sampling and analysis of this material was undertaken by Geo-Environmental following the placement of this material with the private gardens. The results of this testing are testing are presented in Appendix F and detailed and discussed within Section 6 of this report.



6.0 INSPECTION/ VALIDATION (SOILS)

6.1 Validation inspection of Topsoil and Subsoil and sampling of Topsoil (cover system) placement associated with private gardens (Plots 1-7) – 18th and 26th November 2020

The inspection/ validation works of the cover systems installed within the private gardens and areas of soft landscaping were undertaken by a Geo-Environmental Engineer on the 18th and 26th November 2020. The inspection on the 18th November included a meeting with the groundworkers (Bells) with respect to the proposed works and an inspection of the installation of the crushed concrete break layer installed as part of the cover system, with the deter-to-dig Geo-textile type membrane and placement of subsoil and topsoil inspected on the 26th November 2020. The visual inspection records including site photographs and hand pit logs are presented in Appendix E.

Inspection comprised three independent shallow hand pits (HP101-HP103) which were excavated by the ground workers under the supervision of an engineer from Geo-Environmental within the private front garden of Plot 3, and the private rear gardens of Plot 1 and Plot 6, to confirm the presence of a geo-textile type membrane and the thickness of the soil cover system. The location of these hand pits is presented on Figure 3, photographs and site inspection records taken during this inspection visit are presented in Appendix E, which confirm the depth of the installed subsoil and Topsoil with the cover system installed, along with soil logs of the material encountered. It should be noted that at the point of inspection the Turf and the final 100mm of the soil likely associated with the turf placement had not been laid within any areas of soft landscaping at the time of the inspection.

The inspection confirmed that in all inspected areas (hand pits HP101-HP103) a deter-to-dig Geo-textile type membrane was present beneath the subsoil and the installed subsoil and Topsoil was found to be between 350mm and 400mm in thickness within all hand pits with a minimum 200mm thickness of Topsoil.

The three soil samples, referenced HP101, HP102 and HP103 were submitted to a UKAS accredited laboratory for testing for a suite of commonly occurring brownfield contaminants including asbestos screening. The laboratory test results are presented within Appendix F.

The results of the analyses were compared to the Suitable for Use (S4UL) Levels for 'private gardens with home-grown produce' (representative of the proposed development end use), which are summarised in Table 6.1 below:

Determinand	Soil Screening Value (mg/kg)	Sample Max. Conc. (mg/kg)	Below Screening Value?
Arsenic	37	14.0	Yes
Benzo(a)pyrene	2.7	2.2	Yes
Beryllium	1.7	<1.0	Yes
Boron (Water Soluble)	290	1.0	Yes
Cadmium	11	<0.5	Yes
Chromium (Total)	130	38.7	Yes
Copper	2400	35.1	Yes
Hexavalent Chromium	6	<0.8	Yes
Lead	200	121	Yes
Mercury (inorganic)	40	<0.5	Yes
Nickel	180	16.1	Yes
Phenols	110	<0.6	Yes
Selenium	250	<1.0	Yes
Total Petroleum Hydrocarbons	110	41.0	Yes



Vanadium	410	35.1	Yes
Zinc	3700	136	Yes

Table 6.1 Summary of chemical analyses (Plots 1-7 Inspection Visit 26/11/2020)

The results indicated that all of the determinands tested, were below the limiting concentrations set within the Remediation Strategy and Verification Plan (RSVP).

All samples were submitted for asbestos screening and returned with no asbestos fibres identified.

In addition, the results of the speciated hydrocarbon analyses were all returned as either below the laboratory detection limits or below their respective human health screening values for the proposed end use.

All three of the validation samples from Plots 1-7 were also submitted for a nutrient testing suite. The results of the soils tested were compared to the Table 1 from BS3882:2015 entitled 'Specification for topsoil'.

The results are summarised in Table 6.2 below:

Parameters	Limits for Multipurpose Topsoil	Sample Range	Within acceptable Limits?
<u>Maximum Coarse Fragment Content (%)</u>			
Stones >2mm	30	16-20	Yes
Stones > 20mm	10	<1	
Stones >50mm	0	<1	
<u>Mass loss on ignition %</u>			
Clay 5% to 20%	3 to 20	4.73-4.99	Yes
Soil pH	5.5 to 8.5	8.1-8.7	Yes
<u>Plant nutrient content</u>			Yes
Total nitrogen %	>0.15	0.15-0.17	
Extractable phosphate mg/l	16 to 140	66-75	
Extractable potassium mg/l	121 to 1500	225-250	
Extractable magnesium mg/l	51 to 600	92-99	
Carbon:nitrogen ratio	<20:1	17.2-18.7	Yes
Electrical conductivity µS-cm	<3300	2460-2550	Yes
<u>Potentially Phytotoxic Elements</u>			
Zn mg/kg	<200	118-136	Yes
Cu mg/kg	<135	29.9-35.1	
Ni mg/kg	<75	14.3-16.1	
<u>Visible contaminants</u>			
% m/m	<0.5	<0.01	Yes
...of which plastics	<0.25	<0.01	

Table 6.2 Summary of BS8332 Topsoil Analysis (Plots 1-7, Inspection Visit 26/11/2020)

The results demonstrate that the Topsoil soils analysed are in accordance with BS3882:2015 Multipurpose Topsoil.

6.2 Validation inspection and sampling of Topsoil and Subsoil (cover system) placement associated with private gardens (Plots 8-15) – 7th January 2021

The inspection/ validation works were undertaken by a Geo-Environmental Engineer on 7th January 2021. The visual inspection records including site photographs and hand pit logs are presented in Appendix E.



Inspection comprised six independent shallow hand pits (HP1-HP6) which were excavated by the ground workers under the supervision of an engineer from Geo-Environmental within the private rear gardens of Plots 8, 9, 10/11, 12, 13 and 14/15, to confirm the presence of a geo-textile type membrane and the thickness of the soil cover system. The location of these hand pits is presented in Figure 3, photographs taken during this inspection visit are presented in Appendix E confirming the depth of the installed subsoil and Topsoil, along with soil logs of the material encountered. It should be noted that at the point of inspection the Turf and the final 100mm of the soil likely associated with the turf placement had not been laid within any areas of soft landscaping at the time of the inspection.

The inspection confirmed that in all inspected areas (Hand pits HP1-HP6) a deter-to-dig Geo-textile type membrane was present beneath the subsoil and the installed subsoil and Topsoil was found to be between 400mm and 550mm in thickness within all hand pits with a minimum 150mm thickness of Topsoil.

Six soil samples, referenced HP1 (subsoil), HP2-HP5 (Topsoil), and HP6 (subsoil), were submitted to a UKAS accredited laboratory for testing for a suite of commonly occurring brownfield contaminants including asbestos screening. The laboratory test results are presented within Appendix F.

The results of the analyses were compared to the Suitable for Use (S4UL) Levels for 'private gardens with home-grown produce' (representative of the proposed development end use), which are summarised in Table 6.3 below:

Determinand	Soil Screening Value (mg/kg)	Sample Max. Conc. (mg/kg)	Below Screening Value?
Arsenic	37	14.5	Yes
Benzo(a)pyrene	2.2	0.4	Yes
Beryllium	1.7	<1.0	Yes
Boron (Water Soluble)	290	1.5	Yes
Cadmium	11	0.5	Yes
Chromium (Total)	130	27.7	Yes
Copper	2400	42.6	Yes
Hexavalent Chromium	6	<0.8	Yes
Lead	200	167	Yes
Mercury (inorganic)	40	<0.5	Yes
Nickel	180	27.3	Yes
Phenols	110	<6.0	Yes
Selenium	250	<1.0	Yes
Total Petroleum Hydrocarbons	110	6.1	Yes
Vanadium	410	42.1	Yes
Zinc	3700	154	Yes

Table 6.3 Summary of chemical analyses (Plots 8-15, Inspection Visit 07/01/2021)

The results indicated that all of the determinands tested, were below the limiting concentrations set within the Remediation Strategy and Verification Plan (RSVP).

All samples were submitted for asbestos screening and returned with no asbestos fibres identified.

In addition, the results of the speciated hydrocarbon analyses were all returned as either below the laboratory detection limits or below their respective human health screening values for the proposed end use.

Four of the validation samples (2No.Topsoil and 2 No. Subsoil) samples from Plots 8-15 were also submitted for a



nutrient testing suite. The results of the Topsoil tested were compared to the Table 1 of BS3882:2015 entitled 'Specification for topsoil'. The results of the subsoil tested were compared to Table 1 of BS8601:2013 entitled 'Specification for subsoil and requirements for use'.

The results are summarised in Table 6.4 below:

Parameters	Limits for Multipurpose Topsoil	Sample Range	Within acceptable Limits?
<u>Maximum Coarse Fragment Content (%)</u>			
Stones >2mm	30		To Follow
Stones > 20mm	10		
Stones >50mm	0		
<u>Mass loss on ignition %</u>			
Clay 5% to 20%	3 - 20	3.94-4.23	Yes
Soil pH	5.5 - 8.5	8.2-8.3	Yes
<u>Plant nutrient content</u>			
Total nitrogen %	>0.15	0.12-0.15	Some results are <0.15% for total nitrogen
Extractable phosphate mg/l	16 to 140	51-67	
Extractable potassium mg/l	121 to 1500	206-250	
Extractable magnesium mg/l	51 to 600	88-89	
Carbon:nitrogen ratio	<20:1	16.7-19.2	Yes
Electrical conductivity $\mu\text{S}\cdot\text{cm}$	<3300	2300-2430	Yes
<u>Potentially Phytotoxic Elements</u>			
Zn mg/kg	<200	125-154	Yes
Cu mg/kg	<135	28.4-42.6	
Ni mg/kg	<75	17.2-19.7	
<u>Visible contaminants</u>			
% m/m	<0.5	<0.01	Yes
...of which plastics	<0.25	<0.01	

Table 6.4 Summary of BS8332 Topsoil Analysis (Plots 8-15, Inspection Visit 07/01/2021)

The results available to date demonstrate that the soils tested are in accordance with BS3882:2015 Multipurpose Topsoil with the exception of a slight short fall (minimum values) of total nitrogen. However, this is within limits based on the mean percentages.



Parameters	Limits for Multipurpose Topsoil	Sample Range	Within acceptable Limits?
<u>Maximum Coarse Fragment Content (%)</u> Stones >2mm Stones > 20mm Stones >50mm	40 20 0		To Follow
<u>Mass loss on ignition %</u>	maximum 2%	1.74-5.04	The highest recorded value is slightly above limiting value, but is within the limit for Topsoil
Soil pH	5.5 - 8.5	7.5-8.3	Yes
Electrical conductivity $\mu\text{S}\cdot\text{cm}$	<3300	2260-2340	Yes
<u>Potentially Phytotoxic Elements</u> Zn mg/kg Cu mg/kg Ni mg/kg	<200 <135 <75	92.3-103 23.8-31.2 24.4-27.3	Yes
<u>Other contaminants</u> % m/m ...of which plastics	<0.5 <0.25	<0.01 <0.01	Yes

Table 6.5 Summary of BS8332 Subsoil Analysis (Plots 8-15, Inspection Visit 07/01/2021)

The results available to date demonstrate that the soils tested are in accordance with BS8601:2013 entitled Multipurpose subsoil with the exception of a slight exceedance (on maximum values) on mass loss on ignition which is however noted to be within the range for Topsoil.



7.0 CONTROLLED WATERS

7.1 Groundwater Monitoring

A monitoring plan strategy was developed within the Water Quality Management Plan for the site (GE18103-WQMP-NOV19), which detailed that monitoring that was to be undertaken prior to, during and following the intrusive groundworks on the site (deep foundation and piling works). Where groundworks were to be phased, monitoring was to be undertaken until all such works are completed in line with those phases.

Five monitoring wells were installed and selected to enable monitoring during the construction period (BH110, BH103, BHA, BHB & BHC), whilst the remaining wells have been decommissioned prior to the March 2020 monitoring. Table 7.1 below lists the testing frequency and suite of analysis that was agreed to be undertaken during the development works:

Locations	Frequency	Suite of Analysis	Phase
BH103, BH110 & BHA-BHC*	1No. visit to determine baseline conditions if commencement date on site >6 months past WQMP issue date	General brownfield suite, speciated PAH, TPH, MNA parameters, water quality parameters and ground water level.	Pre commencement
BH103, BH110 & BHA-BHC	Bi-monthly		Initial 6 months
BH103, BH110 & BHA-BHC	Quarterly		6-24 months
BH103, BH110 & BHA-BHC	Six-monthly		>24 months (to be reviewed and agreed with LA/EA subject to results during initial 24 months)
BH103, BH110 & BHA-BHC	1No. visit post intrusive development to confirm GW conditions following works on site.		Post Development on intrusive groundworks element

*Updated baseline from wells to be utilised for ongoing monitoring programme undertaken on 5th November 2019

Table 7.1 Groundwater Monitoring Schedule

The pre commencement monitoring visit was undertaken on 5th November 2019 to record the baseline conditions.

Table 7.2 details the response zones within the groundwater monitoring wells selected for monitoring in line with the WQMP during the development period.

