EVANS Rivers and Coastal

PROPOSED DEVELOPMENT ACROSS LAND OFF KELVEDON ROAD, TIPTREE, ESSEX

FLOOD RISK ASSESSMENT AND SURFACE WATER DRAINAGE/SUDS STRATEGY

OCTOBER 2020

REF: 2229/RE/01-19/01 REVISION A

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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Marden Homes to carry out a Flood Risk Assessment and Surface Water Drainage/SUDS Strategy for a proposed development across land off Kelvedon Road, Tiptree, Essex.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; hydrological and hydrogeological assessments; surface water drainage designs; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

Report carried out by:

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1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Marden Homes to carry out a Flood Risk Assessment and Surface Water Drainage/SUDS Strategy for a proposed development across land off Kelvedon Road, Tiptree, Essex.

1.1.2 It is understood that this assessment will be submitted to the Planning Authority as part of a planning application. Specifically, this assessment intends to:

1) Carry out an assessment of the practical use of sustainable drainage (SUDS) measures using the relevant soil maps, software and other literature;

2) Determine the existing surface water drainage regime across the site using appropriate methods;

3) Develop a post-development management plan/drainage strategy for surface water across the site, which considers the use of SUDS and alternative methods of surface water disposal;

4) Make an assessment of the flood risk to the site during return period events up to the climate change enhanced 1 in 100 year storm event and recommend mitigation measures accordingly;

5) Carry out an appraisal of flood risk from any other sources such as groundwater as required by NPPF;

6) Report findings and recommendations.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated 2019. Other documents which have been consulted include:

- Woods-Ballard., et al. 2015. *The SUDS Manual, Report C753*. London: CIRIA.
- Woods-Ballard., et al. 2007. *The SUDS Manual, Report C697*. London: CIRIA.
- BS8582:2013 entitled *Code of practice for surface water management for development sites*.
- DEFRA document entitled *Sustainable Drainage Systems – Non statutory technical standards for sustainable drainage systems* dated March 2015.
- LASOO document entitled *Non statutory technical standards for sustainable drainage systems – Best Practice Guidance* dated 2015.
- DEFRA/EA document entitled *Rainfall runoff management for developments* dated 2013.
- Communities and Local Government 2007. *Improving the Flood Performance of New Buildings*. HMSO.
- DEFRA/EA document entitled *The flood risks to people methodology (FD2321/TR1),* 2006;

- EA *Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose*, 2008;

- National Planning Practice Guidance – Flood Risk and Coastal Change.

- Essex County Council's SUDS Design Guide dated 2020.

- Essex County Council Local Flood Risk Management Strategy (LFRMS) dated 2013.

- Essex County Council Preliminary Flood Risk Assessment dated 2011 (PFRA).

- Colchester Borough Council Strategic Flood Risk Assessment (SFRA) Appendix C Colchester Supplementary Report dated 2008.

- Colchester Borough Council Strategic Flood Risk Assessment (SFRA) Level 1 Update dated 2016.

- Colchester Town Surface Water Management Plan (SWMP) dated 2013.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- Ordnance Survey 1:10,000 street view map obtained via Promap (Evans Rivers and Coastal Ltd OS licence number 100049458).
- British Geological Survey, *Online Geology of Britain Viewer*.
- British Geological Survey, *Groundwater flooding susceptibility map.*
- British Geological Society, *BGS SuDS detailed data*.
- 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- Topographical survey carried out by J Taylor Ltd (shown at the end of this report).
- Anglian Water asset plans (Appendix B).
- Topographical survey carried out by BB Surveys Ltd (shown on Drawing Numbers 2219-1968-SU00, 2219-1968-SU01, 2219-1968-SU02, 2219-1968-SU03, 2219-1968-SU04, 2219-1968-SU05).
- Filtered LIDAR data at 1m resolution.
- Infiltration testing carried out by Geosphere Environmental (Appendix A).

3. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

3.1.1 The site is located across land off Kelvedon Road, Tiptree, Essex. The approximate Ordnance Survey (OS) grid reference for the site is 588663 216996 and the location of the site is shown on Figure 1.

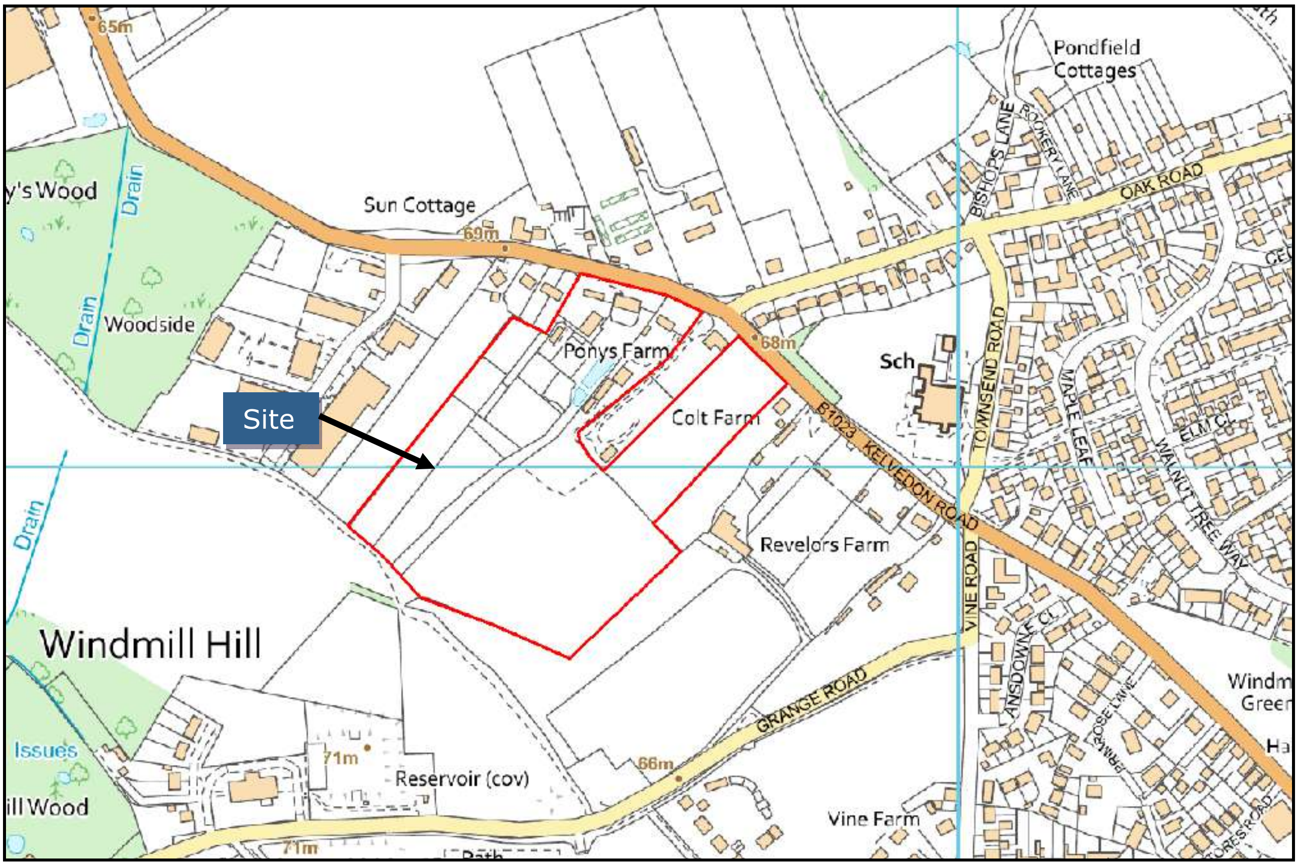

Figure 1: Site location plan (Source: Ordnance Survey)

3.1.2 The site is irregular in shape and covers a total area of approximately 5.11 ha. The site currently comprises Pony's Farm and grassed paddocks. The site is accessed via Kelvedon Road adjacent to the north eastern frontage of the site.

3.1.3 A topographical survey has been carried out by J Taylor Ltd (shown at the end of this report) and BB Surveys Ltd (shown on Drawing Numbers 2219-1968-SU00, 2219-1968-SU01, 2219-1968-SU02, 2219-1968-SU03, 2219-1968-SU04, 2219-1968-SU05). Ground levels are in metres above Ordnance Datum (m AOD). It can be seen that ground levels fall in a south easterly direction.

3.1.4 Filtered LIDAR data at 1m resolution has been obtained in order to determine and illustrate the topography across the site and surrounding area (Figure 2).

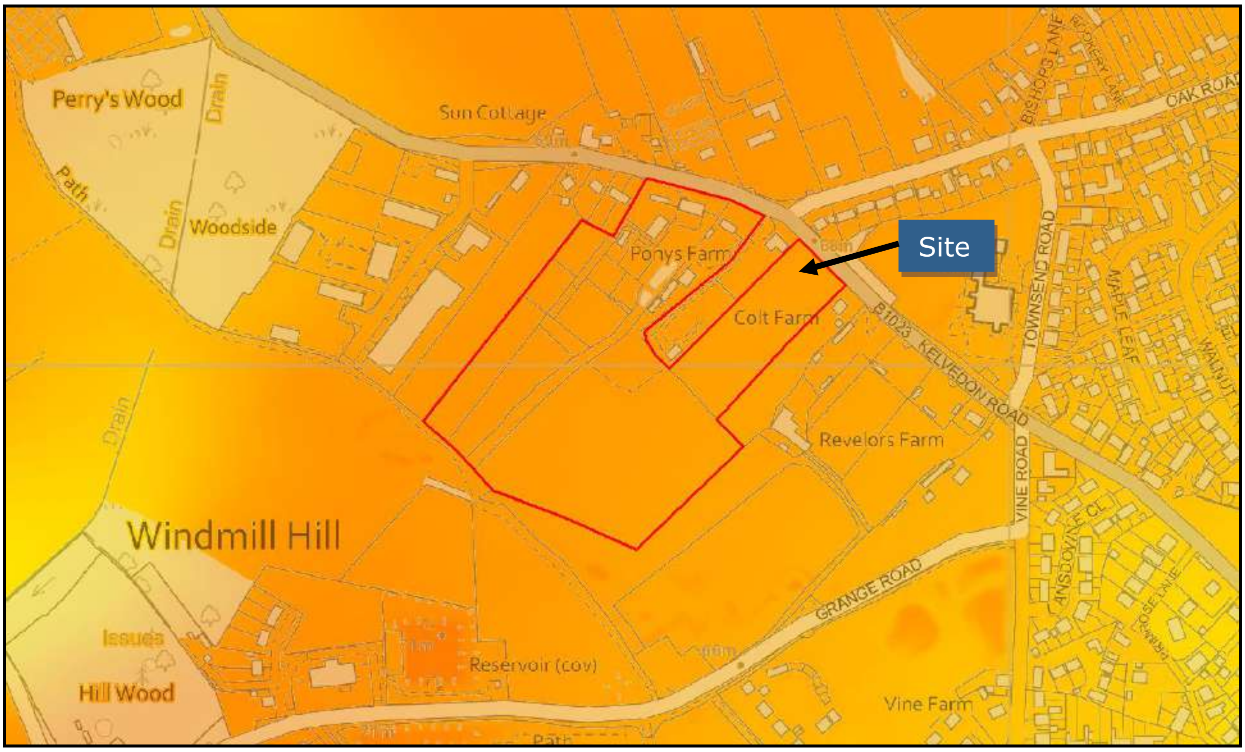

Figure 2: Filtered LIDAR survey data at 1m resolution where higher ground is denoted by red and orange colours and lower ground is denoted by yellow and green colours

3.2 Site Proposals

3.2.1 It is the Client's intention to develop the site with up to 130 residential dwellings, together with driveways, garages, access roads, open space and gardens.

3.2.2 Access will be provided from Kelvedon Road. The site proposals can be seen on Drawing Number 1432.300.00.

4. SOURCES OF FLOODING

4.1 Fluvial

4.1.1 The Environment Agency Flood Map (Figure 3) and Figure 2H/1 of the 2016 SFRA shows that the site is located within the NPPF Flood Zone 1, 'Low Probability' which comprises land as having less than a 1 in 1000 year annual probability of fluvial or tidal flooding (i.e. an event more severe than the extreme 1 in 1000 year event). NPPF states that all uses of land are appropriate in this zone.

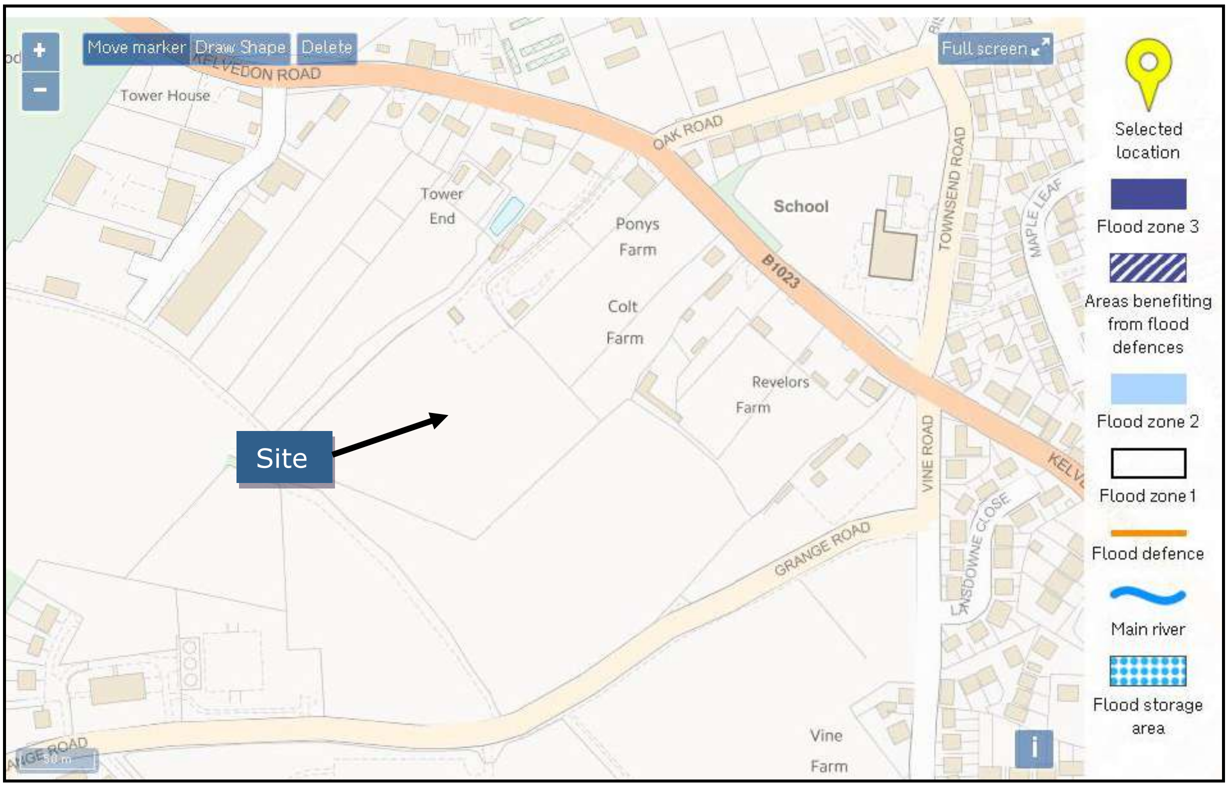

Figure 3: Environment Agency Flood Map (Source: Environment Agency)

4.2 Groundwater Flooding

4.2.1 In order to assess the potential for groundwater flooding during higher return period rainfall events, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

Soil and Geology at the Site

4.2.2 The infiltration testing report indicates that the soils beneath the site comprise topsoil overlying London Clay. No groundwater strikes were recorded during the intrusive investigation.

Groundwater Flooding Potential at the Site

4.2.3 There have been no recorded groundwater flood events across the area between 2000 and 2003, as indicated by the Jacobs study. The BGS Groundwater Flooding

Susceptibility Map indicates that there is "Limited Potential for Groundwater Flooding to Occur".

4.2.4 It is considered that the evidence suggests a low risk of groundwater flooding to the site.

4.3 Surface Water Flooding and Sewer Flooding

4.3.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewer thus causing it to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding. Surface water flooding can also occur as a result of overland flow across poorly drained rural areas.

4.3.2 Figure 2H/1 of the 2016 SFRA shows that there have been no recorded Essex County Council flood incidents within the vicinity of the site.

4.3.3 The Environment Agency's Surface Water Flooding Map (Figure 4) indicates that across the site and access there is a very low surface water flooding risk (i.e. chance of flooding less than 1 in 1000 years). Therefore, safe refuge and access/egress is available at all times.

Figure 4: Environment Agency Surface Water Flooding Map (Source: Environment Agency)

4.4 Reservoirs, Canals And Other Artificial Sources

4.4.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can also occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.

4.4.2 The Environment Agency's "Risk of flooding from reservoirs" map indicates that the site is not at risk from such features.

5. SURFACE WATER DRAINAGE AND SUDS

5.1 Introduction

5.1.1 Planning policy recommends the maximum practical use of Sustainable Drainage Systems (SUDS) within proposals for new sites. There is a requirement that sustainable drainage systems (SUDS) be installed where appropriate, in order to limit the amount of surface water runoff entering drainage systems and to return surface water into the ground to follow its natural drainage path.

5.1.2 The National Planning Policy Framework (NPPF) and the Environment Agency require that the effects of climate change to be considered in any assessment of flood risk for developments. When considering the impacts of climate change on rainfall intensity, Table 2 of the UK Government's climate change allowances guidance dated February 2016, advises that when designing surface water drainage systems, an increase in peak rainfall intensity of up to 40% should be considered.

5.1.3 In addition to the consideration of the design event for the SUDS techniques adopted in this report, the possibility of exceedance has been considered further in Section 5.8, and as outlined in CIRIA 635 entitled *Designing for exceedance in urban drainage – good practice,* and the CIRIA/HR Wallingford document entitled *Drainage of development sites – a guide* dated 2004. Although the guidance does not specify a return period event, the exceedance event is usually considered as the event which would exceed the design requirements of the drainage system in question. For example, SUDS attenuation/infiltration devices are usually designed to consider the climate change 1 in 100 year event and therefore the exceedance event in this instance could be considered as the 1 in 1000 year storm event.

5.2 Existing Surface Water Drainage

5.2.1 A detailed drainage survey is not available (and therefore the hydraulic characteristics and condition of the system cannot be determined), therefore in accordance with 2b of Section 24.5 of CIRIA 753, runoff from the site can be estimated using the urbanisation methods in the ReFH2 software.

5.2.2 In order to quantify the existing runoff rate from the site, the methodology outlined within the document entitled *The Revitalised Flood Hydrograph Model ReFH2 Technical Guidance* has been adopted. The document states that Table 24.1 of CIRIA 753 prefers FEH Methods over the IoH 124 Method, as they are more accurate when calculating peak flows within small catchments and plot scale Greenfield runoff calculations.

5.2.3 The method also uses the more up-to-date FEH13 Point rainfall data (which replaces the FEH99 data) which have been imported into the ReFH2.3 software from the FEH Web Service as well as the catchment descriptors (ReFH 2.3+ xml).

5.2.4 The total site area is 5.11 ha and as the site has existing roofs/hardstanding, the impact of these areas (3155 sq m) on existing runoff rates have been taken into account by using the Urbanisation tab within the ReFH2.3 software, as recommended in Section 9.3 of the technical guidance (for example the existing hardstanding area of 0.3155 ha was entered as well as an Imperviousness factor of 1 and Impervious Runoff Factor of 1).

5.2.5 When choosing either a winter or summer storm profile, the advice in Section 8.1 of the technical guide and Hydrosolutions support team suggests that winter profiles are used in all but the most heavily urbanised catchments (i.e. URBEXT greater than 0.3) in which a summer storm should be specified. The URBEXT value for the existing site has been calculated using the QMED Urbanisation tab in the WINFAP Version 4 software and equates to 0.03940 (based on an URBAN value of 0.06174). Therefore, the URBEXT value for the site is less than the URBEXT threshold of 0.3 and hence a winter storm should be used.

5.2.6 As the site area is less than 50 ha, Section 9.1.1 of the technical guidance has been followed in order for the results to be rescaled in accordance with the SUDS guidance (i.e. Tp updated to 3.251 and B_L updated to 38.885).

5.2.7 The results for the existing (urbanised) site have been extracted from the ReFH2.3 software and can be seen in Table 1. The (direct) runoff volume can also be calculated by specifying a storm duration of 6 hours and timestep of 8 minutes.

Table 1: Runoff rates and volumes for the existing site using ReFH2.3

Return Period	Runoff rate (l/s)	Runoff volume for 6 hour event (cu m)
1	14.4	277
2	16.4	319
30	33.8	685
100	43.2	887
100+40%CC	62.4	1300

5.3 Soil Types and SUDS Suitability

5.3.1 Part H of the Building Regulations and Section 3.2.3 of CIRIA 753 prioritises discharges to the ground and then a watercourse, with discharge to a sewer only to be considered when both infiltration and discharge to a watercourse is not reasonably practicable.

5.3.2 The infiltration testing report indicates that the soils beneath the site comprise topsoil overlying London Clay. No groundwater strikes were recorded during the intrusive investigation. The test results in Appendix A yielded no appreciable infiltration across the site.

5.3.3 Therefore, due to the soil types/infiltration capacity across the site, there is a stronger case to implement an attenuation SUDS solution at the site instead of an infiltration SUDS solution.

5.3.4 The topographical survey shows a drainage ditch running in a south westerly direction through the middle of the site. However, the ditch abruptly ends along part of the south western frontage of the site. To the south of the site at this location another ditch exists and runs in a south easterly direction away from the site and towards Grange Road. However, there is no obvious connection between the two ditches and the land between the site and the other ditch is under the control of a third party making it unviable to discharge to this ditch system.

5.3.5 The Anglian Water asset plans (Appendix B) shows that the closest public surface water sewer is located 452m east and within Maple Leaf. Therefore, an attenuated discharge will be directed into this sewer.

5.3.6 Lined permeable paving (in the form of permeable block paving, porous asphalt or grass reinforcement/plastic grids with gravel - See Section 20.1.3 of CIRIA 753) used for attenuation and water quality could be used to construct the proposed hardstanding areas such as driveways and private access roads. Surface water from building roofs could then be drained onto, or into, the permeable paving directly thus providing additional water quality treatment. This approach is described further in CIRIA 582 entitled *Source control using constructed pervious surfaces.*

5.3.7 Surface water from the permeable paving and proposed public access roads (which would be constructed using conventional building materials) could be directed to a detention basin located across the large open space area.

