Land South of Barrow Green Road,
Oxted, RH8 0NN

Flood Risk Assessment and Drainage Strategy

For

Croudace Homes Limited

Document Control Sheet

Land South of Barrow Green Road,

Oxted, RH8 0NN

Croudace Homes Limited

This document has been issued and amended as follows:

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27th November 2024	Draft	Chris Gray	Neil Jaques
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1.0 Introduction

1.1 This Flood Risk Assessment (FRA) and Drainage Strategy Report has been produced by Motion on behalf of Croudace Homes Limited. This report is to accompany an outline application for residential development of up to 190 dwellings (including affordable homes) (Use Class C3), an extra care facility with up to up 80 beds (Use Class C2), together with the formation of vehicular access, landscaping, parking, open space, green and blue infrastructure, and all other associated development works. All matters are reserved except for access.

1.2 The site location plan can be seen in **Appendix A**. The site is accessible via an existing farm access off Barrow Green Road to the north of the site. A layout of the proposed development can be seen in **Appendix B**.

1.3 The approximately 9.7 hectares (ha) development site falls within the administrative boundary of Tandridge District Council (TDC) and Surrey County Council (SCC) is the Lead Local Flood Authority (LLFA). As the development is over 1 ha, the development is classified as major. A major development has the potential to generate surface water runoff and increase flood risk in an area, and as such, a drainage strategy is required to demonstrate how the development will manage and discharge surface water generated in all rainfall events up to and including the 1 in 100-year + 45% storm.

1.4 Therefore, this FRA and drainage strategy has been produced to discuss the flood risks to the proposed development, from all sources. This FRA and drainage strategy will also define how the site will manage its surface water and foul sewage so that the development does not increase flood risk in the area or to neighbouring properties/land.

1.5 This FRA and drainage strategy follows the guidance set out in:

- National Planning Policy Framework[1] (NPPF)
- Planning Practice Guidance (PPG) to the NPPF
- CIRIA SuDS Manual 2015 (C753)
- Environment Agency Rainfall Runoff Management for Developments
- Non-Statutory Technical Standards for SuDS (NSTS)
- SCC Planning Advice - Sustainable Drainage Systems (SuDS)[2]

1.6 This FRA and drainage strategy report pertains only to the design of the drainage system for the built site. It does not provide details of how the site will be drained during the construction phase. This is considered to be temporary works and can only be prescribed and provided by the eventual appointed contractor. Therefore this information will be provided via a condition / the RM application.

1.7 Similarly, this report does not provide information on how the drainage infrastructure will be protected during the construction phase of the project. The provision of this information is, again, the responsibility of the appointed contractor. Therefore this information will be provided via a condition / the RM application.

[1] https://www.gov.uk/government/publications/national-planning-policy-framework--2
[2] https://www.surreycc.gov.uk/community/emergency-planning-and-community-safety/flooding/more-about-flooding/suds-drainage

2.0 Site Description

Table 2.1 – Site Summary

Site Name	Land South of Barrow Green Road,
Location	Oxted, RH8 0NN
Grid Reference	538792,153131
Site Area	9.7ha
Development Type	Residential development of up to 190 dwellings (including affordable homes) (Use Class C3), an extra care facility with up to up 80 beds (Use Class C2), together with the formation of vehicular access, landscaping, parking, open space, green and blue infrastructure, and all other associated development works.
Flood Zone	Flood Zone 1
Surface Water Flood Risk	Predominantly located in the 'very low' surface water flood risk category (less than 1 in 1000 chance of flooding each year). However, there is a low, medium and high risk surface water flood flow path through the western half of the site (i.e. between 1 in 1000 and 1 in 100, between 1 in 100 and 1 in 30 and more than 1 in 30 chance of flooding each year respectively).
Local Water Authority	Southern Water (SW)
Local Planning Authority	Tandridge District Council (TDC)
Lead Local Flood Authority	Surrey County Council (SCC)

Site Location and Description

2.1 The red line boundary of the site is around 9.7 ha, and the site is accessible via an existing farm access off Barrow Green Road to the north of the site. The site location can be seen in the plan in **Appendix A**.

2.2 The site is currently greenfield and is predominantly agricultural land.

Topography

2.3 With reference to the Topographical Survey of the site in **Appendix C**, the site falls from a high point of around 111.50m Above Ordnance Datum (AOD) along the northeast boundary of the site, to a low point of around 95.00m AOD at the southwest corner of the site. The general slope from the high point to the low point is estimated to be around 1 in 25.

Hydrology

2.4 The EA Statutory Main River Map[3] confirms that the nearest main river (River Darent) flows east approximately 5.20km east of the site.

2.5 The EA Statutory Main River Map and the OS 25 Inch 1892-1914 and OS 1:2,500 1948-1973 map series available to view on the National Library of Scotland Side by Side Georeferenced Maps Viewer Website[4]

[3] https://www.arcgis.com/apps/webappviewer/index.html?id=17cd53dfc524433980cc333726a56386
[4] https://maps.nls.uk/geo/explore/side-by-side/#zoom=15.9&lat=51.25730&lon=-0.01479&layers=258&right=ESRIWorld

show ordinary watercourses flowing south along the eastern boundary of the site and close to the western boundary of the site that meet approximately 175m downstream of the site.

Geology

2.6 The British Geological Survey (BGS) online 1:50,000 GeoIndex[5] mapping identifies that the underlying solid geology is FOLKESTONE FORMATION - SANDSTONE, which is 'comprises medium- and coarse-grained, well-sorted cross-bedded sands and weakly cemented sandstones'[6].

2.7 Defra's Magic Map website[7] lists the soil as being 'freely draining slightly acid loamy soils'.

2.8 The Infiltration Testing Report[8] prepared for the site in **Appendix D** summarises the ground conditions as Topsoil to a depth of 0.2m bgl and either CLAY to 1.60m (TP2) or SAND to 2.00m below ground level (bgl). After four hours of infiltration testing the starting water depth had not changed in the test pit that encountered CLAY. TP3 was excavated to 2.0m bgl, however collapsed during the first test so infiltration testing could not be undertaken. Three BRE365 infiltration tests were completed in each of the two remaining infiltration test pits (TP1 and TP4).

2.9 With reference to the Groundwater Monitoring Report and Groundwater Investigation Plan in **Appendix D**, there is a permanently wet area located in the southwest of the site. Groundwater monitoring wells were installed in this area and predominantly recorded the groundwater level at; close to; or in some cases, above the ground surface. Trial pits subsequently excavated in close proximity to the spring area defined by vegetation showed that groundwater levels were below ground when moving away from the saturated ground associated with the spring and as ground levels rise. Groundwater flow directions have not been definitively derived, but it is most likely the local flow direction is NW to SE. This emerges in the topographic depression where the wet spring area is located.

Hydrogeology

2.10 Defra's Magic Map website indicates the site is in the Medway Management Catchment; the bedrock geology is designated a Principal aquifer; and the Groundwater Vulnerability Map (England) classification is High.

2.11 Defra's Magic Map website indicates the site is located in a drinking water safeguard zone (surface water) and a groundwater source protection zone 3.

2.12 Defra's Magic Map website indicates the site is not located in a drinking water protected area.

2.13 Groundwater was not encountered to 2.00m bgl during the infiltration testing undertaken at the site in November 2024.

Infiltration Potential

2.14 The Infiltration Testing Report prepared for the site in **Appendix D** indicates that infiltration SuDS will be possible for the proposed development where SAND is present at the site on the basis water will empty via infiltration.

Existing Drainage Regime

2.15 The wastewater plans obtained from SW in **Appendix E** show that a 175mm diameter foul water gravity public sewer flows south across the site.

[5] https://www.bgs.ac.uk/map-viewers/geoindex-onshore/
[6] https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=FO
[7] https://magic.defra.gov.uk/magicmap.aspx
[8] Ground & Water Limited, Infiltration Testing Report, referenced GWPR6338/GIR/November 2024 V1.01

Brownfield Runoff Rate

2.16 The topographic survey shows that there are no impermeable areas at the site. On the basis the drainage strategy for the proposed development will be required to discharge at greenfield runoff rates, brownfield calculations are not considered necessary.

Greenfield Runoff Rate

2.17 On the basis the FEH Rainfall method has been applied to the MicroDrainage calculations, the FEH QMED Method has been used to derive a QMED value of 10.1 l/s i.e. 467.6 (QMED Rural) / 164.0 (FEH Catchment Area) x 3.527 (Development Impermeable Area) = 10.1 (**Appendix F**).

2.18 The QMED value will be used to guide the appropriate surface water discharge rate and volume from the development.

3.0 Legislative and Policy Framework

3.1 The Flood and Water Management Act 2010 (FWMA) received Royal Assent on 8th April 2010. The Act was introduced to enforce some of the key proposals set out within UK Government flood and water strategies along with UK Government's response to the Sir Michael Pitt's Review of the summer 2007 floods.

3.2 LLFA's including WSCC have a responsibility under the FWMA to develop, maintain, apply and monitor the application of a strategy for local flood risk in their area. Local flood risk is defined as flood risk arising from local sources, such as surface run-off, groundwater and ordinary watercourses (i.e., non-main rivers). The EA plays a role in managing the watercourses designated as 'main rivers'.

3.3 Relevant to the site, the FWMA encourages the uptake of Sustainable Drainage Systems (SuDS) by removing the automatic right to connect to sewers and providing for LLFA's to adopt SuDS for new developments.

3.4 This report will provide a review of SuDS opportunities and constraints for the development and recommend a sustainable drainage strategy that will employ the highest available tiers of the drainage hierarchy. Thus, this report will adhere to the Act through looking to use SuDS as a fundamental element of the surface water drainage system.

The Environment Agency Flood Map for Planning

3.5 The Environment Agency's Flood Map for Planning gives an indicative prediction of areas at risk of fluvial and tidal flooding. The mapping is an amalgamation of modelled flood levels and historical flood event outlines.

3.6 The Flood Map is split into 'Flood Zones', which demarcate the extent of flooding from rivers or the sea for different return periods. The Flood Map for Planning shows the extent of the natural floodplain if there were no defences or other man-made structures. They do not provide a definitive picture of where flooding would occur; rather, they provide an indicative prediction of areas at risk.

3.7 Table 3.1, below, lists the flood zone categories and explains the flood risk probabilities they represent.

Table 3.1 – Flood Zone Categories

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of tidal flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of tidal flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map, but may be distinguished in Product 4 information, for example). Subsequent to the 2022 update to the NPPF, Flood Zone 3b is currently considered to be anywhere within the 1 in 30-year flood envelope.

The National Planning Policy Framework

3.8 The NPPF sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. The Technical Guidance to the NPPF provides further information on the policies set out in the NPPF. It encourages development to take place in areas of lower flood risk wherever possible and stresses the importance of preventing increases in flood risk off-site to the wider catchment area. This includes ensuring that flood risk is taken into account at all stages of the planning process, avoiding inappropriate development in areas at risk of flooding and directing development away from those areas where risks are highest.

3.9 A site-specific FRA is required for proposals of 1ha or greater in Flood Zone 1, all proposals for development in Flood Zones 2 and 3, or in an area within Flood Zone 1 that has critical drainage problems (as notified to the local planning authority by the EA).

3.10 The FRA will identify and assess the risks of all forms of flooding to and from the development and, if necessary, demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.

3.11 Within each Flood Zone, a key factor in determining planning applications for development is the flood risk vulnerability of a development. Table 2 of the Technical Guidance to the NPPF categorises different development types according to their vulnerability to flooding. These categories are:

- Essential infrastructure;
- Highly vulnerable development;
- More vulnerable development;
- Less vulnerable development, and;
- Water-compatible development.

3.12 Within the different Flood Zones each of the above development categories are considered appropriate or not permissible. The Technical Guidance to the NPPF lists these as:

Flood Zone 1:

- All the development categories listed above are appropriate.

Flood Zone 2:

- Water-compatible, less vulnerable development, more vulnerable development and essential infrastructure is appropriate in this zone.

Flood Zone 3a:

- Water-compatible and less vulnerable development is appropriate in this zone. Highly vulnerable development should not be permitted in this zone.

Flood Zone 3b:

- Only water-compatible development and essential infrastructure that has to be there should be permitted in this zone.

3.13 The above information sets out the basis by which developments must be assessed in terms of flood risk. Later in this report, the site will be reviewed against the Flood Zone in which it is located, and, noting the proposed site layout in **Appendix B**, an assessment will be made of the appropriateness of the proposed development, as per the advice within the Technical Guidance to the NPPF.

Lead Local Flood Authority

3.14 As of April 2015, the LLFA became a statutory consultee on all major planning applications. The LLFA is required to assess planning applications in respect of surface water drainage and sustainable drainage systems.

4.0 Current Flood Risk

4.1 Flooding can arise from a variety or combination of sources. These may be natural or artificial and may be affected by climate change. These are discussed, below, in the following two sections and summarised in Table 6.1. The probability of any likely impacts is also assessed, where necessary.

Flooding from Rivers and the Sea

4.2 The 9.7 hectares (ha) site is located within Flood Zone 1 according to the EA's Flood Map for Planning (**Appendix G**). This means in any year the site has a less than 1 in 1000 (0.1%) chance of flooding from rivers or the sea.

4.3 There will be no increased risk of flooding from rivers or the sea on site post development.

Surface Water Flooding

4.4 Surface water, or pluvial flooding, results from rainfall-generated overland flow, where rainwater has not yet reached a watercourse or sewer and where the local drainage systems become overwhelmed. Pluvial flooding often occurs during short, very intense storms, but can also occur during longer periods of rainfall when the ground is already saturated, or where land has low permeability due to development.

4.5 In these conditions surface water can build up where the topography allows it to converge or pond. Where it gathers it will travel down prevailing gradients. Pluvial flooding then occurs at locations where significant surface water flow paths converge, at localised low points and/or due to overland obstructions. In urban areas pluvial flooding often occurs where the built environment channels overland flow routes (down roads that are bounded by kerbs, for example) or where there are obstacles to the natural overland flow routes. Boundary walls and buildings are often the main causes and, hence, the likelihood of pluvial flooding to impact property and gardens.

4.6 Pluvial flooding is exacerbated in many cases by the mistreatment or failure of the below ground infrastructure (including partial or full blockages of gullies and/or within the combined sewers and the accumulation of fats, oils and greases within the sewer networks).

4.7 With reference to Figure 1-1 of the Surface Water Hydraulic Modelling Report in **Appendix D**, the site is predominantly located in the 'very low' surface water flood risk category (less than 1 in 1000 chance of flooding each year). However, there is a low, medium and high risk surface water flood flow path through the western half of the site (i.e. between 1 in 1000 and 1 in 100, between 1 in 100 and 1 in 30 and more than 1 in 30 chance of flooding each year respectively).

4.8 With reference to Sections 5.8-5.10 of the Surface Water Hydraulic Modelling Report in **Appendix D**, through the northwest of the site the flow path is modelled to be shallow, typically less than 0.10m, ranging in width from approximately 5-20m. In the centre of the site the flow path becomes more concentrated within a slight valley in the local topography that directs the flow path southwest towards the ordinary watercourse, with peak depths in this area typically around 0.15m. In the southwest corner where the flow path joins the ordinary watercourse, depths of approximately 0.25m are predicted.

4.9 With reference to Section 6.1 of the Surface Water Hydraulic Modelling Report in **Appendix D**, to increase the developable area of the site, post-development modelling was undertaken to assess the potential impacts of reprofiling ground levels so the overland flow path is diverted along the western boundary, away from the proposed residential development in the centre of the site.

4.10 With reference to Section 6.9 of the Surface Water Hydraulic Modelling Report in **Appendix D**, the model results demonstrate the proposals are not predicted to have a detrimental impact on flood risk to third party land, with all increases in peak depths contained within the site boundary.

4.11 As the proposed development will manage surface water in line with appropriate guidance, there will be no risk of surface water flooding to the proposed development on site, or increased risk of surface water flooding off site.

Groundwater Flooding

4.12 The risk of groundwater flooding is dependent on local geological and hydrogeological conditions at any given time. Groundwater levels rise during wet winter months and fall again in the summer when rainfall is low and extractions are higher. In very wet winters, rising groundwater levels can reactivate flow in ephemeral streams that only flow for part of the year or even lead to the flooding of normally dry land.

4.13 The GeoSmart GW5 groundwater information for the site location in **Appendix G** shows the entirety of the Site to be at negligible risk of groundwater flooding.

4.14 Groundwater was not encountered to 2.00m bgl during the infiltration testing undertaken at the site in November 2024. The infiltration testing investigation included a trial pit excavated at the approximate low point of the site (TP3).

4.15 During the site visit undertaken on the 9th May 2024, it was noted that there appears to be a spring onsite. Please see **Figure 4.1** below. Approximately where the spring originates onsite has been shown on the Drainage Strategy in **Appendix H**.

Figure 4.1: Spring onsite

4.16 Groundwater monitoring wells were installed in the permanently wet area and predominantly recorded the groundwater level at; close to; or in some cases, above the ground surface. Trial pits subsequently excavated in close proximity to the spring area defined by vegetation showed that groundwater levels were below ground when moving away from the saturated ground associated with the spring and as ground levels rise. Groundwater flow directions have not been definitively derived, but it is most likely the local flow direction is NW to SE. This emerges in the topographic depression where the wet spring area is located.

4.17 Development has been kept out of the wet area, and no buildings have been located either between the watercourse and the wet area, or within 10m of the wet area. Proposed development ground levels will also be approximately 700mm-1000mm higher than existing levels in the southwest of the site post development. The proposed built development will be at low risk of groundwater flooding at the surface. Further mitigation will be provided by setting building floor levels at least 150mm above the existing ground levels and ensuring ground levels fall away from the proposed dwellings.

4.18 It is concluded that due to the spring having been identified, and the intention to incorporate appropriate mitigation measures informed by ground investigation and monitoring assured, the likelihood of groundwater flooding is low.

Flooding from Infrastructure Failure

4.19 Sewer flooding can occur when the capacity of the infrastructure is exceeded by excessive flows, or because of a reduction in capacity due to collapse, siltation, blockage, or if the downstream system becomes surcharged. This can lead to the sewers flooding onto the surrounding ground via manholes and gullies, which can generate overland flows.

4.20 Typically, sewer systems are constructed to accommodate rainstorms with a 30-year return period or less, depending on their age. Consequently, rainstorm events greater than 1 in 30-years would be expected to result in surcharging of some parts of the sewer system. In fact, due to most gullies being poorly maintained and often partially blocked with silt, leaves and other debris, their capacity is often estimated to be closer to the 1 in 10-year storm.

4.21 Looking forward, the development's drainage must be designed in accordance with Sewers for Adoption, The Design and Construction Guidance (DCG), Building Regulations Approved Document Part H and BS EN 752. This will minimise the future risk of flooding due infrastructure failure.

4.22 The wastewater plans obtained from SW in **Appendix E** show that a 175mm diameter foul water gravity public sewer flows south across the site.

4.23 The low point of the site (around 95.00m AOD at the southwest corner) and the invert level (IL) of SW Manhole 8901 in Wheeler Avenue (99.34 m AOD) confirm that a pumping station will be required for a proportion of the proposed dwellings and the care home to connect to this manhole.

4.24 A capacity check was lodged with SW for the following:

Foul Water: Approx 188 dwellings and 80-100 bed care home to SW Manhole 8901 (Wheeler Avenue) by gravity and pumping station.

4.25 The SW capacity check response is included in **Appendix E**. The response states that there 'is currently inadequate capacity within the foul sewerage network' and 'Southern Water has a duty to provide Network capacity from the point of practical connection (point of equivalent or larger diameter pipe) funded by the New Infrastructure Charge'.

4.26 Water and Sewerage Companies have a legal obligation under Section 94 of the Water Industry Act 1991 (WIA 1991) to provide developers with the right to connect to a public sewer regardless of capacity issues.

4.27 The report has identified the preferred point of foul water connection and the peak foul flow rate from the site, to allow for capacity to be considered by SW and any upgrading work to be programmed if required.

4.28 The planning authority can make planning permission conditional upon there being in place adequate sewerage facilities to cater for the requirements of the development if required. Such an approach would allow the legal right to connect to be managed prior to implementation.

4.29 Therefore, it is concluded that the proposed development site is at low risk of flooding from infrastructure failure.

Flooding from Artificial sources

4.30 There are no canals in the site area to create flood risk.

4.31 The EA Maximum extent of flooding from reservoirs map indicates that the site is not in an area at risk of reservoir flooding.

Historic Flooding

4.32 Appendix H of the TDC Level 1 Strategic Flood Risk Assessment[9] indicates there are no records of historic flooding in the site area.

[9] JBA Consulting Level 1 Strategic Flood Risk Assessment Final Report December 2017

5.0 Future Flood Risk & Climate Change

5.1 The NPPF and the supporting Technical Guidance document sets out how flood risk should be considered over the lifetime of a development. This requires an increase in flood risk due to climate change to be taken into account. Both peak river flows and rainfall intensity should be assessed.

Peak River Flows

5.2 Please see Sections 4.2-4.3.

Peak Rainfall Intensity and Climate Change

5.3 As of May 2022, the NPPF's climate change rainfall increase predictions for developments was updated and is to be used with immediate effect. Whereas previous climate change parameters for rainfall increases used set values (20% or 40%) across the UK depending on the probable lifetime of a development, the latest climate change advice is determined by which catchment the development is within and every river catchment in the UK has different climate change rainfall increase predictions.

5.4 This is because the southeast of England tends to see heavier, stormier rainfall than the northwest, which tends to see longer rainfall events with less intensity. This, in combination with the prevailing geo-environmental characteristics of each catchment, has determined the climate change increases that are to be used.

5.5 The other major change to the 2022 climate change rainfall predictions is that climate change increases should also be applied to the 1 in 30-year rainfall event, whereas previously it was only applied to the 1 in 100-year event. As such, the hydraulic modelling for the proposed development will also apply a climate change increase to the 1 in 30-year rainfall event.

5.6 The site lies within the Medway Management Catchment peak rainfall allowances[10]. The peak rainfall climate change allowances are as follows in Table 5.1, below:

Table 5.1 – Climate Change Predictions for Medway Management Catchment

1 in 30-year Rainfall Event	**Central Allowance**	**Upper End Allowance**
2050's epoch	20%	35%
2070's epoch	20%	35%
1 in 100-year Rainfall Event	**Central Allowance**	**Upper End Allowance**
2050's epoch	20%	45%
2070's epoch	20%	40%

5.7 For a residential development, which could have a lifespan of up to 100 years, the 2070's epoch should be used and the NPPF advises that for developments with a lifetime beyond 2100, flood risk assessments should assess the upper end allowances for both the 1% and 3.3% annual exceedance probability events.

[10] https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall

5.8 Therefore, for the proposed development site, the climate change increase predictions that should be applied to the hydraulic model are 35% for the 1 in 30-year rainfall event and 45% for the 1 in 100-year event.

5.9 The drainage strategy for the development will take the latest climate change predictions into account so that the surface water generated in the 1 in 100-year + 45% rainfall event will be attenuated on site and will not cause flooding locally or to neighbouring areas.

Residual Flood Risk

5.10 It is important to recognise that flood risk can never be fully mitigated and there will always be a residual risk of flooding. The residual risk is associated with several potential risk factors, including (but not limited to):

- A flood event that exceeds that for which the local flood defences or local drainage system has been designed to withstand.
- A residual danger posed to property and life because of flood defence failure through overtopping or structural collapse.
- General uncertainties inherent in the prediction of flooding.

5.11 Modelling of flood events is not an exact science. Therefore, there is an inherent uncertainty in the prediction of flood levels and extents used in the assessment of flood risk. EA's Flood Map for Planning is largely based upon detailed modelling within the area. However, other mapping products require numerous assumptions to be made. Whilst they all provide a good depiction of flood risk for specific modelled conditions, all modelling requires the making of core assumptions and these might not occur in the open and dynamic environment of a flood event. Also, the EA's Flood Map for Planning and other flood modelling is updated regularly. Interested parties are recommended to keep abreast of this so that a significant change or increase in flood risk can be determined.

The Sequential and Exception Tests

5.12 The NPPF specifies that 'The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk)'.

5.13 A sequential test is required because the site is subject to a surface water and localised groundwater spring flood risk prior to reprofiling ground levels as part of the proposed development. The client has commissioned a sequential test to be carried out by RPS, and this will be submitted for the outline planning application as a separate document.

6.0 Summary of Flood Risk

6.1 Table 6.1, below, summarises the level of flood risk to the development site.

Table 6.1: Summary of Flood Risk

Flood Source	Risk Level				Comment
	High	Medium	Low	Very Low	
Fluvial				X	Flood Zone 1
Tidal				X	Tidal Flood Zone 1
Surface Water			X		As the proposed development will manage surface water in line with appropriate guidance, there will be no risk of surface water flooding to the proposed development on site, or increased risk of surface water flooding off site.
Groundwater			X		It is concluded that due to the spring having been identified, and the intention to incorporate appropriate mitigation measures informed by ground investigation and monitoring assured, the likelihood of groundwater flooding is low.
Infrastructure Failure				X	The report has identified the preferred point of foul water connection and the peak foul flow rate from the site, to allow for capacity to be considered by Southern Water and any upgrading work to be programmed if required.
Canals				X	There are no canals in the vicinity
Reservoirs				X	Site is not in an area at risk of reservoir flooding
Increase due to Climate Change			X		Increased peak rainfall intensities[11] are expected to affect surface water flood risk and infrastructure. This has been taken into account in the surface water hydraulic modelling report and proposed drainage strategy.

6.2 On the basis the FRA indicates the site lies within Flood Zone 1 - i.e. land assessed as having less than a 0.1 per cent (1 in 1000) chance of river flooding occurring each year as defined in Government Guidance

[11] https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall

on Flood risk and coastal change[12] - and the flood risk assessment indicates a low risk of flooding from all sources both now and in the future once appropriate mitigation measures are implemented, flood risk should not form an impediment to the proposed development.

[12] https://www.gov.uk/guidance/flood-risk-and-coastal-change

7.0 Proposed Surface Water Drainage Strategy

Sustainable Drainage Overview

7.1 Current planning policy and Environment Agency guidance requires developments to employ SuDS techniques wherever feasible. Careful design of SuDS features can ensure that a development's surface water drainage closely reflects the natural hydrology of the predeveloped site.

7.2 SuDS will attenuate and treat surface water run-off quantities at the source (source control) in line with NPPF and EA policies.

7.3 Source control systems treat surface water close to the point of origin, in features such as soakaways, permeable paving and swales, to name a few.

7.4 The key benefits of SuDS are as follows:

- Improving water quality over a conventional piped system by removing pollutants from diffuse pollutant sources (e.g., roads);
- Improving amenity through the provision of open green space;
- Improving biodiversity through increased areas for wildlife habitat; and
- Enabling a natural drainage regime that recharges groundwater (where possible).

7.5 SuDS provide a flexible approach to drainage, with a wide range of components from soakaways to large-scale basins or ponds. The individual techniques should be used where possible in a management train that mimics the natural pre-developed pattern of drainage.

Site Areas

7.6 The site areas to undergo development are to be assessed as follows in Table 7.1:

Table 7.1 – Existing and Proposed Surface Cover

Land Use	Impermeable Area		Permeable Area	
	Area (ha)	% Cover	Area (ha)	% Cover
Existing	0.000	0	9.63	100
Proposed	3.527	37	6.103	63

Greenfield Runoff Rate

7.7 On the basis the FEH Rainfall method has been applied to the MicroDrainage calculations, the FEH QMED Method has been used to derive a QMED value of 10.1 l/s i.e. 467.6 (QMED Rural) / 164.0 (FEH Catchment Area) x 3.527 (Development Impermeable Area) = 10.1 (**Appendix F**).

7.8 The QMED value will be used to guide the appropriate surface water discharge rate and volume from the development.

7.9 Based on the previous sections of the report, the drainage strategy for the development will look to use pervious pavements, geocellular storage/soakaways and open SuDS (swales, detention basins, infiltration basins and a pond) for the attenuation of surface water runoff. HydroBrake flow control chambers will be incorporated into the design to control discharge to the existing ordinary watercourse

that flows along the western boundary of the site to 10.1 l/s for up to the 100 year + 45% climate change critical rainfall event.

The Drainage Hierarchy

7.10 The NPPF states that opportunities to reduce overall flood risk should be sought and achieved through sustainable development and careful drainage design. This can be achieved through the layout and form of development, including green infrastructure and the appropriate application of SuDS designed to control surface water runoff close to where it falls and mimic natural drainage as closely as possible. They provide opportunities to:

- Reduce the causes and impacts of flooding;
- Remove pollutants from urban run-off at source;
- Combine water management with green space with benefits for amenity, recreation and biodiversity.

7.11 To deliver SuDS benefits and ensure that a development reduces overall flood risk, there is an established hierarchy of surface water drainage methods that should be considered. The most preferable and sustainable are at the top and the least preferable and least sustainable at the bottom.

7.12 The drainage hierarchy is a sequential check that intends to ensure that all practical and reasonable measures are taken to manage surface water as high up the hierarchy (with '1' being the highest) as possible, and that the amount of surface water managed at the bottom of the hierarchy is minimised. The Planning Practice Guidance to the National Planning Policy Framework (NPPF) states that *"Generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable"*.

7.13 The drainage hierarchy presented in the NPPF presents only four tiers of drainage options. This has been expanded on and adopted by others and now can be viewed as the following:

1. Store rainwater for later use
2. Use infiltration techniques, such as porous surfaces in non-clay areas
3. Attenuate rainwater in ponds or open water features for gradual release
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release
5. Discharge rainwater direct to a watercourse
6. Discharge rainwater to a surface water sewer/drain
7. Discharge rainwater to the combined sewer
8. Discharge rainwater to the foul sewer

7.14 LPA's, LLFA's and Water Authorities may enforce the surface water drainage hierarchy and demand that the highest practicable tier of the hierarchy is used.

7.15 The first two tiers of the drainage hierarchy ensure that surface water is retained within the site boundary and does not increase flood risk to others. This is always the most preferable method of surface water management.

7.16 The next six tiers of the hierarchy provide regional control, but with decreasing levels of pollution removal and reduced potential for amenity and habitat creation.

7.17 Within the lower six tiers of the drainage hierarchy, there must be some form of flow restriction, so that off-site surface water discharge resembles greenfield runoff rates, as much as is reasonably practicable. This requires on-site storage facilities, which may include ponds, swales, subsurface storage tanks and

System C (non-infiltration) permeable paviours with flow control devices. Again, methods that provide the most potential for amenity and pollution removal should be favoured.

Drainage Strategy Overview

7.18 Based on the previous sections of the report, the drainage strategy for the development will look to use pervious pavements, geocellular storage/soakaways and open SuDS (swales, detention basins, infiltration basins and a pond) for the attenuation of surface water runoff. HydroBrake flow control chambers will be incorporated into the design to control discharge to the existing ordinary watercourse that flows along the western boundary of the site to 10.1 l/s for up to the 100 year + 45% climate change critical rainfall event.

7.19 The Topographical Survey in **Appendix C** indicates that slopes with <5% grade are achievable, which is suitable for pervious pavements.

7.20 The proposed layout of the drainage strategy can be seen in **Appendix H** of this report. With specific reference to each tier of the drainage hierarchy, the proposed drainage strategy is discussed, below.

Tier 1 – Store rainwater for later use

7.21 Water re-use systems can rarely manage 100% of the surface water discharges from a development. This requires the surface water yield from the building and hardstanding areas to balance perfectly with the demands from the proposed development; too much demand will result in lack of water supply; too little demand will cause the storage systems to become overwhelmed and could result in flooding when the next rainfall event happens. Consequently, even if there are opportunities and a need for rainwater recycling systems, further solutions for attenuating and discharging surface water will almost always be required.

7.22 There is likely to be a moderate rainwater yield from the roof areas of the development that could be used for domestic non-potable water uses. The proposed development includes landscaping that may benefit from having a supply of recycled rainwater for the watering of gardens, beds, etc.

7.23 The opportunity for water re-use and recycling on site have been explored and this report recommends the use of water butts for each property. These will reduce the reliance on potable water supplies during activities such as gardening and car washing. They can also provide small amounts of storage for surface water. The typical types and storage volumes of water butts are in Table 7.2, below:

7.24 Water butts can also provide small amounts of storage for surface water and can often assist in achieving zero discharge for rainfall depths up to 5mm, which covers 50% of annual rainfall events (according to the EA's Rainfall Runoff Management for Developments report - SC030219).

Table 7.2 – Types and storage volumes of water butts

Typical Water Butt Options	Dimensions (m)	Storage Volume Provided
Type 1 (wall-mounted – small)	1.22 x 0.46 x 0.23	100 litres (0.10m³)
Type 2 (standard house water butt)	0.9 x 0.68 diameter	210 litres (0.21m³)
Type 3 (large house water butt)	1.26 x 1.24 x 0.8	510 litres (0.51m³)
Type 4 (column tank – very large)	2.23 x 1.28 diameter	2000 litres (2.00m³)

7.25 This report recommends that Type 2 standard water butts are installed on all houses. As 190 houses are proposed, this approximately equates to up to 39,900 litres (39.9m³) of surface water attenuation and recycled water on site.

7.26 The surface water storage available in the water butts has not been included in the hydraulic calculations as it can't be guaranteed that they will be empty at the start of a rainfall event.

Tier 2 - Use Infiltration techniques, such as porous surfaces in non-clay areas

7.27 Exploratory BRE365 soakage testing has been carried out that indicates at least a proportion of the site is underlain by geology that will support infiltration SuDS techniques. The worst case infiltration rate of $2.55x10^{-4}$ m/s with an additional factor of safety of 5 has been assumed in the location of the proposed infiltration SuDS.

7.28 It is intended to use swales, detention basins (that will also permit infiltration where possible/appropriate) and geocellular soakaways for the discharge of surface water from development.

7.29 The swales / detention basins will have side slopes of 1 in 3 and the design features of the geocellular soakaway are as follows:

- suitable for minimum 500 or 1000mm cover as appropriate
- Permeable Separating Geotextile wrapped on all sides
- 100mm Type 2/6mm Sharp Grit or Clean Sand Surround

7.30 Construction details are to be provided at the detailed design stage.

Tier 3 - Attenuate rainwater in ponds or open water features for gradual release

7.31 There is the opportunity to attenuate rainwater in a pond and swales / detention basins (that will not permit infiltration) for gradual release.

7.32 The pond has currently been modelled with a 1 in 6 side slope and the swales / detention basins will have side slopes of 1 in 3.

Tier 4 - Attenuate rainwater by storing in tanks or sealed water features for gradual release

7.33 It is intended to use permeable paving for the shared car parking areas. The design features of the permeable paving are as follows:

- 80mm Concrete Block Permeable Paviours (CBPP)
- 50mm Type 2/6mm Sharp Grit or Clean Sand
- Permeable Separating Geotextile
- 300mm Type 4/20 Coarse Graded Aggregate (CGA) Subbase (nominal porosity = 30%)
- Permeable Separating Geotextile

7.34 The total depth of these permeable paviours is 430mm, with an effective storage depth of 300mm. Please note that the above depth of CGA has been designed on its hydraulic requirements and surface water storage capacity. At the detailed design stage, the depth of the CGA, which forms the foundation of the pavement, may need to be refined once the bearing capacity of the sub-grade is known.

7.35 Surface water falling directly onto the permeable paviours will drain into the sub-base, percolating through the joints in the paviours and then through the sharp grit and the geotextile.

7.36 Where shown on the drainage strategy drawing in **Appendix H**, the permeable pavement sub-bases will drain to underlying geocellular attenuation storage or geocellular soakaway tanks via engineered CGA sub grade.

7.37 The design features of the geocellular attenuation storage are as follows:

- suitable for minimum 650mm cover
- Wrapped in an Impermeable Separating Geomembrane except where underlying the pervious pavement
- Completely wrapped in a Heavy Duty Permeable Separating Geotextile to protect the geomembrane and permit infiltration between the Type C no infiltration permeable pavement sub-base; engineered CGA sub grade and the geocellular attenuation storage tank
- Granular backfill material or as-dug backfill to meet assumptions made by the detailed designer (Figure 21.4 of the CIRIA SuDS Manual) at the sides
- 'Sand blinding / bedding layer' (Figure 21.4 of the CIRIA SuDS Manual) at the base

7.38 Construction details are to be provided at the detailed design stage.

Tier 5 - Discharge rainwater direct to a watercourse

7.39 This tier of the drainage hierarchy will be possible for surface water discharge.

7.40 With reference to Section 7.18, it is proposed to discharge surface water to the existing ordinary watercourse that flows along the western boundary of the site at a restricted rate of 10.1 l/s, which is the QMED greenfield runoff rate for the proposed impermeable area of the site.

Tier 6 - Discharge rainwater to a surface water sewer/drain

7.41 This tier of the drainage hierarchy will not be possible for surface water discharge.

Tier 7 - Discharge rainwater to the combined sewer

7.42 This tier of the drainage hierarchy will not be possible for surface water discharge.

Tier 8 - Discharge rainwater to the foul sewer

7.43 This tier of the drainage hierarchy will not be possible for surface water discharge.

Micro Drainage Hydraulic Modelling

7.44 The drainage system outlined above has been tested in MicroDrainage's Network hydraulic modelling module. The results of the MicroDrainage hydraulic modelling for the proposed development can be seen in **Appendix I**.

7.45 The results of the hydraulic modelling show that the drainage strategy can attenuate and discharge surface water generated in the 1 in 100-year + 45% climate change critical rainfall event with negligible flooding in the communal soft landscaping areas.

7.46 An appropriate allowance should be made for urban creep throughout the lifetime of the development as per 'BS 8582:2013 Code of Practice for Surface Water Management for Developed Sites'.

7.47 As per paragraph 5.4.3 of Surrey County Council's Sustainable Drainage System Design Guidance[13], an uplift for urban creep is not applicable to flats and apartments. However, a 10% allowance for urban creep will be required to be added to the impermeable areas associated with the 190 dwellings.

7.48 In the hydraulic design of the surface water drainage strategy, the estimated maximum volume of water in the surface water drainage system based on the critical summary of results for the 100 year + 45% climate change critical rainfall event is around 2970m^2, and the total volume of storage in the system is around 3610m^3.

7.49 On the basis the drainage strategy has around an additional 640m^3 surface water storage capacity for in excess of the 100 year + 45% climate change critical rainfall event, it is proposed details of how the proposed surface water drainage system accommodates a 10% allowance for urban creep is provided at the detailed design stage.

7.50 Therefore, the proposal is considered appropriate because the surface water drainage system shows the negligible flooding is managed in the communal soft landscaping areas for the 1 in 100-year + 45% cc critical rainfall event, and an additional approximately 18% surface water storage capacity has been provided in the drainage strategy to account for urban creep and events in excess of the 1 in 100-year + 45% cc critical rainfall event.

[13] https://www.surreycc.gov.uk/community/emergency-planning-and-community-safety/flooding/more-about-flooding/suds-drainage/drainage-guidance#section-5

8.0 Proposed Foul Water Drainage Strategy

8.1 The wastewater plans obtained from SW in **Appendix E** show that a 175mm diameter foul water gravity public sewer flows south across the site.

8.2 The low point of the site (around 95.00m AOD at the southwest corner) and the invert level (IL) of SW Manhole 8901 in Wheeler Avenue (99.34 m AOD) confirm that a pumping station will be required for a proportion of the proposed dwellings and the care home to connect to this manhole.

8.3 A capacity check was lodged with SW for the following:

Foul Water: Approx 188 dwellings and 80-100 bed care home to SW Manhole 8901 (Wheeler Avenue) by gravity and pumping station.

8.4 The SW capacity check response is included in **Appendix E**. The response states that there 'is currently inadequate capacity within the foul sewerage network' and 'Southern Water has a duty to provide Network capacity from the point of practical connection (point of equivalent or larger diameter pipe) funded by the New Infrastructure Charge'.

8.5 The proposed drainage strategy layout is in **Appendix H**. The drainage strategy has been designed to connect to the foul water public sewer that crosses the site via new sewer manhole connection points. Some of the existing foul water public sewer drainage infrastructure that crosses the site will be required to be diverted prior to development commencing. This will need to be agreed with Southern Water beforehand.

9.0 Surface Water Runoff Quality

9.1 The NPPF states that the development should not have a detrimental impact on the environment, including the water environment. The technical guidance to the NPPF provides further advice on the benefits of ensuring runoff quality is to an appropriate standard.

9.2 The CIRIA SuDS Manual provides guidance on the treatment of surface water runoff. With regards to the proposed development, Table 4.3 of the CIRIA SuDS Manual rates the pollution hazard from roof water runoff as 'very low'. The only requirement for roof water runoff is the removal of gross solids and sediments, which would be achieved using catchpits and silt traps upstream of the SuDS.

9.3 With regards to the remaining impermeable areas, Table 4.3 of the CIRIA SuDS Manual rates the pollution hazard from residential car parking and low traffic roads as 'low'. To mitigate a 'low' pollution hazard, the CIRIA SuDS Manual recommends using a simple index approach in line with Section 26.7.1. This is discussed, below.

9.4 Table 26.2 of the CIRIA SuDS Manual provides pollution hazard indices for different land use classifications. The land use classification that requires consideration for the driveway and parking areas on the site is in Table 9.1 below.

Table 9.1: Excerpt from Table 26.2 of CIRIA SuDS Manual

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, homezones and general access roads) with less than 300 traffic movements per day.	Low	0.5	0.4	0.4

9.5 To deliver adequate pollution treatment and mitigation, the CIRIA SuDS Manual recommends using a SuDS component that has a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type).

9.6 Tables 26.3 and 26.4 of the CIRIA SuDS Manual provide indicative SuDS mitigation indices for each SuDS type when discharging to surface water and groundwater. Table 9.2, below, which is an excerpt from Table 26.4, shows the groundwater mitigation indices for a 'A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[14] of at least 300 mm in depth[15]', on the basis groundwater appears to be the most sensitive receptor of discharges from the development.

Table 9.2: Pollution Mitigation Indices for a layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300 mm in depth

Type of pollution removal component	Total Suspended Solids (TSS)	Metals	Hydro-Carbons

[14] For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance

[15] Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.

A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[16] of at least 300 mm in depth	0.6[17]	0.6	0.7

9.7 The mitigation indices for 'A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[18] of at least 300 mm in depth[19]' exceed those of the highest pollution hazard index figures from Table 9.1, and it will be ensured that all residential car parking and low traffic roads are mitigated by (at the very least) this layer and underlying soil (or similar as appropriate) incorporated into the open SuDS prior to discharge to groundwater and surface water.

9.8 The above evidence shows how the open SuDS may be constructed to provide sufficient pollution mitigation, prior to discharge to groundwater and surface water.

[16] For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance
[17] If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.
[18] For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance
[19] Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.

10.0 Residual Risk

10.1 Adjacent areas of hardstanding will comply with building regulations and divert water away from the buildings.

10.2 The top surface of the pervious pavement should finish at least 150mm below any adjoining DPC level. Advice should always be sought from the manufacturer.

10.3 Gullys and linear drainage channels are required to convey surface water for up to the 100 year + 45% climate change critical flow rate. Construction details and supporting calculations are to be provided at the detailed design stage.

10.4 Full main investigation infiltration testing and construction details for the SuDS are to be provided at the detailed design stage. Currently it has been assumed infiltration is not viable where infiltration testing was not undertaken during the exploratory investigation e.g. the approximate eastern third of the site.

10.5 The Surface Water Drainage Strategy is based on preliminary levels and is subject to detailed design.

10.6 With regards to exceedance flows, overall, the site levels will continue to slope as existing, and the proposed SuDS will integrate with the function of the natural drainage systems. Exceedance flow arrows are shown on the drainage strategy in **Appendix H** of this report.