Location	Standpipe diameter (mm)	Depth of Standpipe Response Zone (m bgl)	Level of Monitoring Well (m AOD)
BH103	50	7 – 10	7.92
BH110	50	10 - 15	7.83
BHA	50	7 – 10	7.75
BHB	50	7 – 10	7.75
BHC	50	7 - 10	8.10

Table 7.2 Summary of Monitoring Well Response Zones

Groundwater Monitoring and sampling visits were undertaken on the following dates:



- 10th March 2020
- 12th May 2020
- 11th June 2020
- 3rd September 2020

The monitoring works in March and May 2020 were undertaken during the intrusive works being undertaken in Phases 1-4 of the site. The monitoring in June 2020 was undertaken following the completion of intrusive foundation and piling works in Phases 1-4. The monitoring undertaken in September 2020 was undertaken following completion of the intrusive foundation and piling works associated with Phase 5.

Following the completion of works in Phases 1-4 monitoring wells BH110 and BHA-C were subsequently decommissioned on 2nd July 2020 to ensure no ongoing pathways remained and to allow development works in these phases to continue. Following the completion of works in Phase 5 monitoring well BH102 was subsequently decommissioned on 19th November 2020.

Where monitoring wells have been decommissioned this has been undertaken in line with Environment Agency guidance and best practice. The groundwater analysis undertaken during the monitoring period are presented in Appendix G (Quarterly Groundwater Quality Assessment Letter Report (GE18103/AP01/200402) dated 2nd April 2020, presenting baseline 2019 and March 2020 Results and Appendix H presenting May, June and September 2020 monitoring results.

Groundwater was recorded at the following levels during the pre-commencement and subsequent monitoring visits undertaken on the site.

Position	Groundwater Level (m bgl)	Groundwater level (m AOD)	Dates
BH103	5.63	2.29	05/11/2019
	4.30	3.62	10/03/2020
	6.00	1.92	12/05/2020
	6.40	1.52	11/06/2020
	6.60	1.32	03/09/2020
BH110	5.67	2.16	05/11/2019
	4.18	3.65	10/03/2020
	5.92	1.91	12/05/2020
	6.30	1.53	11/06/2020
BHA	5.53	2.22	05/11/2019
	4.20	3.55	10/03/2020
	5.90	1.85	12/05/2020
	6.27	1.48	11/06/2020
BHB	5.92	1.83	05/11/2019
	4.57	3.18	10/03/2020
	6.21	1.54	12/05/2020
	6.64	1.11	11/06/2020
BHC	6.10	2.00	05/11/2019
	4.58	3.52	10/03/2020
	6.32	1.78	12/05/2020
	6.74	1.36	11/06/2020

Table 7.3 Summary of Groundwater Conditions (within Monitoring Standpipes)



7.2 Groundwater vs Human Health & Controlled Waters

A Tier 1 risk assessment for groundwater was undertaken as part of the Water Quality Management Plan for the site (GE18103/WQMP/NOV19). An updated Tier 1 assessment was subsequently undertaken and presented following receipt of the results of the groundwater analyses from the pre-commencement visit and first monitoring visit (10th March 2020), which was presented in the Quarterly Groundwater Quality Assessment Letter Report (GE18103/AP01/200402) dated the 2nd April 2020, a copy of which is presented in Appendix G. Groundwater analysis was compared against the Environmental Quality Standards for freshwater (EQS) and the Water Supply (Water Quality) Regulations 2000 and Water Framework Directive (WFD). A summary of contaminant concentrations encountered above the respective EQS, WFD and DWS guideline values (where available) over the monitoring period is presented within Table 7.4 below.

Location	Determinand	Concentration	Appropriate Standard	Dated Sampled
Barium	BH103	157ug/l	100ug/l (DWS)	05/11/2019
	BHB	181ug/l		
	BH103	118ug/l		10/03/2020
	BHB	221ug/l		
	BHB	213ug/l		12/05/2020
Boron	BHA	1180ug/l	1000ug/l (WHO)	11/06/2020
	BHC	1080ug/l		
Nickel	BH103	44ug/l	8-40ug/l (EQS) 20ug/l (DWS)	12/05/2020
	BHB	41ug/l		
	BH103	49ug/l		11/06/2020
	BHB	49ug/l		
	BH103	59ug/l		03/09/2020
Iron	BH103	224ug/l	1000ug/l (EQS) 200ug/l (DWS)	12/05/2020
	BHB	4880ug/l		
	BHA	984ug/l		11/06/2020
Sulphate	BHA	466mg/l	250 mg/l (DWS)	12/05/2020
	BHA	599mg/l	400mg/l (EQS)	11/06/2020
TPH	BH103	C21-35 Aro – 11.1ug/l TPH – 25ug/l	10ug/l (DWS) 5.47ug/l (WSV)	05/11/2019
	BH110	TPH – 23.2ug/l C12-C16 Ali 28.2ug/l		
	BHA	TPH – 36.6ug/l C21-C35 Aro – 22.7ug/l		
	BHB	TPH – 239ug/l C10-C12 Ali – 11.5ug/l C12-C16 Ali – 28.2ug/l C16-C21 Ali – 28.4ug/l C21-C35 Ali – 54.4ug/l C10-C12 Aro – 23.5ug/l C12-C16 Aro – 29.4ug/l C16-C21 Aro – 16.5ug/l C21-C35 Aro – 34.7ug/l		
	BH103	C21-35 Ali– 9.6ug/l C21-35 Aro– 7.3ug/l TPH – 169ug/l		12/05/2020
	BHA	C8-C10 Ali – 19.1ug/l C10-C12 Ali – 9.1ug/l		



		C12-C16 Ali – 18.6ug/l C16-C21 Ali – 19.6ug/l C21-C35 Ali – 54.7ug/l C12-C16 Aro – 9.1ug/l C16-C21 Aro – 13.2ug/l C21-C35 Aro – 36.1ug/l TPH – 180 ug/l		
	BHB	C8-C10 Ali – 24ug/l C10-C12 Ali – 48.1ug/l C12-C16 Ali – 172ug/l C16-C21 Ali – 305ug/l C21-C35 Ali – 599ug/l C35-C40 Ali – 20.8ug/l C8-C10 Aro – 10.4ug/l C10-C12 Aro – 39ug/l C12-C16 Aro – 163ug/l C16-C21 Aro – 297ug/l C21-C35 Aro – 505ug/l C35-C40 -Aro – 189.2ug/l TPH – 2200ug/l		
	BHC	C16-C21 Ali – 8.8ug/l C21-C35 Ali – 16.5ug/l C16-C21 Aro – 5.9ug/l C21-C35 Aro – 10ug/l TPH – 41.3ug/l		12/05/2020
	BH103 BHC	TPH – 11.3ug/l TPH – 19.2ug/l		11/06/2020
	BH103	C10-C12 Ali – 12.9ug/l C12-C16 Ali – 38.8ug/l C16-C21 Ali – 60.2ug/l C21-C35 Ali – 208ug/l C35-C40 Ali – 26.7ug/l C10-C12 Aro – 15.2ug/l C12-C16 Aro – 38.8ug/l C16-C21 Aro – 46.8ug/l C21-C35 Aro – 144ug/l C35-C40 Aro – 41.2ug/l TPH – 650ug/l		03/09/20
Anthracene	BH103 BHB	0.06ug/l 0.02ug/l	0.02ug/l (EQS)	10/03/2020
	BH110 BHB BHC	0.03ug/l 0.70ug/l 0.03ug/l		12/05/2020
Fluoranthene	BHA BHB BHC	0.03ug/l 0.04ug/l 0.06ug/l	0.02ug/l (EQS)	05/11/2019
	BH103 BHB	0.38ug/l 0.05ug/l		10/03/2020
	BH103 BH110 BHA	0.20ug/l 0.21ug/l 0.07ug/l		12/05/2020



	BHB	5.31ug/l		
	BHC	0.33ug/l		
	BHB	0.03ug/l		
	BH103	0.04ug/l		
Benzo(a)pyrene	BHB	0.01ug/l	0.01ug/l (WHO) 0.03ug/l (EQS)	05/11/2019
	BHC	0.03ug/l		10/03/2020
	BH103	0.13ug/l		12/05/2020
	BHB	0.01ug/l		
	BH103	0.12ug/l		
	BH110	0.12ug/l		
	BHA	0.04ug/l		
PAH Sum of four *	BHB	6.20ug/l	0.10ug/l (DWS)	12/05/2020
	BHC	0.30ug/l		
	BH103	0.02ug/l		
	BHC	0.11ug/l		
	BH103	0.52ug/l		
	BH103	0.36ug/l		
	BH110	0.33ug/l		
	BHA	0.13ug/l		
	BHB	19.57ug/l		
	BHC	0.87ug/l		

*benzo(b)fluoranthene, benzo(ghi)perylene, benzo (k) fluoranthene & indeno (1,2,3-c,d) pyrene.

- DWS - Water Supply (Water Quality) Regulations 1989.
- EQS - Environmental Quality Standards (freshwater)
- WSV – Atkins ATRISK values for groundwater

Table 7.4 Contaminant exceedances within Groundwater (ug/l) (November 2019 to September 2020)

Additional analysis was undertaken for biochemical oxygen demand, chemical oxygen demand, electrical conductivity, dissolved organic carbon and suspended solids was also undertaken during both visits. The results are presented in Table 7.5.

Location	Biochemical Oxygen Demand (mg/l)	Chemical Oxygen Demand (mg/l)	Electrical Conductivity (uS/cm)	Dissolved Organic Carbon (mg/l)	pH (pH units)	Suspended Solids (mg/l)	Date
BH103	6	23	1530	13	6.8	7700	05/11/2019
	6	10	1530	6.2	6.7	56	10/03/2020
	2	15	1480	5.9	6.7	52000	12/05/2020
	38	17	1610	7.9	6.7	4700	11/06/2020
	7	30	1570	6.7	6.7	17000	03/09/2020
BH110	<2	<2	1100	14	7.0	42	05/11/2019
	8	12	1400	6.3	6.7	8	10/03/2020
	<2	20	1530	7.0	6.7	870	12/05/2020
	4	15	1370	6.8	6.7	56	11/06/2020
BHA	<2	<2	1180	10	7.0	1200	05/11/2019
	3	7	1900	7.1	6.6	410	10/03/2020
	<2	8	1940	7.0	6.6	25000	12/05/2020
	2	17	2050	3.1	6.7	250	11/06/2020



BHB	12	31	2460	18	6.9	2200	05/11/2019
	9	33	1710	14	6.7	120	10/03/2020
	2	34	1660	13	6.7	20000	12/05/2020
	<2	30	1620	12	6.8	170	11/06/2020
BHC	<2	<2	1560	9.6	6.9	1200	05/11/2019
	5	5	2340	5.8	6.7	14	10/03/2020
	<2	11	2310	5.1	6.8	8300	12/05/2020
	<2	11	2200	5.4	6.8	28	11/06/2020

Table 7.5 Water Quality Results (November 2019 to September 2020)

In line with the RSVP and WQMP the aim of the development was to provide a long term betterment of the site's groundwater quality. As such based following a review of the baseline and the development proposals it is considered that no specific remediation is required in this respect of groundwater, however it was agreed that a period of groundwater monitoring would be undertaken during the intrusive element of the development works (piling and foundations) in order to demonstrate that the proposed development had not resulted in a detrimental impact to the site.

Based on the chemical laboratory results, elevated concentrations have either remained at similar levels and order of magnitude to those previously recorded as part of the baseline assessment for the site or, where slight exceedances have been identified, further monitoring has shown that these concentrations have subsequently decreased following the intrusive works. A slight increase in suspended solids was noted following the piling works in Phase 1-4 and to lesser degree in Phase 5, however monitoring has shown that this generally reduced back down in line with background levels within 1 month of these elements of works ceasing. These elements could also have been affected by variations in groundwater levels recorded over the monitoring period. The water results have generally improved between monitoring visits, with increases in biological and chemical oxygen demand and decreases with dissolved organic carbon.

The groundwater analysis monitoring results have also been tabulated per borehole and presented in Appendix H to show the variation in concentration between locations over the monitoring period and in line with the baseline monitoring undertaken for the site.

Whilst some slight variation in concentrations recorded has been recorded over the intrusive development works (foundations and piling) it is considered that the works have not resulted in an increased or determinantal impact to controlled waters. The proposed development is reducing the infiltration through the site compared with the previous land use and will continue to offer a longer term betterment and improvement of groundwater quality beneath the site.



8.0 DISCOVERY STRATEGY

A discovery strategy remains in place throughout the development works on this site. Geo-Environmental have not been made aware of any discoveries having been made to date and thus the strategy, as set out in the RSVP did not require enacting. However, the strategy remains in place for the remainder of the development works.

9.0 VERIFICATION

In accordance with the Client's instruction, Geo-Environmental undertook routine and independent inspection during key stages of the construction process. The risk mitigation measures in relation to remedial measures for Plots 1-15, have been inspected and were considered to comply with the requirements of the design and Remediation Strategy and Verification Plan at the point of inspection, or defects otherwise noted and subsequently rectified and plots re-inspected. Further plots and validation works for the site will be reported via an updated report or under separate cover in due course.