5.3.8 An attenuated discharge will be directed into the Anglian Water sewer within Maple Leaf. Anglian Water will need to be approached in due course in order to determine preferred connection points.

5.4 Pervious Surfaces

5.4.1 The proposed hardstanding areas comprising driveways and private access roads could be constructed using lined pervious paving such as permeable block paving or grass reinforcement/plastic grids with gravel as discussed further in Section 20.1.3 of CIRIA 753, which will be used for attenuation rather than infiltration (Type C). Surface water from the proposed building roofs could then be drained onto, or into, these surfaces directly. This approach is described further in CIRIA 582 entitled *Source control using constructed pervious surfaces.*

5.4.2 The Building Regulations state that "infiltration devices should not be built within 5m of a building or road or in areas of unstable land". However, the CIRIA Susdrain factsheet entitled "Using SUDS Close to Buildings", suggests that the 5m rule was originally devised for soakaways, as these devices concentrate runoff into a quite small area of ground (i.e. point infiltration), whereas permeable paving acts as a blanket and promotes diffuse infiltration.

5.4.3 The aforementioned CIRIA Susdrain document continues to state that permeable paving that collects and drains rainwater falling directly on it can be used against any building providing there is no point source of water from any other impermeable surfaces connected to it. Despite this, the document also states that allowing water to soak into the ground close to foundations should always be done in consultation with a geotechnical advisor or registered ground engineering professional (also acknowledged in Section 25.2.3 of CIRIA 753). This issue does not apply when using permeable paving for attenuation/cleansing purposes only such as in this case.

5.4.4 The Interpave document entitled *Understanding permeable paving: Guidance for designers, planners and local authorities* dated 2010, suggests that permeable paving can permit a flow rate of up to 4000mm/hr. The system shown on Figure 5 allows for the complete capture of water using an impermeable, flexible membrane placed on top of the subgrade level and up the sides of the permeable sub-base.

5.4.5 A hydraulically bound coarse aggregate base will be required to withstand heavy vehicles. Figure 6 shows the typical dimensions of the permeable paving for this load category.

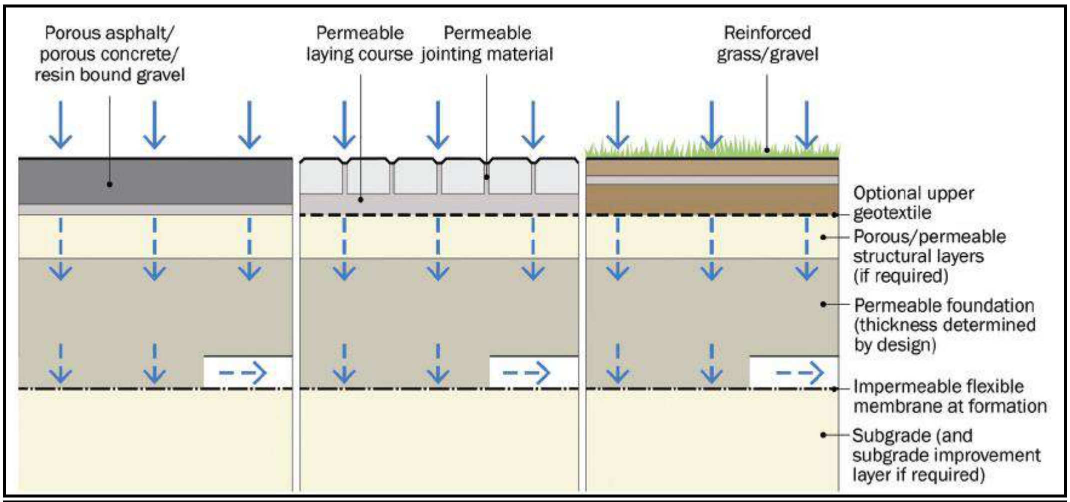

Figure 5: Section through a pervious surface (Source: Figure 20.14 of CIRIA 753)

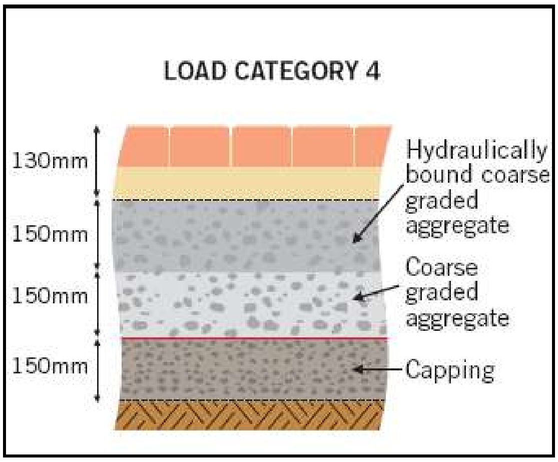

Figure 6: Section through a permeable surface for expected load category (Source: Interpave *Permeable pavements – guide to the design construction and maintenance of concrete block permeable pavements* dated 2010)

5.5 Detention Basin

5.5.1 Surface water from the permeable paving and proposed public access roads (which would be constructed using conventional building materials) could be directed to a detention basin located across the large open space area.

5.5.2 Dry detention basins are discussed further in Chapter 22 of CIRIA 753 and Table 1 of BS8582:2013 and are effective when providing temporary storage and controlled release of detained runoff. Such features are normally vegetated and are mainly dry except during and immediately after storm events. Detention basins can be used for more than one purpose according to Section 22.6 of CIRIA 753 (e.g. play areas). Section 22.4 of CIRIA 753 states that detention basins can be sized to provide flood attenuation for all events up to the 1 in 100 year event and with discharges being constrained to the equivalent Greenfield rate.

5.5.3 Anglian Water will need to be approached in due course in order to determine preferred connection points. It is understood from the ECC SUDS Design Guide that when discharging into an Anglian Water sewer then the discharge rate should be as close to the greenfield 1 in 1 year runoff rate as possible with a minimum final outlet size limit of 75mm.

5.5.4 The DEFRA/EA document entitled *Rainfall runoff management for developments* dated 2013, and BS8582:2013 advise that the post-development site should aim to try and replicate the undeveloped state and that for Greenfield sites, the peak runoff rate from the developed site for the 1 in 1 year event and 1 in 100 year event should be constrained to the equivalent peak Greenfield runoff rate to minimise the impact on the receiving watercourse.

5.5.5 The guidance states that when considering volume control, the volume discharged from the site for the 1 in 100 year, 6 hour event is constrained to the equivalent volume associated with the Greenfield condition.

5.5.6 The ECC SUDS Design Guide states that in all cases, including brownfield sites, wherever practicable the runoff rate should be restricted to the Greenfield 1 in 1 year rate.

5.5.7 The aforementioned guidance and Section 24.10 of CIRIA 753 states that where the additional volume from the development cannot be used or disposed of on-site (e.g. through infiltration or rainwater harvesting) such as in this case, to avoid an increased runoff volume from developed areas into the sewer system, this volume should be discharged at a very low rate.

5.5.8 Therefore, the guidance recommends that:

a) The additional volume resulting from the development (i.e. long term storage volume) should be discharged at a rate of 2 l/s/ha (or less); or

b) <u>*ALL*</u> the runoff for the 1 in 100 year event from the site should be discharged at a rate of 2 l/s/ha or QBAR (whichever is greater).

5.5.9 In order to provide effective attenuation from the site it is proposed that the runoff from the proposed site will be discharged in accordance with criterion b) above.

5.5.10 The contributing total hardstanding area has been calculated as 21444 sq m. Runoff from the contributing hardstanding areas is assumed to be 100% (i.e. 100% PIMP and no infiltration into the ground) and permeable parts of the developed site such as garden areas will be profiled so that they do not enter the drainage system (see Section 5.9). Therefore, in accordance with Section 24.2 of CIRIA 753 permeable areas will not contribute to the drainage system and have therefore not been included in the calculations.

5.5.11 The equivalent Greenfield runoff rate for the contributing area has been calculated using the same methodology outlined in Section 5.2 (using 'As rural' results and not the Urbanisation Tab). The results can be seen in Table 2.

Table 2: Greenfield runoff rate equivalent for contributing area using ReFH2.3

Return Period	Runoff rate (l/s)	Runoff volume for 6 hour event (cu m)
1	5.55	105
2	6.32	121
30	13	262
100	167.	340
100+40%CC	24.2	504

5.5.12 Table 2 shows that the equivalent 1 in 2 year runoff rate (i.e. similar to QBAR) is 6.32 l/s and when considering 2 l/s/ha the rate is 4.29 l/s. The 1 in 1 year runoff rate is 5.55 l/s.

5.5.13 Therefore, a discharge from the proposed site will be set to 5.55 l/s to comply with the ECC guidance.

5.5.14 The basin has been designed in accordance with CIRIA 753 and ECC SUDS Design Guide, which requires the basin to have a depth of up to 1.2m and maximum side slopes of 1 in 3. Section 22.2 of CIRIA 753 recommends that the maximum depth of water within the basin should not exceed 2m and side slopes should not exceed 1 in 3. In this case, the maximum depth of the basin below the existing ground level has been limited to 1m and side slopes of 1 in 4 have been modelled for safety reasons.

5.5.15 It should be noted that the MicroDrainage support team has confirmed that the software does not allow the 1 in 1 year event to be modelled when using FEH13 data and hence the 1 in 2 year event has been chosen instead.

5.5.16 Additionally, a 10% increase in impermeable area has been included in order to consider urban creep as specified by BS8582:2013 and Section 24.7.2 of CIRIA 753 (i.e. total contributing area increases to 23588 sq m).

5.5.17 In order to determine the size of the basin during the 1 in 100 year plus climate change event, the *Source Control – Tank/Pond* function within the Microdrainage software, Version 2020.1, has been used together with the Point rainfall data extracted from the FEH Web Service. The results can be seen in Appendix C and Table 3.

5.5.18 Table 3 shows that during the climate change 1 in 100 year event the storage depth would be greater than the top of the basin. Therefore, in order to prevent flooding of the surrounding area during this event, it is proposed that a low wall of 0.2m height is placed around the basin perimeter. This requirement can be assessed further at detailed design stage when the attenuation benefits of the paving and pipe system are taken into account.

Table 3: Attenuation calculations

Return Period	Post-development discharge rate (l/s)	Storage volume/Discharge volume (cu m)	Storage depth (m)	Total Depth (m)	Area covered (sq m)
1 in 2 year event.	5.55	471/574.5	0.369	1 (plus 0.2m wall)	1850
1 in 30 year event.	5.55	931.9/879.3	0.676	1 (plus 0.2m wall)	1850
1 in 100 year event.	5.55	1225.6/806.9	0.851	1 (plus 0.2m wall)	1850
1 in 100 year event plus (40%) climate change event.	5.55	1783.9/849.5	1.158	1 (plus 0.2m wall)	1850

5.5.19 Table 20.1 of CIRIA 753 indicates that it may be possible for the pervious paving to incorporate partial infiltration (Type B) in order to help with interception (i.e. the capture and retention of the first 5mm of rainfall), although this cannot be factored into the storage design. Section 13.4.2 of CIRIA 753 states that infiltration can play an important role in providing interception even on sites with low infiltration rates.

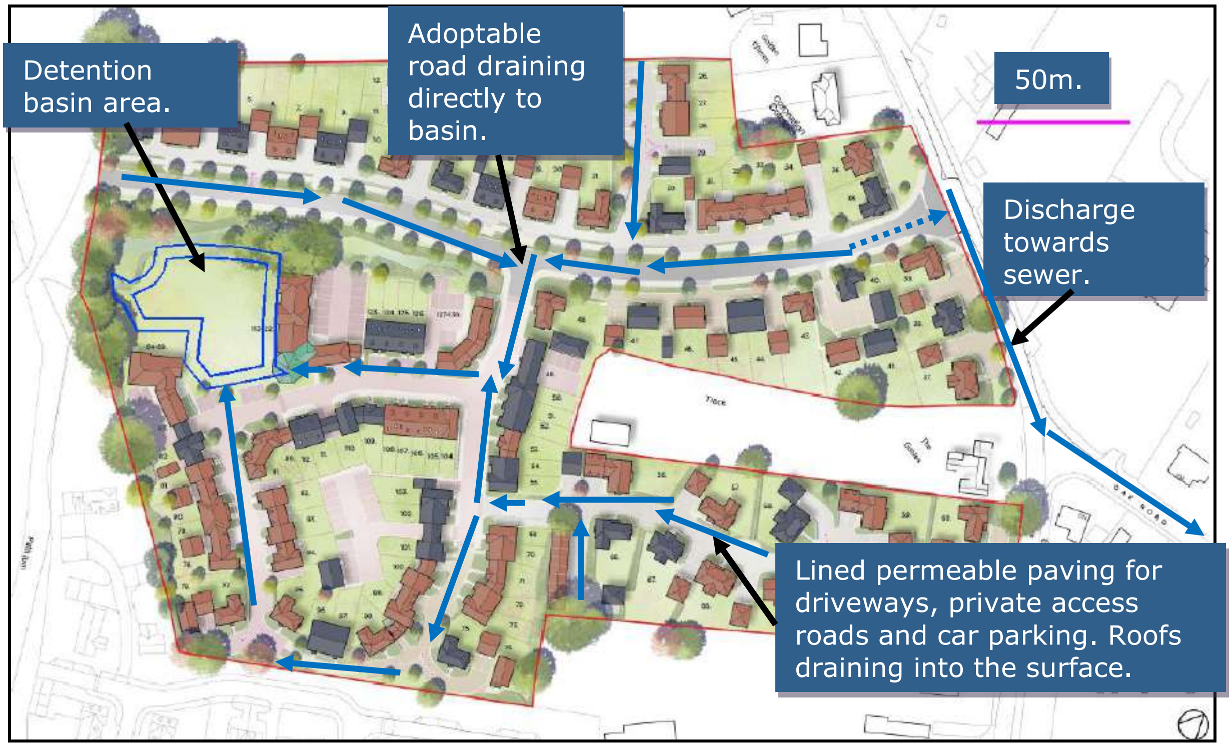

Figure 7: Indicative SUDS scheme (See also Drawing Number 2229/RE/01)

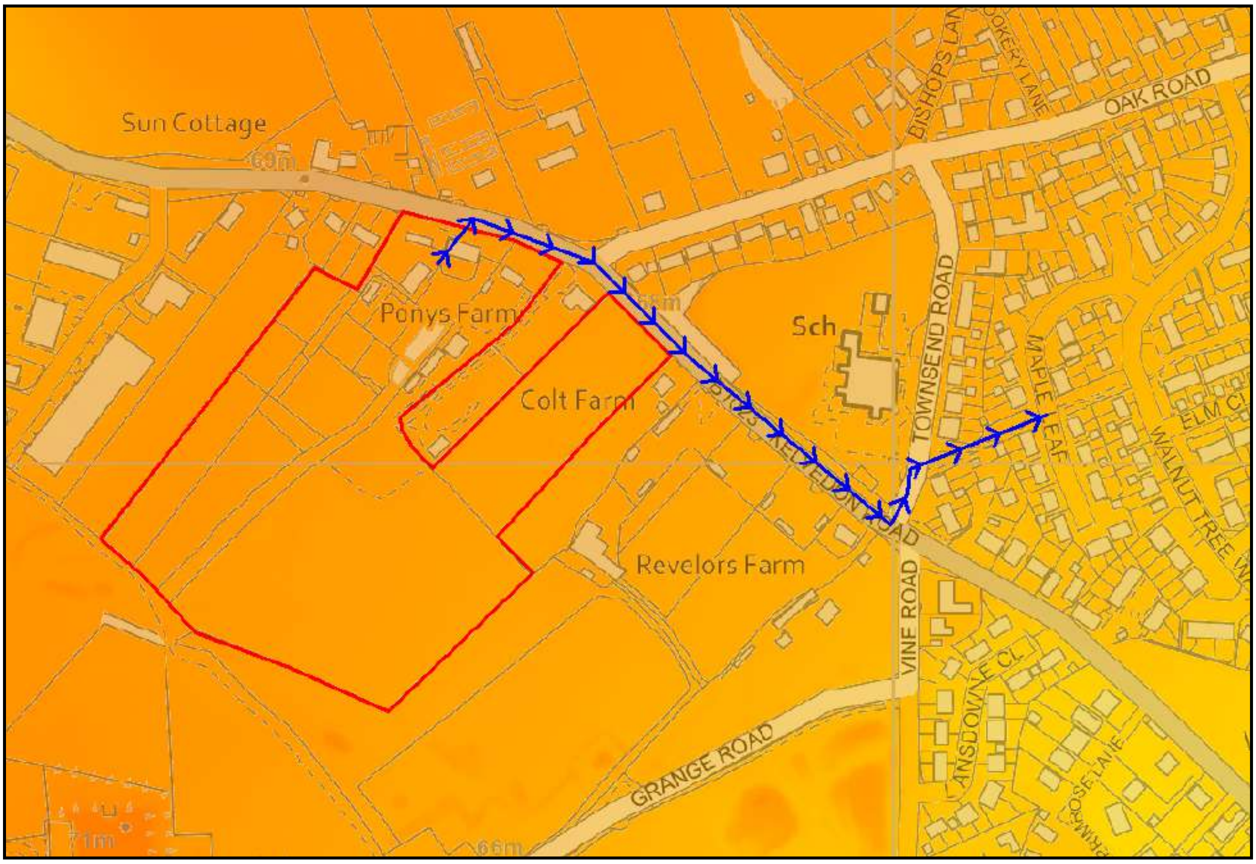

Figure 8: Route from site to public surface water sewer

5.6 Pollution Prevention

5.6.1 Table 26.2 of CIRIA 753 shows that residential roof water has a very low pollution hazard level. Table 26.2 of CIRIA 753 shows that residential driveways and low traffic roads have a low pollution hazard level.

5.6.2 Permeable paving will sufficiently cleanse surface water from roofs and hardstanding areas such as driveways and private roads. Chapter 20 of CIRIA 753 confirms that permeable paving can improve water quality by sedimentation, filtration, adsorption and biodegradation. Where applicable, roof water draining to the permeable paving is also considered to be of a suitable quality and will not be required to be subjected to additional pollution prevention measures.

5.6.3 The detention basin will sufficiently cleanse surface water further from hardstanding areas. Section 22.5 of CIRIA 753 states that vegetated detention basins can help retain runoff and reduce the contaminant load. They can also treat runoff by gravitational settling of particulate pollutants. Table 26.7 of CIRIA 753 shows that detention basins provide interception, primary treatment and secondary treatment in the SUDS management train. Chapter 16 of CIRIA 697 states that detention basins have a medium potential to remove suspended solids and heavy metals and a low potential to remove nutrients. Table 1.7 of CIRIA 697 confirms that detention basins can improve water quality by sedimentation, filtration, adsorption and biodegradation.

5.6.4 It is therefore considered that (collectively) the SUDS measures included within this report will sufficiently improve water quality across the proposed site and comply with Box 4.3 of CIRIA 753.

5.6.5 When considering water quality treatment, the Simple Index Approach set out in 26.7.1 of CIRIA 753 needs to be considered. Using Tables 26.2 and 26.3 in CIRIA 753, it can be seen on Table 4 below, that the use of permeable paving and a detention basin (in combination) to cleanse roof water and access roads/driveways will meet the pollution mitigation requirements (i.e. values in Table 4 for SUDS components should be equal to, or greater than the values for Land Use).

Table 4: Simple Index Approach

Land Use	Total Suspended Solids index	Metals index	Hydrocarbons index
Residential Roofs	0.2	0.2	0.05
Residential Driveways/Low traffic roads including public access roads	0.5	0.4	0.4
SUDS Component for treatment	Total Suspended Solids index	Metals index	Hydrocarbons index
Permeable Paving	0.7	0.6	0.7
Detention Basin	0.5	0.5	0.6

5.7 Adoption and Maintenance

5.7.1 The SUDS measures can be privately adopted and maintained (perhaps by a management company and/or homeowners).

5.7.2 The permeable paving and basin should be maintained in accordance with Table 20.15, and Table 22.1 respectively of CIRIA 753, shown as Tables 5 and 6 hereafter.

Table 5: Maintenance regime for permeable paving (Source: taken from Table 20.15 of CIRIA 753)

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 6: Maintenance regime for detention basin (Source: taken from Table 22.1 of CIRIA 753)

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

5.8 Designing For Exceedance

5.8.1 Section 3.2.6 of CIRIA 753 states that the designated drainage system may include areas that are only designed to flood on an infrequent basis such as car parks, roads and recreational areas. For larger events, the site layout should be designed so that exceedance flows are managed in safe conveyance and storage zones so that the risk of flooding is acceptable for all people and property. Section 13.4.5 of CIRIA 753 states that an exceedance flow route or temporary storage area will be required for rainfall events that exceed the design capacity of the system.

5.8.2 The calculations in this FRA consider the climate change (40%) 1 in 100 year event and therefore are designed to accommodate flows during the design event. The exceedance return period event has been assumed to be the 1 in 1000 year event as this yields a storage depth and volume higher than the design event.

5.8.3 The results in Appendix D indicate that the basin cannot accommodate all of the surface water during the exceedance return period event without surface flooding. The flooded volume of 626.2 cu m will be retained temporarily across the paving/road area of 11226 sq m at a depth of 0.06m and controlled with standard kerbing and shallow gradients.

5.8.4 Excess water can enter the basin by overtopping or via a large gully adjacent to the basin (Figure 9). Erosion control measures may be needed to prevent damage to the basin during this event.

5.8.5 Permeable paving areas should be graded so that runoff onto neighbouring areas is prevented. Kelvedon Road adjacent to the site entrance is set higher than the site which will ensure no off-site flooding via this direction.

5.8.6 It is recommended that all proposed buildings should have a finished floor level of 150mm higher than ground levels to ensure no internal flooding caused by wave action from vehicles.

5.8.7 It is considered that flood routing can be investigated further at the detailed design stage and that the measures outlined in this FRA provide sufficient reassurance that there is scope when designing for exceedance at this site. This element could be conditioned as part of any planning approval.

Figure 9: Example of runoff from highway into a basin (Source: taken from Suffolk County Council Local SUDS Design Guide)

5.9 Runoff from Permeable Areas

5.9.1 Permeable areas will not be permitted to drain into the drainage system and therefore long term storage including climate change allowances from these areas has been considered separately. The Essex County Council's SUDS Design Guide dated 2014 discusses the requirement to consider permeable areas and long term storage, as these will be subject to climate change which may result in measurable runoff.