10.7 Whilst the drainage strategy for the site has been designed to current standards, there would remain a small residual risk of flooding due to blockage or failure of on-site infrastructure. Therefore, appropriate and regular maintenance of the drainage infrastructure should be undertaken by the site management company or their agents (and the residents, where applicable).

10.8 To assist with this process, a Drainage Management and Maintenance Plan has been prepared, which sets out the principles for the long-term management and maintenance of the proposed surface water drainage system on the development. The Drainage Management and Maintenance Plan can be seen in **Appendix J**.

10.9 The purpose of this document is to ensure that those responsible for site maintenance have a robust inspection and maintenance plan going forwards. This will help ensure the optimum operation of the surface water drainage system and that it will be regularly maintained for the lifetime of the development. This will contribute to reducing the risk of surface water flooding both on- and off-site.

11.0 Summary and Conclusion

11.1 This FRA and Drainage Strategy Report has been produced by Motion on behalf of Croudace Homes Limited. This report is to accompany an outline application for residential development of up to 190 dwellings (including affordable homes) (Use Class C3), an extra care facility with up to up 80 beds (Use Class C2), together with the formation of vehicular access, landscaping, parking, open space, green and blue infrastructure, and all other associated development works. All matters are reserved except for access.

11.2 On the basis the FRA indicates the site lies within Flood Zone 1 - i.e. land assessed as having less than a 0.1 per cent (1 in 1000) chance of river flooding occurring each year as defined in Government Guidance on Flood risk and coastal change - and the flood risk assessment indicates a low risk of flooding from all sources both now and in the future once appropriate mitigation measures are implemented, flood risk should not form an impediment to the proposed development.

11.3 Exploratory BRE365 soakage testing has been carried out that indicates at least a proportion of the site is underlain by geology that will support infiltration SuDS techniques. The worst case infiltration rate of $2.55x10^{-4}$ m/s with an additional factor of safety of 5 has been assumed in the location of the proposed infiltration SuDS.

The drainage strategy for the development (**Appendix H**) will look to use pervious pavements, geocellular storage/soakaways and open SuDS (swales, detention basins, infiltration basins and a pond) for the attenuation of surface water runoff. HydroBrake flow control chambers will be incorporated into the design to control discharge to the existing ordinary watercourse that flows along the western boundary of the site to 10.1 l/s for up to the 100 year + 45% climate change critical rainfall event.

11.4 Opportunities for water re-use and recycling on site has been explored and this report recommends the use of water butts for the 190 houses (Section 7.25). These will reduce the reliance on potable water supplies during activities such as gardening.

11.5 The results of the hydraulic modelling (**Appendix I**) show that the drainage strategy can attenuate and discharge surface water generated in the 1 in 100-year + 45% climate change critical rainfall event with negligible flooding in the communal soft landscaping areas.

11.6 In the hydraulic design of the surface water drainage strategy, the estimated maximum volume of water in the surface water drainage system based on the critical summary of results for the 100 year + 45% climate change critical rainfall event is around $2970m^2$, and the total volume of storage in the system is around $3610m^3$.

11.7 On the basis the drainage strategy has around an additional $640m^3$ surface water storage capacity for in excess of the 100 year + 45% climate change critical rainfall event, it is proposed details of how the proposed surface water drainage system accommodates a 10% allowance for urban creep is provided at the detailed design stage.

11.8 Therefore, the proposal is considered appropriate because the surface water drainage system shows the negligible flooding is managed in the communal soft landscaping areas for the 1 in 100-year + 45% cc critical rainfall event, and an additional approximately 18% surface water storage capacity has been provided in the drainage strategy to account for urban creep and events in excess of the 1 in 100-year + 45% cc critical rainfall event.

11.9 The SW capacity check response is included in **Appendix E**. The response states that there 'is currently inadequate capacity within the foul sewerage network' and 'Southern Water has a duty to provide Network capacity from the point of practical connection (point of equivalent or larger diameter pipe) funded by the New Infrastructure Charge'.

11.10 The proposed drainage strategy layout is in **Appendix H**. The drainage strategy has been designed to connect to the foul water public sewer that crosses the site via new sewer manhole connection points.

Some of the existing foul water public sewer drainage infrastructure that crosses the site will be required to be diverted prior to development commencing. This will need to be agreed with Southern Water beforehand.

11.11 The proposed surface water drainage strategy is able to mitigate all pollution hazards created on site using SuDS features and no further pollution mitigation is needed.

11.12 Adjacent areas of hardstanding will comply with building regulations and divert water away from the buildings.

11.13 The top surface of the pervious pavement should finish at least 150mm below any adjoining DPC level. Advice should always be sought from the manufacturer.

11.14 Gullys and linear drainage channels are required to convey surface water for up to the 100 year + 45% climate change critical flow rate. Construction details and supporting calculations are to be provided at the detailed design stage.

11.15 Full main investigation infiltration testing and construction details for the SuDS are to be provided at the detailed design stage. Currently it has been assumed infiltration is not viable where infiltration testing was not undertaken during the exploratory investigation e.g. the approximate eastern third of the site.

11.16 The Surface Water Drainage Strategy is based on preliminary levels and is subject to detailed design.

11.17 With regards to exceedance flows, overall, the site levels will continue to slope as existing, and the proposed SuDS will integrate with the function of the natural drainage systems. Exceedance flow arrows are shown on the drainage strategy in **Appendix H** of this report.

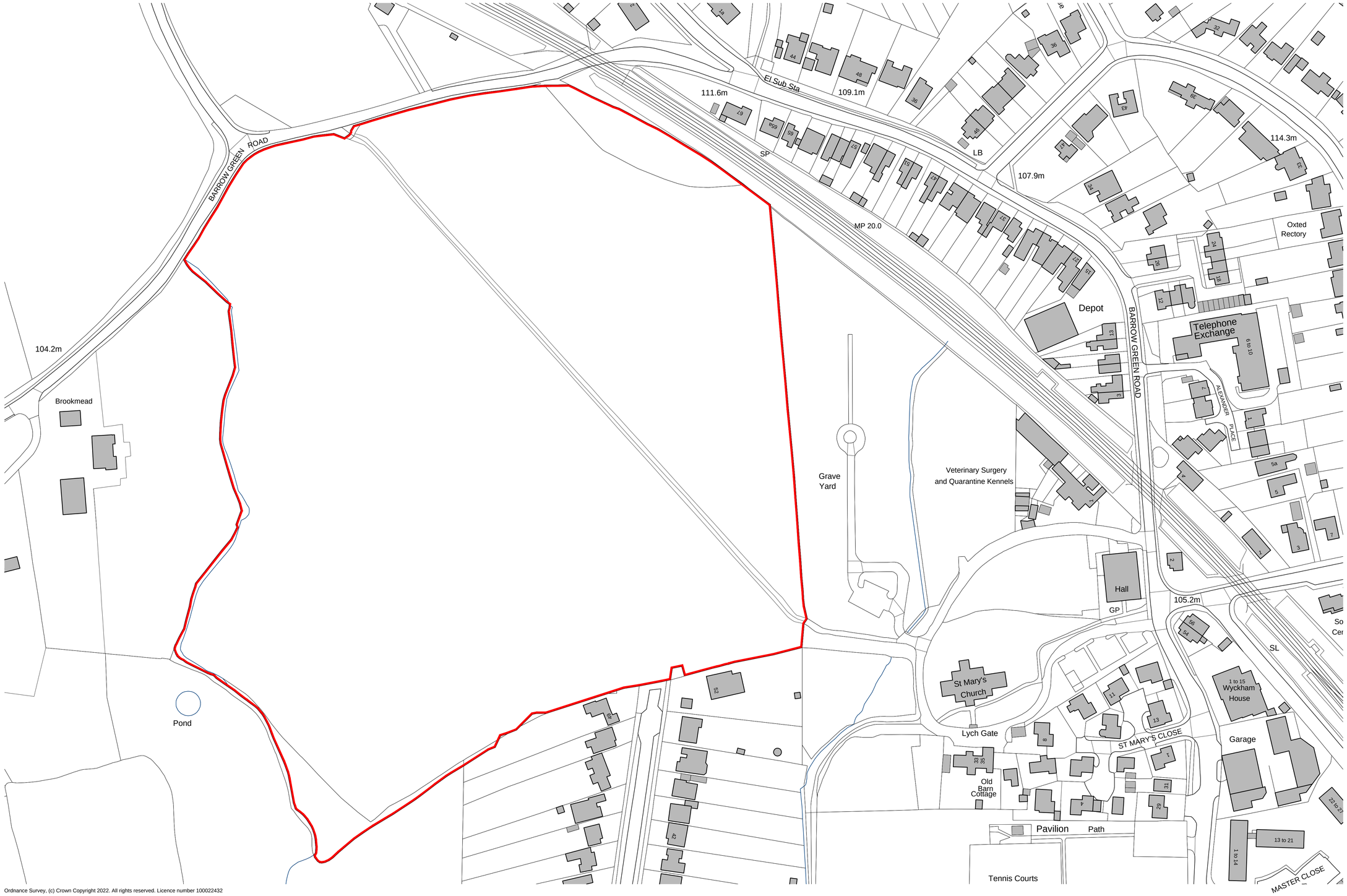
11.18 The Drainage Management and Maintenance Plan can be seen in **Appendix J**.

11.19 In conclusion, flood risk should not form an impediment to the proposed development and the surface water drainage system shows negligible flooding in the communal soft landscaping areas for the 1 in 100-year + 45% cc critical rainfall event. Additionally, approximately 18% surface water storage capacity has been provided in the drainage strategy to account for urban creep and events in excess of the 1 in 100-year + 45% cc critical rainfall event. As such, flood risk and surface water management should not form an impediment to the progress of the planning application for this development.

11.20 The Completed LLFA SuDS Proforma is included in **Appendix K**.

Appendix A

Site Location Plan



N

0 m 50 m 100 m 200 m

SCALE

Client: Croudace Homes Group	Drawing Title: Location Plan					Omega Architects	Project No'	Class	Dwg No'	Status	Rev
Project: Land South of Barrow Green Road, Oxted	Scale: 1:1000 @ A1	Revision	Drawn	Check	Date	The Front Barn, 124 Manor Road North, Thames Ditton, KT7 0BH T: 01372 470 313 W: www.omega-architects.co.uk	3129	A	1000	PL	A
		A	RB	JH	29.11.24						

CLASS: C - COLOURED, A - BLACK & WHITE
STATUS: SK - SKETCH, PE - PRELIMINARY, PL - PLANNING, WD - WORKING DRAWING

Appendix B

Proposed Site Layout

0 m 10 m 20 m 30 m 40 m 50 m 100 m

Scale

croudacehomes

Omega Architects

The Front Barn, 124 Manor Road North, Thames Ditton, KT7 0BH
T: 01372 470 313 W: www.omega-architects.co.uk

Client:
Croudace Homes Group

Project:
Land South of Barrow Green Road, Oxted

Drawing Title:
Illustrative Masterplan

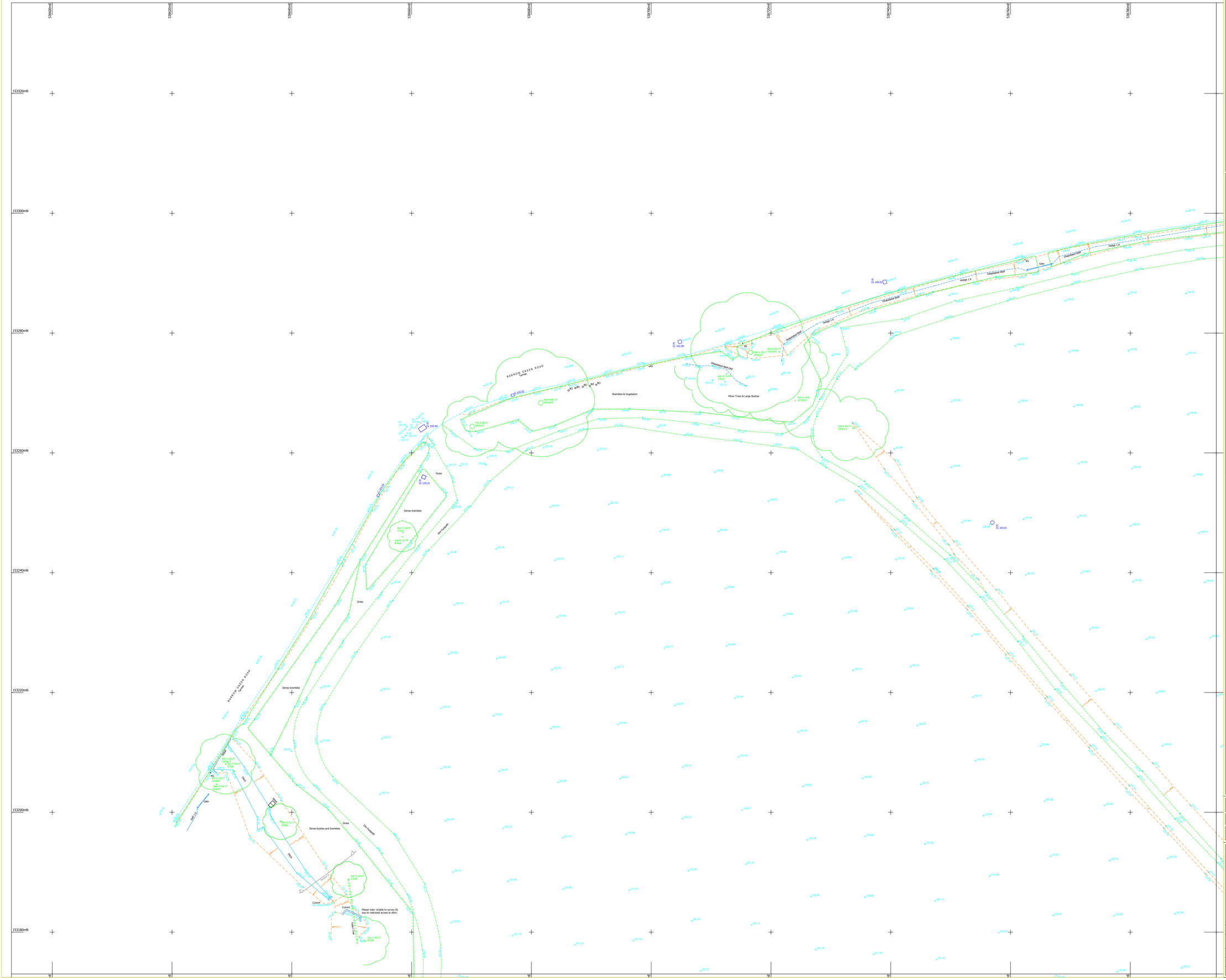
Scale:	Revision	Drawn	Check	Date
1:500 @ A0				

Project No'	Class	Dwg No'	Status	Rev
3129	C	1005	PL	B

CLASS: C - COLOURED, A - BLACK & WHITE
STATUS: SK - SKETCH, PR - PRELIMINARY, PL - PLANNING, WD - WORKING DRAWING

Appendix C

Topographical Survey



NOTES:

Drainage:
Inspection Covers are lifted where possible and all drainage invert information has been obtained through visual inspection only, with no entry into manholes. Therefore the complete accuracy cannot be guaranteed. Where drainage is of critical importance we suggest the services of a specialist drainage expert be used.

Trees:
Every effort has been made to identify and detail all trees on site but where trees are of critical importance we suggest the use of a specialist such as an arborist. Tree spread and heights are indicative.

GPS:
GPS detail is relative to the time and date of survey. GPS levels and grid are obtained using industry standard guidelines and can vary according to the quality of the GPS network at the time of survey. Unless stated otherwise, surveys are Scale factor 1 and Horizontal and Vertical Datums are established from a central site fix and baseline orientation station utilising GNSS correction data.

Survey notes:
Survey specification is linked to the original purpose of the survey commissioned at source and is to be used for this purpose only. Survey is accurate within limitations of site conditions at the time of survey. In areas difficult to survey due to restricted access, lines of sight or dense vegetation, critical dimensions and positions should be verified following suitable clearance.
Survey detail obtained and shown is relative to the plotting scale.

LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAGNOLIA	MAG
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

BARBED WIRE FENCE	BWF
CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BO	NOTICE BOARD	NB
BRITISH TELECOM BOX	BTB	POST	P
BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
EARTHING ROD	ER	SERVICE MARKER POST	SMP
ELECTRICITY CABLE PIT	ELCP	SOIL VENT PIPE	SVP
ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	Tap
NAME PLATE	NP		

Level Datum:
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Grid:
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Northpoint:

ENCOMPASS SURVEYS

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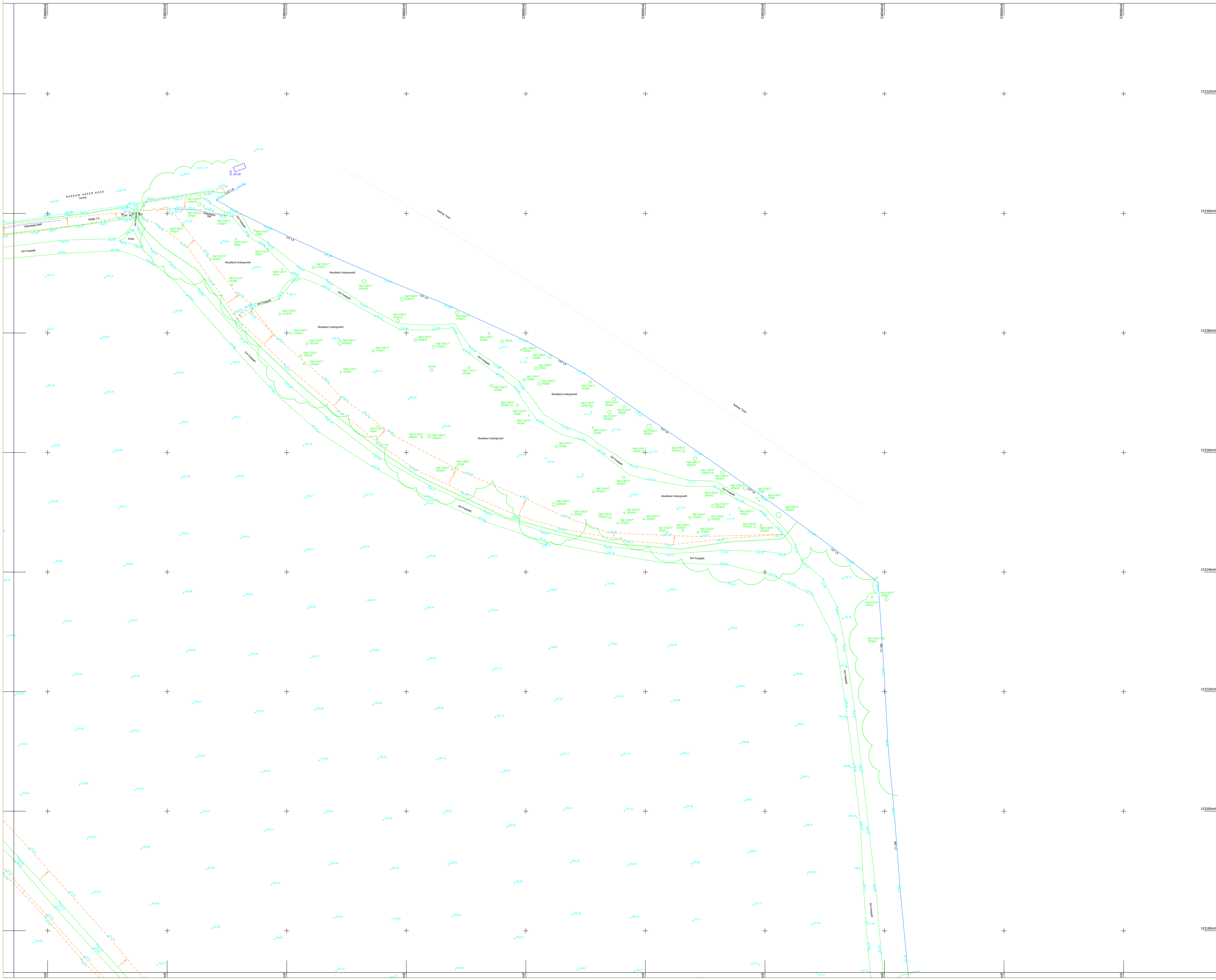
Unit 2
Talisman Business Centre
Duncan Road
Park Gate, Southampton
Hampshire SO31 7GA

Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Croudace Homes
Survey Location:	Stoneyfields Oxted RH8 9LF
Survey type: Topographical	Scale: 1:200@A0
Drawing ref: ENC/220323/269951	Date: March 2023
Drawn/QA: BF/CH	Plot: 1 of 7



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LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAGNOLIA	MAG
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
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LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

BARBED WIRE FENCE	BWF
CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
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IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
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PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BO	NOTICE BOARD	NB
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BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
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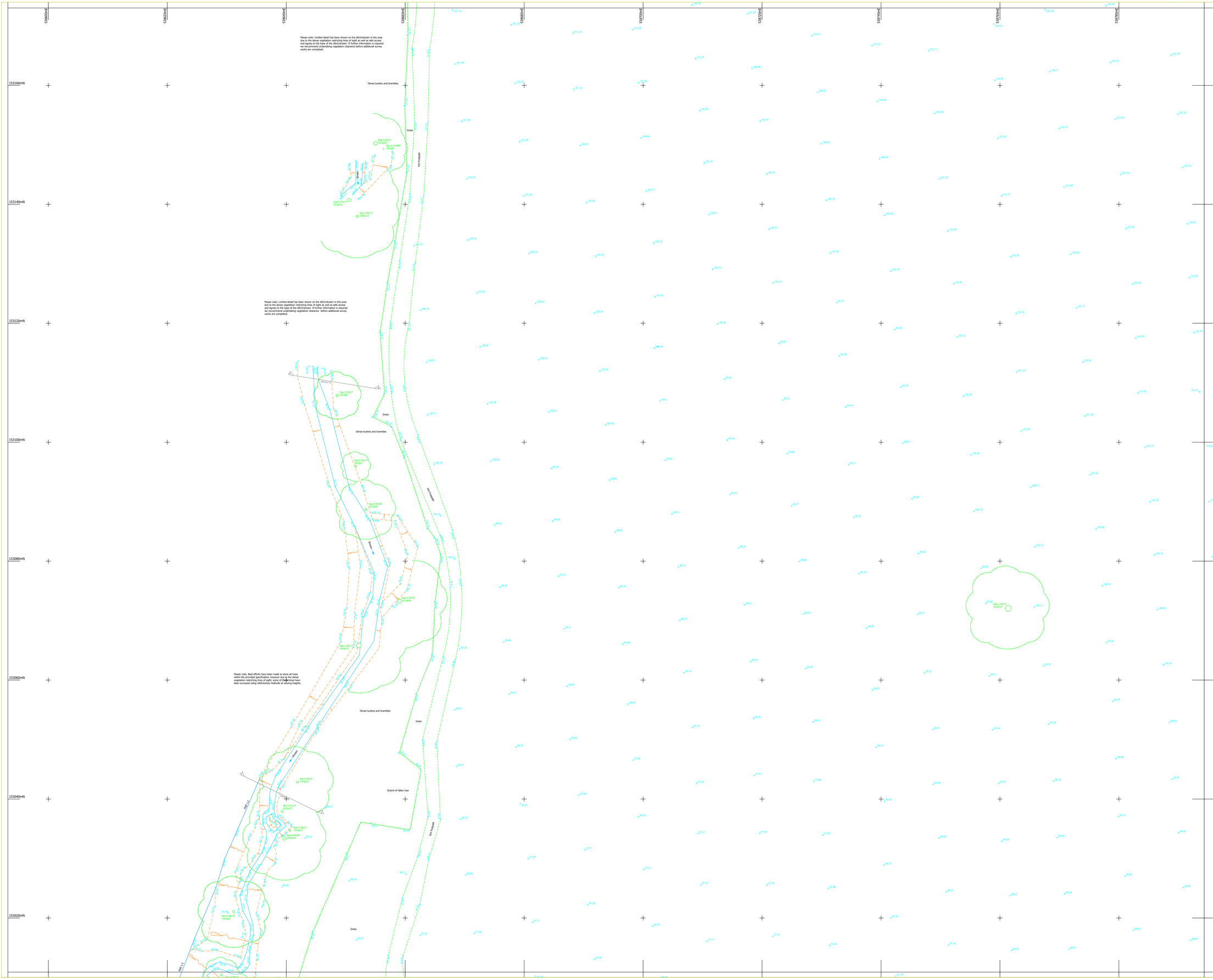
Client:	Croudace Homes		
Survey Location:	Stoneyfields, Oxted, RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/2699S1	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	2 of 7



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LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
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BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
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TREE ANNOTATIONS: Tree Species / Tree Bull Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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HANDRAIL	HDL
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PICKET FENCE	PKF
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POST AND RAIL FENCE	PRF
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LEVEL INFORMATION

BASEMENT LEVEL	BTL
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FOUL WATER	FW
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UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
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Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Croudace Homes		
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	3 of 7

NOTES:

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LEGEND

TREE SPECIES INFORMATION

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TREE ANNOTATIONS: Tree Species / Tree Bull Size / No of Bolls
Tree Height / Tree Canopy Spread

FENCE INFORMATION

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CHAIN LINK FENCE	CLF	DAMP PROOF COURSE	DPC
CHESTNUT PALING	CPF	FLOOR LEVEL	FL
CRASH BARRIER	CBR	INVERT LEVEL	IL
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IRON RAILINGS	IRF	THRESHOLD LEVEL	THL
LARCH LAP FENCE	LLF	POOL WATER	PW
MISCELLANEOUS FENCE	MSF	SURFACE WATER	SW
PALISADE FENCE	PSF	UNABLE TO LIFT	UTL
PICKET FENCE	PKF	WATER LEVEL	WL
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LEVEL INFORMATION

SURFACE INFORMATION

		CONCRETE	Conc
		BRICK PAVERS	BP
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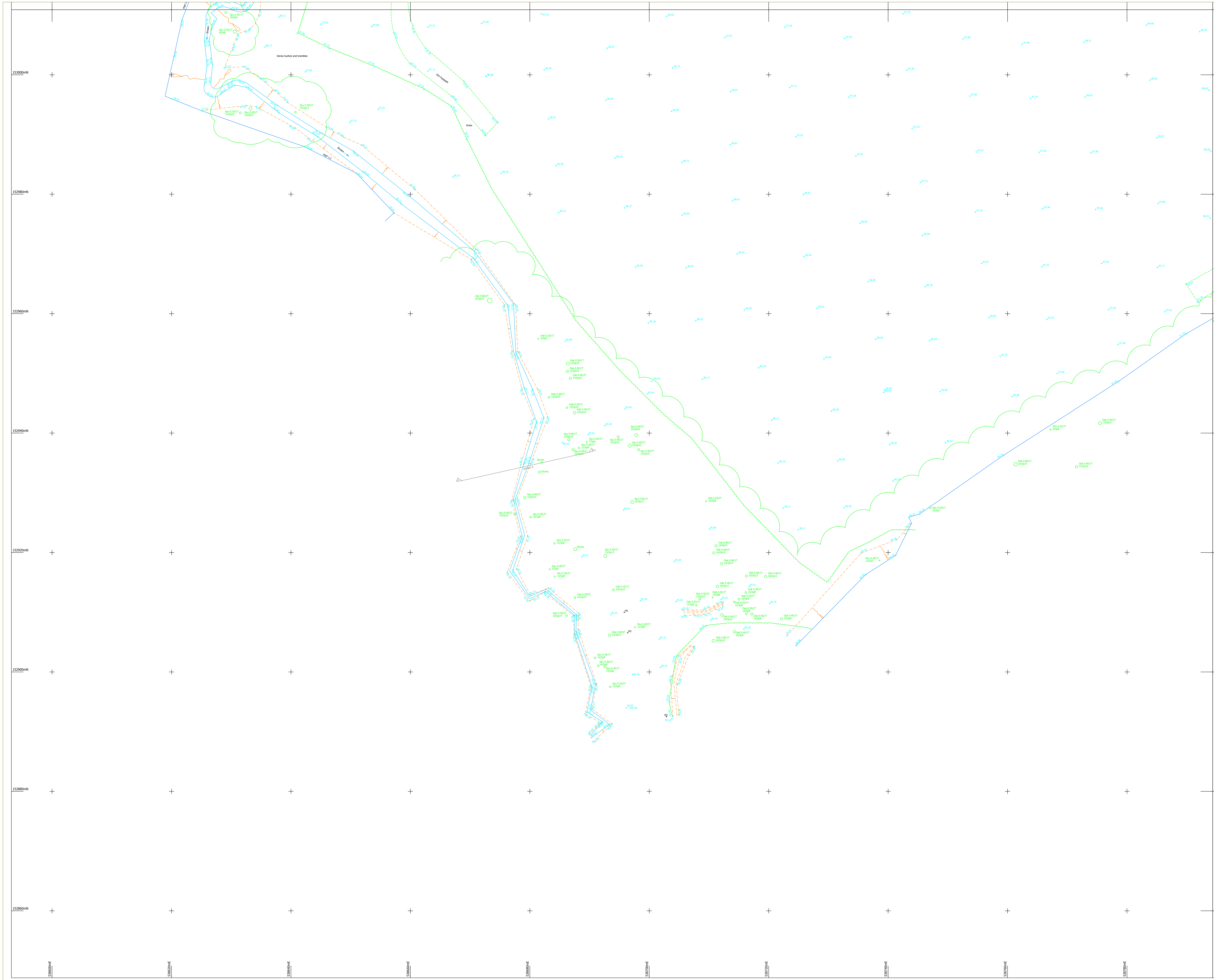
Survey LOCATION:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	4 of 7



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LEGEND

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TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

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STOCK WIRE FENCE	SWF
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LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
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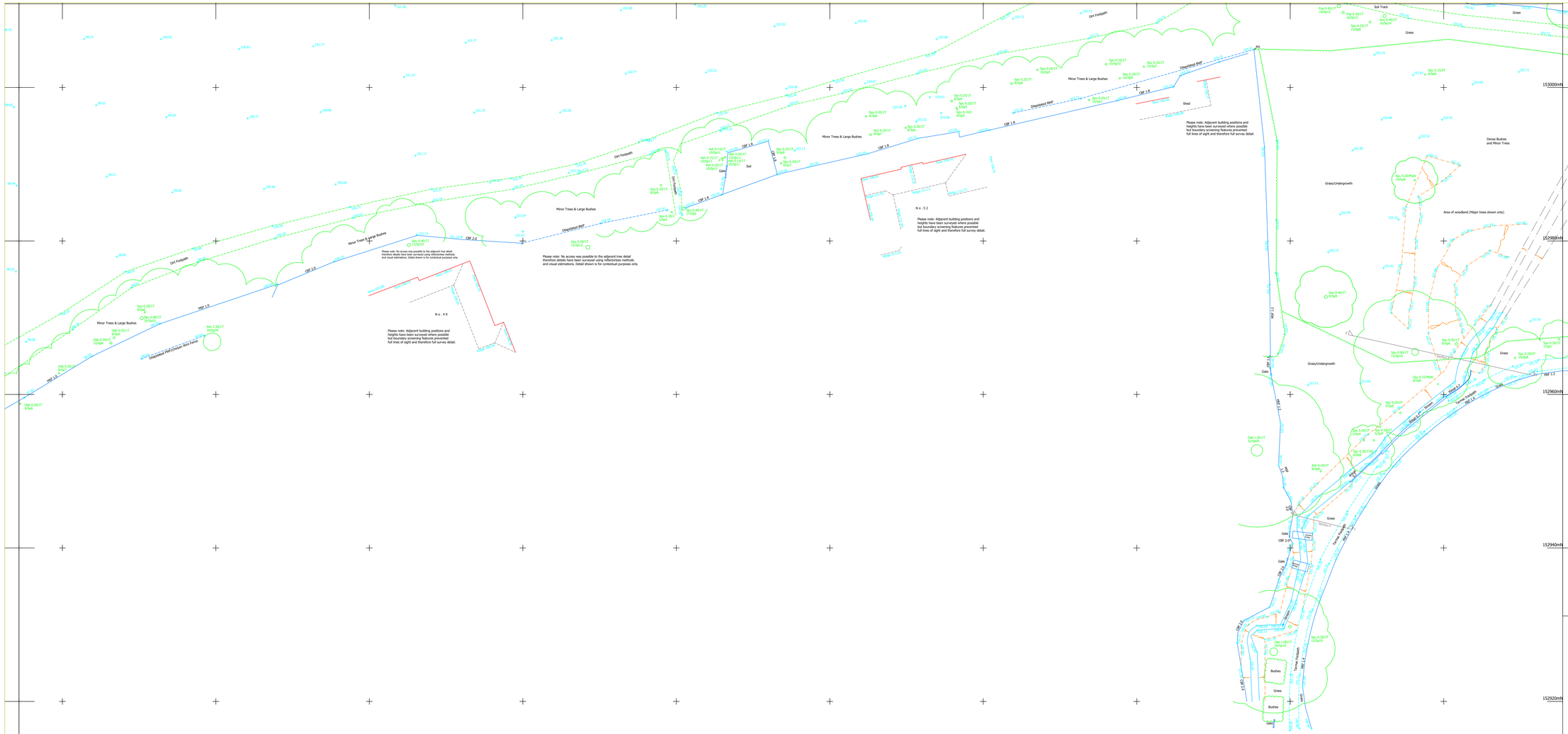

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ELECTRICITY CABLE PIT	ELCP	SOIL VENT PIPE	SVP
ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	Tap
NAME PLATE	NP		

Level Datum:
Levels are related to OSGB15 derived from the GPS network

Grid:
Grid is related to OSGB15 derived from the GPS network

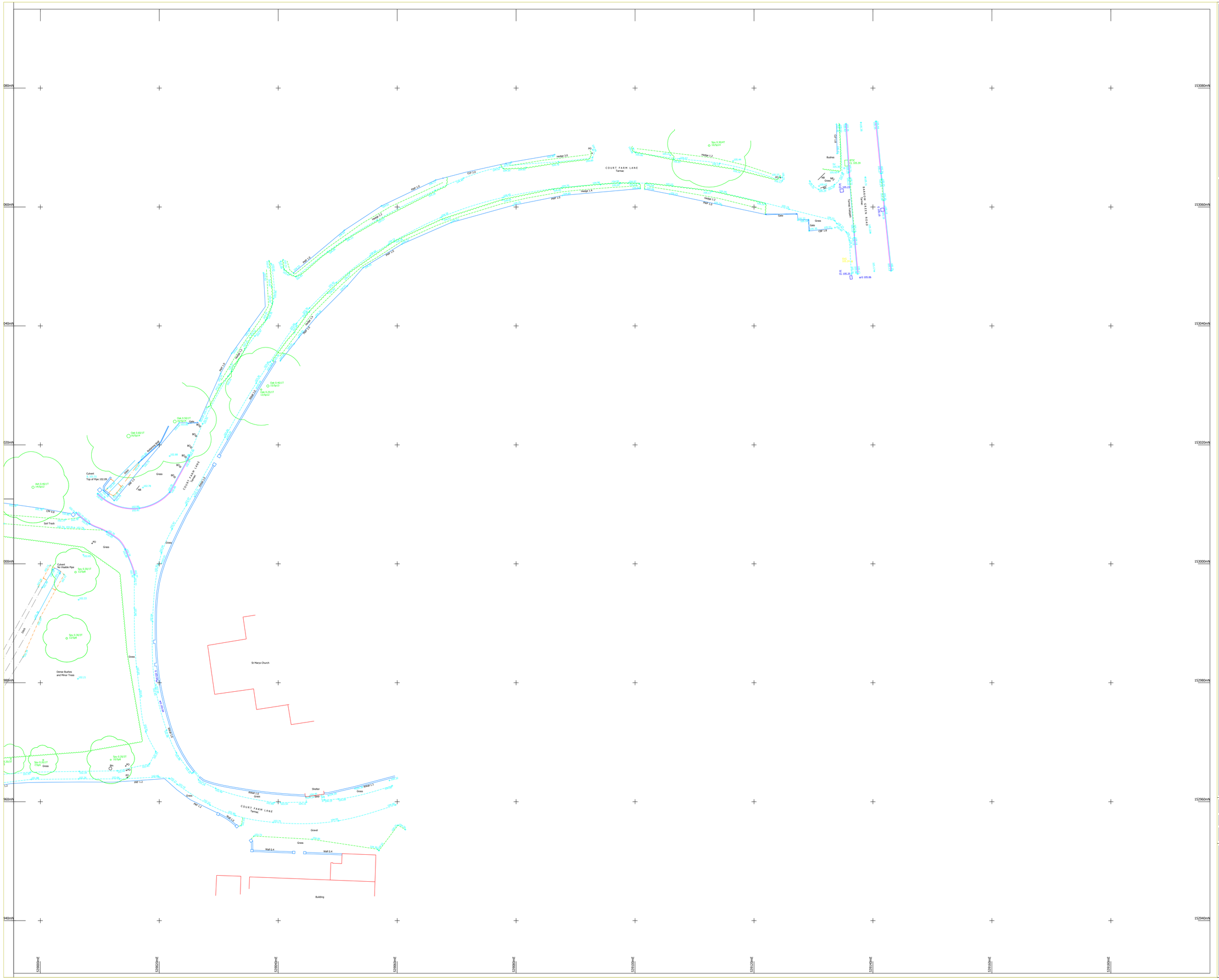
Northpoint:

ENCOMPASS SURVEYS

Encompass Surveys Ltd
Unit 2
Tailsman Business Centre
Duncan Road
Park Gate, Southampton
Hampshire SO31 7GA

Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Croudace Homes		
Survey LOCATION:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	6 of 7



NOTES:

Drainage:
Inspection Covers are lifted where possible and all drainage invert information has been obtained through visual inspection only, with no entry into manholes. Therefore the complete accuracy cannot be guaranteed. Where drainage is of critical importance we suggest the services of a specialist drainage expert be used.

Trees:
Every effort has been made to identify and detail all trees on site but where trees are of critical importance we suggest the use of a specialist such as an arborist. Tree spread and heights are indicative.

GPS:
GPS detail is relative to the time and date of survey. GPS levels and grid are obtained using industry standard guidelines and can vary according to the quality of the GPS network at the time of survey. Unless stated otherwise, surveys are Scale factor 1 and Horizontal and Vertical Datums are established from a central site fix and baseline orientation station utilising GNSS correction data.

Survey notes:
Survey specification is linked to the original purpose of the survey commissioned at source and is to be used for this purpose only. Survey is accurate within limitations of site conditions at the time of survey. In areas difficult to survey due to restricted access, lines of sight or dense vegetation, critical dimensions and positions should be verified following suitable clearance.
Survey detail obtained and shown is relative to the plotting scale.

LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAGNOLIA	MAG
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LRM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		CONIFERS	CDF

TREE ANNOTATIONS: Tree Species / Tree Bull Size / No of Bolts
Tree Height / Tree Canopy Spread

FENCE INFORMATION

BARBED WIRE FENCE	BWF
CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
FOUL WATER	FW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLAGGERED	FB
PAVING SLABS	PS
RETAINING WALL	RWall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BO	NOTICE BOARD	NB
BRITISH TELECOM BOX	BTB	POST	P
BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
EARTHING ROD	ER	SERVICE MARKER POST	SMP
ELECTRICITY CABLE PIT	ELCP	SOIL VENT PIPE	SVP
ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	Tap
NAME PLATE	NP		

Level Datum:
Levels are related to OSGB15 derived from the GPS network

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Grid is related to OSGB15 derived from the GPS network

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Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Croudace Homes		
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	7 of 7

Appendix D

Infiltration Testing, Surface Water Hydraulic Modelling and GI Reports

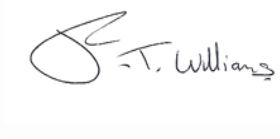
geotechnical and environmental consultants

ground&water

Infiltration Testing Report

Stoneyfields, Oxted, RH8 0NN

On behalf of Motion Limited

Report Reference: GWPR6338/GIR/November 2024 V1.01			Status: Final
Issue	Prepared By	Checked By	Verified By
V1.01			
	Libby Bennett BSc (Hons) Geotechnical and Geoenvironmental Engineer	Miltiadis Mellios MSc(Eng) CGeol FGS GMICE MIEnvSc Principal Engineer	Francis Williams MGeol (Hons) FGS CEnv AGS CGeol Director

Site Investigations | Environmental Consultants | Geotechnical Engineers

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0333 600 1221 enquiries@groundandwater.co.uk **groundandwater.co.uk**

Registered Office: Kineton House, 31 Horse Fair, Banbury, Oxfordshire OX16 0AE Registered in England No. 07032001

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<table>
<tr><th colspan="2">Geotechnical Report</th></tr>
<tr><td>REPORT REFERENCE</td><td>GWPR6338/GIR/November 2024. The conditions and limitations of this infiltration testing report can be viewed within Appendix A, with the aims of the investigation provided within Appendix B. A technical glossary has also been provided within Appendix C.</td></tr>
<tr><td>SITE DETAILS</td><td>The site comprised an irregular shaped plot of land situated to the north of Barrow Green Road. The site was located within Oxted, a town within the Tandridge District of Surrey. A site location plan has been provided within Figure 1.

The site comprised an undeveloped field. An aerial view of the site provided in Figure 2.</td></tr>
<tr><td>PROPOSED DEVELOPMENT</td><td>At the time of reporting, November 2024, the proposed development was understood to comprise the redevelopment of the site into residential housing. A proposed development plan is displayed within Figure 3.</td></tr>
<tr><td>ANTICIPATED GEOLOGY AND HYDROGEOLOGY</td><td>The British Geological Survey (BGS) maps and DEFRA online maps for the area suggest that the site was located on bedrock geology comprising the Folkestone Formation. No superficial deposits were noted on site. The groundwater table is expected at shallow to moderate depths within granular material of the Folkestone Formation. Some perched water might be present at shallower depths within Made Ground.</td></tr>
<tr><td>SITE WORKS</td><td>Site works were undertaken on the 21st November 2024 and comprised the machine excavation of 4no. trial pits (TP1-TP4) to depth of 1.60-2.00m bgl to allow for the conduct of BRE365 Soakage testing.

Given the relatively slow infiltration rate encountered, only one test could be undertaken within TP2 and the test did not reach the 75% mark. TP3 was excavated to 2.0m bgl however collapsed during the first test and so soakage testing could not be undertaken.

A trial hole location plan has been provided within Figure 4.</td></tr>
<tr><td>GROUND CONDITIONS ENCOUNTERED</td><td>A summary of the ground conditions encountered has been summarised in the following table. The trial hole logs can be seen within Appendix E.

<table>
<tr><th colspan="4">Summary of Strata Encountered</th></tr>
<tr><th>Strata</th><th>Top Depth (m bgl)</th><th>Base Depth (m bgl)</th><th>Thickness (m)</th></tr>
<tr><td>TOPSOIL: Dark brown clayey fine SAND.</td><td>GL</td><td>0.20</td><td>0.20</td></tr>
<tr><td>FOLKESTONE FORMATION: Orangish brown to light orangish brown fine SAND to sandy CLAY.</td><td>0.20</td><td>1.60-2.0</td><td>1.40-1.80</td></tr>
</table>
</td></tr>
<tr><td>GROUNDWATER</td><td>No groundwater strikes were encountered during the site investigation works.

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation was undertaken in November 2024 when groundwater levels are likely to be approaching their annual maximum (highest elevation). Exact groundwater levels may only be determined through long term measurements from monitoring wells installed on-site.</td></tr>
</table>

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SURFACE WATER DISPOSAL

Soakage testing, following the principles of BRE365 was undertaken within the bedrock deposits of the Folkestone Formation. The infiltration test results can be seen in the following table. It should be noted that it was not possible to undertake the tests to full compliance of BRE Digest 365 with TP2.

