Geo-Environmental

VERIFICATION REPORT

for PLOTS 24-29 (SOIL COVER SYSTEMS) &

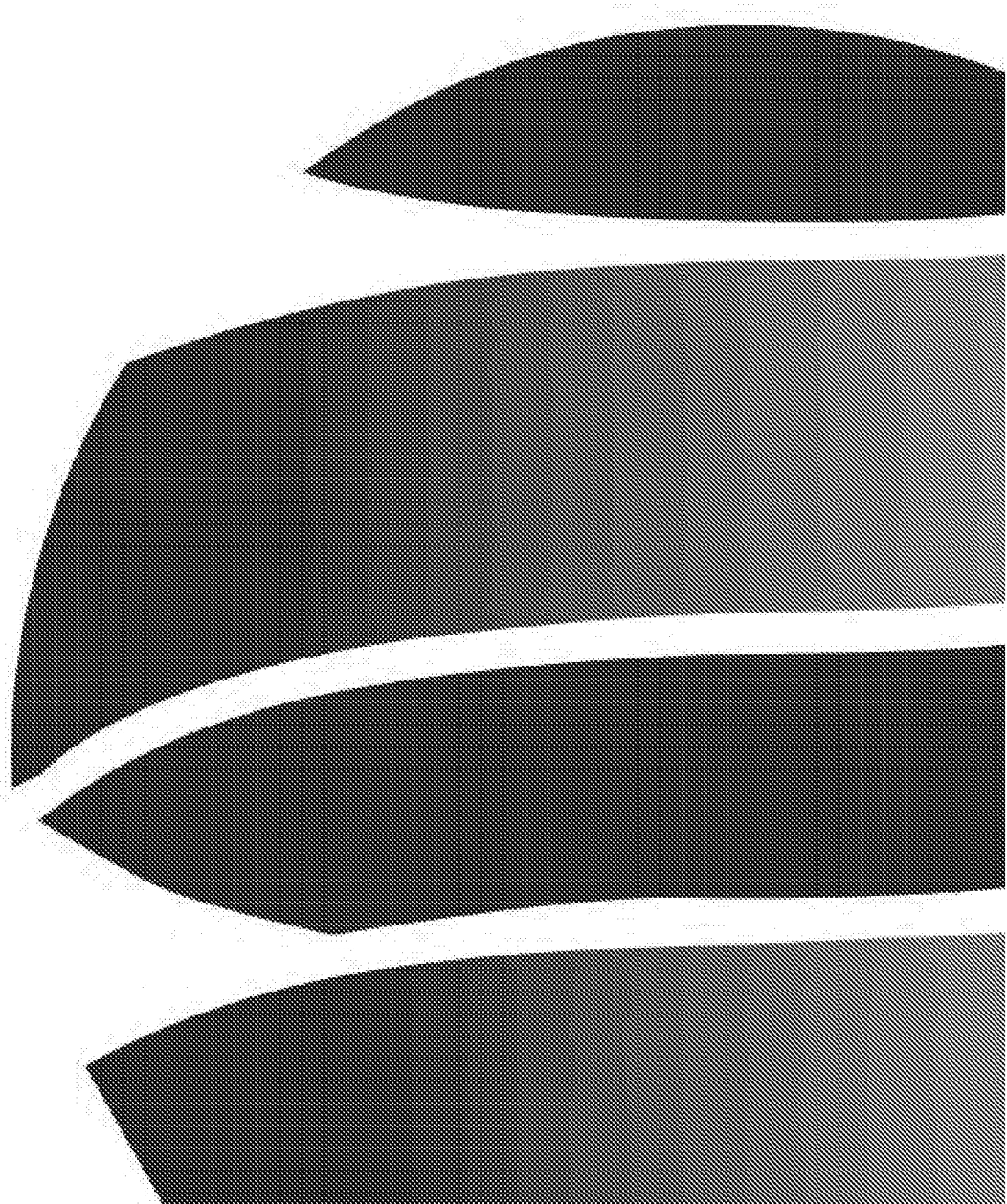
ALL PLOTS (GROUND GAS) AT

CORNFIELD CLOSE, LITTLEHAMPTON,

WEST SUSSEX, BN17 6LD

on behalf of

THAKEHAM CLIENT LTD



ARUN DISTRICT COUNCIL LU/192/21/DOC

Report:	**VERIFICATION REPORT**
Site:	**PLOTS 24-29 (SOIL COVER SYSTEM) & ALL PLOTS (GROUND GAS) AT CORNFIELD CLOSE, LITTLEHAMPTON, WEST SUSSEX, BN17 6LG**
Client:	**THAKEHAM CLIENT LTD**
Date:	**01/06/2021**
Reference:	**GE18103/VR/PLOTS 24-29 (Soil) & All Plots (Gas)/JUN21**
Version:	**1.0**
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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author's initials	Reviewed by	Authorised by
1.0	01/06/2021	First issue for compiled report for Plots 24-29 (Validation for Plots 1-15 (gas protection measures, soil cover system and groundwater), have previously been issued under separate cover, report ref: GE18103/VR/JAN21, Validation for Plots 16-59, Blocks A and B (gas protection measures) issued under report ref: GE18103/VR-GAS/APR21, Validation for Plots 36-39 (soil cover system) issued under report ref: GE18103/INTVR/MAR21, Validation for Plots 40-41 (soil cover system) issued under report ref: GE18103/INTVR/PLOTS40-41/MAR21, and Validation for Plots 30-35 and 42-43 (soil cover) and All Plots (gas) issued under report ref: GE18103/VR/Plot 30-35 & 42-43 (Soil) & all Plots (Gas)/APR21)	FG	LL	SA

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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 Quality Monitoring Plan (WQMP), referenced GE18103/WQMP/NOV19, Geo-Environmental Services Limited ('Geo-Environmental') was instructed by 'the client' Thakeham Client Ltd to prepare a Verification Report to compile the relevant information in relation to the residential development for Plots 24-29, Cornfield Close, Littlehampton, West Sussex, BN17 6LG, herein referred to as 'the site' (see Figure 1).

This report relates specifically to the installation and validation of remedial measures within Plots 24-29 in relation to soft landscaping validation and generally to all Plots across the site in relation to gas protection validation inspections. At the time of reporting, private gardens and areas of soft landscaping on further Plots on site have either been reported under separate cover or were not ready for final validation inspections and will be validated within a separate verification (or an updated) report in due course.

Previous phases of validation works onsite have already been undertaken and reported for the site under GE18103/VR/JAN21, which presented the validation of ground gas protection measures and soil cover systems associated with Plots 1-15 and groundwater analysis and controlled water requirements for the whole site, GE18103/VR-GAS/APR21, which presented the validation of ground gas protection measures for Plots 16-59 and Block A and B, GE18103/INTVR/MAR21, which presented the validation of the soil cover system installed within Plots 36-39 only, GE18103/VR-PLOTS40-41/MAR21, which presents the validation of the soil cover system installed within Plots 40-41 only and GE18103/VR/PLOTS 30-35 & 42-43 (Soil) & All Plots (Gas)/APR21, which presents the validation of the soil cover system installed within Plots 30-35 and 42-43 only and the ground gas protection measures installed within all Plots. This report details and compiles all the works undertaken in relation to the installation of a soil cover system in Plots 24-29 completed in May 2021, and all works in relation to gas validation inspections for all Plots across the site.

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 24-29 only.

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 to Plots 24-29 in relation to soils and for all Plots across the site in relation to gas risk in order to demonstrate that the gas risk and soil risk mitigation measures were implemented within these specific Plots.

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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.

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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.

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- 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 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.

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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 Geoembranes Limited. Independent verification of gas protection measures at various stages of development with respect to all Plots across the site were undertaken by Geo-Environmental on behalf of Thakeham Client Ltd, and included several inspection visits undertaken between June 2020 and March 2021, details of which are presented below:

- 11th June 2020 (Plots 1-2 perimeter);
- 2nd July 2020 (Plots 2-15 perimeter);
- 13th July 2020 (Plots 22-27 and 36-43 perimeter);
- 29th July 2020 (Plot 1-3 whole floor area, and Block A perimeter);
- 5th August 2020 (Plots 22-28 perimeter);
- 10th August 2020 (Plots 4-5 whole floor area);
- 13th August 2020 (Plots 6-7 whole floor area, and Plots 24-33 perimeter);

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- 25th August 2020 (Plots 8-10 whole floor area – Plot 11 in progress, and Plots 24-35 perimeter (reinspection));
- 10th September 2020 (Plots 12-13 whole floor area – Plots 14-15 in progress, and Plots 20-21 perimeter);
- 2nd October 2020 (Plots 36-37 whole floor area, Plots 38-39 in progress);
- 15th October 2020 (Plots 40-42 whole floor area, Plot 43 in progress);
- 29th October 2020 (Plots 32-34 whole floor area, Plot 35 in progress);
- 12th November 2020 (Plots 28-31 whole floor area);
- 19th November 2020 (Plots 24-27 whole floor area);
- 26th November 2020 (Plots 16-17 whole floor area);
- 3rd December 2020 (Plots 18-19 whole floor area);
- 10th December 2020 (Plots 20-21 whole floor area);
- 17th December 2020 (Plots 22-23 whole floor area);
- 21st January 2021 (Plots 47-49 whole floor area);
- 26th January 2021 (Plots 44-45 and Block A whole floor area (flats), Plot 46 in progress);
- 11th February 2021 (Plots 50-53 whole floor area);
- 25th February 2021 (Plots 54-57 whole floor area);
- 11th March 2021 (Plots 58-59 whole floor area);
- 17th March 2021 (Block A (corridor and stairwell and Block B);
- 26th March 2021 (Block A (corridor and stairwell and Block B - reinspection)

Plots 1-59

Plots 1-59 comprised detached, 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 terraced, 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 and unbranded black Juta GP1 gas resistant 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 1-59 comprised:

- Keytec 400 HP – self branded purchased from Juta;
- Unbranded black Juta GP1 gas resistant membrane;
- 301483 Foil Band 150mm width/ 1.5mm thickness/ 10m length – Aluminium heat weld membrane tape.

Block A and Block B

Block A and Block B comprised a series of apartment flats. Floor construction throughout this block comprised a piled foundation with 225mm reinforced concrete slab above. A gas resistant membrane was installed directly on

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top of the reinforced concrete slab. The membrane was installed around the perimeter of the block so as to go directly over external walls to ensure the cavity was sealed. Where party walls were located between masonry apartments 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 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 and unbranded black Juta GP1 gas resistant 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 Block A and Block B comprised:

- Keytec 400 HP – self branded purchased from Juta;
- Unbranded black Juta GP1 gas resistant membrane;
- 301483 Foil Band 150mm width/ 1.5mm thickness/ 10m length – Aluminium heat weld membrane tape.

Advice was given to the site manager/s on a number of visits (13/08/19, 26/01/21, and 17/03/21) in relation to ensuring that the floor surfaces were swept and cleared of any debris and materials prior to membrane installation, that any holes or damage was repaired either using tape or with a patch repair, and following the installation of the membrane no materials or equipment should be placed directly on top of the membrane and it should be swept clean and then covered prior to the floor screed installation to prevent any damage to the membrane. Thakeham (the Client) confirmed that action to rectify any damage and to fully seal the membrane, where areas requiring further work were identified, had been completed, and this was confirmed by either client photographs (Plot 46) or by an engineer from Geo-Environmental with subsequent follow up inspection visits (25/08/20 and 26/03/21).

The gas membrane installation for Plots 1-59, Block A and Block B, were inspected by Geo-Environmental on several occasions to observe and record that the measures installed complied with the requirements as set out within the RSVP. The proposed floor construction detail drawing including the gas membrane detail for the houses and the flats 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 entire membrane installation was not fully completed within Plots 11, 14-15, 35, 38-39, 43 and 46 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. Geo-Environmental has viewed these photos and the membrane installation appears to be in-line with the installation undertaken with the completed Plots independently inspected by Geo-Environmental. As such, Geo-Environmental are satisfied that the membrane installation at the point of inspection was suitable and that the client provided photographs are satisfactory. These photographs are presented within Appendix C.

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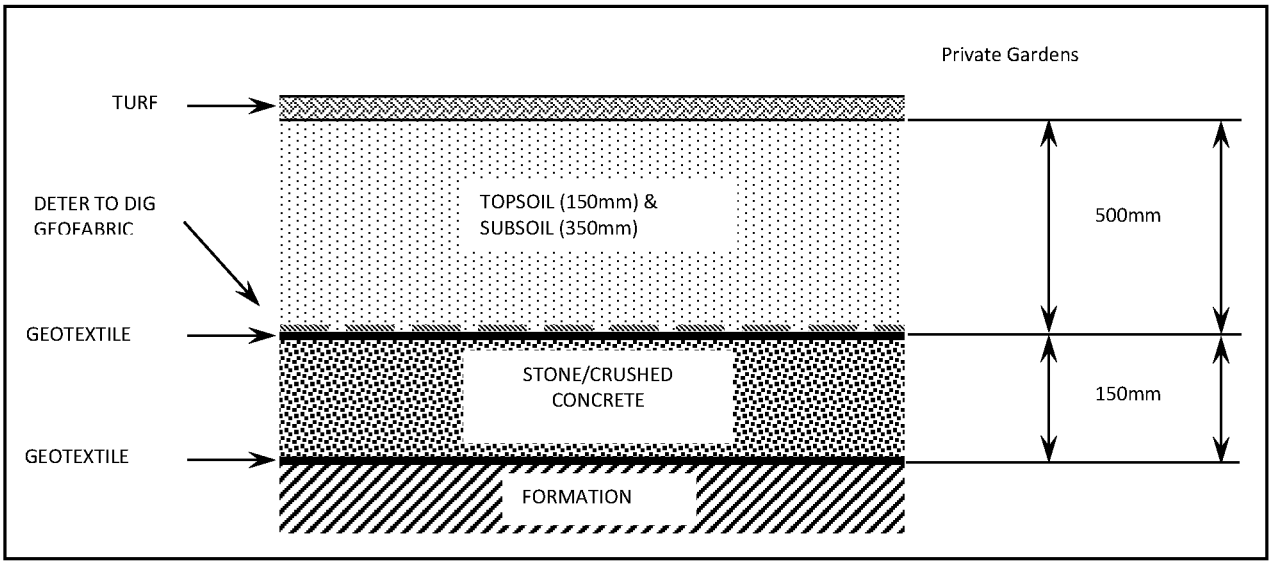
4.0 SOILS

4.1 End Users (Shallow Soils)

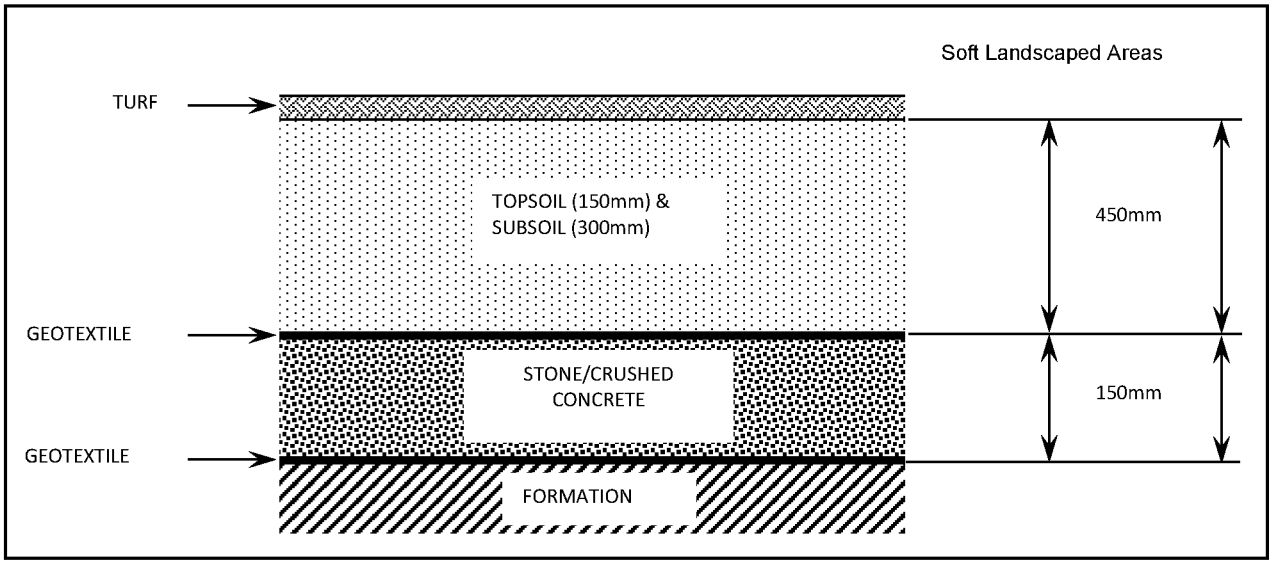
With reference to report Ground Appraisal Report for the site GE17106 - GAR/AP01/231018, through a process of statistical analyses on the results of chemical analyses on both deeper and near surface soil samples, it was considered that the near surface soils were impacted by Lead, Arsenic, PCBs, SVOCs, 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 required that the Made Ground be removed and/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 150m 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 24-29)

The chain of custody (COC) delivery certificates for Topsoil materials imported into site for use within Plots 24-29 were provided by to Geo-Environmental by Thakeham (the Client) and/or Bell (the Groundworks Contractor), copies of which are presented within Appendix D. Geochemical analysis was provided for the source site for the subsoil and Topsoil materials prior to importation to site. A copy of this analysis is also presented in Appendix D. It should be noted that the soil cover system was comprised of both subsoil and Topsoil within Plots 25-29 and the entirety of the soil cover system within Plot 24 was formed of Topsoil.

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 24-29. The results of this independent validation analysis testing are presented in Appendix F detailed and detailed and discussed within Section 6 of this report.

6.0 INSPECTION/VALIDATION (SOILS)

6.1 Validation inspection of subsoil and Topsoil and sampling of subsoil and Topsoil (cover system) placement associated within private gardens (Plots 24-29)

The inspection/validation works of the cover systems installed within the private gardens were undertaken by a Geo-Environmental Engineer on 27th April and 19th May 2021. The visual inspection records including site photographs and hand pit logs are presented in Appendix E.

Inspection Visit 27th April 2021

Inspection comprised six independent shallow hand pits (Plot 24, Plot 25, Plot 26, Plot 27, Plot 28, and Plot 29) which were excavated by the ground workers under the supervision of an engineer from Geo-Environmental within the rear garden areas of Plots 24-29 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 of the rear garden areas at the time of the inspection.

The inspection confirmed that in hand pits Plot 25, Plot 26, Plot 27, Plot 28 and Plot 29 a deter-to-dig Geo-textile type membrane was present beneath the subsoil. However it was not possible to locate the deter-to-dig membrane within the hand pit excavated within Plot 24 as the crushed capillary barrier was encountered within the base of the pit. It was therefore assumed that the membrane was not present beneath the rear garden area of this Plot, however the presence of a crushed physical barrier was confirmed within the excavated pit. Subsoil was present within Plots 25-27 and Plot 29 and was found between 430mm and 550mm in thickness. Topsoil was found to be between 150mm and 200mm in thickness within hand pits excavated in Plots 25-27 and Plot 29. Plots 24 and 28 were found to have a soil cover system comprised entirely of Topsoil and this Topsoil was found to be 600mm in thickness in both Plots. Geo-Environmental were informed by the groundworkers and the Thakeham site manager(s) that a capillary break layer was installed beneath the deter-to-dig membrane, however independent validation of this element was not undertaken by Geo-Environmental. It is understood that Thakeham have photographs of the placement of the capillary break layer but they have not be provided to Geo-Environmental for inclusion to date.

Six soil samples, referenced Plot 24 at 0.3m bgl, Plot 25 at 0.6m bgl, Plot 26 at 0.1m bgl, Plot 27 at 0.4m bgl, Plot 28 at 0.5m bgl, and Plot 29 at 0.1m bgl 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 C.

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 5.1 below:

Determinand	Soil Screening Value (mg/kg)	Sample Max. Conc. (mg/kg)	Below Screening Value?
Arsenic	37	17.1	Yes
Benzo(a)pyrene	2.7	1.4	Yes
Beryllium	1.7	<1.0	Yes
Boron (Water Soluble)	290	1.1	Yes
Cadmium	11	<0.5	Yes
Chromium (Total)	130	33.6	Yes

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Determinand	Soil Screening Value (mg/kg)	Sample Max. Conc. (mg/kg)	Below Screening Value?
Copper	2400	44.3	Yes
Hexavalent Chromium	6	<0.8	Yes
Lead	200	285	No
Mercury (inorganic)	40	<0.5	Yes
Nickel	180	19.7	Yes
Phenols	110	<6	Yes
Selenium	250	<1.0	Yes
Total Petroleum Hydrocarbons	110	94	Yes
Vanadium	410	49.0	Yes
Zinc	3700	152	Yes

Table 5.1 Summary of chemical analyses (Plots 24-29 Inspection Visit 27/04/2021)

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.

The results indicated that out of the six samples collected and analysed 1No. sample from Plot 24 demonstrated elevated concentrations of Lead that were greater than the screening criteria for a residential end use with plant uptake. As such it was required that that the imported Topsoil from the entire rear garden area of Plot 24 be removed and an alternative Topsoil imported that was proven to be chemically suitable. Waste disposal certificates have been requested by Geo-Environmental from the client but have not been received to date.

A further three validation samples from Plots 24-29, Plot 25 at 0.1m bgl, Plot 26 at 0.3m bgl and Plot 29 at 0.6m bgl, were 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 5.2 below:

ARUN DISTRICT COUNCIL LU/192/21/DOC

Parameters	Limits for Multipurpose Topsoil	Sample Range	Within acceptable Limits?
Maximum Coarse Fragment Content (%) Stones >2mm Stones > 20mm Stones >50mm	 30 10 0	 21 5 <1	Yes
Mass loss on ignition % Clay 5% to 20%	 3 to 20	 3.13-4.42	Yes
Soil pH	5.5 to 8.5	7.4-8.1	Yes
Plant nutrient content Total nitrogen % Extractable phosphate mg/l Extractable potassium mg/l Extractable magnesium mg/l	 >0.15 16 to 140 121 to 1500 51 to 600	 0.11-0.15 65-91 105-185 55-95	 Results are <0.15% total for Nitrogen One result for Potassium is <121mg/l
Carbon:nitrogen ratio	<20:1	16:2-17:7	Yes
Electrical conductivity µS·cm	<3300	2470-2660	Yes
Potentially Phytotoxic Elements Zn mg/kg Cu mg/kg Ni mg/kg	 <200 <135 <75	 73.4-152 22.9-44.3 14.7-19.7	Yes
Visible contaminants % m/m …of which plastics	 <0.5 <0.25	 <0.01 <0.01	Yes

Table 5.2 Summary of BS8332 Topsoil Analysis (Plots 24-29, Inspection Visit 27/04/2021)

The results demonstrate that the Topsoil soils analysed are in accordance with BS3882:2015 Multipurpose Topsoil, with the exception of a slight shortfall in total Nitrogen and Potassium. It may therefore be necessary to add a nitrogen based fertiliser to the Topsoil within Plots 24-29 prior to the laying of turf to increase the nitrogen levels to provide a suitable growing medium. However, these soils would still be considered to be suitable as a low fertility topsoil.

Inspection Visit 19th May 2021

Following the removal of the Lead impacted Topsoil from Plot 24 and subsequent replacement, Geo-Environmental were requested to reinspect the garden area of Plot 24 on 19th May 2021.

Re-inspection comprised one independent shallow hand pits (Plot 24 (2)) which was excavated by the ground workers under the supervision of an engineer from Geo-Environmental within the rear garden area of Plots 24 to confirm the presence of a geo-textile type membrane and the thickness of the soil cover system. The location of this hand pit 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 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 the rear garden area at the time of the inspection.

The inspection confirmed that within the hand pit in Plot 24 a deter-to-dig Geo-textile type membrane was present beneath the Topsoil. A Geo-textile membrane had not previously been encountered within the rear garden of Plot 24. Following the necessary removal of the identified impacted Topsoil the groundworkers took the opportunity to install a Geo-textile membrane beneath the replacement Topsoil. The soil cover system within Plot 24 was comprised entirely of Topsoil and this Topsoil was found to be 600mm in thickness. Geo-Environmental were

ARUN DISTRICT COUNCIL LU/192/21/DOC

informed by the groundworkers and the Thakeham site manager(s) that a capillary break layer was installed beneath the deter-to-dig membrane, however independent validation of this element was not undertaken by Geo-Environmental. It is understood that Thakeham have photographs of the placement of the capillary break layer but they have not be provided to Geo-Environmental for inclusion to date.

One soil sample of the replacement topsoil, referenced Plot 24 (2) at 0.15m bgl, was collected and 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 C.

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 5.3 below:

Determinand	Soil Screening Value (mg/kg)	Sample Max. Conc. (mg/kg)	Below Screening Value?
Arsenic	37	25.5	Yes
Benzo(a)pyrene	2.7	0.5	Yes
Beryllium	1.7	<1.0	Yes
Boron (Water Soluble)	290	1.1	Yes
Cadmium	11	<0.5	Yes
Chromium (Total)	130	28.5	Yes
Copper	2400	34.9	Yes
Hexavalent Chromium	6	<0.8	Yes
Lead	200	122	Yes
Mercury (inorganic)	40	<0.5	Yes
Nickel	180	15.4	Yes
Phenols	110	<6.0	Yes
Selenium	250	<1.0	Yes
Total Petroleum Hydrocarbons	110	8.9	Yes
Vanadium	410	41.3	Yes
Zinc	3700	124	Yes

Table 5.3 Summary of chemical analyses (Plot 24 Inspection Visit 19/05/2021)

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

A further validation sample from Plots 24 at 0.45m bgl, was 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 5.4 below:

ARUN DISTRICT COUNCIL LU/192/21/DOC

Parameters	Limits for Multipurpose Topsoil	Sample Range	Within acceptable Limits?
Maximum Coarse Fragment Content (%) Stones >2mm Stones > 20mm Stones >50mm	 30 10 0	To Follow	
Mass loss on ignition % Clay 5% to 20%	 3 to 20	 4.72	Yes
Soil pH	5.5 to 8.5	7.8	Yes
Plant nutrient content Total nitrogen % Extractable phosphate mg/l Extractable potassium mg/l Extractable magnesium mg/l	 >0.15 16 to 140 121 to 1500 51 to 600	 0.16 115 209 89	Yes
Carbon:nitrogen ratio	<20:1	17.3	Yes
Electrical conductivity µS·cm	<3300	2480	Yes
Potentially Phytotoxic Elements Zn mg/kg Cu mg/kg Ni mg/kg	 <200 <135 <75	 124-128 34.9-35.9 14.9-15.4	Yes
Visible contaminants % m/m …of which plastics	 <0.5 <0.25	 <0.01 <0.01	Yes

Table 5.4 Summary of BS8332 Topsoil Analysis (Plots 24, Inspection Visit 19/05/2021)

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

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7.0 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 (to the best of our knowledge). However, the strategy remains in place for the remainder of the development works.

ARUN DISTRICT COUNCIL LU/192/21/DOC

8.0 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 24-29, 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 have been or will be reported via an updated report or under separate cover in due course.

Please be aware that the independent inspection and validation of gas protection measures installed, presented within this report relates to the works undertaken up to the point of inspection. Geo-Environmental accepts 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.

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. However, 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 24-29.