5.9.2 In section 4.2.2 and 4.5.5 of CIRIA 697 *The SUDS Manual,* guidance is provided on how to determine runoff volume. The *REFH2 Greenfield Runoff Volume* calculator provided in the MicroDrainage software also allows a Greenfield runoff volume to be calculated based on the FEH13 data and user defined permeable area.

5.9.3 Figure 10 shows that the runoff volume for a typical garden area of 84 sq m is 1.648 cu m during the 1 in 100 year event. Applying 40% climate change to this figure increases it to 2.31 cu m.

5.9.4 When applying the volume of runoff of 2.31 cu m across its area would result in a depth of 0.03m.

5.9.5 It is recommended that in order to contain the water across these areas, each garden area should be profiled/lowered by a maximum of 0.1m. This will prevent runoff onto other areas. It is considered that this water would evaporate and infiltrate over time (which would mimic a more natural scenario).

5.9.6 It is not considered viable to include permeable areas within the SUDS calculations due to the risk of high sediment loads and the risk of overdesign.

Evans Rivers & Costal Ltd		Page 1
19 St Andrews Avenue Thorpe St Andrew Norwich NR7 0RG	Runoff volume	
Date 15/01/2019 13:01 File 1000yr road.srcx	Designed by rupertercl Checked by	
Micro Drainage	Source Control 2018.1	

ReFH2 Greenfield Runoff Volume

Input

Return Period (Years)	100
Storm Duration (min)	360
FEH Rainfall Version	2013
Site Location	GB 588788 217031
Data Type	Point
Season	Winter
Country	England/Wales/Northern Ireland
Area (ha)	0.008
SAAR (mm)	569
BFIHOST	0.382
FARL	0.000
SPRHOST	0.000
URBEXT (2000)	0.0000

Results

Percentage Runoff (%)	51.10
Greenfield Runoff Volume (m³)	1.648

Figure 10: Greenfield runoff volume from rear garden areas during 1 in 100 year event

5.10 Additional Information

5.10.1 For the purposes of this report a hydrobrake has been used in the model which will limit the flow rate from the pervious paving and basin. However, other control devices such as orifice plates could be used. Section 28.5.3 of CIRIA 753 states that in order to minimise the risk of blockage for very low flow controls perforated risers can be used (Figure 11).

5.10.2 Surface water within the paving structure, (which will also be accepting surface water flows from other parts of the site such as roofs), will drain out of the paving sub-structure and into the basin via a drainage pipe located at the end of the paving extent. Figure 12 and 13 shows a cross section of the paving structure with outfall pipe.

5.10.3 Section 20.10.2 of CIRIA 753 states that where water leaves the sub-base to flow to the next part of the drainage system, an outlet is required from the sub-base. This is usually achieved using either a series of perforated pipes or with a length of fin drain (Figure 14). Section 20.10 of CIRIA 753 states that perforated pipes should extend at least 1m into the sub-base and should be slotted in order to convey water.

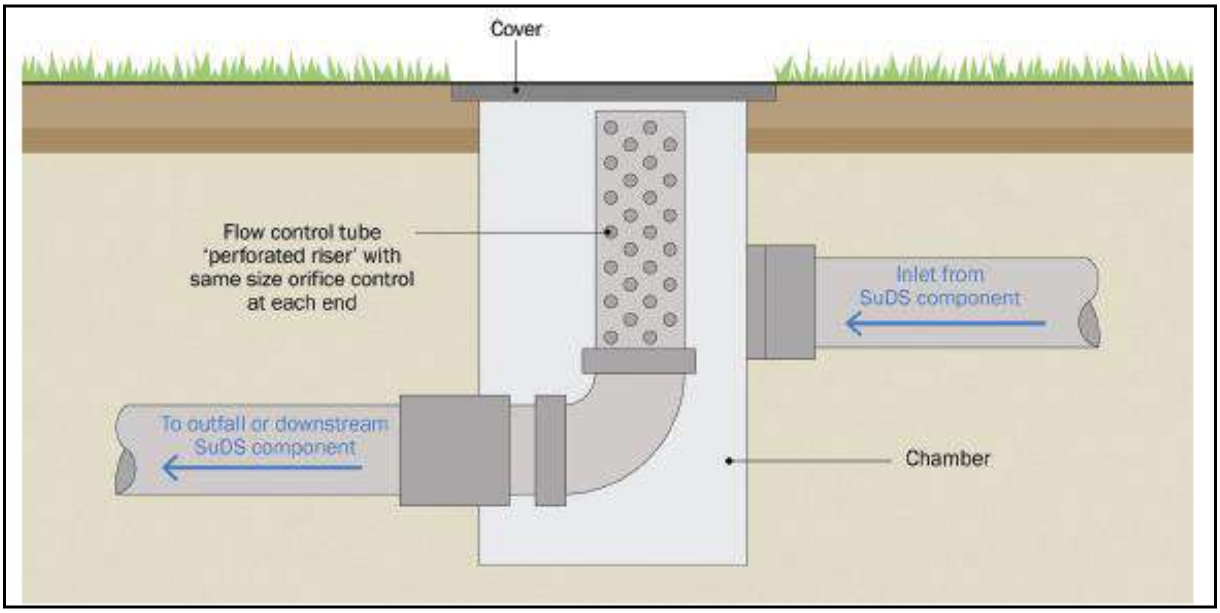

Figure 11: Example of a perforated riser to reduce the risk of blockage (Source: Figure 28.19 of CIRIA 753)

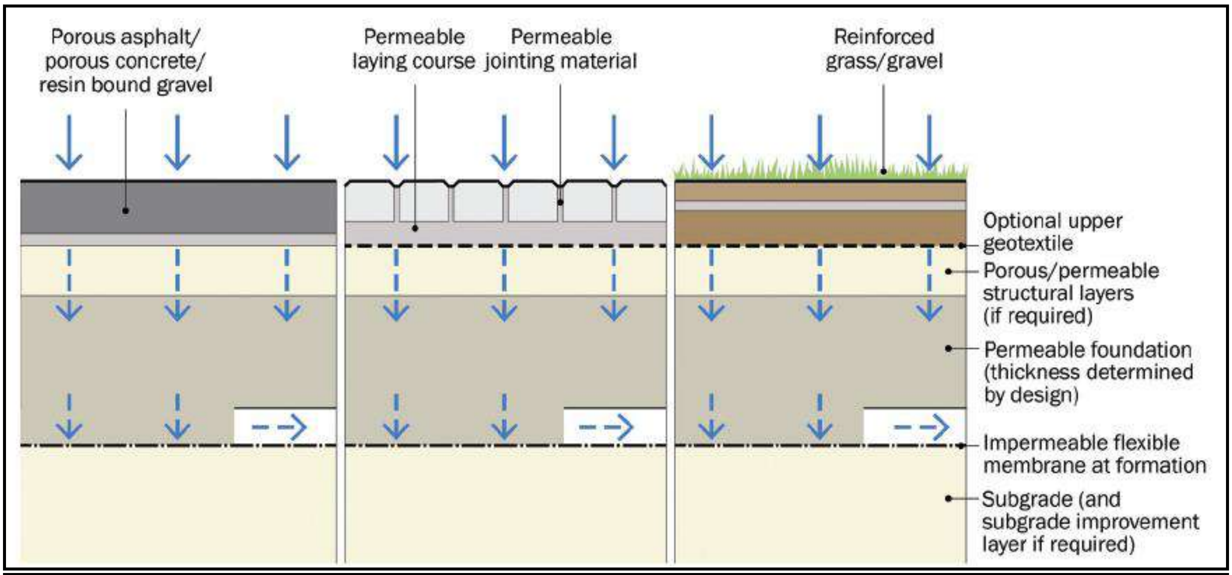

Figure 12: Section through a pervious surface (Source: Figure 20.14 of CIRIA 753)

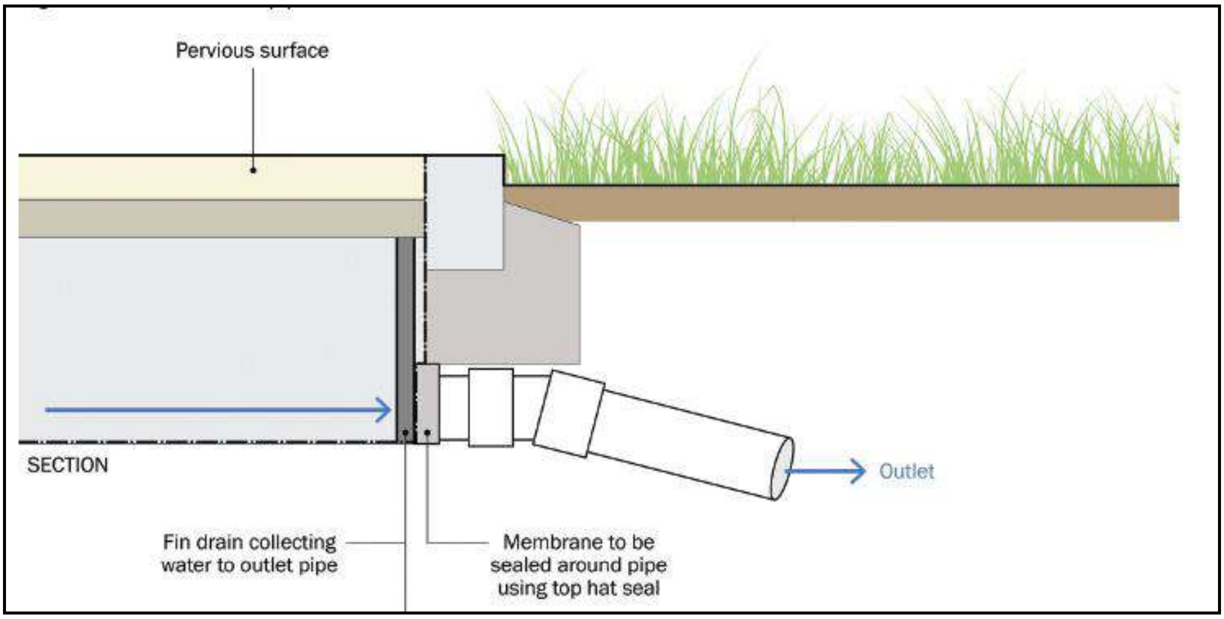

Figure 13: Fin drain outlet (Source: taken from Figure 20.26 of CIRIA 753

6. CONCLUSIONS

- A review of the relevant guidance documents and various types of data collected at the site has enabled a full assessment of the flood risks to be quantified.

- The site is located within the Flood Zone 1 therefore all uses of land are appropriate in this zone.

- This assessment has investigated the possibility of groundwater flooding and flooding from other sources at the site. It is considered that there will be a low risk of groundwater flooding across the site and very low risk of flooding from other sources such as surface water.

- An assessment of the practical use of sustainable drainage techniques has been carried out. As soil types will not support the effective use of infiltration devices, it is proposed that surface water is attenuated through the use of permeable paving and a detention basin prior to discharge into the local AW surface water sewer system.

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APPENDIX A – INFILTRATION TESTING

Our Ref: 4118,SK,PC,SG
Your Ref: Land off Kelvedon Road

Marden Homes Ltd
C/O Evans River & Coastal
19 St Andrews Avenue
Thorpe St Andrew
Norwich
NR7 0RG

Date: 04 September 2019

For the attention of Mr Rupert Evans

By Email:
rupert.evans@evansriversandcoastal.co.uk

Dear Rupert,

INFILTRATION TESTING AT LAND OFF KELVEDON ROAD, TIPTREE, ESSEX

1. Introduction

This letter report has been prepared on behalf of Evans River & Coastal for Marden Homes Ltd.

The primary objective of this ground investigation was to assess the infiltration potential of the natural soils beneath the site.

This was achieved by:

- Excavating a number of machine-dug trial pits across the site;
- Undertaking soakage testing in line with BRE Digest 365 guidance; and
- Undertaking infiltration calculations to allow for an assessment of the suitability of soakaways or infiltration techniques for the future development of the site.

It is understood that the proposed development will comprise residential properties with associated access roads and garden areas. A Proposed Development Plan was not available at the time this report was prepared.

A Site Location Plan, Drawing ref. 4118,SK/001/Rev0, is presented at the end of this letter report in Appendix 4.

The purpose of this letter report is to provide factual data only.

2. Site Works

2.1 Methodology

This ground investigation was carried out on the basis of the practices set out in BRE Digest 365, 'Soakaway Design' 2016, which requires, in summary, a total of three infiltration tests to be undertaken in succession over a 24-hour period or tests to be undertaken on consecutive days.

The exploratory holes were positioned based upon client provided preferred locations and to ensure good coverage of the site subject to access restrictions.

In general, where a test location showed limited or no infiltration, it was allowed to continue for circa 24 hours, the data obtained and the test ceased. Where a test exhibited appreciable infiltration and the "75%" infiltration level was achieved, a further infiltration "run", or more was undertaken.

2.2 Scope

Site works were carried out on 21 and 22 August 2019, and comprised the following:

- Excavation of eight machine excavated trial pits, (SK1 to SK8), to a depth of 2.0m bgl;
- Undertaking infiltration testing in line with BRE Digest 365 guidance; and
- Undertaking infiltration calculations to allow for an assessment of the suitability of soakaways for the future development of the site.

A Site Plan and Exploratory Hole Location Plan, Drawing ref. 4118,SK/002/Rev0, is presented at the end of this letter report in Appendix 4.

2.3 Ground Conditions Encountered

The sequence of the strata encountered during the investigation generally confirms the anticipated geology as interpreted from geological mapping.

The sequence and indicative thickness of strata are summarised in Table 1 below, with the Exploratory Hole Logs provided in Appendix 2:

Table 1 - Ground Conditions

Strata	Depth Encountered (mgl)		Strata Thickness (m)	Location and Composition
	From	To		
Topsoil	0.00	0.35 – 0.45	0.35 – 0.45	All exploratory holes: Generally, a brown slightly gravelly slightly silty SAND.
London Clay Formation	0.35	2.00	Unproven	All exploratory holes; A light brown slightly gravelly CLAY with grey mottling SK3 only: With pockets of chalk recovered as a sand.

2.4 Groundwater

No groundwater was encountered in any of the exploratory holes during the intrusive investigation.

2.5 Infiltration Testing Results

Soil infiltration testing did not indicate any appreciable infiltration to have occurred within any of the testing locations.

Full results are provided in full in Appendix 3, presented at the end of this letter report.

We trust the above is clear and acceptable. If you have any questions, please do not hesitate to contact us.

Yours sincerely

Peter Coyne
Technical Assistant
Geosphere Environmental Ltd
peter@geosphere-environmental.co.uk

Enclosures:
Appendix 1 – Report Limitations and Conditions
Appendix 2 – Exploratory Hole Logs
Appendix 3 – Infiltration Testing Results
Appendix 4 – Drawings

APPENDICES

APPENDIX 1 – REPORT LIMITATIONS AND CONDITIONS

This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of future changes in the condition of the site.

This report has been prepared for the sole use of the Client for the purposes described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.

This report is prepared and written for the use stated herein; it should not be used for any other purposes without reference to Geosphere Environmental Limited. The report has been prepared in relation to the proposed end use, should another end use be intended, a further re-assessment may be required. It is likely that over time practises will improve and the relevant guidance and legislation be amended or superseded, which may necessitate a re-assessment of the site.

The accuracy of any map extracts cannot be guaranteed. It is possible that different conditions existed onsite, between and subsequent to the various map surveys appended.

Whilst the report may express an opinion on possible configurations of strata between or beyond exploratory holes discussed or on the possible presence of features based upon visual, verbal or published evidence, this is for guidance only and no liability can be accepted for its accuracy.

GEOSPHERE ENVIRONMENTAL

APPENDIX 2 – EXPLORATORY HOLE LOGS

Trial Pit Logs
(SK1 to SK8)

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

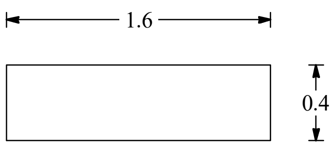
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	**SK1**

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	20-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.40	Brown slightly silty slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.40-2.00	Light brown gravelly CLAY with fine active roots. Gravel is fine and medium subangular to rounded flint (LONDON CLAY FORMATION) 1.70 Occasional light grey mottling present with depth				
					Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

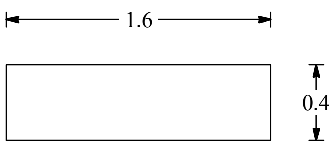
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	SK2

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	20-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.35	Brown slightly silty slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.35-2.00	Light orangish brown with occasional light grey mottling slightly gravelly CLAY. Gravel is fine subangular to subrounded flint (LONDON CLAY FORMATION) 1.60 Becoming grey mottled with depth				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

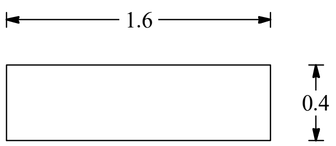
All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

TRIAL PIT LOG

Project		Client		TRIAL PIT No
Land off Kelvedon Road, Tiptree		Marden Homes		SK3
Job No: 4118,SK	Date: 20-08-19	Ground Level (m):	Coordinates (): ,	
Fieldwork By: Laser		Logged By: PC		Sheet: 1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.40	Brown slightly silty slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.40-2.00	Light brown slightly gravelly CLAY. Gravel is fine flint (LONDON CLAY FORMATION) 1.40 With pockets of off-white chalk recovered as a fine sand				
					Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

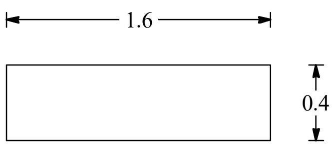
All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

TRIAL PIT LOG

Project		Client		TRIAL PIT No
Land off Kelvedon Road, Tiptree		Marden Homes		SK4
Job No: 4118,SK	Date: 20-08-19	Ground Level (m):	Coordinates (): ,	
Fieldwork By: Laser		Logged By: PC		Sheet: 1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.40	Brown slightly silty slightly gravelly SAND. Gravel is fine to coarse subangular to subrounded flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.40-2.00	Light brown slightly gravelly CLAY. Gravel is fine flint (LONDON CLAY FORMATION) 1.60 Becoming grey mottled with depth				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

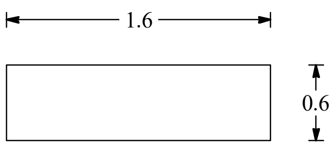
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	SK5

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	21-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.45	Dark brown silty organic fine SAND (TOPSOIL)				Trial pit remained dry and stable upon completion
0.45-2.00	Light brown slightly gravelly CLAY. Gravel is fine subangular and subrounded flint (LONDON CLAY FORMATION)				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

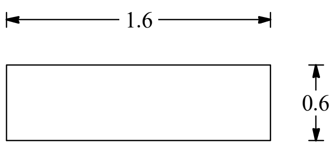
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	SK6

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	21-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.35	Brown slightly gravelly fine SAND. Gravel is fine and medium flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.35-2.00	Light brown slightly gravelly CLAY. Gravel is fine flint (LONDON CLAY FORMATION) 1.40 Becoming light grey mottled with depth				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

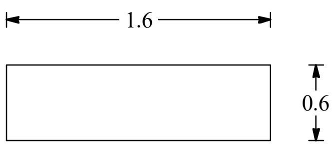
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	SK7

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	21-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.35	Brown slightly gravelly fine SAND. Gravel is fine and medium flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.35-2.00	Light brown occasionally light grey mottled slightly gravelly CLAY. Gravel is fine flint (LONDON CLAY FORMATION)				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

Geosphere Environmental Ltd
Brightwell Barns, Ipswich Road
Brightwell, Suffolk, IP10 0BJ
Telephone: 01603 298076

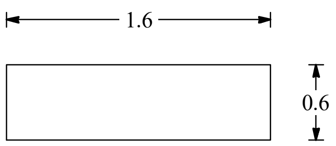
TRIAL PIT LOG

Project	Client	TRIAL PIT No
Land off Kelvedon Road, Tiptree	Marden Homes	SK8

Job No	Date	Ground Level (m)	Coordinates ()
4118,SK	21-08-19		,

Fieldwork By	Logged By	Sheet
Laser	PC	1 of 1

Depth	DESCRIPTION	Legend	Depth	No	Remarks/Tests
0.00-0.35	Brown slightly gravelly fine SAND. Gravel is fine and medium flint (TOPSOIL)				Trial pit remained dry and stable upon completion
0.35-2.00	Light brown occasionally light grey mottled slightly gravelly CLAY. Gravel is fine flint (LONDON CLAY FORMATION)				Trial pit completed at 2.0m. Infiltration testing undertaken



Shoring/Support: Gravel backfill
Stability: Stable

All dimensions in metres Scale 1:20.8333333333333	Method Trial Pit/trench	Plant Used MECHANICAL EXCAVATOR	Checked By SG

APPENDIX 3 – INFILTRATION TEST RESULTS

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 4118,SK

Date: 04/09/2019

Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.505
1	1.505
2	1.505
3	1.505
4	1.505
5	1.505
10	1.505
78	1.505
140	1.505
1165	1.510
1460	1.510

Pit Size [m]		
Length	**Width**	**Depth**
1.6	0.4	2.00

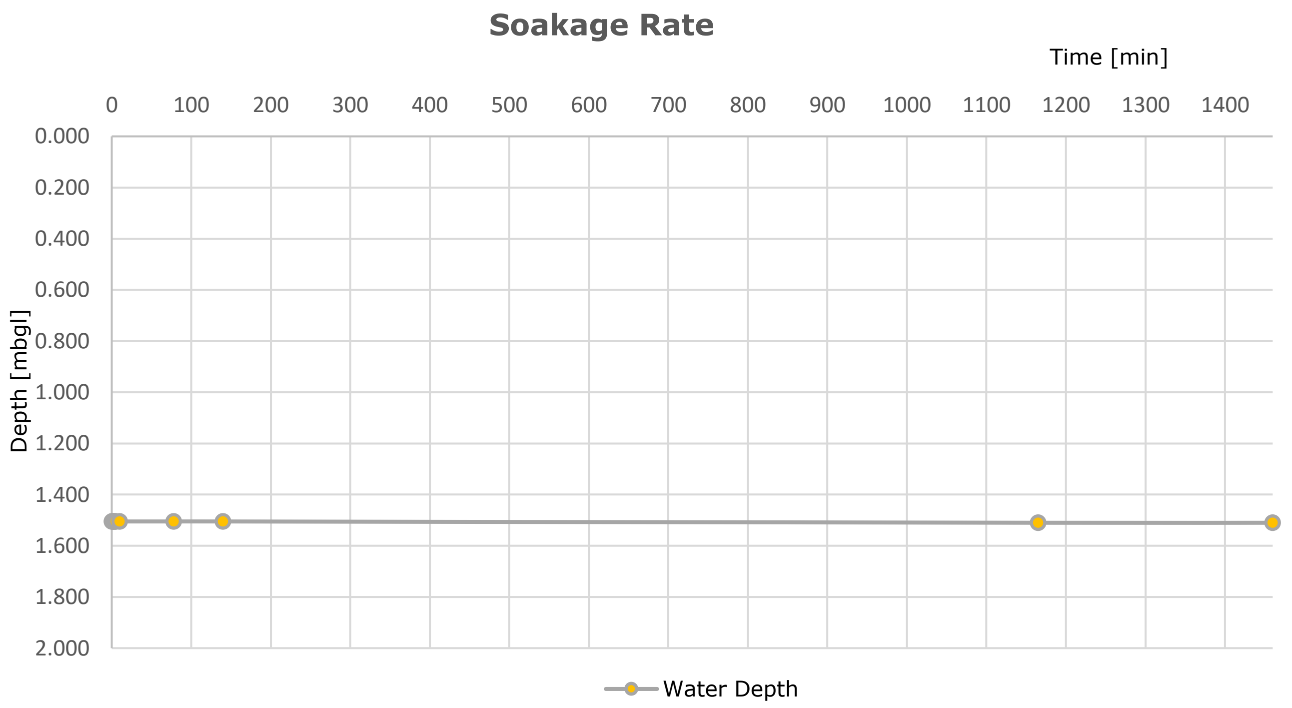
It was not possible to undertake full-depth soakaway test.