Soakage Testing Results

Trial Hole	Test Number	Depth (m bgl)	Start Depth (m bgl)	Finish Depth (m bgl)	Time Taken (mins)	Infiltration Rate (m/sec)
TP1	1	2.00	1.00	2.00	10	4.13 x 10^-4
	2	2.00	1.00	2.00	10	3.84 x 10^-4
	3	2.00	1.00	2.00	10	4.13 x 10^-4
TP2*	1	1.60	0.80	0.80	240	-
TP4	1	2.00	1.00	2.00	20	2.55 x 10^-4
	2	2.00	1.00	2.00	20	2.80 x 10^-4
	3	2.00	1.00	2.00	20	2.59 x 10^-4

***Given that no infiltration occurred, only one test could be undertaken and it did not reach 75% mark. It was also not possible to calculate an infiltration rate.**

The principles of sustainable urban drainage system (SUDS) should be applied to reduce the risk of flooding from surface water ponding and collection associated with the construction of the foundations.

Consultation with the Environment Agency must be sought regarding any use that may have an impact on groundwater resources, abstractions and surface water features/watercourses.

DUTY OF CARE

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site should be kept damp during dry weather and at other times when dust is generated as a result of construction activities.

The site should be securely fenced at all times to prevent unauthorised access. Washing facilities should be provided and eating restricted to mess huts.

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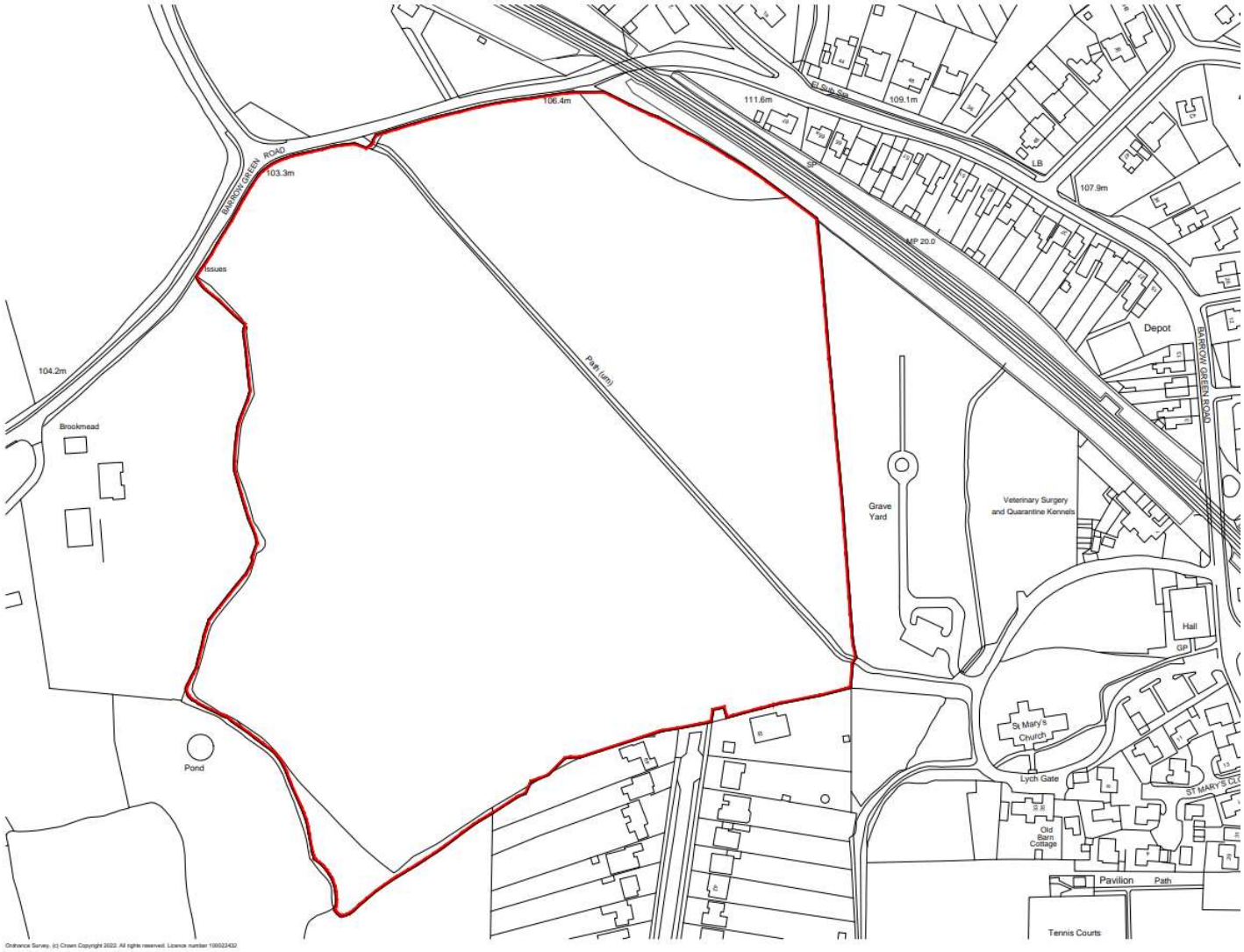
FIGURES



Site Location

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**November 2024**
Figure 1: Site Location Plan	**GWPR6338**

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Site boundary

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**November 2024**
Figure 2: Aerial View of the Site	**GWPR6338**

Site boundary

HOUSE TYPE KEY:

PRIVATE		AFFORDABLE	
1 BED	SYCAMORE	1 BED	FLAT
			SYCAMORE
2 BED	JAY	2 BED	GOLDCREST
			HAZEL
3 BED	MERLIN	3 BED	LAUREL
	ROBIN		
	KITE		
	SISKIN		
	OSPREY		
4 BED	SWIFT		
	TAWNY		
	BILBERRY		
	ROSE		
	SORREL		

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**November 2024**
Figure 3: Proposed Development Plan	**GWPR6338**

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Site boundary

Machine Excavated Trial Pit for BRE365 testing

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**November 2024**
Figure 4: Trial Hole Location Plan	**GWPR6338**

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APPENDIX A: Conditions and Limitations

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The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to Stoneyfields, Oxted, RH8 0NN.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

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The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

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APPENDIX B: Scope of the Investigation

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The design of foundations by means of in-situ and laboratory geotechnical testing undertaken on soil samples recovered from the trial holes were not part of the remit of this report.

A full-scale Environmental Desk Study and Contamination Assessment including a gas, vapour, radon or groundwater risk assessment were not part of the remit of this report.

The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

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APPENDIX C: Technical Glossary

TECHNICAL GLOSSARY

The list of possible definitions within the report may be seen below. Please note that some definitions may not be relevant to this report.

HYDROGEOLOGY:

A **Principal Aquifer** is a layer of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary (A) Aquifers consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

Secondary (B) Aquifers consist of deposits with predominantly lower permeability layers with may stoke and yield limited amounts of groundwater due to localised features such as fissures, think permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary Aquifers (Undifferentiated) are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both a minor aquifer and non-aquifer in different locations due to the variable characteristics of the rock type.

Unproductive Strata are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

FLOOD ZONES:

Environment Agency Flood Zone 2, defined as; land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

Environment Agency Flood Zone 3 shows the extent of a river flood with a 1 in 100 (1%0 or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year.

Environment Agency Flood Zone 3 area that benefits from flood defences, defined as; land and property in this flood zone would have a high probability of flooding without the local flood defences. These protect the area against a river flood with a 1% chance of happening each year, or a flood from the sea with a 0.5% chance of happening each year.

GROUNDWATER SOURCE PROTECTION ZONES (SPZS):

Inner Zone (SPZ1): This zone is 50 day travel time of pollutant to source with a 50 metres default minimum radius.

Outer Zone (SPZ2): This zone is 400 day travel time of pollutant to source. This has a 250 or 500 metres minimum radius around the source depending on the amount of water taken.

Total Catchment (SPZ3): This is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point.

Zone of Special Interest (SPZ4): This zone is where local conditions require additional protection.

IN-SITU STRENGTH GEOTECHNICAL TESTING:

Windowless Sample and/or Cable Percussion and/or Rotary Boreholes provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50mm and an inside diameter of 35mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. The sample tube is driven 150mm into the ground and then the number of blows needed for the tube to penetrate each 75mm up to a depth of 450mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

Dynamic Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.5kg (SHDP) hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. (The Dynamic Probe 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).

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APPENDIX D: Trial Hole Logs

Trial Pit Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 21/11/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP1	TP			1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.20			TOPSOIL: Dark brown clayey fine SAND.
		0.50	D					Light orangish brown fine SAND. (FOLKESTONE FORMATION).
		0.80	D					
		1.00	D					
		1.50	D					
		2.00	D		2.00			End of Borehole at 2.000m

1
2
3
4
5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks

Remarks

No groundwater encountered.

Trial Pit Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 21/11/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP2	TP			1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.20			TOPSOIL: Dark brown clayey fine SAND. Orangish brown sandy CLAY. Sand is fine to medium. (FOLKESTONE FORMATION).
		0.50	D					
		0.80	D					
		1.00	D					
		1.50	D					
					1.60			End of Borehole at 1.600m

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks

Remarks

No groundwater encountered.

Trial Pit Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 21/11/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP3	TP			1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.20			TOPSOIL: Dark brown clayey fine SAND.
		0.50	D					Light orangish brown fine SAND. (FOLKESTONE FORMATION).
		0.80	D					
		1.00	D					
		1.50	D					
		2.00	D		2.00			End of Borehole at 2.000m

1
2
3
4
5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks

Remarks

No groundwater encountered.

Trial Pit Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 21/11/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Equipment:

Location Number	Location Type	Level	Logged By	Scale	Page Number
TP4	TP			1:25	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	D		0.20			TOPSOIL: Dark brown clayey fine SAND.
		0.50	D					Light orangish brown fine SAND. (FOLKESTONE FORMATION).
		0.80	D					
		1.00	D					
		1.50	D					
		2.00	D		2.00			End of Borehole at 2.000m

1
2
3
4
5

Dimensions		Trench Support and Comment			Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks	Date	Rate	Remarks

Remarks

No groundwater encountered.

ARDENT
CONSULTING ENGINEERS
AN EMPLOYEE OWNED COMPANY

Croudace Homes Limited

Stoneyfields, Oxted

Hydraulic Modelling Report

REPORT REF.
2404420-ACE-XX-XX-RP-C-0501AA

December 2024

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REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
-	DRAFT	JA	GA	DRAFT	November 2024
	FINAL	JA	GA	BC	November 2024
A	Update to include Illustrative Masterplan	JA	GA	BC	December 2024

Distribution

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1. Introduction

1.1. Ardent Consulting Engineers (hereafter referred to as Ardent) has been instructed by Croudace Homes Limited to undertake surface water hydraulic modelling to support a proposed development at Stoneyfields, Oxted.

1.2. The Site location is shown in **Figure 1-1**. The proposed development consists of residential dwellings and a care home with associated parking and landscaping, with vehicular access via Wheeler Avenue from the south and Barrow Green Road to the north.

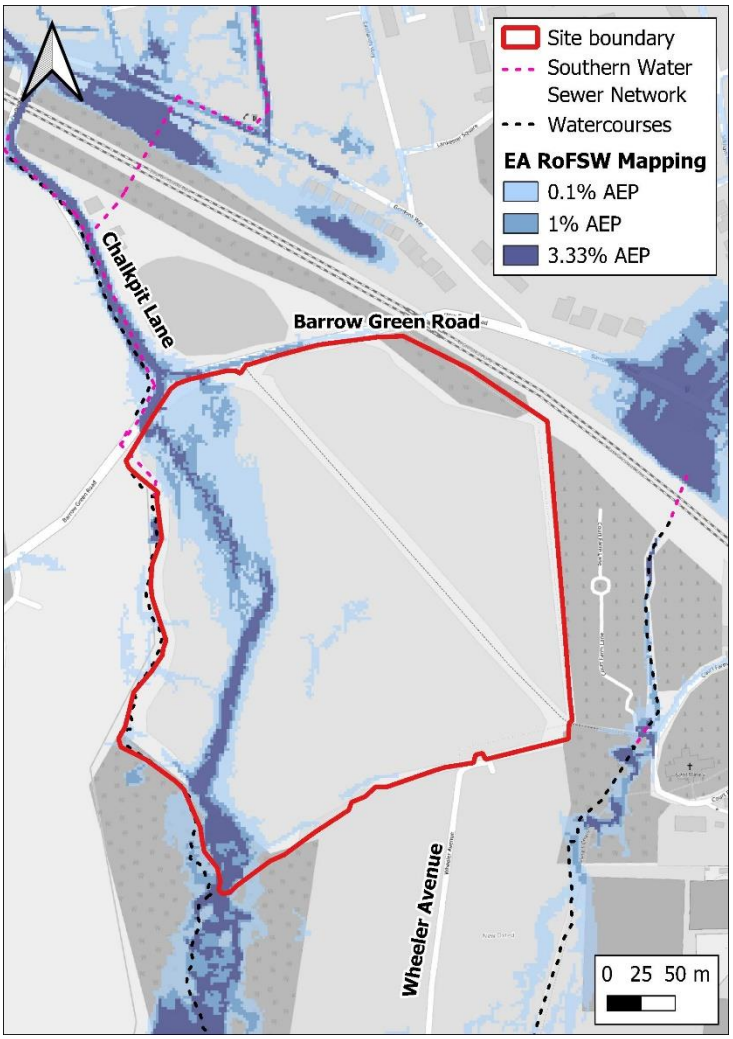


Figure 1-1: Site location plan and EA surface water flood mapping

1.3. An ordinary watercourse runs along the western boundary from north to south. The watercourse is primarily fed by a Southern Water surface water sewer that discharges into the watercourse in the northwest of the Site, along with a ditch that runs adjacent to Chalkpit Lane from the north. An ordinary watercourse is also located east of the Site through the adjacent cemetery.

1.4. The Environment Agency (EA) Risk of Flooding from Surface Water (RoFSW) shows parts of the Site are predicted to be at a low to high risk of surface water flooding (see **Figure 1-1**). However, the EA mapping is carried out at national scale and does not explicitly represent local drainage features such as the sewer network.

1.5. Therefore, a detailed 1D-2D linked direct rainfall-runoff model has been developed using TUFLOW software to refine the understanding of surface water flood risk to the Site and inform potential flood risk mitigation measures.

2. Site Visit

2.1. To support the hydraulic model build, a Site visit was undertaken on 24 May 2024 to identify any structures/drainage features that may influence the surface water flood risk to the Site and assess the condition of the watercourse. Features identified during the Site visit are shown in **Figure 2-1**, with photographs shown in **Appendix A**. The Site visit was supported by topographic survey (see **Appendix B**) and Southern Water sewer mapping (see **Appendix C**).

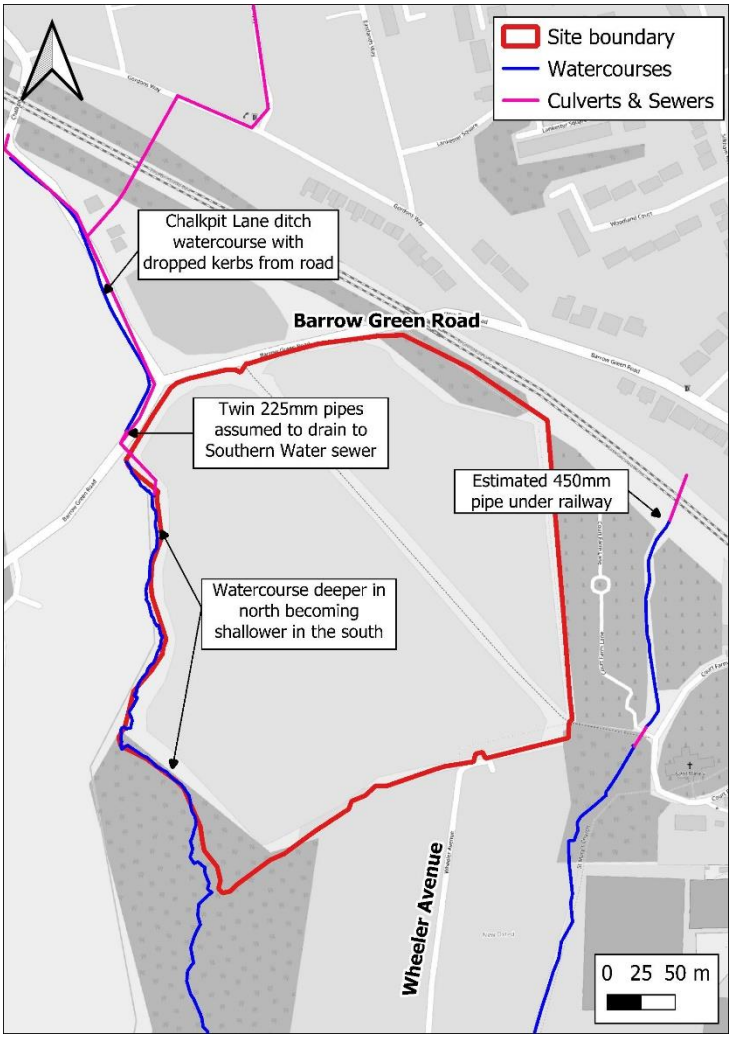


Figure 2-1: Culverts identified during Site visit

2.2. A ditch running north to south adjacent to Chalkpit Lane was identified during the Site visit, which then turns west for a short length along Barrow Green Road (see **Photo A.1**). A series of dropped kerbs along Chalkpit Lane leading into the ditch were also identified. The ditch was approximately 0.75m - 1m deep and 1m – 1.5m wide at bankfull. At the time of the visit the ditch contained a large amount of summer vegetation.

2.3. Several road gullies and manholes were identified along Chalkpit Lane and Barrow Green Road. It is assumed that these drain into a surface water sewer shown on Southern Water sewer mapping to run along Chalkpit Lane before entering the northwest corner of the site and discharging into the watercourse adjacent to the Site (see **Appendix C**).

2.4. At the downstream end of the ditch two 225mm culverts were observed, one concrete and one PVC (see **Photo A.2**). No culvert was identified immediately south of Barrow Green Road along the watercourse adjacent to the Site. The 225mm culverts are therefore assumed to drain into the Southern Water surface water network.

2.5. Due to vegetation growth it was not possible to view the outfall of the Southern Water network to the watercourse to the west of the Site. However, the location shown of the outfall on sewer mapping correlates with the Site topographic survey. Additionally, flow within the watercourse was only observed downstream of the mapped outfall location.

2.6. The watercourse is relatively deeply incised along boundary in the northwest of the Site (see **Photo A.3**), with a defined channel shown to be approximately 0.75 – 1.25m deep in the topographic survey. At the time of the Site visit the channel was largely clear, though with occasional debris and densely vegetated banks.

2.7. In the southwest of the Site the watercourse becomes shallower and spreads over a wider area with waterlogged ground (see **Photo A.4**). The channel becomes more overgrown within this area.

2.8. The watercourse to the east of the Site was also visited and is largely a clear channel approximately 1m deep with grass lined banks. The culvert under the railway into the cemetery from the north was estimated to be 450mm in diameter based on observations taken during the Site visit (see **Photo A.5**).

3. Hydrological Assessment

3.1. To inform the hydraulic modelling and assess surface water flood risk to the Site, rainfall hyetographs were derived to input to the hydraulic model.

3.2. FEH22 catchment descriptor data was obtained from the Flood Estimation Handbook (FEH) Web Service for the catchment covering the Site (see **Figure 3-1**). The catchments consist of rural areas to the north and west of Oxted, and a residential area in the north of Oxted.

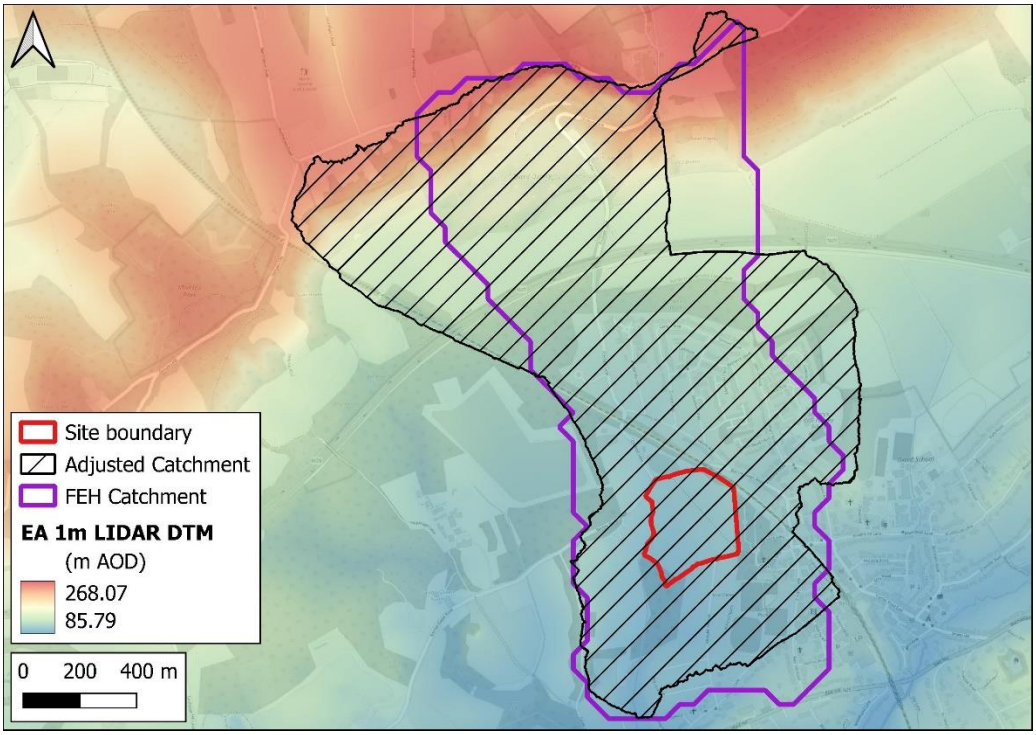


Figure 3-1: Estimated catchment boundary

3.3. A catchment analysis was undertaken using catchment delineation tools within QGIS to determine the catchment area draining to the Site based on the latest 1m EA LIDAR Composite DTM, with the LIDAR data last collected in 2018. The updated catchment area is shown in **Figure 3-1**. The adjusted catchment has an area of 2.28km^2, compared to the value of 2.12km^2 for the FEH catchment, with the adjusted area used to derive rainfall.

3.4. Analysis of satellite imagery indicated no major development had occurred within the catchment and as such URBEXT values were only updated to 2024 in line with available guidance.

3.5. The other catchment descriptors used to derive design rainfall and net rainfall for rural areas (SPRHOST, BFIHOST, SAAR, DPLBAR etc.) were assessed against

available data, such as British Geological Society geology mapping and LANDIS SoilScapes mapping. The key FEH catchment descriptors were considered appropriate and as a result only the catchment area and URBEXT values were updated.

3.6. The FEH22 data was inputted to the Revitalised Flood Hydrograph 2 (ReFH2) software, which was used to derive rainfall hyetographs for the 3.3%, 1%, and 0.1% Annual Exceedance Probability (AEP) events.

3.7. Rainfall hyetographs were also derived for the 3.3% AEP event uplifted by 35% and the 1% AEP event uplifted by 45% to account for the potential impacts of climate change, in line with the latest EA guidance for the 2070s epoch upper end allowance in the Medway Management Catchment[1].

3.8. A winter storm profile was used to derive the hyetographs in line with available ReFH2 guidance on critical seasonality for rural areas based on the BFIHOST value and updated URBEXT2000 value.

3.9. The default storm duration for the catchment is 3.25 hours. Hyetographs were also derived for a 1.25-hour, 2.25-hour, and 4.25-hour storm duration, with all four durations tested within the model for the 1% AEP plus 45% climate change event in the baseline model. The duration testing found the 2.25-hour storm event resulted in the highest peak flood depths at key locations in the Site, with this therefore used as the final design storm duration.

3.10. The design and net rainfall hyetographs were exported from ReFH2, with details of how rainfall losses from rural and urban areas were represented in the hydraulic model outlined in **Section 4**. An example ReFH2 report for the 1% AEP plus 45% climate change event is provided in **Appendix D**, including details of the descriptor data.

[1] Medway Management Catchment peak rainfall allowances, Environment Agency. Available: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3055

4. Baseline model build

4.1. The baseline model has been built using the hydraulic modelling software TUFLOW. All scenarios have been run using Tuflow build version 2023-03-AC-iSP-w64.

2D build

4.2. A 2D model schematic is shown in **Figure 4-1**.

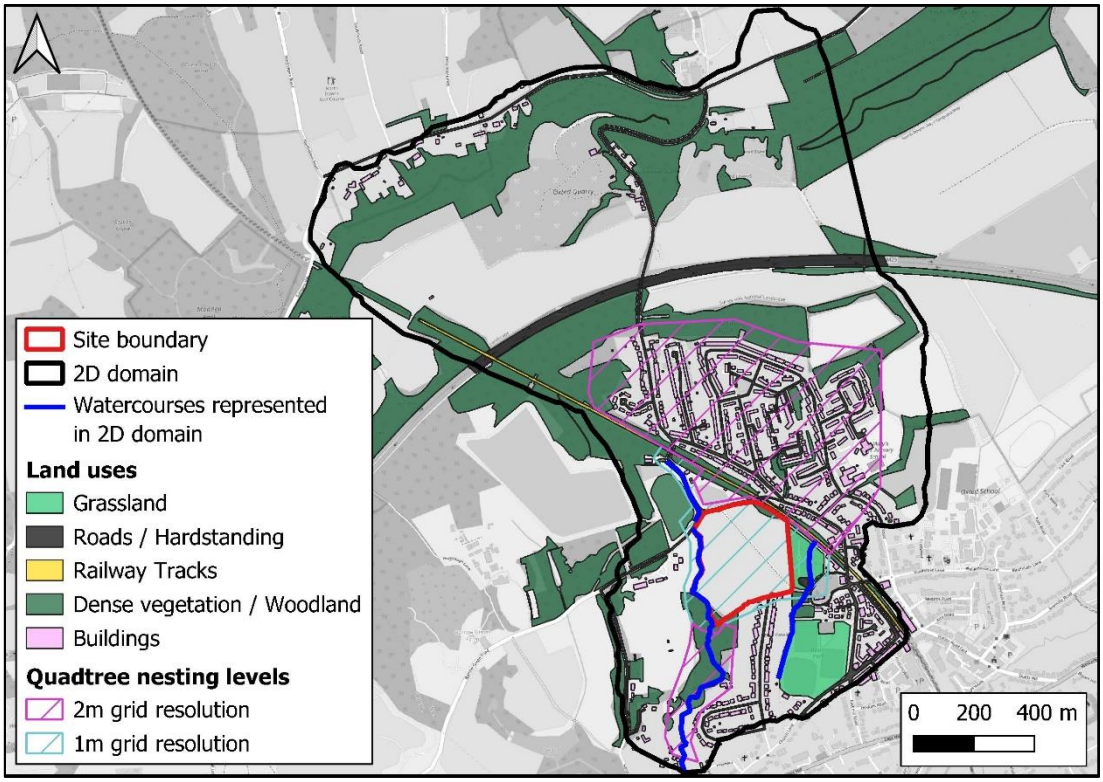


Figure 4-1: 2D Model schematic

4.3. Watercourses and the wider catchment are represented in the 2D domain, which covers an area of 2.78km^2, including the entire catchment derived in **Section 3**.

4.4. Ground levels at the Site have been informed by a topographic survey collected in March 2023 by Encompass Surveys (see **Appendix B**). Elevations across the wider catchment were derived from the 2018 EA 1m LIDAR DTM.

4.5. A 4m cell size has been applied across the model with Quadtree used to refine this to a 2m grid size within the urban area north of the Site and the watercourse downstream of the Site. A 1m grid size is applied at the Site, adjacent watercourse and along Chalkpit Lane. Sub-grid sampling has been enabled within TUFLOW, ensuring surface water flow paths were adequately represented.

4.6. Different land uses derived from topographic survey and OS VectorMapping have been assigned roughness values within the 2D domain. A general roughness value of 0.055 was applied to the model domain representing light vegetation/pasture and fenced gardens. '2D_mat' files were then used to specify roughnesses for different land uses (see **Figure 4-1**). The values applied are shown in **Table 4-1**.

Table 4-1: 2D Manning's 'n' roughness values

Land use	Manning's 'n' roughness value
Light vegetation / pasture / fenced gardens	0.055
Open areas / Grassland	0.045
Railway tracks	0.035
Roads / Hardstanding	0.02
Buildings	0.3
Woodland / Dense vegetation	0.1
2D Watercourses	0.048

4.7. The ordinary watercourse was represented in the 2D domain. Adjacent to the Site boundary a 'Z-line' was used to stamp in channel levels taken from the topographic survey (see **Figure 4-1**). Where survey data was not available the watercourse levels were taken from the LIDAR DTM. This approach is considered conservative as LIDAR data only captures the water surface and not the channel bed levels, therefore underestimating the channel capacity.

4.8. The ditch along Chalkpit Lane was poorly represented within the LIDAR DTM. As a result, a 'Z-line' was used to lower the ground model by 0.5m to conservatively represent the capacity of the ditch.

1D build

4.9. The culverts identified during the Site visit (see **Section 3**) and from topographic survey were represented in the 1D domain (see **Figure 4-2**). A culvert to southeast of the Site was represented as a 580mm circular pipe, with the dimensions and inverts taken from topographic survey.

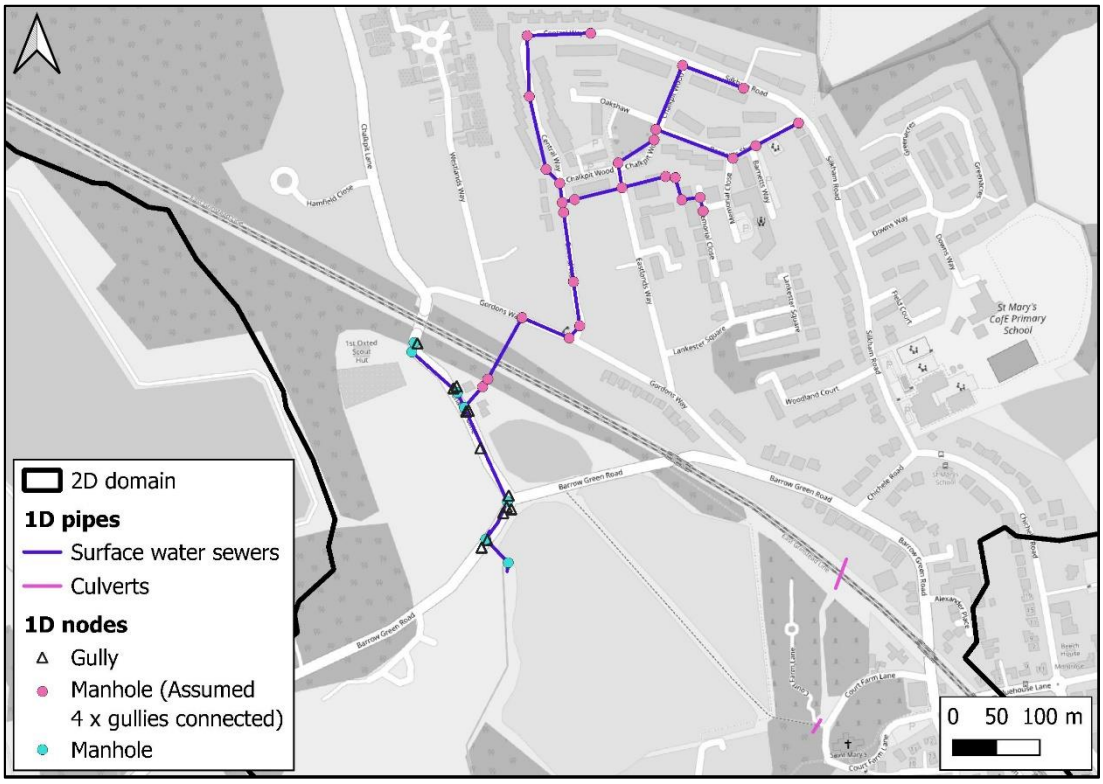


Figure 4-2: 1D model schematic

4.10. The two 225mm culverts at the downstream end of the ditch north the of Site were represented in the 1D domain, connecting into the adjacent sewer network, while the 450mm culvert under the railway line to the east of the Site was connected to the 2D domain at the upstream and downstream ends. In the absence of topographic survey, the culvert invert levels were inferred from the EA LIDAR data used to define the ground model. The culvert dimensions were informed by measurements and observations taken during the Site visit.

4.11. The sewers were represented using information obtained from Southern Water sewer mapping (see **Appendix C**). Pipe inverts and dimensions were taken from the mapping, with details inferred or interpolated where values were missing. A pipe roughness of 0.013 was applied in line with available guidance (i.e. Chow, 1959) assuming a good condition.

4.12. Road gullies along Chalkpit Lane identified during the Site visit were represented within the model (see **Figure 4-2**), with cover levels taken from the EA LIDAR DTM and invert levels set 0.5m below this. Manholes were represented with cover levels taken from the EA LIDAR DTM to ensure a linkage between the 1D and 2D domains using SXL connections (see **Figure 4-2**).

4.13. The flow in and out of road gullies was represented using standard head discharge curves, in line with industry guidance assuming 150mm pipe connections. The road gullies were set to connect to the nearest manhole in the 1D domain. Where road gullies were represented in the model, manholes were represented using standard head discharge curves that assume minimal inflows but allow surcharging to occur. Where no gullies were represented in the model upstream of the railway line the manholes were set to have a head discharge curve that assumed four gullies were connected to each manhole in the absence of gully mapping.

4.14. A blockage analysis of the twin 225mm culvert at the downstream end of the ditch north of the Site was undertaken to assess the residual flood risk to the Site and demonstrate the sensitivity of the model outputs to the assumptions made regarding their representation. The blockage analysis found only a minor impact on flood depths within the Site boundary meaning the representation of the culverts was considered appropriate (see **Appendix E** for further details).

4.15. Pipe roughness was applied in line with available guidance (i.e. Chow, 1959) based on observations and assumptions about the pipe material and condition. All sewers had a Manning's 'n' value of 0.013 applied, while the three culverts had values of 0.015 applied. Standard entry and exit losses were applied in line with TUFLOW guidance.

Boundary conditions

4.16. A '2d_rf' layer was used to apply rainfall directly to the 2D model domain. Rainfall losses associated with infiltration for the rural areas of the catchment were estimated within ReFH2, with the rural net rainfall hyetograph applied to the area shown in **Figure 4-3**.

4.17. The urban eastern half of the catchment is heavily urbanised, with indicative measurements indicating approximately 60-70% of the area is hardstanding. As a result, a conservative approach to apply rainfall to the urban catchment was undertaken, with the design rainfall hyetograph applied to the entire urban area shown in **Figure 4-3**. To account for infiltration losses and storage within urban areas (i.e. gutters, drains) 80% of the total design rainfall hyetograph was applied to the urban areas.

4.18. No losses were applied to account for the presence of surface water sewers within the catchment where these were not represented explicitly as it is assumed these would drain to the study watercourse and not be lost from the catchment.

4.19. Sensitivity testing of the application of rainfall to the model was undertaken and demonstrates the model has a low sensitivity to the approach used (see **Appendix E**).

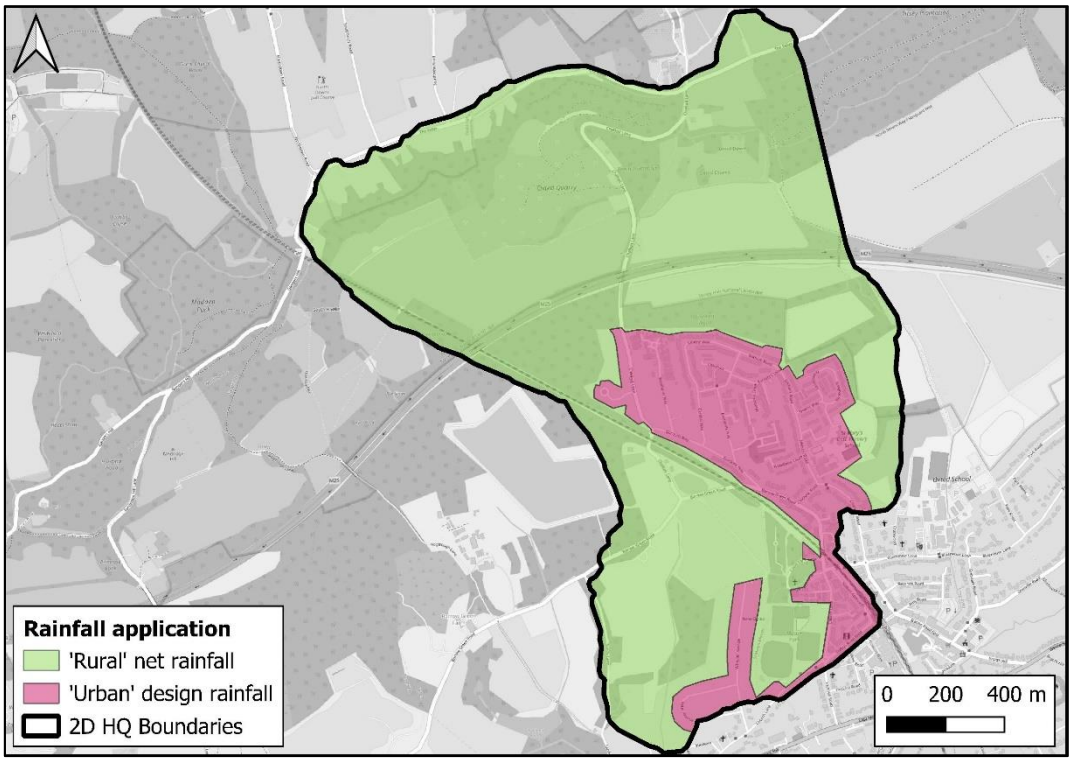


Figure 4-3: Model boundaries

4.20. To allow runoff to pass out of the 2D domain an HQ boundary was applied at the downstream extent of the watercourse and other flow paths in the model domain, with a gradient derived from the EA LIDAR DTM. The downstream boundary was located sufficiently downstream that it does not impact the model outputs at the Site. HQ boundaries with general slope values were applied to the rest of 2D domain to prevent glass-walling (see **Figure 4-3**).

4.21. 2D_bc 'SX' links have been used to link the 1D culverts to the 2D domain, with inverts taken from the EA LIDAR DTM. The 1D manholes and gullies were also connected to the 2D domain using 'SX' links.

Assumptions / limitations

4.22. The representation of any complex system by a model requires a number of assumptions to be made. In the case of the 1D and 2D elements of the model, the following assumptions have been made:

- Model parameters, such as roughness and structure coefficients, are representative of the general conditions;
- The units used to represent hydraulic structures within the model represent the situation accurately using the available information, including assumptions made to simplify representations where necessary;
- Culvert dimensions and inverts have been estimated where data is not available;
- The model hydrology accurately represents flows in the models given there was no flow / level data available for the catchment to calibrate flows in the model;
- Watercourses are modelled to be dry at the beginning of the simulation, with inflows solely from rainfall;
- The LIDAR and OS mapping are representative of the land surface and are an up to date reflection of current ground levels and land uses.

5. Baseline modelling results

5.1. The model has been run using the TUFLOW HPC solver with adaptive timestepping. The model is run for a total duration of 6 hours to allow the full storm event to pass through the Site. Model results have been filtered to remove depths below 0.05m.

5.2. Peak flood extents for the modelled storm events are shown in **Figure 5-1**.

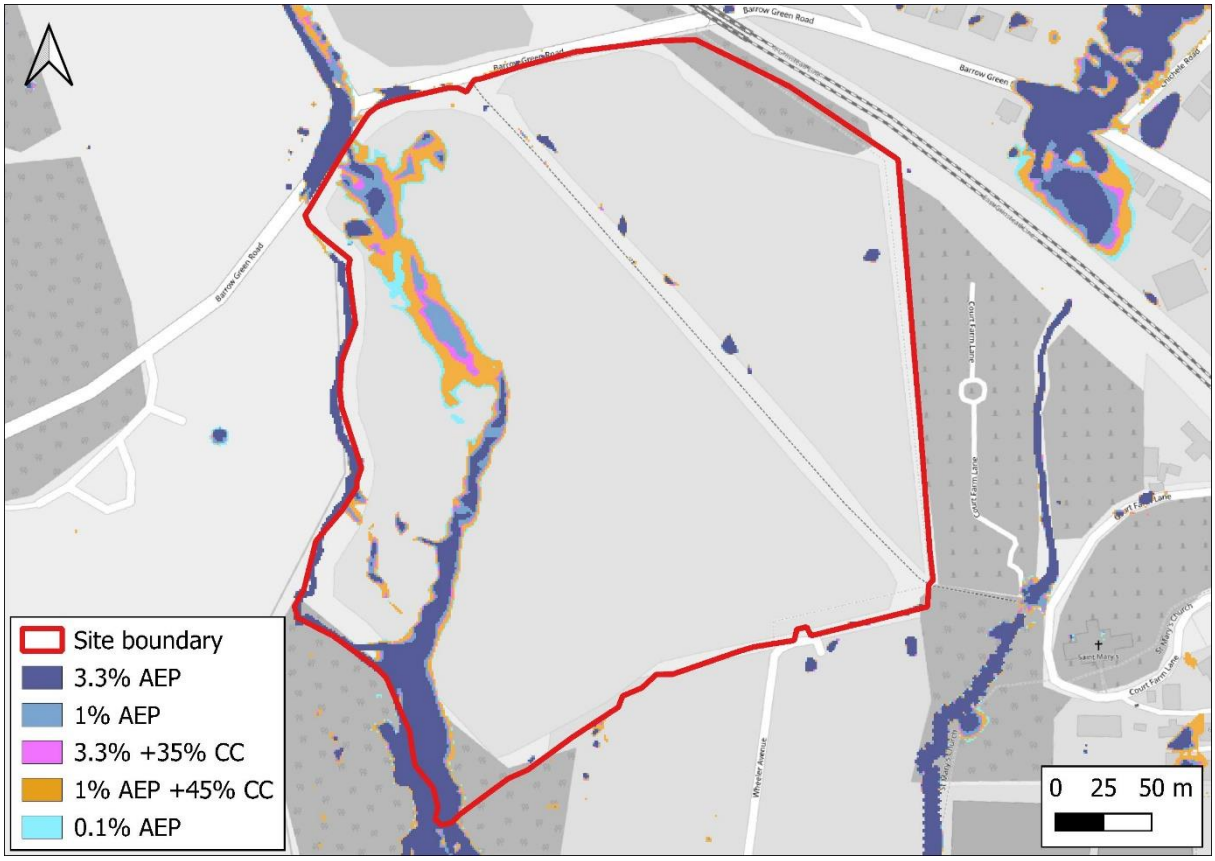


Figure 5-1: Baseline model flood extents

5.3. During all modelled events overland flows are predicted to enter the northwest corner of the Site, forming a shallow overland flow path that runs north to south through the Site separated from the adjacent watercourse by a slight ridge of higher land along the field boundary.

5.4. The capacity of the drainage ditch and surface water sewer network along Chalkpit Lane are modelled to be exceeded during all events, resulting in ponding on Barrow Green Road before flows spill into the Site. During the smaller magnitude events the flow path through the Site is very shallow (i.e. <0.05m).

5.5. The remainder of the Site is not predicted to be at risk of surface water flooding, with only isolated areas of surface water ponding shown in topographic depressions.

Additionally, the location of the proposed vehicular accesses are outside of the areas of flood risk.

5.6. The flow path is predicted to be very flashy with flows only conveyed through the Site for approximately 1.5-2 hours during the design storm for a 1% AEP plus 45% climate change event.