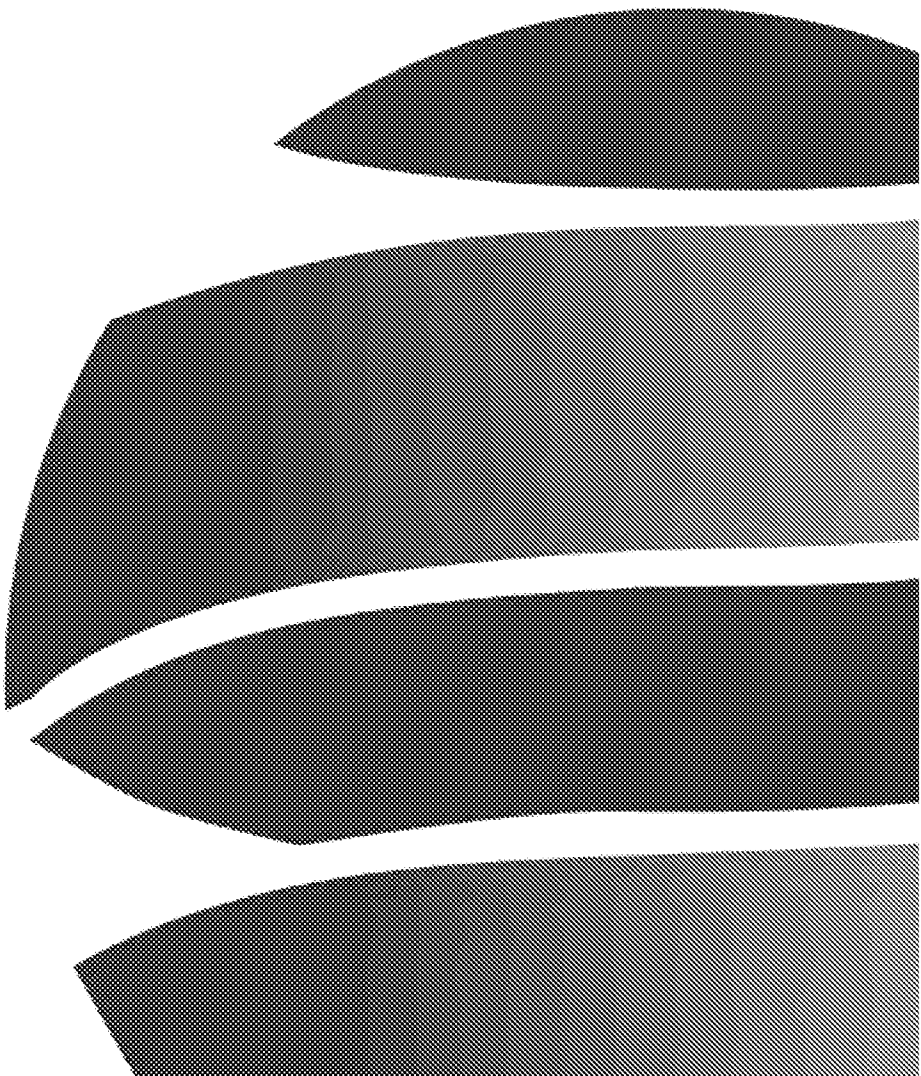
Geo-Environmental can only verify the installation of a cover system at the locations and depths inspected at the time of inspections. Geo-Environmental accepts no liability for areas that have not been directly inspected or works that have subsequently been undertaken on the site following our inspection 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 soil cover system remedial measures installed within Plots 24-29, and also generally to the ground gas remedial measures installed within all Plots across the site. Validation with respect to the soil cover systems to be installed within remaining Plots will be presented under separate cover in due course.

ARUN DISTRICT COUNCIL LU/192/21/DOC

Geo-Environmental

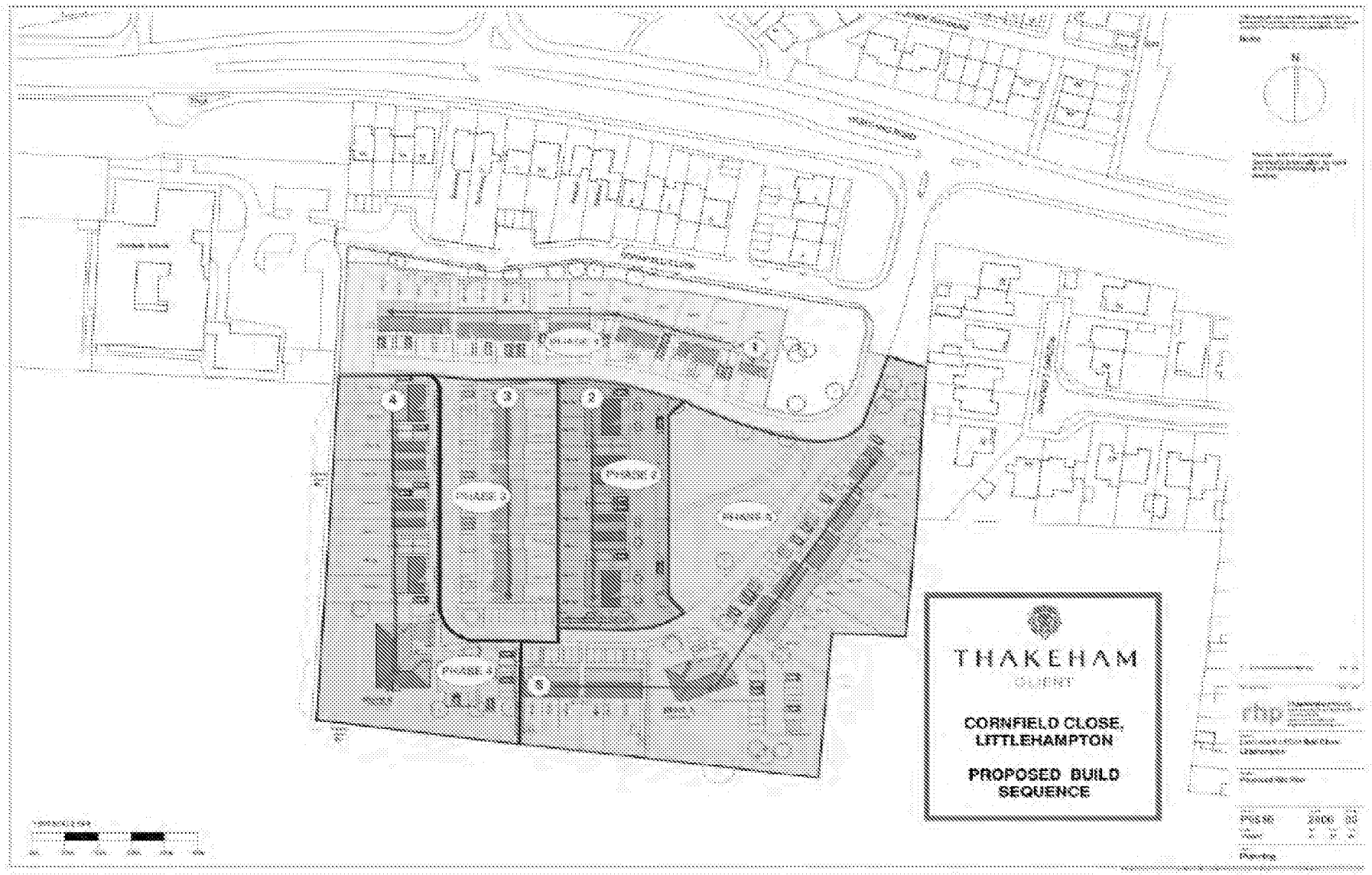
FIGURES





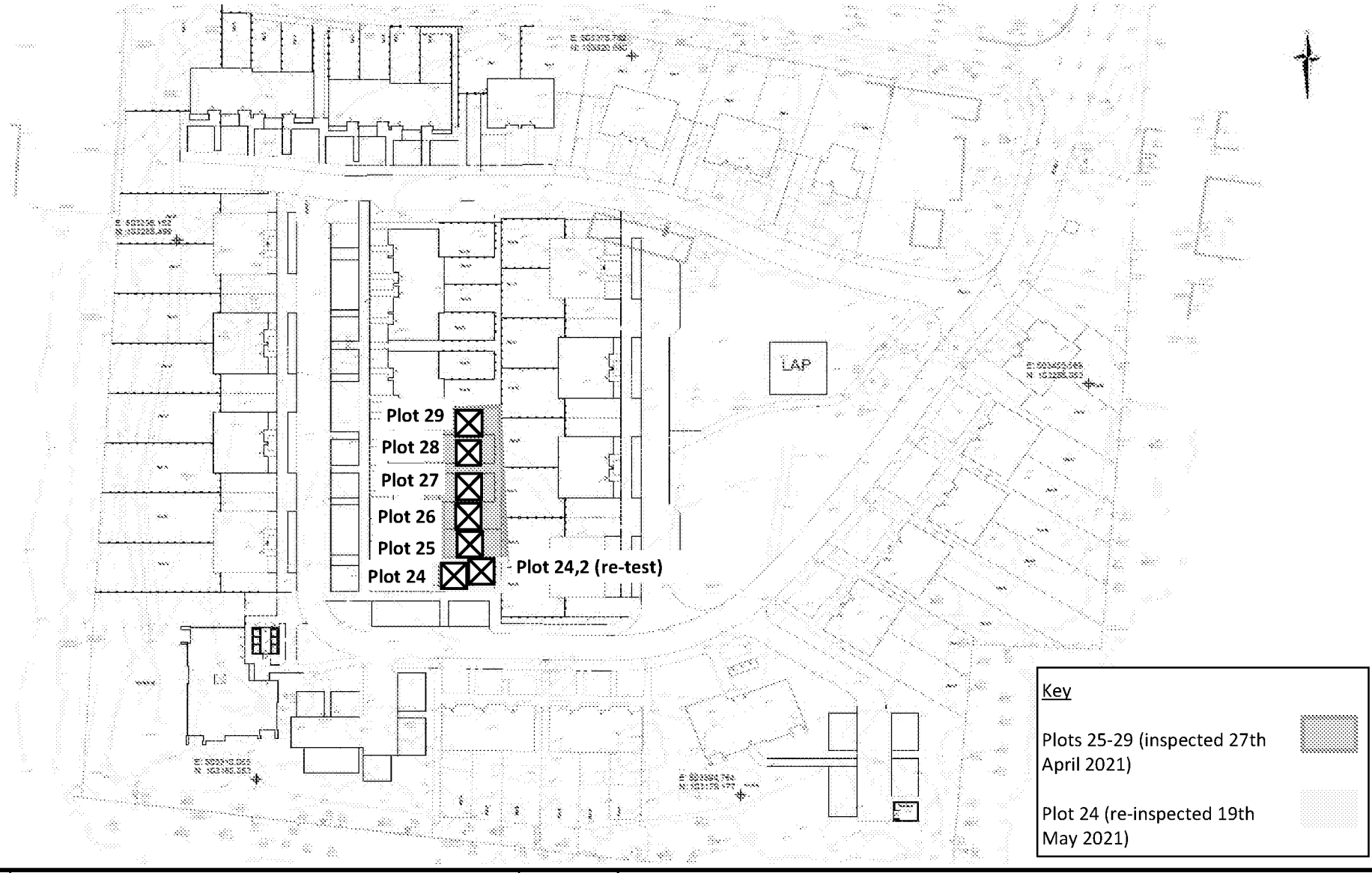
Project:	Cornfield Close, Littlehampton, West Sussex			**Title**	Site Location Plan
Client:	Thakeham Homes			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE18103	**Revision:**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

ARUN DISTRICT COUNCIL LL/132/21/DOC



Project:	Cornfield Close, Littlehampton, West Sussex			**Title**	Site Development Phasing Plan (Phase 1-5)
Client:	Thakeham Homes			**Geo-Environmental Services Ltd**	
Ref No:	GE18103	**Revision:**	0	**Unit 7 Danworth Farm, Cuckfield Road**	
Drawn:	LL	**Date:**	01/10/2019	**Hurstpierpoint, West Sussex BN6 9GL**	
Figure:	2	**Scale:**	Not To Scale	**+44(0)1273 832972 www.gesl.net**	Geo-Environmental

ARUN DISTRICT COUNCIL LU/132/21/DOC



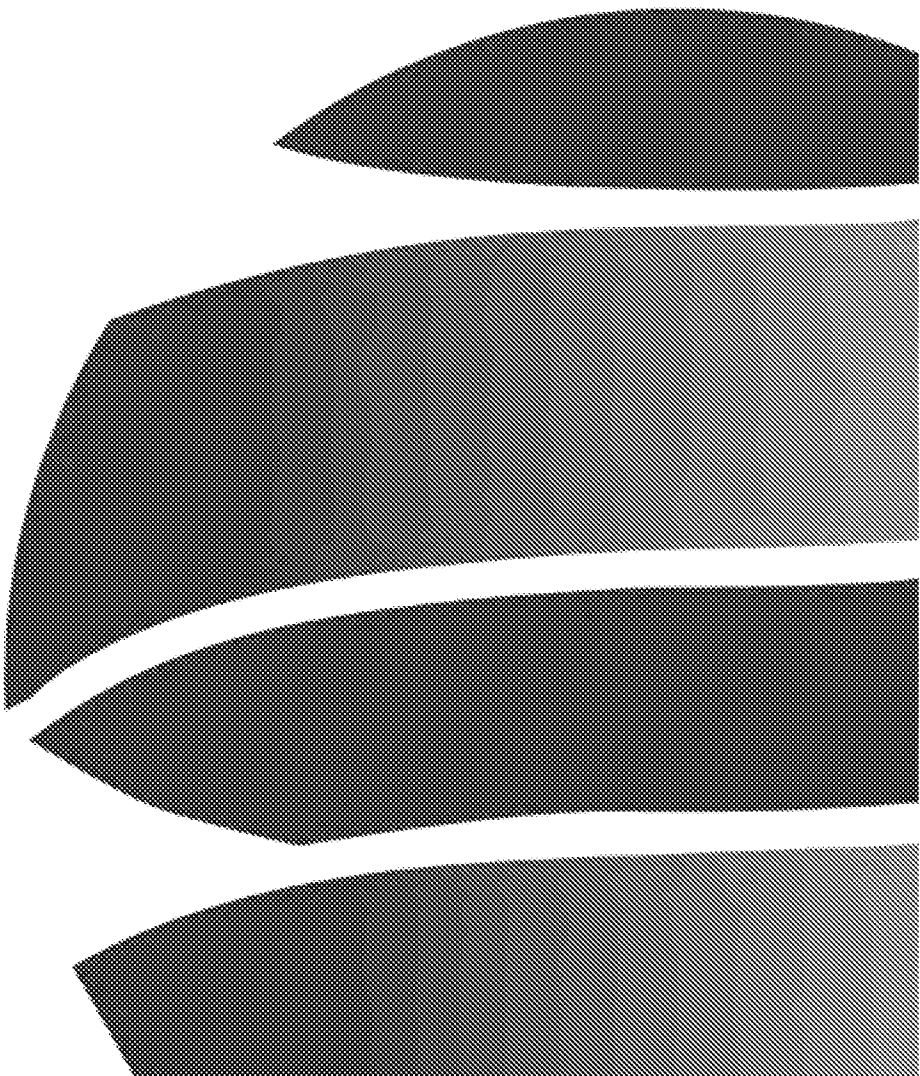
Project:	Cornfield Close, Littlehampton, West Sussex			**Title**	Validation Sample Location Plan (Plots 24-29)
Client:	Thakeham Homes			**Geo-Environmental Services Ltd**	
Ref No:	GE18103	**Revision:**	0	**Unit 7 Danworth Farm, Cuckfield Road**	
Drawn:	FG	**Date:**	01/06/2021	**Hurstpierpoint, West Sussex BN6 9GL**	
Figure:	3	**Scale:**	Not To Scale	**+44(0)1273 832972 www.gesl.net**	Geo-Environmental

ARUN DISTRICT COUNCIL LU/132/21/DOC

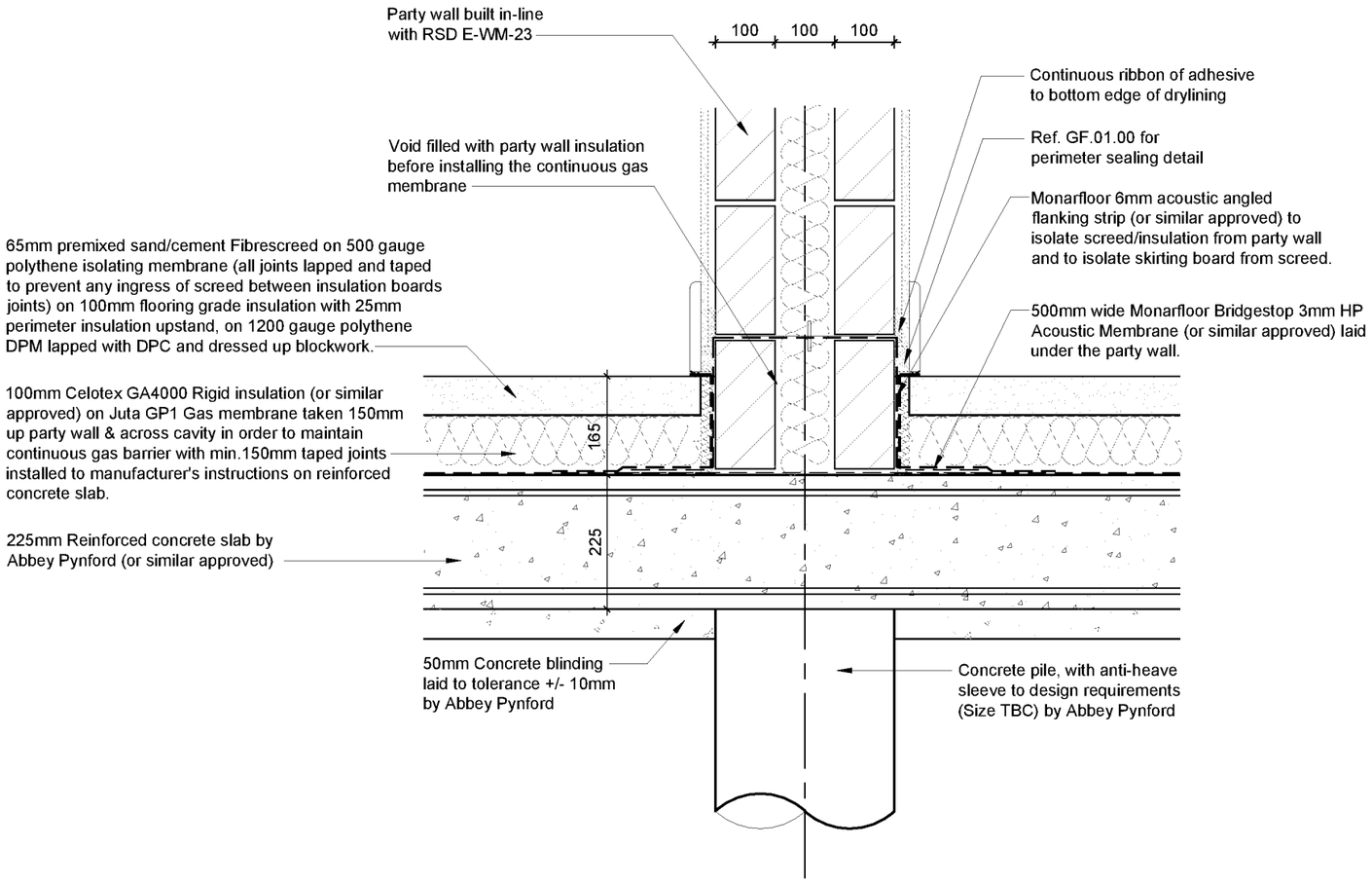
Geo-Environmental

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)

CONSTRUCTION

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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)

REV	DATE	DESCRIPTION	INITIAL	CHECKED
C03	19.12.19	DETAIL UPDATED TO SUIT GAS MEMBRANE COMMENTS.	AJH	CD
C02	09.10.19	SUB FLOOR VOID & VENTS OMITTED & DPC'S UPDATED.	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

enquiries@architecture.co.uk
01344 752 271

CLIENT: THAKEHAM CLIENT

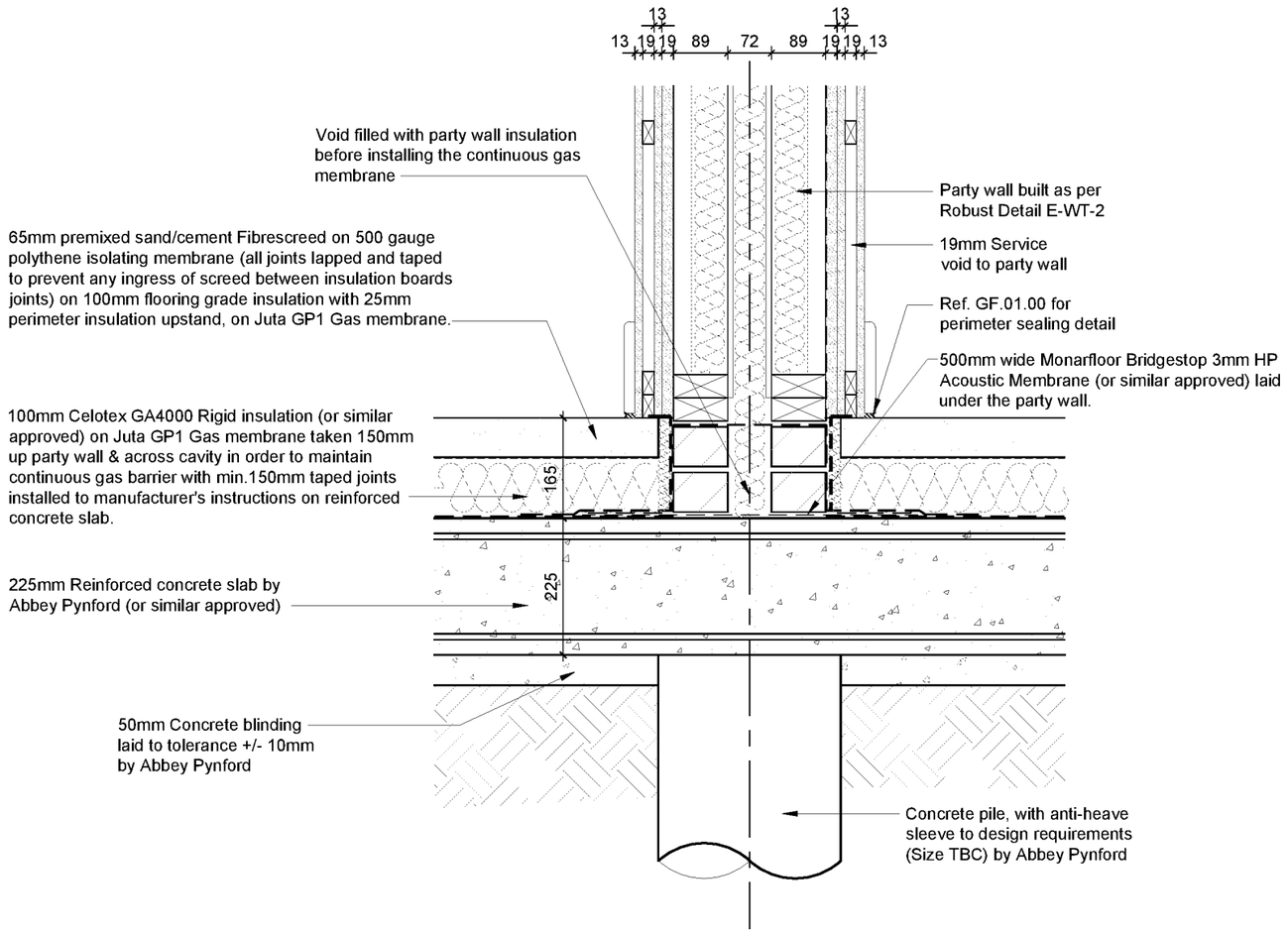
PROJECT: CORNFIELD CLOSE, LITTLEHAMPTON

TITLE: PARTY WALL/G.F. SLAB SUBSTRUCTURE MASONRY APARTMENTS

SCALE	DATE	PROJECT NO
1:10 @ A3	07/12/18	18.335

DRAWN	CHECKED	
AJH	CD	M637_60.50.03 C03

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



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

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

CONSTRUCTION

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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)

REV	DATE	DESCRIPTION	INITIAL	CHECKED
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

enquiries@architecture.co.uk
01344 752 271

CLIENT: THAKEHAM CLIENT

PROJECT: CORNFIELD CLOSE, LITTLEHAMPTON

TITLE: PARTY WALL/G.F. SLAB SUBSTRUCTURE TIMBER FRAME HOUSES

SCALE: 1:10 @ A3 | DATE: 07/12/18 | PROJECT NO.: 18.335

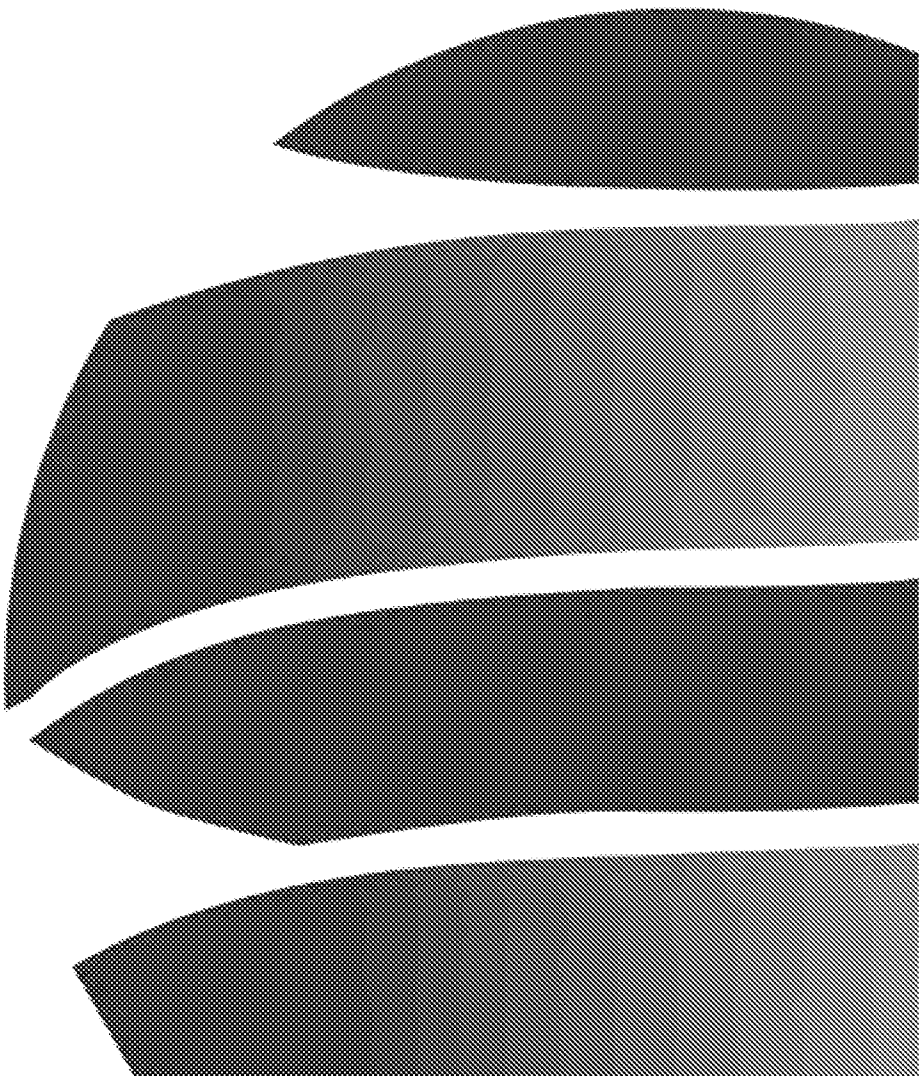
DRAWN: AJH | CHECKED: CD

M637_60.50.04 C03

Geo-Environmental

APPENDIX B

Visual Inspection Records of Gas Membrane Installations



Geo-Environmental

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	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 conpleted
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

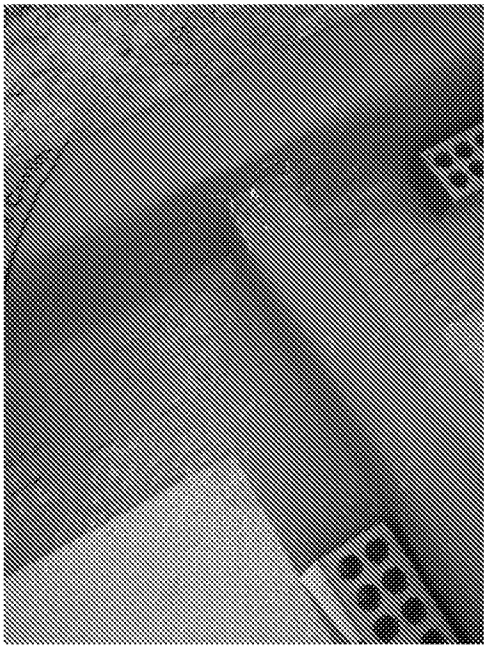
1.1 Condition of sub-grade and underside of membrane	Clean, recently swept flat concrete.
1.2 Gas membrane type	Keytec 400 HP - Self branded bought from Juta.
1.3 Gas membrane condition	Very good. No sign of previous repair or weakness.
Jointing tape product	Membrane cutouts used as principal joint tape. 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.