Trial Pit: SK1

Run: 1 of 1

Test Date: 21 August 2019

Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 4118,SK

Date: 04/09/2019

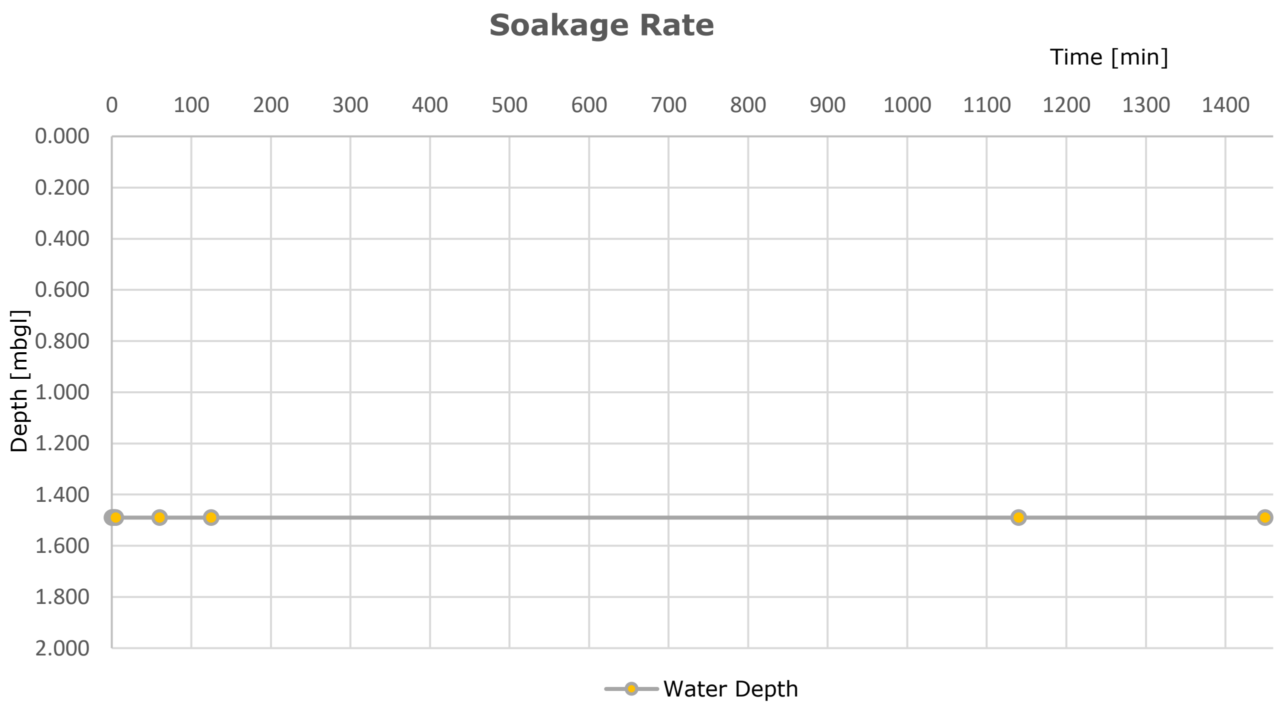
Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.490
1	1.490
2	1.490
3	1.490
4	1.490
5	1.490
60	1.490
125	1.490
1140	1.490
1450	1.490

Pit Size [m]		
Length	Width	Depth
1.6	0.4	2.00

It was not possible to undertake full-depth soakaway test.

Trial Pit: SK2
Run: 1 of 1
Test Date: 21 August 2019
Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 4118,SK

Date: 04/09/2019

Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.500
1	1.520
2	1.530
3	1.550
4	1.565
5	1.570
10	1.595
43	1.630
120	1.635
1130	1.640
1440	1.640

Pit Size [m]		
Length	Width	Depth
1.6	0.4	2.00

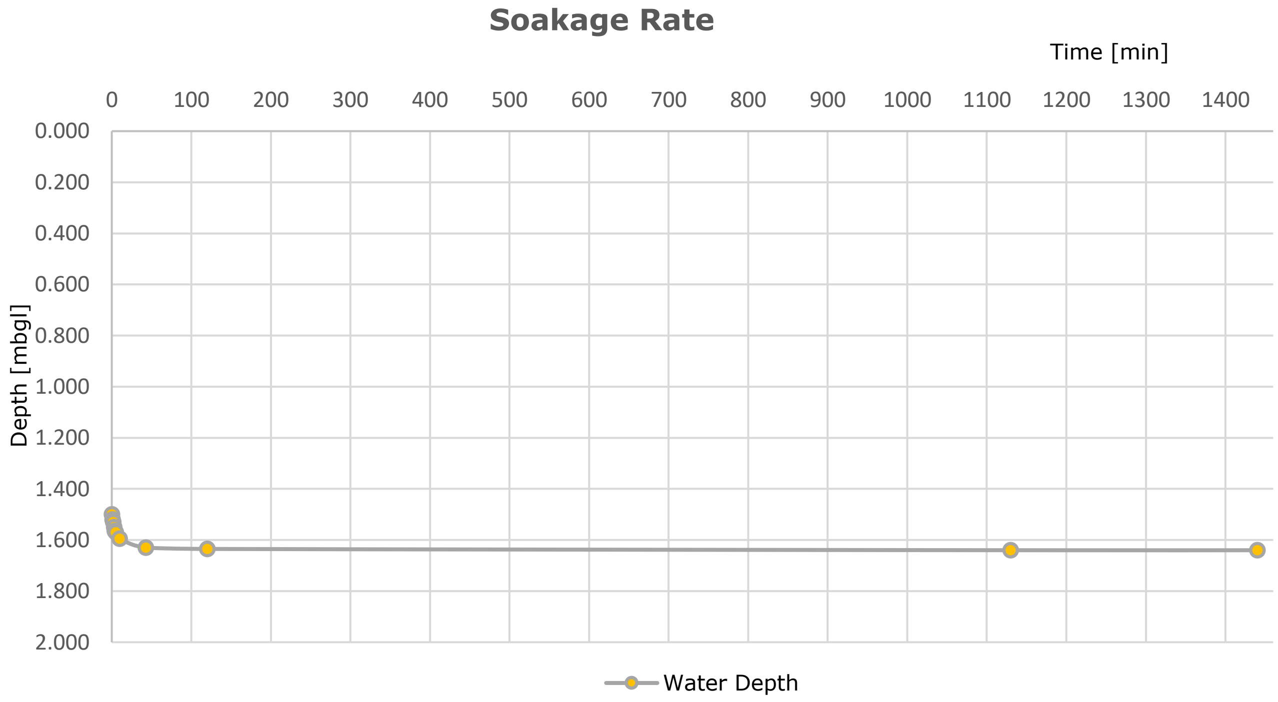
It was not possible to undertake full-depth soakaway test.

Trial Pit: SK3

Run: 1 of 1

Test Date: 21 August 2019

Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC

Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

Project Number: 4118,SK

Date: 04/09/2019

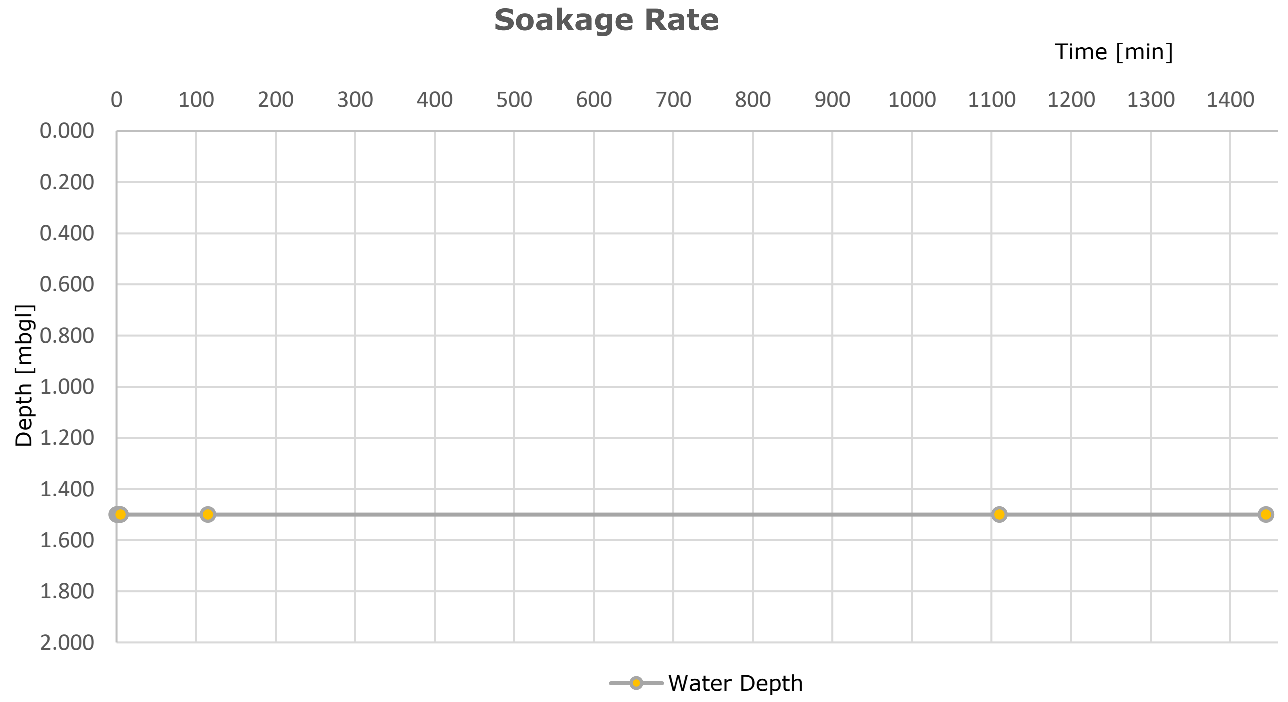
Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.500
1	1.500
2	1.500
3	1.500
4	1.500
5	1.500
115	1.500
1110	1.500
1445	1.500

Pit Size [m]		
Length	Width	Depth
1.6	0.4	2.00

It was not possible to undertake full-depth soakaway test.

Trial Pit: SK4
Run: 1 of 1
Test Date: 21 August 2019
Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC   Checked by: SG

TPSK02 / 03-10-18 / V2

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 4118,SK

Date: 04/09/2019

Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.480
1	1.480
2	1.480
3	1.480
4	1.480
5	1.480
22	1.480
180	1.480
1270	1.490
1460	1.490

Pit Size [m]		
Length	Width	Depth
1.6	0.6	2.00

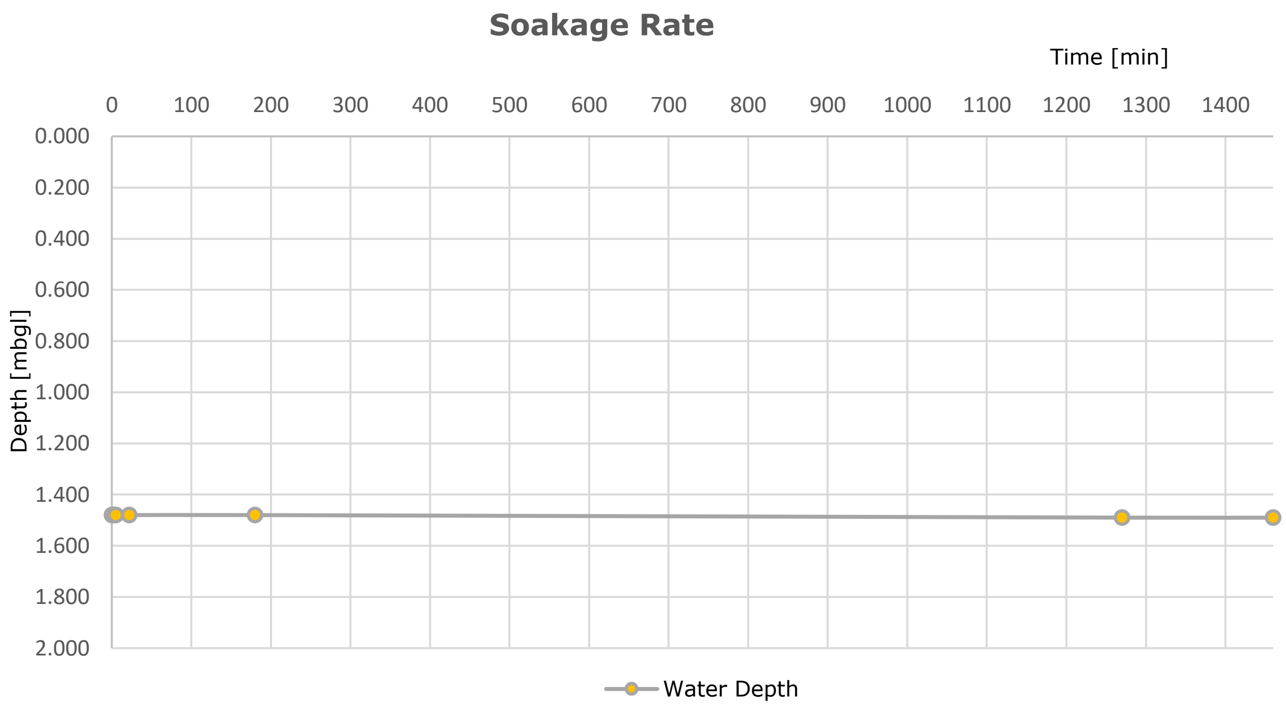
It was not possible to undertake full-depth soakaway test.

Trial Pit: SK5

Run: 1 of 1

Test Date: 21 August 2019

Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

GEOSPHERE ENVIRONMENTAL

Project Number: 4118,SK

Date: 04/09/2019

Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.480
1	1.480
2	1.480
3	1.480
4	1.480
5	1.480
170	1.485
1260	1.500
1455	1.500

Pit Size [m]		
Length	Width	Depth
1.6	0.6	2.00

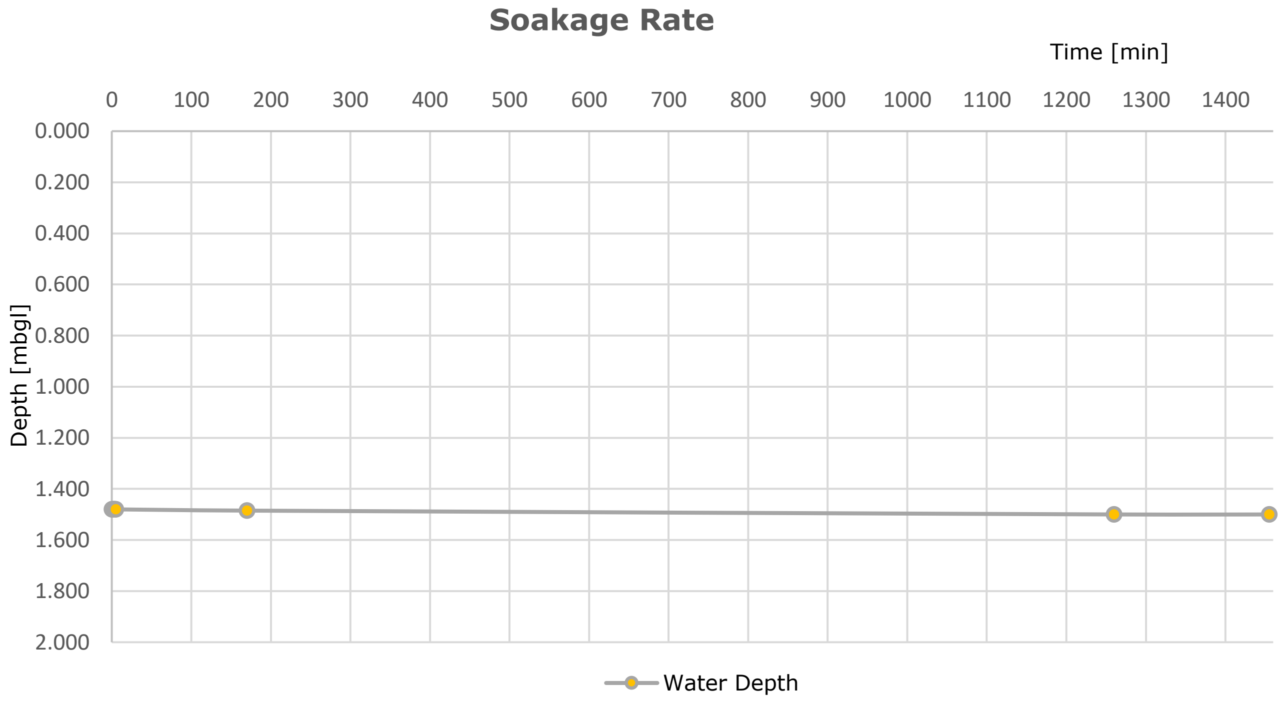
It was not possible to undertake full-depth soakaway test.

Trial Pit: SK6

Run: 1 of 1

Test Date: 21 August 2019

Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC

Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

Project Number: 4118,SK

Date: 04/09/2019

Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.470
1	1.470
2	1.470
3	1.470
4	1.470
5	1.470
155	1.470
1245	1.460
1470	1.460

Pit Size [m]		
Length	Width	Depth
1.6	0.6	2.00

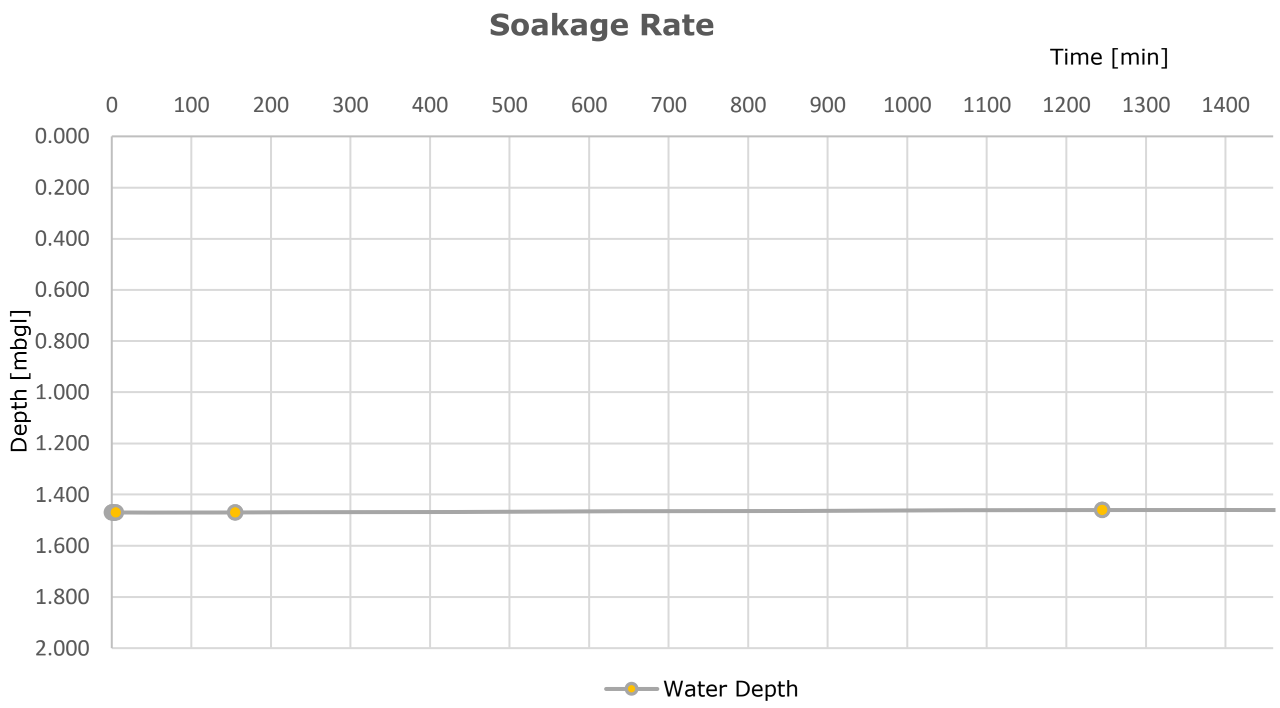
It was not possible to undertake full-depth soakaway test.