5.7. Peak modelled flood depths during the 1% AEP plus 45% climate change event are presented in **Figure 5-2**.

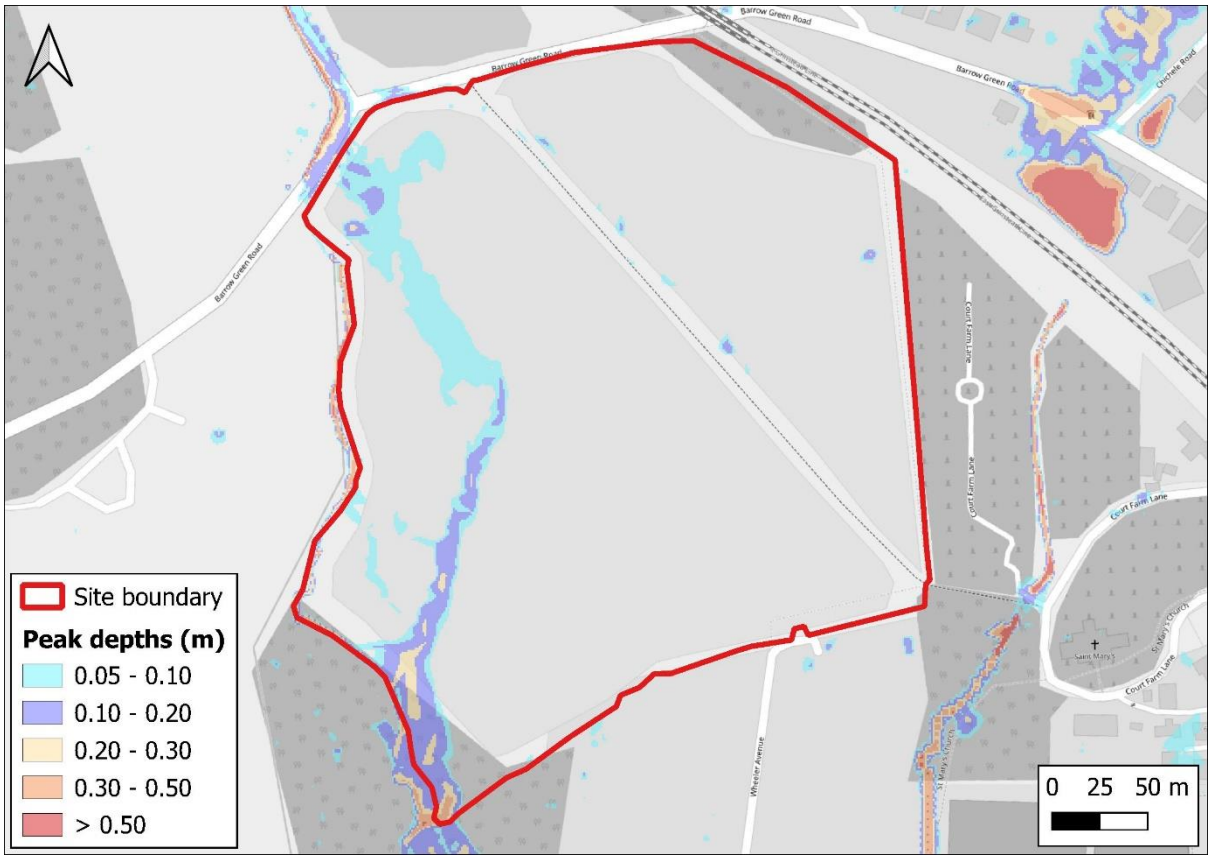


Figure 5-2: Peak modelled depths – 1% AEP +45% climate change

5.8. Through the northwest of the Site the flow path is modelled to be shallow, typically less than 0.10m, ranging in width from approximately 5-20m.

5.9. In the centre of the Site the flow path becomes more concentrated within a slight valley in the local topography that directs the flow path southwest towards the ordinary watercourse, with peak depths in this area typically around 0.15m.

5.10. In the southwest corner where the flow path joins the ordinary watercourse depths of approximately 0.25m are predicted.

Model Validation

5.11. No gauging data of flows or levels was available to inform the model validation. However, the modelling shows a good comparison with the existing EA RoFSW flood mapping (see **Figure 1-1**). The modelled flood extent is predicted to be slightly less extensive in the northwest of the Site due to the inclusion of the site specific topographic survey and local drainage features.

5.12. The similarities between the model outputs and the EA RoFSW mapping indicate the model is appropriately representing the flood risk to the Site.

5.13. The maximum uncertainty associated with the model outputs is approximately +/-50mm (see **Appendix E**).

Model stability

5.14. A review of the model outputs indicates the model is stable for the duration of the event, with total mass errors of 0% and timestep efficiency above 99% after the model initialisation. The model runs have no negative depths or repeated timesteps.

6. Post-development Modelling

Model updates

6.1. The proposed Site masterplan is provided in **Appendix F**. To increase the developable area of the Site post-development modelling was undertaken to assess the potential impacts of reprofiling ground levels so the overland flow path is diverted along the western boundary, away from the proposed residential development in the centre of the Site (see **Figure 6-1**).

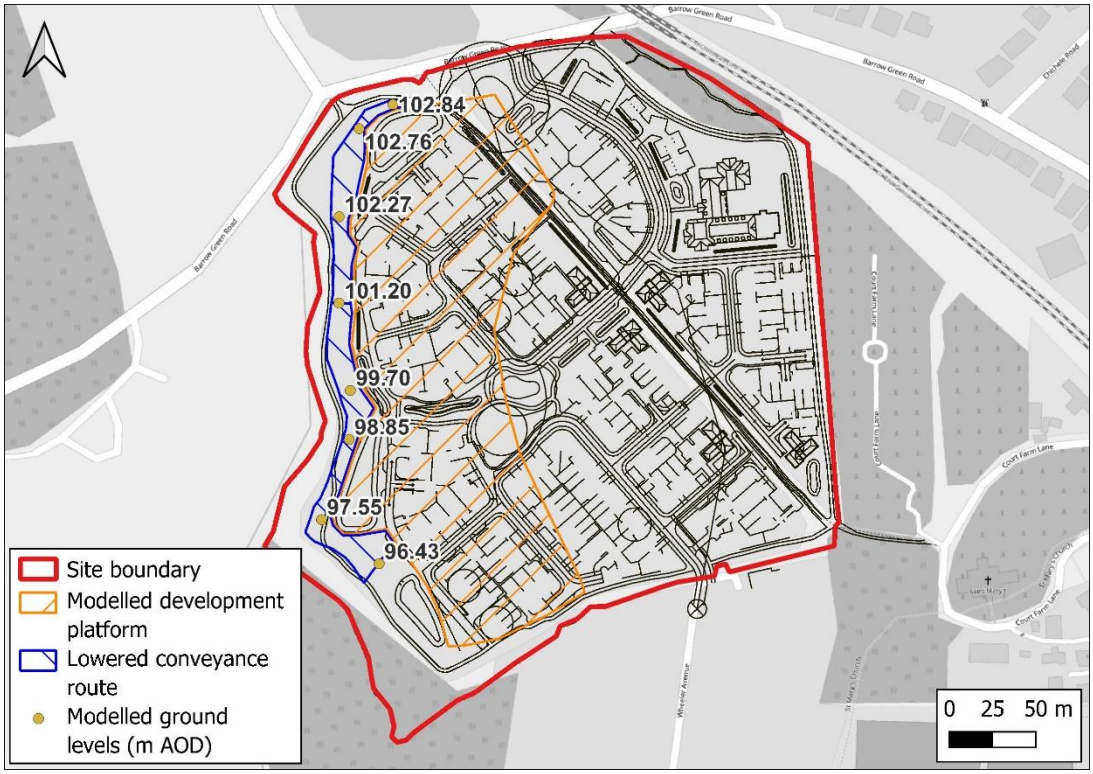


Figure 6-1: Proposed mitigation measures and Site layout

6.2. A conveyance route was formed along the western Site boundary, running from where the flow path enters the Site down to the southwest corner where the existing flow path joins the watercourse. The conveyance route was formed by slight ground lowering typically 100-300mm, with the modelled levels shown in **Figure 6-1**.

6.3. The conveyance route was represented within the post-development scenario using a Z-shape. Additionally, a development platform was represented adjacent to this, raising ground levels above the peak modelled flood levels for the purposes of the modelling so the platform remains dry.

6.4. The only other change to the post-development model was that rainfall was excluded from the developed area of the Site as this will be managed by the on-site drainage network. A '2D_bc' layer was used to apply the discharge from the drainage network to the watercourse at the proposed connection point, in line with the maximum discharge rate specified in the drainage strategy. This maximum discharge rate was applied for the duration of the model simulation, providing a conservative estimate of the outflow.

Post-Development Model Results

6.5. Peak flood depths and levels for the 1% AEP plus 45% climate change event during the post-development scenario are shown in **Figure 6-2**.

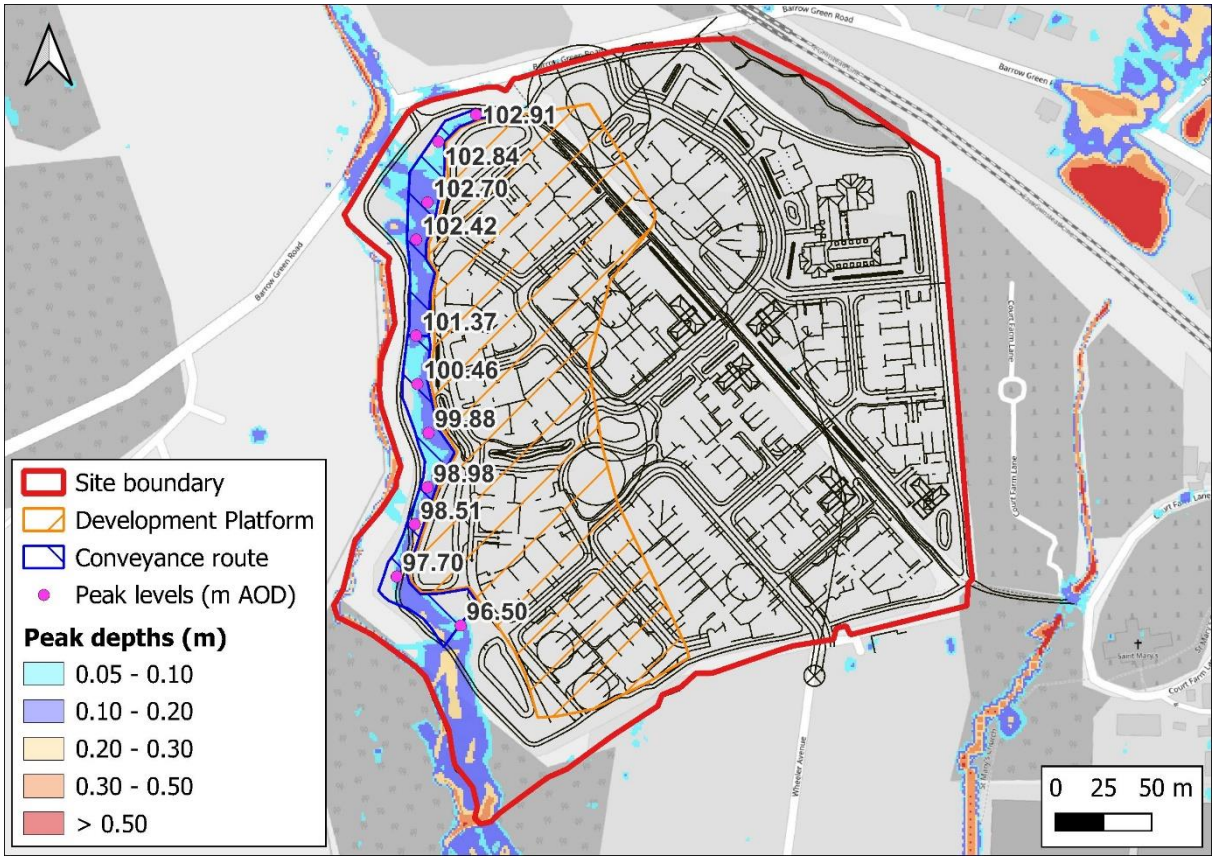


Figure 6-2: Peak modelled depths and levels – 1% AEP plus 45% climate change – Post-development scenario

6.6. The ground level reprofiling is modelled to divert the overland flows along the Site western boundary between the watercourse and the modelled development platform. All residential development and SuDS features are located outside of the western flow path.

6.7. The peak flood depths along the flow path are typically shallow, modelled to be approximately 150-170mm along much of the western boundary during the 1% AEP plus climate change event. Depths of up to approximately 250mm are predicted within the deepest areas.

6.8. The peak levels along the flow path range from 102.91m AOD in the north of the Site to 96.5m AOD in the southwest during the 1% AEP plus climate change event. It is recommended that the ground levels and SuDS features within the development platform, as well as residential finished floor levels, are set above the peak modelled flood levels during the 1% AEP plus climate change event with an appropriate freeboard.

6.9. A comparison of the peak flood depths between the baseline and post-development scenarios is shown in **Figure 6-3**. The model results demonstrate the proposals are not predicted to have a detrimental impact on flood risk to third party land, with all increases in peak depths contained within the Site boundary.

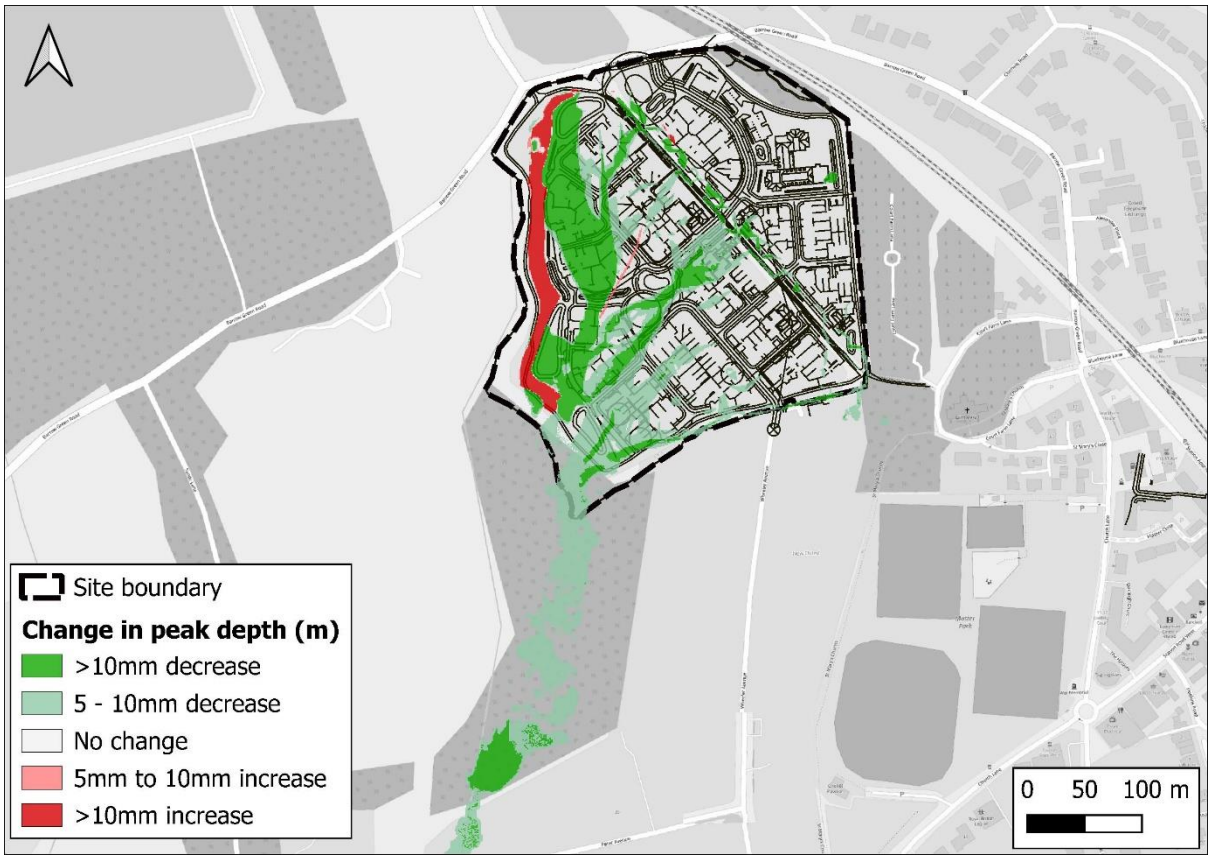


Figure 6-3: Change in peak modelled depths – 1% AEP +45% climate change

6.10. The area to the south of the Site is predicted to show slight benefits due to a reduction in the overall flows leaving the Site associated with the on-site

drainage network. The decreases in peak depths are typically around 6-7mm, with an area where decreases of up to 11-12mm are predicted.

6.11. The peak modelled flood hazard during the 1% AEP plus 45% climate change event is shown in **Figure 6-4**.

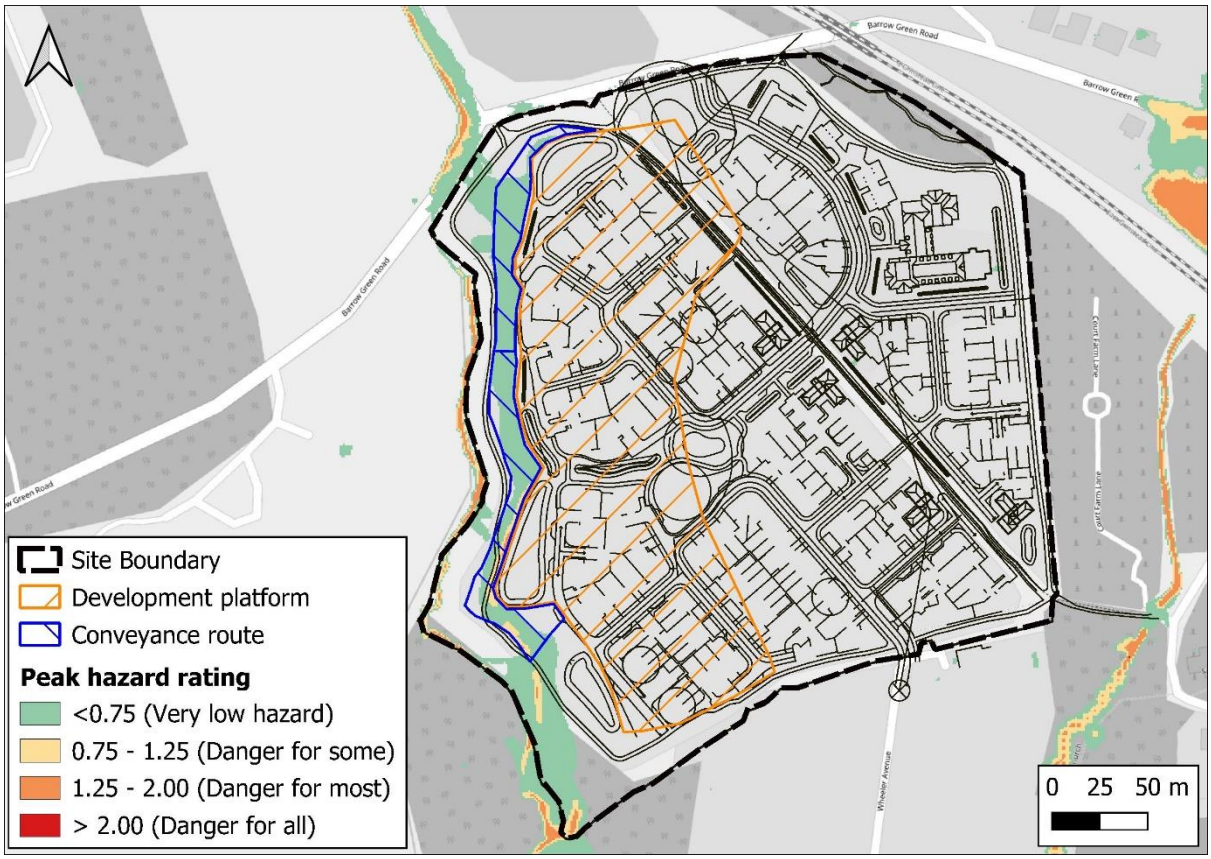


Figure 6-4: Peak modelled hazard rating – 1% AEP +45% climate change

6.12. The hazard rating is modelled to be very low during the 1% AEP plus climate change event along most of the flow path, with small areas at a 'danger for some'. As the development platform and associated accesses are shown to be outside the modelled flood extents the entire Site is provided safe dry access and egress.

7. Summary

7.1. Ardent Consulting Engineers has been instructed by Croudace Homes Limited to undertake surface water hydraulic modelling to support a proposed development at Stoneyfields, Oxted.

7.2. A detailed 1D-2D linked direct rainfall-runoff model has been developed using TUFLOW software to refine the understanding of surface water flood risk to the Site. The model outputs have also been used to inform the Site design and associated flood risk mitigation measures.

7.3. A hydrological analysis has been undertaken to derive rainfall hyetographs for the study area for the 3.3%, 3.3% plus 35% climate change, 1%, 1% plus 45% climate change uplift and 0.1% Annual Exceedance Probability Events.

7.4. A baseline hydraulic model has been built using a combination of LIDAR data, topographical survey data, Ordnance Survey land use data, sewer mapping, and information on the local drainage network obtained during a Site visit.

7.5. During all modelled events overland flows are predicted to enter the northwest corner of the Site, forming a shallow overland flow path that runs north to south through the Site separated from the adjacent watercourse by a slight ridge of higher land along the field boundary. Most of the Site is shown to be at a very low risk of surface water flooding.

7.6. The flow path is predicted to be very flashy with flows only conveyed through the Site for approximately 1.5-2 hours during the design storm for a 1% AEP plus 45% climate change event.

7.7. Post-development modelling was undertaken to assess the potential impacts of reprofiling ground levels so the overland flow path is diverted along the western boundary, away from the proposed residential development in the centre of the Site.

7.8. The ground level reprofiling is modelled to divert the overland flows along the Site western boundary between the watercourse and the modelled development platform, with peak depths of up to approximately 150-250mm during the 1% AEP plus 45% climate change event.

7.9. All residential development and SuDS features are located outside of the western flow path. It is recommended that the ground levels and SuDS features within the

development platform, as well as residential finished floor levels, are set above the peak modelled flood levels during the 1% AEP plus climate change event with an appropriate freeboard.

7.10. Comparison between the baseline and post-development model outputs during the 1% AEP plus 45% climate change event demonstrate the proposals are not predicted to have a detrimental impact on flood risk to third parties. The post-development scenario is predicted to result in a decrease in peak depths downstream of up to 11mm.

7.11. The entire Site is provided safe, dry access and egress during a 1% AEP plus 45% climate change flood event for vehicles and pedestrians. The modelled flood hazard along the western conveyance route is predicted to be 'very low' along most of its course.

7.12. Sensitivity testing of Manning's 'n' roughness values, critical storm duration, rainfall intensity, and structure blockage has been carried out. The results of the analysis show that the model is not overly sensitive to changes in these parameters and that the proposed development is appropriate.

7.13. The proposed residential development is compliant with national and local policy in terms of surface water flood risk and will not exacerbate flooding off Site. Therefore, there are no surface water flood risk issues to prevent the development from being implemented.

Appendices

Appendix A – Site visit photographs

Figure A.1 – Ditch along Chalkpit Lane (on left hand side of image)

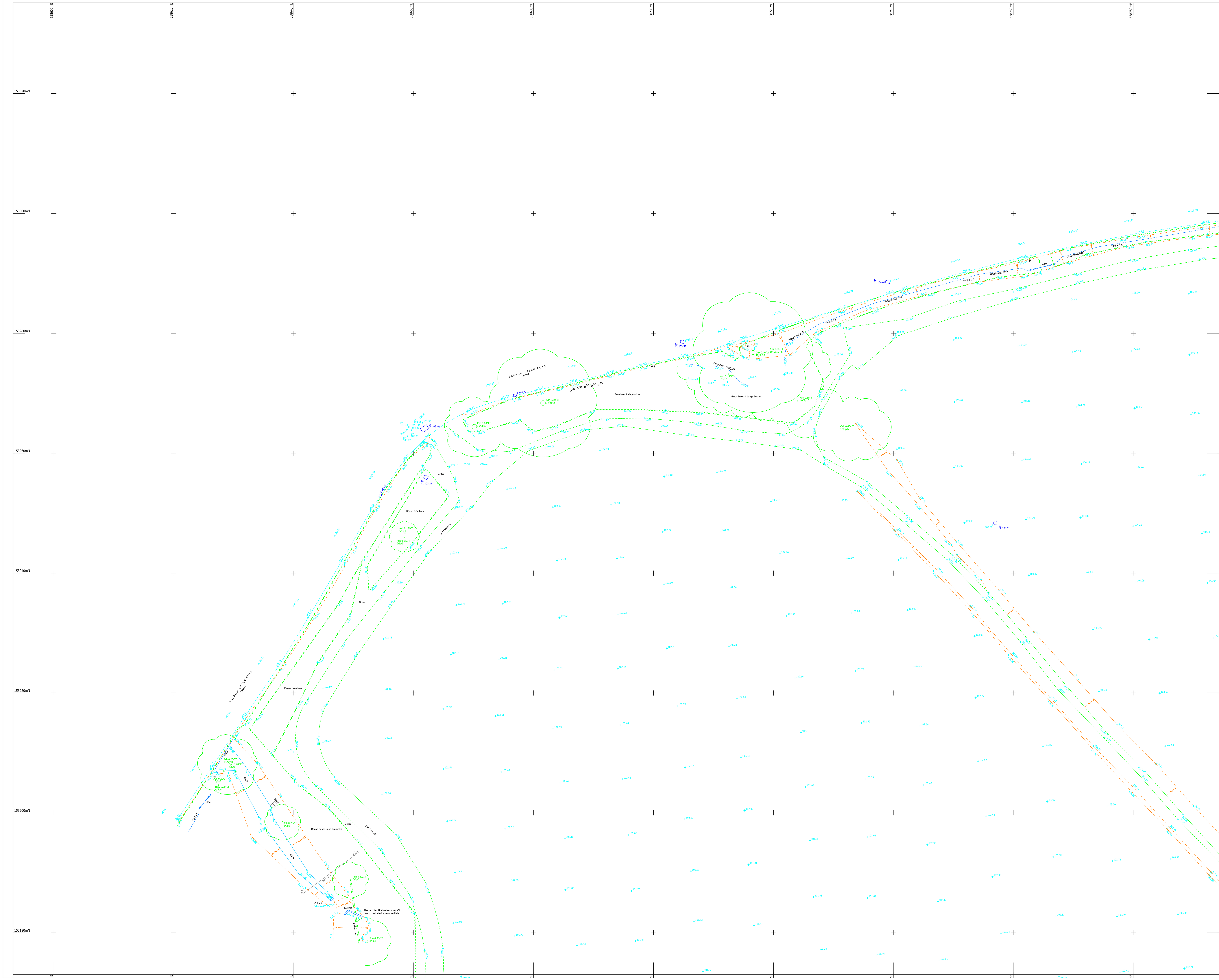
Figure A.2 – Two 225mm culverts identified at downstream end of ditch along Chalkpit Lane / Barrow Green Road

Figure A.3 – Upper reach of watercourse within Site boundary

Figure A.4 – Lower reach of watercourse within Site boundary

Figure A.5 – Culvert under railway line draining to watercourse within adjacent cemetery

Appendix B – Topographic Survey



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UNABLE TO LIFT	UTL
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SURFACE INFORMATION

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Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

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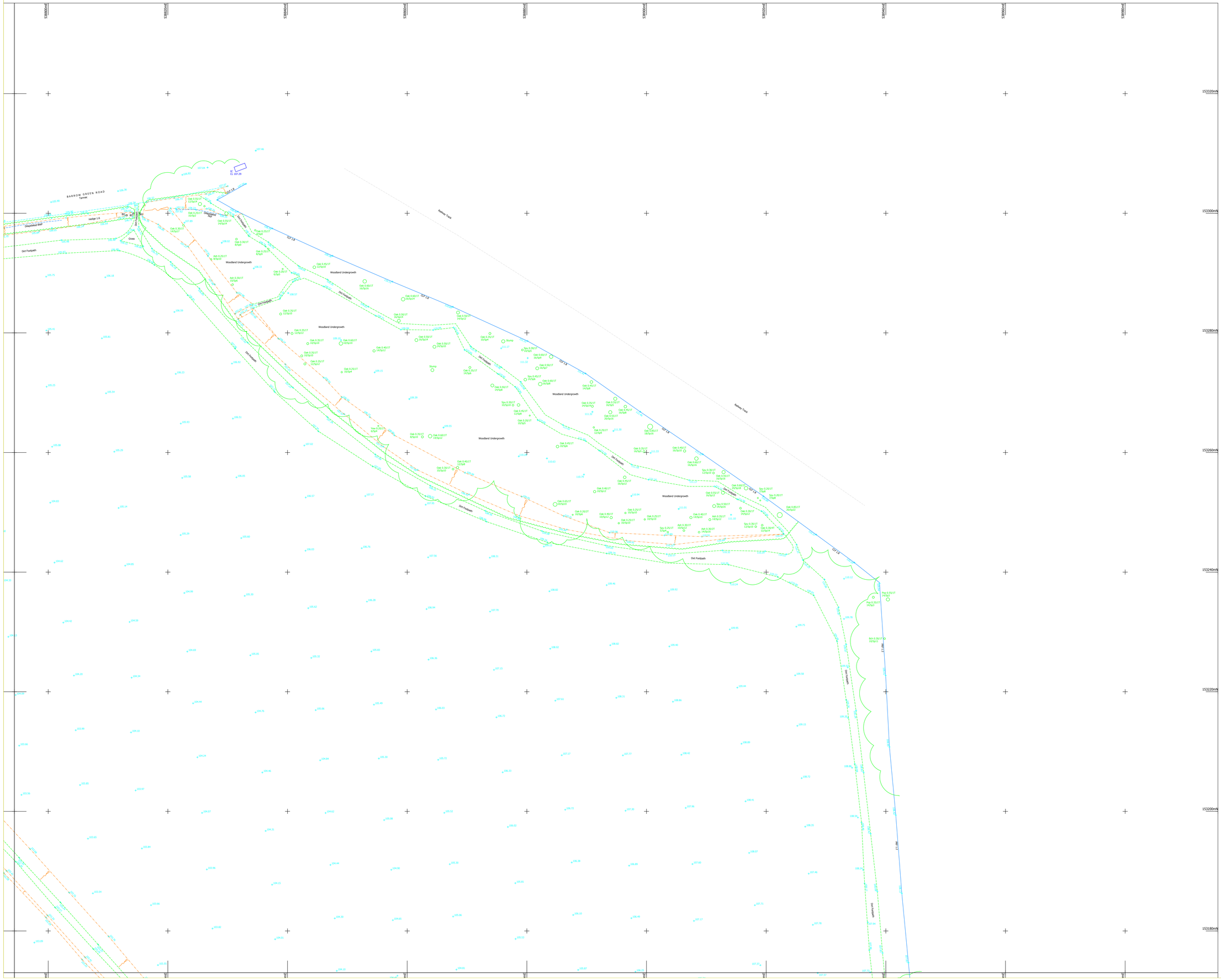
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/2699S1	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	1 of 7



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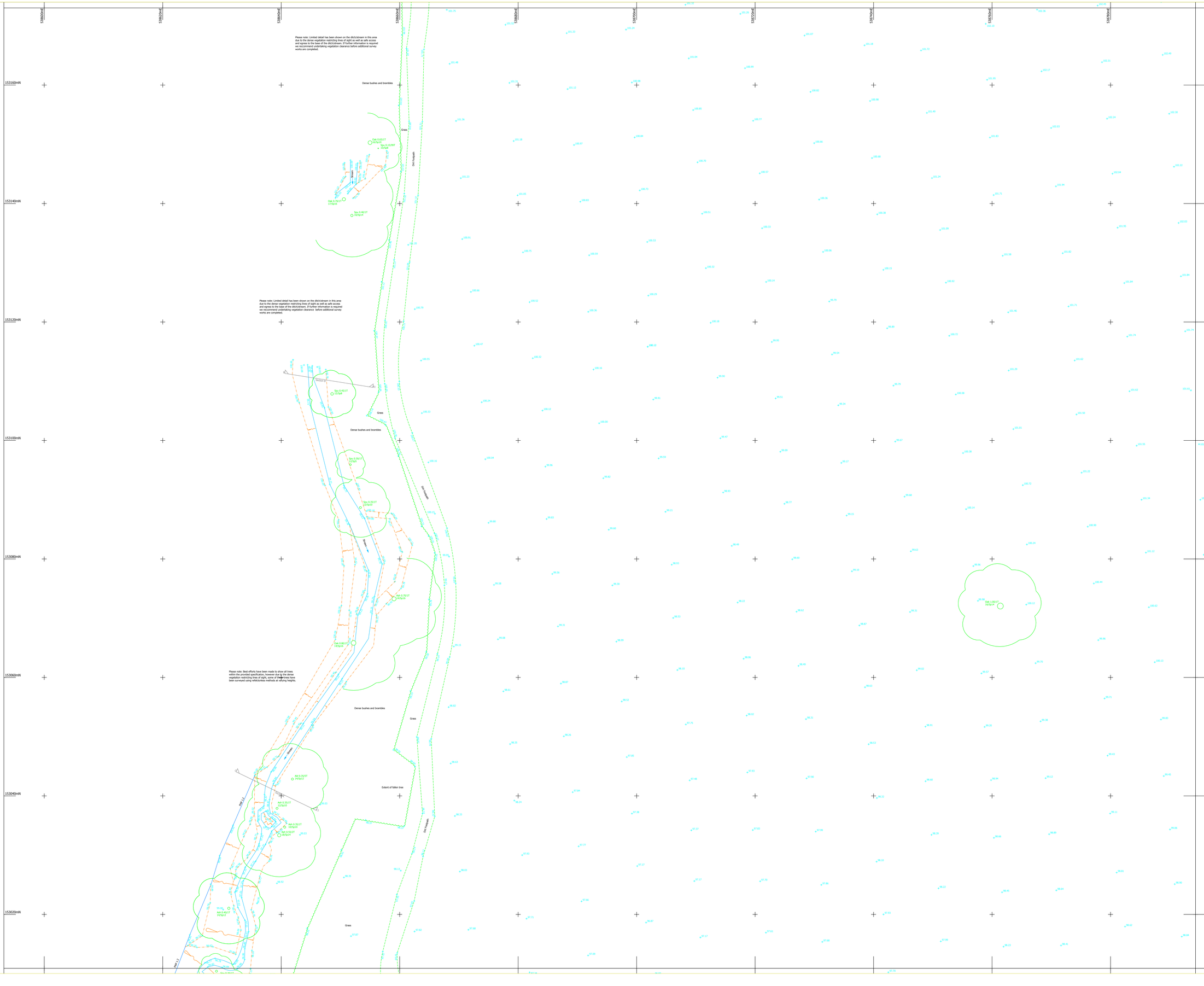
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	2 of 7



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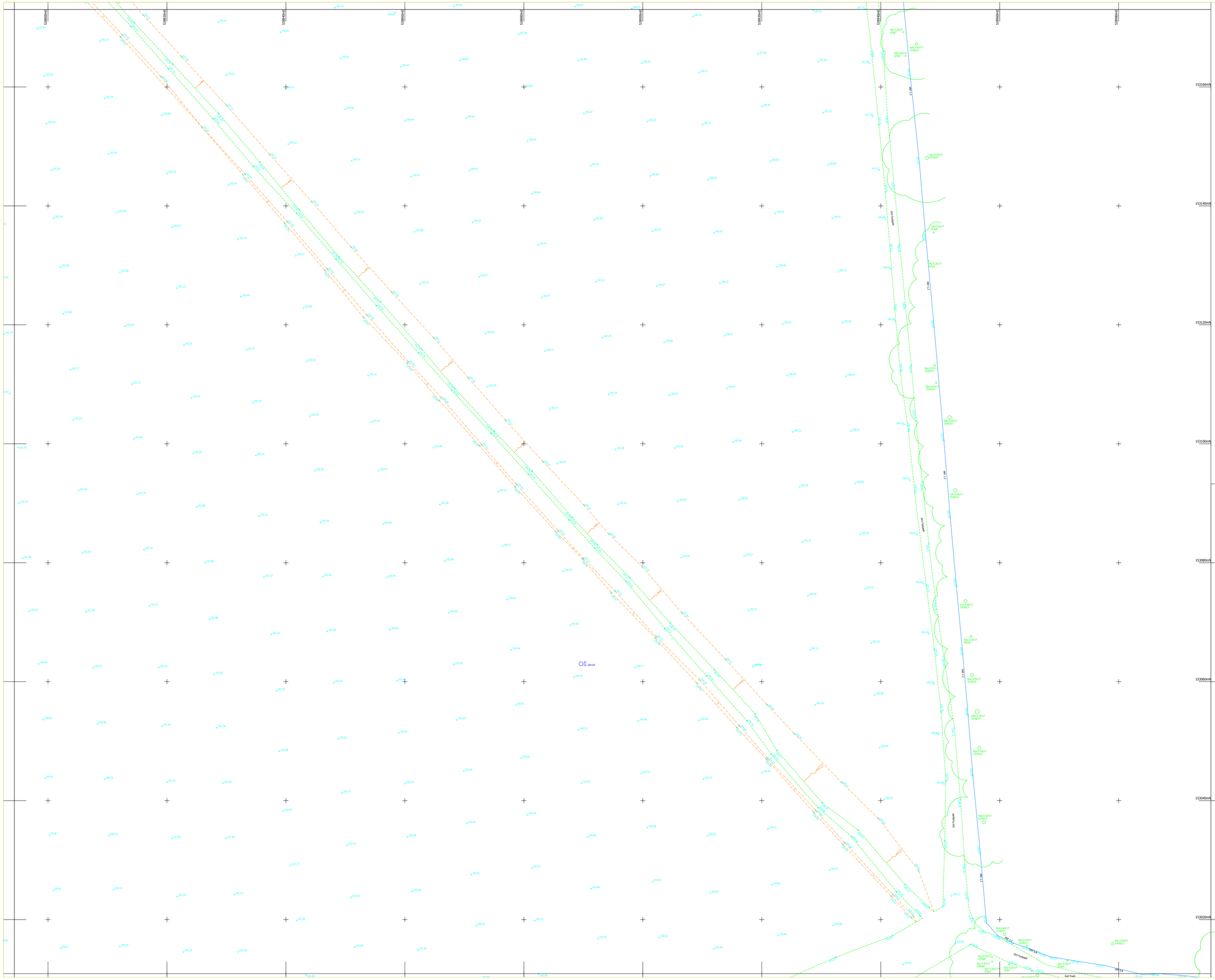

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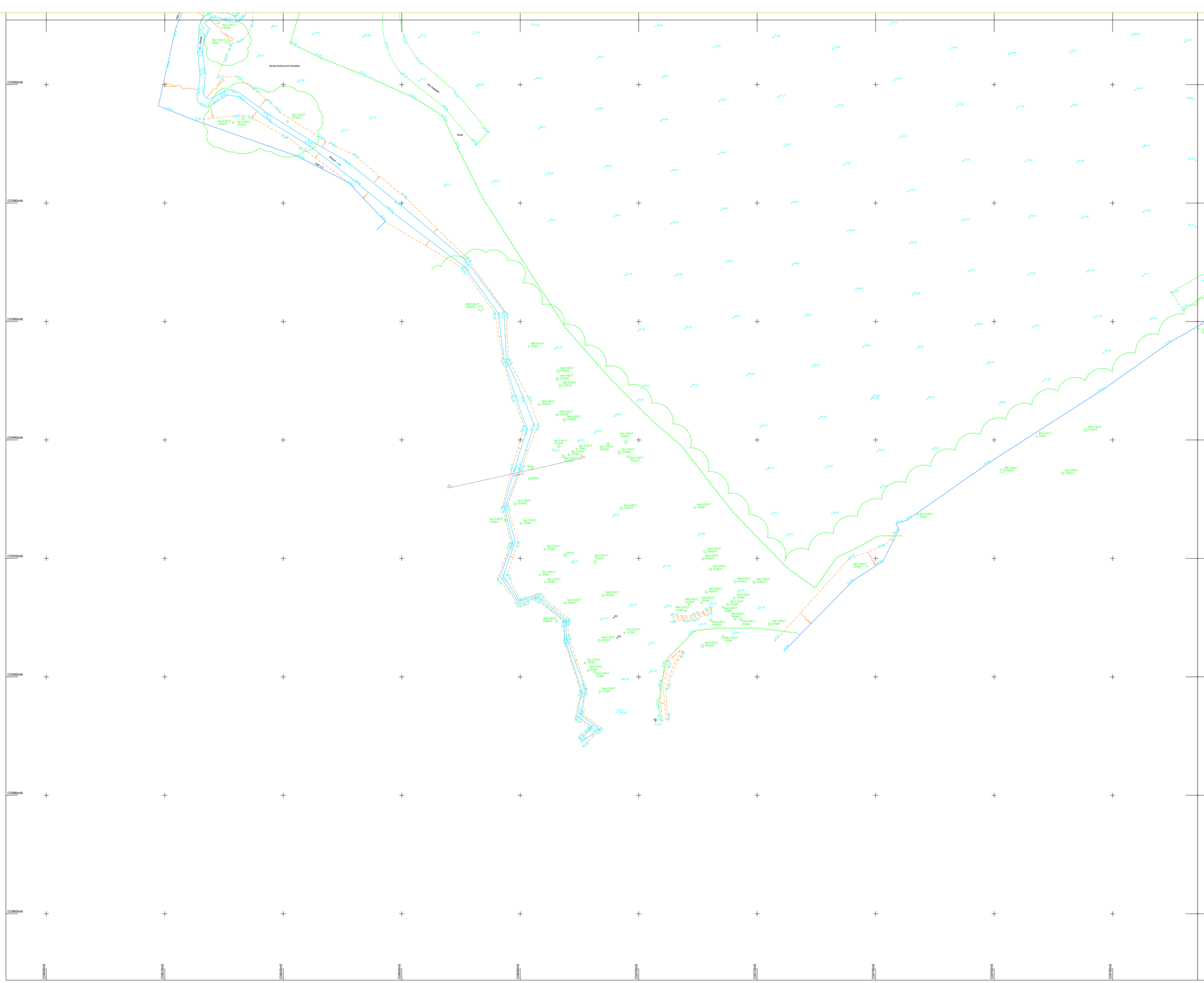

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BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
EARTHING ROD	ER	SERVICE MARKER POST	SMP
ELECTRICITY CABLE PIT	ELCP	SOIL VENT PIPE	SVP
ELECTRICITY CONTROL BOX	ECB	STOP COCK	SC
ELECTRICITY POLE	EP	STOP VALVE	SV
FIRE HYDRANT	FH	TELEGRAPH POLE	TP
INSPECTION COVER	IC	TELEPHONE CALL BOX	TCB
LAMP POST	LP	TRAFFIC SIGNAL	TS
LETTER BOX	LB	TRAFFIC SIGNALS IC	TSIC
LITTER BIN	BIN	WATER METER	WM
KERB OUTLET	KO	WATER TAP	Tap
NAME PLATE	NP		

Level Datum:
Levels are related to OSGB15 derived from the GPS network

Grid:
Grid is related to OSGB15 derived from the GPS network

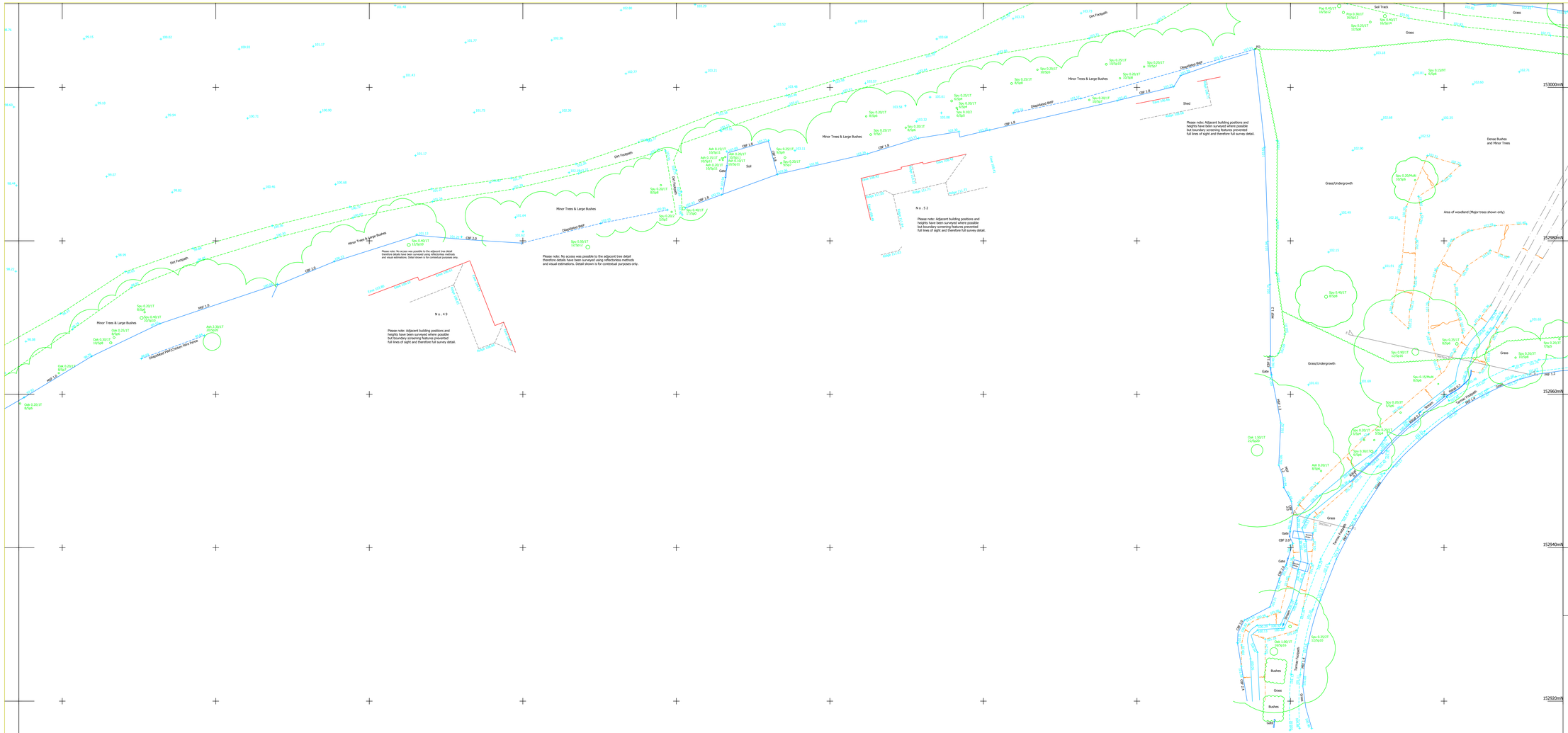
Northpoint:

ENCOMPASS SURVEYS

Encompass Surveys Ltd
Unit 2
Tahnean Business Centre
Duncan Road
Park Gate, Southampton
Hampshire SO31 7GA

Tel: 023 80692002 Email: info@encompass-surveys.co.uk
Fax: 023 80697125 Website: encompass-surveys.co.uk

Client:	Croudace Homes		
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	5 of 7



NOTES:

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Survey notes:
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Survey detail obtained and shown is relative to the plotting scale.