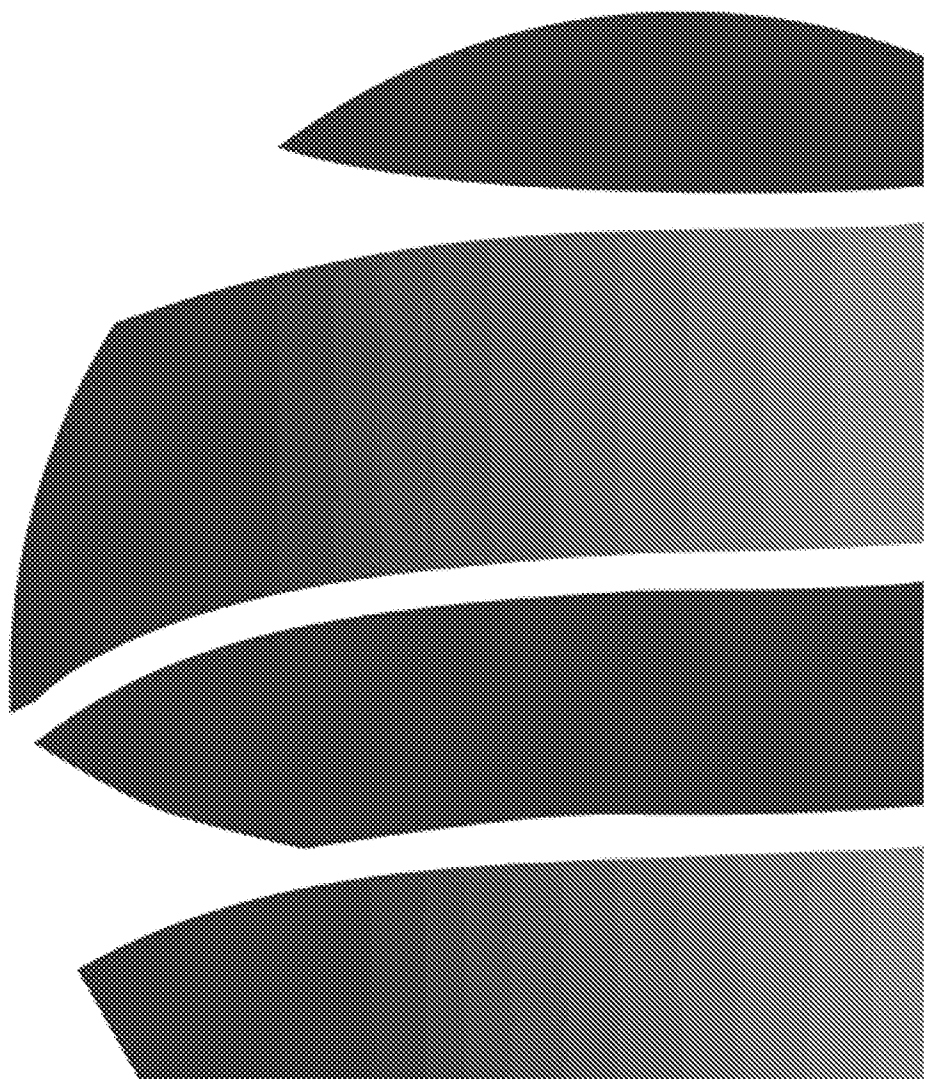
Please be aware that the independent inspection and validation of the gas protection measures installed presented within this report relates to the works undertaken up to the point of inspection. Geo-Environmental accept no responsibility or liability for any works following the inspection that may have resulted in subsequent damage to the gas protection measures and membranes installed due to any failure to protect the membrane prior to or after screeding works on site. In addition, the inspection of the installed soil cover system was undertaken by Geo-Environmental via the excavation of a selected number of hand pits. There was no visual evidence on the site to indicate that the areas remote from the pits undertaken were likely to differ significantly from the areas where the pits had been undertaken for inspection. As such, the confirmation of the presence of a geo-textile membrane, the confirmation of depth and composition of subsoil and Topsoil has only been independently verified by Geo-Environmental within these hand pit locations. It has been assumed that these hand pits are representative of the imported soils within the garden areas of Plots 1-15.

Geo-Environmental can only verify the installation of a cover system at the locations inspected at the time of inspections. Geo-Environmental accepts no liability for areas that have not been directly inspected or works that have subsequently been undertaken on the site following our inspection visit(s) that may in any way alter or affect the validation works inspected and reported herein.

The report relates solely to the validation of the remedial measures installed within Plots 1-15. Validation with respect the remaining Plots will be presented under separate cover in due course.

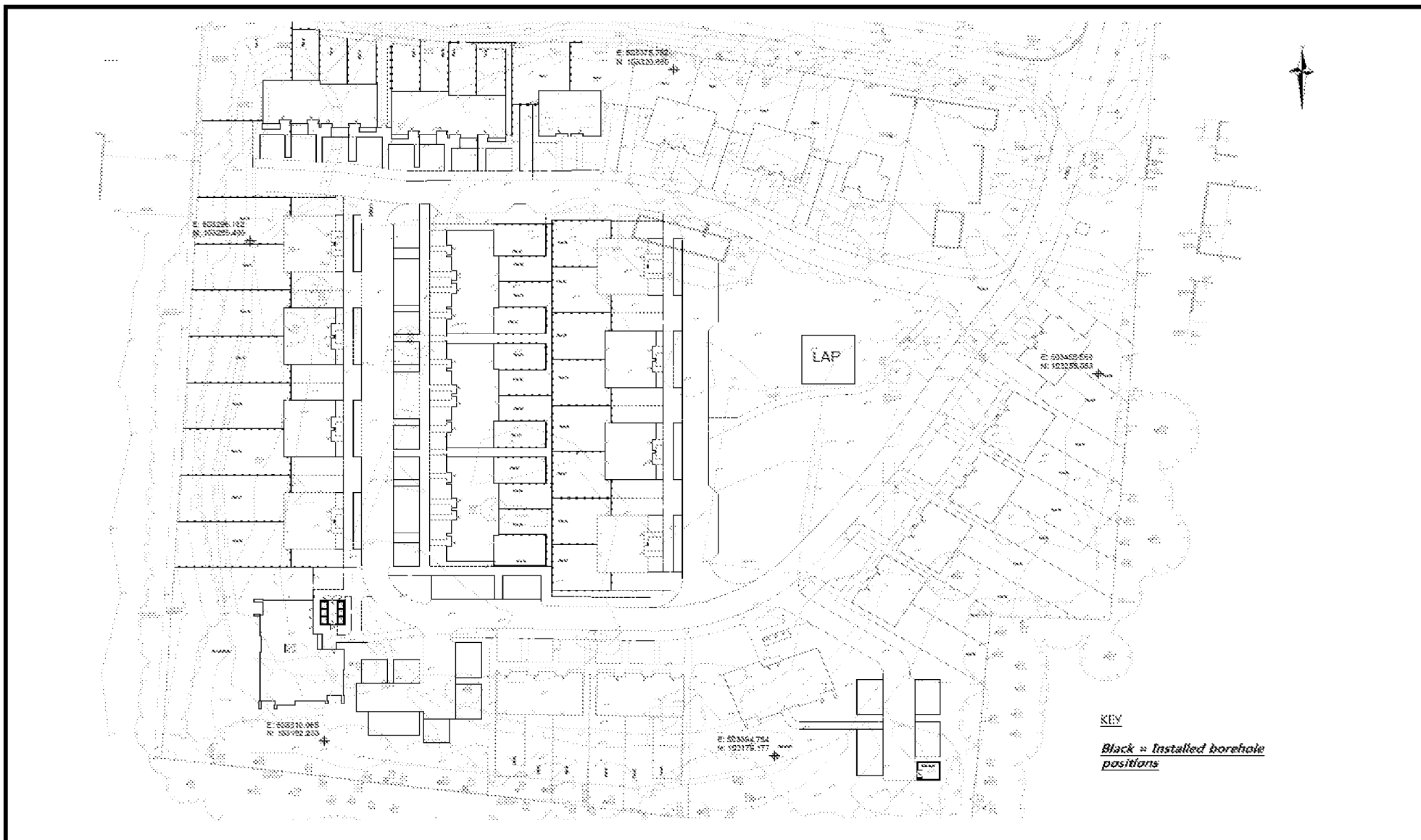


FIGURES

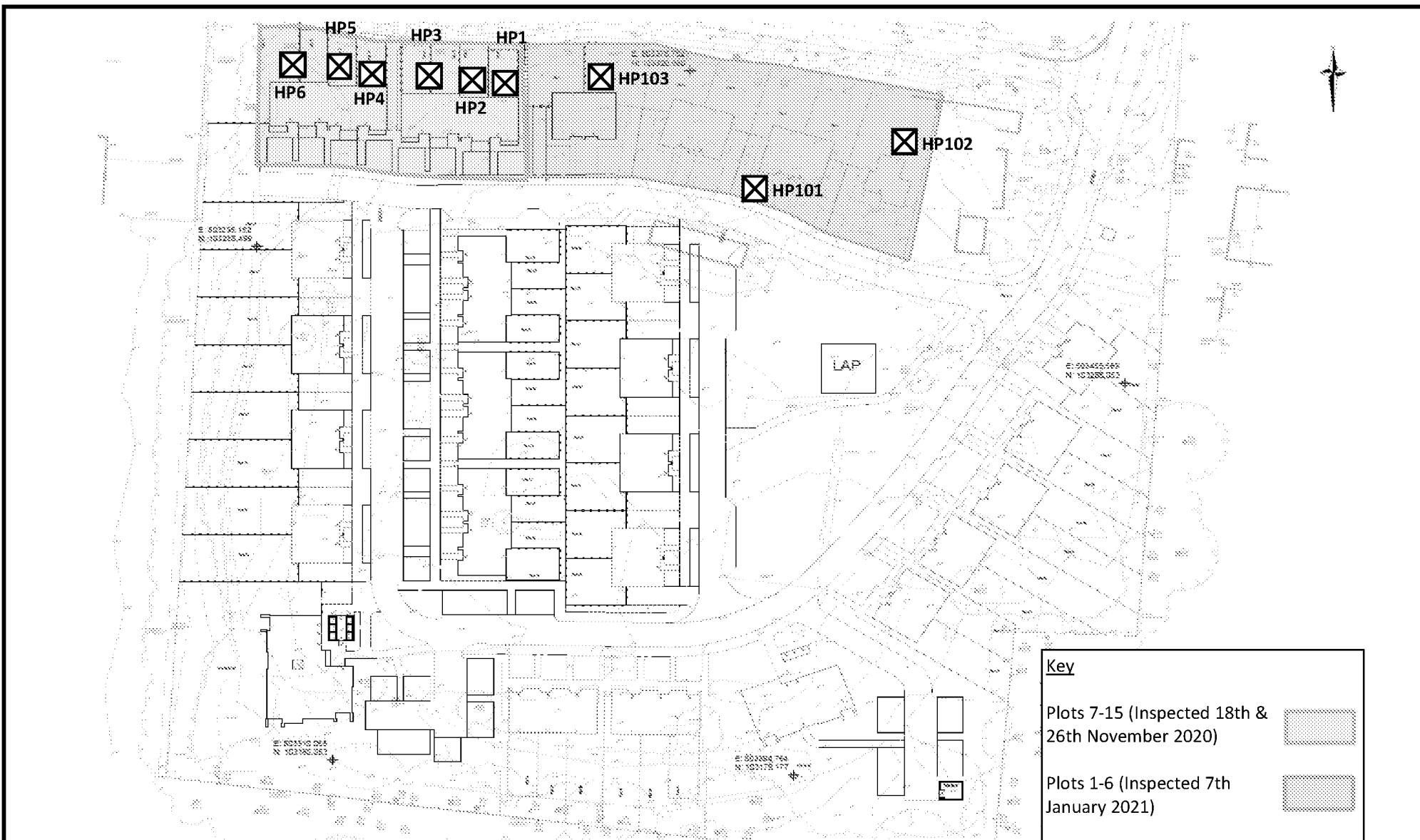




Project: Cornfield Close, Littlehampton, West Sussex		Title: Site Location Plan	
Client: Thakeham Homes		Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	
Ref No: GE18103	Revision: 0		
Drawn: LL	Date: 01/10/2019		
Figure: 1	Scale: Not To Scale		
		 Geo-Environmental	