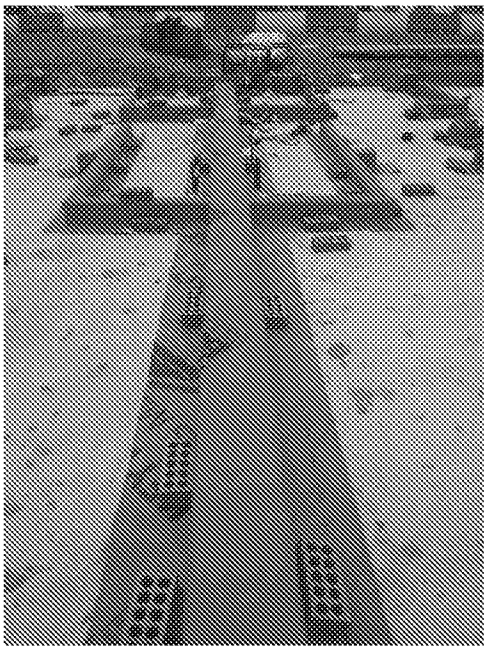
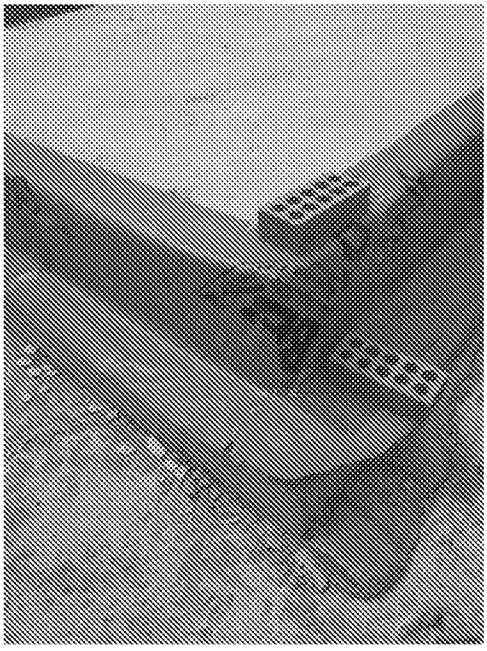
4. PHOTOGRAPHS

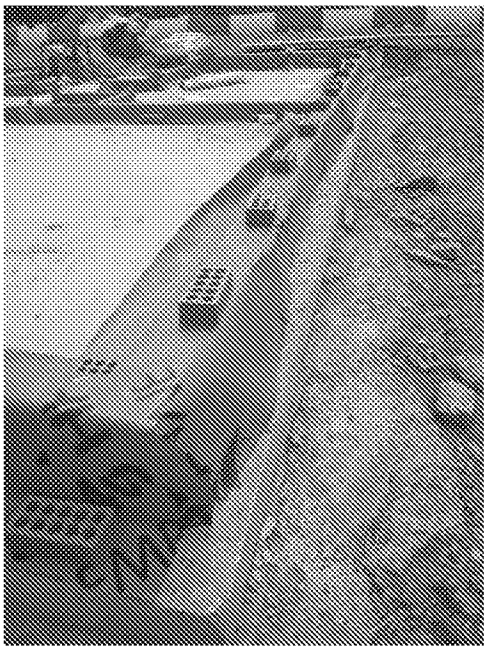
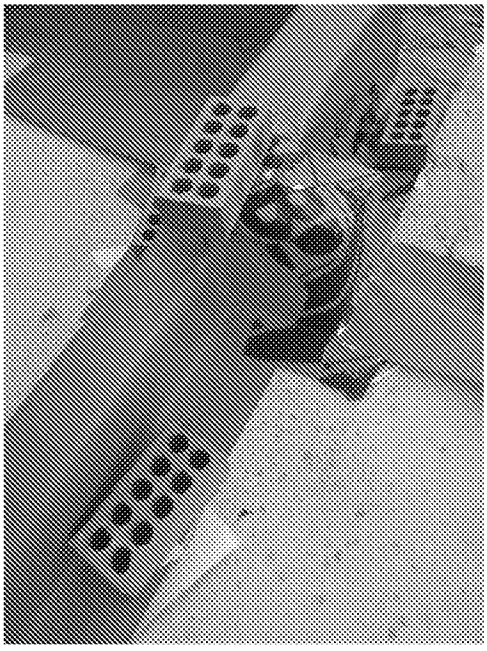
Photographs

(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	[redacted]
Date	11/06/2020

Geo-Environmental

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	
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 [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

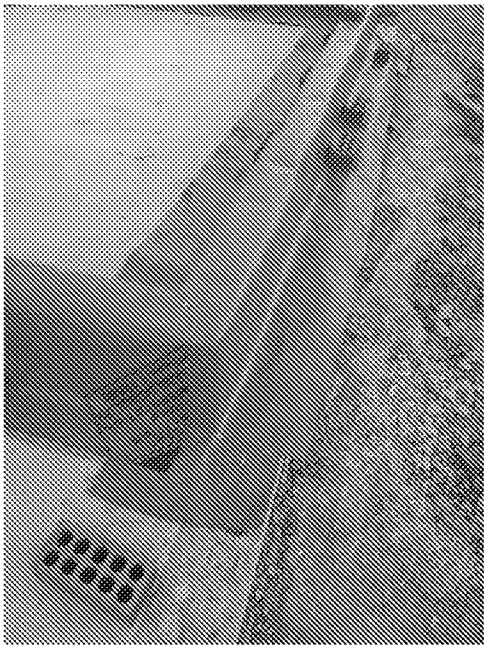
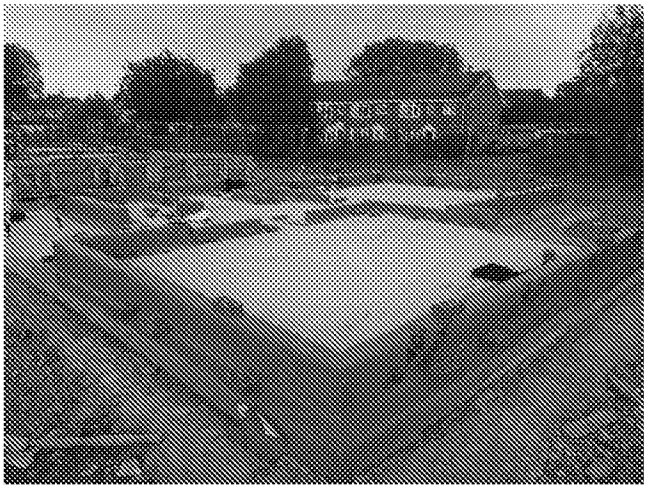
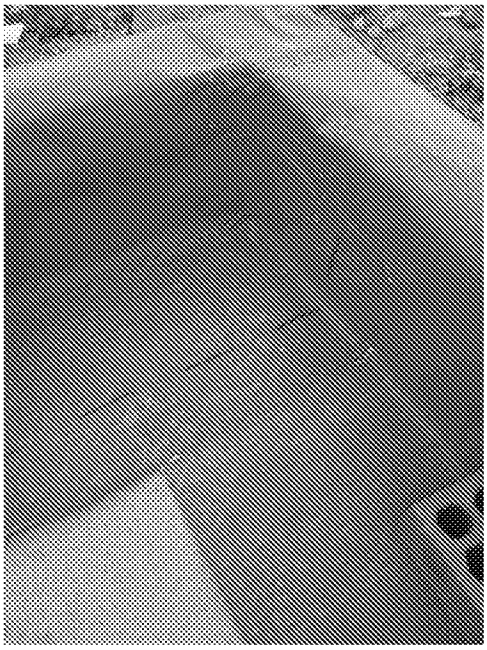
1.1 Condition of sub-grade and underside of membrane	Very clean, recently swept.
1.2 Gas membrane type	Keytec 400 HP - bought from Juta branded by Keytec. Red. Stored in van.
1.3 Gas membrane condition	No punctures, evidence of footprints, repairs or weakness. Joining tape will be used to protect membrane against wooden beam installation at later date
Jointing 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

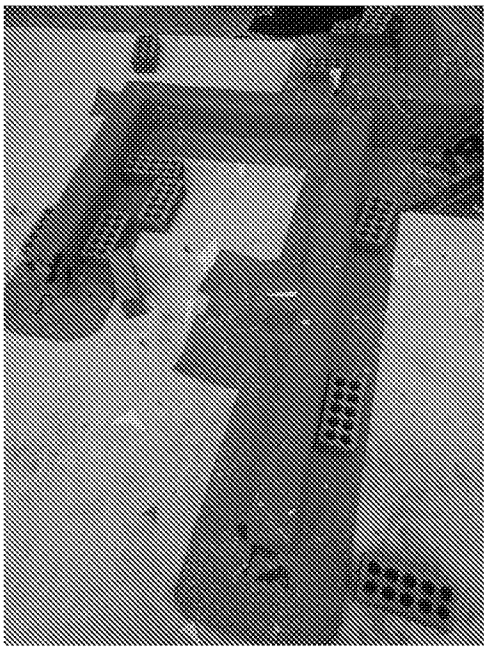
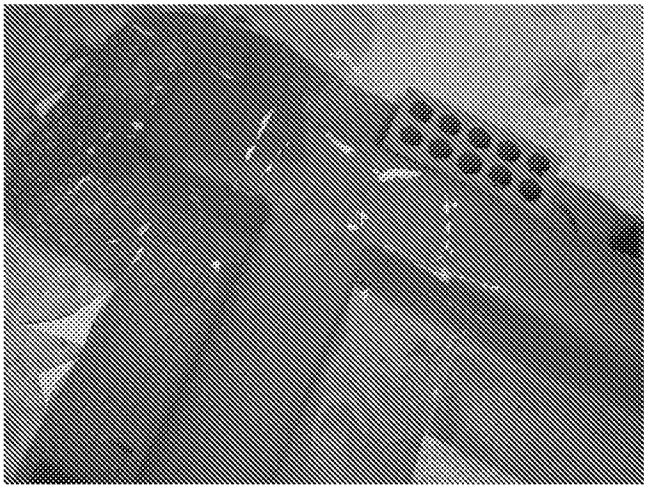
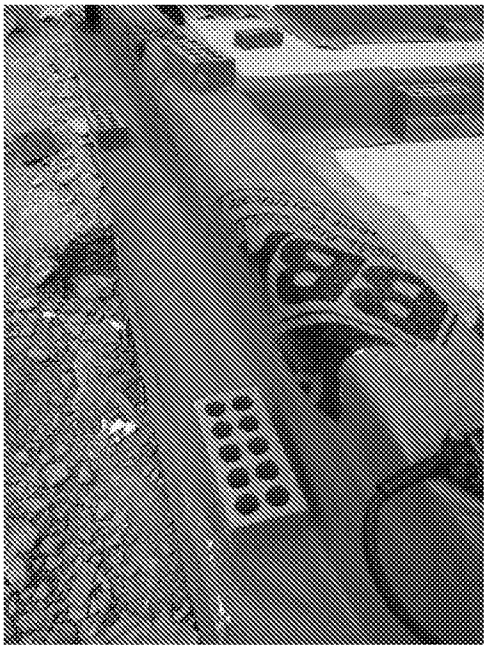
Photographs

(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

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	11/06/2020

Geo-Environmental

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 [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

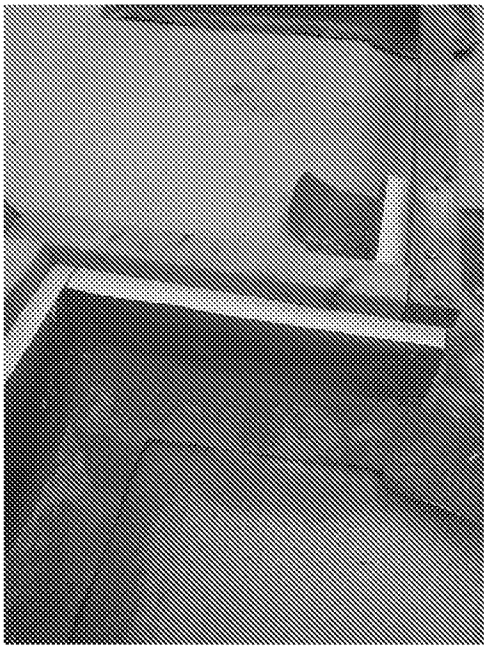
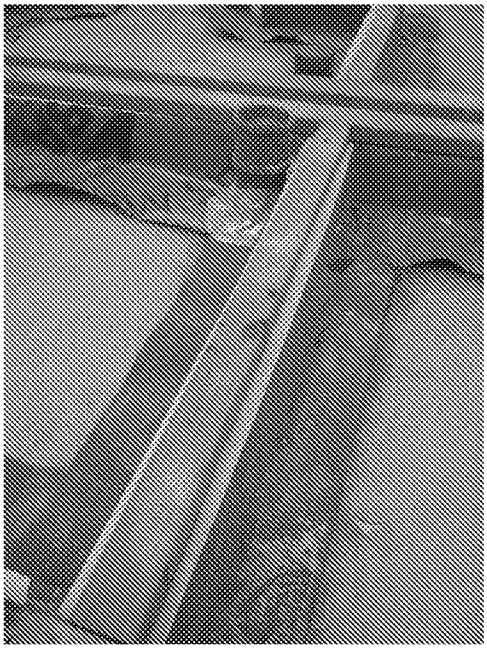
1.1 Condition of sub-grade and underside of membrane	Good condition, clean with no visible damage
1.2 Gas membrane type	Keytec gas resistant 400 membrane and on a few plots black juta unbranded gas resistant membrane
1.3 Gas membrane condition	Membrane in good condition some dust but well protected
Jointing 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

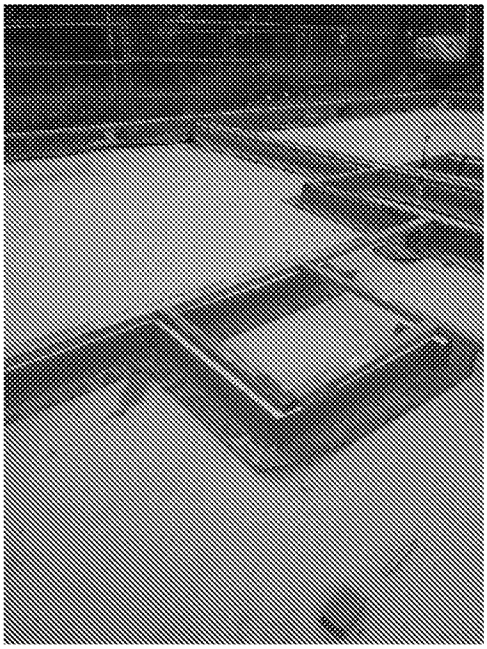
4. PHOTOGRAPHS

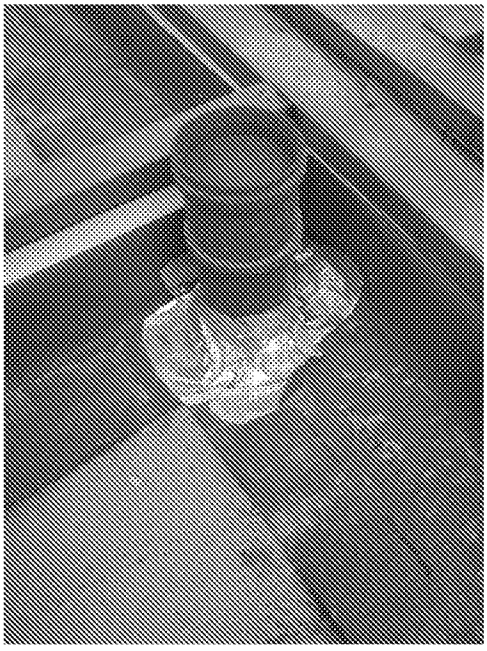
Photographs

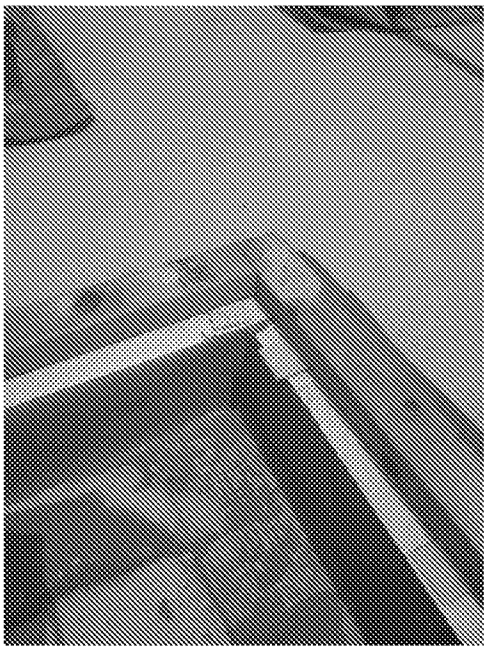
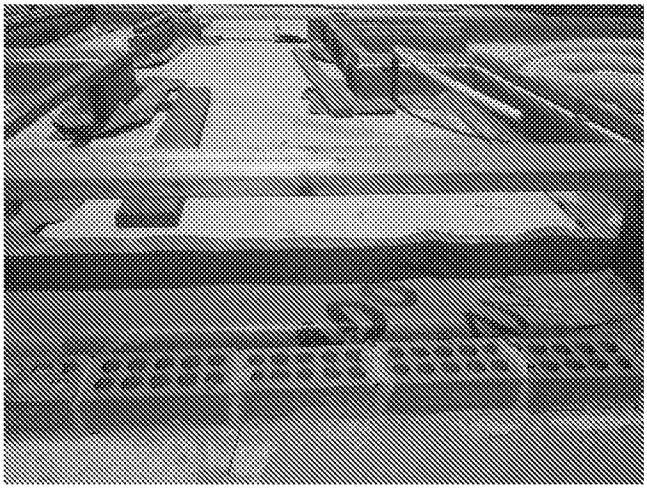
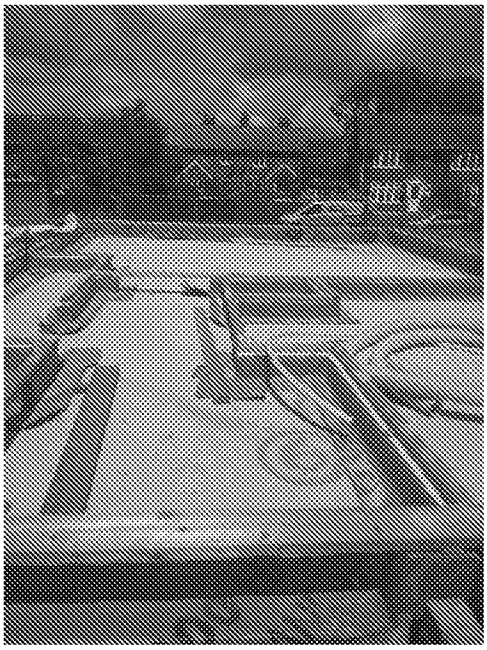
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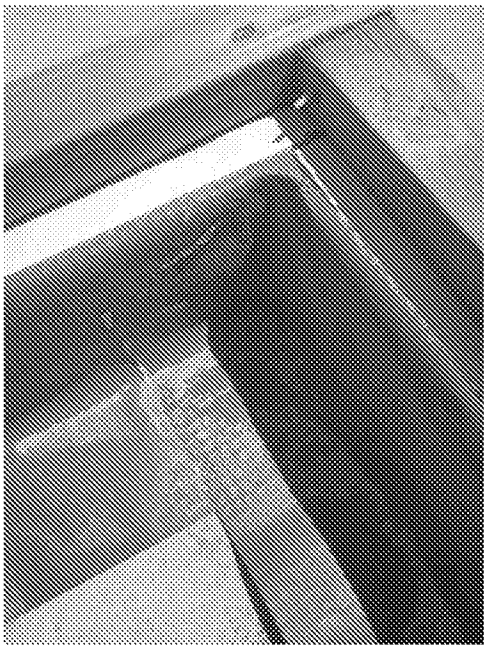
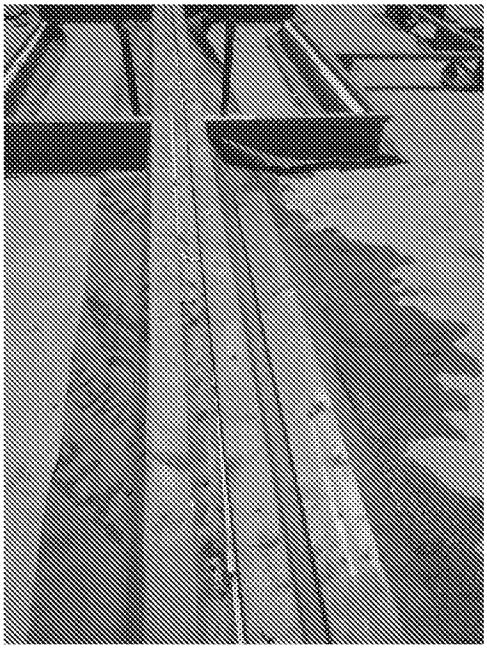
Photograph	*Photograph Title*

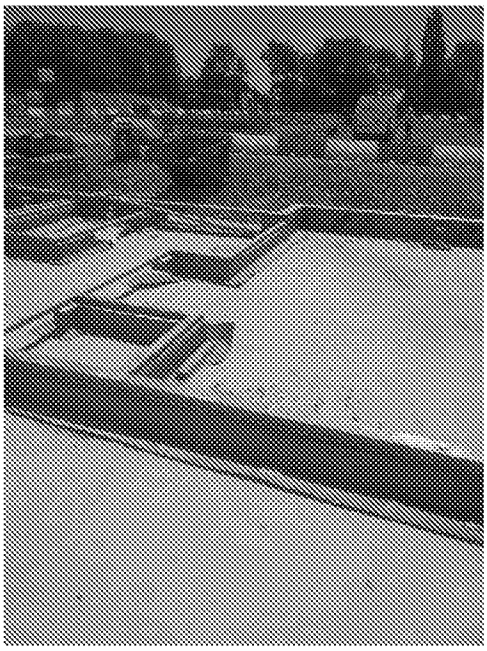
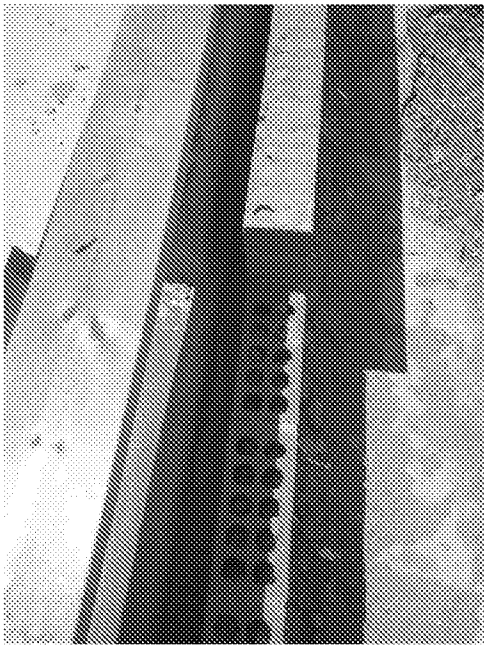
	Plot 3 timber
	Plot 2 timber

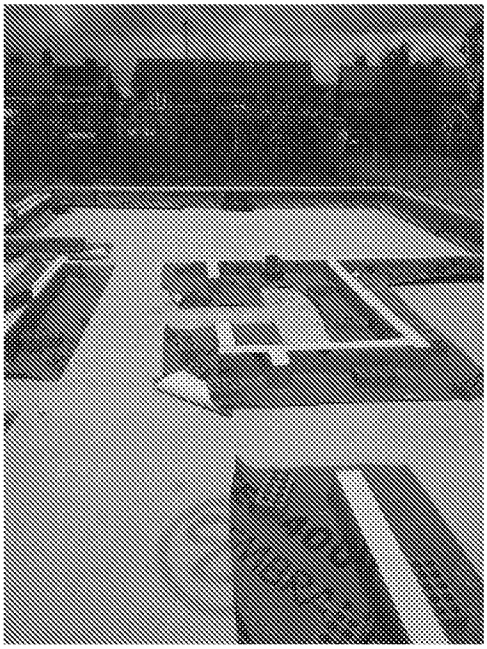
	Plot 5 underside
	Plot 5 overview

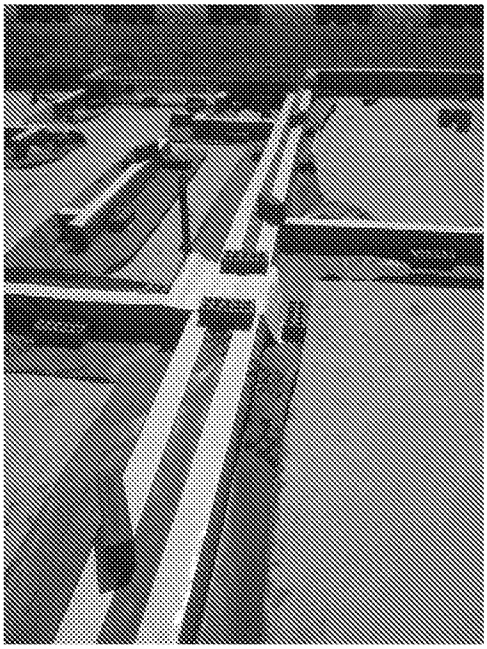
	Plot 5 corner
	Plot 5 services

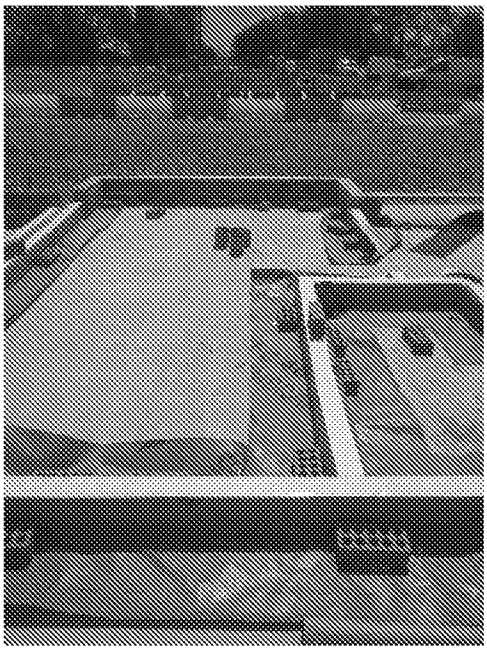
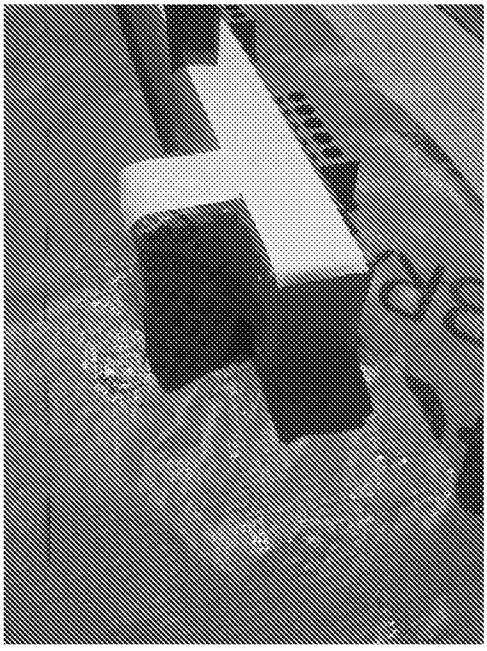
	Plot 4 timber
	Plot 6 doorway
	Plot 6 overview