LEGEND

TREE SPECIES INFORMATION

ALDER	ALD	LOCUST	LOC
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAGNOLIA	MAG
BEECH	BCH	MAPLE	MPL
CEDAR	CED	OAK	OAK
CHERRY	CHY	PINE	PNE
CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SBI
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LBM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Bolt Size / No of Bolts
Tree Height / Tree Canopy Spread

FENCE INFORMATION

BARBED WIRE FENCE	BWF
CORRUGATED IRON FENCE	CIF
CLOSE BOARD FENCE	CBF
CHAIN LINK FENCE	CLF
CHESTNUT PALING	CPF
CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

LEVEL INFORMATION

BASEMENT LEVEL	BTL
BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
POOL WATER	PW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

CONCRETE	Conc
BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
RETAINING WALL	RtWall
TACTILE PAVING	Tac

FEATURE INFORMATION

BOLLARD	BD	NOTICE BOARD	NB
BRITISH TELECOM BOX	BTB	POST	P
BRITISH TELECOM IC	BTIC	RAIN WATER PIPE	RWP
BUS STOP	BS	RAISED FLOWERBED	RFB
CABLE TELEVISION BOX	CATB	ROAD SIGN	RS
CABLE TELEVISION IC	CATV	RODDING EYE	RE
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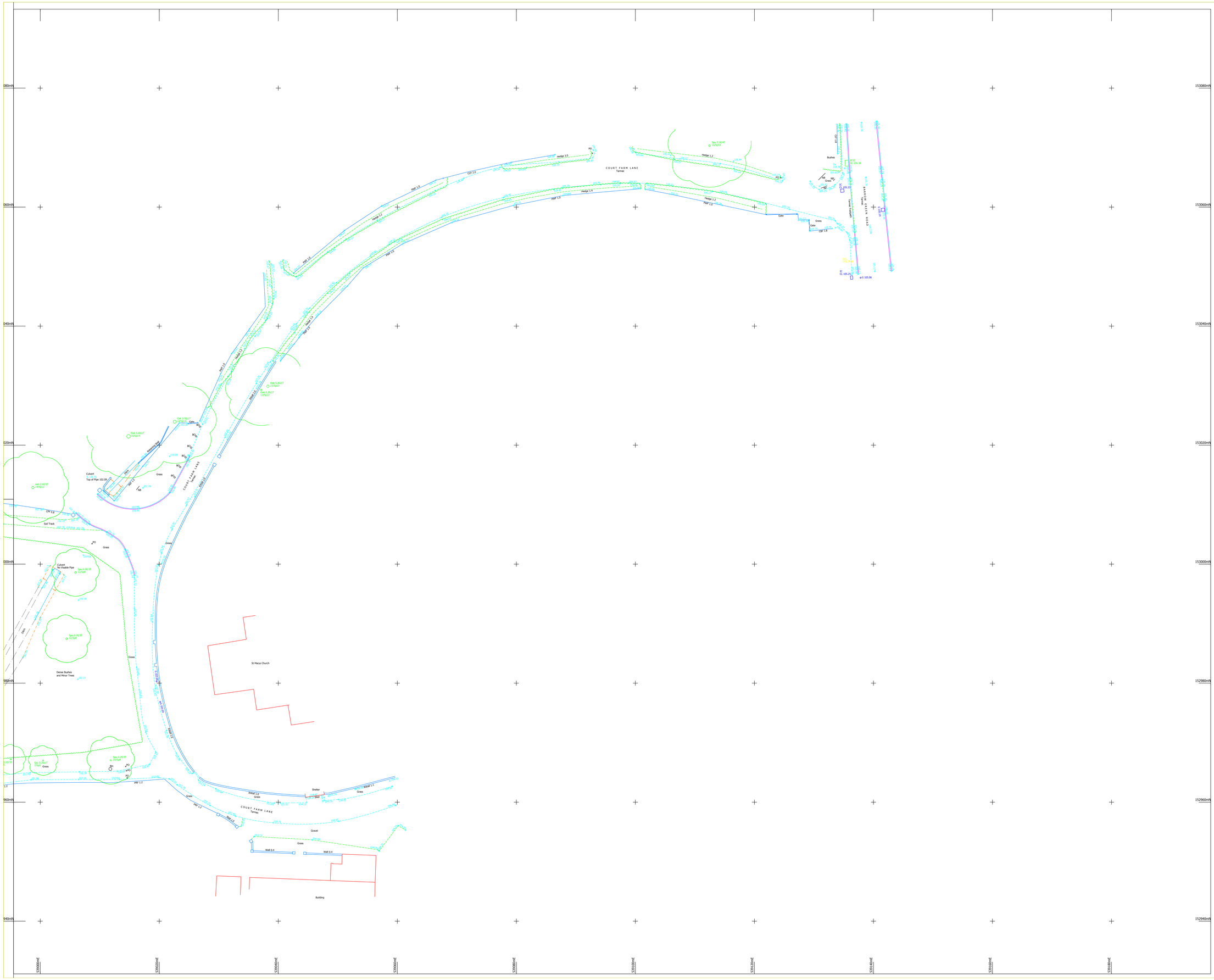
Client:	Croudace Homes		
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	6 of 7



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CYPRESS	CYP	POPLAR	POP
ELM	ELM	PRUNUS	PNS
FIR	FIR	RHODODENDRONS	RDN
FRUIT	FRT	ROWAN	RWN
HAWTHORN	HAW	SILVER BIRCH	SIB
HAZEL	HAZ	SORBUS	SOR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HRM	WALNUT	WNT
LABURNUM	LBM	WILLOW	WLW
LARCH	LAR	YEW	YEW
LIME	LIM	SPECIES UNKNOWN	SPU
		COPPICED	COP

TREE ANNOTATIONS: Tree Species / Tree Boll Size / No of Bolls
Tree Height / Tree Canopy Spread

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CRASH BARRIER	CBR
HANDRAIL	HDL
IRON RAILINGS	IRF
LARCH LAP FENCE	LLF
MISCELLANEOUS FENCE	MSF
PALISADE FENCE	PSF
PICKET FENCE	PKF
POST AND CHAIN FENCE	PCF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STOCK WIRE FENCE	SWF
TRELLIS FENCING	TLF

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BED LEVEL	BL
COVER LEVEL	CL
DAMP PROOF COURSE	DPC
FLOOR LEVEL	FL
INVERT LEVEL	IL
OUTFALL LEVEL	OL
THRESHOLD LEVEL	THL
POOL WATER	PW
SURFACE WATER	SW
UNABLE TO LIFT	UTL
WATER LEVEL	WL

SURFACE INFORMATION

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BRICK PAVERS	BP
FLOWERBED	FB
PAVING SLABS	PS
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TACTILE PAVING	Tac

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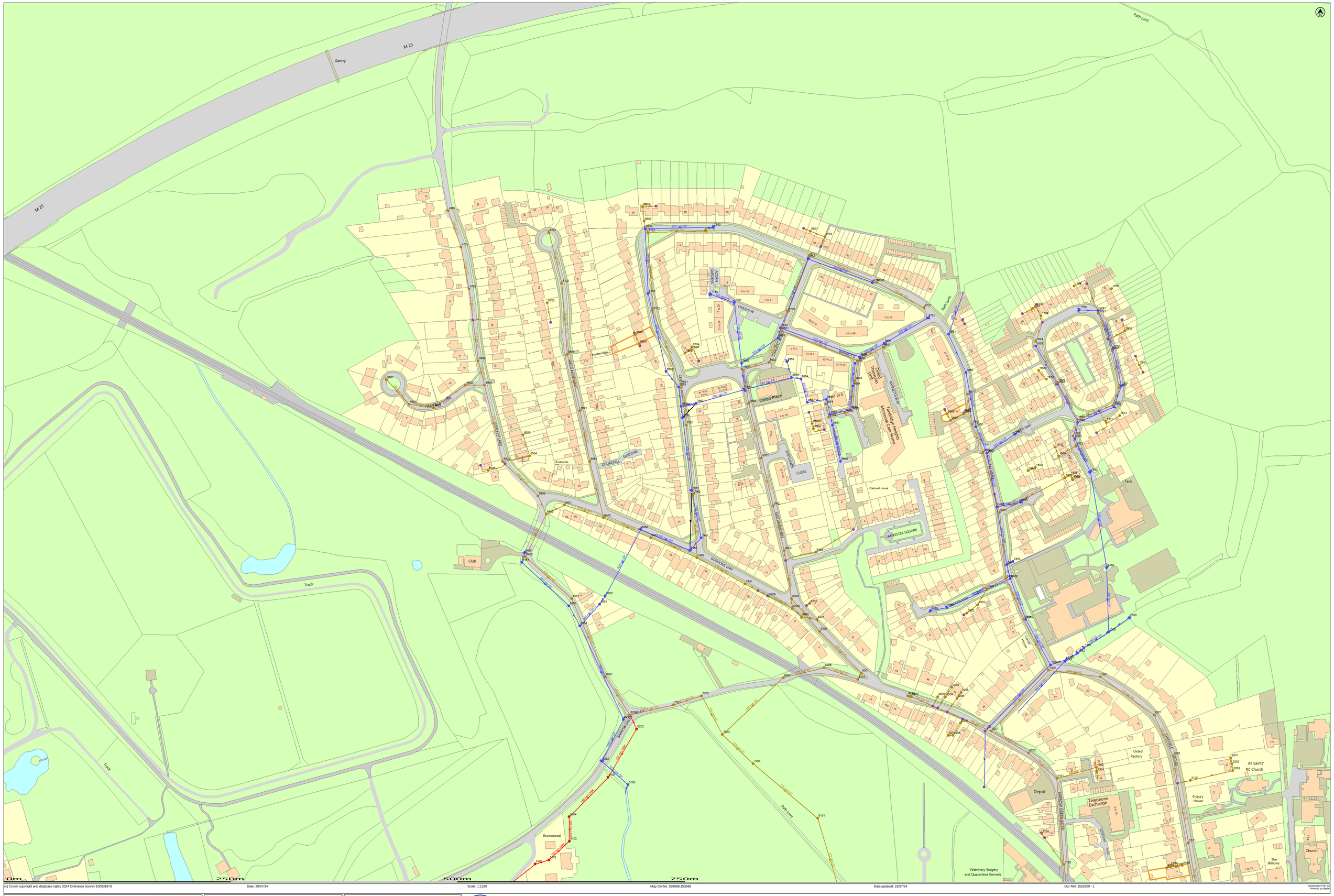
Client:	Croudace Homes		
Survey Location:	Stoneyfields Oxted RH8 9LF		
Survey type:	Topographical	Scale:	1:200@A0
Drawing ref:	ENC/220323/269951	Date:	March 2023
Drawn/QA:	BF/CH	Plot:	7 of 7

Appendix C – Southern Water Asset Mapping



Date: 29/07/24 | Scale: 1:1250 | Map Centre: 538698,153568 | Data updated: 23/07/24 | Our Ref: 1532209 - 1

Wastewater Plan A0
Powered by digital

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer | Combined Gravity Sewer | Culverted Water Course or Inland Rivers | Surface Water Gravity Sewer | Rising Main, Vacuum or Siphon

Combined Outfall | Foul Outfall | Surface Water Outfall | Surface Water Weir

Combined Pumping Station | Surface Water Pumping Station | Foul Pumping Station | Water Treatment Works | Section 104 Area | Building Over Agreement Area

Foul Manhole | Combined Manhole | Surface Water Manhole | Dual Entry Manhole, Association Overflow, Gulley Manhole or Surface Water Soakaway

javzon@ardent-ce.co.uk

Oxted

WATER for LIFE

from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5101	C	0.00	0.00	
5102	C	0.00	0.00	
5103	C	0.00	0.00	
5104	C	0.00	0.00	
6101	C	0.00	0.00	
6202	C	0.00	0.00	
0201	F	107.96	105.80	
0202	F	109.53	105.38	
0203	F	0.00	0.00	
0204	F	0.00	0.00	
0205	F	0.00	0.00	
0206	F	0.00	0.00	
0207	F	0.00	0.00	
0208	F	0.00	0.00	
0209	F	0.00	0.00	
0301	F	110.35	108.14	
0302	F	0.00	0.00	
0303	F	0.00	0.00	
0401	F	117.23	115.19	
0402	F	112.61	110.18	
0403	F	112.96	110.52	
0501	F	122.16	119.91	
0502	F	120.83	118.70	
0505	F	0.00	0.00	
0506	F	0.00	0.00	
0507	F	0.00	0.00	
0508	F	0.00	0.00	
0601	F	123.23	121.73	
1101	F	110.67	104.97	
1102	F	105.95	103.98	
1104	F	0.00	0.00	
1201	F	0.00	0.00	
1202	F	0.00	0.00	
1301	F	111.68	109.58	
1302	F	109.31	107.45	
1501	F	119.67	116.92	
1502	F	119.24	116.73	
1503	F	118.92	116.67	
1504	F	119.66	116.29	
1505	F	118.32	116.09	
1506	F	0.00	0.00	
1507	F	0.00	0.00	
1508	F	0.00	0.00	
1509	F	0.00	0.00	
1510	F	0.00	0.00	
1511	F	0.00	0.00	
1512	F	0.00	0.00	
1601	F	120.98	119.10	
1602	F	119.30	117.47	
1603	F	118.74	0.00	
1604	F	123.93	122.47	
1605	F	121.85	119.90	
1609	F	0.00	0.00	
1610	F	0.00	0.00	
1701	F	122.79	120.75	
1702	F	0.00	0.00	
1703	F	0.00	0.00	
1704	F	0.00	0.00	
1705	F	0.00	0.00	
1706	F	0.00	0.00	
2003	F	0.00	0.00	
2101	F	109.44	106.53	
2102	F	0.00	0.00	
2104	F	0.00	0.00	
2105	F	0.00	0.00	
2106	F	0.00	0.00	
2201	F	114.64	112.72	
2202	F	114.60	0.00	
2601	F	0.00	0.00	
2602	F	0.00	0.00	
3201	F	0.00	0.00	
3202	F	0.00	0.00	
3203	F	0.00	0.00	
3601	F	115.97	113.73	
4601	F	114.53	112.83	
4602	F	113.76	112.29	
4603	F	113.49	111.81	
4604	F	113.37	111.41	
4605	F	114.34	112.38	
4701	F	119.66	117.59	
4702	F	117.51	115.59	
4801	F	121.55	119.41	
5301	F	104.84	102.81	
5401	F	109.36	106.28	
5402	F	108.13	106.03	
5403	F	107.18	105.28	
5501	F	110.13	0.00	
5502	F	109.16	107.18	
5504	F	0.00	0.00	
5505	F	0.00	0.00	
5506	F	0.00	0.00	
5601	F	114.76	113.10	
5701	F	120.13	118.78	
5702	F	117.74	116.23	
5703	F	0.00	0.00	
6201	F	103.51	101.79	
6301	F	103.59	102.06	
6401	F	109.62	106.97	
6402	F	108.97	106.50	
6501	F	110.27	108.80	
6601	F	112.26	110.77	
6602	F	0.00	0.00	
6603	F	0.00	0.00	
6701	F	121.42	119.72	
6702	F	117.26	115.85	
6801	F	0.00	0.00	
6802	F	0.00	0.00	
7201	F	103.52	101.56	
7202	F	103.97	101.39	
7203	F	103.60	101.11	
7204	F	103.95	100.87	
7401	F	110.25	107.45	
7402	F	110.46	107.14	
7501	F	112.34	110.14	
7502	F	111.85	108.93	
7601	F	113.27	111.95	
7602	F	115.09	113.64	
7603	F	115.29	112.78	
7604	F	0.00	0.00	
7605	F	0.00	0.00	
7606	F	0.00	0.00	
7801	F	122.36	120.28	
8101	F	104.29	100.37	
8301	F	112.10	110.87	
8302	F	111.71	109.14	
8303	F	111.42	108.49	
8304	F	111.63	108.76	
8305	F	112.11	108.23	
8306	F	109.08	107.51	
8307	F	106.88	105.35	
8309	F	0.00	0.00	
8310	F	0.00	0.00	
8401	F	114.19	111.03	
8402	F	112.68	0.00	
8403	F	0.00	0.00	
8501	F	115.01	112.20	
8502	F	0.00	0.00	
8503	F	0.00	0.00	
8504	F	0.00	0.00	
8601	F	117.89	116.37	
8602	F	115.94	114.41	
8603	F	0.00	0.00	
8604	F	119.82	118.96	
8701	F	121.88	120.45	
8702	F	118.93	117.50	
8703	F	0.00	0.00	
8801	F	0.00	0.00	
9201	F	109.46	0.00	
9202	F	109.68	0.00	
9203	F	0.00	0.00	
9301	F	112.33	108.02	
9302	F	111.01	107.86	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
9601	F	122.00	120.07	
9602	F	120.33	118.03	
9603	F	120.20	118.78	
9604	F	120.35	118.40	
9701	F	124.76	123.34	
9702	F	123.17	121.42	
0350	S	110.31	108.58	
0351	S	113.70	112.16	
0450	S	117.39	115.53	
0451	S	113.39	111.24	
0452	S	112.46	110.22	
0453	S	113.82	112.58	
0550	S	122.09	120.16	
0551	S	121.11	119.53	
0552	S	120.77	118.86	
0553	S	117.37	116.13	
0650	S	124.08	122.37	
0651	S	125.22	0.00	
0652	S	0.00	0.00	
1350	S	110.37	109.12	
1351	S	0.00	0.00	
1352	S	109.47	108.56	
1353	S	109.65	108.30	
1354	S	109.33	107.82	
1355	S	109.67	108.48	
1450	S	112.95	112.12	
1550	S	119.53	116.90	
1551	S	119.21	116.88	
1552	S	117.75	116.76	
1650	S	121.03	119.43	
1651	S	119.24	117.92	
1652	S	118.69	117.63	
1653	S	123.74	0.00	
1654	S	121.74	119.09	
1750	S	123.55	121.89	
1751	S	122.86	121.17	
2350	S	0.00	0.00	
5350	S	0.00	0.00	
5450	S	107.25	105.48	
5451	S	0.00	0.00	
6150	S	102.64	100.19	
6251	S	103.38	101.32	
6252	S	103.55	100.62	
6350	S	0.00	0.00	
6351	S	0.00	0.00	
6352	S	104.70	0.00	
6450	S	109.16	107.29	
6650	S	0.00	0.00	
6750	S	118.00	116.47	
6850	S	121.68	119.87	
7450	S	110.21	108.35	
7451	S	110.58	108.64	
7550	S	112.38	110.78	
7551	S	111.87	0.00	
7650	S	115.42	113.90	
7651	S	115.14	113.24	
7652	S	112.79	0.00	
7653	S	113.19	111.32	
7654	S	112.76	111.24	
7750	S	118.82	117.35	
7751	S	118.73	116.65	
7850	S	122.40	120.39	
8550	S	118.97	117.56	
8551	S	119.04	117.20	
8552	S	118.50	116.90	
8650	S	118.02	116.16	
8651	S	117.34	115.58	
8652	S	117.18	115.63	
8653	S	0.00	0.00	
8654	S	117.28	116.39	
8656	S	118.50	116.81	
8657	S	118.00	116.60	
8658	S	120.20	118.14	
8751	S	121.85	120.02	
9350	S	114.17	112.44	
9651	S	122.10	120.17	
9652	S	120.40	118.10	
9653	S	120.40	118.87	
9654	S	120.39	118.38	
9750	S	123.07	121.54	
9751	S	124.90	123.53	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix D – 1% AEP plus climate change ReFH2 outputs

UK Design Flood Estimation

Generated on 27 November 2024 13:45:27 by jaxton
Printed from the ReFH2 Flood Modelling software package, version 4.1.8879.22310

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: F423-9362

Site name: FEH_Catchment_Descriptors_538600_152450_v5_0_1_Edit

Easting: 538600

Northing: 152450

Country: England, Wales or Northern Ireland

Catchment Area (km²): 2.28

Using plot scale calculations: No

Model: 2.3

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH22 (mm):	43.75	Total runoff (ML):	15.92
Total Rainfall (mm):	27.56	Total flow (ML):	40.71
Peak Rainfall (mm):	7.50	Peak flow (m³/s):	1.58

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH22)

Name	Value	User-defined?
Duration (hh:mm:ss)	02:15:00 [03:15:00]	Yes
Timestep (hh:mm:ss)	00:15:00	No
SCF (Seasonal correction factor)	0.66	No
ARF (Areal reduction factor)	0.96	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	83.47	No
Cmax (mm)	508.54	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	1.78	No
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0.05	No
BL (hr)	38.87	No
BR	2.43	No

Urbanisation parameters

Name	Value	User-defined?
Sewer capacity (m^3/s)	0	No
Exporting drained area (km^2)	0	No
Urban area (km^2)	0.63	No
Effective URBEXT2000	0.18	n/a
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	0.788	0.000	0.178	0.000	0.041	0.041
00:15:00	1.478	0.000	0.343	0.004	0.041	0.045
00:30:00	2.748	0.000	0.648	0.019	0.041	0.060
00:45:00	5.020	0.000	1.218	0.057	0.041	0.097
01:00:00	7.496	0.000	1.905	0.136	0.041	0.177
01:15:00	5.020	0.000	1.332	0.283	0.042	0.325
01:30:00	2.748	0.000	0.749	0.499	0.045	0.544
01:45:00	1.478	0.000	0.408	0.752	0.050	0.802
02:00:00	0.788	0.000	0.219	1.011	0.057	1.068
02:15:00	0.000	0.000	0.000	1.245	0.066	1.310
02:30:00	0.000	0.000	0.000	1.414	0.077	1.491
02:45:00	0.000	0.000	0.000	1.488	0.089	1.578
03:00:00	0.000	0.000	0.000	1.473	0.103	1.576
03:15:00	0.000	0.000	0.000	1.384	0.117	1.501
03:30:00	0.000	0.000	0.000	1.254	0.131	1.385
03:45:00	0.000	0.000	0.000	1.108	0.143	1.251
04:00:00	0.000	0.000	0.000	0.968	0.155	1.122
04:15:00	0.000	0.000	0.000	0.838	0.164	1.003
04:30:00	0.000	0.000	0.000	0.720	0.173	0.893
04:45:00	0.000	0.000	0.000	0.614	0.180	0.794
05:00:00	0.000	0.000	0.000	0.520	0.186	0.706
05:15:00	0.000	0.000	0.000	0.435	0.191	0.626
05:30:00	0.000	0.000	0.000	0.357	0.195	0.553
05:45:00	0.000	0.000	0.000	0.288	0.199	0.487
06:00:00	0.000	0.000	0.000	0.228	0.202	0.430
06:15:00	0.000	0.000	0.000	0.181	0.205	0.385
06:30:00	0.000	0.000	0.000	0.141	0.206	0.347
06:45:00	0.000	0.000	0.000	0.106	0.207	0.314
07:00:00	0.000	0.000	0.000	0.076	0.208	0.283
07:15:00	0.000	0.000	0.000	0.048	0.208	0.256
07:30:00	0.000	0.000	0.000	0.027	0.207	0.234
07:45:00	0.000	0.000	0.000	0.013	0.206	0.219
08:00:00	0.000	0.000	0.000	0.005	0.205	0.210
08:15:00	0.000	0.000	0.000	0.002	0.204	0.205

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
08:30:00	0.000	0.000	0.000	0.000	0.203	0.203
08:45:00	0.000	0.000	0.000	0.000	0.201	0.201
09:00:00	0.000	0.000	0.000	0.000	0.200	0.200
09:15:00	0.000	0.000	0.000	0.000	0.199	0.199
09:30:00	0.000	0.000	0.000	0.000	0.197	0.197
09:45:00	0.000	0.000	0.000	0.000	0.196	0.196
10:00:00	0.000	0.000	0.000	0.000	0.195	0.195
10:15:00	0.000	0.000	0.000	0.000	0.194	0.194
10:30:00	0.000	0.000	0.000	0.000	0.192	0.192
10:45:00	0.000	0.000	0.000	0.000	0.191	0.191
11:00:00	0.000	0.000	0.000	0.000	0.190	0.190
11:15:00	0.000	0.000	0.000	0.000	0.189	0.189
11:30:00	0.000	0.000	0.000	0.000	0.187	0.187
11:45:00	0.000	0.000	0.000	0.000	0.186	0.186
12:00:00	0.000	0.000	0.000	0.000	0.185	0.185
12:15:00	0.000	0.000	0.000	0.000	0.184	0.184
12:30:00	0.000	0.000	0.000	0.000	0.183	0.183
12:45:00	0.000	0.000	0.000	0.000	0.182	0.182
13:00:00	0.000	0.000	0.000	0.000	0.180	0.180
13:15:00	0.000	0.000	0.000	0.000	0.179	0.179
13:30:00	0.000	0.000	0.000	0.000	0.178	0.178
13:45:00	0.000	0.000	0.000	0.000	0.177	0.177
14:00:00	0.000	0.000	0.000	0.000	0.176	0.176
14:15:00	0.000	0.000	0.000	0.000	0.175	0.175
14:30:00	0.000	0.000	0.000	0.000	0.174	0.174
14:45:00	0.000	0.000	0.000	0.000	0.172	0.172
15:00:00	0.000	0.000	0.000	0.000	0.171	0.171
15:15:00	0.000	0.000	0.000	0.000	0.170	0.170
15:30:00	0.000	0.000	0.000	0.000	0.169	0.169
15:45:00	0.000	0.000	0.000	0.000	0.168	0.168
16:00:00	0.000	0.000	0.000	0.000	0.167	0.167
16:15:00	0.000	0.000	0.000	0.000	0.166	0.166
16:30:00	0.000	0.000	0.000	0.000	0.165	0.165
16:45:00	0.000	0.000	0.000	0.000	0.164	0.164
17:00:00	0.000	0.000	0.000	0.000	0.163	0.163

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
17:15:00	0.000	0.000	0.000	0.000	0.162	0.162
17:30:00	0.000	0.000	0.000	0.000	0.161	0.161
17:45:00	0.000	0.000	0.000	0.000	0.160	0.160
18:00:00	0.000	0.000	0.000	0.000	0.159	0.159
18:15:00	0.000	0.000	0.000	0.000	0.158	0.158
18:30:00	0.000	0.000	0.000	0.000	0.157	0.157
18:45:00	0.000	0.000	0.000	0.000	0.156	0.156
19:00:00	0.000	0.000	0.000	0.000	0.155	0.155
19:15:00	0.000	0.000	0.000	0.000	0.154	0.154
19:30:00	0.000	0.000	0.000	0.000	0.153	0.153
19:45:00	0.000	0.000	0.000	0.000	0.152	0.152
20:00:00	0.000	0.000	0.000	0.000	0.151	0.151
20:15:00	0.000	0.000	0.000	0.000	0.150	0.150
20:30:00	0.000	0.000	0.000	0.000	0.149	0.149
20:45:00	0.000	0.000	0.000	0.000	0.148	0.148
21:00:00	0.000	0.000	0.000	0.000	0.147	0.147
21:15:00	0.000	0.000	0.000	0.000	0.146	0.146
21:30:00	0.000	0.000	0.000	0.000	0.145	0.145
21:45:00	0.000	0.000	0.000	0.000	0.144	0.144
22:00:00	0.000	0.000	0.000	0.000	0.143	0.143
22:15:00	0.000	0.000	0.000	0.000	0.142	0.142
22:30:00	0.000	0.000	0.000	0.000	0.141	0.141
22:45:00	0.000	0.000	0.000	0.000	0.140	0.140
23:00:00	0.000	0.000	0.000	0.000	0.139	0.139
23:15:00	0.000	0.000	0.000	0.000	0.139	0.139
23:30:00	0.000	0.000	0.000	0.000	0.138	0.138
23:45:00	0.000	0.000	0.000	0.000	0.137	0.137
24:00:00	0.000	0.000	0.000	0.000	0.136	0.136
24:15:00	0.000	0.000	0.000	0.000	0.135	0.135
24:30:00	0.000	0.000	0.000	0.000	0.134	0.134
24:45:00	0.000	0.000	0.000	0.000	0.133	0.133
25:00:00	0.000	0.000	0.000	0.000	0.132	0.132
25:15:00	0.000	0.000	0.000	0.000	0.132	0.132
25:30:00	0.000	0.000	0.000	0.000	0.131	0.131
25:45:00	0.000	0.000	0.000	0.000	0.130	0.130

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
26:00:00	0.000	0.000	0.000	0.000	0.129	0.129
26:15:00	0.000	0.000	0.000	0.000	0.128	0.128
26:30:00	0.000	0.000	0.000	0.000	0.127	0.127
26:45:00	0.000	0.000	0.000	0.000	0.127	0.127
27:00:00	0.000	0.000	0.000	0.000	0.126	0.126
27:15:00	0.000	0.000	0.000	0.000	0.125	0.125
27:30:00	0.000	0.000	0.000	0.000	0.124	0.124
27:45:00	0.000	0.000	0.000	0.000	0.123	0.123
28:00:00	0.000	0.000	0.000	0.000	0.123	0.123
28:15:00	0.000	0.000	0.000	0.000	0.122	0.122
28:30:00	0.000	0.000	0.000	0.000	0.121	0.121
28:45:00	0.000	0.000	0.000	0.000	0.120	0.120
29:00:00	0.000	0.000	0.000	0.000	0.120	0.120
29:15:00	0.000	0.000	0.000	0.000	0.119	0.119
29:30:00	0.000	0.000	0.000	0.000	0.118	0.118
29:45:00	0.000	0.000	0.000	0.000	0.117	0.117
30:00:00	0.000	0.000	0.000	0.000	0.116	0.116
30:15:00	0.000	0.000	0.000	0.000	0.116	0.116
30:30:00	0.000	0.000	0.000	0.000	0.115	0.115
30:45:00	0.000	0.000	0.000	0.000	0.114	0.114
31:00:00	0.000	0.000	0.000	0.000	0.114	0.114
31:15:00	0.000	0.000	0.000	0.000	0.113	0.113
31:30:00	0.000	0.000	0.000	0.000	0.112	0.112
31:45:00	0.000	0.000	0.000	0.000	0.111	0.111
32:00:00	0.000	0.000	0.000	0.000	0.111	0.111
32:15:00	0.000	0.000	0.000	0.000	0.110	0.110
32:30:00	0.000	0.000	0.000	0.000	0.109	0.109
32:45:00	0.000	0.000	0.000	0.000	0.109	0.109
33:00:00	0.000	0.000	0.000	0.000	0.108	0.108
33:15:00	0.000	0.000	0.000	0.000	0.107	0.107
33:30:00	0.000	0.000	0.000	0.000	0.106	0.106
33:45:00	0.000	0.000	0.000	0.000	0.106	0.106
34:00:00	0.000	0.000	0.000	0.000	0.105	0.105
34:15:00	0.000	0.000	0.000	0.000	0.104	0.104
34:30:00	0.000	0.000	0.000	0.000	0.104	0.104

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
34:45:00	0.000	0.000	0.000	0.000	0.103	0.103
35:00:00	0.000	0.000	0.000	0.000	0.102	0.102
35:15:00	0.000	0.000	0.000	0.000	0.102	0.102
35:30:00	0.000	0.000	0.000	0.000	0.101	0.101
35:45:00	0.000	0.000	0.000	0.000	0.100	0.100
36:00:00	0.000	0.000	0.000	0.000	0.100	0.100
36:15:00	0.000	0.000	0.000	0.000	0.099	0.099
36:30:00	0.000	0.000	0.000	0.000	0.099	0.099
36:45:00	0.000	0.000	0.000	0.000	0.098	0.098
37:00:00	0.000	0.000	0.000	0.000	0.097	0.097
37:15:00	0.000	0.000	0.000	0.000	0.097	0.097
37:30:00	0.000	0.000	0.000	0.000	0.096	0.096
37:45:00	0.000	0.000	0.000	0.000	0.095	0.095
38:00:00	0.000	0.000	0.000	0.000	0.095	0.095
38:15:00	0.000	0.000	0.000	0.000	0.094	0.094
38:30:00	0.000	0.000	0.000	0.000	0.094	0.094
38:45:00	0.000	0.000	0.000	0.000	0.093	0.093
39:00:00	0.000	0.000	0.000	0.000	0.092	0.092
39:15:00	0.000	0.000	0.000	0.000	0.092	0.092
39:30:00	0.000	0.000	0.000	0.000	0.091	0.091
39:45:00	0.000	0.000	0.000	0.000	0.091	0.091
40:00:00	0.000	0.000	0.000	0.000	0.090	0.090
40:15:00	0.000	0.000	0.000	0.000	0.089	0.089
40:30:00	0.000	0.000	0.000	0.000	0.089	0.089
40:45:00	0.000	0.000	0.000	0.000	0.088	0.088
41:00:00	0.000	0.000	0.000	0.000	0.088	0.088
41:15:00	0.000	0.000	0.000	0.000	0.087	0.087
41:30:00	0.000	0.000	0.000	0.000	0.087	0.087
41:45:00	0.000	0.000	0.000	0.000	0.086	0.086
42:00:00	0.000	0.000	0.000	0.000	0.086	0.086
42:15:00	0.000	0.000	0.000	0.000	0.085	0.085
42:30:00	0.000	0.000	0.000	0.000	0.084	0.084
42:45:00	0.000	0.000	0.000	0.000	0.084	0.084
43:00:00	0.000	0.000	0.000	0.000	0.083	0.083
43:15:00	0.000	0.000	0.000	0.000	0.083	0.083

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
43:30:00	0.000	0.000	0.000	0.000	0.082	0.082
43:45:00	0.000	0.000	0.000	0.000	0.082	0.082
44:00:00	0.000	0.000	0.000	0.000	0.081	0.081
44:15:00	0.000	0.000	0.000	0.000	0.081	0.081
44:30:00	0.000	0.000	0.000	0.000	0.080	0.080
44:45:00	0.000	0.000	0.000	0.000	0.080	0.080
45:00:00	0.000	0.000	0.000	0.000	0.079	0.079
45:15:00	0.000	0.000	0.000	0.000	0.079	0.079
45:30:00	0.000	0.000	0.000	0.000	0.078	0.078
45:45:00	0.000	0.000	0.000	0.000	0.078	0.078
46:00:00	0.000	0.000	0.000	0.000	0.077	0.077
46:15:00	0.000	0.000	0.000	0.000	0.077	0.077
46:30:00	0.000	0.000	0.000	0.000	0.076	0.076
46:45:00	0.000	0.000	0.000	0.000	0.076	0.076
47:00:00	0.000	0.000	0.000	0.000	0.075	0.075
47:15:00	0.000	0.000	0.000	0.000	0.075	0.075
47:30:00	0.000	0.000	0.000	0.000	0.074	0.074
47:45:00	0.000	0.000	0.000	0.000	0.074	0.074
48:00:00	0.000	0.000	0.000	0.000	0.073	0.073
48:15:00	0.000	0.000	0.000	0.000	0.073	0.073
48:30:00	0.000	0.000	0.000	0.000	0.072	0.072
48:45:00	0.000	0.000	0.000	0.000	0.072	0.072
49:00:00	0.000	0.000	0.000	0.000	0.071	0.071
49:15:00	0.000	0.000	0.000	0.000	0.071	0.071
49:30:00	0.000	0.000	0.000	0.000	0.071	0.071
49:45:00	0.000	0.000	0.000	0.000	0.070	0.070
50:00:00	0.000	0.000	0.000	0.000	0.070	0.070
50:15:00	0.000	0.000	0.000	0.000	0.069	0.069
50:30:00	0.000	0.000	0.000	0.000	0.069	0.069
50:45:00	0.000	0.000	0.000	0.000	0.068	0.068
51:00:00	0.000	0.000	0.000	0.000	0.068	0.068
51:15:00	0.000	0.000	0.000	0.000	0.067	0.067
51:30:00	0.000	0.000	0.000	0.000	0.067	0.067
51:45:00	0.000	0.000	0.000	0.000	0.067	0.067
52:00:00	0.000	0.000	0.000	0.000	0.066	0.066

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
52:15:00	0.000	0.000	0.000	0.000	0.066	0.066
52:30:00	0.000	0.000	0.000	0.000	0.065	0.065
52:45:00	0.000	0.000	0.000	0.000	0.065	0.065
53:00:00	0.000	0.000	0.000	0.000	0.064	0.064
53:15:00	0.000	0.000	0.000	0.000	0.064	0.064
53:30:00	0.000	0.000	0.000	0.000	0.064	0.064
53:45:00	0.000	0.000	0.000	0.000	0.063	0.063
54:00:00	0.000	0.000	0.000	0.000	0.063	0.063
54:15:00	0.000	0.000	0.000	0.000	0.062	0.062
54:30:00	0.000	0.000	0.000	0.000	0.062	0.062
54:45:00	0.000	0.000	0.000	0.000	0.062	0.062
55:00:00	0.000	0.000	0.000	0.000	0.061	0.061
55:15:00	0.000	0.000	0.000	0.000	0.061	0.061
55:30:00	0.000	0.000	0.000	0.000	0.060	0.060
55:45:00	0.000	0.000	0.000	0.000	0.060	0.060
56:00:00	0.000	0.000	0.000	0.000	0.060	0.060
56:15:00	0.000	0.000	0.000	0.000	0.059	0.059
56:30:00	0.000	0.000	0.000	0.000	0.059	0.059
56:45:00	0.000	0.000	0.000	0.000	0.059	0.059
57:00:00	0.000	0.000	0.000	0.000	0.058	0.058
57:15:00	0.000	0.000	0.000	0.000	0.058	0.058
57:30:00	0.000	0.000	0.000	0.000	0.057	0.057
57:45:00	0.000	0.000	0.000	0.000	0.057	0.057
58:00:00	0.000	0.000	0.000	0.000	0.057	0.057
58:15:00	0.000	0.000	0.000	0.000	0.056	0.056
58:30:00	0.000	0.000	0.000	0.000	0.056	0.056

Appendix

Catchment descriptors

Name	Value	User-defined value used?
Area (km²)	2.28	No
ALTBAR	140	No
ASPBAR	184	No
ASPVAR	0.69	No
BFIHOST	0.62	No
BFIHOST19	0.59	No
DPLBAR (km)	1.44	No
DPSBAR (mkm-¹)	95.1	No
FARL	1	No
LDP	2.67	No
PROPWET	0.36	No
RMED1H	11.2	No
RMED1D	33.5	No
RMED2D	44.8	No
SAAR (mm)	795	No
SAAR4170 (mm)	793	No
SPRHOST	30.49	No
URBEXT2000	0.18	No
URBEXT1990	0.07	No
URBCONC	0.79	No
URBLOC	0.73	No
DDF parameter C	-0.03	No
DDF parameter D1	0.36	No
DDF parameter D2	0.43	No
DDF parameter D3	0.27	No
DDF parameter E	0.32	No
DDF parameter F	2.44	No
DDF parameter C (1km grid value)	-0.03	No
DDF parameter D1 (1km grid value)	0.37	No
DDF parameter D2 (1km grid value)	0.44	No
DDF parameter D3 (1km grid value)	0.28	No
DDF parameter E (1km grid value)	0.32	No
DDF parameter F (1km grid value)	2.43	No

Appendix E – Sensitivity Analysis

A. It is standard hydraulic modelling practice to undertake a sensitivity analysis of key model parameters to consider any uncertainty attached to the adopted values and understand how sensitive the model is to changes in these parameters.

B. In the absence of any gauged data / recorded flood events / observable historic information, Ardent have undertaken a sensitivity test of key parameters in order to improve confidence in the model outputs and to ensure the model is robust to changes in these parameters. All sensitivity runs have been undertaken on the 1% AEP plus 45% climate change event.

C. Ardent have undertaken a sensitivity analysis on the following parameters for the post development scenario:

- Manning's 'n' roughness values +/- 20%;
- Rainfall Intensity; and
- Blockage analysis.

Manning's 'n' roughness

D. Manning's 'n' roughness values have been adjusted by +/- 20% in the 1D and 2D domains during post-development scenario. The peak modelled extents from the sensitivity testing are shown in **Figure E.1.**, with peak depths at the result points shown in **Figure E.1** presented in **Table E.1**.