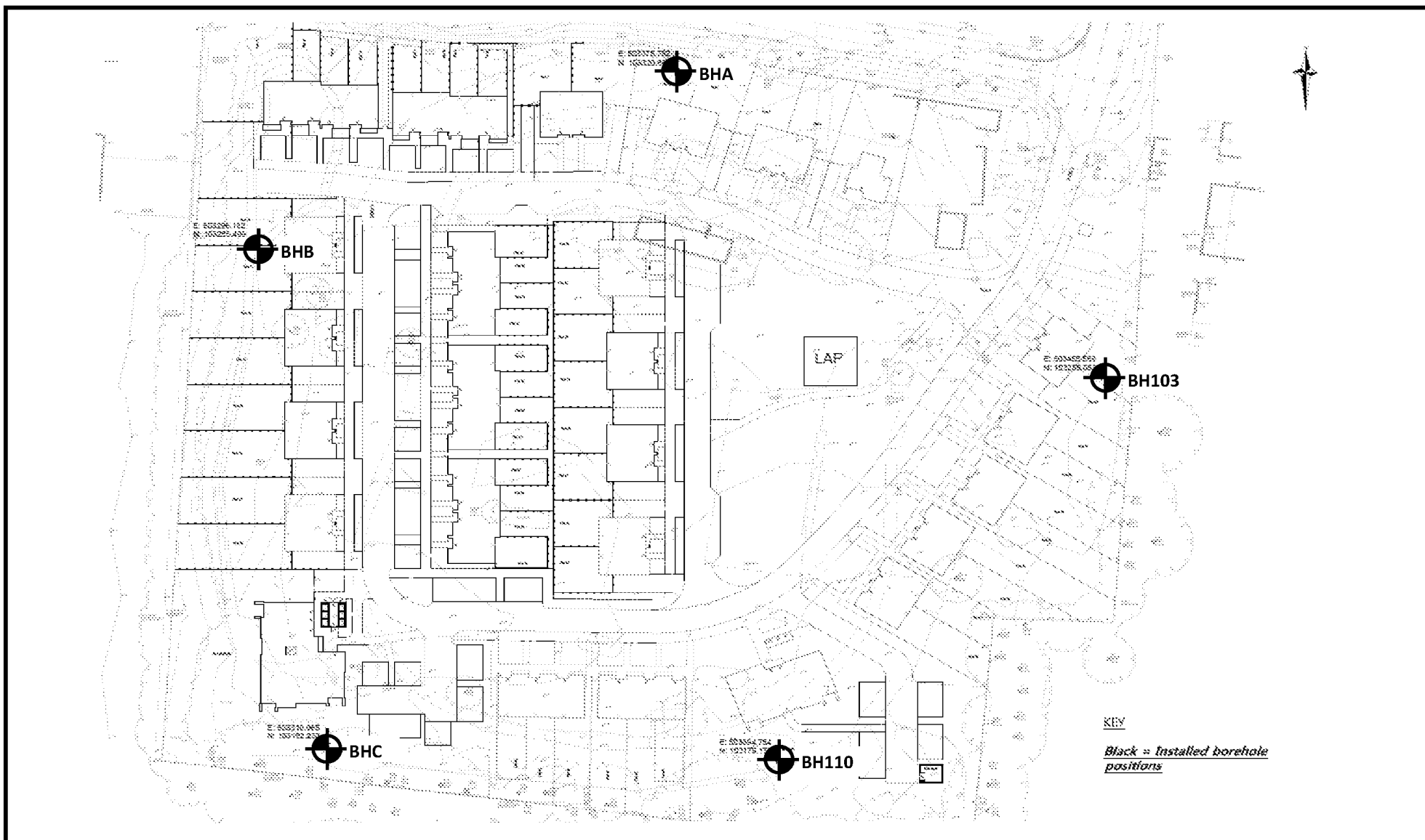
Project:	Cornfield Close, Littlehampton, West Sussex			Title	Development Layout Plan	
Client:	Thakeham Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net	 Geo-Environmental	
Ref No:	GE18103	Revision:	0			
Drawn:	LL	Date:	01/10/2019			
Figure:	2	Scale:	Not To Scale			



Project:	Cornfield Close, Littlehampton, West Sussex			Title	Validation Sample Location Plan (Plots 1-5)	
Client:	Thakeham Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE18103	Revision:	0			
Drawn:	FG	Date:	12/01/2021			
Figure:	4	Scale:	Not To Scale			



Geo-Environmental

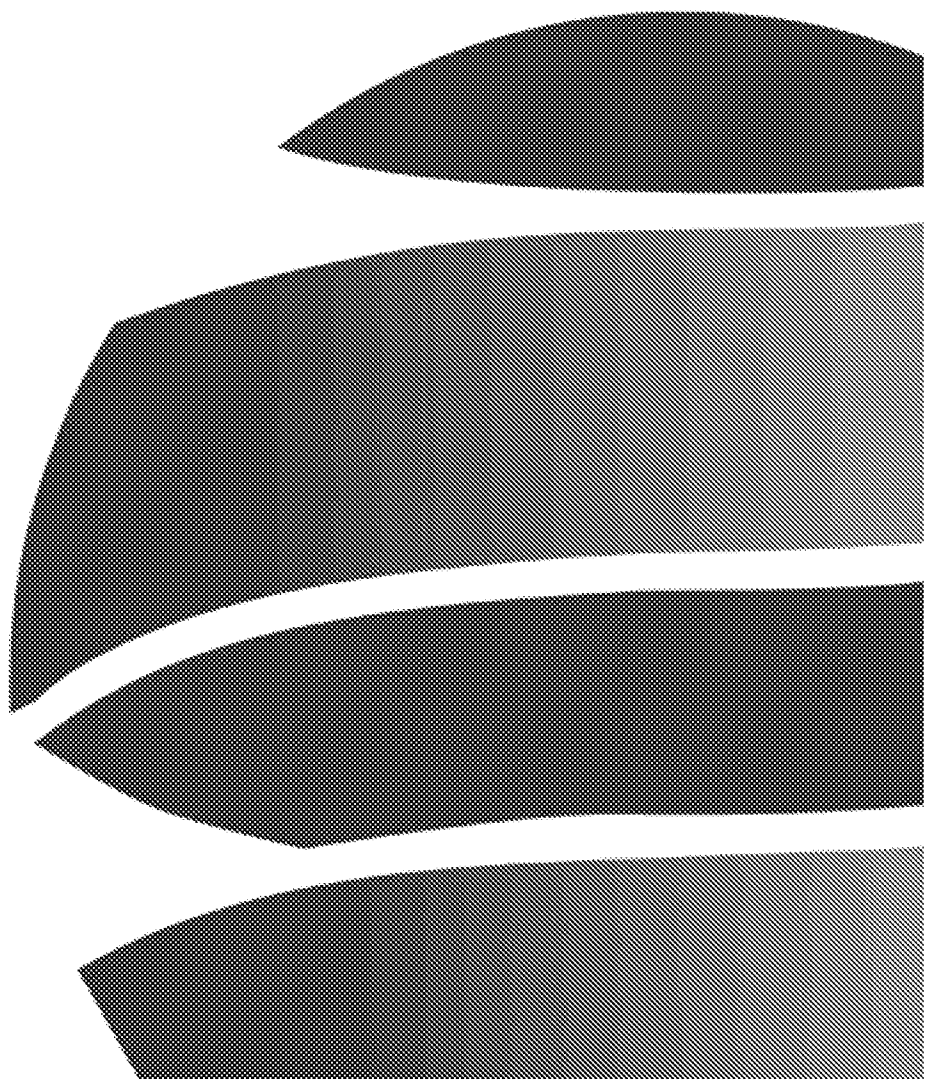


Project:	Cornfield Close, Littlehampton, West Sussex			Title	Groundwater Monitoring Well Borehole Locations (BH103, BH110, BHA, BHB and BHC)	
Client:	Thakeham Homes			Geo-Environmental Services Ltd Unit 7 Danworth Farm, Cuckfield Road Hurstpierpoint, West Sussex BN6 9GL +44(0)1273 832972 www.gesl.net  Geo-Environmental		
Ref No:	GE18103	Revision:	0			
Drawn:	LL	Date:	01/10/2019			
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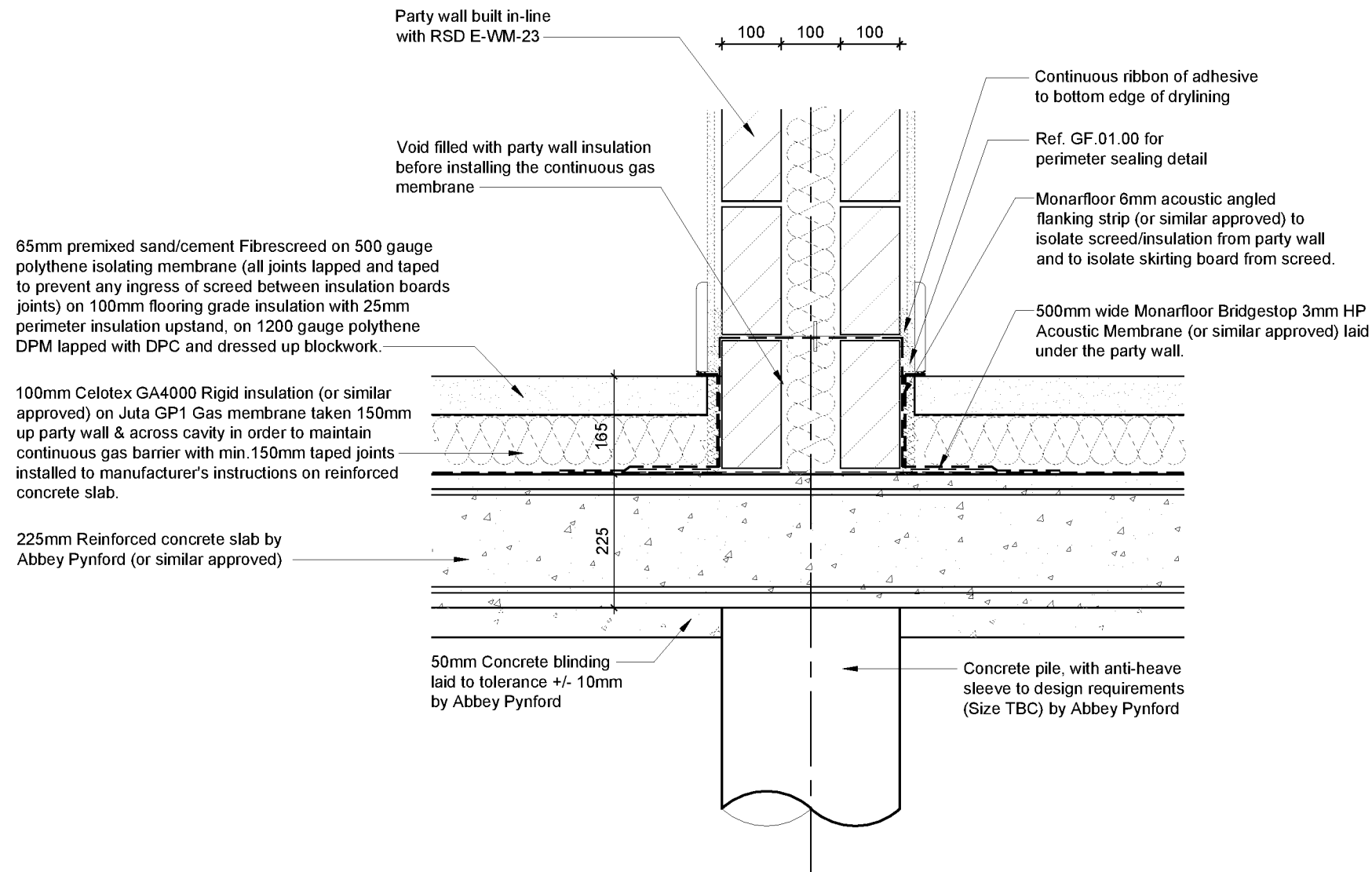


APPENDIX A

Proposed Floor Construction Detail Plans (Flats and Houses)



Drawing to be read in conjunction with Construction Specification & Standard Details



PARTY WALL/G.F. SLAB SUBSTRUCTURE DETAIL - MASONRY APARTMENTS

(GROUND WORKS TO BE IN STRICT ACCORDANCE WITH ENGINEERS DETAILS & INFORMATION)

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This drawing is to be read in conjunction with all relevant consultants, specialist manufacturers drawings and specifications.

Any discrepancies in dimensions or details on or between these drawings should be drawn to our attention.

All dimensions are in millimetres unless noted otherwise.

Any surveyed information incorporated within this drawing cannot be guaranteed as accurate unless confirmed by fixed dimension.