Trial Pit: SK7

Run: 1 of 1

Test Date: 21 August 2019

Groundwater Encountered: n/a



mbgl - (meters below ground level)

Calculated by: PC

Checked by: SG

TRIAL PIT INFILTRATION TEST - BRE DIGEST 365

Project Number: 4118,SK

Date: 04/09/2019

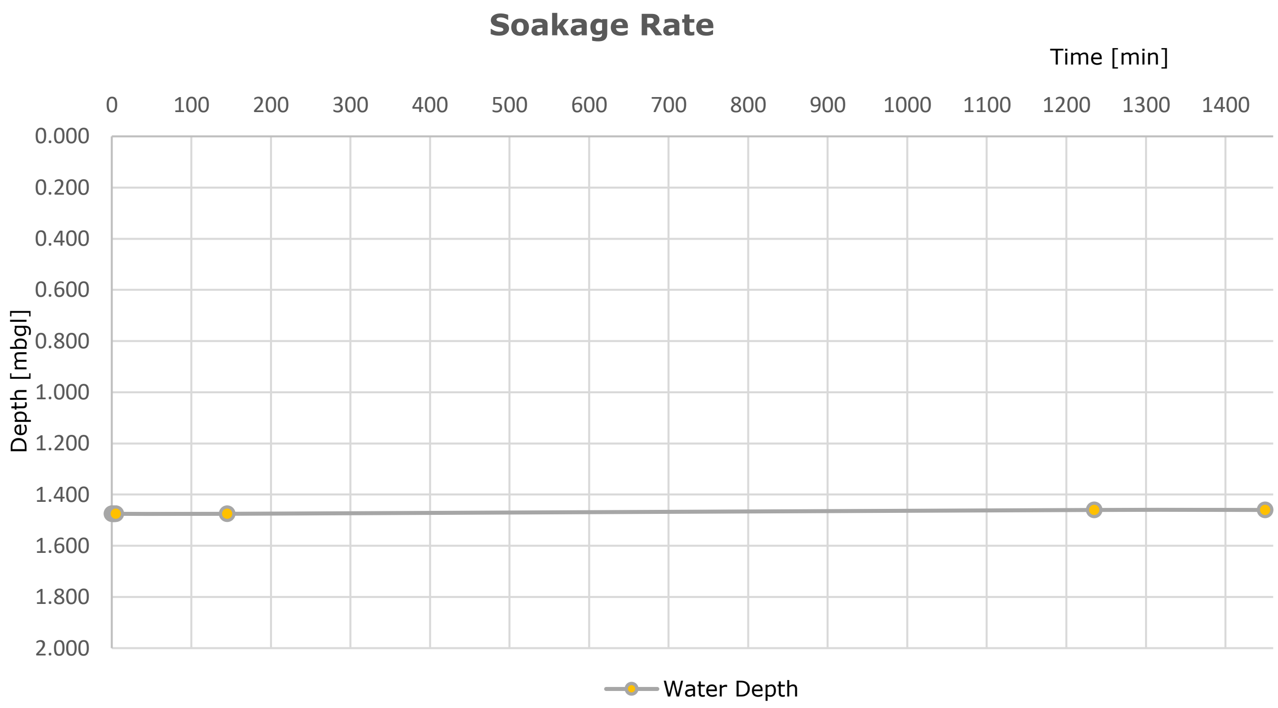
Project Name: Land off Kelvedon Road, Tiptree, Essex

Time [min]	Depth to Water [mbgl]
0	1.475
1	1.475
2	1.475
3	1.475
4	1.475
5	1.475
145	1.475
1235	1.460
1450	1.460

Pit Size [m]		
Length	Width	Depth
1.6	0.6	2.00

It was not possible to undertake full-depth soakaway test.

Trial Pit: SK8
Run: 1 of 1
Test Date: 21 August 2019
Groundwater Encountered: n/a



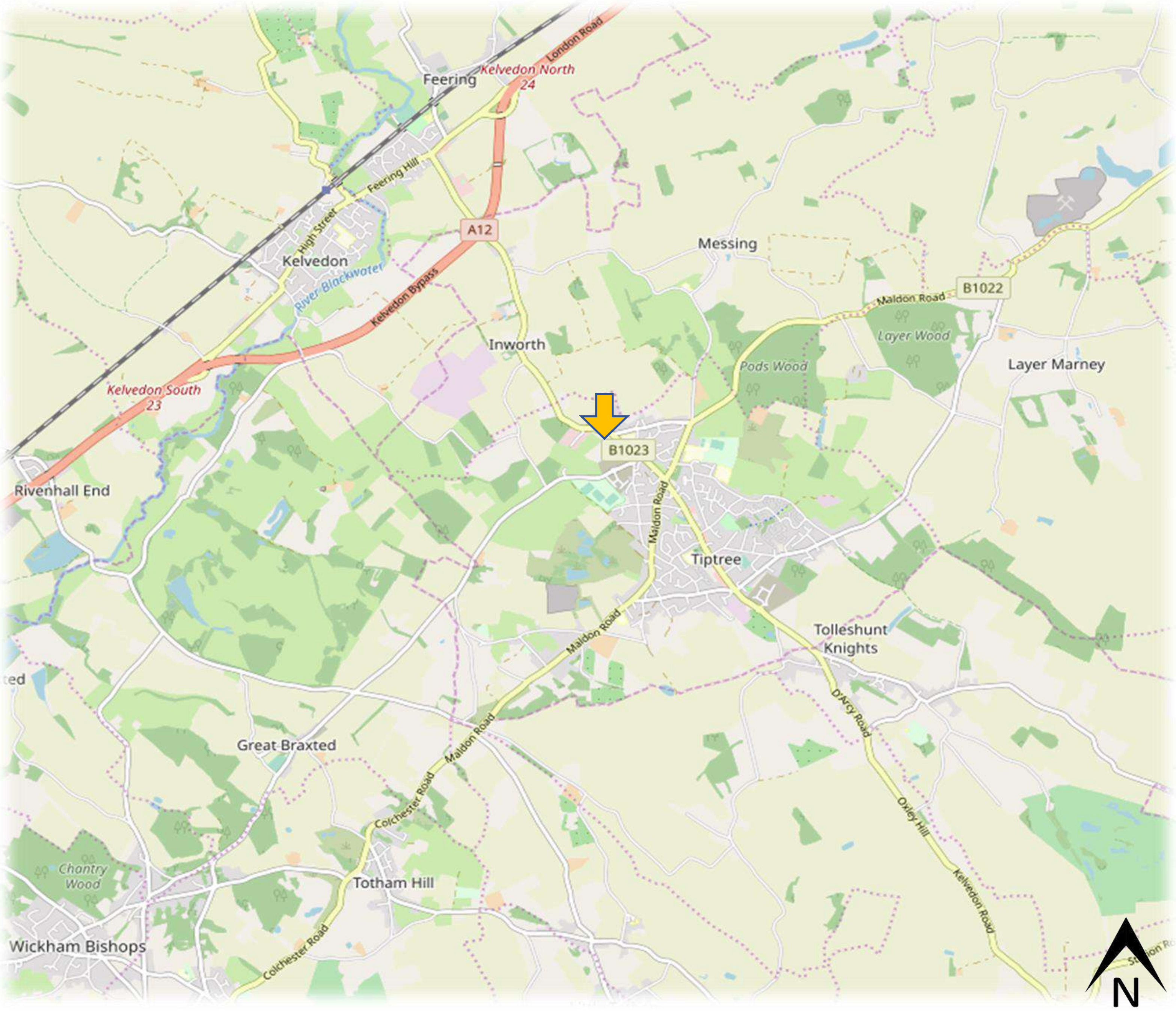
mbgl - (meters below ground level)

Calculated by: PC Checked by: SG

APPENDIX 4 – DRAWINGS

Site Location Plan – Drawing ref. 4118,SK/001/Rev0

Site and Exploratory Hole Location Plan – Drawing ref. 4118,SK/002/Rev0



GEOSPHERE ENVIRONMENTAL

LEGEND

Site Location

SOURCE

© OpenStreetMap contributors

PROJECT

Land off Kelvedon Road, Tiptree, Essex

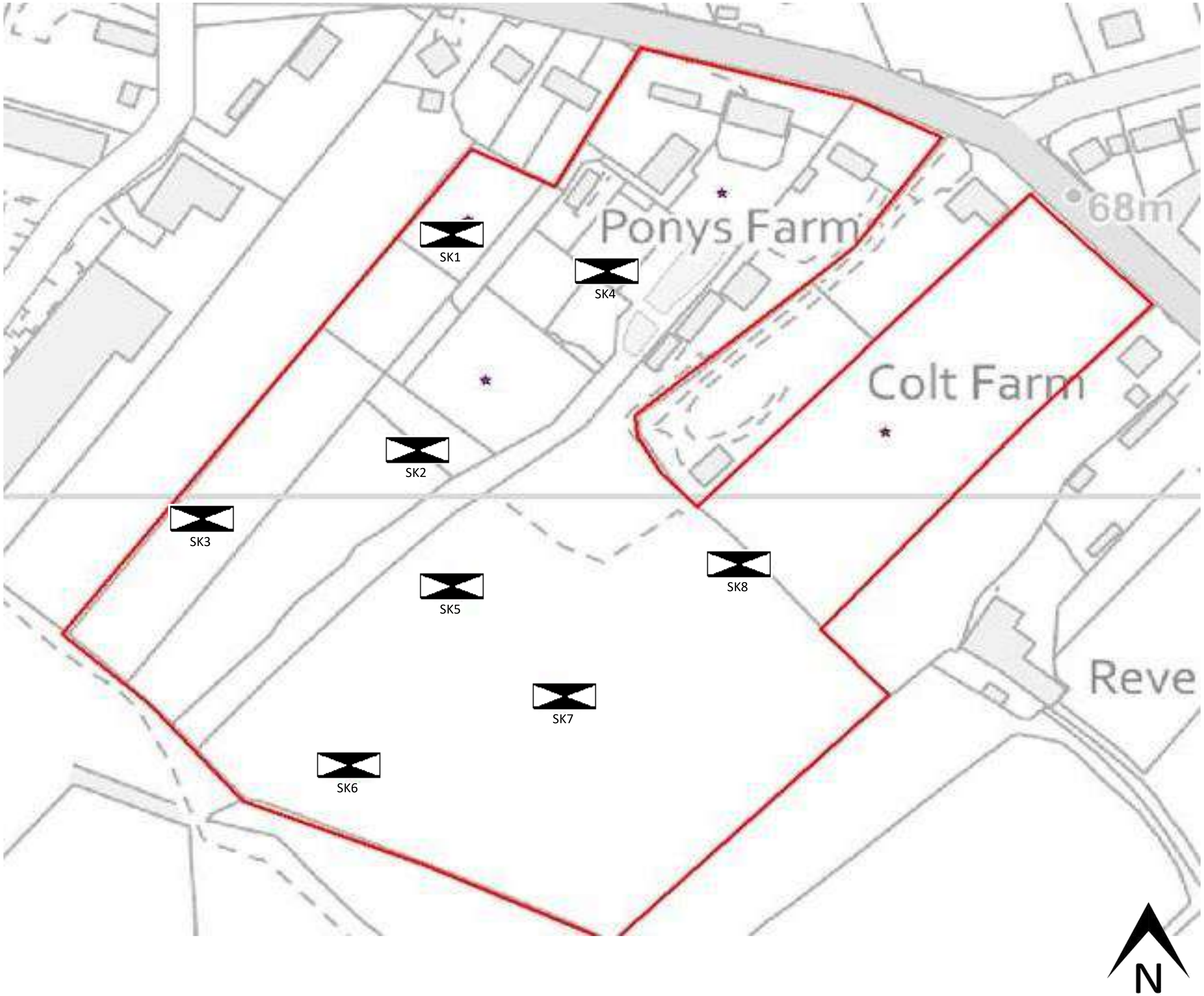
TITLE

Site Location Plan

DRAWING NUMBER

4118,SK/001/Rev0

SCALE	DATE
NTS	29/08/2019
DRAWN BY	**CHECKED BY**
PC	SG



GEOSPHERE ENVIRONMENTAL

LEGEND

Site boundary

Infiltration Pit

SOURCE

Provided by client

PROJECT

Land off Kelvedon Road, Tiptree, Essex

TITLE

Site and Exploratory Hole Location Plan

DRAWING NUMBER

4118,SK/002/Rev0

SCALE	**DATE**
NTS	29/08/2019
DRAWN BY	**CHECKED BY**
PC	SG

GEO

GEOSPHERE ENVIRONMENTAL

Ec Ecology.

Fr Flood Risk.

Ge Geotechnical.

En Environmental.

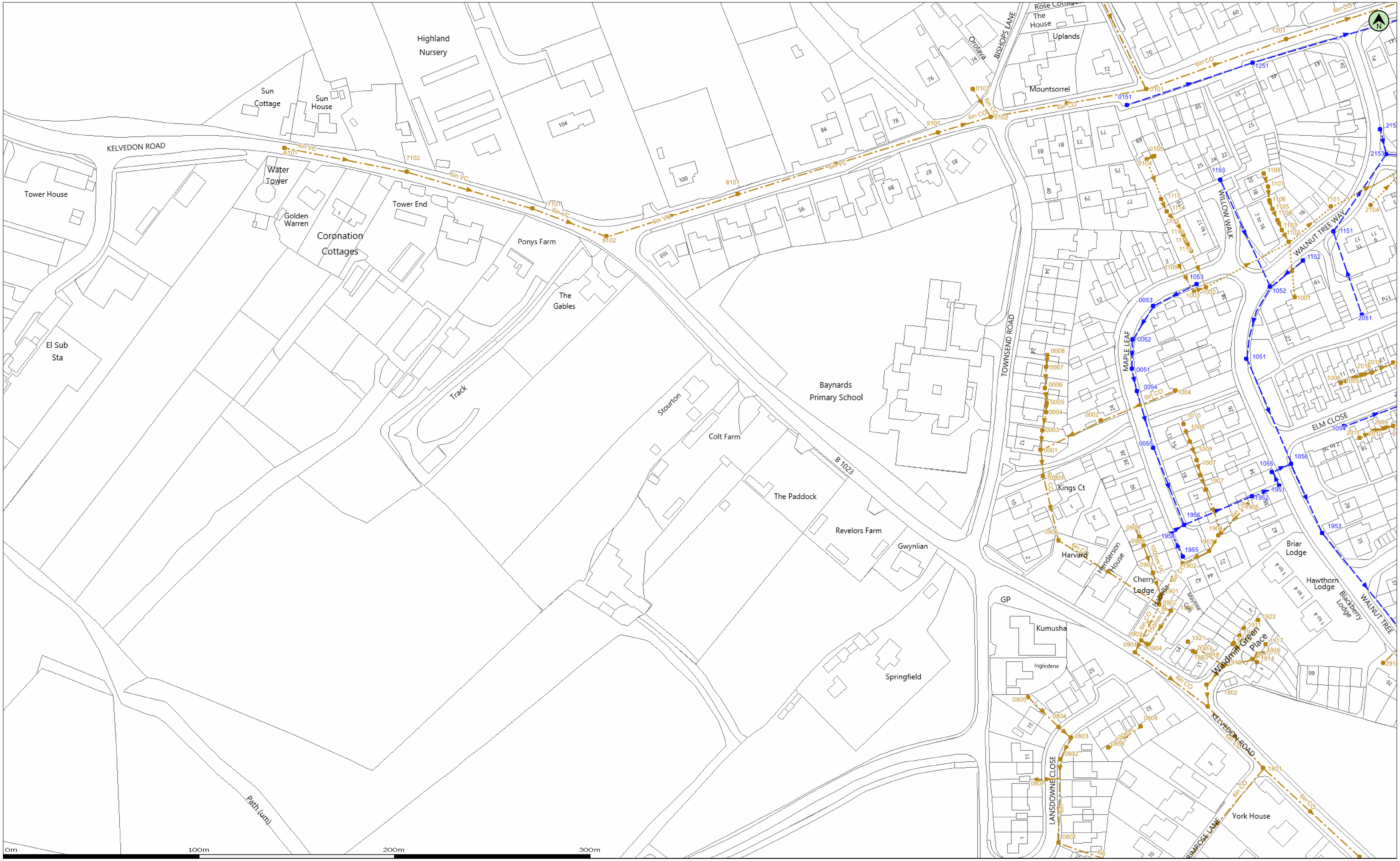
Kw Knotweed.

GEOSPHERE ENVIRONMENTAL LTD

Brightwell Barns, Ipswich Road, Brightwell, Suffolk, IP10 0BJ

T: 01603 298076 | 01473 353519 | **E**: info@geosphere-environmental.co.uk | **W**: geosphere-environmental.co.uk

APPENDIX B - ANGLIAN WATER PLANS



(c) Crown copyright and database rights 2019 Ordnance Survey 100022432 | Date: 13/01/19 | Scale: 1:1250 | Map Centre: 588865,217025 | Data updated: 01/11/18 | Our Ref: 294182 - 1 | Wastewater Plan A2

Foul Sewer
Surface Sewer
Combined Sewer
Final Effluent
Rising Main*
Private Sewer*
Decommissioned Sewer*

Outfall*
Inlet*
Manhole*

Sewage Treatment Works
Public Pumping Station
Decommissioned Pumping Station
*(Colour denotes effluent type)

rupert.evans@evansriversandcoastal.co.uk

Tiptree

love every drop
anglianwater

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	-	-	2.6
0002	F	-	-	1.77
0003	F	-	-	-
0004	F	-	1.91	-
0005	F	-	1.86	-
0006	F	-	1.87	-
0007	F	-	1.74	-
0008	F	-	1.1	-
0101	F	67.63	64.68	2.95
0102	F	-	-	2.37
0103	F	-	-	1.2
0104	F	-	-	1.47
0105	F	-	-	1.28
0801	F	-	-	1.61
0802	F	-	-	0.54
0803	F	-	-	0.56
0804	F	-	-	1.08
0805	F	-	-	0.59
0807	F	-	-	0.62
0808	F	-	-	-
0809	F	-	-	-
0901	F	-	-	2.24
0902	F	-	-	1.9
0903	F	-	-	2.52
0904	F	63.5	61.46	2.04
0905	F	63.57	61.4	2.17
0906	F	-	-	-
0907	F	-	-	-
0908	F	-	-	-
0909	F	-	-	-
1001	F	-	-	0.75
1002	F	-	-	1.32
1003	F	-	-	1.3
1004	F	-	-	1.2
1005	F	-	-	0.92
1006	F	-	-	0.95
1007	F	-	-	-
1008	F	-	-	-
1009	F	-	-	-
1010	F	-	-	-
1101	F	-	-	1.4
1102	F	-	-	1.36
1103	F	-	-	1.4
1104	F	-	-	1.05
1105	F	-	-	1
1106	F	-	-	0.95
1107	F	0.85	-	0.85
1108	F	-	-	0.9
1109	F	-	-	1.31
1110	F	-	-	1.4
1111	F	-	-	1.3
1112	F	-	-	1.2
1113	F	-	-	1.24
1114	F	-	-	1.24
1115	F	-	-	1.3
1201	F	66.49	64.1	2.39
1801	F	62.155	60.402	1.753
1802	F	62.904	61.103	1.801
1803	F	62.555	61.205	1.35
1901	F	-	-	1.75
1902	F	-	-	7.75
1903	F	-	-	1.51
1904	F	-	-	1.45
1905	F	-	-	1.14
1906	F	63.6	61.7	1.9
1907	F	-	-	-
1908	F	-	-	-
1909	F	-	-	-
1910	F	-	-	-
1911	F	-	-	-
1912	F	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1913	F	-	-	-
1914	F	-	-	-
1915	F	-	-	-
1916	F	-	-	-
1917	F	-	-	-
1918	F	-	-	-
1919	F	-	-	-
1920	F	-	-	-
1921	F	-	-	-
1922	F	-	-	-
2008	F	-	-	1.11
2009	F	-	-	1.1
2010	F	-	-	1
2011	F	-	-	0.88
2013	F	-	-	1.49
2015	F	-	-	1.12
2016	F	-	-	1.06
2104	F	-	-	1.44
2801	F	61.08	59.38	1.7
2914	F	-	-	-
6101	F	70.01	68.34	1.67
7101	F	69.43	67.62	1.81
7102	F	69.754	67.94	1.814
8101	F	68.53	66.83	1.7
8102	F	69.06	67.26	1.8
9101	F	67.925	65.45	2.475
0051	S	-	-	-
0052	S	-	-	-
0053	S	-	-	-
0054	S	-	-	-
0055	S	-	-	-
0151	S	-	-	-
1051	S	-	-	-
1052	S	-	-	-
1053	S	-	-	-
1054	S	-	-	-
1055	S	-	-	-
1056	S	-	-	-
1151	S	-	-	-
1152	S	-	-	-
1153	S	-	-	-
1251	S	-	-	-
1951	S	-	-	-
1952	S	-	-	-
1953	S	-	-	-
1954	S	-	-	-
1955	S	-	-	-
1956	S	-	-	-
2051	S	-	-	-
2152	S	-	-	-
2153	S	-	-	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

APPENDIX C – DETENTION BASIN

2 YEAR EVENT

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.119	0.119	4.4	141.9	O K
30 min Summer	0.149	0.149	5.0	179.2	O K
60 min Summer	0.179	0.179	5.2	217.1	O K
120 min Summer	0.246	0.246	5.5	304.2	O K
180 min Summer	0.280	0.280	5.5	349.9	O K
240 min Summer	0.301	0.301	5.6	377.0	O K
360 min Summer	0.320	0.320	5.6	403.0	O K
480 min Summer	0.325	0.325	5.6	410.3	O K
600 min Summer	0.325	0.325	5.6	410.3	O K
720 min Summer	0.324	0.324	5.6	408.5	O K
960 min Summer	0.319	0.319	5.6	401.9	O K
1440 min Summer	0.306	0.306	5.6	384.9	O K
2160 min Summer	0.286	0.286	5.5	357.9	O K
2880 min Summer	0.268	0.268	5.5	333.2	O K
4320 min Summer	0.238	0.238	5.4	293.9	O K
5760 min Summer	0.215	0.215	5.4	264.2	O K
7200 min Summer	0.198	0.198	5.3	241.6	O K
8640 min Summer	0.184	0.184	5.2	224.0	O K
10080 min Summer	0.173	0.173	5.1	210.1	O K
15 min Winter	0.132	0.132	4.8	158.9	O K
30 min Winter	0.166	0.166	5.1	201.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	32.617	0.0	118.3	19
30 min Summer	20.831	0.0	155.6	33
60 min Summer	12.872	0.0	213.0	64
120 min Summer	9.257	0.0	310.7	122
180 min Summer	7.282	0.0	368.0	182
240 min Summer	6.033	0.0	407.1	242
360 min Summer	4.518	0.0	457.5	360
480 min Summer	3.628	0.0	489.6	480
600 min Summer	3.045	0.0	513.1	536
720 min Summer	2.632	0.0	531.4	594
960 min Summer	2.085	0.0	559.1	714
1440 min Summer	1.500	0.0	596.2	980
2160 min Summer	1.085	0.0	679.8	1384
2880 min Summer	0.869	0.0	725.1	1788
4320 min Summer	0.649	0.0	806.6	2556
5760 min Summer	0.535	0.0	903.6	3344
7200 min Summer	0.467	0.0	983.1	4040
8640 min Summer	0.420	0.0	1060.0	4760
10080 min Summer	0.387	0.0	1133.1	5544
15 min Winter	32.617	0.0	134.5	19
30 min Winter	20.831	0.0	176.2	33