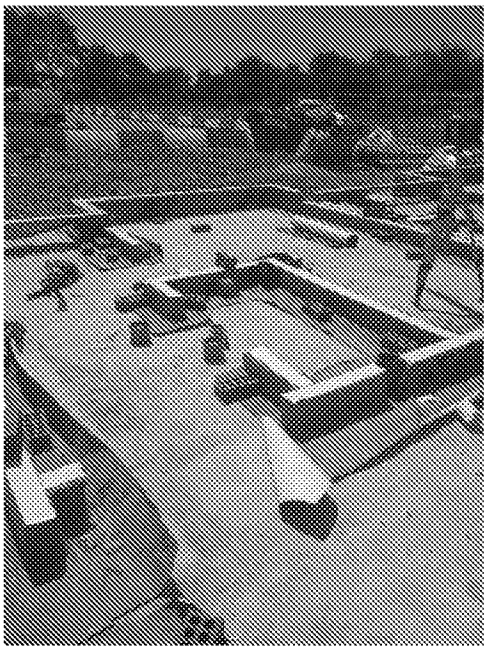
	Plot 6 corner
	Plots 6 and 7

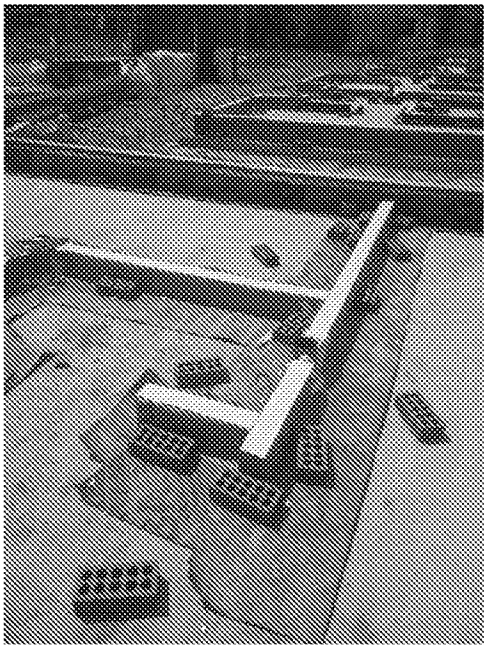
	Plot 7 overview
	Plot 7 cavity

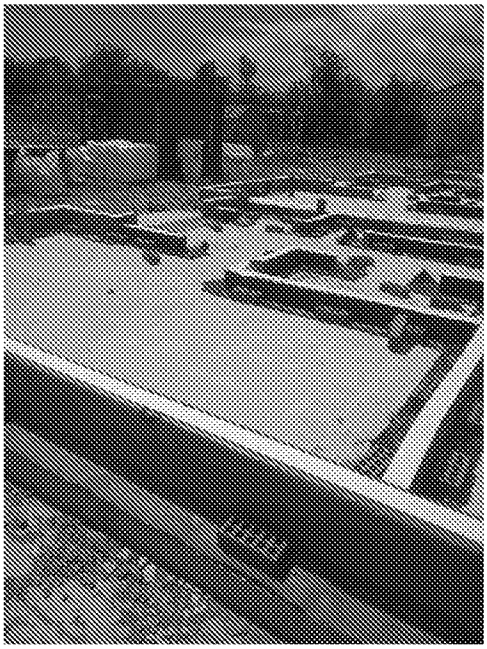
	Plot 7 services
	Plot 8 overview

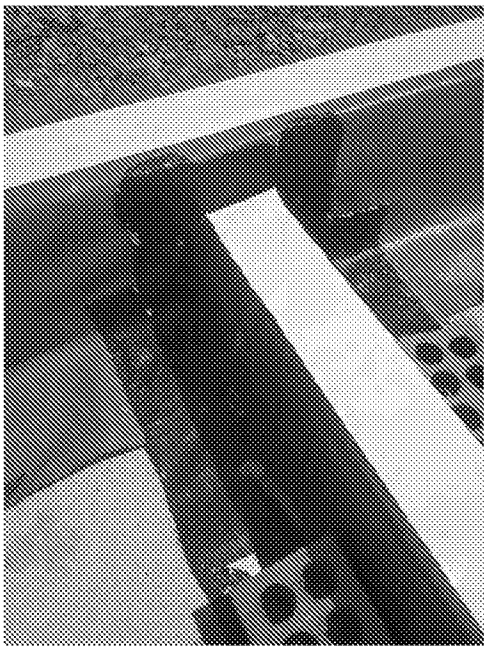
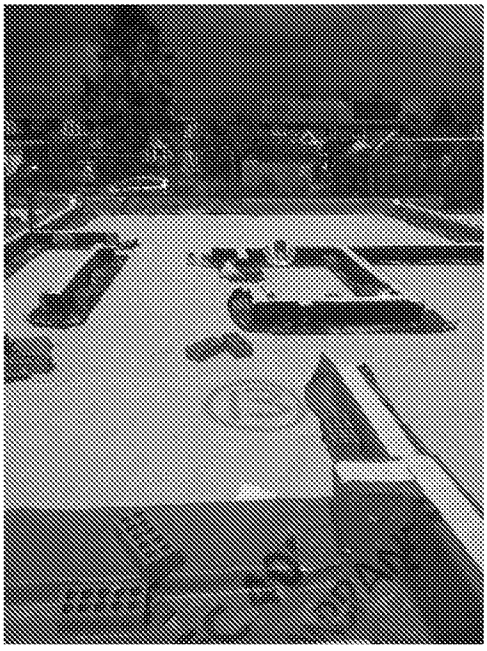
	Plot 8 services
	Plot 8 and 9

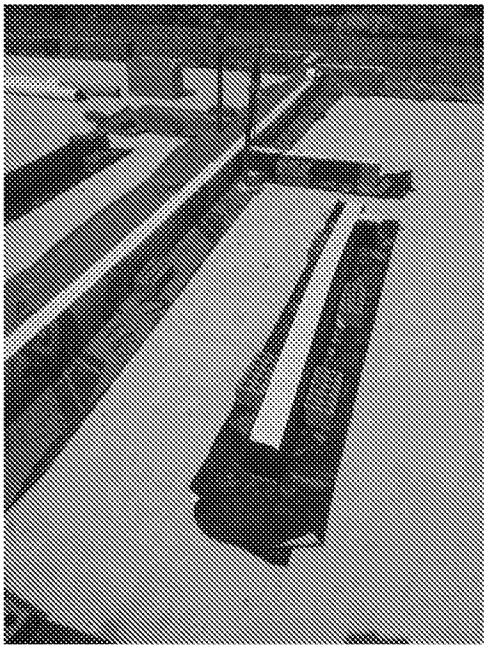
	Plot 9 overview
	Plot 9 corner

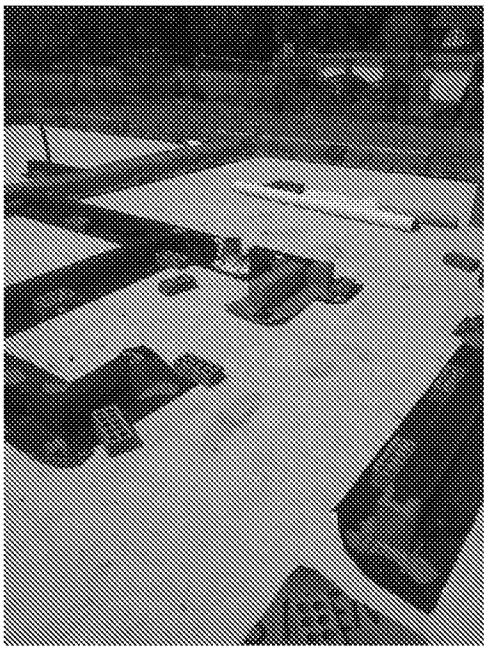
	Plot 10 overview
	Plot 10 wall

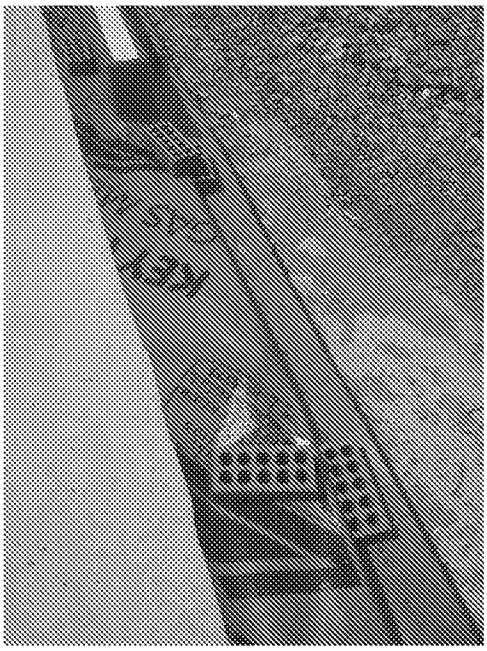
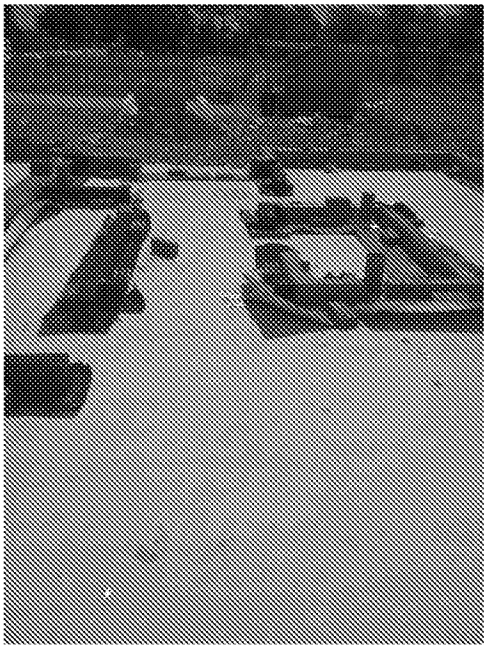
	Plot 10 services
	Plot 11 overview

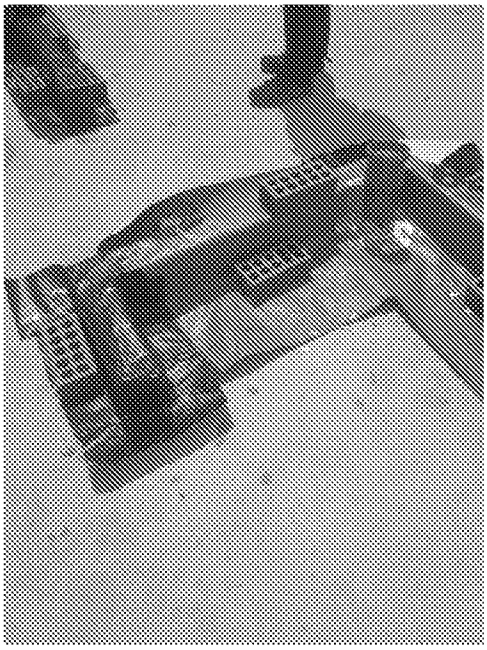
	Plot 11 services
	Plot 12 overview

	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	[redacted]
Date	02/07/2020

Geo-Environmental

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	
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 [X] 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 joins 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 joins
1.6 Laps, welds and joints seals	All heat sealed joins some double sided tape on services and corners. Patch repairs heat sealed
1.7 Service seals	All well sealed with site formed taped seals

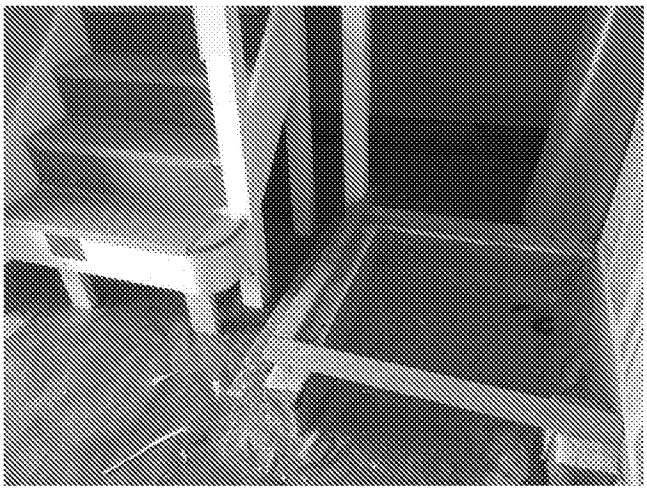
4. PHOTOGRAPHS

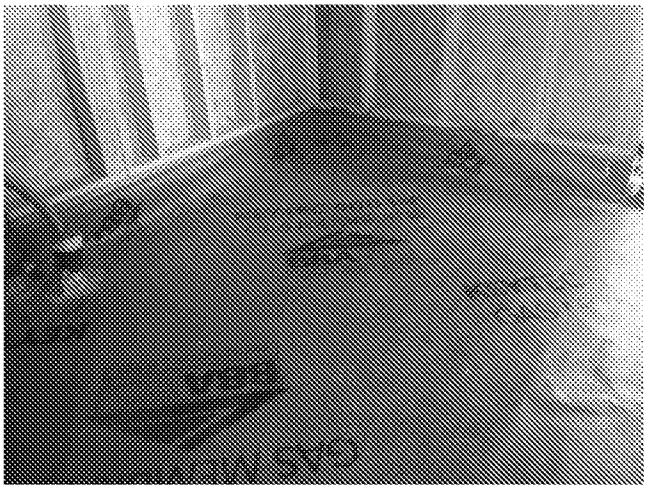
Photographs

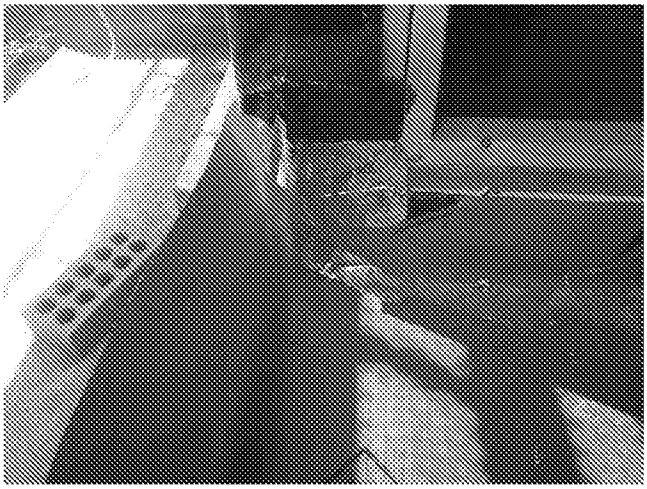
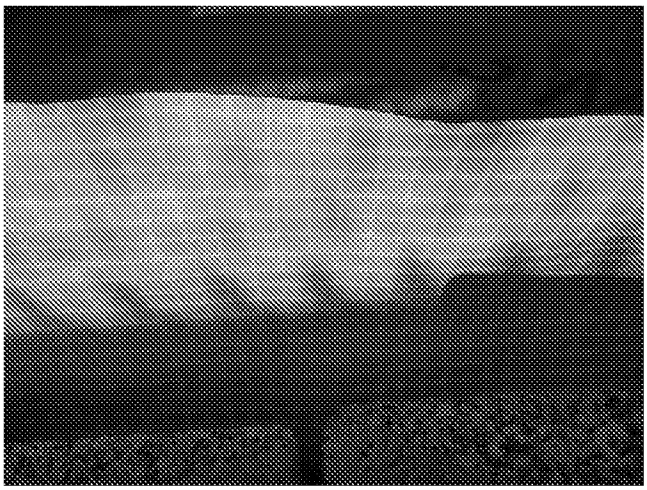
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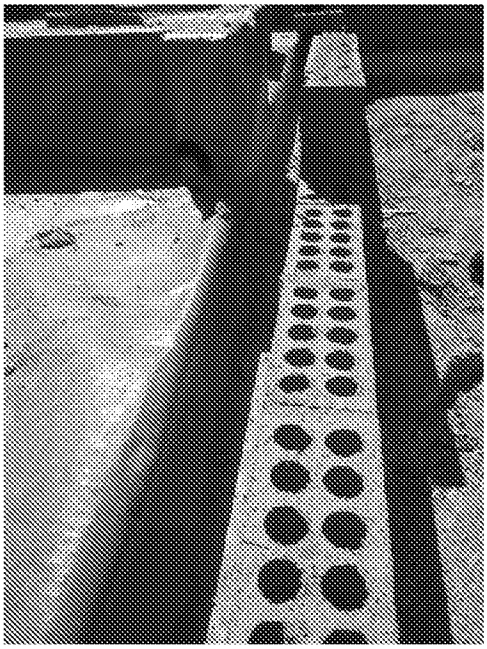
Photograph	*Photograph Title*

	Plot 1 services
	Plot 1steel

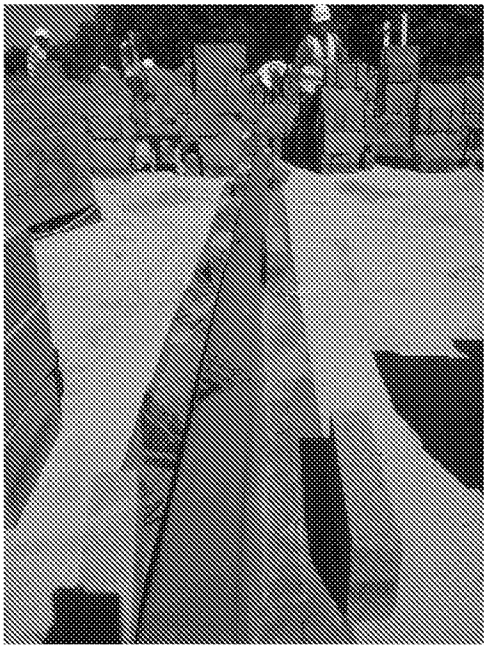
	Plot 1 seals
	Plot door threshold
	Plot 1 stairwell

	Plot 1 overview
	Plot 2 overview
	Plot 2 under stairs

	Plot 2 services
	Plot 2 details
	Plot 2 underside

	Block A services
	Block A cavity

	Block A tape under blockwork
	Block A corner

	Block A water
	Block A overview

	Block B pit
	Block B damage

	Block B overview
	Plot 3 overview

	Plot 3 services
	Plot 3 under stairs

	Plot 3 overview

5. PASS/FAIL

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	29/07/2020

Geo-Environmental

Project Name	Cornfield Close Validation
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	10/08/2020, 12:04
Site Engineer	
Katie O'Dea	[redacted]
Weather at time of inspection	Hot, sunny, humid
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential
Plot No.	Plots 4-5 whole floor, Block B Plots 66-77 perimeter only
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

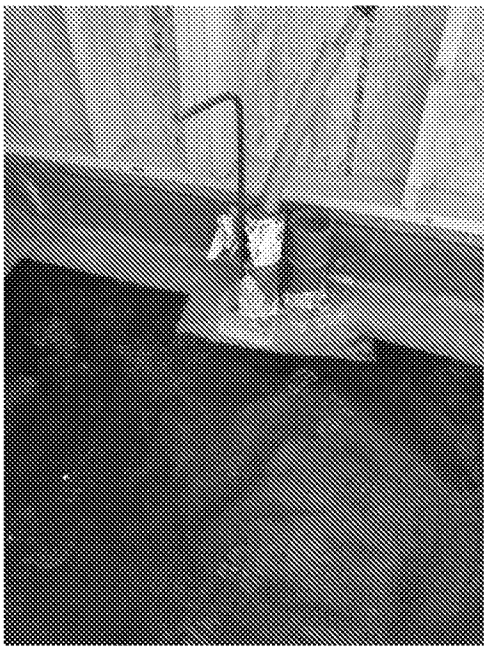
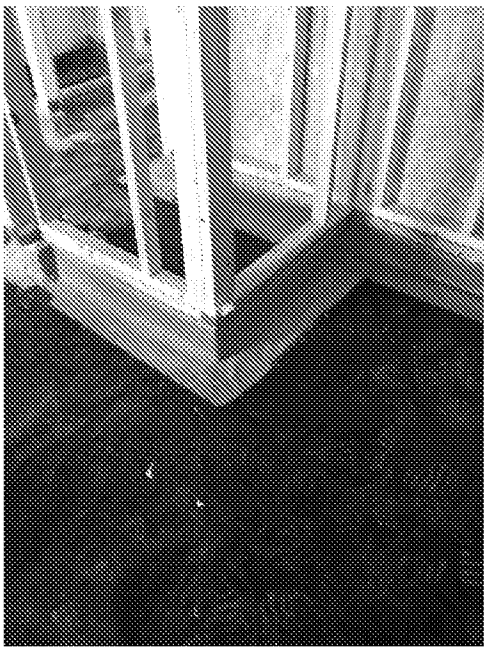
1.1 Condition of sub-grade and underside of membrane	Sub grade and underside of membrane in good condition.
1.2 Gas membrane type	Keytec 400 gas membrane and black unbranded gas membrane.
1.3 Gas membrane condition	Membrane in good condition.
Jointing tape product	Heat welded joints. Tape used for service seals. Black putty tape between membrane and timber frame to seal screw holes
1.5 Lapping design	Welded lapping. Min 150mm.
1.6 Laps, welds and joints seals	Heat sealed welds in good condition.
1.7 Service seals	Services sealed with double sided tape and membrane. All in good condition.

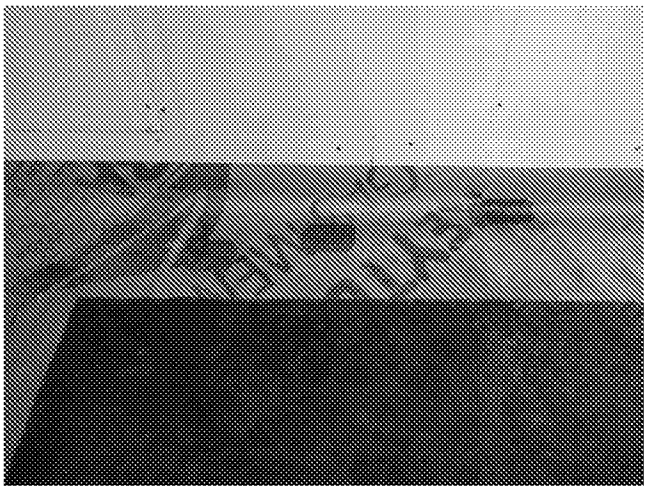
4. PHOTOGRAPHS

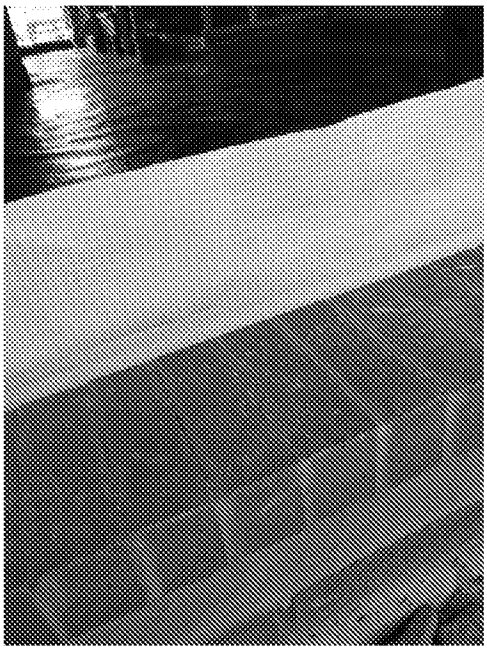
Photographs

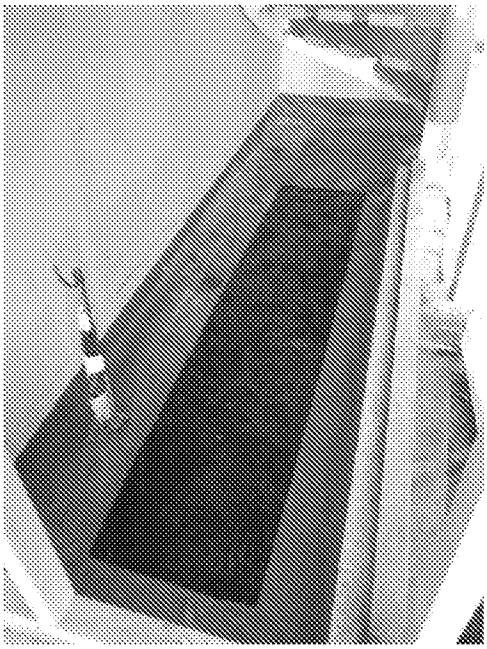
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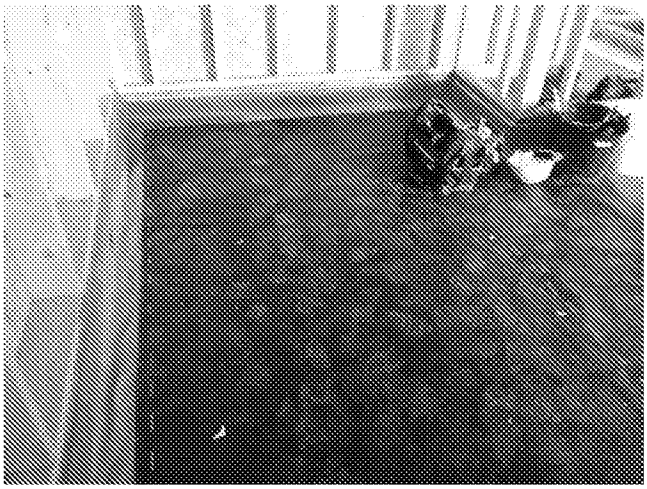
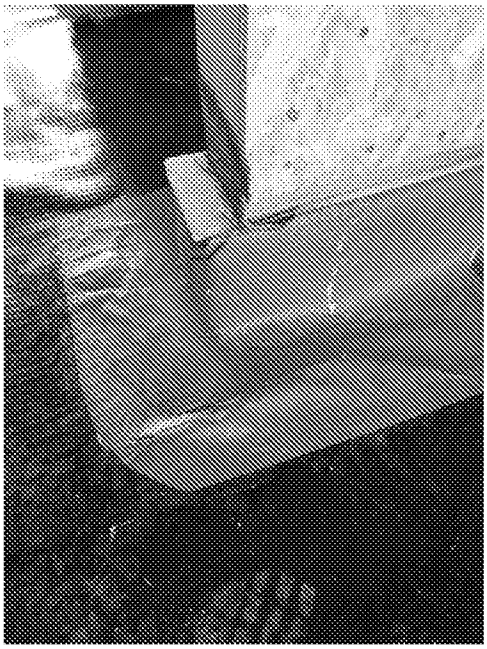
Photograph	*Photograph Title*