Table E.1: Roughness sensitivity peak depths at points shown in Figure E.1

	+20% 'n'	1% AEP plus 45% CC	-20% 'n'
Point	Depth (m)	Depth (m)	Depth (m)
1	0.27	0.26	0.27
2	0.13	0.13	0.14
3	0.08	0.08	0.09
4	0.10	0.11	0.12
5	0.14	0.15	0.17
6	0.19	0.21	0.22

Figure E.1: Roughness sensitivity extents – 1% AEP plus 45% climate change

E. The results show the model has a negligible sensitivity to the roughness values applied to the model domain, with only minor changes in the peak flood extents and negligible differences in peak flood depths (<+/- up to 20mm) at key locations across the Site.

Rainfall intensity

F. The sensitivity to the rainfall intensity applied to the model have been assessed by increasing the rainfall profiles applied to rural and urban areas by 20%. Peak modelled extents in the sensitivity scenario are shown in **Figure E.2** with peak depths at the points shown in **Figure E.2** presented in **Table E.2**.

Table E.2 Rainfall Intensity sensitivity peak depths at points shown in Figure E.2

	1% AEP plus 45% CC	Rainfall sensitivity
Point	Depth (m)	Depth (m)
1	0.26	0.30
2	0.13	0.17
3	0.08	0.12
4	0.11	0.15
5	0.15	0.20
6	0.21	0.25

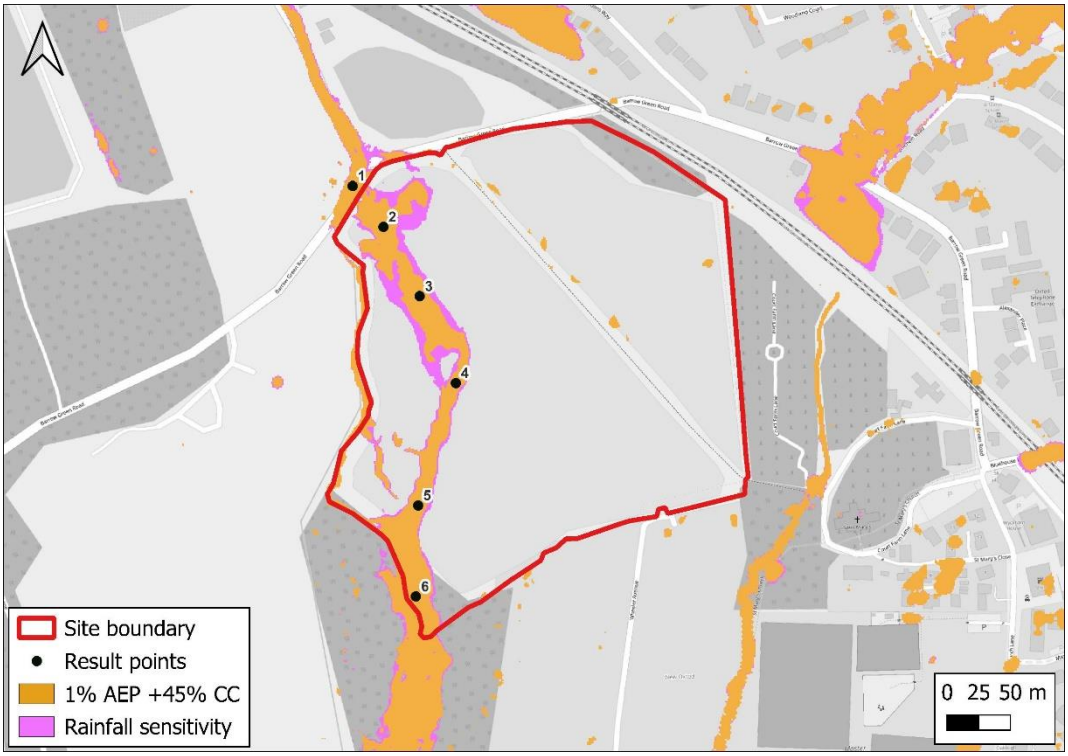


Figure E.2: Rainfall intensity sensitivity extents – 1% AEP plus 45% climate change

G. The results show the model has a low sensitivity to the rainfall intensity applied within the model as the higher volume of flows conveyed along the flow path only results in a slight increase in peak depth of 40-50mm within the Site boundary. The model therefore has a low sensitivity to the rainfall applied and associated losses.

Blockage Analysis

H. Blockage analysis has undertaken on the 225mm culvert linking the ditch north of the Site to the surface water drainage network. A 90% blockage was applied for the duration of the model run. Peak modelled extents in the sensitivity scenario are shown in **Figure E.3** with peak depths at the points shown in **Figure E.3** presented in **Table E.3**.

Table B.3 Blockage sensitivity peak depths at points shown in Figure E.3

	1% AEP plus 45% CC	Blockage Scenario
Point	Depth (m)	Depth (m)
1	0.26	0.28
2	0.13	0.14
3	0.08	0.09
4	0.11	0.12
5	0.15	0.16
6	0.21	0.21

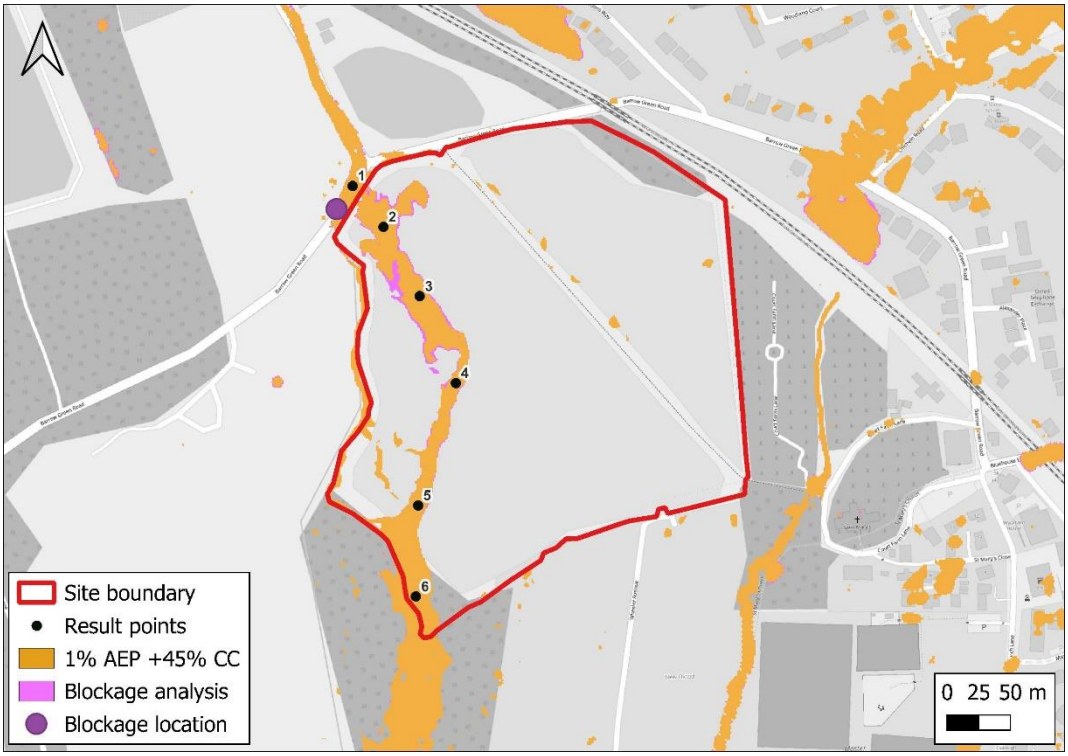


Figure E.3: Blockage sensitivity extents – 1% AEP plus 45% climate change

I. The blockage sensitivity analysis shows that the modelled blockage only has a minor impact on peak depths within the Site boundary, with increases of 10-20mm. This is due to the culvert being surcharged for the majority of the simulation during the baseline scenario. As a result, the residual risk of blockage is low. Additionally, assumptions made regarding the representation of the culvert are shown not to have a notable impact on the results at the Site.

Sensitivity test conclusions

J. Ardent has carried out a range of sensitivity tests on key parameters for the hydraulic model in order to test the validity of the model outputs and ensure that the proposed mitigation measures are appropriate, and that the proposed residential development can be made safe for the duration of its lifetime. The review of the sensitivity test outlined above suggests that the adopted model parameters are appropriate and that the proposed mitigation scheme is appropriate. The maximum uncertainty associated with the model outputs is approximately +/-50mm.

Appendix F – Site Masterplan


N
Sub Sta
LB
Grave Yard
GP
Pond
Ordnance Survey, (c) Crown Copyright 2022. All rights reserved. Licence number 100022432
0 m 10 m 20 m 30 m 40 m 50 m 100 m
Scale
croudacehomes
Omega Architects
The Front Barn, 124 Manor Road North, Thames Ditton, KT7 0BH
T: 01372 470 313 W: www.omega-architects.co.uk
Client: Croudace Homes Group
Project: Land South of Barrow Green Road, Oxted
Drawing Title: Illustrative Masterplan
Scale: 1:500 @ A0
Revision Drawn Check Date
Project No' 3129
Class C
Dwg No' 1005
Status PL
Rev A
CLASS: C - COLOURED, A - BLACK & WHITE
STATUS: SK - SKETCH, PR - PRELIMINARY, PL - PLANNING, WD - WORKING DRAWING
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Groundwater Monitoring Report	
SITE ADDRESS	Stoneyfields, Oxted, RH8 0NN
CLIENT	Motion Ltd
REPORT REFERENCE	GWPR6338/GMR/January 2025. The conditions and limitations of this groundwater monitoring report can be viewed within Appendix A. A technical glossary has also been provided within Appendix B.
SCOPE OF WORKS	The investigation was to be undertaken to provide the installation of groundwater monitoring wells, manual groundwater monitoring and the installation of dataloggers within 2 wells across a 4 week period. This was to formalise the drainage design. The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.
SITE DETAILS	The site comprised an irregular shaped plot of land situated to the north of Barrow Green Road. The site was located within Oxted, a town within the Tandridge District of Surrey. A site location plan has been provided within Figure 1. The site comprised an undeveloped field. An aerial view of the site provided in Figure 2.
SITE WORKS AND ENCOUNTERED GROUND CONDITIONS	Site works were undertaken on the 3rd December 2024 and comprised the drilling of 4No. windowless sampler boreholes (WS1 – WS8). The trial hole logs can be seen within Appendix C. The trial hole location plan can be seen in Figure 4. Combined groundwater and ground-gas monitoring standpipes were installed within each of the boreholes, summarised in the following table.

Summary of Installations

Trial Hole	Type of Installation	Depth of Installation (m bgl)	Thickness of slotted piping with gravel filter pack (m)	Depth of plain piping with bentonite seal (m bgl)	Response Zone (m bgl)	Piping internal diameter (mm)
WS1	Standpipe	3.00	2.00	1.00	1.00 – 3.00	50
WS2	Standpipe	2.20	1.20	1.00	1.00-2.20	50
WS3	Standpipe	1.20	0.70	0.30	0.30-1.00	50
WS4	Standpipe	2.20	1.20	1.00	1.00-2.20	50
WS5	Standpipe	2.00	1.00	1.00	1.00-2.00	50
WS6	Standpipe	1.00	0.70	0.30	0.30-1.00	50
WS7	Standpipe	2.20	1.20	1.00	1.00-2.20	50
WS8	Standpipe	2.00	1.00	1.00	1.00-2.00	50

	During the site investigation works and subsequent monitoring the site was noted to be saturated.
GROUNDWATER CONDITIONS	During the site investigation works, groundwater strikes were encountered within the boreholes between ground level (WS3) and 1.70m bgl (WS1).

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Summary of Groundwater Strikes	
Trial Hole	**Groundwater Depth (m bgl)**
WS1	1.70
WS2	0.80
WS3	0.00
WS4	0.60
WS5	0.20
WS6	0.50
WS7	0.70
WS8	0.10

GROUNDWATER MONITORING

Groundwater monitoring was undertaken from each well installation on 3no. visits within December 2024 and January 2025. The results from the monitoring have been tabulated below:

Date	Trial Hole	Water Level (from top of well)	Water Level (from GL)	Well Depth (from top of well)	Height of well from GL
11/12/2024 09:45	WS1	1.25	0.90	2.85	0.35
	WS2	0.39	0.00	2.24	0.39
	WS3	0.32	+0.05	1.27	0.37
	WS4	0.37	0.00	2.22	0.37
	WS5	0.27	+0.12	1.91	0.39
	WS6	0.23	+0.11	1.21	0.34
	WS7	0.16	+0.24	2.17	0.40
	WS8	0.10	+0.24	2.06	0.34
08/01/2025 09:30	WS1	1.25	0.90	2.85	0.35
	WS2	0.29	+0.10	2.24	0.39
	WS3	0.29	+0.08	1.27	0.37
	WS4	0.37	0.00	2.22	0.37
	WS5	0.29	+0.10	1.91	0.39
	WS6	0.25	+0.09	1.21	0.34
	WS7	0.18	+0.22	2.17	0.40
	WS8	0.10	+0.24	2.06	0.34
28/01/2025 10:30	WS1	1.05	0.70	2.85	0.35
	WS2	0.46	0.07	2.24	0.39

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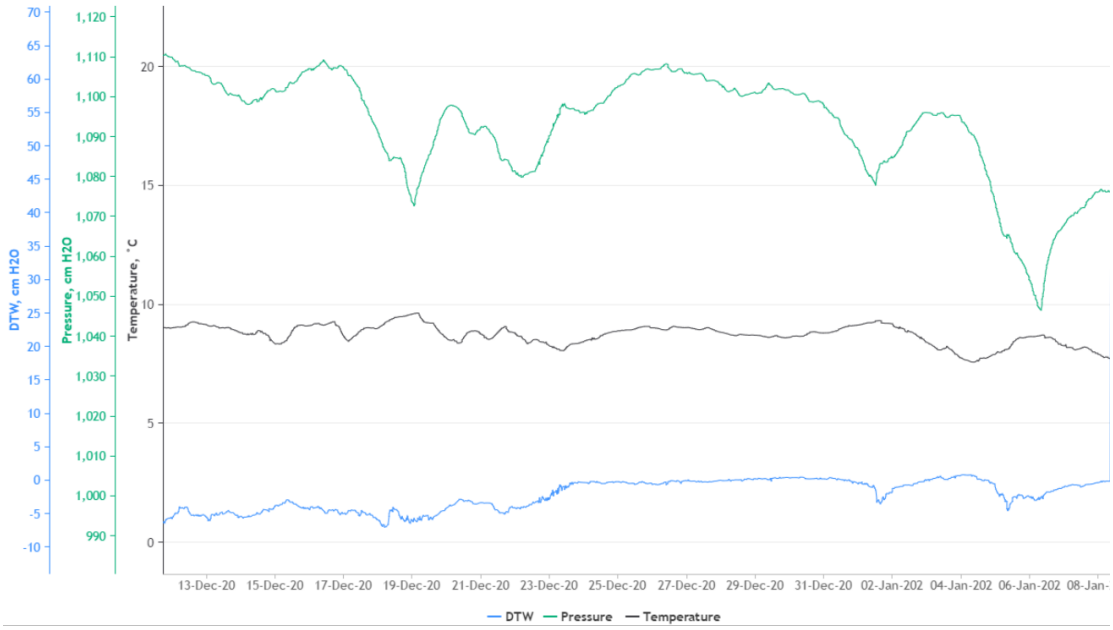
	WS3	0.38	0.01	1.27	0.37
	WS4	0.55	0.13	2.22	0.37
	WS5	0.17	+0.22	1.91	0.39
	WS6	0.28	+0.06	1.21	0.34
	WS7	0.20	+0.20	2.17	0.40
	WS8	0.12	+0.22	2.06	0.34

Groundwater monitoring was undertaken within WS3 and WS4 via dataloggers across a 4-week period between 11th December 2024 and 8th January 2025. The results from the monitoring have been provided within graphs below and within Appendix D.

Trial Hole	Shallowest Groundwater Depth	Highest Groundwater Depth (cm)
WS3	0.86 cm below ground level	+7.01cm above ground level
WS4	15.86 cm bgl below ground level	+6.15cm above ground level

WS3:



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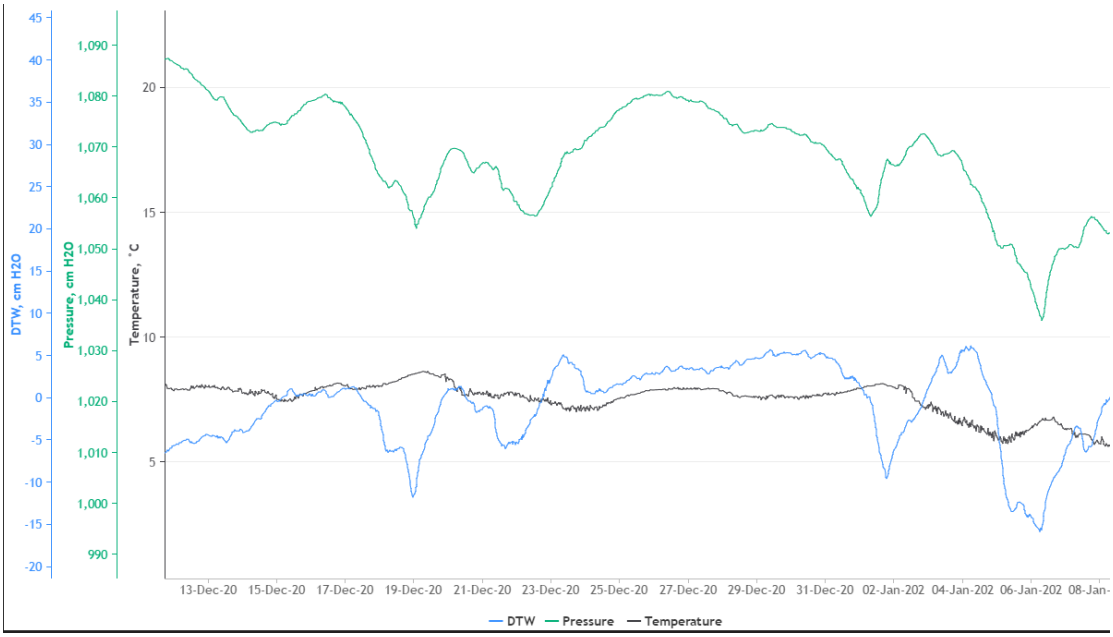
WS4:



Please feel free to contact us should you have any queries regarding the information enclosed within this report.

Summary of Authors		
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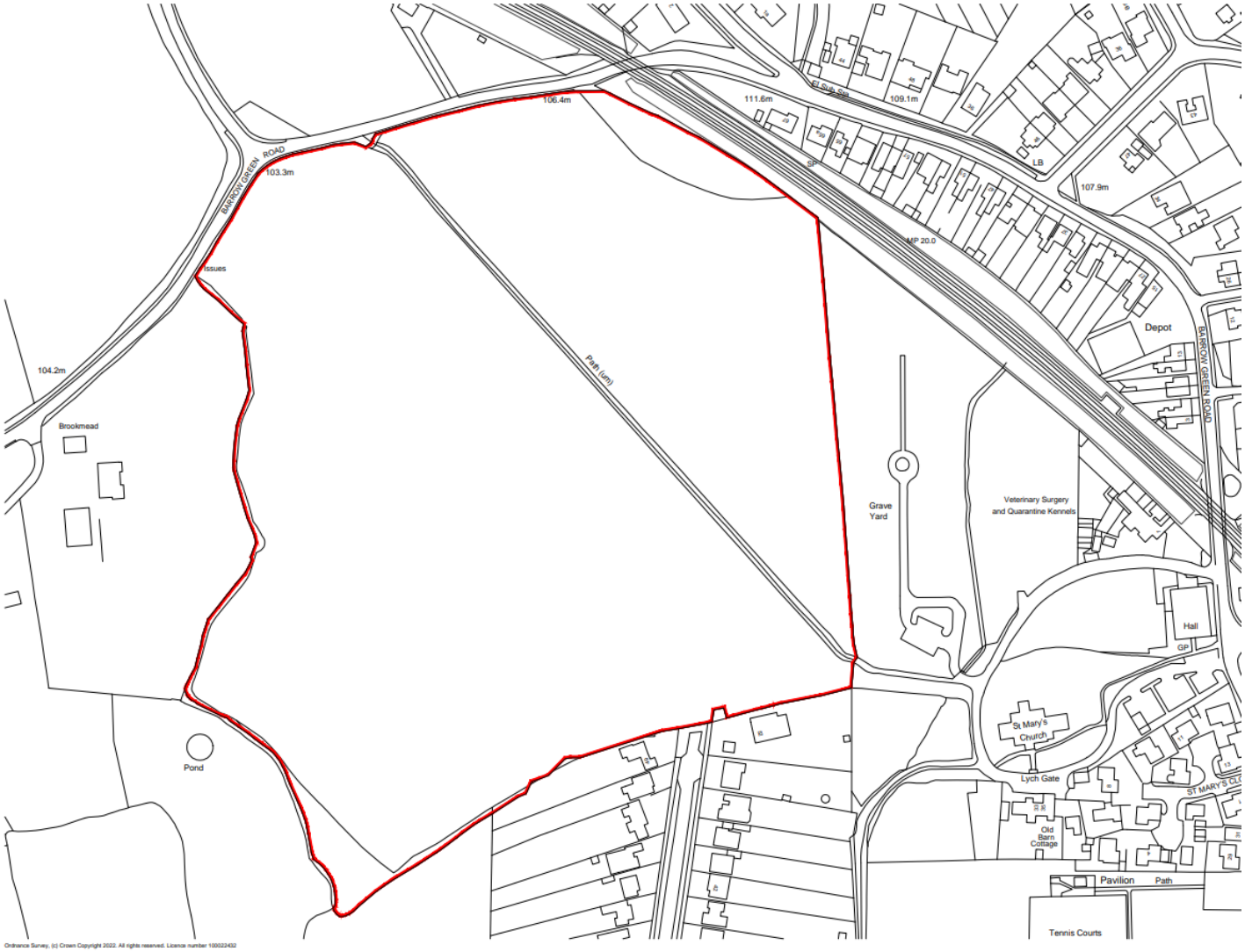
FIGURES



Site Location

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Figure 1: Site Location Plan	**GWPR6338**

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Site boundary

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Figure 2: Aerial View of the Site	**GWPR6338**

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Site boundary

HOUSE TYPE KEY:

PRIVATE	AFFORDABLE
1 BED	1 BED
SYCAMORE	FLAT
	SYCAMORE
2 BED	2 BED
JAY	GOLDCREST
	HAZEL
3 BED	3 BED
MERLIN	LAUREL
ROBIN	
KITE	
SISKIN	
OSPREY	
4 BED	
SWIFT	
TAWNY	
BILBERRY	
ROSE	
SORREL	

Not to Scale

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Figure 3: Proposed Development Plan	**GWPR6338**

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Windowless Sampler Borehole

Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Figure 4: Trial Hole Location Plan	**GWPR6338**

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APPENDIX A: Conditions and Limitations

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The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist. It was not part of the scope of this report to comment on environment/contaminated land considerations.

The conclusions and recommendations relate to Stoneyfields, Oxted, RH8 0NN.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

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The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

The aim of the investigation was understood to be to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

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APPENDIX B: Technical Glossary

TECHNICAL GLOSSARY

The list of possible definitions within the report may be seen below. Please note that some definitions may not be relevant to this report.

HYDROGEOLOGY:

A **Principal Aquifer** is a layer of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

Secondary (A) Aquifers consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

Secondary (B) Aquifers consist of deposits with predominantly lower permeability layers with may stoke and yield limited amounts of groundwater due to localised features such as fissures, think permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

Secondary Aquifers (Undifferentiated) are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both a minor aquifer and non-aquifer in different locations due to the variable characteristics of the rock type.

Unproductive Strata are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

FLOOD ZONES:

Environment Agency Flood Zone 2, defined as; land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

Environment Agency Flood Zone 3 shows the extent of a river flood with a 1 in 100 (1%0 or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year.

Environment Agency Flood Zone 3 area that benefits from flood defences, defined as; land and property in this flood zone would have a high probability of flooding without the local flood defences. These protect the area against a river flood with a 1% chance of happening each year, or a flood from the sea with a 0.5% chance of happening each year.

GROUNDWATER SOURCE PROTECTION ZONES (SPZS):

Inner Zone (SPZ1): This zone is 50 day travel time of pollutant to source with a 50 metres default minimum radius.

Outer Zone (SPZ2): This zone is 400 day travel time of pollutant to source. This has a 250 or 500 metres minimum radius around the source depending on the amount of water taken.

Total Catchment (SPZ3): This is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point.

Zone of Special Interest (SPZ4): This zone is where local conditions require additional protection.

IN-SITU STRENGTH GEOTECHNICAL TESTING:

Windowless Sample and/or Cable Percussion and/or Rotary Boreholes provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50mm and an inside diameter of 35mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. The sample tube is driven 150mm into the ground and then the number of blows needed for the tube to penetrate each 75mm up to a depth of 450mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

Dynamic Probing involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.5kg (SHDP) hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. (The Dynamic Probe 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).

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APPENDIX C: Trial Hole Logs

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS1	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			TOPSOIL: Dark brown clayey fine SAND.
					1.10			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint. (FOLKESTONE FORMATION).
					3.00			Grey slightly clayey medium SAND. (FOLKESTONE FORMATION).
								End of Borehole at 3.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 1.70m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS2	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			TOPSOIL: Dark brown clayey fine SAND.
					0.85			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint and ironstone. (FOLKESTONE FORMATION).
								Light orangish brown clayey fine SAND. (FOLKESTONE FORMATION).
					2.20			End of Borehole at 2.200m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.80m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS3	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								TOPSOIL: Dark brown clayey fine SAND.
					0.60			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint and ironstone. (FOLKESTONE FORMATION).
					1.00			End of Borehole at 1.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.80m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS4	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
					0.30			TOPSOIL: Dark brown clayey fine SAND.
					0.55			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint and ironstone. (FOLKESTONE FORMATION).
								Light orangish brown clayey fine SAND. (FOLKESTONE FORMATION).
					2.50			End of Borehole at 2.500m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.60m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS5	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20			TOPSOIL: Dark brown clayey fine SAND.
								Light orangish brown clayey fine SAND. (FOLKESTONE FORMATION).
					2.50			End of Borehole at 2.500m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.20m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS6	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			TOPSOIL: Dark brown clayey fine SAND.
					1.00			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint and ironstone. (FOLKESTONE FORMATION).
								End of Borehole at 1.000m

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.50m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS7	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.30			TOPSOIL: Dark brown clayey fine SAND.
					1.10			Orangish brown sandy slightly gravelly CLAY. Sand is fine to medium and gravel comprises fine to medium sub-angular flint and ironstone. (FOLKESTONE FORMATION).
					2.50			Light orangish brown clayey fine SAND. (FOLKESTONE FORMATION).
								End of Borehole at 2.500m

1 2 3 4 5 6 7 8 9 10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.70m bgl.

Percussion Drilling Log

Project Name: Stoneyfields, Oxted, RH8 0NN	Client: Motion Limited	Date: 03/12/2024
Location: Stoneyfields, Oxted, RH8 0NN	Contractor:	
Project No. : GWPR6338	Crew Name:	Drilling Equipment:

Borehole Number	Hole Type	Level	Logged By	Scale	Page Number
WS8	WS			1:50	Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.40			TOPSOIL: Dark brown clayey fine SAND.
								Light orangish brown clayey fine SAND. (FOLKESTONE FORMATION).
					2.00			End of Borehole at 2.000m

1 2 3 4 5 6 7 8 9 10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

Groundwater encountered at 0.10m bgl.

2 The Long Barn,
Norton Farm, Selborne Road,
Alton, Hampshire GU34 3NB

0333 600 1221
enquiries@groundandwater.co.uk

groundandwater.co.uk

APPENDIX D: Site Photos

Photograph 1. View of the site looking southeast (WS3, WS4, WS1)

Photograph 2. Saturated ground surrounding WS3

Photograph 3. View of the site looking northwest (WS4, WS3, WS7, WS2)

Photograph 4. Saturated ground surrounding WS3

Stoneyfields, Oxted, RH8 0NN

GWPR6338

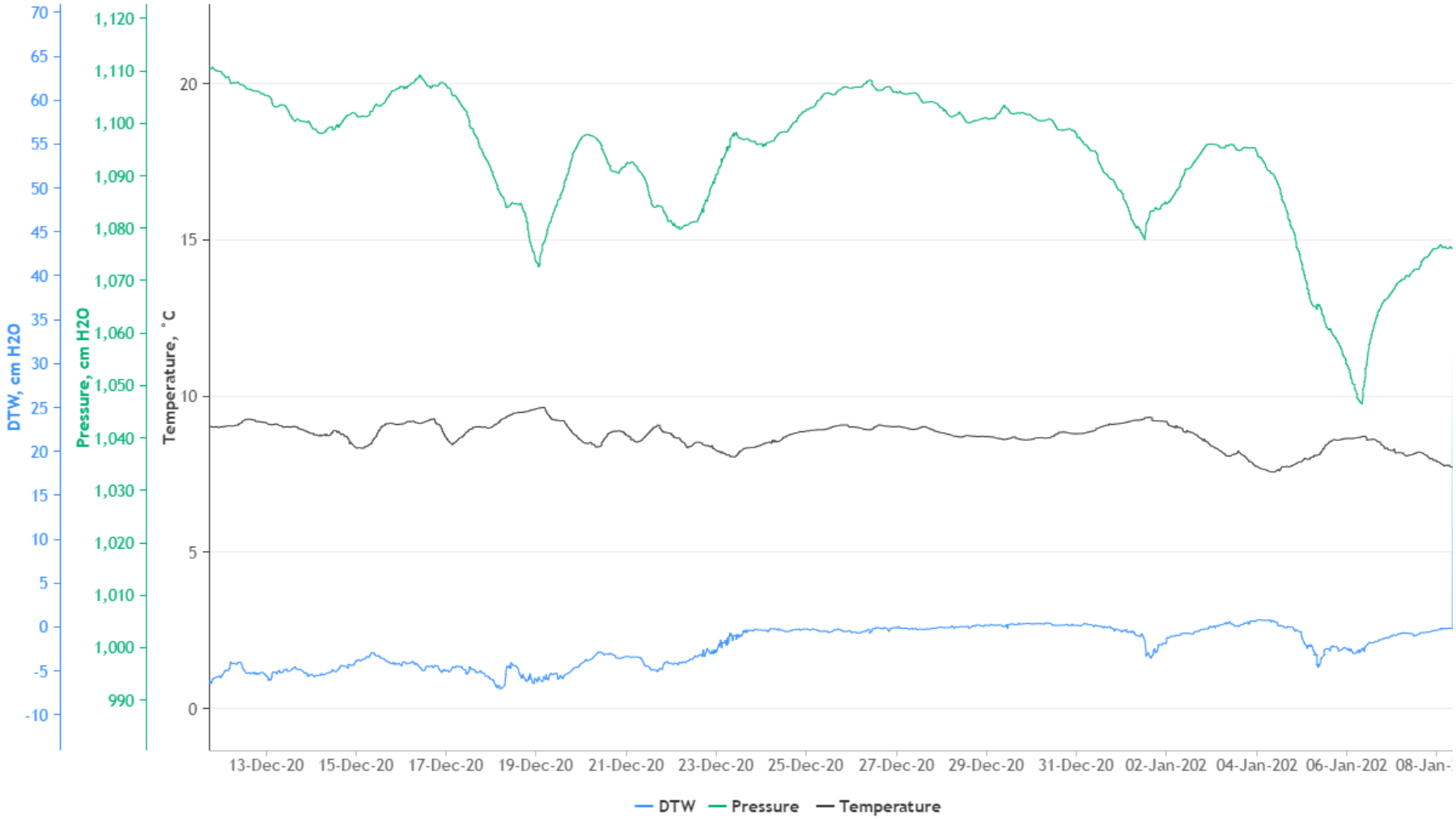
Appendix D: Site Photos

2 The Long Barn,
Norton Farm, Selborne Road,
Alton, Hampshire GU34 3NB

0333 600 1221
enquiries@groundandwater.co.uk

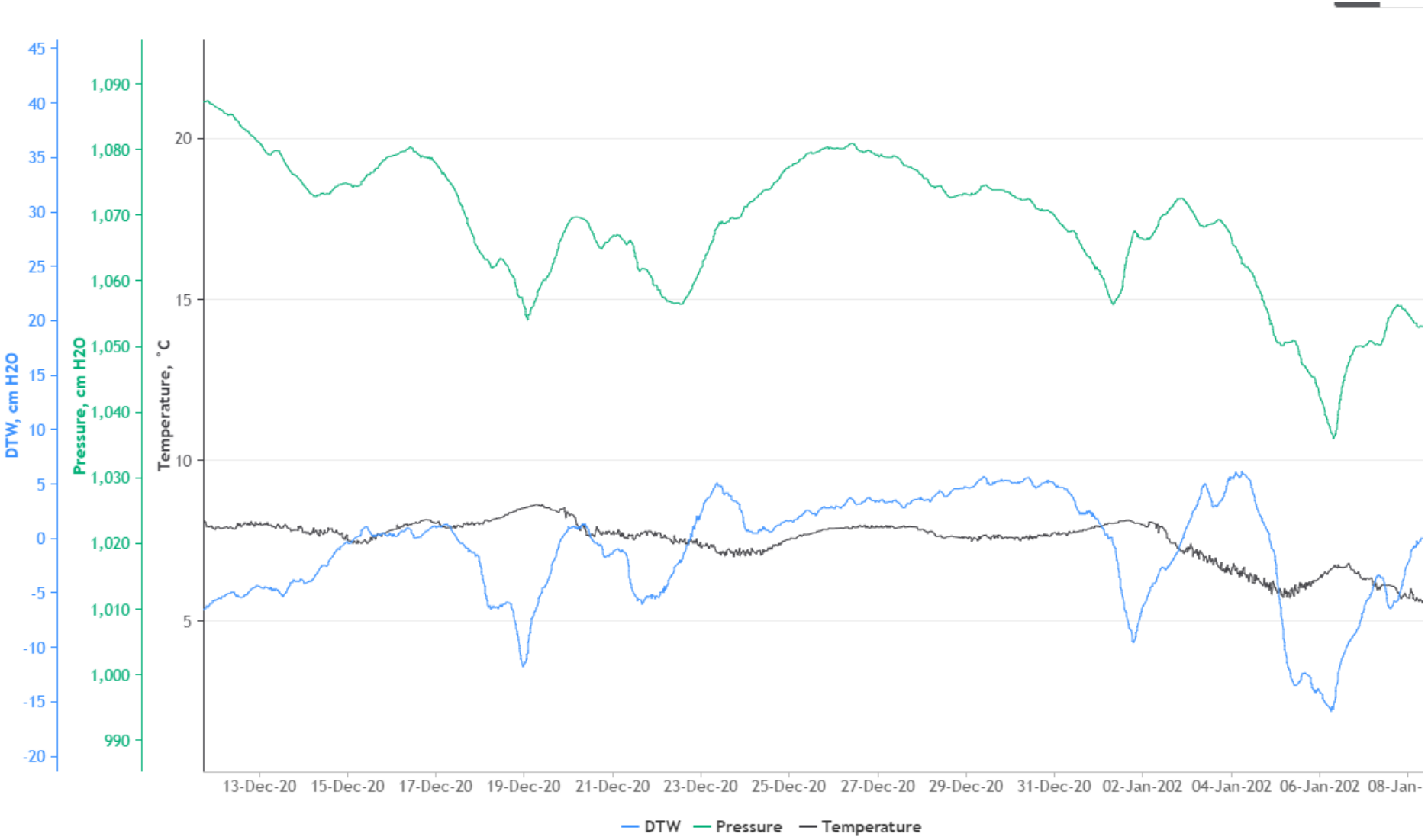
groundandwater.co.uk

APPENDIX E: Groundwater Monitoring Data



Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Groundwater Monitoring Data: WS3	**GWPR6338**

ground&water



Stoneyfields, Oxted, RH8 0NN	
Motion Limited	**January 2025**
Groundwater Monitoring Data: WS4	**GWPR6338**

ground&water

n o r t h

Notes

1. All levels and dimensions are to be checked on site before any work commences. All dimensions are in metres unless stated otherwise.
2. Any discrepancies shall be reported to the engineer immediately, so that clarification can be sought prior to the commencement of works.
3. This drawing shall be read in conjunction with all other relevant engineering details, drawings and specification.
4. The contractor is to keep a record of any variations made on site.
5. It is the contractors responsibility to obtain service plans and identify the location of services prior to excavation.
6. This drawing has been based upon survey information supplied by Encompass Surveys and Motion cannot guarantee the accuracy of the data provided.

Legend

TP
(GW Depth mBGL /
GW Depth mAOD)

Trial Pit 0.50 x 2.00 x 2.00m below ground level or to groundwater (whichever is lesser)

Approximate extent of wet ground associated with spring

Coordinates obtained around the edge of the spring on 03/10/2024

WS
Windowless Sampler Boreholes Drilled on 03/12/2024

Revision Notes:	Drn	Chk	App	Date
P02 Second Issue	ST	CG	NJ	27/02/2025
P01 First Issue	ST	CG	NJ	11/02/25

Drawing Status:

FOR PLANNING
NOT FOR CONSTRUCTION

motion

Guildford - Reading - London
www.motion.co.uk

Client:
Croudace Homes Limited

Project:
Stoneyfields, Oxted

Title:
Groundwater Investigation Plan

Scale: 1:1000 | Size: A1 | Project No: 2404081

Drawing: 2404081-SK05 | Revision: P02

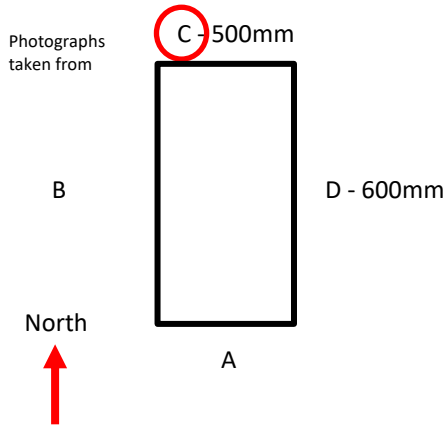
20m 0 20 40 60m
SCALE IN METRES
1:1000

C:\Users\CGray\Motion\Staff\Site - 1\root 2404081\Drawings\2404081-SK05 P02 (Groundwater Investigation Plan).dwg

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 10

Excavation method:	Machine Excavator		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38716 53061	**Elevation**	98.07 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)		Description and depth/type of samples
			TOPSOIL: Dark brown clayey fine SAND.
		0.2	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Damp clay Rapid water inflow	0.6	0.6	FOLKESTONE FORMATION: Light orange mottled grey SAND.
		0.8	End of Trial Pit

Remarks:

- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.5mbgl after 1 hour 45 minutes.

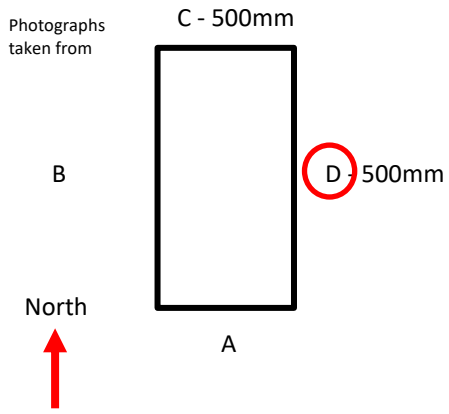
Produced by:	Print: Julian Hatherall	Signed CGeol

JH Groundwater Ltd
Hydrogeological Solutions

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 11

Excavation method:	Mechanical Excavator		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38736 53035	**Elevation**	98.11 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)	Description and depth/type of samples
	0.3	TOPSOIL: Dark brown clayey fine SAND. HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Damp clay	0.65	FOLKESTONE FORMATION: Light orange mottled grey SAND.
Water inflow	0.8	
	0.85	End of Trial Pit

Remarks:

- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.8mbgl after 60 minutes.

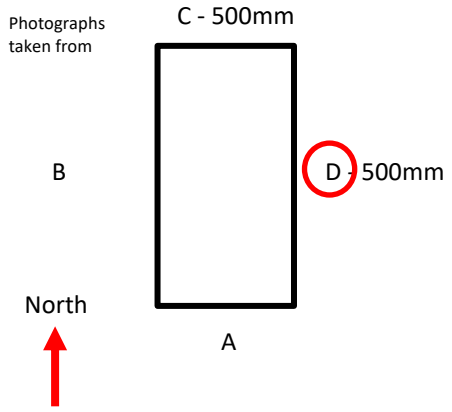
Produced by:	Print: Julian Hatherall	Signed

JH Groundwater Ltd
Hydrogeological Solutions

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 13

Excavation method:	Hand Dug		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38697 53041	**Elevation**	97.69 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)	Description and depth/type of samples
		TOPSOIL: Dark brown clayey fine SAND.
	0.3	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Saturated clay		
	0.55	FOLKESTONE FORMATION: Light orange mottled grey SAND.
Water inflow	0.8	End of Trial Pit
	0.9	

Remarks:

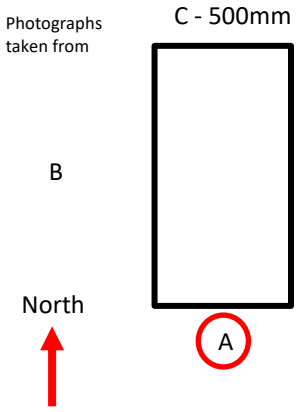
- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- Trial pit collapsing at Greensand interface with the Head
- FINAL RECORDED WATER LEVEL = 0.4mbgl after 2 hours.

Produced by:	Print: Julian Hatherall	Signed	CGeol

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 14

Excavation method:	Hand Dug		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38720 53044	**Elevation**	97.91 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)		Description and depth/type of samples
			TOPSOIL: Dark brown clayey fine SAND.
		0.2	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Damp clay Water inflow	0.6	0.6	FOLKESTONE FORMATION: Light orange mottled grey SAND.
		0.8	End of Trial Pit

Remarks:

- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.5mbgl after 5 hours.

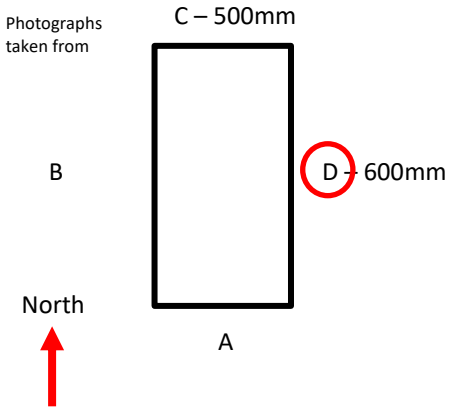
Produced by:	Print: Julian Hatherall	Signed

JH Groundwater Ltd
Hydrogeological Solutions

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 16

Excavation method:	Mechanical Excavator		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38688 53022	**Elevation**	97.71 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)	Description and depth/type of samples
	0.3	TOPSOIL: Dark brown clayey fine SAND. HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Damp clay becoming wetter with depth	0.55	FOLKESTONE FORMATION: Light orange mottled grey SAND.
Water inflow	0.7	
	0.8	End of Trial Pit

Remarks:

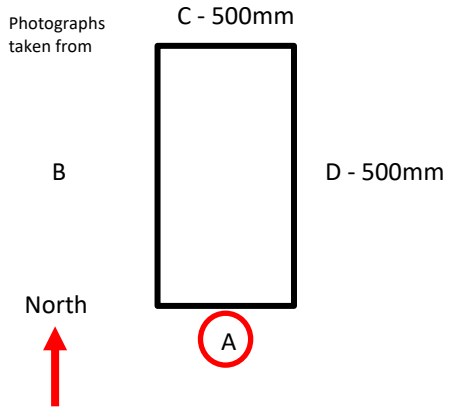
- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.5mbgl after 1 hour 30 minutes.