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.200	0.200	5.3	244.1	O K
120 min Winter	0.275	0.275	5.5	342.5	O K
180 min Winter	0.314	0.314	5.6	394.9	O K
240 min Winter	0.337	0.337	5.6	426.5	O K
360 min Winter	0.360	0.360	5.6	458.2	O K
480 min Winter	0.368	0.368	5.6	469.3	O K
600 min Winter	0.369	0.369	5.6	471.0	O K
720 min Winter	0.366	0.366	5.6	467.4	O K
960 min Winter	0.358	0.358	5.6	455.3	O K
1440 min Winter	0.339	0.339	5.6	429.9	O K
2160 min Winter	0.309	0.309	5.6	388.0	O K
2880 min Winter	0.280	0.280	5.5	348.9	O K
4320 min Winter	0.232	0.232	5.4	286.4	O K
5760 min Winter	0.197	0.197	5.3	240.0	O K
7200 min Winter	0.170	0.170	5.1	206.3	O K
8640 min Winter	0.150	0.150	5.0	181.5	O K
10080 min Winter	0.136	0.136	4.8	163.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	12.872	0.0	239.8	62
120 min Winter	9.257	0.0	349.1	120
180 min Winter	7.282	0.0	413.1	180
240 min Winter	6.033	0.0	456.8	238
360 min Winter	4.518	0.0	512.9	352
480 min Winter	3.628	0.0	548.5	464
600 min Winter	3.045	0.0	574.5	572
720 min Winter	2.632	0.0	594.7	678
960 min Winter	2.085	0.0	624.9	768
1440 min Winter	1.500	0.0	664.2	1068
2160 min Winter	1.085	0.0	762.1	1512
2880 min Winter	0.869	0.0	813.0	1932
4320 min Winter	0.649	0.0	905.2	2724
5760 min Winter	0.535	0.0	1012.8	3464
7200 min Winter	0.467	0.0	1102.0	4184
8640 min Winter	0.420	0.0	1188.6	4920
10080 min Winter	0.387	0.0	1271.7	5552

Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 588788 217031 TL 88788 17031
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.359

Time (mins) From:	**To:**	**Area (ha)**
0	4	2.359

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1159.0	0.700	1627.0	1.400	1850.0	2.100	1850.0
0.100	1222.0	0.800	1700.0	1.500	1850.0	2.200	1850.0
0.200	1285.0	0.900	1774.0	1.600	1850.0	2.300	1850.0
0.300	1351.0	1.000	1850.0	1.700	1850.0	2.400	1850.0
0.400	1417.0	1.100	1850.0	1.800	1850.0	2.500	1850.0
0.500	1486.0	1.200	1850.0	1.900	1850.0		
0.600	1555.0	1.300	1850.0	2.000	1850.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0108-5600-1200-5600
Design Head (m)	1.200
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.6
Flush-Flo™	0.354	5.6
Kick-Flo®	0.750	4.5
Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.6	3.000	8.6	7.000	12.9
0.200	5.3	1.400	6.0	3.500	9.3	7.500	13.3
0.300	5.6	1.600	6.4	4.000	9.9	8.000	13.7
0.400	5.6	1.800	6.8	4.500	10.4	8.500	14.1
0.500	5.5	2.000	7.1	5.000	11.0	9.000	14.5
0.600	5.3	2.200	7.4	5.500	11.5	9.500	14.9
0.800	4.6	2.400	7.7	6.000	12.0		
1.000	5.1	2.600	8.0	6.500	12.4		

30 YEAR EVENT

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.255	0.255	5.5	316.5	O K
30 min Summer	0.325	0.325	5.6	409.7	O K
60 min Summer	0.394	0.394	5.6	506.3	O K
120 min Summer	0.483	0.483	5.6	634.9	O K
180 min Summer	0.530	0.530	5.6	703.9	O K
240 min Summer	0.558	0.558	5.6	746.3	O K
360 min Summer	0.586	0.586	5.6	790.7	O K
480 min Summer	0.598	0.598	5.6	809.1	O K
600 min Summer	0.602	0.602	5.6	814.9	O K
720 min Summer	0.601	0.601	5.6	813.3	O K
960 min Summer	0.591	0.591	5.6	797.1	O K
1440 min Summer	0.562	0.562	5.6	753.0	O K
2160 min Summer	0.528	0.528	5.6	701.7	O K
2880 min Summer	0.500	0.500	5.6	659.1	O K
4320 min Summer	0.452	0.452	5.6	588.9	O K
5760 min Summer	0.413	0.413	5.6	532.5	O K
7200 min Summer	0.381	0.381	5.6	488.4	O K
8640 min Summer	0.355	0.355	5.6	451.7	O K
10080 min Summer	0.333	0.333	5.6	421.1	O K
15 min Winter	0.284	0.284	5.5	354.8	O K
30 min Winter	0.361	0.361	5.6	459.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	72.378	0.0	279.5	19
30 min Summer	47.098	0.0	360.2	34
60 min Summer	29.401	0.0	498.0	64
120 min Summer	18.743	0.0	633.7	124
180 min Summer	14.072	0.0	710.2	184
240 min Summer	11.360	0.0	759.8	242
360 min Summer	8.266	0.0	817.9	362
480 min Summer	6.536	0.0	848.0	482
600 min Summer	5.427	0.0	862.8	602
720 min Summer	4.653	0.0	867.6	722
960 min Summer	3.638	0.0	859.8	960
1440 min Summer	2.570	0.0	826.0	1198
2160 min Summer	1.824	0.0	1143.8	1556
2880 min Summer	1.439	0.0	1199.8	1956
4320 min Summer	1.043	0.0	1289.6	2764
5760 min Summer	0.840	0.0	1419.6	3568
7200 min Summer	0.717	0.0	1515.1	4328
8640 min Summer	0.635	0.0	1607.6	5104
10080 min Summer	0.576	0.0	1695.3	5848
15 min Winter	72.378	0.0	312.8	19
30 min Winter	47.098	0.0	397.6	33

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.437	0.437	5.6	568.1	O K
120 min Winter	0.536	0.536	5.6	713.9	O K
180 min Winter	0.588	0.588	5.6	792.9	O K
240 min Winter	0.619	0.619	5.6	842.1	O K
360 min Winter	0.653	0.653	5.6	895.3	O K
480 min Winter	0.668	0.668	5.6	919.6	O K
600 min Winter	0.675	0.675	5.6	929.9	O K
720 min Winter	0.676	0.676	5.6	931.9	O K
960 min Winter	0.669	0.669	5.6	921.5	O K
1440 min Winter	0.641	0.641	5.6	876.0	O K
2160 min Winter	0.595	0.595	5.6	804.2	O K
2880 min Winter	0.557	0.557	5.6	745.2	O K
4320 min Winter	0.486	0.486	5.6	639.3	O K
5760 min Winter	0.425	0.425	5.6	549.7	O K
7200 min Winter	0.374	0.374	5.6	477.7	O K
8640 min Winter	0.331	0.331	5.6	418.2	O K
10080 min Winter	0.295	0.295	5.6	369.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	29.401	0.0	557.9	64
120 min Winter	18.743	0.0	707.1	122
180 min Winter	14.072	0.0	788.3	180
240 min Winter	11.360	0.0	837.4	240
360 min Winter	8.266	0.0	882.8	358
480 min Winter	6.536	0.0	891.4	474
600 min Winter	5.427	0.0	886.6	590
720 min Winter	4.653	0.0	879.3	706
960 min Winter	3.638	0.0	862.8	932
1440 min Winter	2.570	0.0	828.2	1358
2160 min Winter	1.824	0.0	1279.3	1684
2880 min Winter	1.439	0.0	1340.7	2132
4320 min Winter	1.043	0.0	1432.5	2988
5760 min Winter	0.840	0.0	1590.3	3816
7200 min Winter	0.717	0.0	1697.8	4616
8640 min Winter	0.635	0.0	1802.0	5368
10080 min Winter	0.576	0.0	1901.7	6152

Rainfall Details

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 588788 217031 TL 88788 17031
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.359

Time (mins) From:	To:	Area (ha)
0	4	2.359

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1159.0	0.700	1627.0	1.400	1850.0	2.100	1850.0
0.100	1222.0	0.800	1700.0	1.500	1850.0	2.200	1850.0
0.200	1285.0	0.900	1774.0	1.600	1850.0	2.300	1850.0
0.300	1351.0	1.000	1850.0	1.700	1850.0	2.400	1850.0
0.400	1417.0	1.100	1850.0	1.800	1850.0	2.500	1850.0
0.500	1486.0	1.200	1850.0	1.900	1850.0		
0.600	1555.0	1.300	1850.0	2.000	1850.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0108-5600-1200-5600
Design Head (m)	1.200
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.6
Flush-Flo™	0.354	5.6
Kick-Flo®	0.750	4.5
Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.6	3.000	8.6	7.000	12.9
0.200	5.3	1.400	6.0	3.500	9.3	7.500	13.3
0.300	5.6	1.600	6.4	4.000	9.9	8.000	13.7
0.400	5.6	1.800	6.8	4.500	10.4	8.500	14.1
0.500	5.5	2.000	7.1	5.000	11.0	9.000	14.5
0.600	5.3	2.200	7.4	5.500	11.5	9.500	14.9
0.800	4.6	2.400	7.7	6.000	12.0		
1.000	5.1	2.600	8.0	6.500	12.4		

100 YEAR EVENT

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.319	0.319	5.6	401.6	O K
30 min Summer	0.409	0.409	5.6	527.0	O K
60 min Summer	0.497	0.497	5.6	654.5	O K
120 min Summer	0.599	0.599	5.6	810.0	O K
180 min Summer	0.655	0.655	5.6	898.3	O K
240 min Summer	0.690	0.690	5.6	955.3	O K
360 min Summer	0.730	0.730	5.6	1020.5	O K
480 min Summer	0.750	0.750	5.6	1053.6	O K
600 min Summer	0.760	0.760	5.6	1070.3	O K
720 min Summer	0.764	0.764	5.6	1077.0	O K
960 min Summer	0.762	0.762	5.6	1072.6	O K
1440 min Summer	0.735	0.735	5.6	1028.5	O K
2160 min Summer	0.687	0.687	5.6	949.5	O K
2880 min Summer	0.650	0.650	5.6	889.8	O K
4320 min Summer	0.588	0.588	5.6	792.9	O K
5760 min Summer	0.537	0.537	5.6	715.7	O K
7200 min Summer	0.497	0.497	5.6	655.9	O K
8640 min Summer	0.464	0.464	5.6	606.0	O K
10080 min Summer	0.434	0.434	5.6	563.7	O K
15 min Winter	0.354	0.354	5.6	450.1	O K
30 min Winter	0.453	0.453	5.6	590.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	91.665	0.0	351.7	19
30 min Summer	60.400	0.0	438.5	34
60 min Summer	37.816	0.0	639.6	64
120 min Summer	23.722	0.0	791.4	124
180 min Summer	17.755	0.0	866.8	184
240 min Summer	14.327	0.0	897.1	244
360 min Summer	10.434	0.0	894.5	362
480 min Summer	8.259	0.0	879.3	482
600 min Summer	6.861	0.0	864.6	602
720 min Summer	5.883	0.0	851.6	722
960 min Summer	4.598	0.0	829.2	962
1440 min Summer	3.235	0.0	794.8	1440
2160 min Summer	2.282	0.0	1421.8	1756
2880 min Summer	1.788	0.0	1475.0	2080
4320 min Summer	1.274	0.0	1506.9	2856
5760 min Summer	1.011	0.0	1709.6	3680
7200 min Summer	0.854	0.0	1803.6	4464
8640 min Summer	0.748	0.0	1895.2	5272
10080 min Summer	0.673	0.0	1982.1	6048
15 min Winter	91.665	0.0	389.1	19
30 min Winter	60.400	0.0	461.9	34

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.550	0.550	5.6	734.3	O K
120 min Winter	0.663	0.663	5.6	910.6	O K
180 min Winter	0.725	0.725	5.6	1011.6	O K
240 min Winter	0.765	0.765	5.6	1077.8	O K
360 min Winter	0.810	0.810	5.6	1154.0	O K
480 min Winter	0.833	0.833	5.6	1193.4	O K
600 min Winter	0.845	0.845	5.6	1214.3	O K
720 min Winter	0.851	0.851	5.6	1224.5	O K
960 min Winter	0.851	0.851	5.6	1225.6	O K
1440 min Winter	0.833	0.833	5.6	1192.8	O K
2160 min Winter	0.789	0.789	5.6	1118.9	O K
2880 min Winter	0.740	0.740	5.6	1035.7	O K
4320 min Winter	0.653	0.653	5.6	895.4	O K
5760 min Winter	0.577	0.577	5.6	776.4	O K
7200 min Winter	0.514	0.514	5.6	680.5	O K
8640 min Winter	0.459	0.459	5.6	599.3	O K
10080 min Winter	0.411	0.411	5.6	530.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	37.816	0.0	713.5	64
120 min Winter	23.722	0.0	866.9	122
180 min Winter	17.755	0.0	905.6	182
240 min Winter	14.327	0.0	895.0	240
360 min Winter	10.434	0.0	871.1	358
480 min Winter	8.259	0.0	853.2	476
600 min Winter	6.861	0.0	839.1	594
720 min Winter	5.883	0.0	827.2	708
960 min Winter	4.598	0.0	806.9	942
1440 min Winter	3.235	0.0	772.6	1396
2160 min Winter	2.282	0.0	1569.1	2036
2880 min Winter	1.788	0.0	1598.9	2336
4320 min Winter	1.274	0.0	1554.9	3156
5760 min Winter	1.011	0.0	1914.9	3984
7200 min Winter	0.854	0.0	2020.3	4824
8640 min Winter	0.748	0.0	2123.6	5616
10080 min Winter	0.673	0.0	2222.8	6360

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 588788 217031 TL 88788 17031
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.359

Time (mins) From:	To:	Area (ha)
0	4	2.359

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1159.0	0.700	1627.0	1.400	1850.0	2.100	1850.0
0.100	1222.0	0.800	1700.0	1.500	1850.0	2.200	1850.0
0.200	1285.0	0.900	1774.0	1.600	1850.0	2.300	1850.0
0.300	1351.0	1.000	1850.0	1.700	1850.0	2.400	1850.0
0.400	1417.0	1.100	1850.0	1.800	1850.0	2.500	1850.0
0.500	1486.0	1.200	1850.0	1.900	1850.0		
0.600	1555.0	1.300	1850.0	2.000	1850.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0108-5600-1200-5600
Design Head (m)	1.200
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.6
Flush-Flo™	0.354	5.6
Kick-Flo®	0.750	4.5
Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.6	3.000	8.6	7.000	12.9
0.200	5.3	1.400	6.0	3.500	9.3	7.500	13.3
0.300	5.6	1.600	6.4	4.000	9.9	8.000	13.7
0.400	5.6	1.800	6.8	4.500	10.4	8.500	14.1
0.500	5.5	2.000	7.1	5.000	11.0	9.000	14.5
0.600	5.3	2.200	7.4	5.500	11.5	9.500	14.9
0.800	4.6	2.400	7.7	6.000	12.0		
1.000	5.1	2.600	8.0	6.500	12.4		

100 YEAR PLUS (40%) CLIMATE CHANGE

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.434	0.434	5.6	563.5	O K
30 min Summer	0.554	0.554	5.6	740.3	O K
60 min Summer	0.670	0.670	5.6	921.6	O K
120 min Summer	0.805	0.805	5.6	1145.9	O K
180 min Summer	0.880	0.880	5.6	1274.8	O K
240 min Summer	0.927	0.927	5.6	1359.1	Flood Risk
360 min Summer	0.982	0.982	5.6	1458.5	Flood Risk
480 min Summer	1.011	1.011	5.6	1512.2	Flood Risk
600 min Summer	1.028	1.028	5.6	1543.1	Flood Risk
720 min Summer	1.037	1.037	5.6	1560.3	Flood Risk
960 min Summer	1.042	1.042	5.6	1570.5	Flood Risk
1440 min Summer	1.029	1.029	5.6	1546.0	Flood Risk
2160 min Summer	0.991	0.991	5.6	1476.0	Flood Risk
2880 min Summer	0.954	0.954	5.6	1408.3	Flood Risk
4320 min Summer	0.895	0.895	5.6	1302.8	O K
5760 min Summer	0.850	0.850	5.6	1223.8	O K
7200 min Summer	0.817	0.817	5.6	1166.1	O K
8640 min Summer	0.789	0.789	5.6	1118.1	O K
10080 min Summer	0.764	0.764	5.6	1076.3	O K
15 min Winter	0.481	0.481	5.6	631.5	O K
30 min Winter	0.612	0.612	5.6	829.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	128.332	0.0	453.8	19
30 min Summer	84.560	0.0	473.8	34
60 min Summer	52.943	0.0	865.9	64
120 min Summer	33.210	0.0	893.2	124
180 min Summer	24.857	0.0	867.2	184
240 min Summer	20.057	0.0	851.4	244
360 min Summer	14.608	0.0	834.9	364
480 min Summer	11.563	0.0	826.2	482
600 min Summer	9.605	0.0	820.6	602
720 min Summer	8.236	0.0	816.7	722
960 min Summer	6.438	0.0	811.2	962
1440 min Summer	4.528	0.0	801.4	1442
2160 min Summer	3.194	0.0	1659.9	2140
2880 min Summer	2.503	0.0	1601.5	2448
4320 min Summer	1.784	0.0	1474.2	3196
5760 min Summer	1.415	0.0	2390.6	3984
7200 min Summer	1.195	0.0	2518.8	4832
8640 min Summer	1.048	0.0	2639.6	5704
10080 min Summer	0.942	0.0	2732.5	6552
15 min Winter	128.332	0.0	469.2	19
30 min Winter	84.560	0.0	471.2	34

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.739	0.739	5.6	1034.0	O K
120 min Winter	0.886	0.886	5.6	1286.2	O K
180 min Winter	0.967	0.967	5.6	1432.0	Flood Risk
240 min Winter	1.019	1.019	5.6	1527.9	Flood Risk
360 min Winter	1.081	1.081	5.6	1642.4	Flood Risk
480 min Winter	1.116	1.116	5.6	1705.8	Flood Risk
600 min Winter	1.136	1.136	5.6	1743.6	Flood Risk
720 min Winter	1.148	1.148	5.6	1766.0	Flood Risk
960 min Winter	1.158	1.158	5.6	1783.9	Flood Risk
1440 min Winter	1.150	1.150	5.6	1769.4	Flood Risk
2160 min Winter	1.118	1.118	5.6	1710.2	Flood Risk
2880 min Winter	1.078	1.078	5.6	1636.0	Flood Risk
4320 min Winter	1.005	1.005	5.6	1501.5	Flood Risk
5760 min Winter	0.947	0.947	5.6	1395.8	Flood Risk
7200 min Winter	0.900	0.900	5.6	1310.4	O K
8640 min Winter	0.857	0.857	5.6	1235.1	O K
10080 min Winter	0.817	0.817	5.6	1166.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	52.943	0.0	909.5	64
120 min Winter	33.210	0.0	871.2	122
180 min Winter	24.857	0.0	849.7	182
240 min Winter	20.057	0.0	840.5	240
360 min Winter	14.608	0.0	836.1	358
480 min Winter	11.563	0.0	838.8	478
600 min Winter	9.605	0.0	844.1	596
720 min Winter	8.236	0.0	848.1	712
960 min Winter	6.438	0.0	849.5	944
1440 min Winter	4.528	0.0	839.0	1400
2160 min Winter	3.194	0.0	1670.1	2072
2880 min Winter	2.503	0.0	1622.2	2708
4320 min Winter	1.784	0.0	1532.0	3372
5760 min Winter	1.415	0.0	2675.0	4320
7200 min Winter	1.195	0.0	2814.1	5256
8640 min Winter	1.048	0.0	2924.9	6144
10080 min Winter	0.942	0.0	2885.1	7064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 588788 217031 TL 88788 17031
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.359

Time From:	**(mins) To:**	**Area (ha)**
0	4	2.359

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1159.0	0.700	1627.0	1.400	1850.0	2.100	1850.0
0.100	1222.0	0.800	1700.0	1.500	1850.0	2.200	1850.0
0.200	1285.0	0.900	1774.0	1.600	1850.0	2.300	1850.0
0.300	1351.0	1.000	1850.0	1.700	1850.0	2.400	1850.0
0.400	1417.0	1.100	1850.0	1.800	1850.0	2.500	1850.0
0.500	1486.0	1.200	1850.0	1.900	1850.0		
0.600	1555.0	1.300	1850.0	2.000	1850.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0108-5600-1200-5600
Design Head (m)	1.200
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.6
Flush-Flo™	0.354	5.6
Kick-Flo®	0.750	4.5
Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.6	3.000	8.6	7.000	12.9
0.200	5.3	1.400	6.0	3.500	9.3	7.500	13.3
0.300	5.6	1.600	6.4	4.000	9.9	8.000	13.7
0.400	5.6	1.800	6.8	4.500	10.4	8.500	14.1
0.500	5.5	2.000	7.1	5.000	11.0	9.000	14.5
0.600	5.3	2.200	7.4	5.500	11.5	9.500	14.9
0.800	4.6	2.400	7.7	6.000	12.0		
1.000	5.1	2.600	8.0	6.500	12.4		

APPENDIX D – DETENTION BASIN EXCEEDANCE (1000YR EVENT)