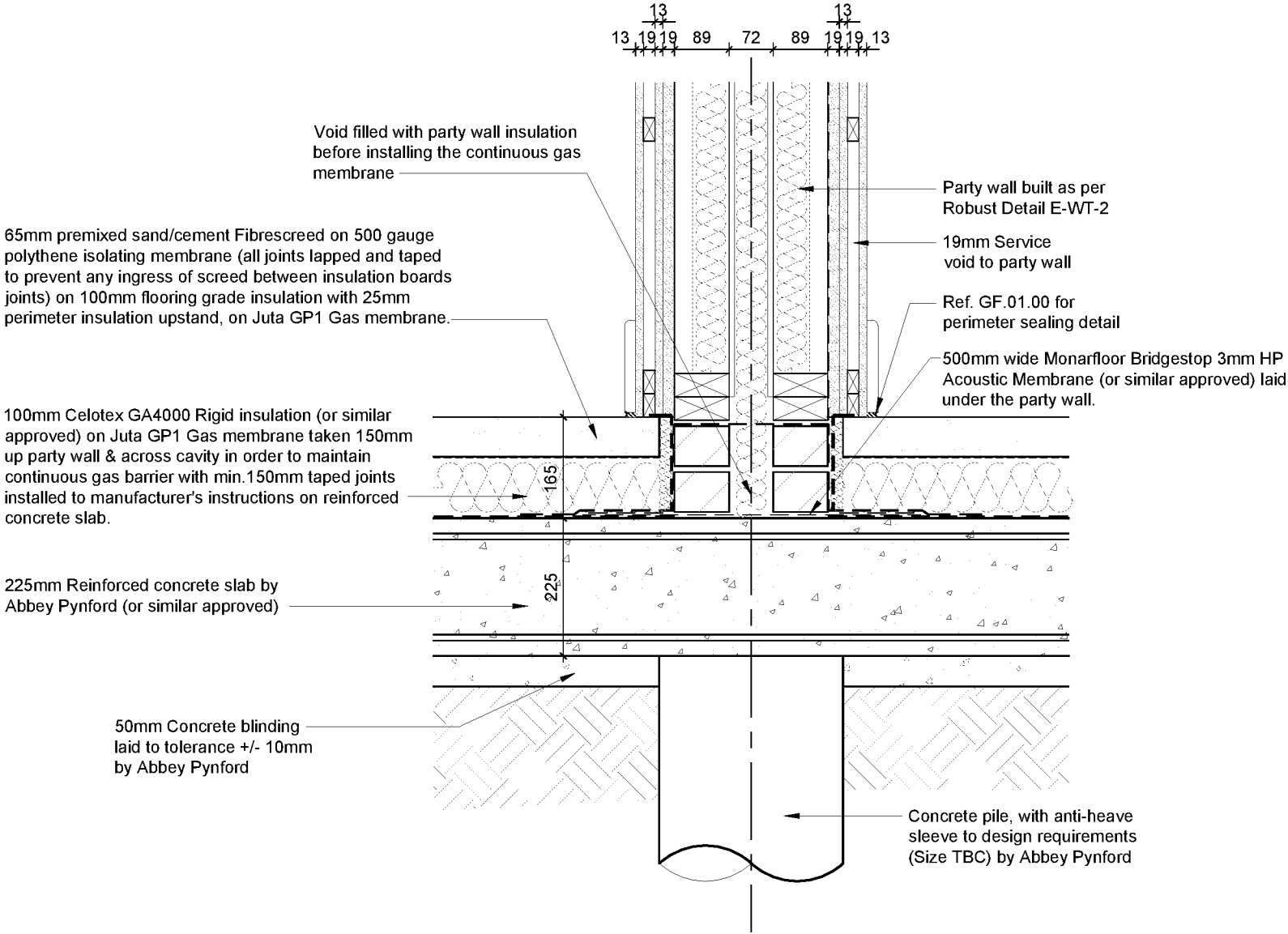
Party Wall/G.F. Slab Substructure Detail

Littlehampton - (Masonry Apartments)

C03	19.12.19	DETAIL UPDATED TO SUIT GAS MEMBRANE COMMENTS.	A/H	C
C02	09.10.19	SUB FLOOR VOID & VENTS COMMITTED & DPCS UPDATED.	A/H	C
C01	12.06.19	ISSUED FOR CONSTRUCTION	A/H	C
P02	07.03.19	225mm AIR VOID AND TELESCOPIC VENTS INTRODUCED.	A/H	C
P01	07.12.18	FIRST ISSUE	A/H	C
REV	DATE	DESCRIPTION	INITIAL	CHECK

CONSTRUCTION

		enquiries@architecture.co.uk 01344 756 271	
CLIENT THAKEHAM CLIENT			
PROJECT CORNFIELD CLOSE, LITTLEHAMPTON			
TITLE PARTY WALL/G.F. SLAB SUBSTRUCTURE MASONRY APARTMENTS			
SCALE	DATE		PROJECT NO.
1:10 @ A3	07/12/18		18.335
DRAWN	CHECKED	M637 _60.50.03 C03	
AJH	CD		



PARTY WALL/G.F. SLAB SUBSTRUCTURE DETAIL - TIMBER FRAME HOUSES

(GROUND WORKS TO BE IN STRICT ACCORDANCE WITH ENGINEERS DETAILS & INFORMATION)

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Any discrepancies in dimensions or details on or between these drawings should be drawn to our attention.

All dimensions are in millimetres unless noted otherwise.

Any surveyed information incorporated within this drawing cannot be guaranteed as accurate unless confirmed by fixed dimension.

Party Wall/G.F. Slab Substructure Detail
Littlehampton - (Timber Frame Houses)

C03	19.12.19	DETAIL UPDATED TO SUIT GAS MEMBRANE COMMENTS.	AJH	CD
C02	09.10.19	SUB FLOOR VOID & VENTS OMITTED, PARTY WALL DETAIL AMENDED.	AJH	CD
C01	12.06.19	ISSUED FOR CONSTRUCTION	AJH	CD
P02	07.03.19	225mm AIR VOID AND TELESCOPIC VENTS INTRODUCED.	AJH	CD
P01	07.12.18	FIRST ISSUE	AJH	CD
REV	DATE	DESCRIPTION	INITIAL	CHECKED

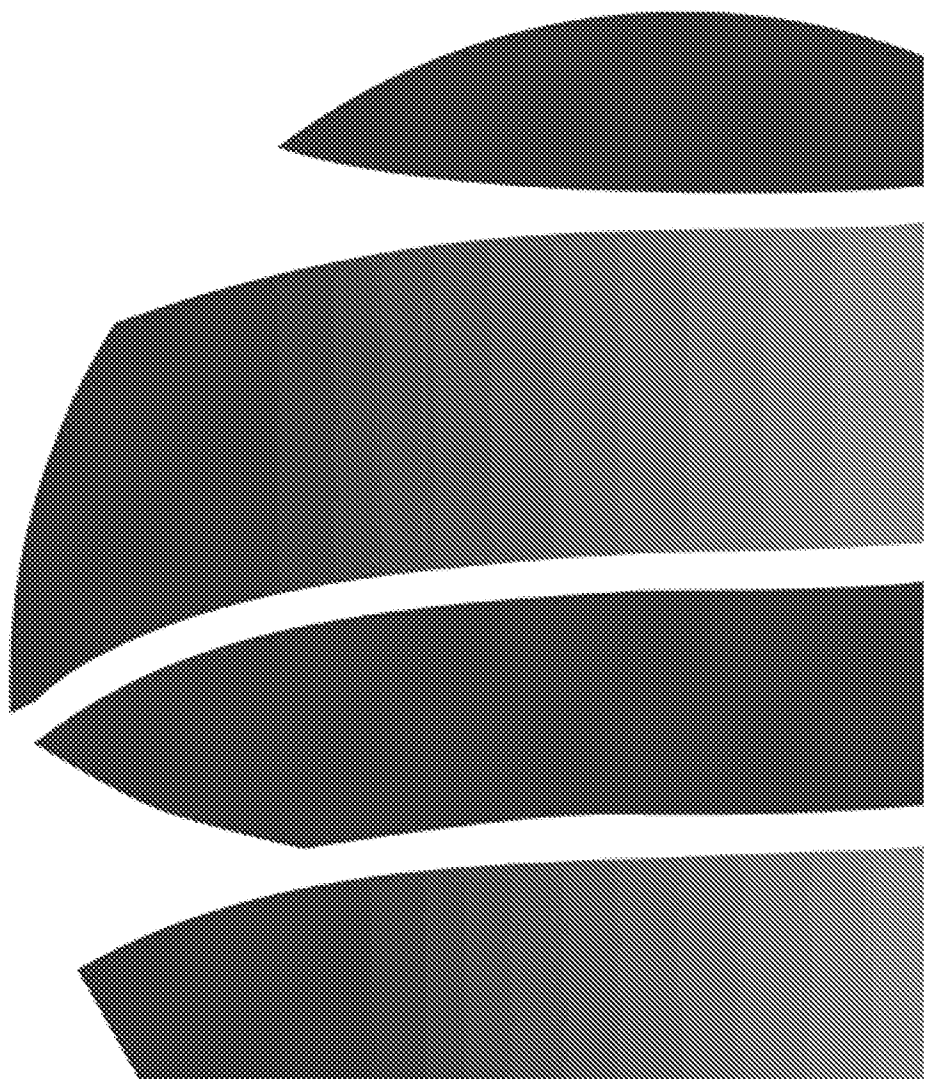
CONSTRUCTION

CLIENT	THAKEHAM CLIENT	enquiries@architecture.co.uk 01944 752 271
PROJECT	CORNFIELD CLOSE, LITTLEHAMPTON	
TITLE	PARTY WALL/G.F. SLAB SUBSTRUCTURE TIMBER FRAME HOUSES	
SCALE	1:10 @ A3	DATE 07/12/18
DRAWN	AJH	CHECKED CD
PROJECT NO.	18.335	
	M637_60.50.04	C03



APPENDIX B

Visual Inspection Records of Gas Membrane Installations



Project Name	Cornfield Close, Littlehampton
Project No.	GE18103
Client	Thakeham
Geo-Environmental Project Manager's Email	[REDACTED]
Date	11/06/2020, 13:20
Site Engineer	[REDACTED]
 Toby Smith	[REDACTED]
Weather at time of inspection	Overcast, light wind.
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential
Plot No.	Plot 2 - unfinished - cavity walls only half completed
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	☐ Venting ☒ Membrane ☐ Venting and Membrane

1. MEMBRANE

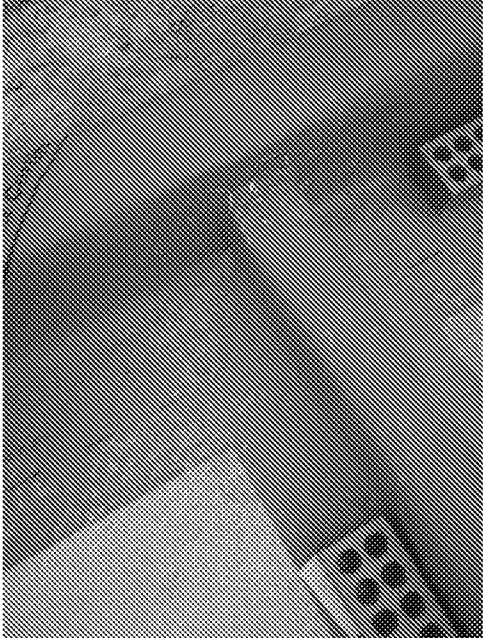
1.1 Condition of sub-grade and underside of membrane	Clean, recently swept flat concrete.
1.2 Gas membrane type	Keytec 400 HP - Self branded bought from Juta.
1.3 Gas membrane condition	Very good. No sign of previous repair or weakness. Membrane cutouts used as principal joint tape.
Jointing tape product	301483 Foil Band 150mm width/ 1.5mm thickness/10m length - Aluminum heat weld membrane tape - used around service ducts.
1.5 Lapping design	Lapped >=50mm in all areas where achievable
1.6 Laps, welds and joints seals	Heat welded membrane used to seal joints.
1.7 Service seals	Seal with foil band weld membrane joining tape.

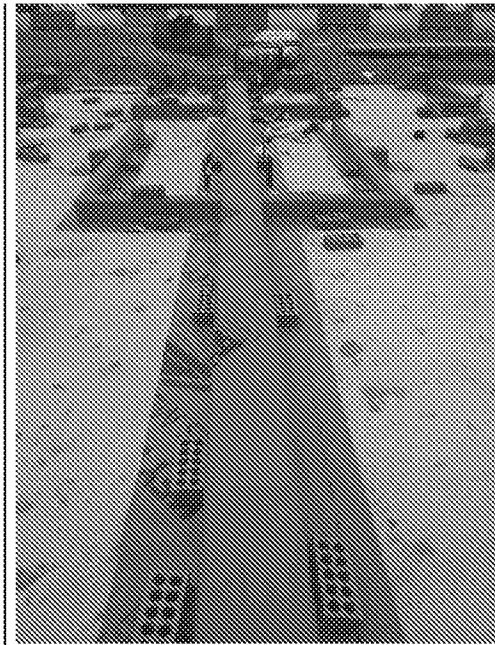
4. PHOTOGRAPHS

Photographs

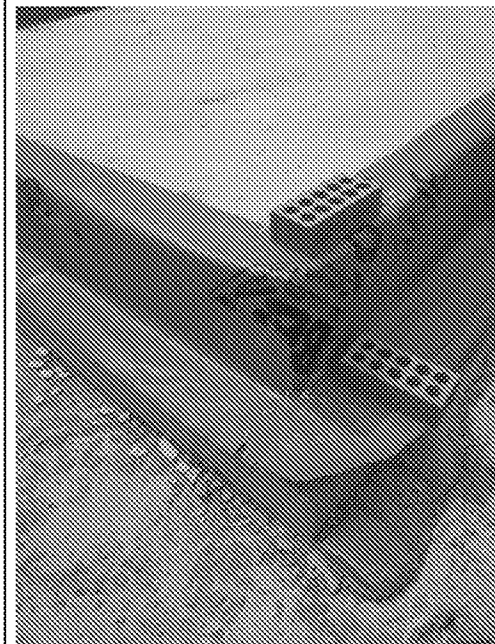
(7 records)