Produced by:	Print: Julian Hatherall	Signed	CGeol

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 17

Excavation method:	Hand Dug		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38729 53018	**Elevation**	97.69 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)	Description and depth/type of samples
		TOPSOIL: Dark brown clayey fine SAND.
	0.2	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Damp clay		
	0.4	FOLKESTONE FORMATION: Light orange mottled grey SAND.
Small water seepage	0.5	
Water inflow	0.75	
	0.8	End of Trial Pit

Remarks:

- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.6mbgl after 4 hours.

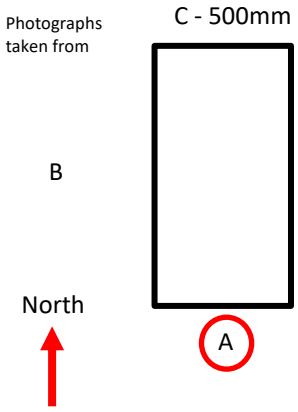
Produced by:	Print: Julian Hatherall	Signed CGeol

JH Groundwater Ltd
Hydrogeological Solutions

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 19

Excavation method:	Hand Dug		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38720 52981	**Elevation**	96.77 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)		Description and depth/type of samples
Saturated clay			TOPSOIL: Dark brown clayey fine SAND.
		0.2	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
Water Strike	0.5		
		0.7	FOLKESTONE FORMATION: Light orange mottled grey SAND.
Running inflow	0.8	0.8	End of Trial Pit

Remarks:

- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL = 0.65mbgl after 3 hours.

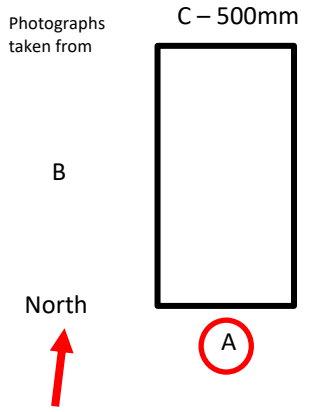
Produced by:	Print: Julian Hatherall	Signed	CGeol

JH Groundwater Ltd
Hydrogeological Solutions

JHG	**Project Name:**	Stoneyfields Oxted	
Location of Trial Pit	Stoneyfields close to spring location		
Date:	13/2/25	**Trial Pit ID:**	TP 20

Excavation method:	Mechanical Excavator		
Purpose:	Investigate the depth of groundwater close to spring		
Co-ordinates	TQ 38729 52960	**Elevation**	96.51 mAOD

Dimensions and Photos:



Water Strike/Level	Depth (mbgl)	Description and depth/type of samples
Dry – No groundwater encountered	0.2	TOPSOIL: Dark brown clayey fine SAND.
	0.7	HEAD: Brown/grey and orange sandy CLAY with some angular flint pebbles.
	1.1	FOLKESTONE FORMATION Light orange mottled grey SAND.
		End of Trial Pit

Remarks:

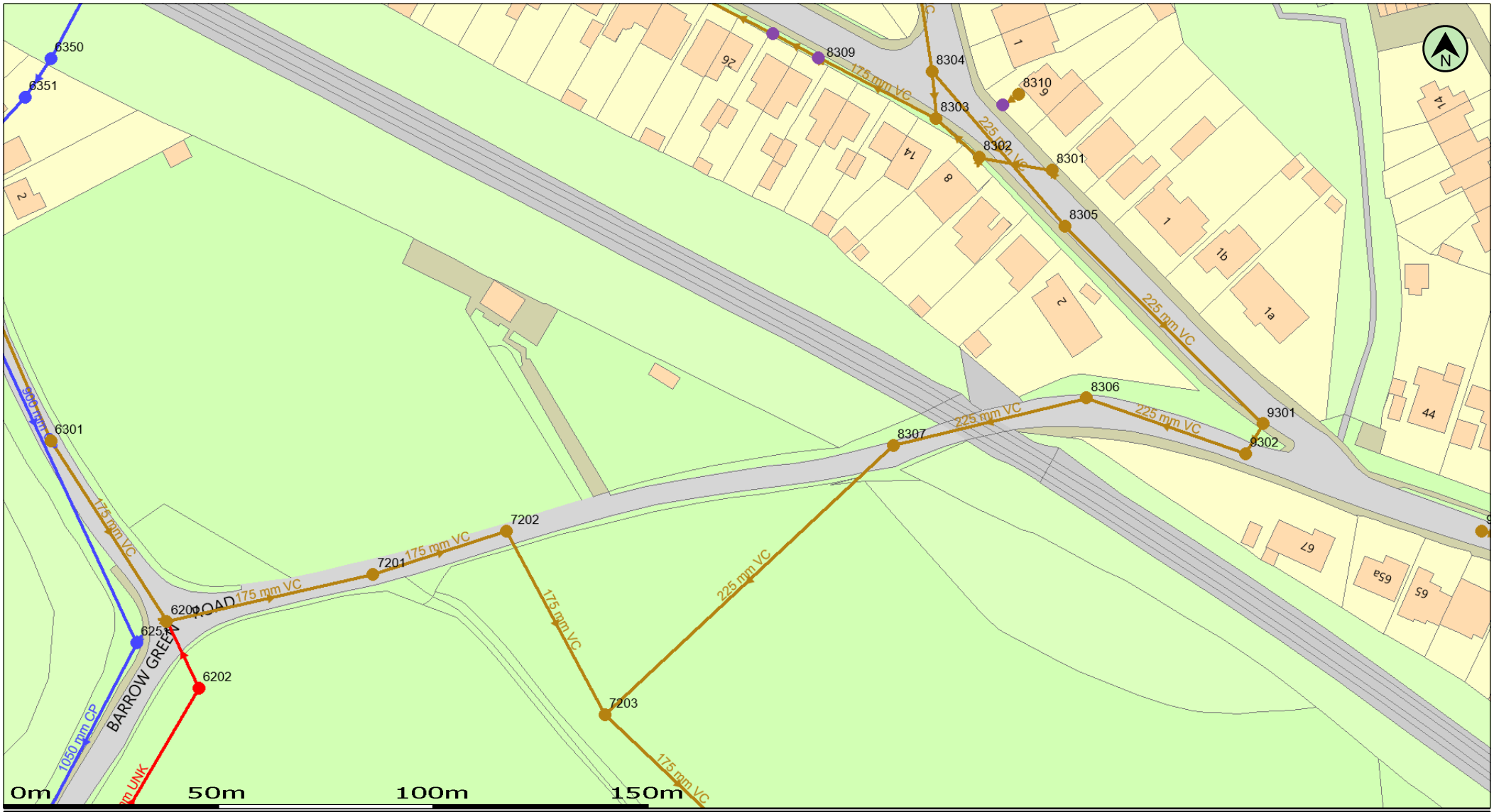
- Co-ordinates are taken using Trimble DA2 with approximate elevations from the previous survey.
- Photos show geological formation.
- FINAL RECORDED WATER LEVEL not recorded as TP dry.

Produced by:	Print: Julian Hatherall	Signed

JH Groundwater Ltd
Hydrogeological Solutions

Appendix E

Southern Water Wastewater Plans and Capacity Check Response



(c) Crown copyright and database rights 2024 Ordnance Survey 100031673 | Date: 02/05/24 | Scale: 1:1250 | Map Centre: 538792,153318 | Data updated: 12/04/24 | Our Ref: 1460107 - 1 | Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

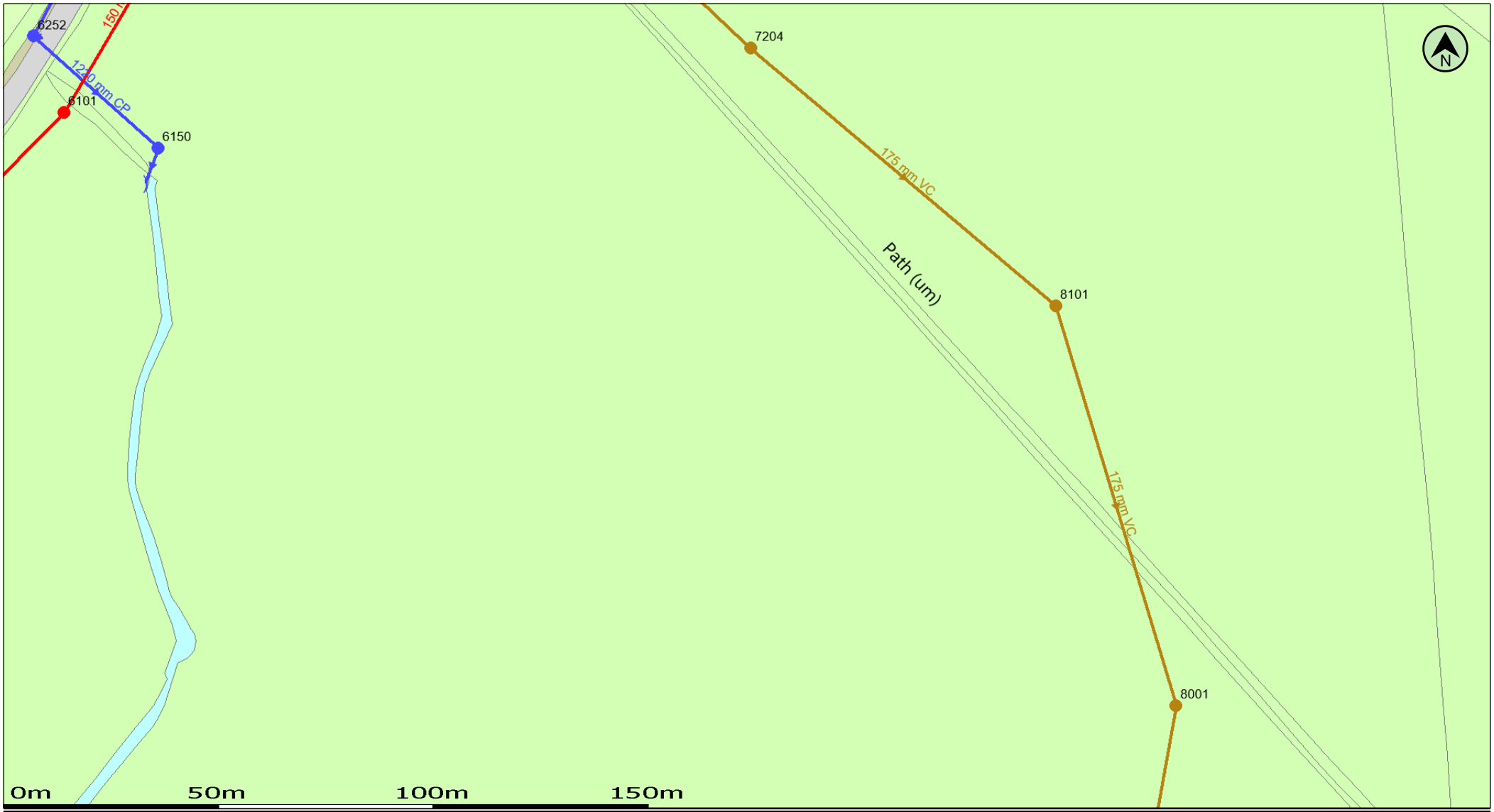
cgray@motion.co.uk

Stoneyfields, Oxted

WATER for LIFE from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
6202	C	0.00	0.00	-
6201	F	103.51	101.79	-
6301	F	103.59	102.06	-
7201	F	103.52	101.56	-
7202	F	103.97	101.39	-
7203	F	103.60	101.11	-
8301	F	112.10	110.87	-
8302	F	111.71	109.14	-
8303	F	111.42	108.49	-
8304	F	111.63	108.76	-
8305	F	112.11	108.23	-
8306	F	109.08	107.51	-
8307	F	106.88	105.35	-
8309	F	0.00	0.00	-
8310	F	0.00	0.00	-
9202	F	109.68	0.00	-
9301	F	112.33	108.02	-
9302	F	111.01	107.86	-
6251	S	103.38	101.32	-
6350	S	0.00	0.00	-
6351	S	0.00	0.00	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

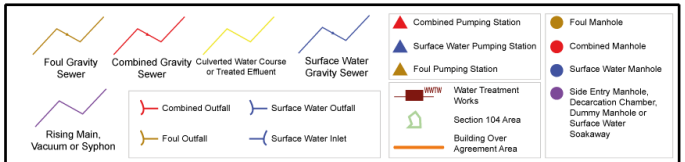


Date: 02/05/24 | Scale: 1:1250 | Map Centre: 538792,153131 | Data updated: 12/04/24 | Our Ref: 1460093 - 1 | Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



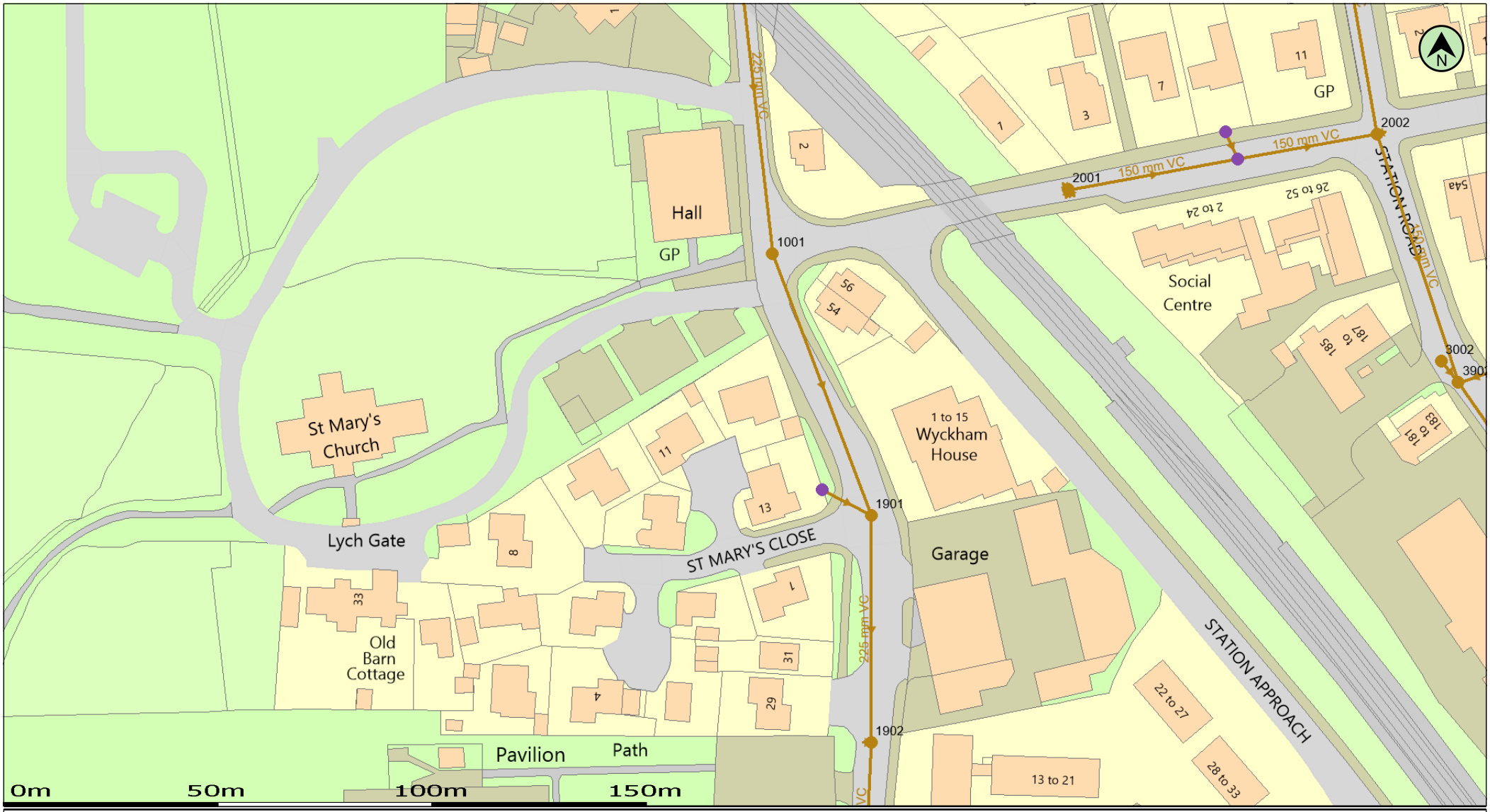
cgray@motion.co.uk

Stoneyfields, Oxted

WATER for LIFE from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
6101	C	0.00	0.00	-
7204	F	103.95	100.87	-
8001	F	104.59	99.89	-
8101	F	104.29	100.37	-
6150	S	102.64	100.19	-
6252	S	103.55	100.62	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

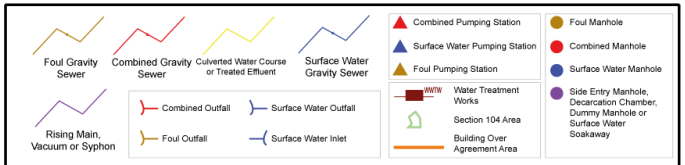


Date: 02/05/24 | Scale: 1:1250 | Map Centre: 539138,152990 | Data updated: 12/04/24 | Our Ref: 1460107 - 3 | Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



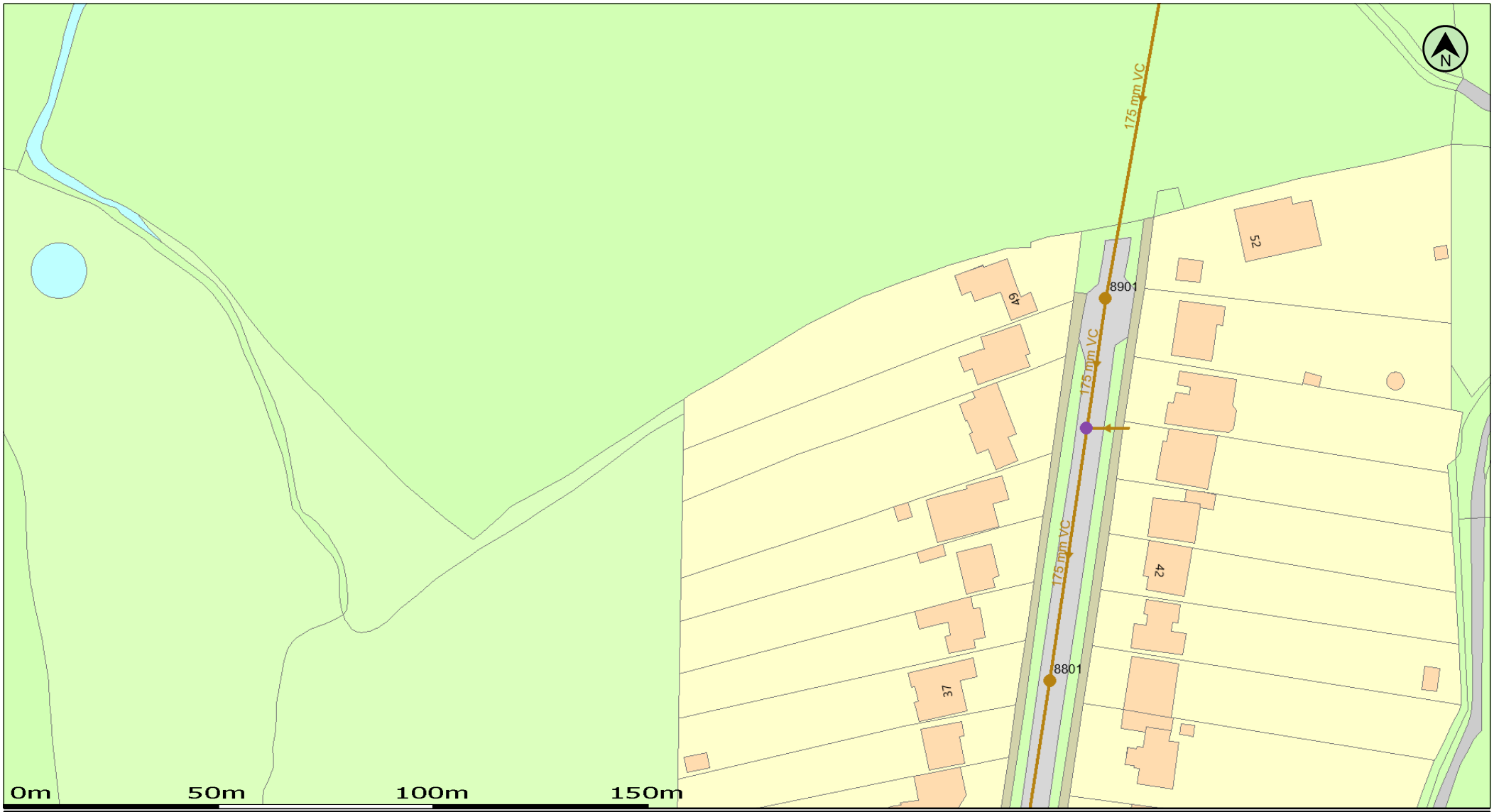
cgray@motion.co.uk

Stoneyfields, Oxted

WATER for LIFE from Southern Water.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
1001	F	104.96	103.19	-
1901	F	103.97	102.58	-
1902	F	103.15	101.83	-
2001	F	104.94	103.43	-
2002	F	105.35	102.94	-
3002	F	0.00	0.00	-
3902	F	103.06	101.48	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert



Date: 02/05/24 | Scale: 1:1250 | Map Centre: 538792,152943 | Data updated: 12/04/24 | Our Ref: 1460107 - 2 | Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

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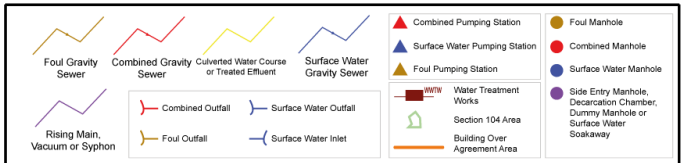
WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



cgray@motion.co.uk

Stoneyfields, Oxted

WATER for LIFE

from Southern Water

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
8801	F	99.96	97.46	-
8901	F	102.62	99.34	-

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Appendix F

Greenfield Runoff Calculation

FEH Mean Annual Flood

Input

QMED Method	2008	URBEXT (2000)	0.1181
Site Location	GB 538700 152900 TQ 38700 52900	SPRHOST	33.690
Area (ha)	164.000	BFIHOST	0.559
SAAR (mm)	802	FARL	1.000

Results

QMED Rural (l/s) 467.6 QMED Urban (l/s) 533.5

Appendix G

EA Flood Map for Planning and GeoSmart GW5 data

Flood map for planning

Your reference	Location (easting/northing)	Created
1croxt 240408	**538877/153094**	**2 May 2024 14:01**

Your selected location is in flood zone 1, an area with a low probability of flooding.

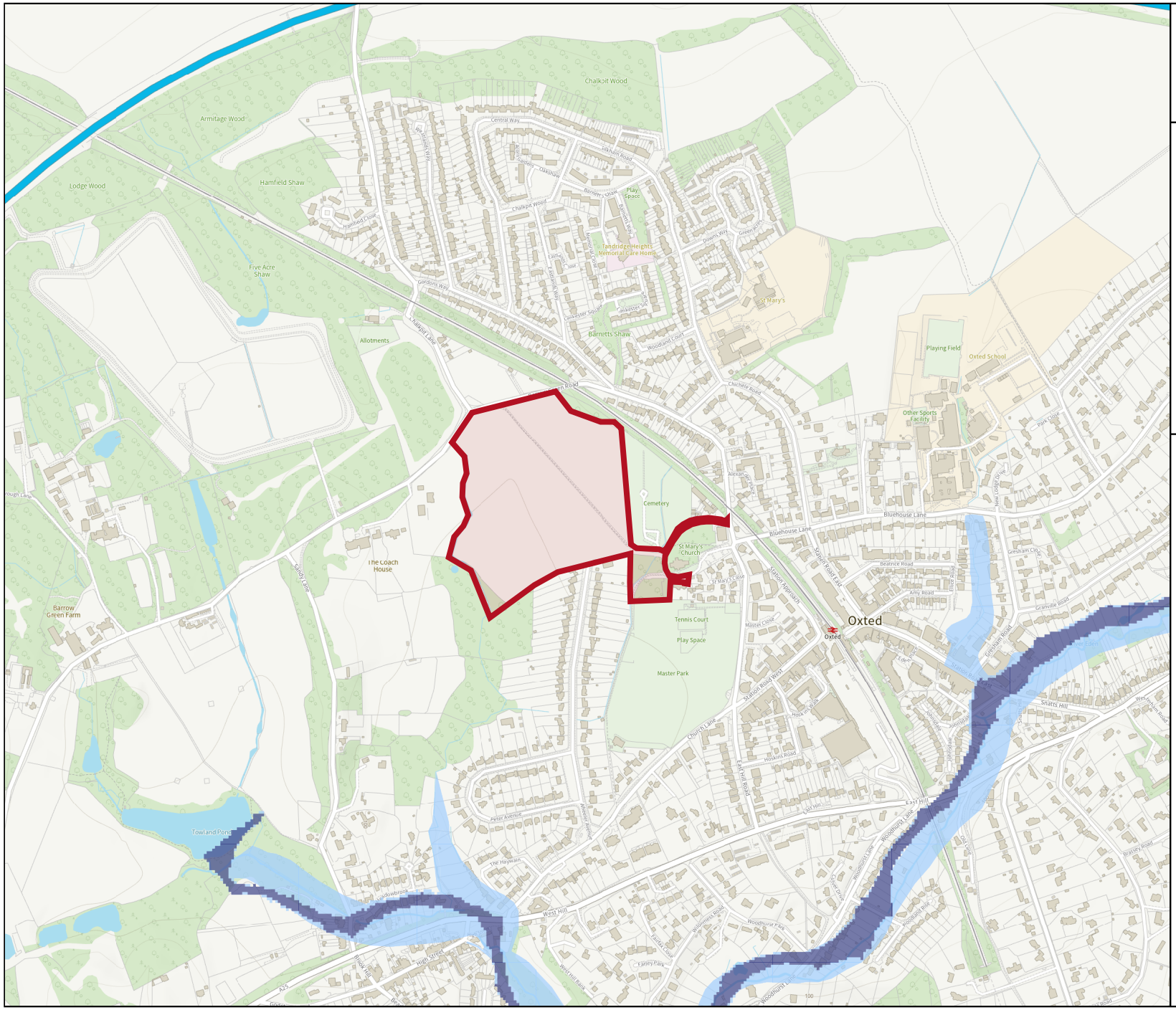
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
1croxt 240408

Location (easting/northing)
538877/153094

Scale
1:10000

Created
2 May 2024 14:01

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

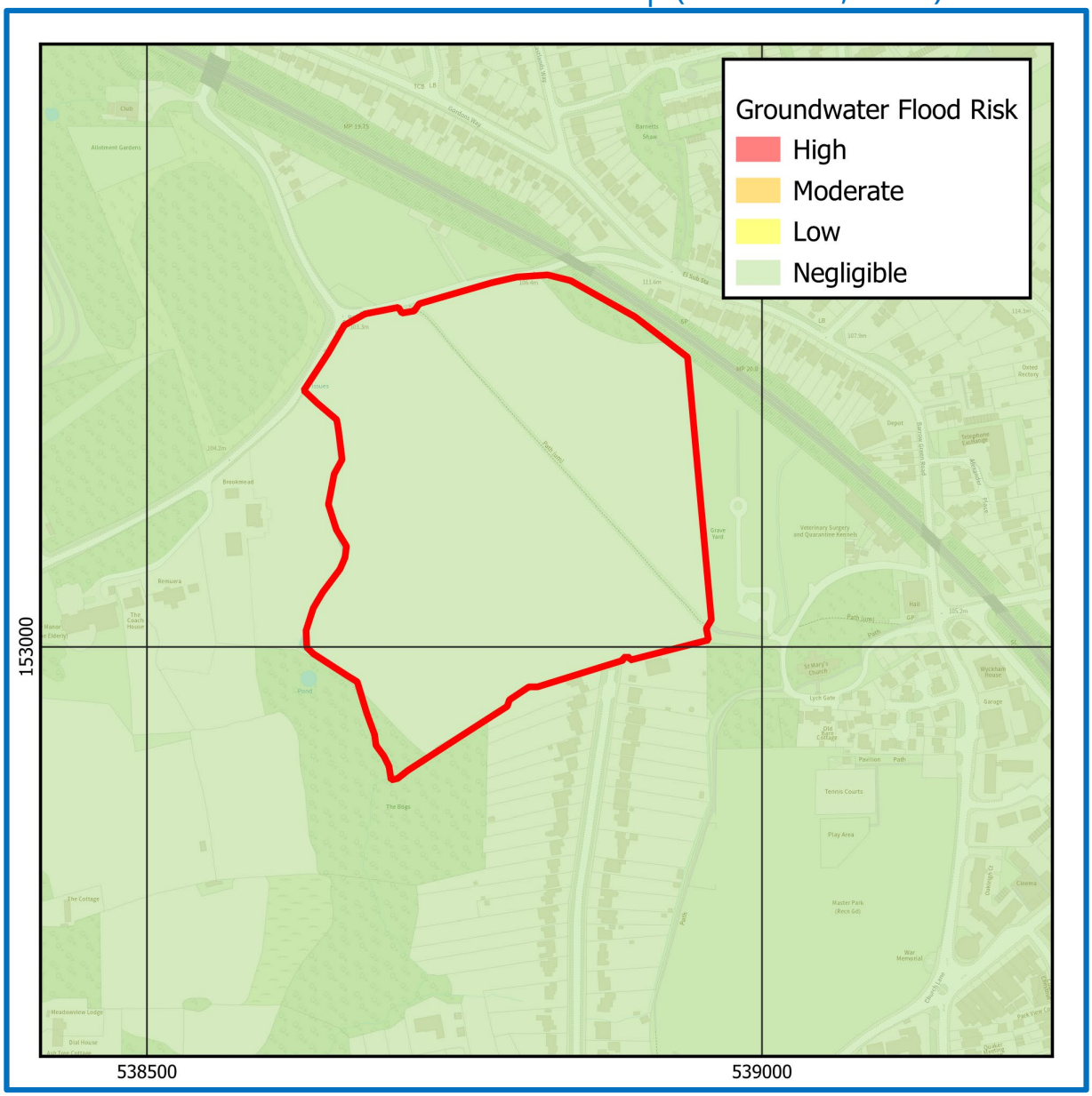
0 100 200 300m

GeoSmart Information

Environmental Thinking

GeoSmart Data

GW5 Groundwater Flood Risk Map (GeoSmart, 2025)



GeoSmart Information Ltd
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Old Bank Buildings, Bellstone
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CDM regulations can be found on our website:

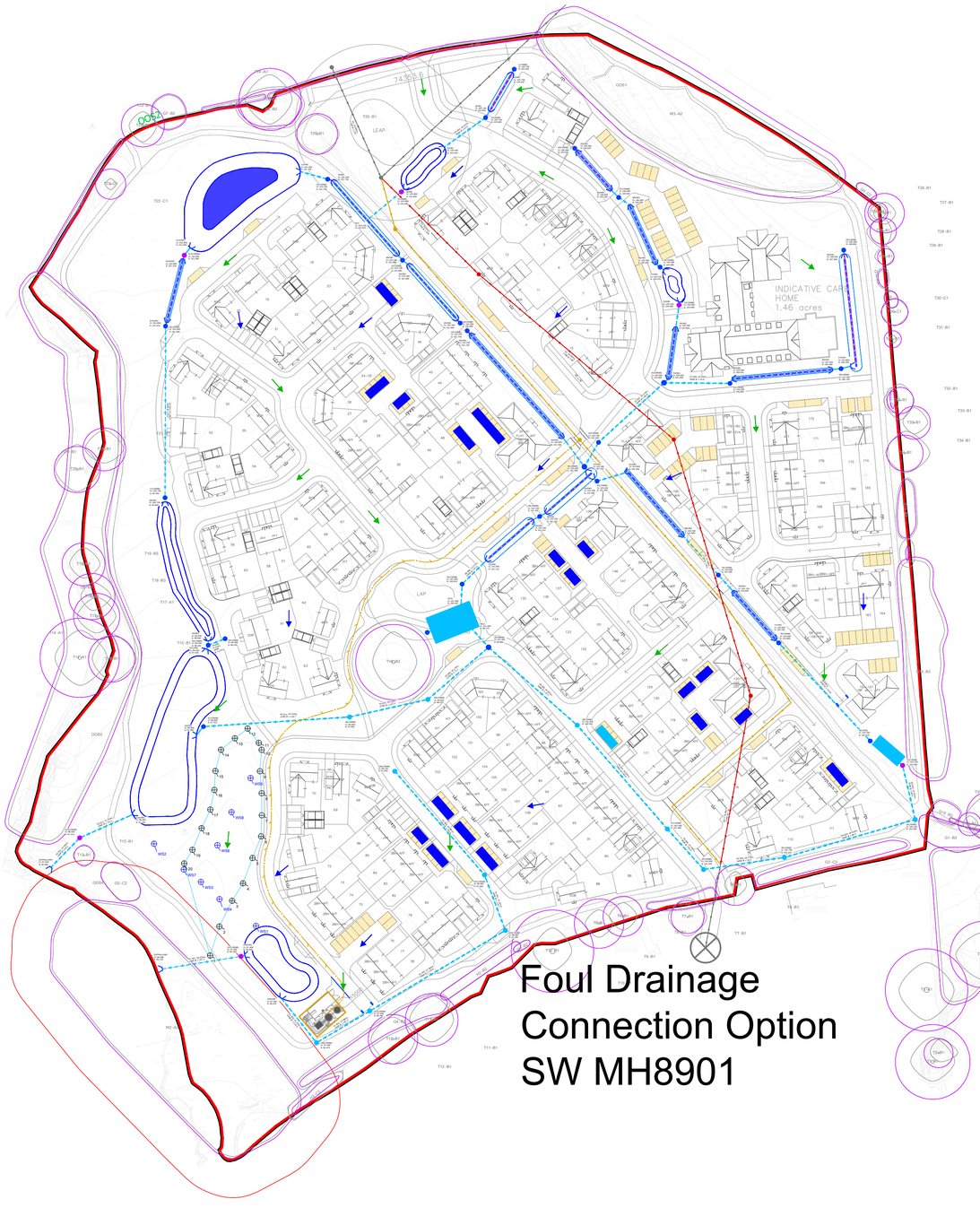
http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/

Appendix H

Proposed Drainage Strategy Layout



north

Notes

1. All levels and dimensions are to be checked on site before any work commences. All dimensions are in metres unless stated otherwise.
2. Any discrepancies shall be reported to the engineer immediately, so that clarification can be sought prior to the commencement of works.
3. This drawing shall be read in conjunction with all other relevant engineering details, drawings and specification.
4. The contractor is to keep a record of any variations made on site, including the relocation of sewers or drains, for their "as built" drawings to be prepared upon project completion.
5. All works to adopted systems are to be carried out in accordance with Sewerage Sector Guidance Appendix C, Approved Version 2.1, 25 May 2021. All works to private drainage systems are to be in accordance with the Building Regulations Approved Document Part "H" 2015 edition.
6. 350mm min cover to the pipe crown to be provided for private pipes laid in soft/paved areas. 900mm min cover to be provided for private pipes laid beneath agricultural land and public open space unless not practicable. 1200mm min cover to be provided for highways and parking areas with unrestricted access to vehicles with a gross vehicle weight in excess of 7.5 tonnes unless not practicable. Where unachievable, shallow private drains may require protection using concrete surround or paving slabs bridging the trench, subject to the NHBC inspector's requirements.
7. All pipes shall be laid soffit to soffit with outgoing pipes unless otherwise stated.
8. Manholes situated within areas accessible to motor vehicles are to be fitted with suitable strength covers and frames. Please refer to the manhole schedule for guidance on this.
9. This drawing has been based upon survey information supplied by Hook Survey and Motion cannot guarantee the accuracy of the data provided.
10. Adjacent areas of hardstanding will comply with building regulations and divert water away from the buildings.
11. The top surface of the pervious pavement should finish at least 150mm below any adjoining DPC level. Advice should always be sought from the manufacturer.
12. Gullys and linear drainage channels are required to convey surface water for up to the 100 year + 45% climate change critical flow rate. Construction details and supporting calculations are to be provided at the detailed design stage.
13. Full main investigation infiltration testing and construction details for the SuDS are to be provided at the detailed design stage. Currently it has been assumed infiltration is not viable where infiltration testing was not undertaken during the exploratory investigation e.g. the approximate eastern third of the site.
14. The Drainage Strategy is based on preliminary levels and is subject to detailed design.
15. The drainage strategy has been designed to connect to the foul water public sewer that crosses the site via new sewer manhole connection points. Some of the existing foul water public sewer drainage infrastructure that crosses the site will be required to be diverted prior to development commencing. This will need to be agreed with Southern Water beforehand.

Legend

- Site Boundary
- Pervious Pavement
- Geocellular Soakaway - Refer to MicroDrainage Calculations for Dimensions
- Indicative Surface Water Gully Location
- Proposed swale - Refer to MicroDrainage Calculations for Dimensions
- Approximate extent of wet ground associated with spring
- Coordinates obtained around the edge of the spring on 03/10/2024
- Geocellular Attenuation Storage - Refer to MicroDrainage Calculations for Dimensions
- Indicative Surface Water Gully Location
- Detention Basin/Infiltration Basin/Pond - Refer to MicroDrainage Calculations for Dimensions
- New Surface Water Gravity Pipe
- Indicative existing exceedance flow route
- New Surface Water Catchpit Chamber
- New Surface Water Manhole
- New Surface Water Hydro-Brake Flow Control Chamber - Refer to MicroDrainage Calculations for 100 + 45% climate change critical flow rate
- Existing Manhole
- New Surface Water Linear Drainage with Sump Unit
- Proposed exceedance flow route where different from existing
- Proposed Headwall
- New Surface Water Perforated Collector Pipe
- New Foul Water Gravity Pipe
- New Foul Water Manhole
- Indicative Route of Proposed Rising Main
- Indicative Location of Foul Water Pumping Station
- Existing Foul Water Gravity Pipe to be Removed
- Existing Foul Water Manhole to be Removed
- Windowless Sampler Boreholes Drilled on 03/12/2024 (WS)

P04	Fourth Issue	ST	CG	NJ	27/02/2025
P03	Third Issue	ST	CG	NJ	19/12/2024
P02	Second Issue	ST	CG	NJ	29/11/2024
P01	First Issue	ST	CG	NJ	27/11/24
Revision Notes:		Drn	Chk	App	Date

Drawing Status:
FOR PLANNING
NOT FOR CONSTRUCTION

motion
Guildford - Reading - London
www.motion.co.uk

Client:
Croudace Homes Limited

Project:
Land South of Barrow Green Road, Oxted

Title:
Drainage Strategy

Scale: 1:1000 | Size: A1 | Project No: 2404081

Drawing: 2404081-0500-01 | Revision: P04

20m 0 20 40 60m
SCALE IN METRES
1:1000

C:\Users\CGrey\Motion\SharePoint - Icrox\ 2404081\Drawings\2404081-0500-01 P04 [Drainage Strategy].dwg

Appendix I

MicroDrainage Hydraulic Modelling Results

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Mainline 1

Pipe Sizes Manhole Sizes

FEH Rainfall Model

Return Period (years)	100	Volumetric Runoff Coeff.	0.750
		PIMP (%)	100
FEH Rainfall Version	2013	Add Flow / Climate Change (%)	45
Site Location	GB 538700 152900 TQ 38700 52900	Minimum Backdrop Height (m)	0.000
Data Type	Catchment	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	500	Min Design Depth for Optimisation (m)	0.000
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	100

Designed with Level Soffits

Time Area Diagram for Mainline 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.253	4-8	0.357	8-12	0.038	12-16	0.038	16-20	0.024

Total Area Contributing (ha) = 0.709

Total Pipe Volume (m³) = 19.759

Network Design Table for Mainline 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	49.881	0.350	142.5	0.142	15.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	96.13	15.63	97.650	0.142	0.0	0.0	16.6	1.32	93.0	53.6

Network Design Table for Mainline 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.001	21.561	0.120	179.7	0.153	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	57.396	0.480	119.6	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	22.589	0.075	301.2	0.343	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.004	20.735	0.065	319.0	0.010	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.005	20.267	0.010	2026.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	1.468	0.010	146.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	29.010	0.270	107.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.001	95.21	15.94	97.300	0.295	0.0	0.0	34.3	1.17	82.7«	110.5
1.002	93.27	16.61	97.180	0.356	0.0	0.0	40.4	1.44	101.5«	130.2
1.003	92.36	16.93	96.550	0.699	0.0	0.0	78.7	1.17	185.5«	253.5
1.004	91.52	17.23	96.475	0.709	0.0	0.0	79.1	1.13	180.2«	254.8
1.005	89.48	18.00	96.410	0.709	0.0	0.0	79.1	0.44	70.4«	254.8
1.006	89.40	18.03	96.400	0.709	0.0	0.0	79.1	0.83	14.6«	254.8
1.007	96.53	15.50	96.390	0.000	1.0	0.0	0.3	0.97	17.1	1.0

Manhole Schedules for Mainline 1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
100	99.150	1.500	Open Manhole	1500	1.000	97.650	300				
101	98.800	1.500	Open Manhole	1500	1.001	97.300	300	1.000	97.300	300	
102	98.800	1.620	Open Manhole	1500	1.002	97.180	300	1.001	97.180	300	
103	97.600	1.050	Open Manhole	1500	1.003	96.550	450	1.002	96.700	300	
104	97.400	0.925	Open Manhole	1350	1.004	96.475	450	1.003	96.475	450	
105(HW)	97.400	0.990	Junction		1.005	96.410	450	1.004	96.410	450	
106(HW)	97.400	1.000	Junction		1.006	96.400	150	1.005	96.400	450	
106	97.400	1.010	Open Manhole	1500	1.007	96.390	150	1.006	96.390	150	
Outfall	96.280	0.160	Open Manhole	1200		OUTFALL		1.007	96.120	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
100	538762.010	153032.289	538762.010	153032.289	Required	
101	538794.639	152994.561	538794.639	152994.561	Required	
102	538802.224	152974.378	538802.224	152974.378	Required	
103	538752.880	152945.060	538752.880	152945.060	Required	
104	538733.473	152933.500	538733.473	152933.500	Required	
105(HW)	538720.607	152949.761			No Entry	
106(HW)	538707.436	152965.165			No Entry	
106	538705.987	152964.929	538705.987	152964.929	Required	
Outfall	538677.342	152960.344			No Entry	

PIPELINE SCHEDULES for Mainline 1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	300	100	99.150	97.650	1.200	Open Manhole	1500
1.001	o	300	101	98.800	97.300	1.200	Open Manhole	1500
1.002	o	300	102	98.800	97.180	1.320	Open Manhole	1500
1.003	o	450	103	97.600	96.550	0.600	Open Manhole	1500
1.004	o	450	104	97.400	96.475	0.475	Open Manhole	1350
1.005	o	450	105(HW)	97.400	96.410	0.540	Junction	
1.006	o	150	106(HW)	97.400	96.400	0.850	Junction	
1.007	o	150	106	97.400	96.390	0.860	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	49.881	142.5	101	98.800	97.300	1.200	Open Manhole	1500
1.001	21.561	179.7	102	98.800	97.180	1.320	Open Manhole	1500
1.002	57.396	119.6	103	97.600	96.700	0.600	Open Manhole	1500
1.003	22.589	301.2	104	97.400	96.475	0.475	Open Manhole	1350
1.004	20.735	319.0	105(HW)	97.400	96.410	0.540	Junction	
1.005	20.267	2026.7	106(HW)	97.400	96.400	0.550	Junction	
1.006	1.468	146.8	106	97.400	96.390	0.860	Open Manhole	1500
1.007	29.010	107.4	Outfall	96.280	96.120	0.010	Open Manhole	1200