Summary of Results for 1000 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.504	0.504	5.5	665.8	O K
30 min Summer	0.649	0.649	5.5	889.0	O K
60 min Summer	0.791	0.791	5.5	1122.1	O K
120 min Summer	0.984	0.984	5.5	1461.9	Flood Risk
180 min Summer	1.096	1.096	5.5	1669.0	Flood Risk
240 min Summer	1.171	1.171	5.5	1808.6	Flood Risk
360 min Summer	1.262	1.262	5.5	1977.6	FLOOD
480 min Summer	1.315	1.315	5.5	2073.9	FLOOD
600 min Summer	1.346	1.346	5.5	2131.7	FLOOD
720 min Summer	1.365	1.365	5.5	2167.1	FLOOD
960 min Summer	1.381	1.381	5.5	2197.6	FLOOD
1440 min Summer	1.373	1.373	5.5	2182.0	FLOOD
2160 min Summer	1.325	1.325	5.5	2092.4	FLOOD
2880 min Summer	1.265	1.265	5.5	1982.1	FLOOD
4320 min Summer	1.162	1.162	5.5	1791.2	Flood Risk
5760 min Summer	1.084	1.084	5.5	1646.8	Flood Risk
7200 min Summer	1.022	1.022	5.5	1532.7	Flood Risk
8640 min Summer	0.968	0.968	5.5	1433.0	Flood Risk
10080 min Summer	0.914	0.914	5.5	1335.9	Flood Risk
15 min Winter	0.557	0.557	5.5	746.1	O K
30 min Winter	0.716	0.716	5.5	996.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.466	0.0	460.7	19
30 min Summer	101.386	0.0	471.0	34
60 min Summer	64.293	0.0	920.6	64
120 min Summer	42.153	0.0	865.9	124
180 min Summer	32.298	0.0	825.0	184
240 min Summer	26.425	0.0	809.2	244
360 min Summer	19.518	115.5	807.6	364
480 min Summer	15.553	211.8	819.4	484
600 min Summer	12.957	269.7	828.4	602
720 min Summer	11.120	305.1	833.2	722
960 min Summer	8.679	335.5	835.5	962
1440 min Summer	6.054	320.0	825.7	1442
2160 min Summer	4.190	230.4	1616.1	2160
2880 min Summer	3.224	120.1	1575.2	2856
4320 min Summer	2.233	0.0	1492.1	3500
5760 min Summer	1.726	0.0	2899.4	4256
7200 min Summer	1.420	0.0	2949.1	5040
8640 min Summer	1.214	0.0	2907.7	5880
10080 min Summer	1.066	0.0	2820.6	6664
15 min Winter	151.466	0.0	468.8	19
30 min Winter	101.386	0.0	467.8	34

Summary of Results for 1000 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.870	0.870	5.5	1258.6	O K
120 min Winter	1.080	1.080	5.5	1640.3	Flood Risk
180 min Winter	1.206	1.206	5.5	1873.8	FLOOD
240 min Winter	1.292	1.292	5.5	2031.7	FLOOD
360 min Winter	1.396	1.396	5.5	2224.4	FLOOD
480 min Winter	1.456	1.456	5.5	2335.8	FLOOD
600 min Winter	1.493	1.493	5.5	2404.3	FLOOD
720 min Winter	1.516	1.516	5.5	2447.3	FLOOD
960 min Winter	1.538	1.538	5.6	2488.2	FLOOD
1440 min Winter	1.537	1.537	5.6	2484.6	FLOOD
2160 min Winter	1.493	1.493	5.5	2404.2	FLOOD
2880 min Winter	1.437	1.437	5.5	2299.8	FLOOD
4320 min Winter	1.318	1.318	5.5	2079.6	FLOOD
5760 min Winter	1.222	1.222	5.5	1902.2	FLOOD
7200 min Winter	1.143	1.143	5.5	1755.9	Flood Risk
8640 min Winter	1.071	1.071	5.5	1622.7	Flood Risk
10080 min Winter	1.003	1.003	5.5	1497.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	64.293	0.0	914.8	64
120 min Winter	42.153	0.0	833.6	122
180 min Winter	32.298	11.7	810.3	182
240 min Winter	26.425	169.7	814.6	242
360 min Winter	19.518	362.4	842.9	360
480 min Winter	15.553	473.8	859.2	478
600 min Winter	12.957	542.3	868.0	596
720 min Winter	11.120	585.3	872.5	714
960 min Winter	8.679	626.2	873.7	950
1440 min Winter	6.054	622.6	861.0	1414
2160 min Winter	4.190	542.2	1661.0	2096
2880 min Winter	3.224	437.8	1638.3	2764
4320 min Winter	2.233	217.6	1571.0	3976
5760 min Winter	1.726	40.2	3190.7	4496
7200 min Winter	1.420	0.0	3114.2	5408
8640 min Winter	1.214	0.0	2982.0	6320
10080 min Winter	1.066	0.0	2846.7	7264

Rainfall Details

Rainfall Model	FEH
Return Period (years)	1000
FEH Rainfall Version	2013
Site Location	GB 588788 217031 TL 88788 17031
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.359

Time From:	**(mins) To:**	**Area (ha)**
0	4	2.359

Model Details

Storage is Online Cover Level (m) 1.200

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1159.0	0.700	1627.0	1.400	1850.0	2.100	1850.0
0.100	1222.0	0.800	1700.0	1.500	1850.0	2.200	1850.0
0.200	1285.0	0.900	1774.0	1.600	1850.0	2.300	1850.0
0.300	1351.0	1.000	1850.0	1.700	1850.0	2.400	1850.0
0.400	1417.0	1.100	1850.0	1.800	1850.0	2.500	1850.0
0.500	1486.0	1.200	1850.0	1.900	1850.0		
0.600	1555.0	1.300	1850.0	2.000	1850.0		

Hydro-Brake® Optimum Outflow Control

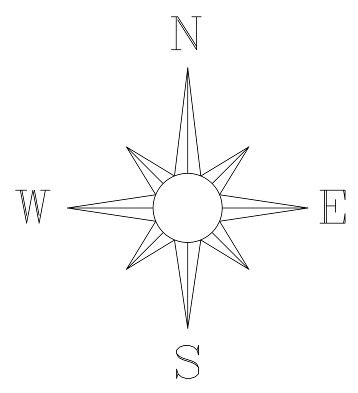
Unit Reference	MD-SHE-0103-5600-1550-5600
Design Head (m)	1.550
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

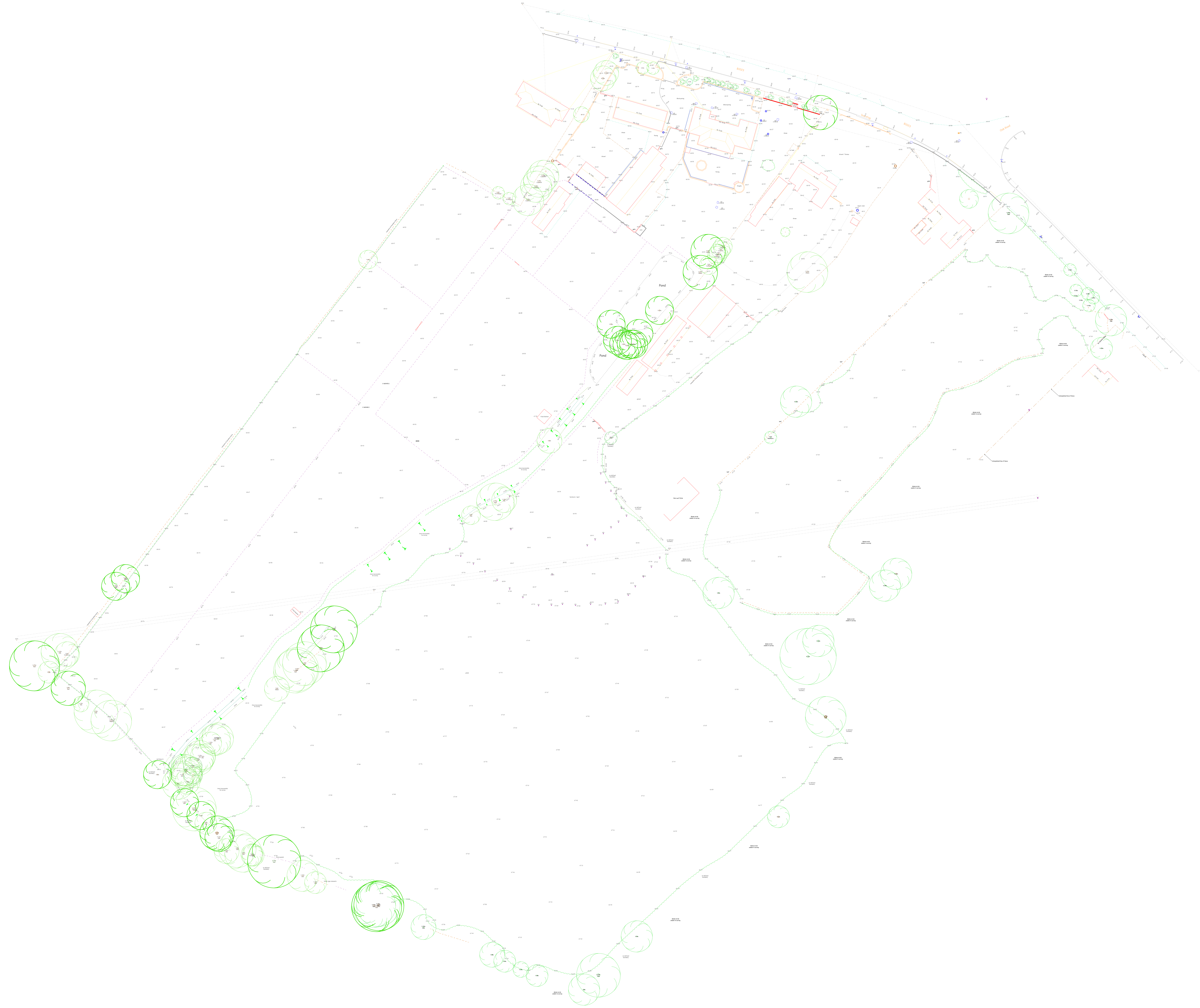
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.550	5.6
Flush-Flo™	0.452	5.5
Kick-Flo®	0.924	4.4
Mean Flow over Head Range	-	4.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	1.200	5.0	3.000	7.6	7.000	11.4
0.200	5.0	1.400	5.3	3.500	8.2	7.500	11.8
0.300	5.4	1.600	5.7	4.000	8.7	8.000	12.1
0.400	5.5	1.800	6.0	4.500	9.2	8.500	12.5
0.500	5.5	2.000	6.3	5.000	9.7	9.000	12.8
0.600	5.4	2.200	6.6	5.500	10.2	9.500	13.2
0.800	5.0	2.400	6.9	6.000	10.6		
1.000	4.6	2.600	7.1	6.500	11.0		

DRAWINGS





CONTROL STATION COORDINATES			
Station	Easting	Northing	Level
GPS1	588708.597	217153.763	69.398
GPS2	588727.975	217148.798	69.213
GPS3	588750.012	217143.078	69.106
GPS4	588790.853	217129.436	68.808
GPS5	588832.090	217118.010	68.409

All levels related to Ordnance Survey (Leica Smartnet network)

Revision	Description	Date

L E G E N D

Survey control station — 5

Banking

Gate (double)

Tree Spread and Girth shown to scale

Abbreviations

Bollard	BD	Post	P
Borehole	BH	Pipe	PE
British Telecom Box	BTB	Road Sign	RS
BT Inspection Cover	BT	Rodding Eye	RE
Concrete Paving Slabs	CPS	Service Marker	MK
Cable Television Cover	CTV	Sign Post	SP
Electricity Cable Pit	EC	Sluice Valve	SV
Electricity Pole	EP	Stop Tap	ST
Earth Rod	ER	Stop Cock	SC
Fire Hydrant	FH	Telegraph Pole	TP
Flag Staff	FS	Telephone Call Box	TCB
Gas Valve	GV	Traffic Light	TL
Gate Post	GP	Underside	U\S
Gully	GY	Vent Pipe	VP
Inspection Cover	IC	Water Meter	WM
Kerb Outlet	KO	Eaves Tile Level	ETL
Lamp Post	LP	Ridge Level	RL
Manhole	MH	Roof Level	RFL
Marker Post	MK	Soffit Level	SFL
Parking Meter	PM	Stop Valve	SV
		Threshold Level	THL
Retaining Wall	RTW	Cover Level	CL
Barbed Wire Fence	BWF	Invert Level	IL
Close Boarded Fence	CBF	No Visible Connection	NVC
Chainlink Fence	CLF	Unable to Lift	UTL
Panel Fence	PF		
Post and Chain Fence	PCF		
Post and Rail Fence	PRF		
Post and Wire Fence	PWF		

JTaylor Site Surveying Limited

20 Heycroft Way
Nayland,
Colchester
CO6 4LN

Tel 07881631165

Email : jtaylorsiteeng@aol.co.uk

CLIENT:

Marden Homes Ltd

PROJECT:

Towers End,
Kelvedon Rd,
Tipree

TITLE:

Topographical Survey

SURVEYOR: JT/RC

DRAWN BY: JT/RC — SHEET SIZE: A0

DATE: Nov 17 — SCALE: 1:500 @A0

DRAWING No: 0 — JOB No:

Scale 1:1000 — 0 20 40 60 80 100

Notes:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	Hedge	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
Bushes	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BT	BT Box	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Channel	PO	Post	YL	Yellow Line
Door	Door	RE	Rodding Eye		
EEB	Electric MH Cover	Ridge	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Rod	RS	Road Sign		
ET	EP Transformer	SETTS	Granite Setts		
Feeder	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers
Storm Sewers
Pipe position and alignment is indicative only.

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.

THE SURVEY HAS BEEN ACCURATELY POSITIONED ON THE ORDNANCE SURVEY NATIONAL GRID SYSTEM USING GPS OBSERVATIONS TO THE OS ACTIVE NETWORK AND AND THE LATEST ORDNANCE SURVEY TRANSFORMATION (OSTN15/OSGM15)

LOCAL SCALE FACTOR HAS BEEN REMOVED TO TRANSFORM THE SURVEY TO A FLAT EARTH GRID (SCALE FACTOR 1.00000)

ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM (NEWLYN). VERTICAL CONTROL HAS BEEN ESTABLISHED USING GPS OBSERVATIONS TO THE OS ACTIVE NETWORK AND AND THE LATEST ORDNANCE SURVEY TRANSFORMATION (OSTN15/OSGM15)

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.

ANY CRITICAL DIMENSIONS AND MEASUREMENTS SHOULD BE BASED ON THE ORIGINAL DIGITAL DATA AND CONFIRMED WITH BB SURVEYS LTD.
ANY ERRORS SHOULD BE NOTIFIED TO BB SURVEYS LTD.

NO ATTEMPT HAS BEEN MADE TO ENTER ANY CONFINED SPACES ON THIS SITE. WE HAVE MEASURED INVERT DEPTHS/ESTIMATED PIPE SIZES AND SHOWN THE DIRECTION OF FLOW ONLY WHERE DRAIN RUNS ARE ACTIVE AT THE TIME OF SURVEY. INSPECTION COVERS WHICH WE WERE UNABLE TO LIFT BY MANUAL METHODS ARE DENOTED AS MH (UTL). WE DID NOT QUOTE FOR THE USE OF HYDRAULIC LIFTING EQUIPMENT.

DRAINAGE RUNS BETWEEN INSPECTION COVERS HAVE NOT BEEN INVESTIGATED. ANY SHOWN ARE ESTIMATED AND NOT CONFIRMED. ALL DRAINAGE RUNS SHOULD BE PROVED BY DYE TRACING AND IF NECESSARY BY RADIO DETECTION METHODS PRIOR TO ANY DESIGN WORK. ALL PIPE SIZES AND CONNECTIONS SHOULD ALSO BE CONFIRMED WITH YOUR LOCAL DRAINAGE AUTHORITY PRIOR TO ANY DESIGN WORK.

THERE MAY BE INSPECTION COVERS ON SITE WHICH WERE NOT VISIBLE AT THE TIME OF SURVEY. THEY MAY HAVE BEEN BURIED OR COVERED BY VEGETATION. YOU SHOULD CONSULT YOUR LOCAL DRAINAGE AUTHORITY OR COMMISSION A CCTV DRAINAGE SURVEY TO ENSURE THAT YOU LOCATE ANY MISSING COVERS OR DRAINAGE RUNS.

REV	Date	Created By	Comments
□	06.09.20	BB	First Issue

Scale at A1	Project Number
1:1000	2219-1968

Drawing Status
X Existing Topographic Survey
As Built Survey
For Information

BBS BB SURVEYS LTD
1 Chestnut Place, Cringleford
Norwich, Norfolk NR4 7BD
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

Client
Marden Homes Ltd

Project
Land off Kelvedon Road
Tiptree

Title
Existing Ground Level Survey
Overview

BBS-BB-EGL-SU-00 □
Originator Initials Detail Type Number Revision

BBS-BB-EGL-SU-00
Originator Initials Detail Type Number Revision □

Scale 1:250 (0 5 10 15 20 25)

Notes

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	Hedge	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
Bushes	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BT	BT Box	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P/W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Channel	PO	Post	YL	Yellow Line
Door	Door	RE	Rodding Eye		
EEB	Electric MH Cover	Ridge	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Rod	RS	Road Sign		
ET	EP Transformer	SETTS	Granite Setts		
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FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers
Storm Sewers
Pipe position and alignment is indicative only.

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.

THE SURVEY HAS BEEN ACCURATELY POSITIONED ON THE ORDNANCE SURVEY NATIONAL GRID SYSTEM USING GPS OBSERVATIONS TO THE OS ACTIVE NETWORK AND AND THE LATEST ORDNANCE SURVEY TRANSFORMATION (OSTN15/OSGM15)

LOCAL SCALE FACTOR HAS BEEN REMOVED TO TRANSFORM THE SURVEY TO A FLAT EARTH GRID (SCALE FACTOR 1.000000)

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REV	Date	Created By	Comments
□	06.09.20	BB	First Issue

Scale at A1	Project Number
1:250	2219-1968

Drawing Status
- [x] Existing Topographic Survey
- [ ] As Built Survey
- [ ] For Information

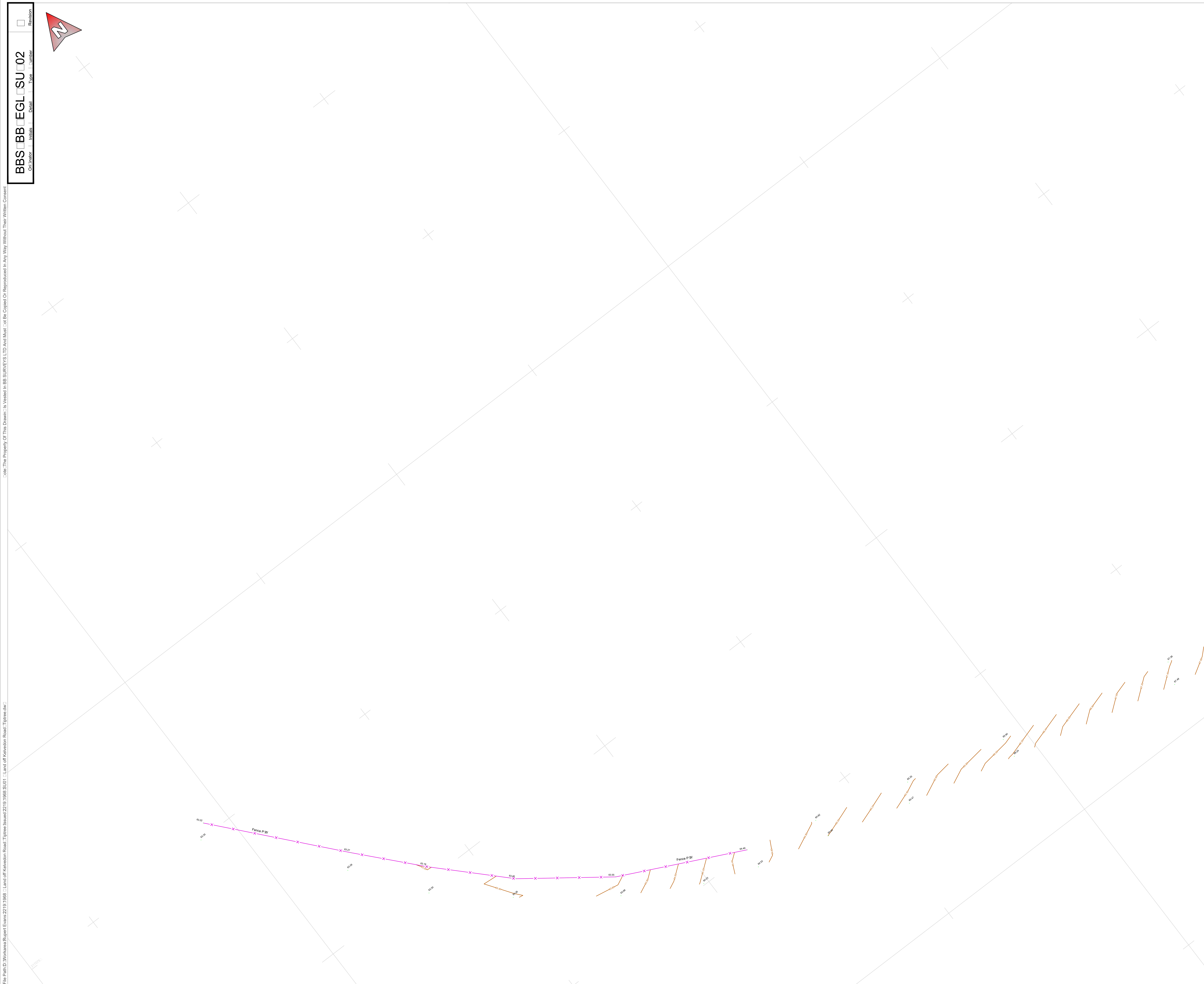
BBS BB SURVEYS LTD
1 Chestnut Place, Cringleford
Norwich, Norfolk NR4 7BD
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

Client
Marden Homes Ltd

Project
Land off Kelvedon Road
Tiptree

Title
Existing Ground Level Survey
Sheet 1

Originator	Initials	Detail	Type	Number	Revision
BBS	BB	EGL	SU	01	□



Scale 1:250

0 5 10 15 20 25

Notes

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	Hedge	Hedge	TB	Top Bank
BIN	Bin	IC	Inspection Cover	TBOX	Telephone Box
BS	Bus Stop	IL	Invert Level	TL	Traffic Light
Bushes	Bush	KO	Kerb Outlet	TOK	Top Of Kerb
BT	BT Box	LP	Lamp Post	TP	Telegraph Pole
CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P&W	Partition Wall	W	Water Cover
COL	Column	PB	Post Box	WL	White Line
DB	Ditch Bottom	PM	Parking Meter	WO	Wash Out
DCHNL	Drainage Channel	PO	Post	YL	Yellow Line
Door	Door	RE	Rodding Eye		
EEB	Electric MH Cover	Ridge	Ridge Level		
EP	Electric Pole	RP	Reflector Post		
ER	Earth Rod	RS	Road Sign		
ET	EP Transformer	SETTS	Granite Setts		
Feeder	Feeder Pillar	SF	Safety Fence		

FCB	Close Boarded
FCL	Chain Link
FHD	Hoarding
FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers — Pipe position and alignment is indicative only.
Storm Sewers

Building Heights

RIDGE
TILE
EAVES
SOFFIT

SURVEY CARRIED OUT USING TRIMBLE S6 TOTAL STATION & TRIMBLE R10 GPS.