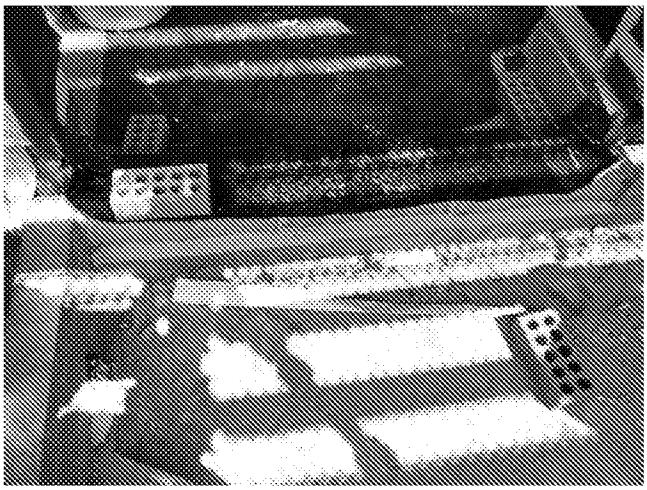
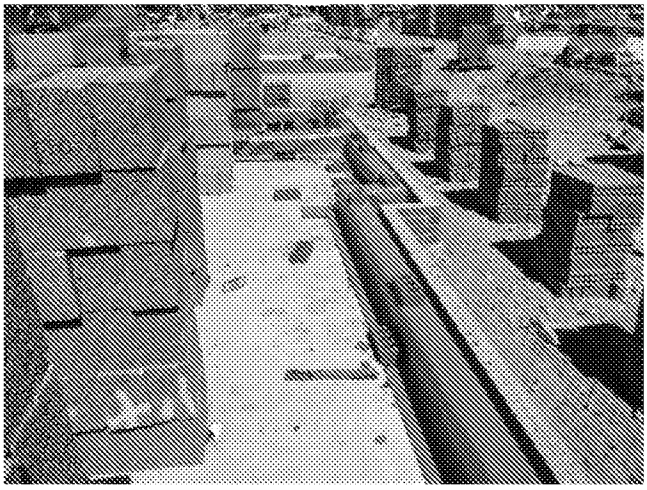
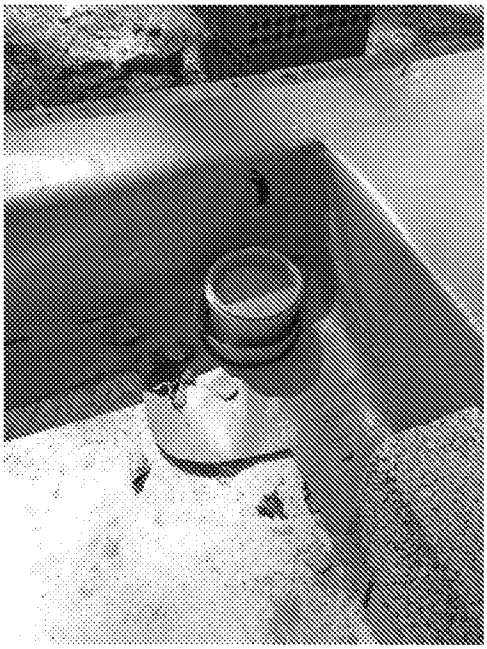
	Plot 4 - service seal
	Plot 4 - join between wall and floor

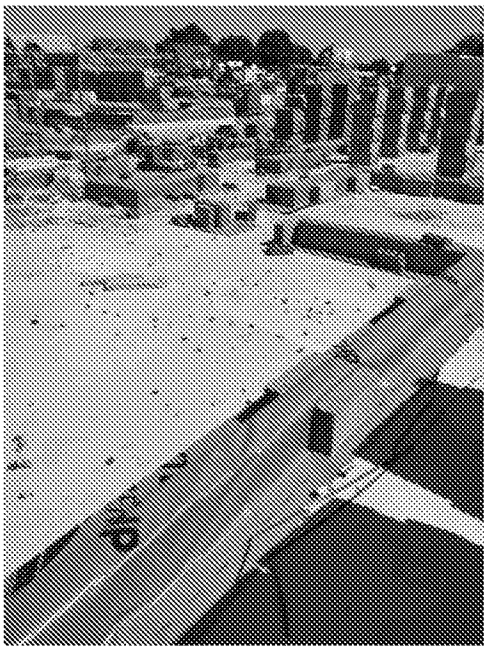
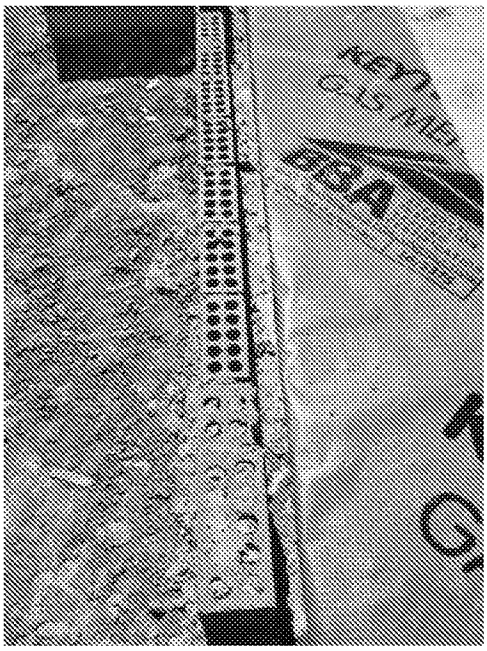
	Plot 4 - Threshold
	Plot 4 - Black putty tape sealant under frame
	Plot 4 - Patching of any holes has already been completed

	Plot 4 - underside of membrane in good condition
	Plot 5 -Threshold corner detail
	Plot 5 - Patching of holes already complete

	Plot 5 - Threshold
	Plot 5 - under stairs and service seal.
	Plot 5 - service seal

	Plot 5 - floor
	Plot 5 - Corner detail
	Plot 5 - floor

	Plot 5 - threshod
	Block B - perimeter
	Block B - services not yet sealed

	Block B - membrane
	Block B - Threshold
	Block B - Threshold

5. PASS/FAIL

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	10/08/2023

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	13/08/2020, 13:20
Site Engineer	
Fiona Goode	[redacted]
Weather at time of inspection	Overcast, warm, humid, slight breeze
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Semis detached house
Plot No.	Plot 6 and 7 (floor area)
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

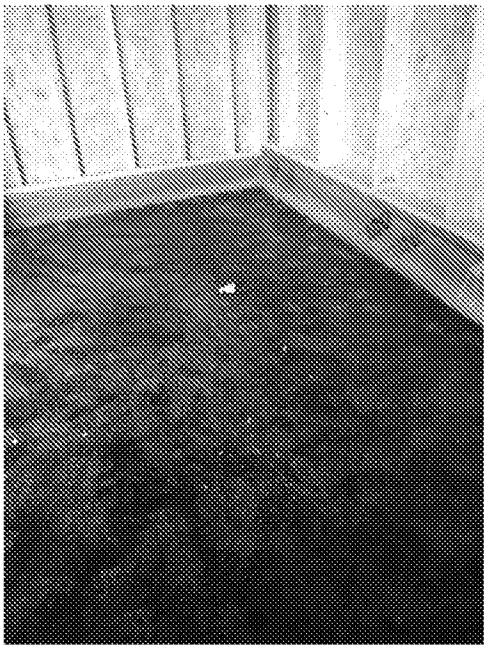
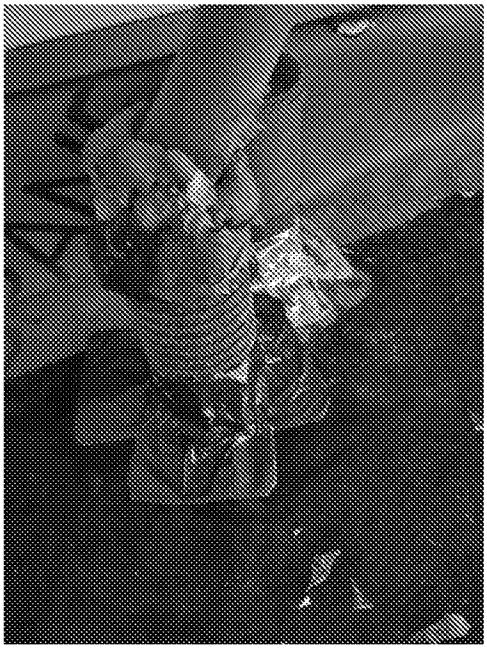
1.1 Condition of sub-grade and underside of membrane	Membrane sealed unable to insect
1.2 Gas membrane type	Juta gas resistant membrane- black
1.3 Gas membrane condition	Membrane is in good condition with some dust and evidence of footfall
Jointing tape product	Double sided tape on service seals all other joins heat sealed
1.5 Lapping design	150mm lap
1.6 Laps, welds and joints seals	Heat sealed and well sealed
1.7 Service seals	Site made taped seals on all services

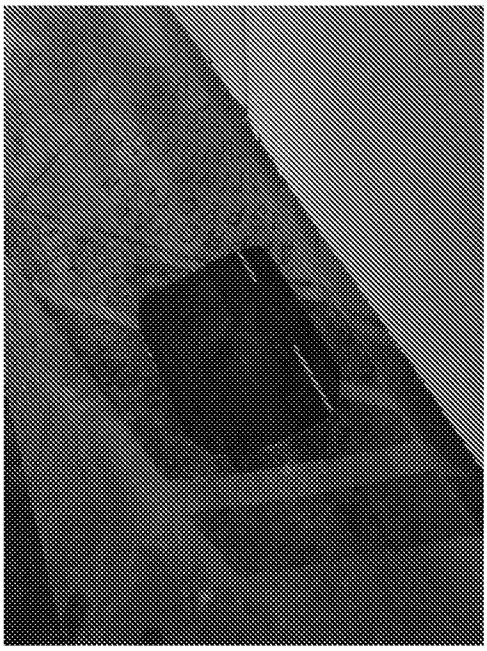
4. PHOTOGRAPHS

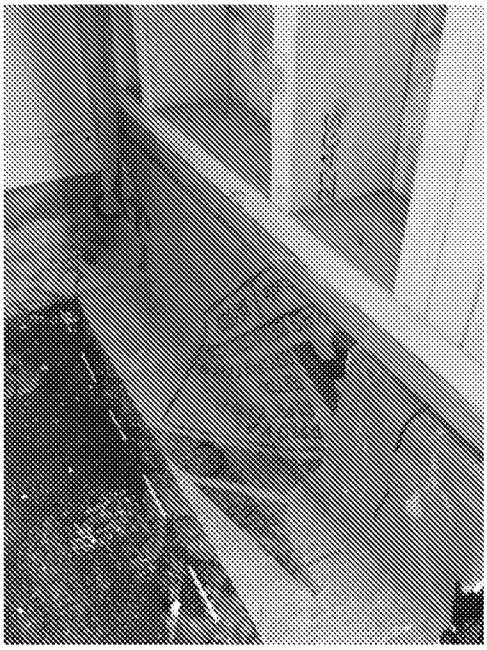
Photographs

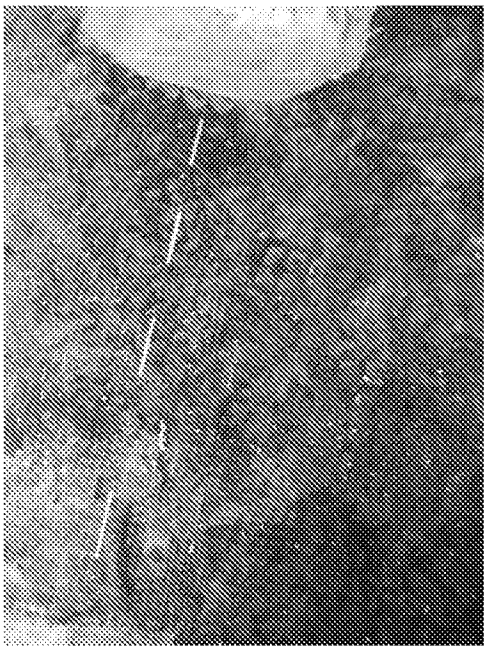
(9 records)

Photograph	*Photograph Title*

	Plot 6
	Plot 6 services

	Plot 6 repair
	Plot 6 threshold

	Plot 6 timber frame
	Plot 7

	Plot 7 joins
	Plot 7 timber frame

	Plot 7 threshold

5. PASS/FAIL

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	13/08/2020

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	25/08/2020, 14:09
Site Engineer	
Fiona Goode	[redacted]
Weather at time of inspection	Windy, warm, overcast
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Terraced house
Plot No.	perimeter
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Unable to inspect in plots 8-11 as sealed
1.2 Gas membrane type	Juta GP1 gas resistant membrane (black)
1.3 Gas membrane condition	Generally good condition, some signs of foot traffic
Jointing tape product	Heat sealed joins, double sided tape used on service seals and patch repairs
1.5 Lapping design	At least 150mm
1.6 Laps, welds and joints seals	All well sealed
1.7 Service seals	Site made seals, all services well sealed

4. PHOTOGRAPHS

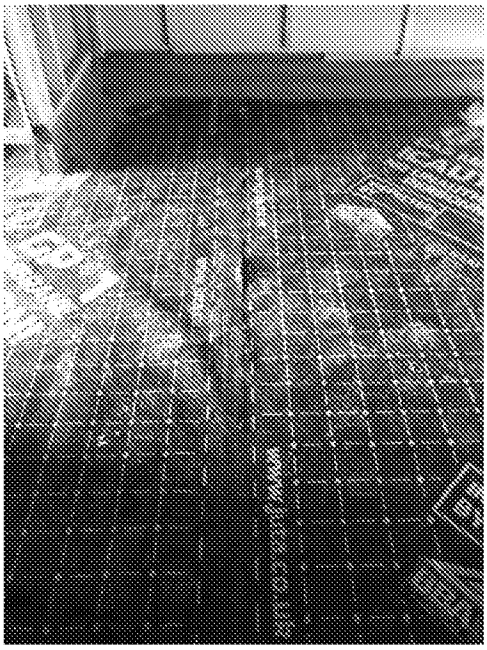
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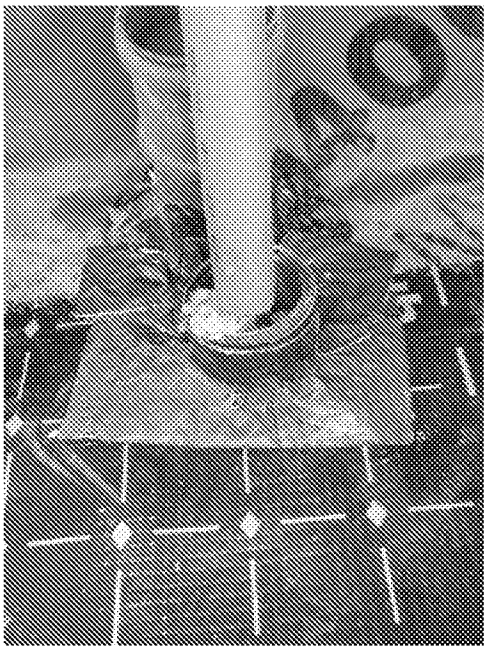
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Photograph	*Photograph Title*

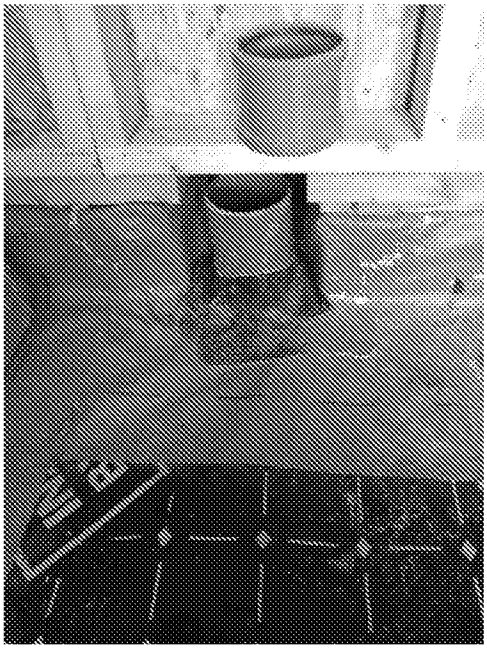
	Plot 8 overview
	Plot 8 under stairs

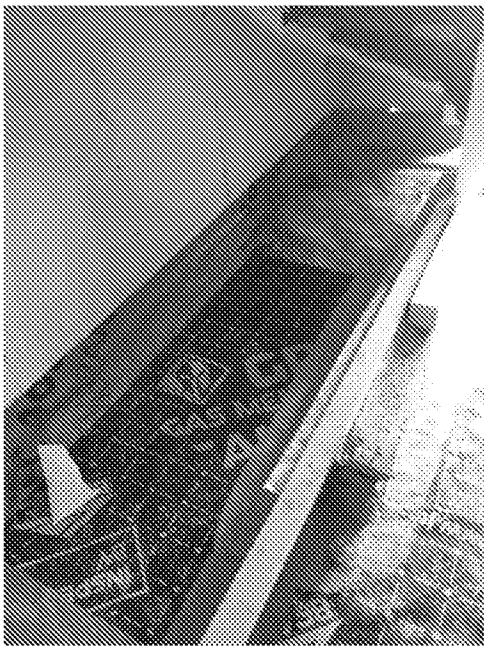
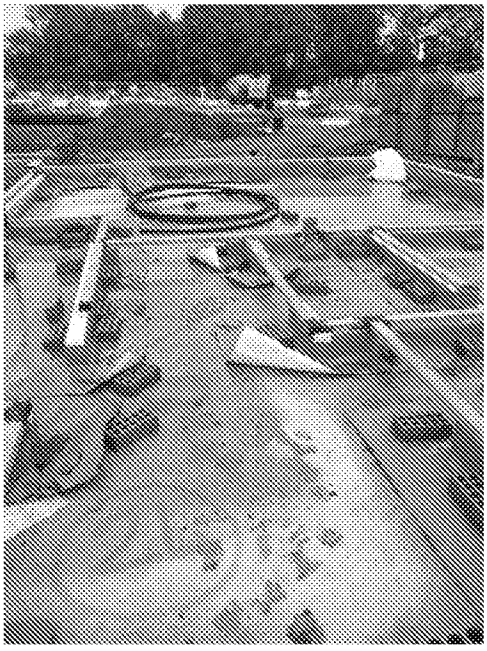
	Plot 8 patch repair
	Membrane type

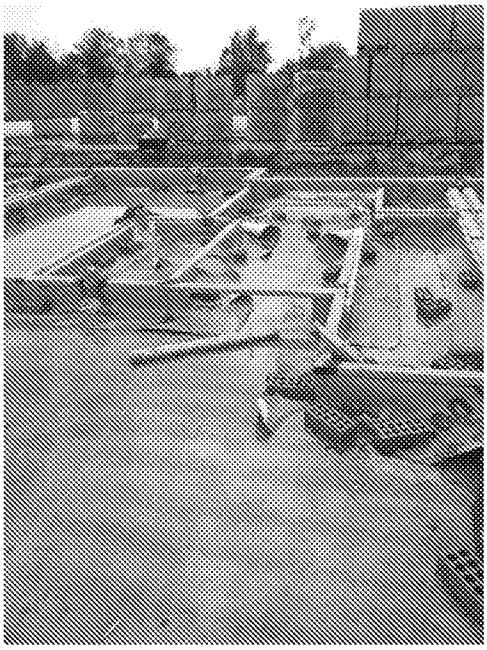
	Plot 8 join
	Plot 9 overview

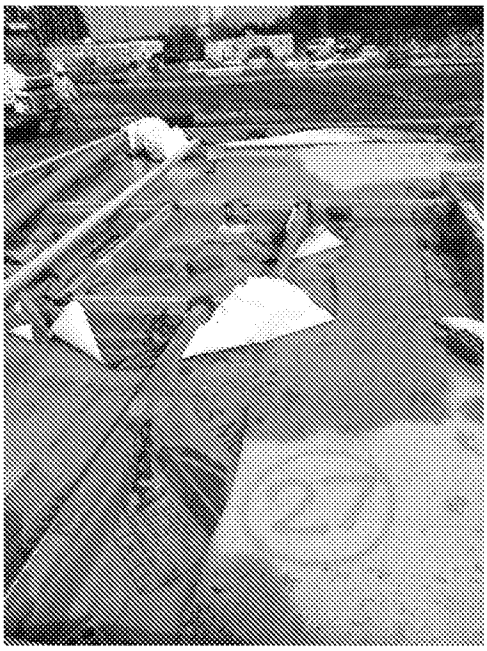
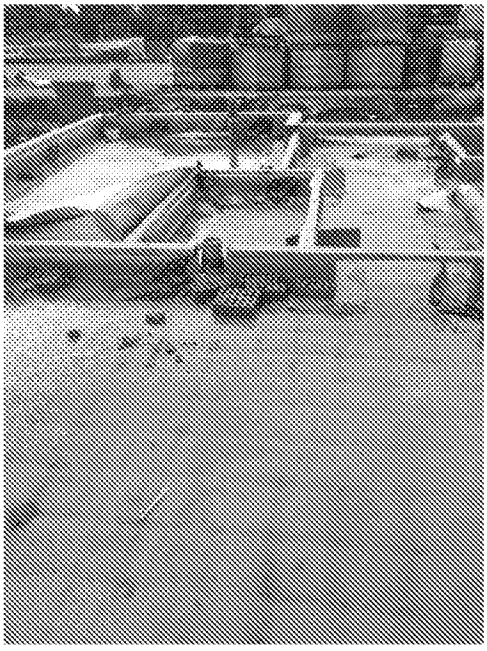
	Plot 9 service seal
	Plot 9 patch repair

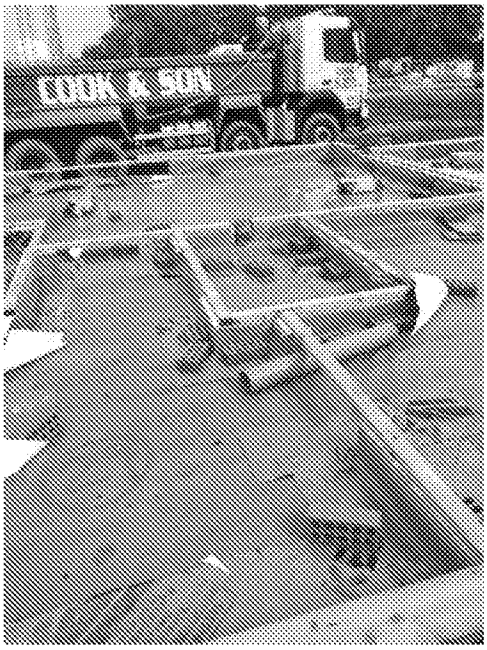
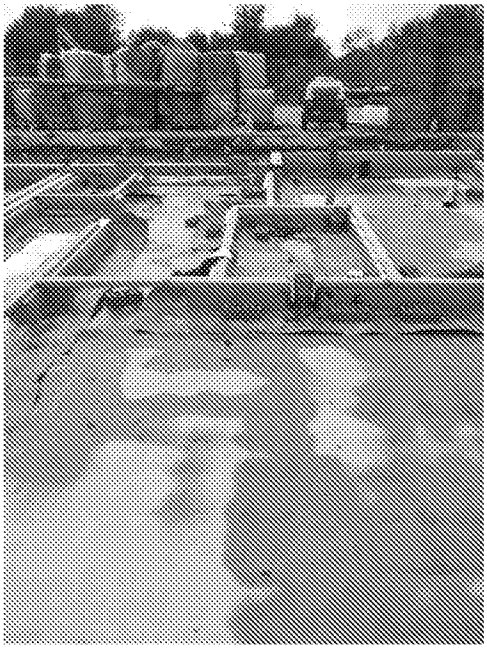
	Plot 9 floor
	Plot 10 overview

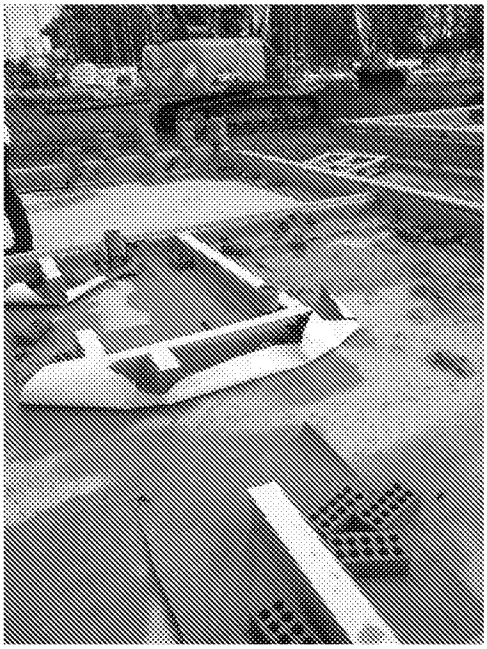
	Pot 10 membrane joins
	Plot 10 services

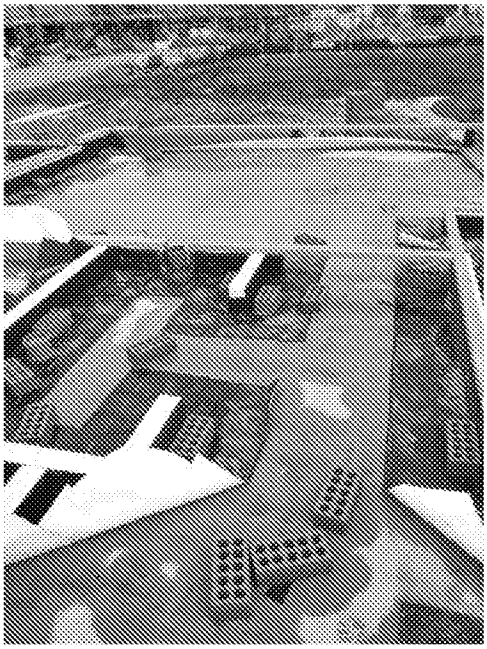
	Plot 10 under stairs
	Plot 24 reinspection

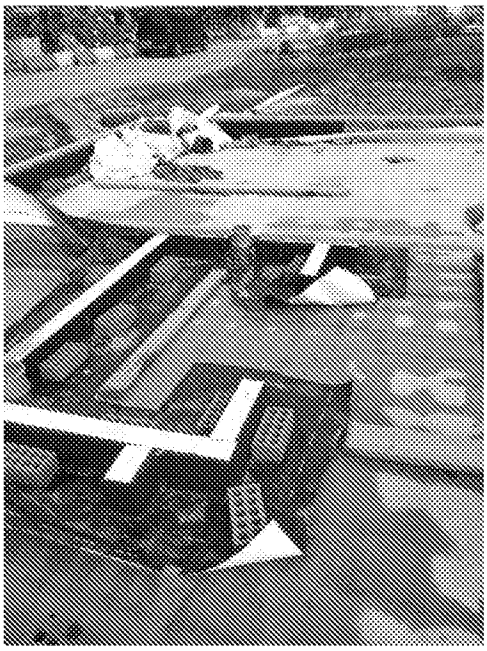
	Plot 25 reinspection
	Plot 26 service

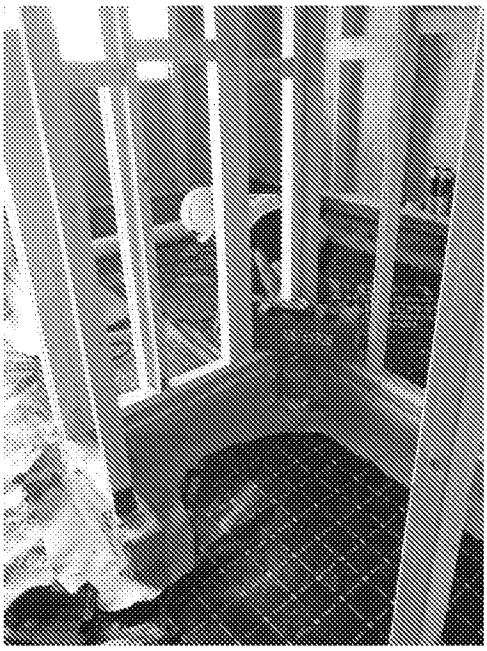
	Plot 27
	Plot 28

	Plot 29
	Plot 30

	Plot 31
	Plot 32

	Plot 33
	Plot 34

	Plot 35
	Plot 11 in progress

	Plot 11 in progress

5. PASS/FAIL

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	25/08/2020

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	10/09/2020, 12:23
Site Engineer	
Katie O'Dea	[redacted]
Weather at time of inspection	Warm, sunny, dry
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential - terraced houses
Plot No.	Plots 12-13 complete, Plots 14-15 in progress, Plots 20-21 (Phase 4) perimeter
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

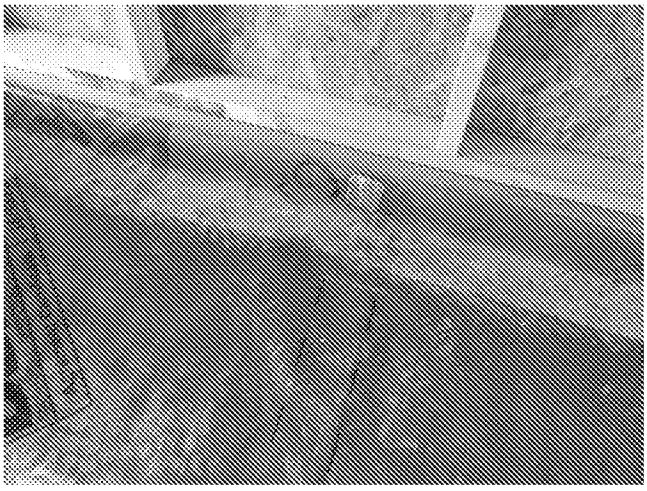
1.1 Condition of sub-grade and underside of membrane	Good condition where visible. Membrane sealed in Plots12-13.
1.2 Gas membrane type	Red Keytec gas membrane and black gas membrane.
1.3 Gas membrane condition	Good condition. Any holes or tears had been patched.
Jointing tape product	Heat welded joints.
1.5 Lapping design	Min 150mm overlap
1.6 Laps, welds and joints seals	Welded joints in good condition and well sealed.
1.7 Service seals	Service seals using membrane and tape. All well sealed and in good condition.