Photograph	Photograph Title

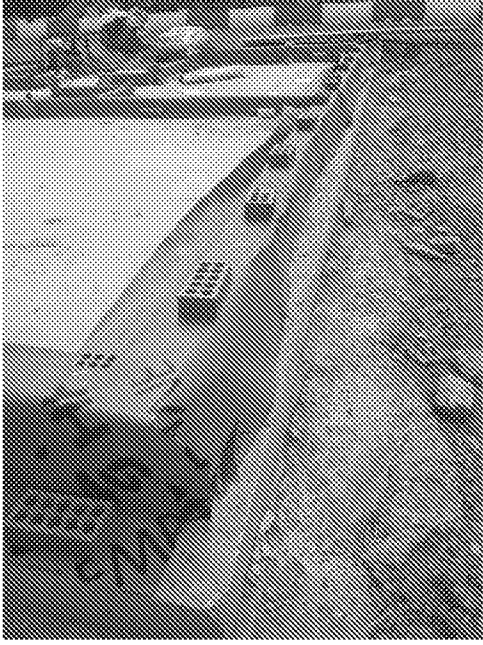
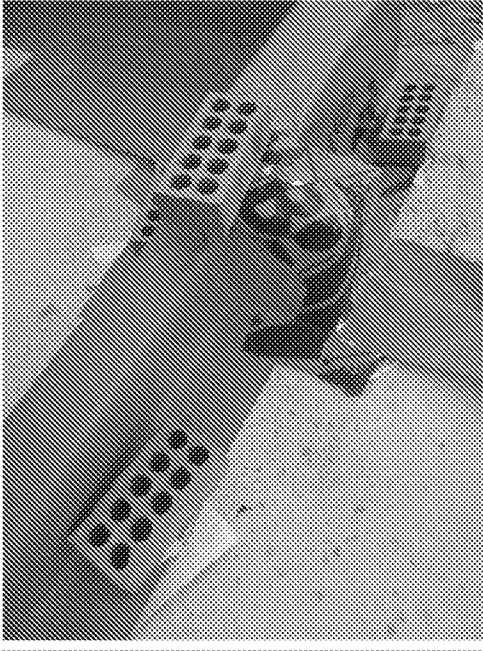
	Area - incomplete
	Inner wall
	Service



Inner walls - centre



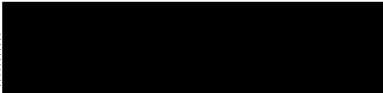
Outer wall corner north east

	Outer North West - still unfinished
	Inner walls south (front of property)

5. PASS/FAIL

The gas protection measures inspected: Are acceptable & comply with the specification

Details of issues

Approved by
 Fiona Goode 

Date 11/06/2020

Project Name	Cornfield Close, Littlehampton
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[REDACTED]
Date	11/06/2020, 12:22
Site Engineer	[REDACTED]
 Toby Smith	[REDACTED]
Weather at time of inspection	Overcast, light wind but dry.
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential housing
Plot No.	Plot 1 - wall cavity only - unfinished.
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	☐ Venting ☒ Membrane ☐ Venting and Membrane

1. MEMBRANE

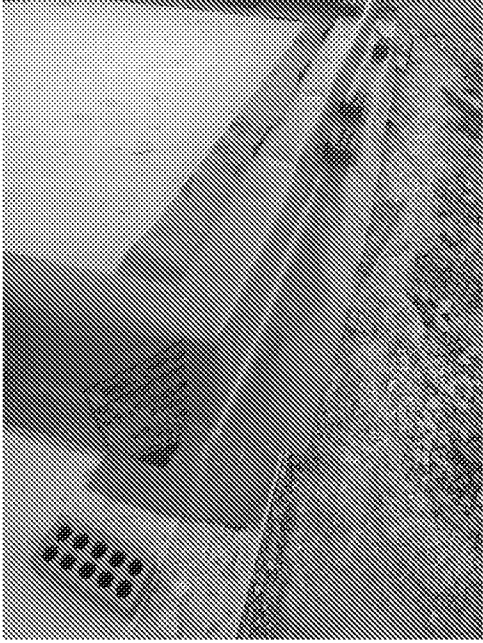
1.1 Condition of sub-grade and underside of membrane	Very clean, recently swept.
1.2 Gas membrane type	Keytec 400 HP - bought from Juta branded by Keytec. Red. Stored in van.
1.3 Gas membrane condition	No punctures, evidence of footprints, repairs or weakness. Joining tape will be used to protect membrane against wooden beam installation at later date
Joining tape product	Membrane used as principal joint tape as opposed to membrane tape due to longer life span (25 years). Joining tape used on service ducts only. Brand:301483 Foil Band 150mm width/ 1.5mm thickness/10m length - Aluminum heat membrane tape - used around service ducts
1.5 Lapping design	Joints lapped and welded. Overlap >=50mm across all welds.
1.6 Laps, welds and joints seals	Welds very securely sealed. Membrane used to seal at joints as opposed to joining tape.
1.7 Service seals	Services sealed with heat sealed tape

4. PHOTOGRAPHS

Photographs

(8 records)

Photograph	Photograph Title

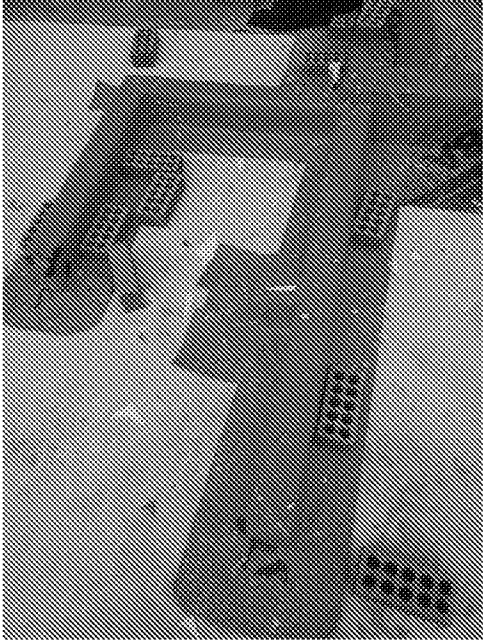
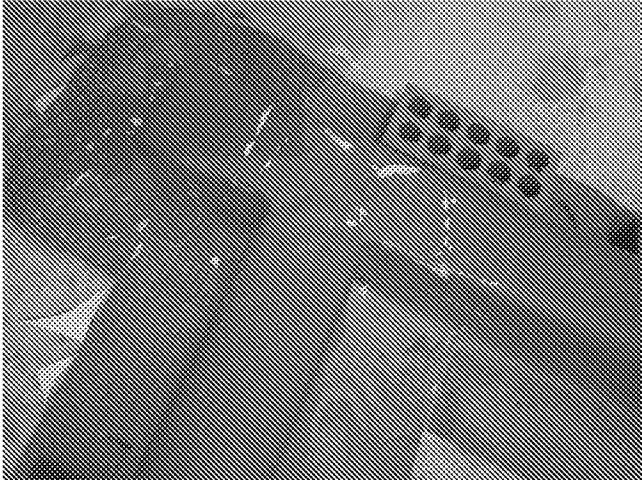
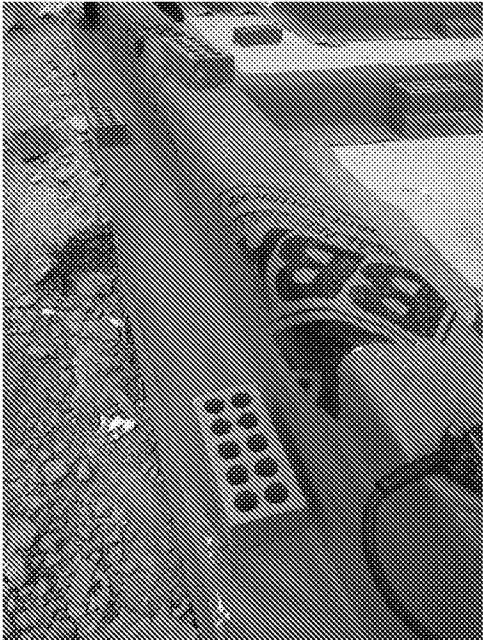
	Outer corner
	Area
	Overlap on inside corner.



Alum tape around service duct



Foil tape around service duct

	Sufficient length for overlap
	Joint sealed with no gaps or voids
	Outer layer seal

5. PASS/FAIL

Gas Protection Measures Inspection Report

The gas protection measures inspected: Are acceptable & comply with the specification

Details of issues

Approved by

 Fiona Goode

Date 11/06/2020

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham
Geo-Environmental Project Manager's Email	[REDACTED]
Date	02/07/2020, 12:59
Site Engineer	 Fiona Goode [REDACTED]
Weather at time of inspection	Windy, overcast, warm
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Semi detached and terraced houses
Plot No.	Plots 2-4 timber frame and Plots 5-15 perimeter
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	☐ Venting ☒ Membrane ☐ Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Good condition, clean with no visible damage
1.2 Gas membrane type	Keytec gas resistant 400 membrane and on a few plots black juta unbranded gas resistant membrane
1.3 Gas membrane condition	Membrane in good condition some dust but well protected
Jointing tape product	Heat sealed, no tape
1.5 Lapping design	At least 100mm lap on all joins
1.6 Laps, welds and joints seals	All heat sealed and well sealed
1.7 Service seals	Site made seals around all services that fall within perimeter. Services outside perimeter yet to be sealed

4. PHOTOGRAPHS

Photographs

(34 records)