THE SURVEY HAS BEEN ACCURATELY POSITIONED ON THE ORDNANCE SURVEY NATIONAL GRID SYSTEM USING GPS OBSERVATIONS TO THE OS ACTIVE NETWORK AND AND THE LATEST ORDNANCE SURVEY TRANSFORMATION (OSTN15/OSGM15)

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REV	Date	Created By	Comments
-	06.09.20	BB	First Issue

Scale at A1: 1:250
Project Number: 2219/1968

Drawing Status
- [x] Existing Topographic Survey
- [ ] As Built Survey
- [ ] For Information

BBS BB SURVEYS LTD
1 Chestnut Place, Cringleford
Norwich, Norfolk NR4 7BD
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

Client
Marden Homes Ltd

Project
Land off Kelvedon Road
Tiptree

Title
Existing Ground Level Survey
Sheet 2

BBS-BB-EGL-SU-02
Originator | Initials | Detail | Type | Number | Revision

Sheet Size A1 841 x 594

Plot Date:07 September 2020 Plot Style:BB Surveys Std.ctb Saved By:Barry on 07 September 2020
Plot Scale Check 100mm

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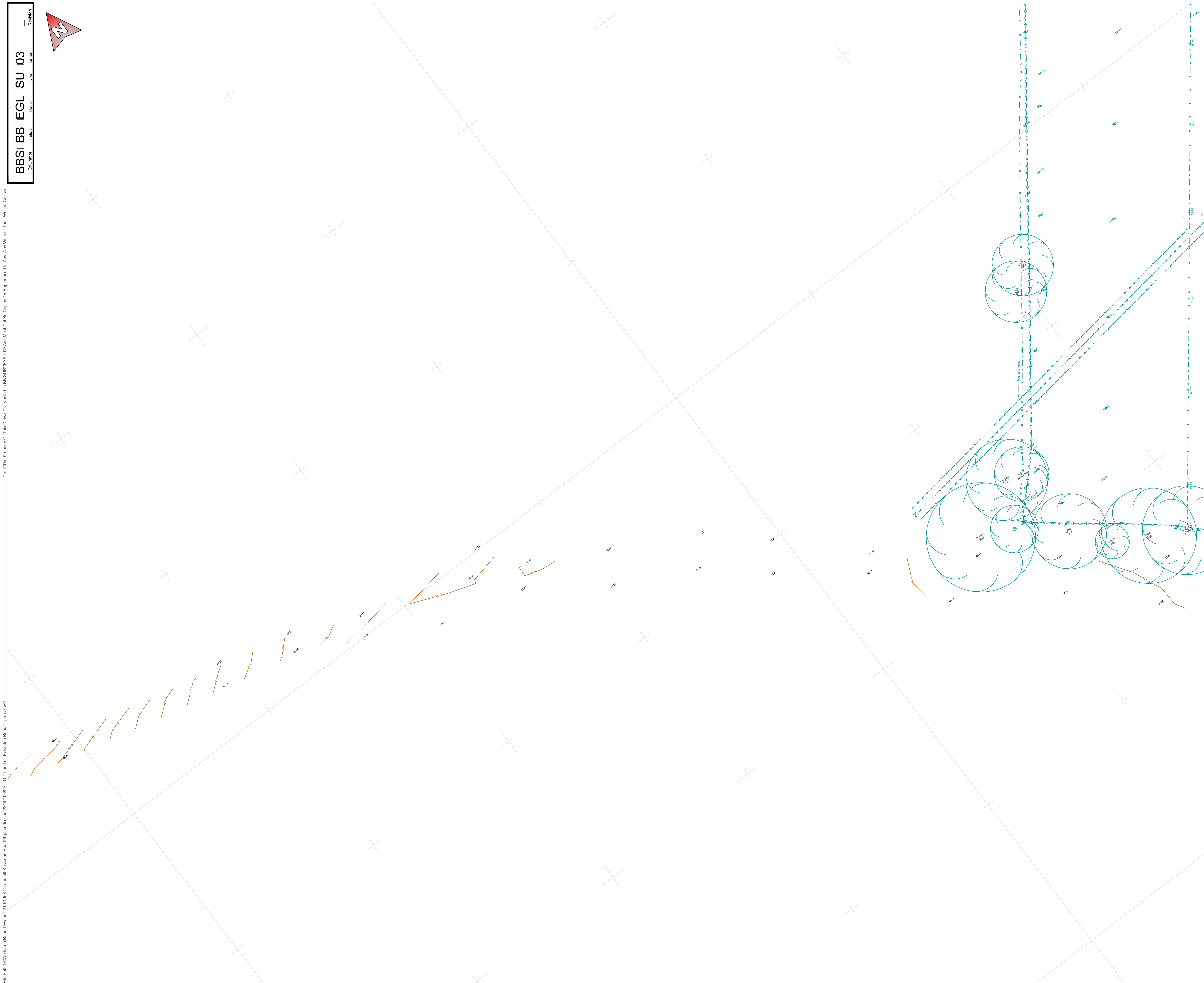

BBS-BB-EGL-SU-03
Originator | Initials | Detail | Type | Number | Revision

Scale 1:250 (0, 5, 10, 15, 20, 25)

Notes

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
BL	Lit Bollard	GV	Gas Valve	TAC	Tactile Paving
BOL	Bollard	Hedge	Hedge	TB	Top Bank
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BS	Bus Stop	IL	Invert Level	TL	Traffic Light
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CAB	Cabinet	MH	Manhole	TRK	Track
CHNL	Channel	MP	Marker Post	TS	Traffic Sign MH
CL	Centreline	NB	Name Board	VENT	Vent
CONC	Concrete	P:W	Partition Wall	W	Water Cover
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FHR	Heras Fence
FPL	Pallisade
FPR	Post & Rail
FPW	Post & Wire
RAIL	Railings

Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences — FCB 1.6h
Walls — Wall 1.2h
Hedges — Hedge 1.3h — Average root line shown.
Overhead Line — OHL — Indicative position of cables.

Services

Foul Sewers
Storm Sewers
Pipe position and alignment is indicative only.

Building Heights

RIDGE
TILE
EAVES
SOFFIT

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REV	Date	Created By	Comments
-	06.09.20	BB	First Issue

Scale at A1	Project Number
1:250	2219-1968

Drawing Status
X Existing Topographic Survey
As Built Survey
For Information

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1 Chestnut Place, Cringleford
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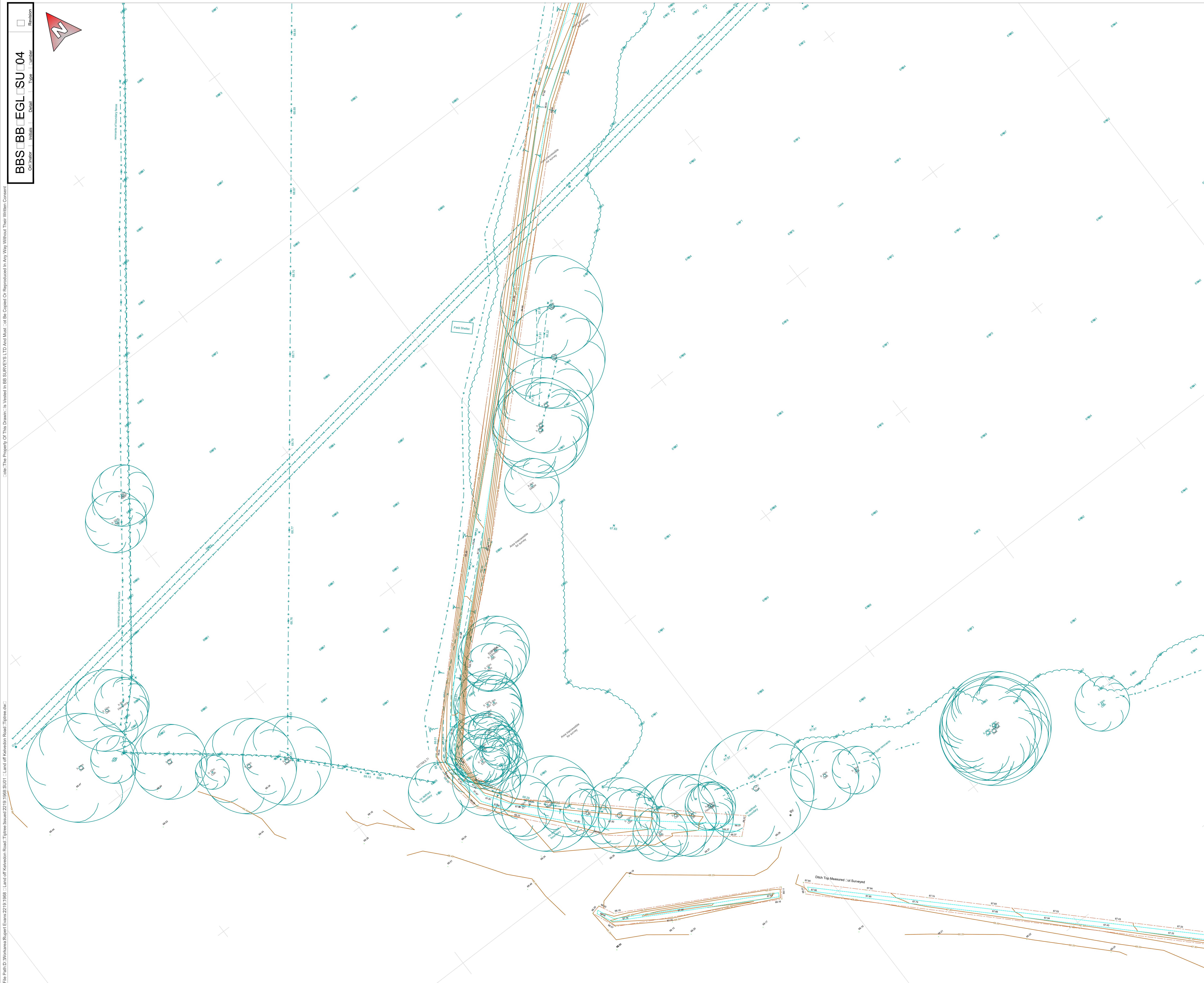
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

Client
Marden Homes Ltd

Project
Land off Kelvedon Road
Tiptree

Title
Existing Ground Level Survey
Sheet 3

BBS-BB-EGL-SU-03
Originator | Initials | Detail | Type | Number | Revision



Scale 1:250 (0 5 10 15 20 25)

Notes:

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
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Control Station
Column
Floor to Ceiling Height
Floor to False Ceiling Height

Features

Fences — FCB 1.6h
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Hedges — Hedge 1.3h — Average root line shown.
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REV	Date	Created By	Comments
-	06.09.20	BB	First Issue

Scale at A1: 1:250
Project Number: 2219-1968

Drawing Status
- [X] Existing Topographic Survey
- As Built Survey
- For Information

BBS BB SURVEYS LTD
1 Chestnut Place, Cringleford
Norwich, Norfolk NR4 7BD
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

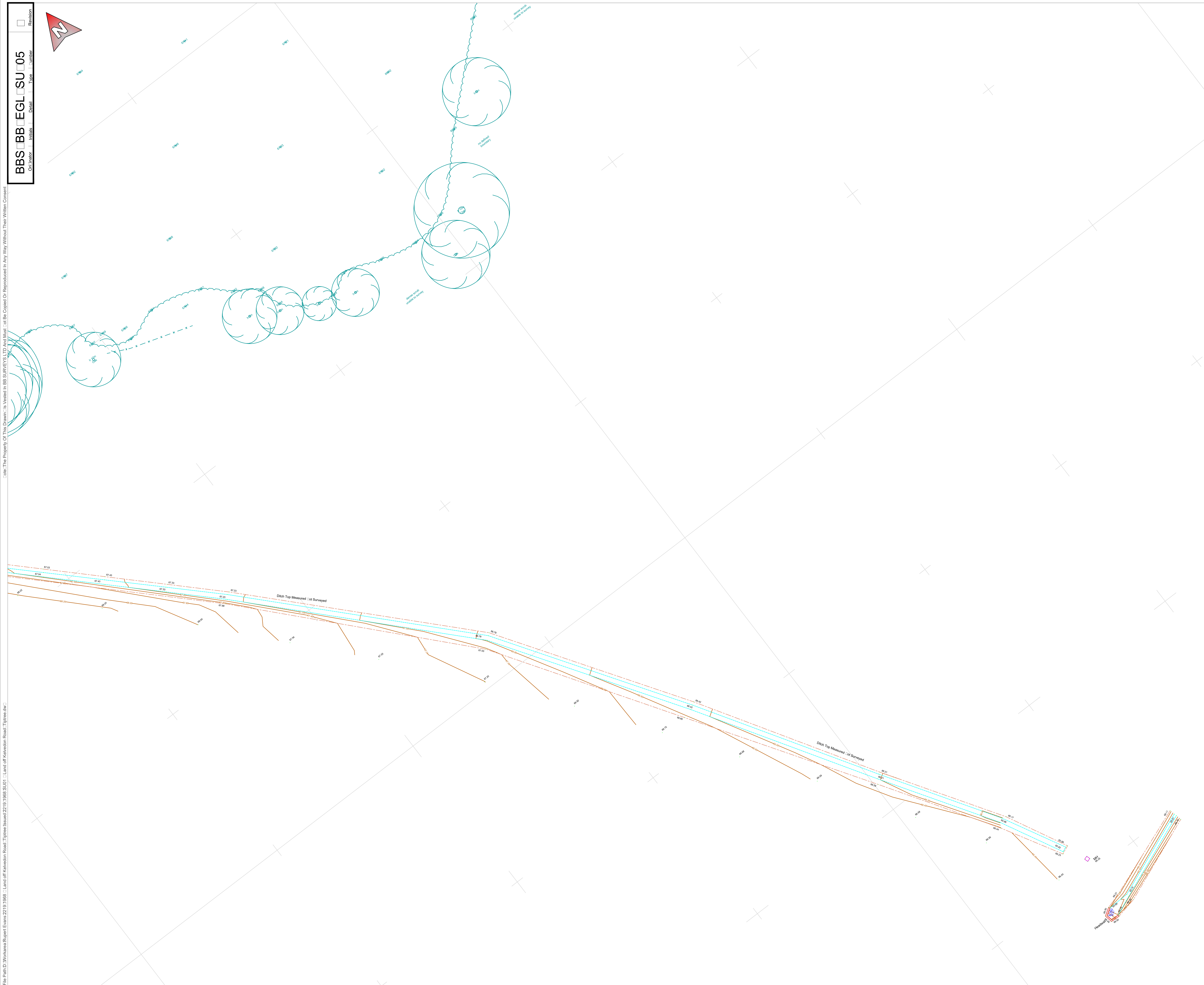
Client: Marden Homes Ltd

Project: Land off Kelvedon Road Tiptree

Title: Existing Ground Level Survey Sheet 4

BBS-BB-EGL-SU-04 (Originator / Initials / Detail / Type / Number) Revision -

Sheet Size A1 841 x 594



BBS-BB-EGL-SU-05
Originator | Initials | Detail | Type | Number | Revision

Scale 1:250 (0, 5, 10, 15, 20, 25)

Notes

AV	Air Valve	FH	Fire Hydrant	SP	Sign Post
BB	Bottom Bank	FP	Footpath	STAY	Stay
BH	Bore Hole	G	Gully Grate	SV	Sluice Valve
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Column
Floor to Ceiling Height
Floor to False Ceiling Height

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REV	Date	Created By	Comments
-	06.09.20	BB	First Issue

Scale at A1: 1:250
Project Number: 2219-1968

Drawing Status
X Existing Topographic Survey
As Built Survey
For Information

BBS BB SURVEYS LTD

1 Chestnut Place, Cringleford
Norwich, Norfolk NR4 7BD
t: 01603 507917
m: 07786 388175
e: barry@bbsurveys.co.uk

Client
Marden Homes Ltd

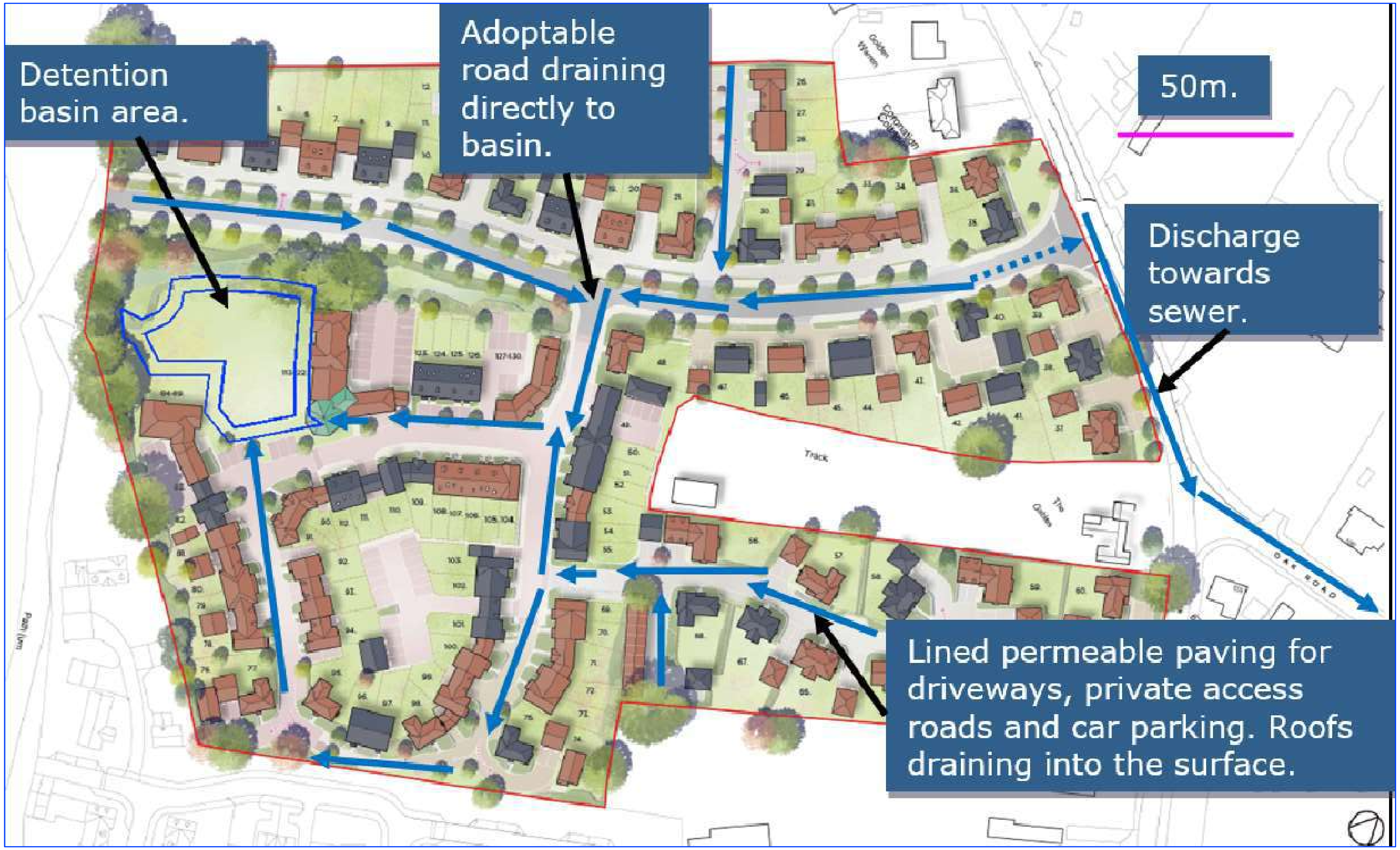
Project
Land off Kelvedon Road
Tiptree

Title
Existing Ground Level Survey
Sheet 5

BBS-BB-EGL-SU-05
Originator | Initials | Detail | Type | Number | Revision

AS PROPOSED LAYOUT PLAN

KELVEDON ROAD
PROPOSED SITE LAYOUT
TIPTREE
COLCHESTER
CO5 OLX
MARDEN HOMES LTD.
23.10.20 1:500@A1 Project#1432
300.00
www.daparchitecture.co.uk



N

LEGEND

DETENTION BASIN DRAINING ROOFS AND HARDSTANDING (1850 SQM X 1M, SIZED TO ACCOMMODATE 100YRCC STORM EVENT.

DISCHARGE INTO EXISTING AW SEWERS AT POST-DEVELOPMENT EQUIVALENT GREENFIELD RATE OF 5.55 L/S DURING ALL MODELLED EVENTS INCLUDING CLIMATE CHANGE 1 IN 100 YEAR EVENT.

NOTES

SITE LAYOUT TAKEN FROM DRAWING NUMBER 1432.300.00.

SUDS STRATEGY IS INDICATIVE AND SUBJECT TO DETAILED DESIGN.

DESIGNED	DRAWN	SCALE	DATE
RE	RE	1:1250	14/10/2020

DRAWING NUMBER	REVISION	DRAWING STATUS
2229/RE/01	-	FINAL

PROJECT
PROPOSALS OFF KELVEDON ROAD, TIPTREE.

DRAWING TITLE
SUDS STRATEGY

CLIENT
MARDEN HOMES

EVANS Rivers and Coastal

EVANS RIVERS AND COASTAL LIMITED
19 ST ANDREWS AVENUE
THORPE ST ANDREW, NORWICH, NR7 0RG
T 01603 304077

E enquires@evansriversandcoastal.co.uk
W www.evansriversandcoastal.co.uk

ORIGINAL SHEET SIZE A3H

EVANS
Rivers and Coastal