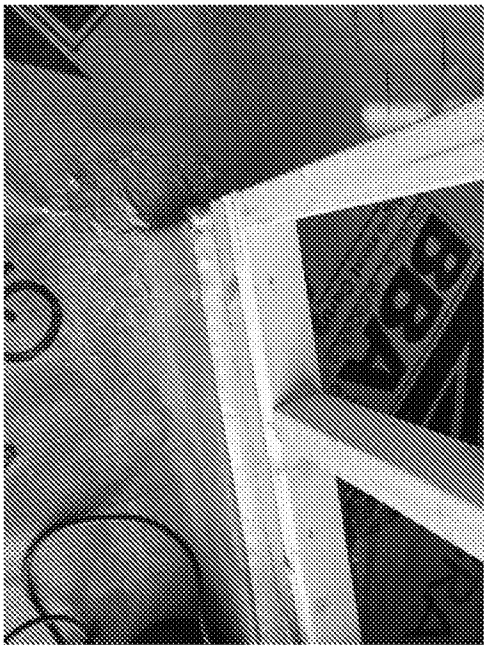
4. PHOTOGRAPHS

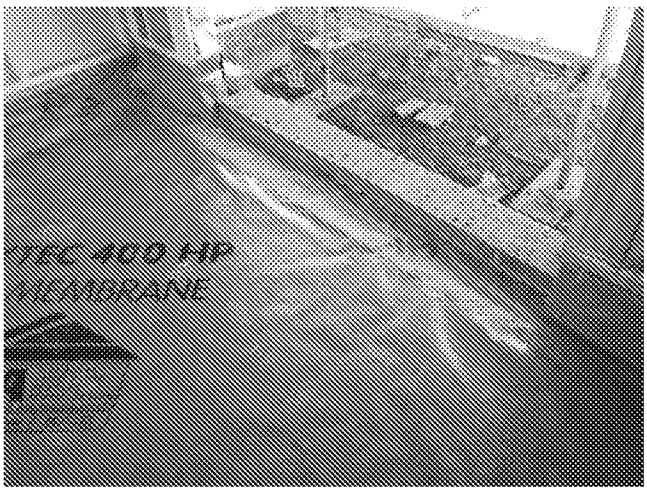
Photographs

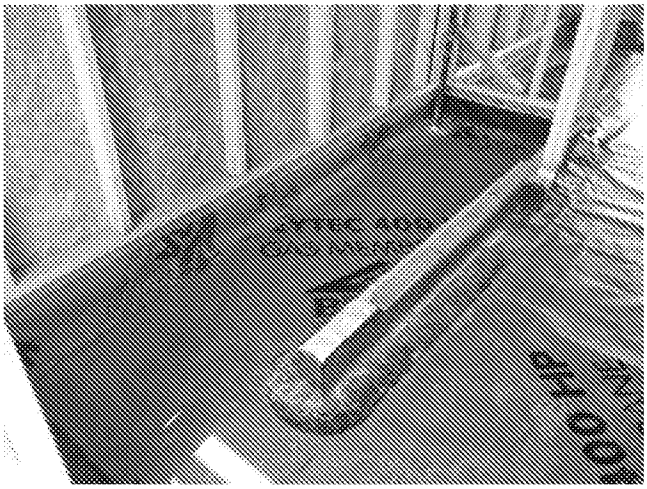
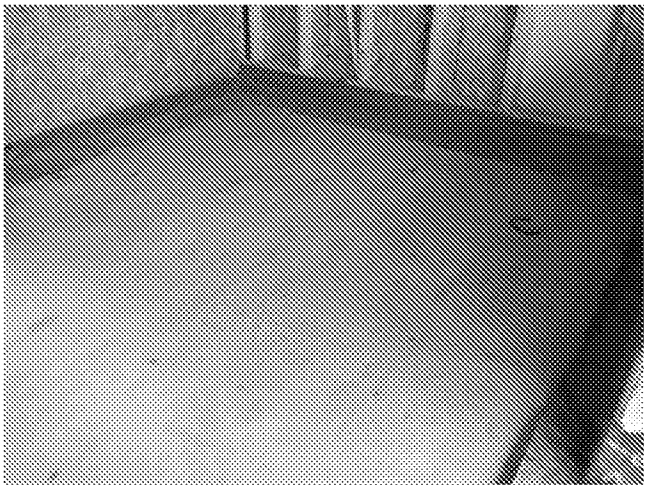
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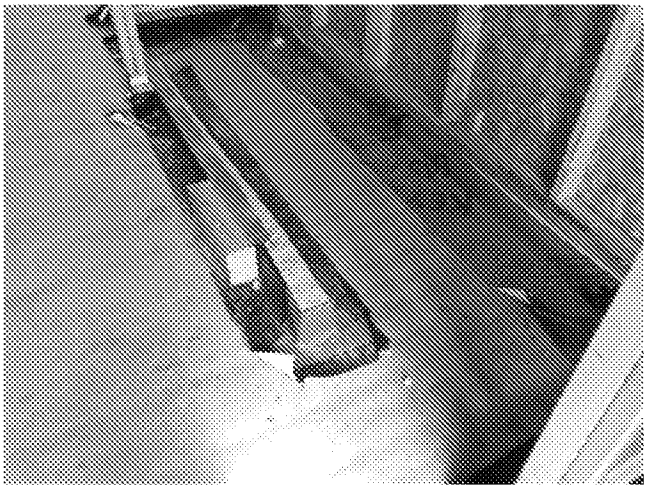
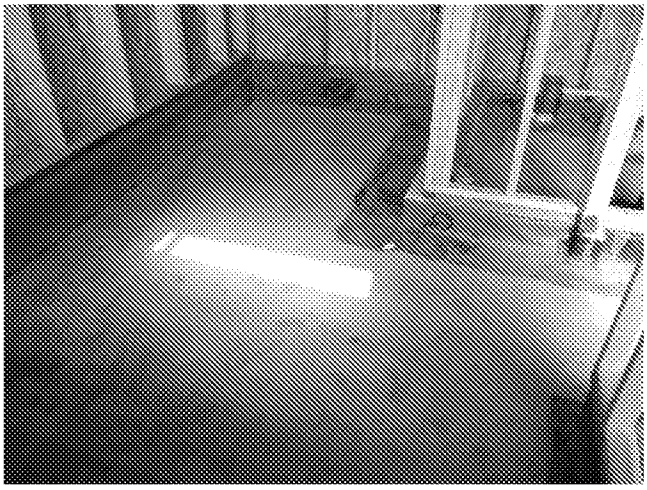
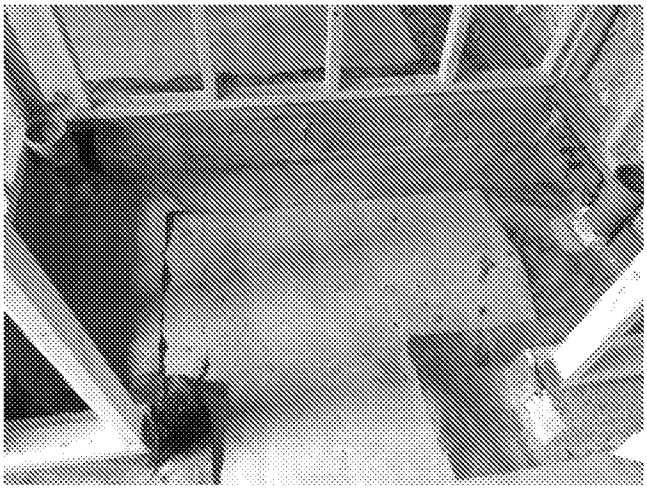
Photograph	*Photograph Title*

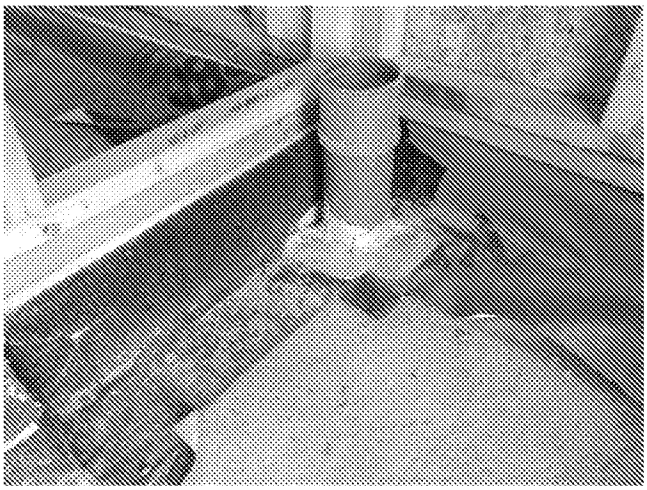
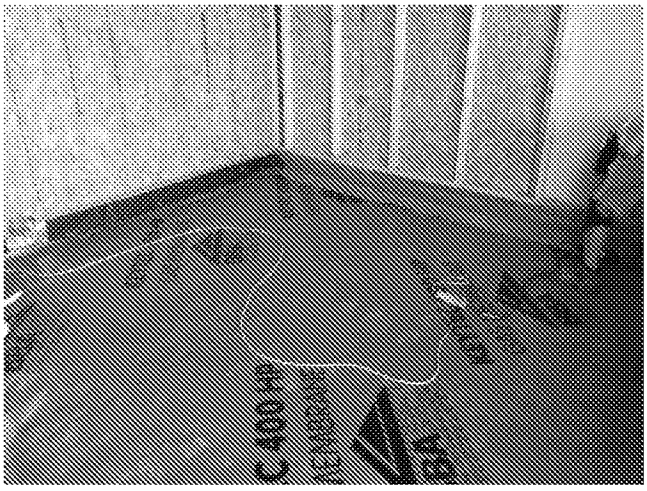
	Plot 12 - View across floor
	Plot 12 - service seal
	Plot 12 - Holes have been patched

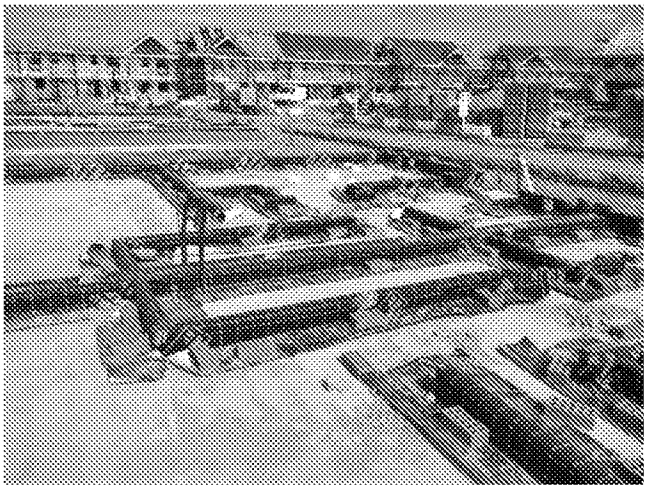
	Plot 12 - Threshold
	Plot 13 - Threshold
	Plot 13 - Corner detail

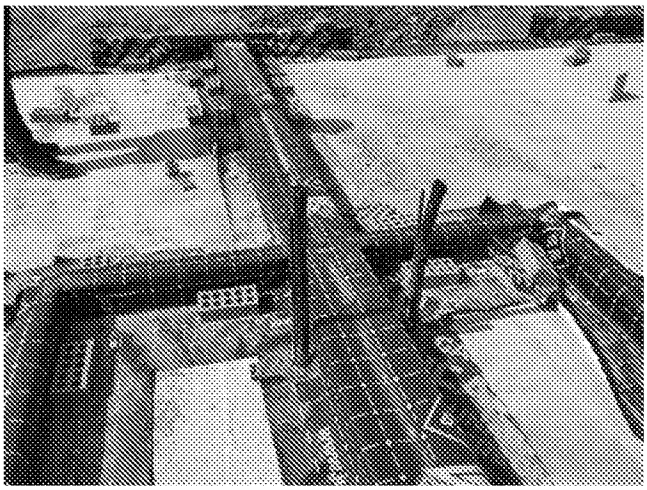
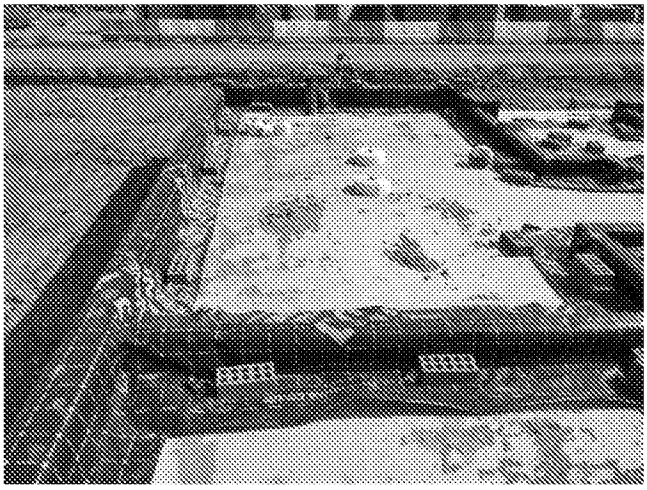
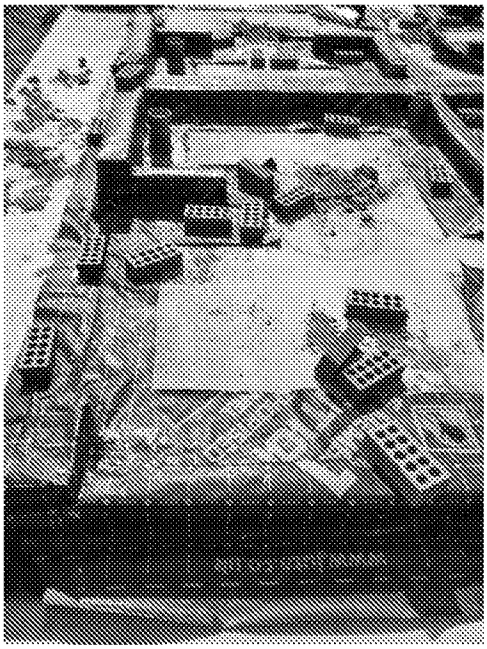
	Plot 13 - Floor
	Plot 13 - Floor and service seal
	Plot 13 - Threshold

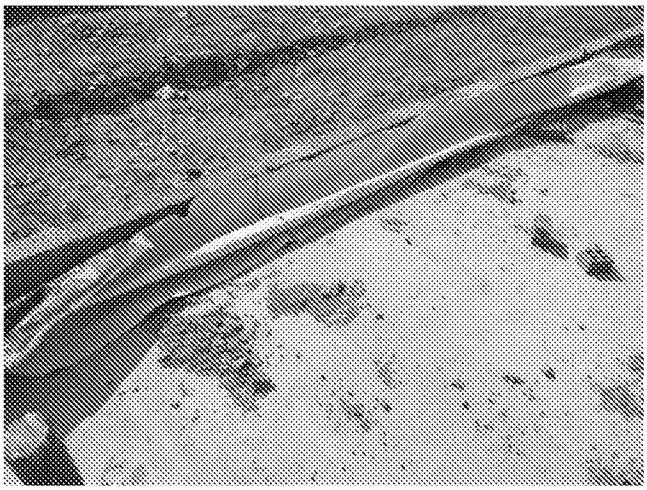
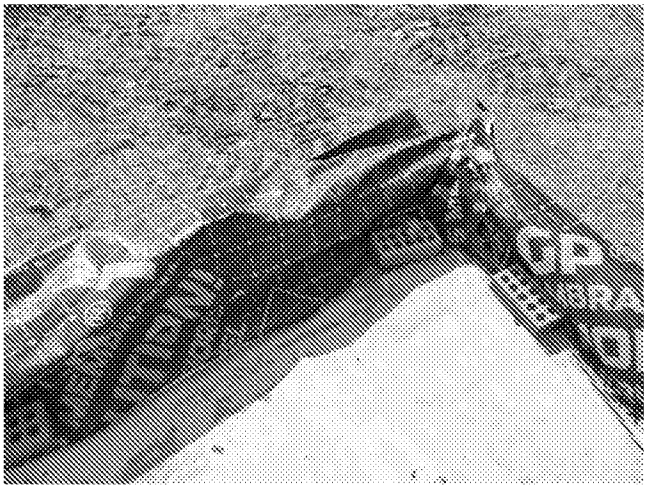
	Plot 13 - Patching
	Plot 13 - Under stairs
	Plot 15 - In progress

	Plot 15 - Under stairs
	Plot 15 - Floor swept and l good condition
	Plot 15 - Services sealed

	Plot 15 - Services sealed
	Plot 14 in progress
	Plot 14 in progress

	Plot 14 in progress
	Plot 14 in progress
	Plot 20-21(Phase 4) - View across plots

	Plot 20-21(Phase 4)
	Plot 20-21(Phase 4)
	Plot 20-21(Phase 4) - walls and doorway

	Plot 20-21(Phase 4) - Wind damage
	Plot 20-21(Phase 4) - Damaged membrane will be replaced before bitumen tape placement

5. PASS/FAIL

The gas protection measures inspected:	Are acceptable & comply with the specification
Details of issues	
Approved by	
Fiona Goode	[redacted]
Date	10/09/2020

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	13/07/2020, 13:37
Site Engineer Katie O'Dea	[redacted]
Weather at time of inspection	Warm, sunny, light breeze
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential houses.
Plot No.	22-27, 36-43
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Sub grade and membrane slightly dusty but in good condition.
1.2 Gas membrane type	Keytec 400 Gas Membrane
1.3 Gas membrane condition	Gas membrane in good condition with no visible damage.
Jointing tape product	Butyl tape to seal screw holes.
1.5 Lapping design	Min 150mm overlap.
1.6 Laps, welds and joints seals	All heated welds in good condition with no gaps.
1.7 Service seals	Bespoke seals using butyl tape. Some services had been marked with a road pin which needs to be cut out and sealed.

Engineer's Prelim Assessment (Mem)

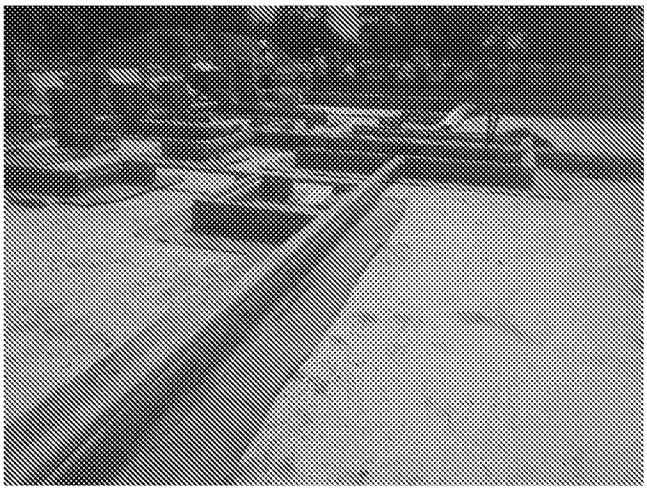
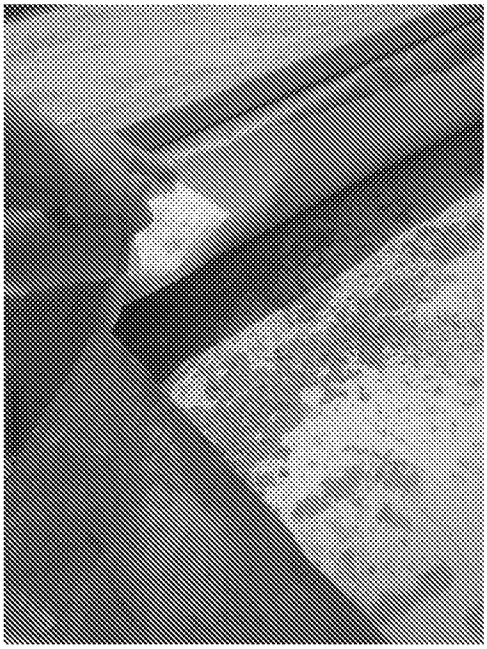
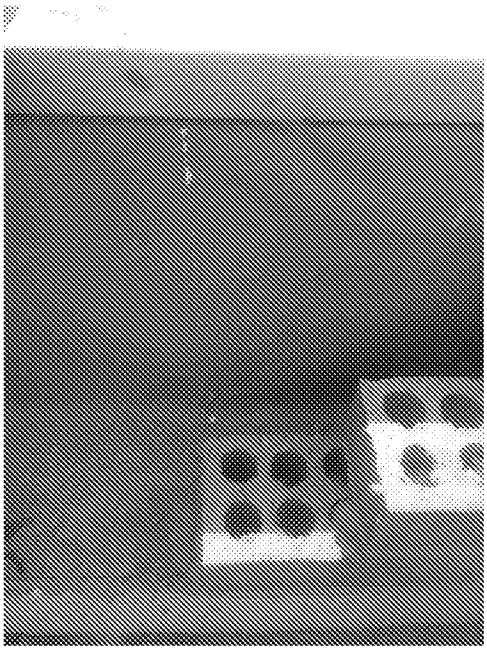
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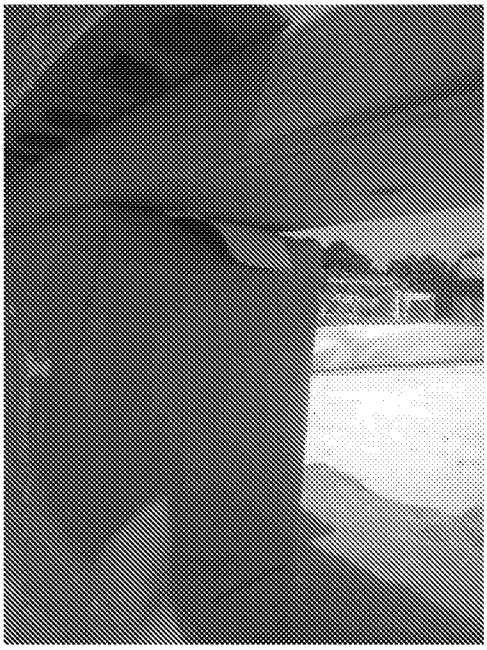
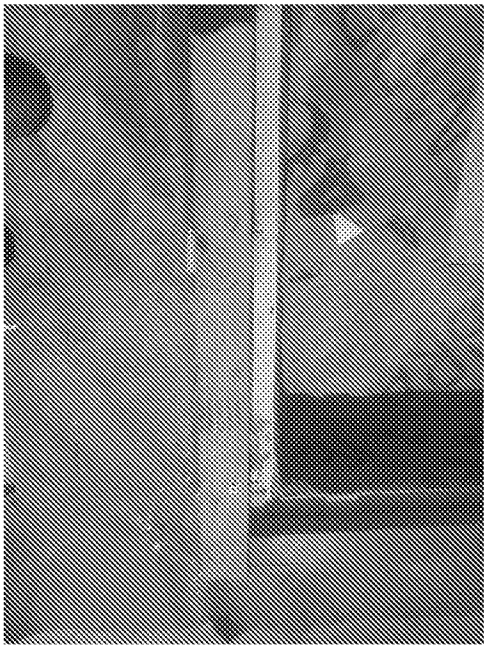
4. PHOTOGRAPHS