Photograph	Photograph Title



Plot 3 timber



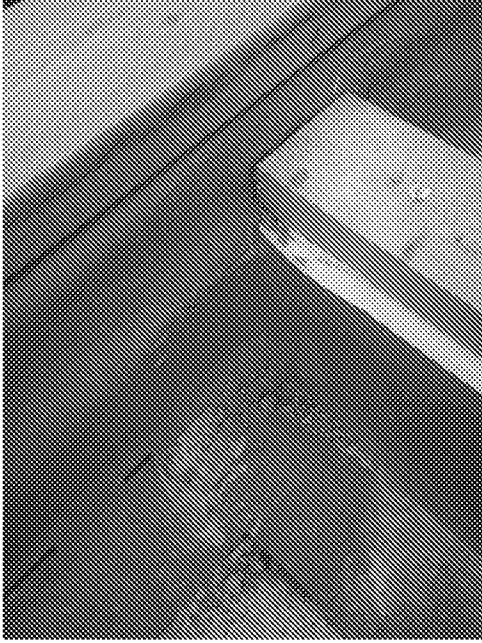
Plot 2 timber



Plot 5 underside



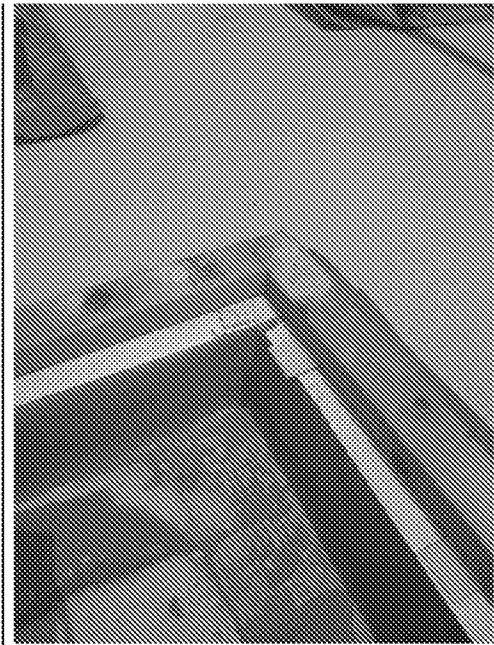
Plot 5 overview



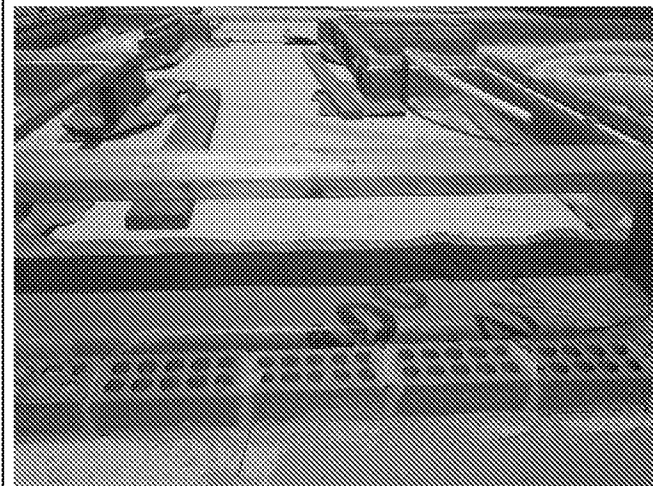
Plot 5 corner



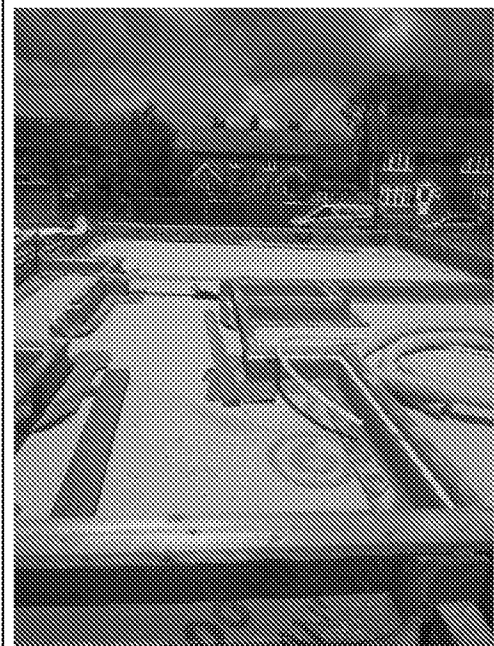
Plot 5 services



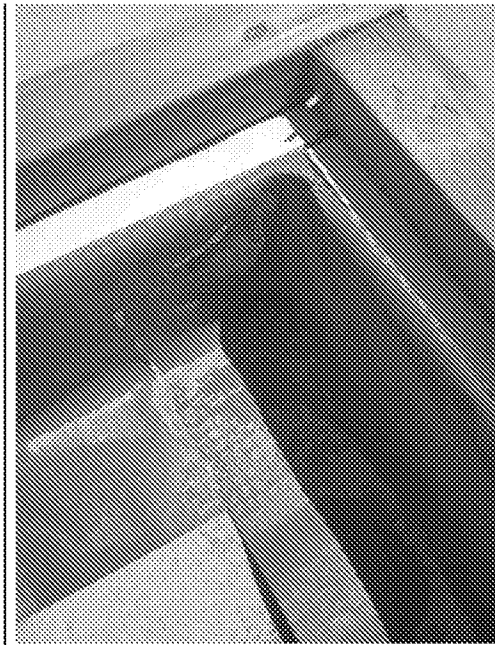
Plot 4 timber



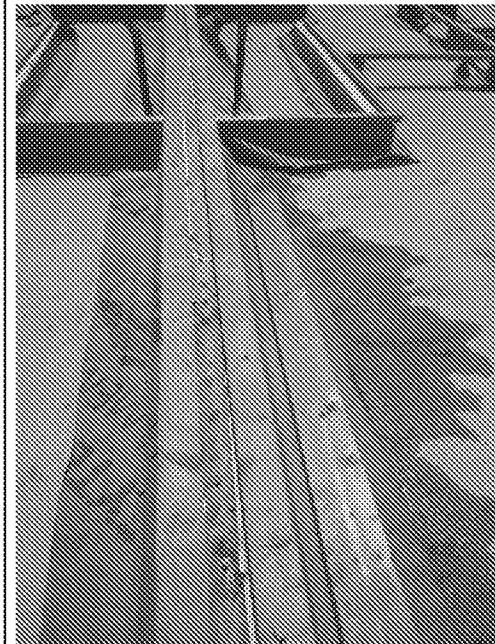
Plot 6 doorway



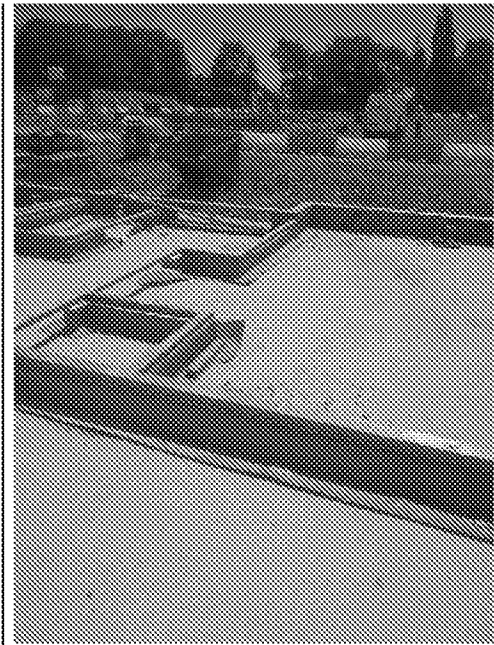
Plot 6 overview



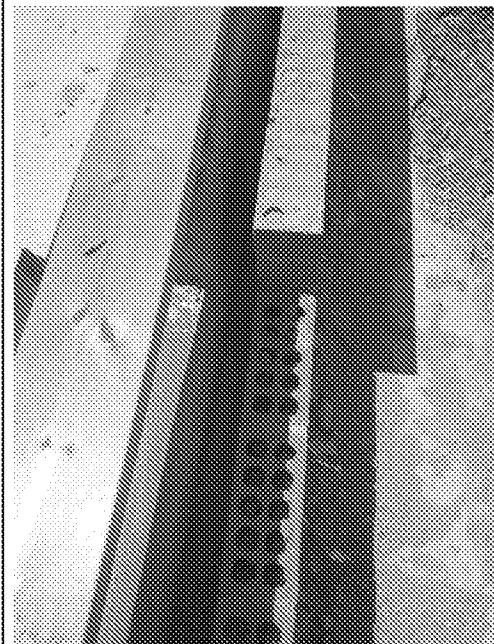
Plot 6 corner



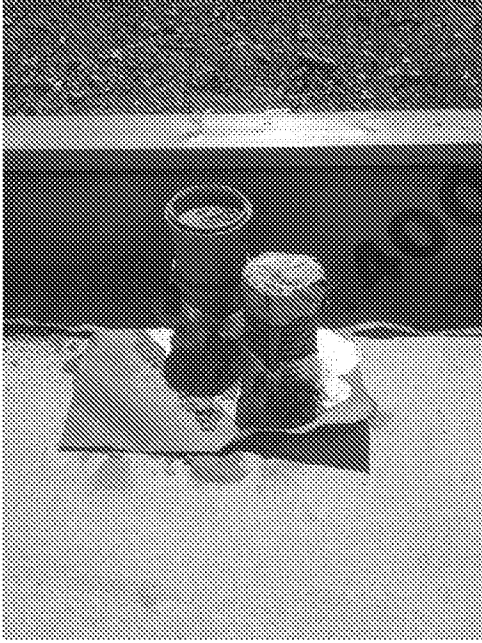
Plots 6 and 7



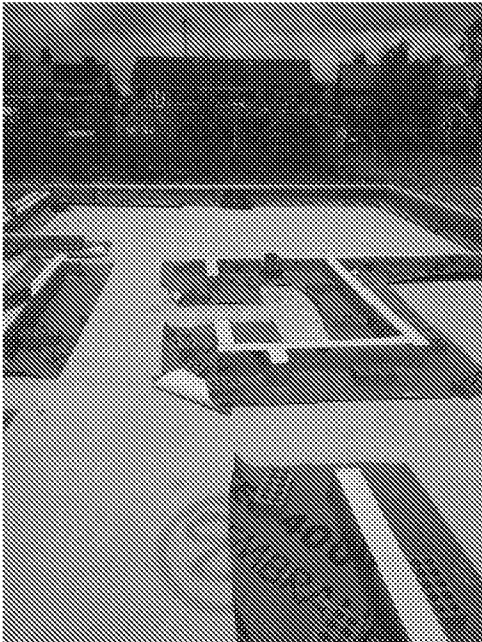
Plot 7 overview



Plot 7 cavity



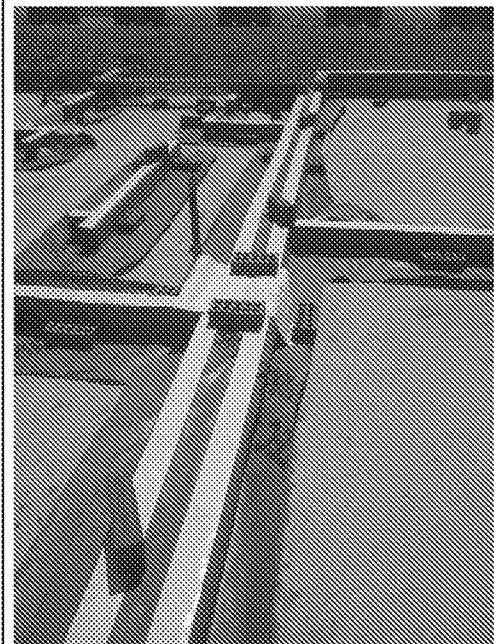
Plot 7 services



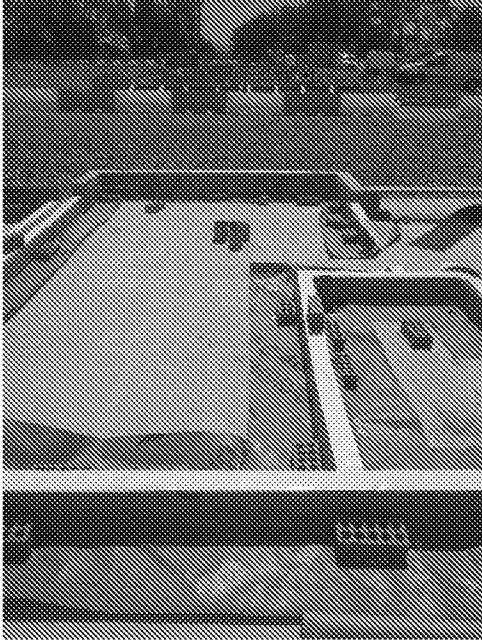
Plot 8 overview



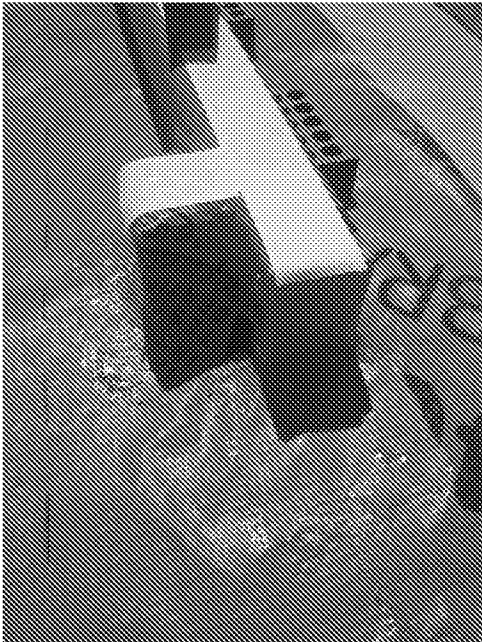
Plot 8 services



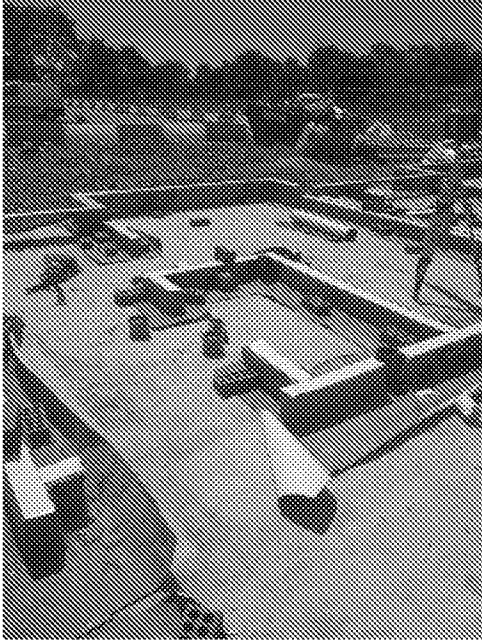
Plot 8 and 9



Plot 9 overview



Plot 9 corner



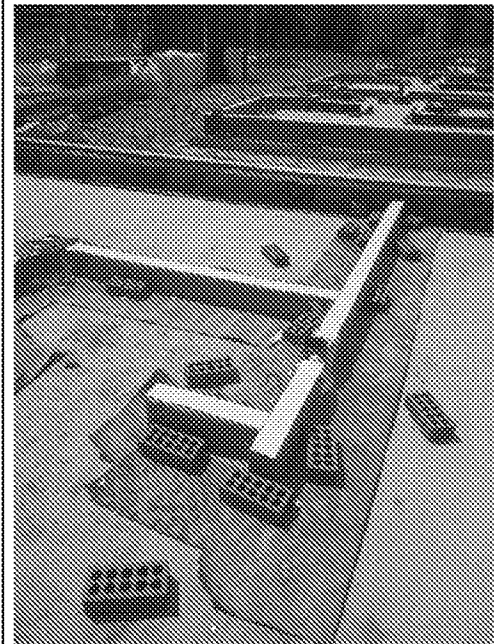
Plot 10 overview



Plot 10 wall



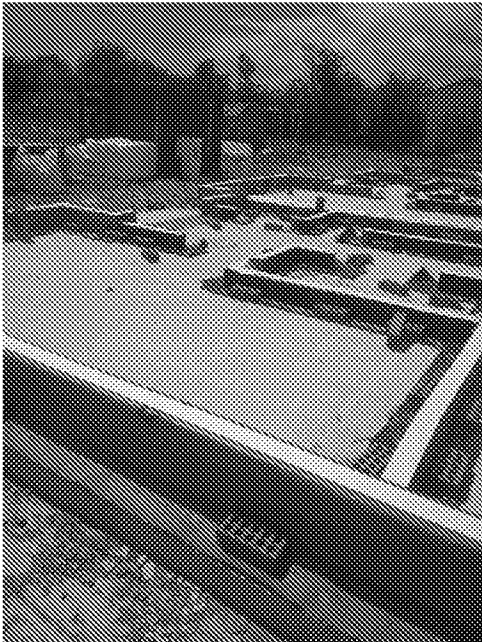
Plot 10 services



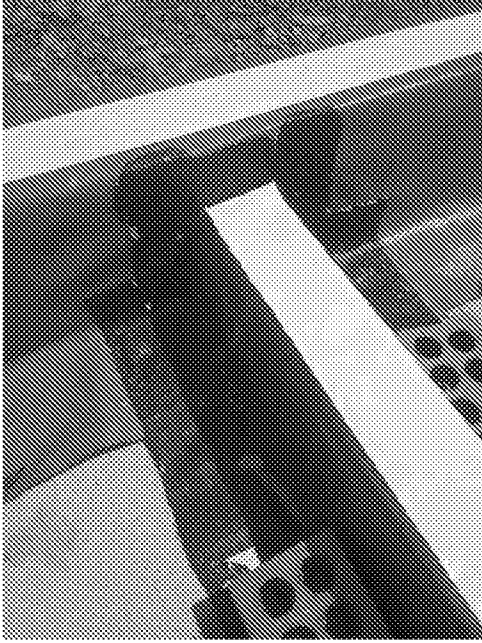
Plot 11 overview



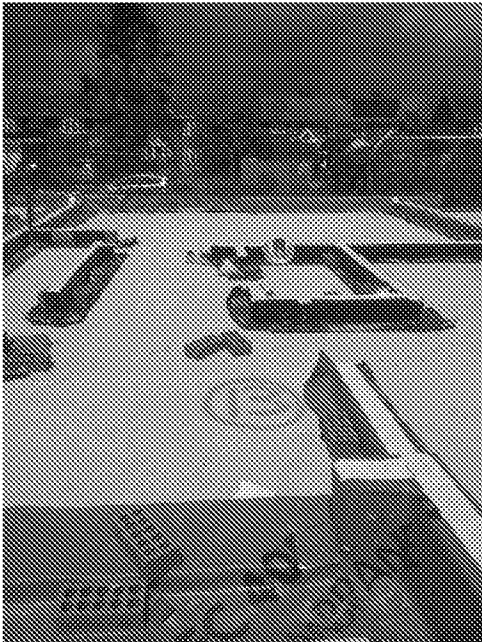
Plot 11 services



Plot 12 overview



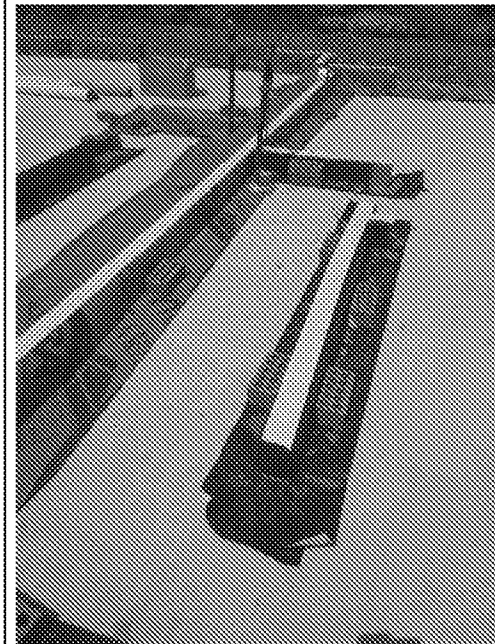
Plot 12 seal



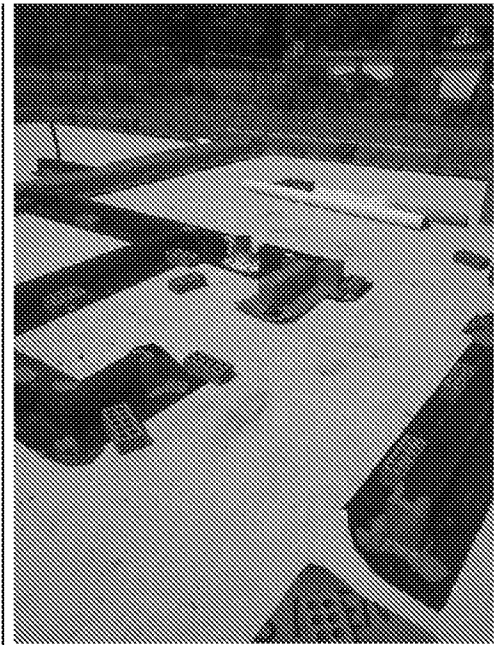
Plot 13 overview



Plot 13 corner



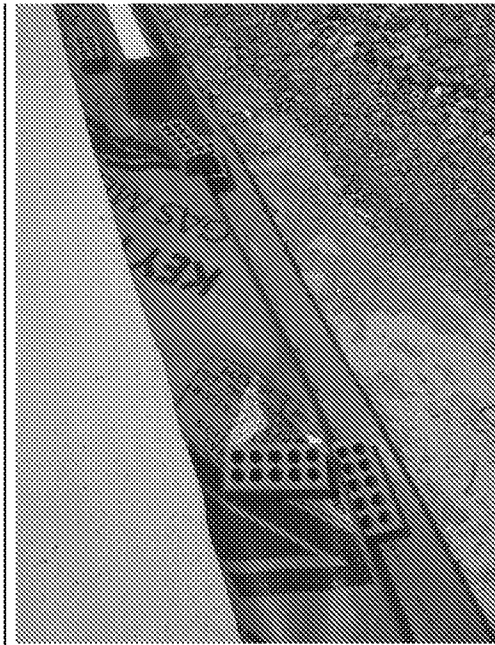
Plot 13 detail



Plot 14 overview



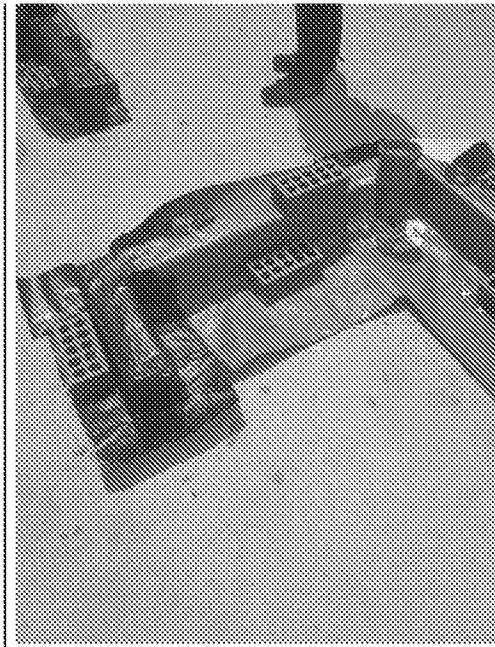
Plot 14 services



Plot 14 doorway



Plot 15 overview



Plot 15 corner

5. PASS/FAIL

The gas protection measures inspected: Are acceptable & comply with the specification

Details of issues

Approved by

 Fiona Goode