Photographs

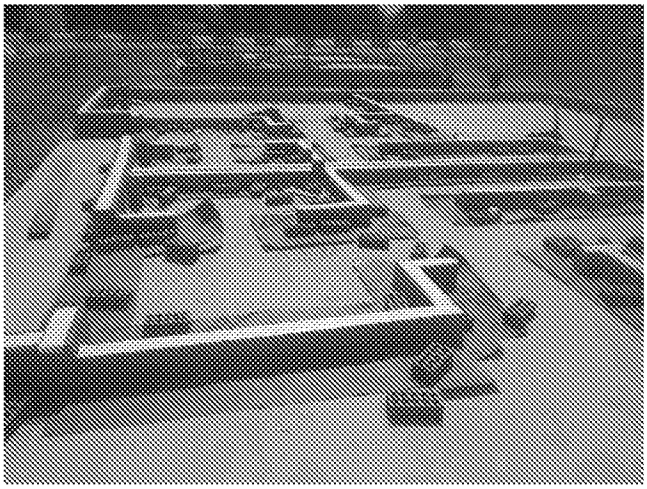
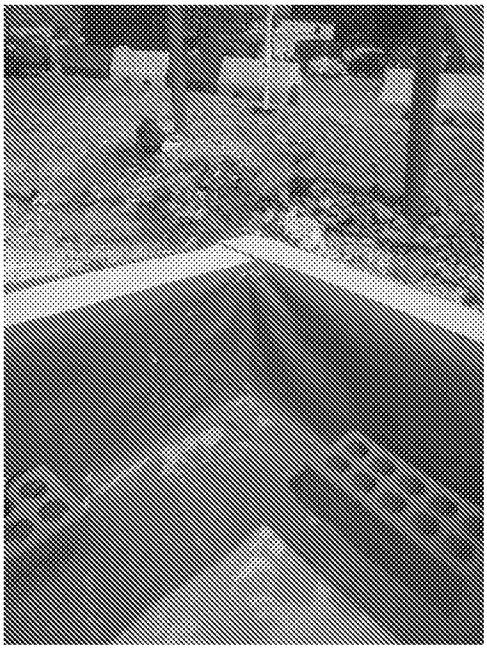
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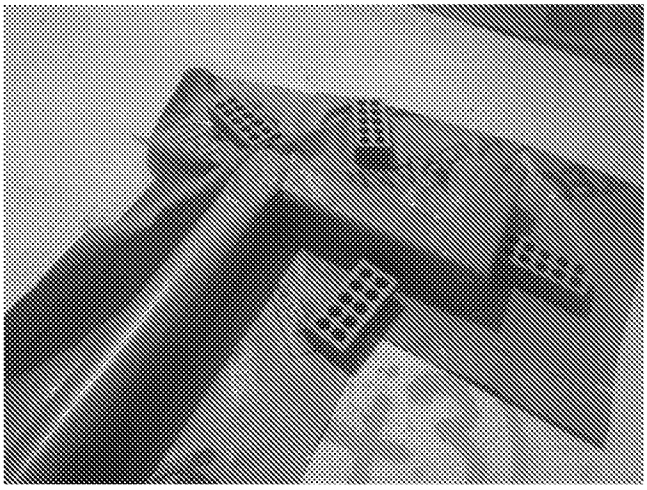
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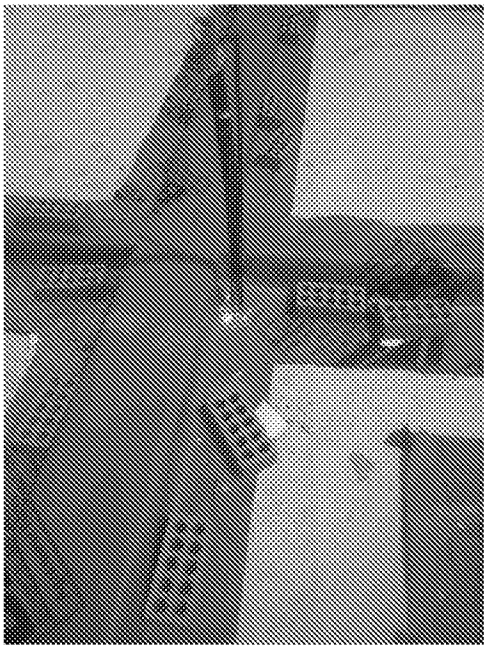
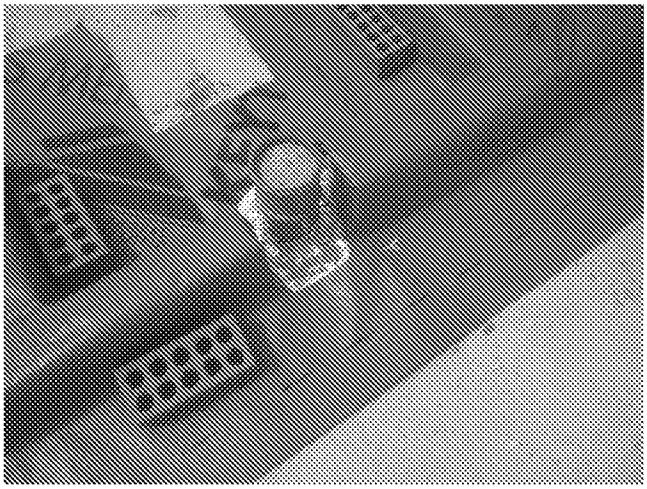
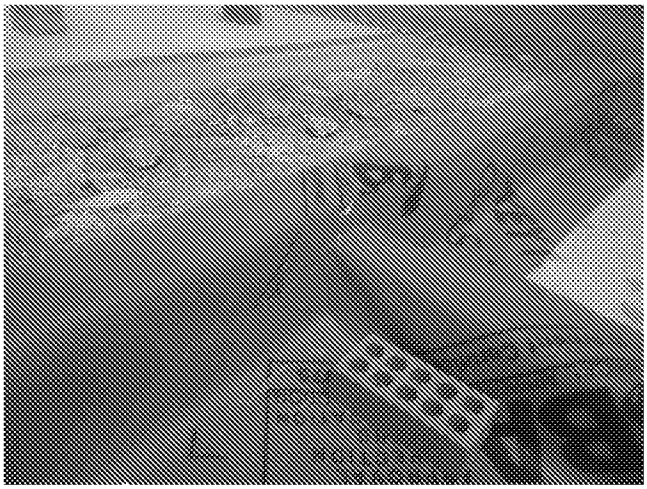
	Plots 36-37. View across plots.
	Plots 36-37. Example of underside of membrane.
	Plots 38-39. Example of weld.

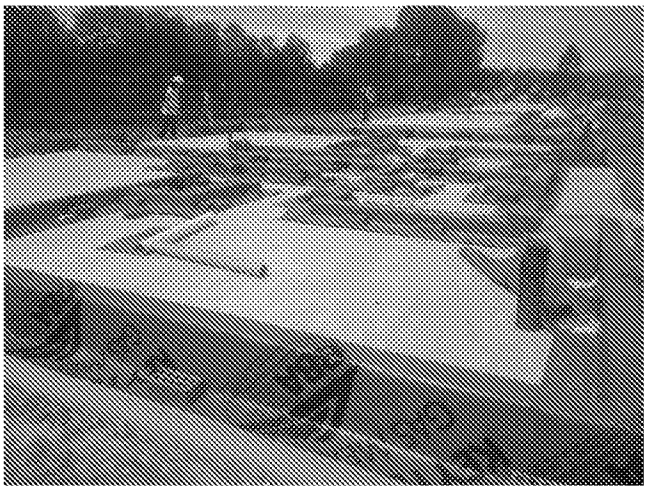
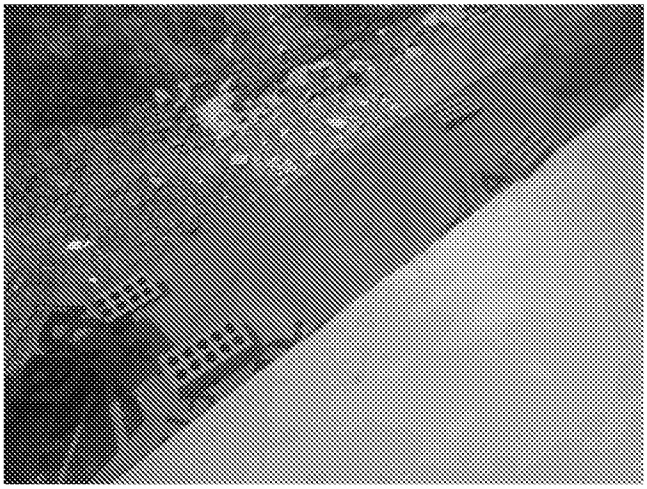
	Plots 38-39. Underside of wooden frame with butyl tape for sealing screws.
	Plots 38-39. Example of butyl tape under wooden frame.

	Plots 38-39. Service seal using foil backed butyl tape.
	Plots 38-39. Service seal using butyl tape.

	Plot 40-41. Servicing seal.
	Plots 40-41. View across Plots showing butyl tape laid out for fixture of wooden frame.
	Plots 40-41. Corner detail.

	Plots 42-43. View across plots.
	Plots 42-43. Corner detail.
	Plots 24-27. View across plots.

	Plots 24-27. Service seal. Road pin will be cut out.
	Plots 24-27. Service seal.
	Plots 24-27. Corner detail.

	Plots 22-23. View across plots.
	Plots 22-23. Threshold detail.
	Plots 22-23. Lapping over external wall.

5. PASS/FAIL

The gas protection measures inspected:

Details of issues

Approved by

No users

Date

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	05/08/2020, 15:35
Site Engineer	
Fiona Goode	[redacted]
Weather at time of inspection	Sunny, hot, breezy little cloud
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Flats and semi detached houses
Plot No.	Block B plots 66-77 (lift pit) and Plots 22 and 23
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Unable to see under side as sealed on lift pit. Underside of membrane on perimeter of Plots 22 and 23 in good condition
1.2 Gas membrane type	Keytec 400 gas resistant membrane
1.3 Gas membrane condition	Membrane in good condition
Jointing tape product	Heat sealed joins
1.5 Lapping design	150mm lap
1.6 Laps, welds and joints seals	All joins are heat sealed and well sealed around block work
1.7 Service seals	No services in lift pit. Services in plots 22 and 23 sealed with site formed taped seals. All well sealed

Engineer's Prelim Assessment (Mem)

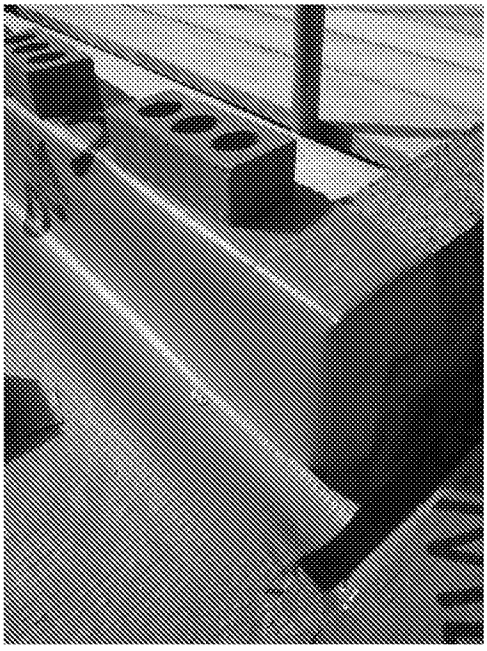
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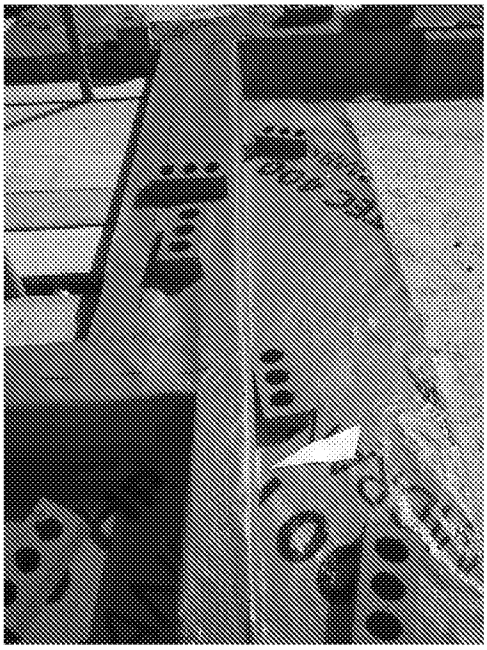
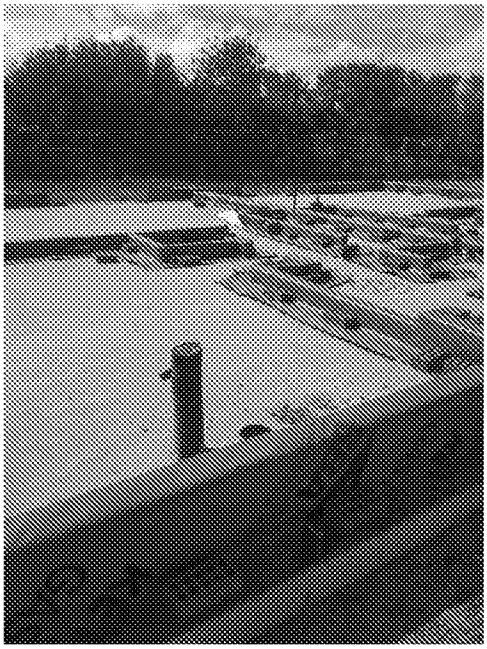
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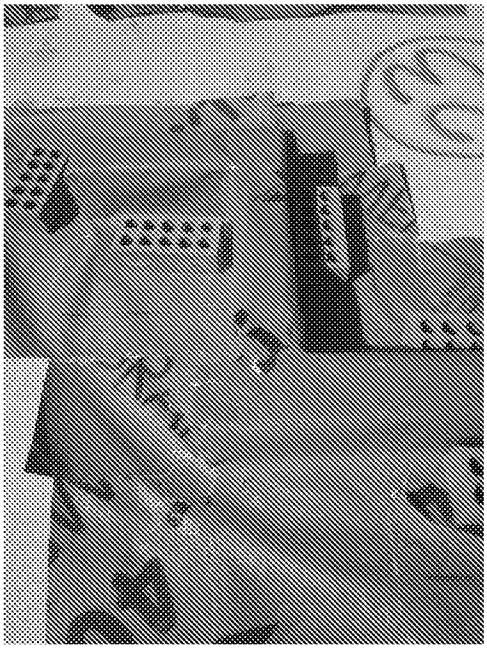
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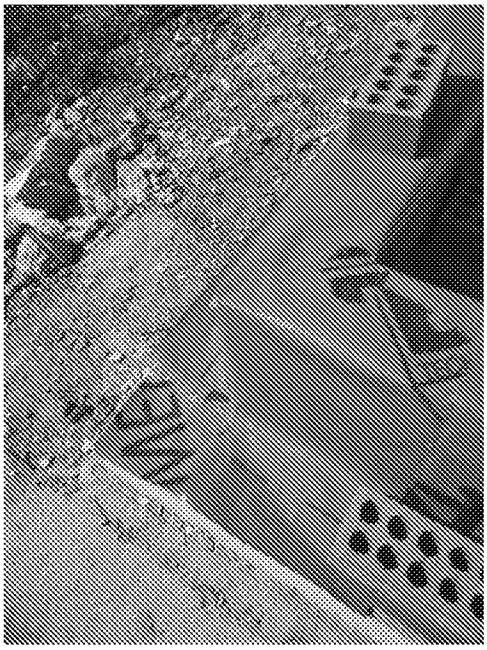
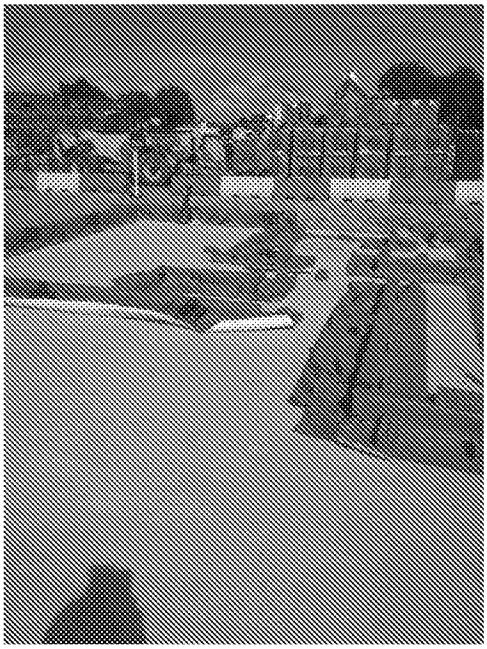
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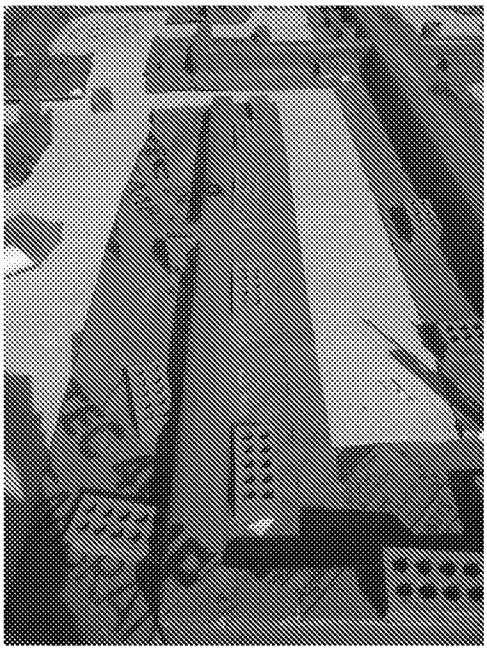
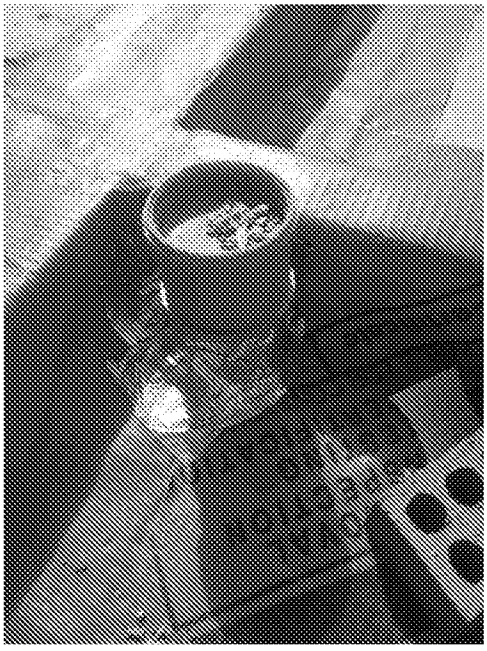
Photograph	*Photograph Title*

	Block B Overview
	Block B Block work

	Block B Rear of pit
	Plot 23

	Plot 23 services
	Plot 23 corners

	Plot 23 corner
	Plot 22 overview

	Plot 22 walls
	Plot 22 service detail

5. PASS/FAIL

The gas protection measures inspected:

Details of issues

Approved by

No users

Date

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	13/08/2020, 13:58
Site Engineer Fiona Goode	[redacted]
Weather at time of inspection	Overcast, humid, slightly breezy, warm
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Blocks of terraced housing
Plot No.	Plots 24-33 (perimeter)
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Underside in good condition
1.2 Gas membrane type	Keytech 400 gas resistant membrane- red
1.3 Gas membrane condition	Membrane in good condition some dust and mortar in places
Jointing tape product	Double sided tape on service seals all other joins heat sealed
1.5 Lapping design	150mm
1.6 Laps, welds and joints seals	Some seals came apart when pulled there are specific areas where remediation works are needed.
1.7 Service seals	Site formed seals with double sided tape

Engineer's Prelim Assessment (Mem)

Remedial Measures Required

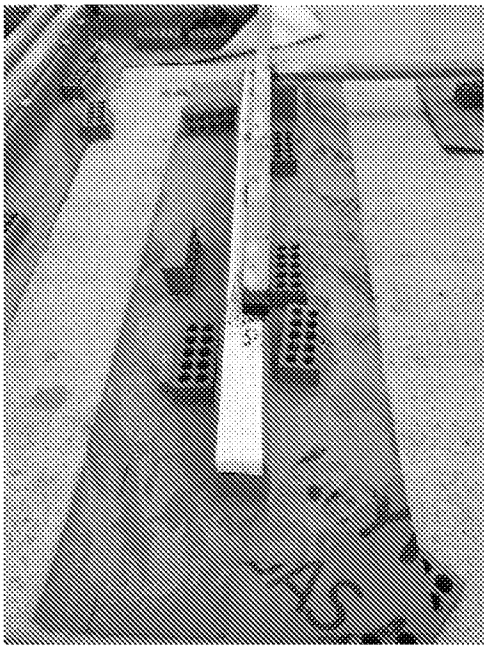
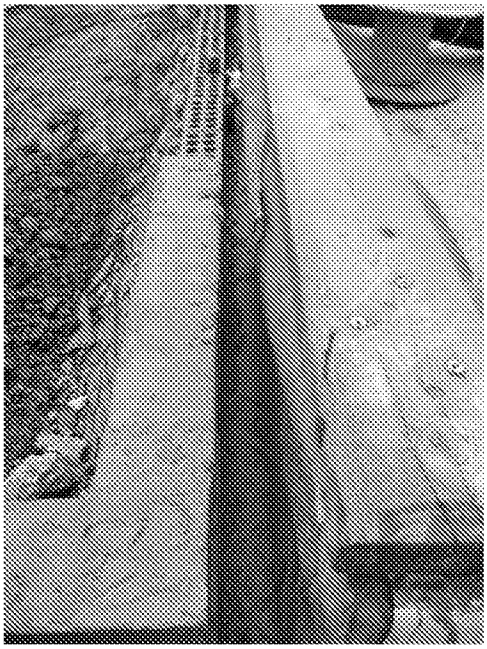
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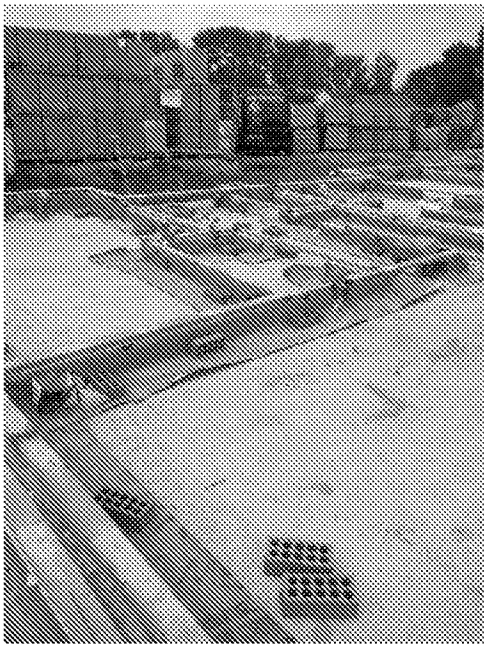
Photographs

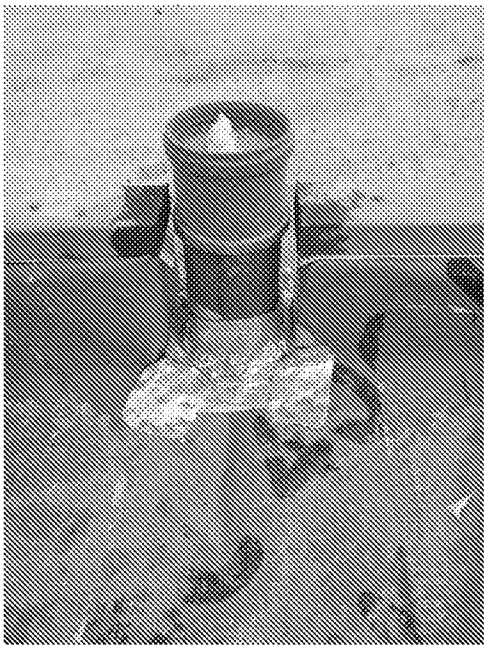
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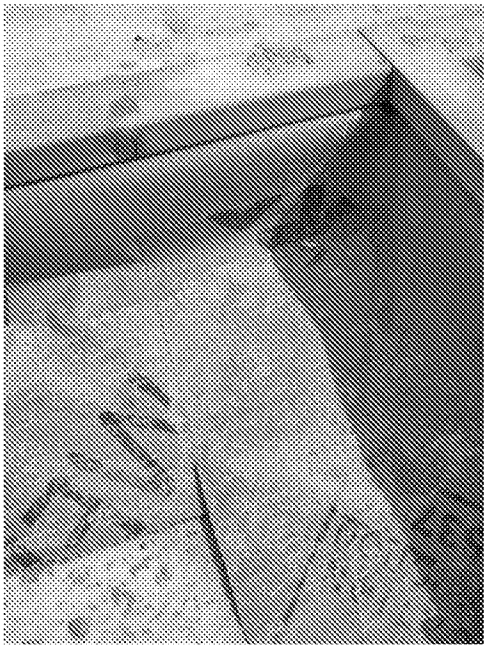
Photograph	*Photograph Title*

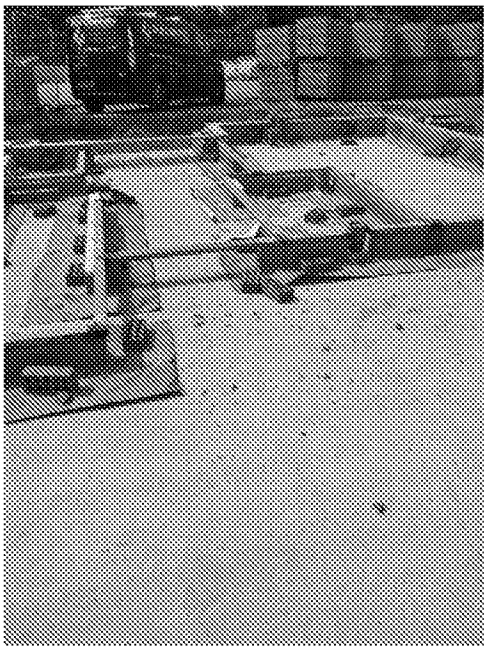
	Plot 24
	Plot 24 services

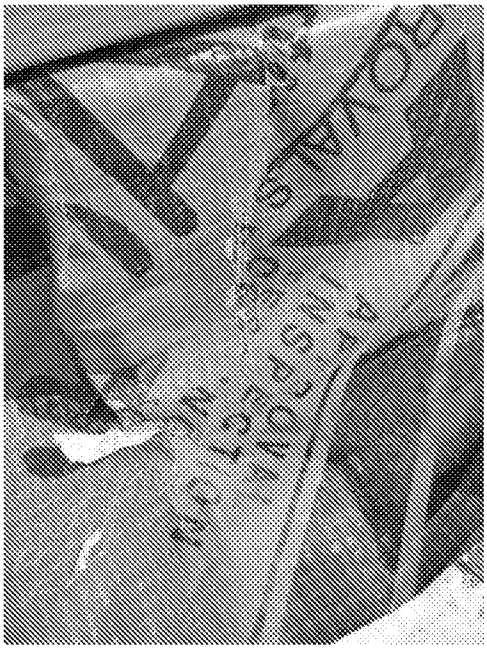
	Plot 24 tape for timber frame
	Plot 24 cavity

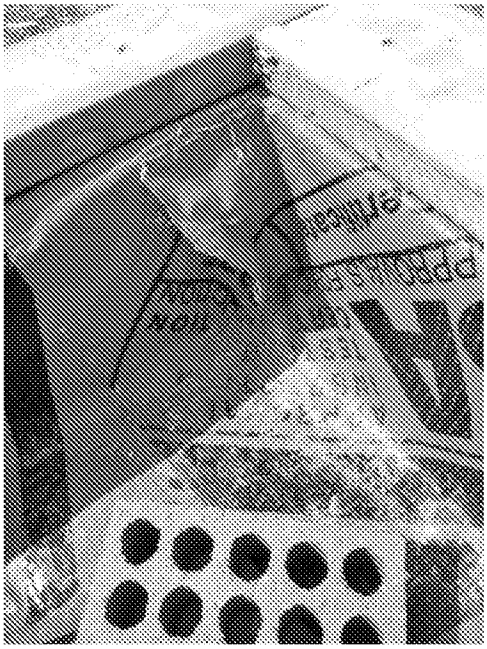
	Plot 25
	Plot 25 threshold

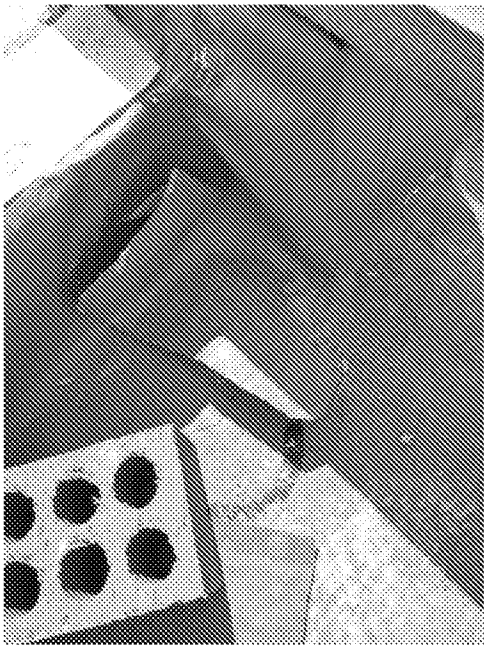
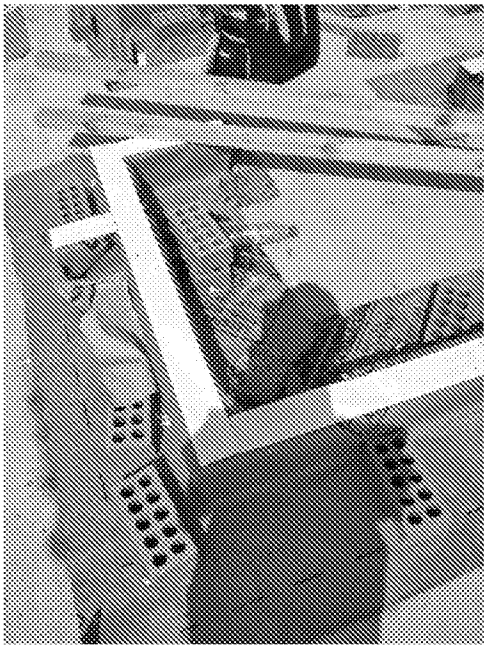
	Plot 25 service
	Plot 26

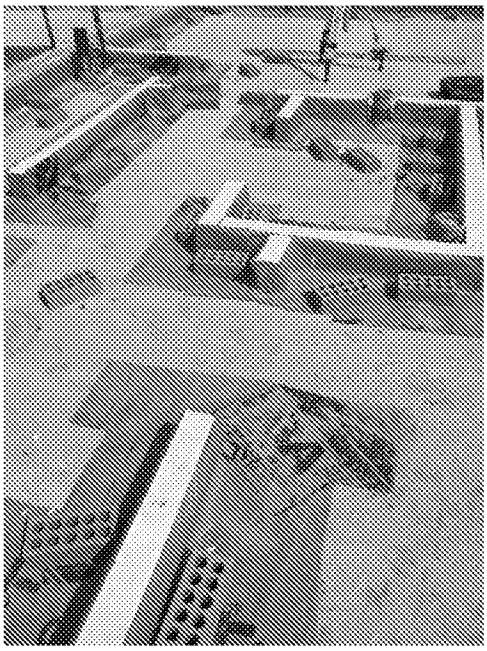
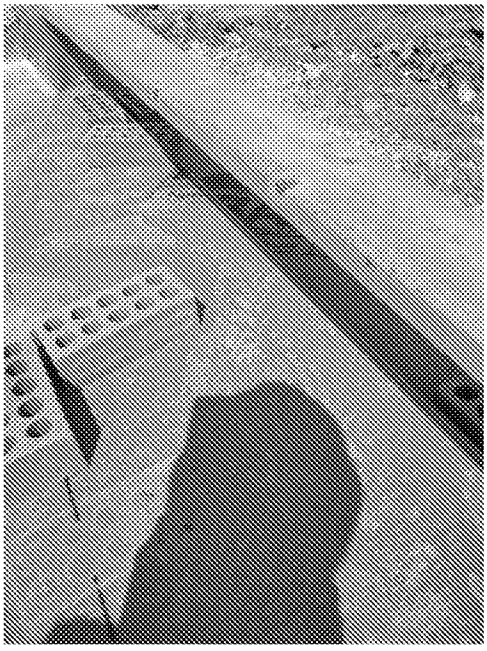
	Plot 26 corner
	Plot 26 lapping

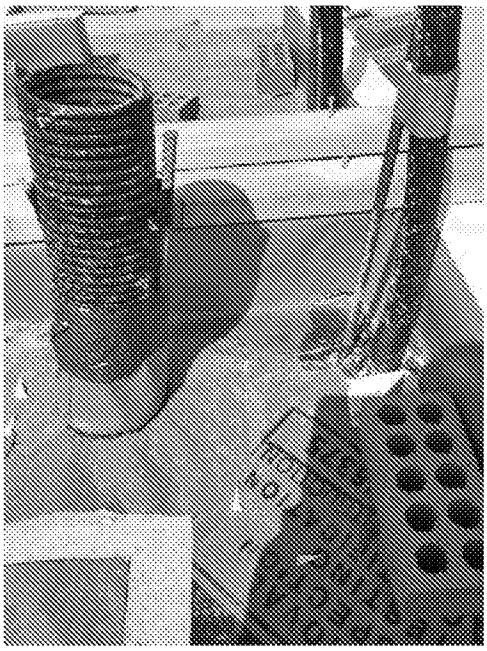
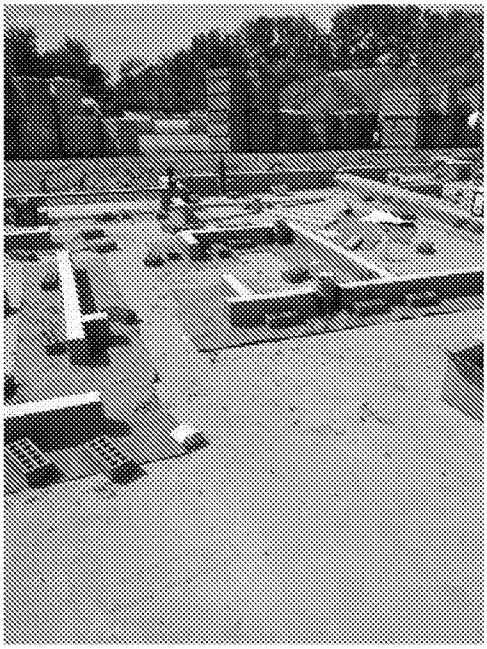
	Plot 27
	Plot 27 service

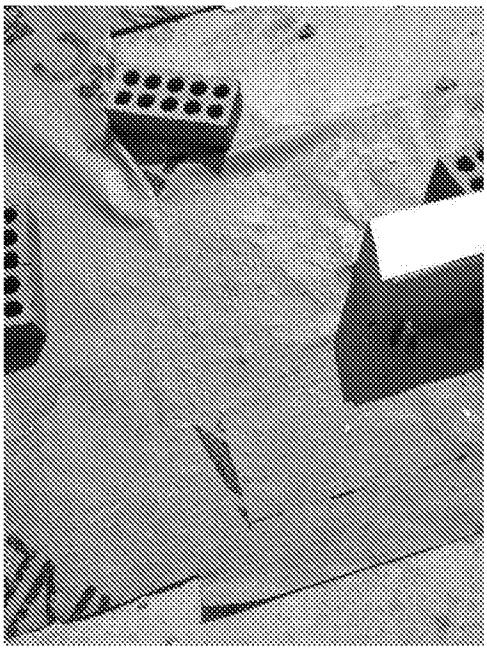
	Plot 27 damage
	Plot 27 corner damage

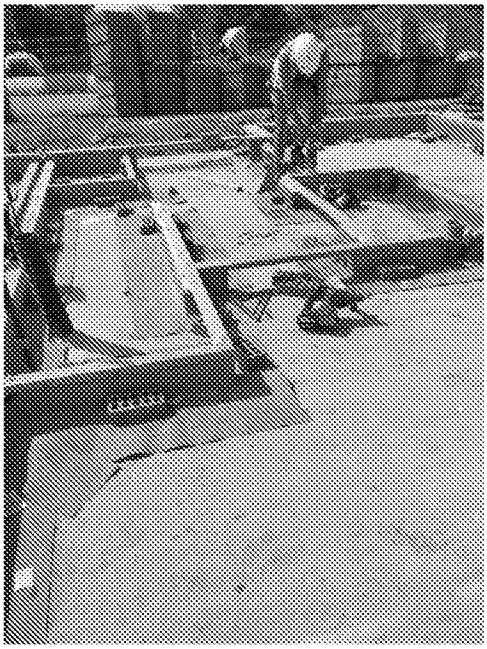
	Plot 28
	Plot 28 corner needs sealing

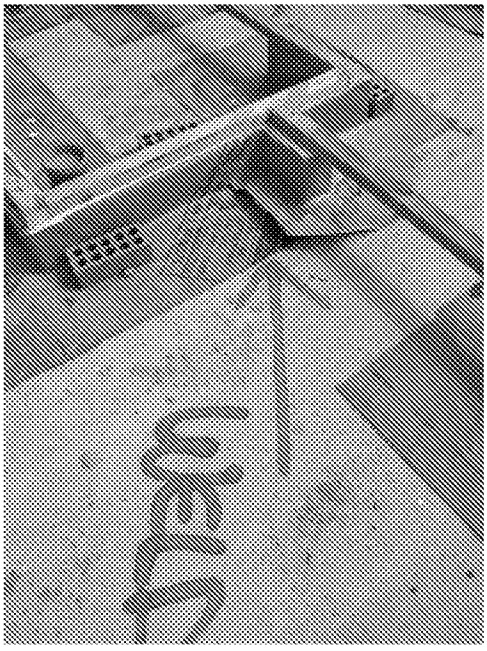
	Plot 28 lapping needs sealing
	Plot 28 tape for frame

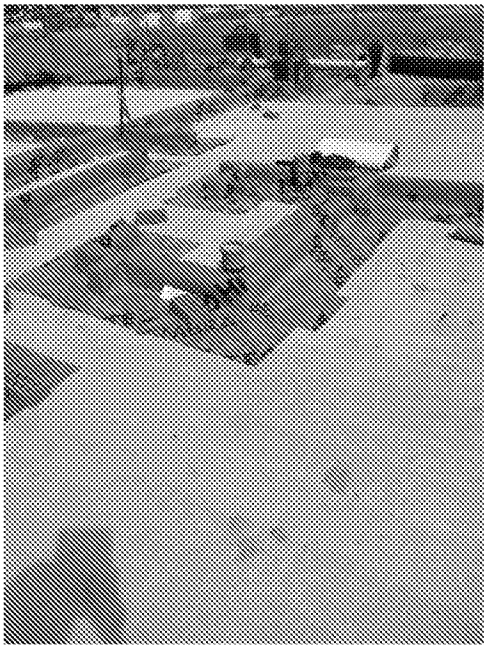
	Plot 29
	Plot 29 threshold

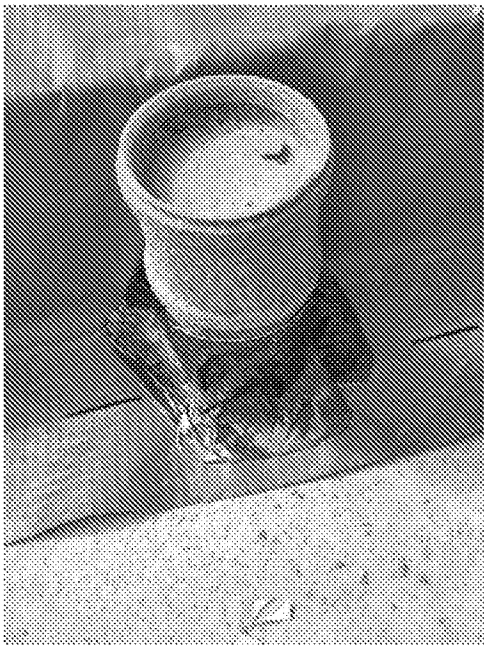
	Plot 29 services
	Plot 30

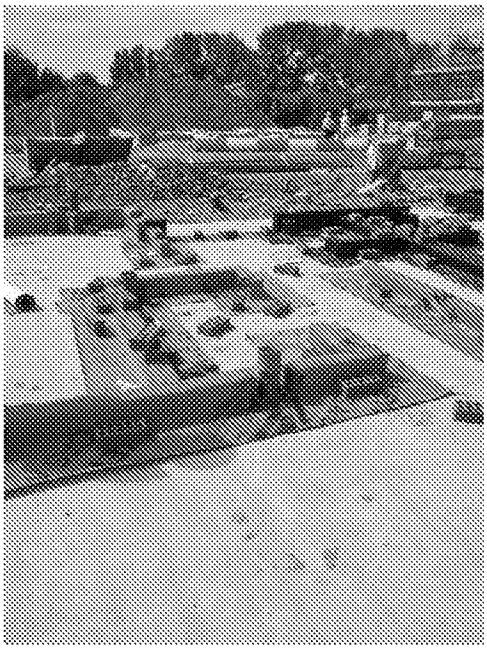
	Plot 30 joins
	Plot 30 services

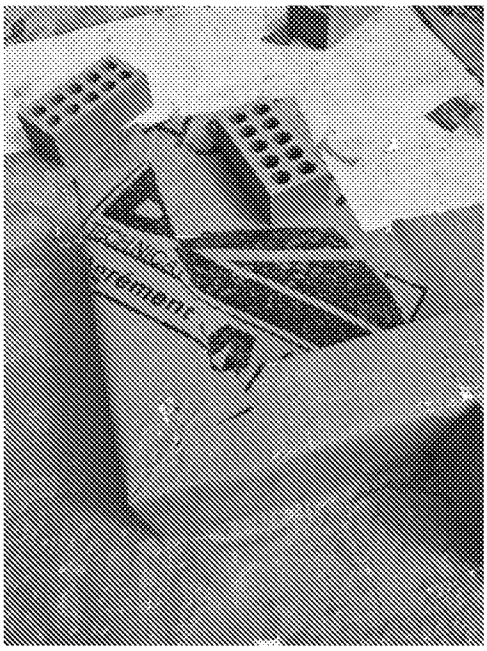
	Plot 30 corner
	Plot 31

	Plot 31 corner
	Plot 31 seal needs attention

	Plot 31 edge detail
	Plot 32

	Plot 32 service
	Plot 32 corner

	Plot 33
	Plot 33 service

	Plot 33 corner

5. PASS/FAIL

The gas protection measures inspected:

Details of issues

Approved by

No users

Date

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham Homes
Geo-Environmental Project Manager's Email	[redacted]
Date	01/10/2020, 11:52
Site Engineer	
William Hughes	[redacted]
Weather at time of inspection	Sunny
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential - terraced houses
Plot No.	Plots 36-37 complete, Plots 38-39 in progress
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Good condition. Membrane sealed in Plots 36-37
1.2 Gas membrane type	Keytec 400 HP
1.3 Gas membrane condition	Good condition. Any damage patched with tape
Jointing tape product	Heat welded joints
1.5 Lapping design	Min 150mm overlap
1.6 Laps, welds and joints seals	Welded joints sealed. In good condition
1.7 Service seals	Sealed using membrane and tape. All well sealed, no damage

Engineer's Prelim Assessment (Mem)

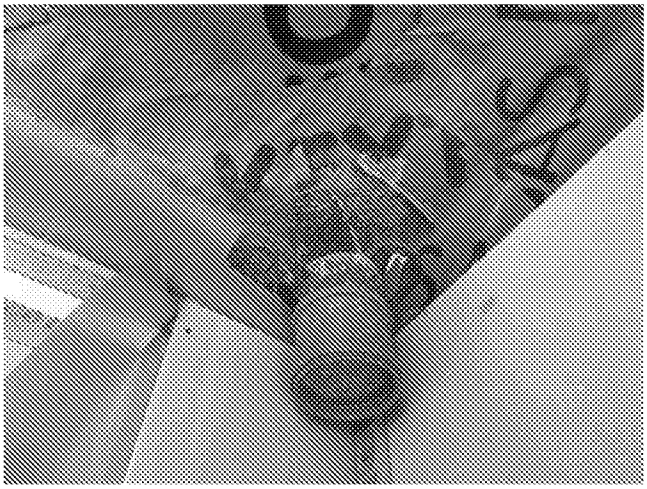
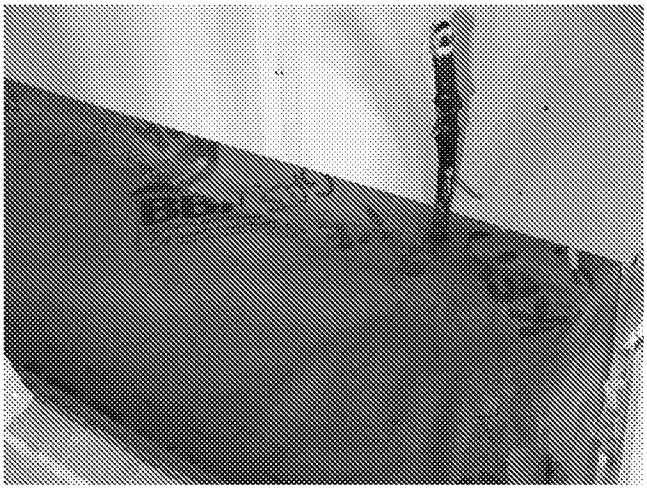
Pass

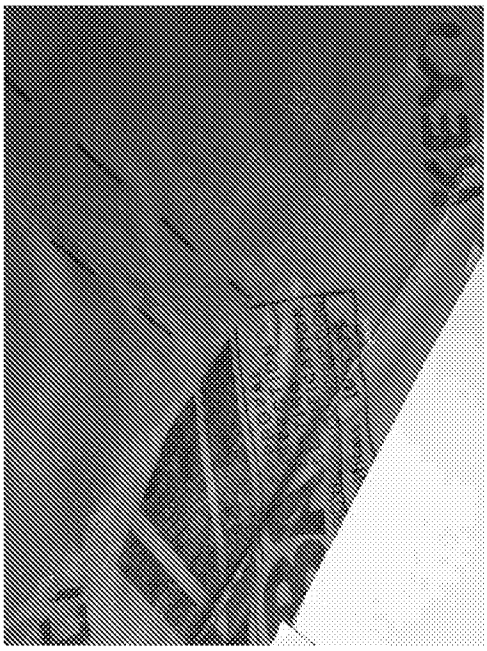
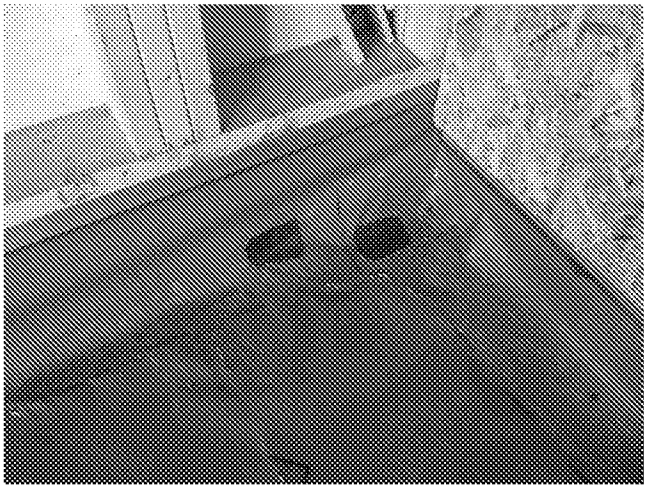
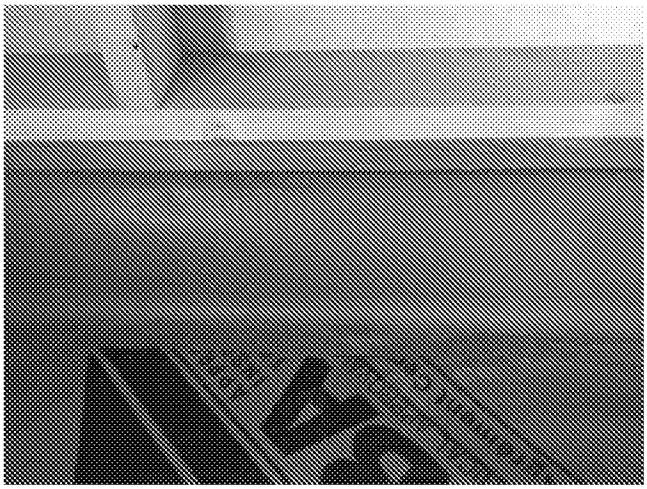
4. PHOTOGRAPHS

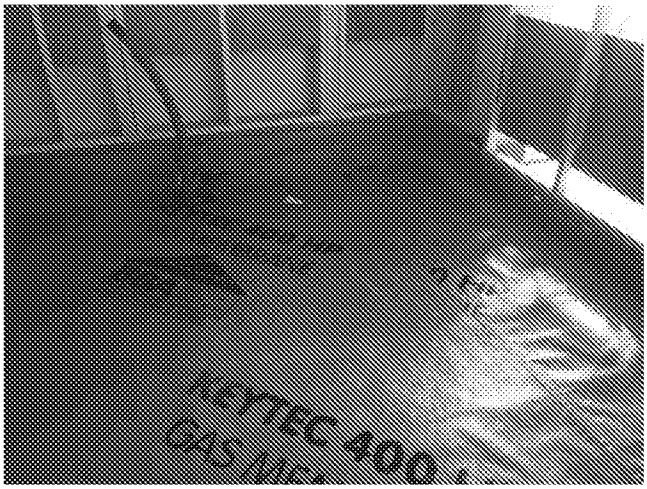
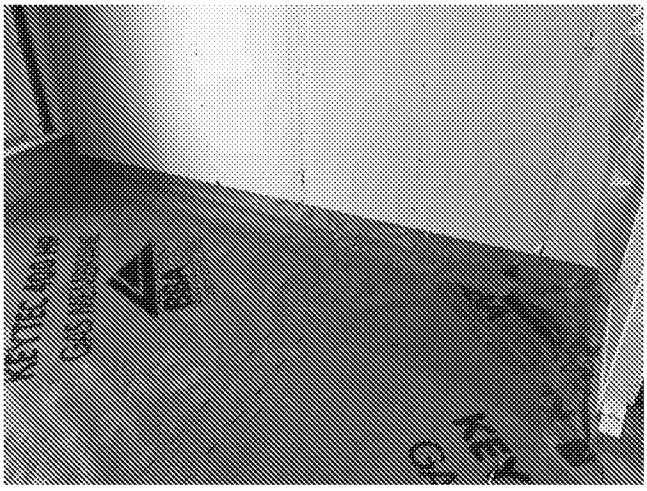
Photographs

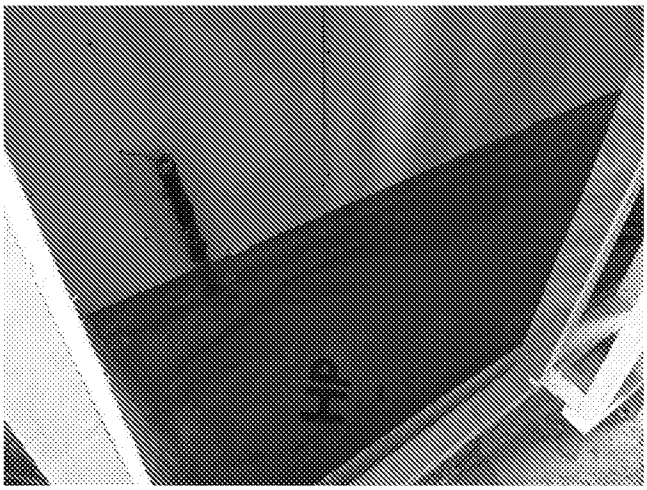
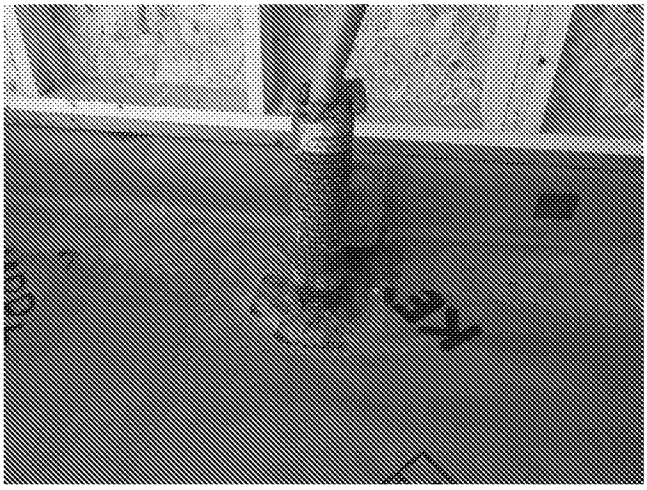
(14 records)

Photograph	*Photograph Title*

	Plot 36
	Plot 36 Service seal
	Plot 36 Under stairs

	Plot 36 Joins
	Plot 36 Patch repairs
	Plot 36 sides

	Plot 36 Front room
	Plot 37
	Plot 37 Joins and a patch repair

	Plot 37 Under stairs
	Plot 37 Service seal
	Plot 37 Front room

	Plot 38
	Plot 39 in progress

5. PASS/FAIL

The gas protection measures inspected:

Details of issues

Approved by

No users

Date

Geo-Environmental

Project Name	Cornfield Close
Project No.	GE18103
Client	Thakeham
Geo-Environmental Project Manager's Email	[redacted]
Date	15/10/2020, 12:17
Site Engineer	*No users*
Weather at time of inspection	Warm, dry, sunny
Gas Characteristic Situation	Characteristic Situation 2
Type of development and building/block checked	Residential.
Plot No.	40-42 complete, 43 inpl progress
Foundation Type	Suspended
Gas Protection Type	Passive
What is being inspected	[ ] Venting [X] Membrane [ ] Venting and Membrane

1. MEMBRANE

1.1 Condition of sub-grade and underside of membrane	Good condition where visible (Plot 42 & 43). Membranes sealed in Plots 40 & 41.
1.2 Gas membrane type	Red Keytec gas membrane.
1.3 Gas membrane condition	Good condition. Holes patched during inspection.
Jointing tape product	Heat welded joints.
1.5 Lapping design	Min 150mm overlap.
1.6 Laps, welds and joints seals	Welded joints well sealed and in good condition. Awaiting final site photos of Plot 43 complete.
1.7 Service seals	Service seals using membrane and tape. All in good condition

Engineer's Prelim Assessment (Mem)

Pass

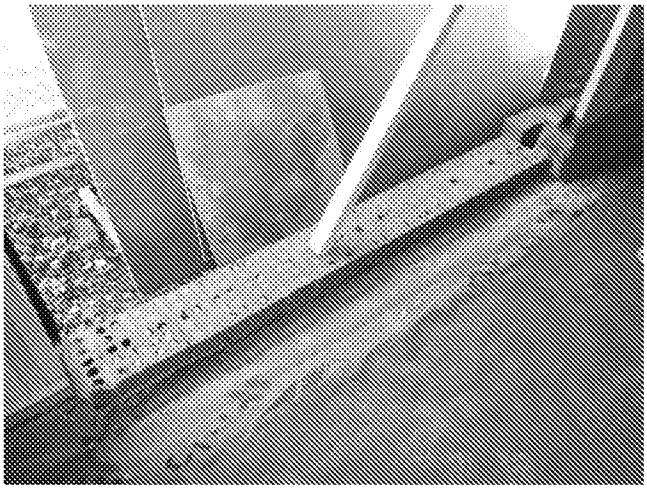
4. PHOTOGRAPHS

Photographs

(24 records)

Photograph	*Photograph Title*

	Plot 40 - floors sealed
	Plot 40 - example of service seal
	Plot 40 - Corner detail

	Plot 40 - under stairs
	Plot 40 - floors sealed
	Plot 40 - Threshold