Date 02/07/2020

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[REDACTED]
Date	29/07/2020, 14:37
Site Engineer	[REDACTED]
 Fiona Goode	[REDACTED]
Weather at time of inspection	Sunny, breezy, warm
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Houses plot 1 detached and Plots 2-3 semi detached Flats Block A plots 60-65 Block B plots 66-77 lift pit skin only
Plot No.	Plots 1-3 (whole floor) and Block A (60-65) perimeter and Block B lift pit
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	☐ Venting ☒ Membrane ☐ Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Very clean
1.2 Gas membrane type	Keytec 400hp gas resistant membrane
1.3 Gas membrane condition	Good condition, some dust but generally clean
Jointing tape product	Heat sealed joints with double sided tape to seal services. Tape along brick and timber frame walls so no brick or other materials puncture membrane and where nails are driven through membrane tape forms a seal
1.5 Lapping design	150mm joints
1.6 Laps, welds and joints seals	All heat sealed joints some double sided tape on services and corners. Patch repairs heat sealed
1.7 Service seals	All well sealed with site formed taped seals

4. PHOTOGRAPHS

Photographs

(24 records)

Photograph	Photograph Title



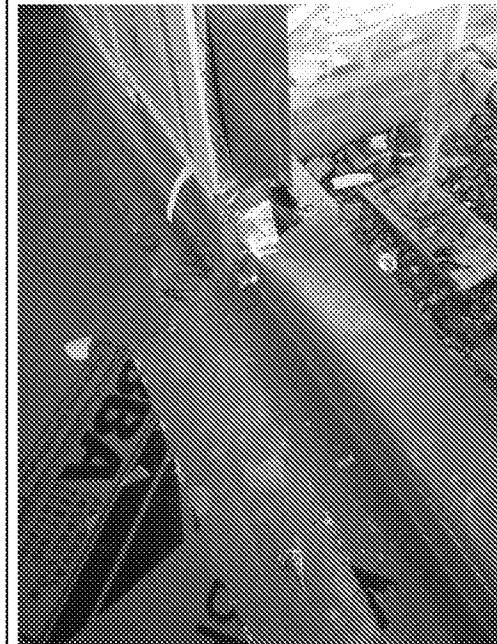
Plot 1 services



Plot 1steel



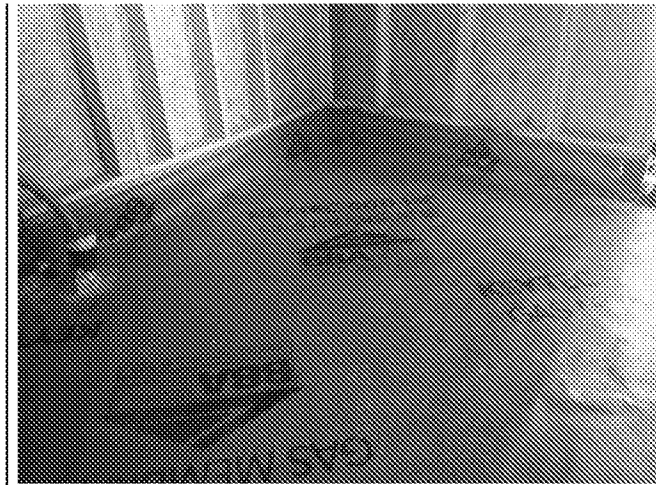
Plot 1 seals



Plot door threshold



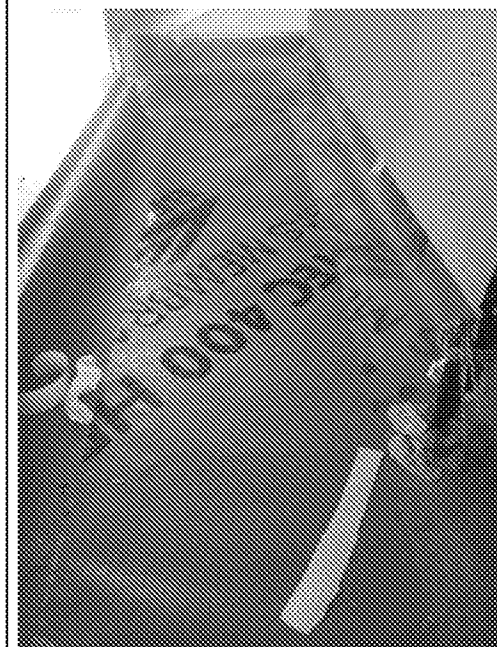
Plot 1 stairwell



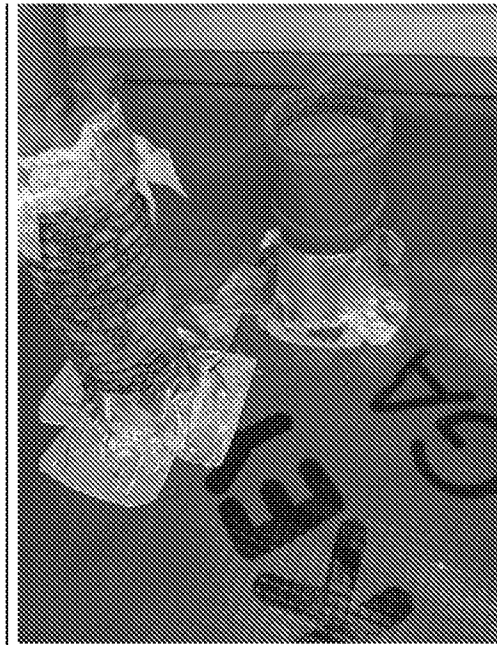
Plot 1 overview



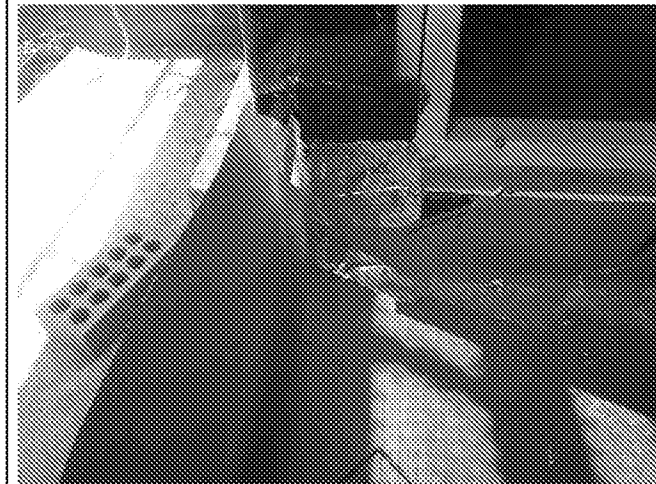
Plot 2 overview



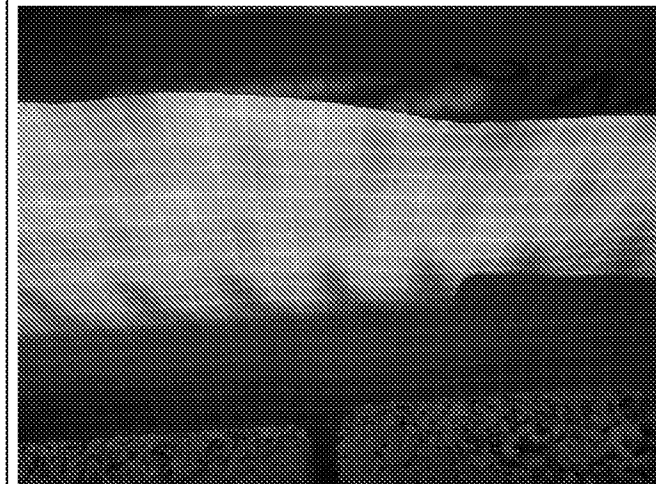
Plot 2 under stairs



Plot 2 services



Plot 2 details



Plot 2 underside