Area Summary for Mainline 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.096	0.096	0.096
	User	-	100	0.012	0.012	0.109
	User	-	100	0.024	0.024	0.133
	User	-	100	0.004	0.004	0.136
	User	-	100	0.006	0.006	0.142
1.001	User	-	100	0.064	0.064	0.064
	User	-	100	0.017	0.017	0.081
	User	-	100	0.017	0.017	0.098
	User	-	100	0.013	0.013	0.111
	User	-	100	0.008	0.008	0.120
	User	-	100	0.003	0.003	0.123
	User	-	100	0.015	0.015	0.137
	User	-	100	0.002	0.002	0.139
	User	-	100	0.011	0.011	0.150
	User	-	100	0.003	0.003	0.153
1.002	User	-	100	0.006	0.006	0.006
	User	-	100	0.004	0.004	0.010
	User	-	100	0.009	0.009	0.019
	User	-	100	0.007	0.007	0.026
	User	-	100	0.010	0.010	0.036
	User	-	100	0.004	0.004	0.040
	User	-	100	0.009	0.009	0.048
	User	-	100	0.001	0.001	0.049
	User	-	100	0.001	0.001	0.051
	User	-	100	0.002	0.002	0.052
	User	-	100	0.002	0.002	0.054
	User	-	100	0.006	0.006	0.060
1.003	User	-	100	0.111	0.111	0.111
	User	-	100	0.025	0.025	0.136
	User	-	100	0.015	0.015	0.150
	User	-	100	0.014	0.014	0.165
	User	-	100	0.058	0.058	0.222
	User	-	100	0.017	0.017	0.239
	User	-	100	0.012	0.012	0.251
	User	-	100	0.003	0.003	0.255
	User	-	100	0.007	0.007	0.262
	User	-	100	0.006	0.006	0.268
	User	-	100	0.004	0.004	0.271
	User	-	100	0.006	0.006	0.278
	User	-	100	0.005	0.005	0.283
	User	-	100	0.004	0.004	0.286
	User	-	100	0.009	0.009	0.296
	User	-	100	0.005	0.005	0.301
	User	-	100	0.004	0.004	0.305
	User	-	100	0.007	0.007	0.311
	User	-	100	0.005	0.005	0.316
	User	-	100	0.010	0.010	0.326
	User	-	100	0.001	0.001	0.327
	User	-	100	0.001	0.001	0.329

Area Summary for Mainline 1

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.002	0.002	0.331
	User	-	100	0.006	0.006	0.337
	User	-	100	0.006	0.006	0.343
1.004	User	-	100	0.010	0.010	0.010
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.709	0.709	0.709

Network Classifications for Mainline 1

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type	PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	100	300	1.200	1.200	Unclassified	1500	0	1.200	Unclassified	1.004	104	450	0.475	0.540	Unclassified	1350	0	0.475	Unclassified
1.001	101	300	1.200	1.320	Unclassified	1500	0	1.200	Unclassified	1.005	105(HW)	450	0.540	0.550	Unclassified				Junction
1.002	102	300	0.600	1.320	Unclassified	1500	0	1.320	Unclassified	1.006	106(HW)	150	0.850	0.860	Unclassified				Junction
1.003	103	450	0.475	0.600	Unclassified	1500	0	0.600	Unclassified	1.007	106	150	0.010	0.860	Unclassified	1500	0	0.860	Unclassified

Free Flowing Outfall Details for Mainline 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	Outfall	96.280	96.120	0.000	1200	0

Simulation Criteria for Mainline 1

Volumetric Runoff Coeff	0.750	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	0.000	Run Time (mins)	60
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800	Output Interval (mins)	5

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 3 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment	Cv (Winter)	0.750
Return Period (years)	100	Summer Storms	No	Storm Duration (mins)	30
FEH Rainfall Version	2013	Winter Storms	Yes		
Site Location	GB 538700 152900 TQ 38700 52900	Cv (Summer)	1.000		

Online Controls for Mainline 1

Hydro-Brake® Optimum Manhole: 106, DS/PN: 1.007, Volume (m³): 1.8

Unit Reference	MD-CHE-0046-1000-0960-1000	Objective	Minimise upstream storage	Invert Level (m)	96.390
Design Head (m)	0.960	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	1.0	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	46		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.960	1.0	Flush-Flo™	0.109	0.7	Kick-Flo®	0.157	0.4	Mean Flow over Head Range	-	0.7

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.7	0.500	0.7	1.200	1.1	2.000	1.4	3.000	1.7	5.000	2.2	7.000	2.6	9.000	3.0
0.200	0.5	0.600	0.8	1.400	1.2	2.200	1.5	3.500	1.9	5.500	2.4	7.500	2.7	9.500	3.1
0.300	0.6	0.800	0.9	1.600	1.3	2.400	1.6	4.000	2.0	6.000	2.5	8.000	2.8		
0.400	0.7	1.000	1.0	1.800	1.4	2.600	1.6	4.500	2.1	6.500	2.6	8.500	2.9		

Storage Structures for Mainline 1

Porous Car Park Manhole: 101, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0	Width (m)	5.0	Depression Storage (mm)	5
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	50.0	Evaporation (mm/day)	3
Max Percolation (l/s)	69.4	Invert Level (m)	98.370	Slope (1:X)	200.0	Membrane Depth (mm)	130

Porous Car Park Manhole: 103, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0	Width (m)	5.0	Depression Storage (mm)	5
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	22.5	Evaporation (mm/day)	3
Max Percolation (l/s)	31.3	Invert Level (m)	96.970	Slope (1:X)	200.0	Membrane Depth (mm)	130

Infiltration Basin Manhole: 106(HW), DS/PN: 1.006

Invert Level (m)	96.400	Infiltration Coefficient Side (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Base (m/hr)	0.91800	Safety Factor	5.0		

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	242.6	1.000	436.5

Manhole Headloss for Mainline 1

PN	US/MH Name	US/MH Headloss
1.000	100	0.500
1.001	101	0.500
1.002	102	0.500
1.003	103	0.500
1.004	104	0.500
1.005	105(HW)	0.000
1.006	106(HW)	0.000
1.007	106	0.500

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	100	2.651	3.526	0.000	6.177
1.001	101	2.651	1.524	20.340	24.515
1.002	102	2.863	4.057	0.000	6.920
1.003	103	1.856	3.593	16.875	22.323
1.004	104	1.324	3.298	0.000	4.622
1.005	105(HW)	0.000	3.223	0.000	3.223
1.006	106(HW)	0.000	0.026	334.846	334.872
1.007	106	1.785	0.513	0.000	2.297
Total		13.129	19.759	372.061	404.949

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	100	2.651	3.420	0.000	6.071
1.001	101	2.651	1.418	20.340	24.409
1.002	102	2.863	3.951	0.000	6.814
1.003	103	1.856	3.366	16.875	22.096
1.004	104	1.324	3.190	0.000	4.514
1.005	105(HW)	0.000	3.223	0.000	3.223
1.006	106(HW)	0.000	0.013	334.846	334.859
1.007	106	1.785	0.489	0.000	2.274
Total		13.129	19.070	372.061	404.260

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 1

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 3 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Site Location	GB 538700 152900 TQ 38700 52900	Cv (Winter)	0.840
Return Period (years)	2	Data Type		Catchment	
FEH Rainfall Version	2013	Cv (Summer)		0.750	

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status ON

Analysis Timestep 2.5 Second Increment (Extended) DVD Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880

Sensitivity flows(s) (%) 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	100	30 minute 2 year Winter Q+0%	99.150	97.723	-0.227	0.000			0.120		11.7	OK
1.001	101	15 minute 2 year Winter Q+0%	98.800	97.431	-0.169	0.000		0.000	0.471	9	28.6	OK
1.002	102	15 minute 2 year Winter Q+0%	98.800	97.307	-0.173	0.000			0.472		35.6	OK
1.003	103	15 minute 2 year Winter Q+0%	97.600	96.910	-0.090	0.000		0.000	1.205	5	73.9	OK
1.004	104	15 minute 2 year Winter Q+0%	97.400	96.859	-0.066	0.000			3.202		68.2	OK
1.005	105(HW)	15 minute 2 year Winter Q+0%	97.400	96.806	-0.054	0.000			3.008		64.3	OK*
1.006	106(HW)	120 minute 2 year Winter Q+0%	97.400	96.591	0.041	0.000		110.547	50.481	51	0.9	SURCHARGED*
1.007	106	120 minute 2 year Winter Q+0%	97.400	96.592	0.052	0.000			0.361		0.7	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 1

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 3 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Site Location	GB 538700 152900 TQ 38700 52900	Cv (Winter)	0.840
Return Period (years)	30	Data Type	Catchment		
FEH Rainfall Version	2013	Cv (Summer)	0.750		

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status ON
Analysis Timestep 2.5 Second Increment (Extended) DVD Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Sensitivity flows(s) (%) 0, +35

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	100	15 minute 30 year Winter Q+35%	99.150	98.151	0.201	0.000			0.877		38.7	SURCHARGED
1.001	101	15 minute 30 year Winter Q+35%	98.800	98.069	0.469	0.000		0.000	4.771	6	83.0	SURCHARGED
1.002	102	15 minute 30 year Winter Q+35%	98.800	97.898	0.418	0.000			2.678		104.6	SURCHARGED
1.003	103	15 minute 30 year Winter Q+35%	97.600	97.296	0.296	0.000		0.000	13.854	6	219.4	SURCHARGED
1.004	104	15 minute 30 year Winter Q+35%	97.400	97.136	0.211	0.000			4.305		221.7	FLOOD RISK
1.005	105(HW)	15 minute 30 year Summer Q+0%	97.400	96.860	0.000	0.000			3.677		174.4	SURCHARGED*
1.006	106(HW)	120 minute 30 year Winter Q+35%	97.400	97.073	0.523	0.000		223.639	207.622	113	1.3	SURCHARGED*
1.007	106	120 minute 30 year Winter Q+35%	97.400	97.075	0.535	0.000			1.215		0.8	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 1

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 3 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH Site Location GB 538700 152900 TQ 38700 52900 Cv (Winter) 0.840
Return Period (years) 100 Data Type Catchment
FEH Rainfall Version 2013 Cv (Summer) 0.750

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status ON
Analysis Timestep 2.5 Second Increment (Extended) DVD Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Sensitivity flows(s) (%) 0, +45

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	100	15 minute 100 year Winter Q+45%	99.150	98.666	0.716	0.000			1.787		57.2	SURCHARGED
1.001	101	15 minute 100 year Winter Q+45%	98.800	98.550	0.950	0.000		0.000	10.463	4	112.4	FLOOD RISK
1.002	102	15 minute 100 year Winter Q+45%	98.800	98.373	0.893	0.000			3.518		124.1	SURCHARGED
1.003	103	15 minute 100 year Winter Q+45%	97.600	97.601	0.601	0.969		0.000	23.607	7	283.1	FLOOD
1.004	104	15 minute 100 year Winter Q+45%	97.400	97.349	0.424	0.000			4.610		286.8	FLOOD RISK
1.005	105(HW)	15 minute 100 year Summer Q+0%	97.400	96.860	0.000	0.000			3.720		202.6	SURCHARGED*
1.006	106(HW)	120 minute 100 year Winter Q+45%	97.400	97.309	0.759	0.000		252.026	300.073		1.5	FLOOD RISK*
1.007	106	120 minute 100 year Winter Q+45%	97.400	97.312	0.772	0.000			1.633		1.0	FLOOD RISK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Mainline 2

Pipe Sizes Manhole Sizes

FEH Rainfall Model

Return Period (years)	100	Volumetric Runoff Coeff.	0.750
		PIMP (%)	100
FEH Rainfall Version	2013	Add Flow / Climate Change (%)	45
Site Location	GB 538700 152900 TQ 38700 52900	Minimum Backdrop Height (m)	0.000
Data Type	Catchment	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	500	Min Design Depth for Optimisation (m)	0.000
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	100

Designed with Level Soffits

Time Area Diagram for Mainline 2

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.797	4-8	1.736	8-12	0.139	12-16	0.105	16-20	0.040	20-24	0.000

Total Area Contributing (ha) = 2.818

Total Pipe Volume (m³) = 110.721

Network Design Table for Mainline 2

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.000	1.431	0.010	143.1	0.006	15.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	97.99	15.02	104.250	0.006	0.0	0.0	0.8	1.31	92.8	2.4

Network Design Table for Mainline 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.001	16.310	0.590	27.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	2.718	0.010	271.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	18.531	0.390	47.5	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.004	21.018	0.650	32.3	0.076	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.005	1.496	0.015	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.006	16.170	0.615	26.3	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit	
3.000	1.469	0.010	146.9	0.017	15.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	27.183	0.090	302.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.002	2.454	0.010	245.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.003	2.245	0.010	224.5	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.004	17.172	0.065	264.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.007	19.281	0.070	275.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.008	1.681	0.010	168.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.009	10.409	0.040	260.2	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.010	48.669	0.050	973.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.011	3.495	0.270	12.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.012	1.474	0.050	29.5	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.013	23.786	0.320	74.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.001	97.71	15.11	104.240	0.006	0.0	0.0	0.8	3.00	212.2	2.4
2.002	97.57	15.16	103.650	0.006	0.0	0.0	0.8	0.95	67.1	2.4
2.003	97.16	15.29	103.640	0.033	0.0	0.0	3.9	2.29	161.6	12.5
2.004	96.77	15.42	103.250	0.109	0.0	0.0	12.9	2.77	196.1	41.5
2.005	96.70	15.44	102.600	0.109	0.0	0.0	12.9	1.00	17.8«	41.5
2.006	97.63	15.14	102.585	0.000	1.0	0.0	0.3	1.97	34.8	1.0
3.000	97.98	15.02	102.000	0.017	0.0	0.0	2.0	1.30	91.5	6.6
3.001	96.46	15.52	101.990	0.017	0.0	0.0	2.0	0.90	63.6	6.6
3.002	96.33	15.56	101.900	0.017	0.0	0.0	2.0	1.00	70.6	6.6
3.003	96.23	15.60	101.890	0.059	0.0	0.0	6.9	1.05	73.9	22.2
3.004	95.34	15.90	101.880	0.059	0.0	0.0	6.9	0.96	68.0	22.2
2.007	94.33	16.24	101.820	0.059	1.0	0.0	7.2	0.94	66.6	23.2
2.008	94.27	16.26	101.750	0.059	1.0	0.0	7.2	1.21	85.5	23.2
2.009	93.75	16.44	101.740	0.099	1.0	0.0	11.7	0.97	68.6	37.8
2.010	89.27	18.08	101.700	0.099	1.0	0.0	11.7	0.50	35.1«	37.8
2.011	89.24	18.09	101.650	0.099	1.0	0.0	11.7	4.39	310.5	37.8
2.012	98.02	15.01	101.380	0.000	0.4	0.0	0.1	2.91	205.5	0.4
2.013	97.36	15.23	101.330	0.000	0.4	0.0	0.2	1.83	129.0	0.6

Network Design Table for Mainline 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
2.014	1.448	0.010	144.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.015	62.449	1.300	48.0	0.097	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.016	1.492	0.010	149.2	0.036	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.017	52.930	1.030	51.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.018	1.650	0.020	82.5	0.274	0.00	0.0	0.600	o	100	Pipe/Conduit	
4.000	6.570	0.030	219.0	0.231	15.00	0.0	0.600	o	300	Pipe/Conduit	
2.019	1.570	0.010	157.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.020	65.865	1.180	55.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	1.374	0.010	137.4	0.124	15.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	12.030	0.010	1203.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	1.383	0.010	138.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.003	20.204	0.505	40.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.004	49.556	0.575	86.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.005	29.773	0.925	32.2	0.046	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.006	19.796	0.325	60.9	0.009	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.007	50.007	0.625	80.0	0.238	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.008	42.989	1.890	22.7	0.161	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.014	97.30	15.24	101.010	0.000	0.4	0.0	0.2	1.30	92.2	0.6
2.015	95.92	15.70	101.000	0.097	0.4	0.0	11.6	2.27	160.7	37.3
2.016	95.86	15.72	99.700	0.133	0.4	0.0	15.7	1.28	90.8	50.7
2.017	94.67	16.12	99.690	0.133	0.4	0.0	15.7	2.20	155.4	50.7
2.018	94.57	16.15	98.660	0.407	0.4	0.0	47.1	0.85	6.7«	151.9
4.000	97.73	15.10	98.470	0.231	0.0	0.0	27.6	1.06	74.8«	88.8
2.019	94.51	16.18	98.440	0.639	0.4	0.0	73.8	1.25	88.5«	237.7
2.020	93.01	16.70	98.430	0.639	0.4	0.0	73.8	2.11	149.1«	237.7
5.000	97.99	15.02	103.435	0.124	0.0	0.0	14.8	1.34	94.7	47.7
5.001	96.62	15.47	103.425	0.124	0.0	0.0	14.8	0.44	31.4«	47.7
5.002	96.57	15.49	103.415	0.124	0.0	0.0	14.8	1.34	94.4	47.7
5.003	97.63	15.14	103.405	0.000	1.0	0.0	0.3	2.49	176.2	1.0
5.004	96.16	15.62	102.900	0.000	1.0	0.0	0.5	1.69	119.8	1.5
5.005	95.62	15.80	102.325	0.046	1.0	0.0	5.8	2.78	196.6	18.6
5.006	95.14	15.96	101.400	0.055	1.0	0.0	6.8	2.02	142.7	21.8
5.007	93.75	16.44	101.075	0.292	1.0	0.0	33.8	1.76	124.4	109.0
5.008	93.13	16.65	100.450	0.453	1.0	0.0	51.9	3.31	234.0	167.1

Network Design Table for Mainline 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
6.000	1.513	0.010	151.3	0.017	15.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	50.853	0.190	267.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	13.032	0.050	260.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	1.456	0.010	145.6	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
7.001	40.896	1.690	24.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.002	3.655	0.150	24.4	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.003	3.096	0.150	20.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.004	36.668	1.990	18.4	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.005	1.835	0.010	183.5	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.006	24.032	1.010	23.8	0.003	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.000	1.151	0.010	115.1	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
8.001	19.118	0.070	273.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.002	3.745	0.020	187.3	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.003	4.773	0.020	238.7	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.004	23.710	0.410	57.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.005	1.732	0.010	173.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.006	1.721	0.010	172.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.000	97.98	15.02	101.750	0.017	0.0	0.0	2.0	1.28	90.2	6.5
6.001	95.31	15.91	101.740	0.017	0.0	0.0	2.0	0.96	67.6	6.5
6.002	94.65	16.13	101.550	0.017	0.0	0.0	2.0	0.97	68.5	6.5
7.000	97.99	15.02	108.000	0.000	0.0	0.0	0.0	1.30	92.0	0.0
7.001	97.34	15.23	107.990	0.000	0.0	0.0	0.0	3.21	226.9	0.0
7.002	97.28	15.25	106.300	0.017	0.0	0.0	2.1	3.20	226.1	6.6
7.003	97.24	15.26	106.150	0.017	0.0	0.0	2.1	3.48	245.7	6.6
7.004	96.73	15.43	106.000	0.075	0.0	0.0	8.9	3.68	260.1	28.7
7.005	96.65	15.46	104.010	0.102	0.0	0.0	12.0	1.16	81.8	38.6
7.006	96.28	15.58	104.000	0.105	0.0	0.0	12.3	3.24	228.8	39.8
8.000	98.00	15.01	104.620	0.000	0.0	0.0	0.0	1.46	103.5	0.0
8.001	96.98	15.35	104.610	0.000	0.0	0.0	0.0	0.95	66.9	0.0
8.002	96.82	15.40	104.540	0.014	0.0	0.0	1.7	1.15	81.0	5.5
8.003	96.58	15.48	104.520	0.029	0.0	0.0	3.4	1.01	71.6	10.9
8.004	96.00	15.67	104.500	0.029	0.0	0.0	3.4	2.07	146.4	10.9
8.005	95.93	15.70	104.090	0.029	0.0	0.0	3.4	1.19	84.2	10.9
8.006	95.86	15.72	104.080	0.029	0.0	0.0	3.4	1.20	84.5	10.9

Network Design Table for Mainline 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
8.007	12.955	0.070	185.1	0.048	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.008	1.050	0.010	105.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.009	8.202	0.190	43.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.010	19.203	0.800	24.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
8.011	2.020	0.010	202.0	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.007	32.210	0.790	40.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.008	10.270	0.700	14.7	0.285	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.003	3.547	0.030	118.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.000	1.467	0.010	146.7	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
9.001	23.676	0.140	169.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.002	7.903	0.250	31.6	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.003	18.964	0.600	31.6	0.184	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.004	31.366	1.400	22.4	0.025	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.005	10.803	0.900	12.0	0.081	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.006	1.486	0.010	148.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
9.007	2.081	0.020	104.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
8.007	95.30	15.91	104.070	0.077	0.0	0.0	9.0	1.15	81.5	28.8
8.008	95.27	15.92	104.000	0.077	0.0	0.0	9.0	1.53	108.5	28.8
8.009	97.87	15.06	103.990	0.000	1.0	0.0	0.3	2.40	169.6	1.0
8.010	97.57	15.16	103.800	0.014	1.0	0.0	2.1	3.22	227.8	6.8
8.011	97.48	15.19	103.000	0.035	1.0	0.0	4.6	1.10	77.9	14.9
7.007	95.63	15.80	102.990	0.140	1.0	0.0	16.8	2.47	174.6	54.1
7.008	95.50	15.84	102.200	0.425	1.0	0.0	49.9	4.13	291.6	160.8
6.003	94.53	16.17	101.500	0.442	1.0	0.0	51.3	1.44	102.1«	165.4
9.000	97.99	15.02	103.800	0.000	0.0	0.0	0.0	1.30	91.6	0.0
9.001	96.99	15.35	103.790	0.000	0.0	0.0	0.0	1.21	85.3	0.0
9.002	96.85	15.39	103.650	0.028	0.0	0.0	3.3	2.81	198.4	10.8
9.003	96.51	15.51	103.400	0.212	0.0	0.0	25.0	2.81	198.4	80.4
9.004	96.04	15.66	102.800	0.238	0.0	0.0	27.8	3.34	235.8	89.6
9.005	95.92	15.70	102.400	0.319	0.0	0.0	37.3	4.56	322.5	120.0
9.006	95.86	15.72	101.500	0.319	0.0	0.0	37.3	1.29	91.0«	120.0
9.007	95.79	15.74	101.490	0.319	0.0	0.0	37.3	1.54	108.9«	120.0

Network Design Table for Mainline 2

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
6.004	20.986	0.090	233.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.005	2.543	0.010	254.3	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
6.006	2.706	0.010	270.6	0.228	0.00	0.0	0.600	o	675	Pipe/Conduit	
6.007	22.667	0.100	226.7	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
6.008	12.237	0.200	61.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.009	7.270	0.485	15.0	0.074	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.010	9.015	0.040	225.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
6.011	9.922	0.065	152.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.009	29.135	0.410	71.1	0.051	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.010	29.220	0.175	167.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.011	53.324	0.390	136.7	0.131	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.012	4.126	0.020	206.3	0.034	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.013	36.898	0.240	153.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.021	21.156	0.140	151.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.022	14.955	0.620	24.1	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.004	93.76	16.43	101.320	0.760	1.0	0.0	87.3	1.33	211.1«	281.4
6.005	93.69	16.46	101.230	0.760	1.0	0.0	87.3	1.64	586.5	281.4
6.006	93.61	16.49	101.220	0.988	1.0	0.0	113.2	1.59	568.4	364.7
6.007	92.99	16.71	101.210	0.988	1.0	0.0	113.2	1.74	621.5	364.7
6.008	92.76	16.78	101.110	0.988	1.0	0.0	113.2	2.60	414.0	364.7
6.009	92.70	16.81	100.910	1.063	1.0	0.0	120.5	5.27	838.5	388.2
6.010	92.39	16.92	100.425	1.063	1.0	0.0	120.5	1.35	214.7«	388.2
6.011	91.82	17.12	98.775	1.063	1.0	0.0	120.5	0.81	14.3«	388.2
5.009	91.20	17.35	98.485	1.566	2.0	0.0	175.0	2.15	237.7«	563.8
5.010	90.27	17.70	98.075	1.566	2.0	0.0	175.0	1.40	154.6«	563.8
5.011	88.77	18.27	97.900	1.698	2.0	0.0	184.5	1.55	170.9«	594.7
5.012	97.88	15.05	97.510	0.000	46.4	0.0	14.4	1.26	138.9	46.4
5.013	96.60	15.48	97.490	0.000	46.4	0.0	20.9	1.46	161.1	67.3
2.021	91.81	17.13	97.250	0.639	46.8	0.0	92.5	0.82	14.4«	298.1
2.022	97.68	15.12	97.110	0.000	9.3	0.0	2.9	2.06	36.4	9.3

Manhole Schedules for Mainline 2

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	105.750	1.500	Open Manhole	1500	2.000	104.250	300				
2 (HW)	105.750	1.510	Junction		2.001	104.240	300	2.000	104.240	300	
3 (HW)	105.150	1.500	Junction		2.002	103.650	300	2.001	103.650	300	
4	105.150	1.510	Open Manhole	1500	2.003	103.640	300	2.002	103.640	300	
5 (HW)	104.450	1.200	Junction		2.004	103.250	300	2.003	103.250	300	
6 (HW)	103.800	1.200	Junction		2.005	102.600	150	2.004	102.600	300	
7	103.800	1.215	Open Manhole	1500	2.006	102.585	150	2.005	102.585	150	
24	103.300	1.300	Open Manhole	1500	3.000	102.000	300				
12 (HW)	103.300	1.310	Junction		3.001	101.990	300	3.000	101.990	300	
13 (HW)	103.180	1.280	Junction		3.002	101.900	300	3.001	101.900	300	
27	103.180	1.290	Open Manhole	1500	3.003	101.890	300	3.002	101.890	300	
15 (HW)	103.180	1.300	Junction		3.004	101.880	300	3.003	101.880	300	
8 (J)	103.150	1.335	Junction		2.007	101.820	300	2.006	101.970	150	
								3.004	101.815	300	
9 (HW)	103.250	1.500	Junction		2.008	101.750	300	2.007	101.750	300	
10	103.250	1.510	Open Manhole	1500	2.009	101.740	300	2.008	101.740	300	
11 (HW)	103.250	1.550	Junction		2.010	101.700	300	2.009	101.700	300	
12 (HW)	102.850	1.200	Junction		2.011	101.650	300	2.010	101.650	300	
13	102.850	1.470	Open Manhole	1500	2.012	101.380	300	2.011	101.380	300	
14 (HW)	102.850	1.520	Junction		2.013	101.330	300	2.012	101.330	300	
15 (HW)	102.600	1.590	Junction		2.014	101.010	300	2.013	101.010	300	
16	102.600	1.600	Open Manhole	1500	2.015	101.000	300	2.014	101.000	300	
17	100.750	1.050	Open Manhole	1500	2.016	99.700	300	2.015	99.700	300	
18 (HW)	100.750	1.060	Junction		2.017	99.690	300	2.016	99.690	300	
19 (HW)	99.550	0.890	Junction		2.018	98.660	100	2.017	98.660	300	
29	99.900	1.430	Open Manhole	1500	4.000	98.470	300				
20	99.550	1.110	Open Manhole	1500	2.019	98.440	300	2.018	98.640	100	
								4.000	98.440	300	
31 (HW)	99.550	1.120	Junction		2.020	98.430	300	2.019	98.430	300	
30	104.700	1.265	Open Manhole	1500	5.000	103.435	300				
31 (J)	104.700	1.275	Junction		5.001	103.425	300	5.000	103.425	300	
32 (J)	104.250	0.835	Junction		5.002	103.415	300	5.001	103.415	300	

Manhole Schedules for Mainline 2

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
33	104.250	0.845	Open Manhole	1500	5.003	103.405	300	5.002	103.405	300	
34	104.100	1.200	Open Manhole	1500	5.004	102.900	300	5.003	102.900	300	
35	103.750	1.425	Open Manhole	1500	5.005	102.325	300	5.004	102.325	300	
36	102.900	1.500	Open Manhole	1500	5.006	101.400	300	5.005	101.400	300	
37	102.500	1.425	Open Manhole	1500	5.007	101.075	300	5.006	101.075	300	
38	101.950	1.500	Open Manhole	1500	5.008	100.450	300	5.007	100.450	300	
43	103.250	1.500	Open Manhole	1500	6.000	101.750	300				
44(HW)	103.250	1.510	Junction		6.001	101.740	300	6.000	101.740	300	
45(HW)	103.050	1.500	Junction		6.002	101.550	300	6.001	101.550	300	
55	109.500	1.500	Open Manhole	1500	7.000	108.000	300				
56(HW)	109.500	1.510	Junction		7.001	107.990	300	7.000	107.990	300	
57(HW)	107.800	1.500	Junction		7.002	106.300	300	7.001	106.300	300	
58	107.500	1.350	Open Manhole	1500	7.003	106.150	300	7.002	106.150	300	
59(HW)	107.500	1.500	Junction		7.004	106.000	300	7.003	106.000	300	
60(HW)	105.500	1.490	Junction		7.005	104.010	300	7.004	104.010	300	
61	105.500	1.500	Open Manhole	1500	7.006	104.000	300	7.005	104.000	300	
65	106.000	1.380	Open Manhole	1500	8.000	104.620	300				
62(HW)	106.000	1.390	Junction		8.001	104.610	300	8.000	104.610	300	
66(HW)	106.000	1.460	Junction		8.002	104.540	300	8.001	104.540	300	
67	106.000	1.480	Open Manhole	1500	8.003	104.520	300	8.002	104.520	300	
68(HW)	106.000	1.500	Junction		8.004	104.500	300	8.003	104.500	300	
69(HW)	105.590	1.500	Junction		8.005	104.090	300	8.004	104.090	300	
70	105.580	1.500	Open Manhole	1500	8.006	104.080	300	8.005	104.080	300	
71(HW)	105.570	1.500	Junction		8.007	104.070	300	8.006	104.070	300	
72(HW)	105.500	1.500	Junction		8.008	104.000	300	8.007	104.000	300	
73	105.500	1.510	Open Manhole	1500	8.009	103.990	300	8.008	103.990	300	
74(HW)	105.300	1.500	Junction		8.010	103.800	300	8.009	103.800	300	
75(HW)	104.500	1.500	Junction		8.011	103.000	300	8.010	103.000	300	
62	104.500	1.510	Open Manhole	1800	7.007	102.990	300	7.006	102.990	300	
								8.011	102.990	300	
63	103.700	1.500	Open Manhole	1500	7.008	102.200	300	7.007	102.200	300	
46	103.200	1.700	Open Manhole	1800	6.003	101.500	300	6.002	101.500	300	

Manhole Schedules for Mainline 2

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
								7.008	101.500	300	
76	105.600	1.800	Open Manhole	1500	9.000	103.800	300				
77(HW)	105.600	1.810	Junction		9.001	103.790	300	9.000	103.790	300	
78(HW)	105.150	1.500	Junction		9.002	103.650	300	9.001	103.650	300	
79	104.900	1.500	Open Manhole	1500	9.003	103.400	300	9.002	103.400	300	
80(HW)	104.300	1.500	Junction		9.004	102.800	300	9.003	102.800	300	
81(HW)	103.900	2.500	Junction		9.005	102.400	300	9.004	101.400	300	
82	103.200	1.700	Open Manhole	1500	9.006	101.500	300	9.005	101.500	300	
83	103.200	1.710	Junction		9.007	101.490	300	9.006	101.490	300	
47(HW)	103.200	1.880	Junction		6.004	101.320	450	6.003	101.470	300	
								9.007	101.470	300	
48(HW)	102.350	1.120	Junction		6.005	101.230	675	6.004	101.230	450	
49	102.350	1.130	Open Manhole	1500	6.006	101.220	675	6.005	101.220	675	
50(HW)	102.350	1.140	Junction		6.007	101.210	675	6.006	101.210	675	
51(HW)	101.850	0.740	Junction		6.008	101.110	450	6.007	101.110	675	
52	101.850	0.940	Open Manhole	1500	6.009	100.910	450	6.008	100.910	450	
53(J)	101.400	0.975	Junction		6.010	100.425	450	6.009	100.425	450	
54J	101.400	2.625	Junction		6.011	98.775	150	6.010	100.385	450	1910
39	101.550	3.065	Open Manhole	1800	5.009	98.485	375	5.008	98.560	300	
								6.011	98.710	150	
84	99.650	1.575	Open Manhole	1500	5.010	98.075	375	5.009	98.075	375	
40	99.600	1.700	Open Manhole	1500	5.011	97.900	375	5.010	97.900	375	
41	98.800	1.290	Open Manhole	1500	5.012	97.510	375	5.011	97.510	375	
42(HW)	98.800	1.310	Junction		5.013	97.490	375	5.012	97.490	375	
22(HW)	98.600	1.350	Junction		2.021	97.250	150	2.020	97.250	300	
								5.013	97.250	375	
23	98.600	1.490	Open Manhole	1500	2.022	97.110	150	2.021	97.110	150	
Outfall	97.920	1.430	Open Manhole	1200		OUTFALL		2.022	96.490	150	

Manhole Schedules for Mainline 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	538805.464	153287.832	538805.464	153287.832	Required	
2(HW)	538804.771	153286.580			No Entry	
3(HW)	538796.478	153272.536			No Entry	
4	538795.050	153270.223	538795.050	153270.223	Required	
5(HW)	538779.985	153259.433			No Entry	
6(HW)	538765.507	153244.196			No Entry	
7	538764.389	153243.201	538764.389	153243.201	Required	
24	538785.798	153195.437	538785.798	153195.437	Required	
12(HW)	538784.872	153196.577			No Entry	
13(HW)	538766.732	153216.822			No Entry	
27	538764.807	153218.345	538764.807	153218.345	Required	
15(HW)	538763.315	153220.021			No Entry	
8(J)	538751.938	153232.884			No Entry	
9(HW)	538739.166	153247.328			No Entry	
10	538737.550	153247.791	538737.550	153247.791	Required	
11(HW)	538727.520	153250.575			No Entry	
12(HW)	538687.515	153222.858			No Entry	

Manhole Schedules for Mainline 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
13	538685.349	153220.115	538685.349	153220.115	Required	
14(HW)	538684.898	153218.712			No Entry	
15(HW)	538678.878	153195.700			No Entry	
16	538678.509	153194.300	538678.509	153194.300	Required	
17	538678.322	153131.851	538678.322	153131.851	Required	
18(HW)	538678.341	153130.359			No Entry	
19(HW)	538694.103	153079.830			No Entry	
29	538700.187	153080.539	538700.187	153080.539	Required	
20	538694.055	153078.181	538694.055	153078.181	Required	
31(HW)	538693.440	153076.736			No Entry	
30	538935.080	153043.333	538935.080	153043.333	Required	
31(J)	538936.194	153042.528			No Entry	
32(J)	538945.841	153035.340			No Entry	
33	538946.886	153034.435	538946.886	153034.435	Required	
34	538951.449	153014.753	538951.449	153014.753	Required	
35	538903.860	153000.930	538903.860	153000.930	Required	
36	538874.411	152996.549	538874.411	152996.549	Required	

Manhole Schedules for Mainline 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
37	538861.215	153011.304	538861.215	153011.304	Required	
38	538828.412	153049.048	538828.412	153049.048	Required	
43	538788.357	153192.621	538788.357	153192.621	Required	
44(HW)	538789.391	153191.516			No Entry	
45(HW)	538823.313	153153.630			No Entry	
55	538925.423	153222.007	538925.423	153222.007	Required	
56(HW)	538925.586	153220.561			No Entry	
57(HW)	538928.008	153179.736			No Entry	
58	538924.468	153178.825	538924.468	153178.825	Required	
59(HW)	538921.391	153178.486			No Entry	
60(HW)	538884.878	153175.114			No Entry	
61	538884.027	153173.488	538884.027	153173.488	Required	
65	538827.501	153259.048	538827.501	153259.048	Required	
62(HW)	538828.214	153258.145			No Entry	
66(HW)	538840.844	153243.793			No Entry	
67	538843.499	153241.152	538843.499	153241.152	Required	
68(HW)	538847.433	153238.449			No Entry	

Manhole Schedules for Mainline 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
69(HW)	538857.183	153216.836			No Entry	
70	538858.574	153215.805	538858.574	153215.805	Required	
71(HW)	538859.953	153214.774			No Entry	
72(HW)	538865.700	153203.164			No Entry	
73	538865.478	153202.138	538865.478	153202.138	Required	
74(HW)	538864.356	153194.013			No Entry	
75(HW)	538861.514	153175.022			No Entry	
62	538859.996	153173.690	538859.996	153173.690	Required	
63	538836.170	153152.015	538836.170	153152.015	Required	
46	538831.026	153143.126	538831.026	153143.126	Required	
76	538901.755	153079.041	538901.755	153079.041	Required	
77(HW)	538900.785	153080.141			No Entry	
78(HW)	538885.090	153097.868			No Entry	
79	538879.799	153103.738	538879.799	153103.738	Required	
80(HW)	538867.080	153117.805			No Entry	
81(HW)	538845.984	153141.017			No Entry	
82	538835.640	153137.904	538835.640	153137.904	Required	

Manhole Schedules for Mainline 2

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
83	538834.467	153138.815			No Entry	
47(HW)	538832.789	153140.047			No Entry	
48(HW)	538816.976	153126.249			No Entry	
49	538814.731	153125.055	538814.731	153125.055	Required	
50(HW)	538812.285	153123.897			No Entry	
51(HW)	538795.228	153108.968			No Entry	
52	538786.482	153100.410	538786.482	153100.410	Required	
53(J)	538786.131	153093.149			No Entry	
54J	538789.438	153084.762			No Entry	
39	538796.127	153077.434	538796.127	153077.434	Required	
84	538774.029	153058.446	538774.029	153058.446	Required	
40	538745.516	153052.057	538745.516	153052.057	Required	
41	538692.307	153048.562	538692.307	153048.562	Required	
42(HW)	538689.768	153045.310			No Entry	
22(HW)	538666.614	153016.581			No Entry	
23	538647.249	153008.061	538647.249	153008.061	Required	
Outfall	538636.805	152997.357			No Entry	

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	o	300	1	105.750	104.250	1.200	Open Manhole	1500
2.001	o	300	2(HW)	105.750	104.240	1.210	Junction	
2.002	o	300	3(HW)	105.150	103.650	1.200	Junction	
2.003	o	300	4	105.150	103.640	1.210	Open Manhole	1500
2.004	o	300	5(HW)	104.450	103.250	0.900	Junction	
2.005	o	150	6(HW)	103.800	102.600	1.050	Junction	
2.006	o	150	7	103.800	102.585	1.065	Open Manhole	1500
3.000	o	300	24	103.300	102.000	1.000	Open Manhole	1500
3.001	o	300	12(HW)	103.300	101.990	1.010	Junction	
3.002	o	300	13(HW)	103.180	101.900	0.980	Junction	
3.003	o	300	27	103.180	101.890	0.990	Open Manhole	1500
3.004	o	300	15(HW)	103.180	101.880	1.000	Junction	
2.007	o	300	8(J)	103.150	101.820	1.030	Junction	
2.008	o	300	9(HW)	103.250	101.750	1.200	Junction	
2.009	o	300	10	103.250	101.740	1.210	Open Manhole	1500
2.010	o	300	11(HW)	103.250	101.700	1.250	Junction	
2.011	o	300	12(HW)	102.850	101.650	0.900	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.000	1.431	143.1	2(HW)	105.750	104.240	1.210	Junction	
2.001	16.310	27.6	3(HW)	105.150	103.650	1.200	Junction	
2.002	2.718	271.8	4	105.150	103.640	1.210	Open Manhole	1500
2.003	18.531	47.5	5(HW)	104.450	103.250	0.900	Junction	
2.004	21.018	32.3	6(HW)	103.800	102.600	0.900	Junction	
2.005	1.496	100.0	7	103.800	102.585	1.065	Open Manhole	1500
2.006	16.170	26.3	8(J)	103.150	101.970	1.030	Junction	
3.000	1.469	146.9	12(HW)	103.300	101.990	1.010	Junction	
3.001	27.183	302.0	13(HW)	103.180	101.900	0.980	Junction	
3.002	2.454	245.4	27	103.180	101.890	0.990	Open Manhole	1500
3.003	2.245	224.5	15(HW)	103.180	101.880	1.000	Junction	
3.004	17.172	264.2	8(J)	103.150	101.815	1.035	Junction	
2.007	19.281	275.4	9(HW)	103.250	101.750	1.200	Junction	
2.008	1.681	168.1	10	103.250	101.740	1.210	Open Manhole	1500
2.009	10.409	260.2	11(HW)	103.250	101.700	1.250	Junction	
2.010	48.669	973.4	12(HW)	102.850	101.650	0.900	Junction	
2.011	3.495	12.9	13	102.850	101.380	1.170	Open Manhole	1500

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.012	o	300	13	102.850	101.380	1.170	Open Manhole	1500
2.013	o	300	14(HW)	102.850	101.330	1.220	Junction	
2.014	o	300	15(HW)	102.600	101.010	1.290	Junction	
2.015	o	300	16	102.600	101.000	1.300	Open Manhole	1500
2.016	o	300	17	100.750	99.700	0.750	Open Manhole	1500
2.017	o	300	18(HW)	100.750	99.690	0.760	Junction	
2.018	o	100	19(HW)	99.550	98.660	0.790	Junction	
4.000	o	300	29	99.900	98.470	1.130	Open Manhole	1500
2.019	o	300	20	99.550	98.440	0.810	Open Manhole	1500
2.020	o	300	31(HW)	99.550	98.430	0.820	Junction	
5.000	o	300	30	104.700	103.435	0.965	Open Manhole	1500
5.001	o	300	31(J)	104.700	103.425	0.975	Junction	
5.002	o	300	32(J)	104.250	103.415	0.535	Junction	
5.003	o	300	33	104.250	103.405	0.545	Open Manhole	1500
5.004	o	300	34	104.100	102.900	0.900	Open Manhole	1500
5.005	o	300	35	103.750	102.325	1.125	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.012	1.474	29.5	14(HW)	102.850	101.330	1.220	Junction	
2.013	23.786	74.3	15(HW)	102.600	101.010	1.290	Junction	
2.014	1.448	144.8	16	102.600	101.000	1.300	Open Manhole	1500
2.015	62.449	48.0	17	100.750	99.700	0.750	Open Manhole	1500
2.016	1.492	149.2	18(HW)	100.750	99.690	0.760	Junction	
2.017	52.930	51.4	19(HW)	99.550	98.660	0.590	Junction	
2.018	1.650	82.5	20	99.550	98.640	0.810	Open Manhole	1500
4.000	6.570	219.0	20	99.550	98.440	0.810	Open Manhole	1500
2.019	1.570	157.0	31(HW)	99.550	98.430	0.820	Junction	
2.020	65.865	55.8	22(HW)	98.600	97.250	1.050	Junction	
5.000	1.374	137.4	31(J)	104.700	103.425	0.975	Junction	
5.001	12.030	1203.0	32(J)	104.250	103.415	0.535	Junction	
5.002	1.383	138.3	33	104.250	103.405	0.545	Open Manhole	1500
5.003	20.204	40.0	34	104.100	102.900	0.900	Open Manhole	1500
5.004	49.556	86.2	35	103.750	102.325	1.125	Open Manhole	1500
5.005	29.773	32.2	36	102.900	101.400	1.200	Open Manhole	1500

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.006	o	300	36	102.900	101.400	1.200	Open Manhole	1500
5.007	o	300	37	102.500	101.075	1.125	Open Manhole	1500
5.008	o	300	38	101.950	100.450	1.200	Open Manhole	1500
6.000	o	300	43	103.250	101.750	1.200	Open Manhole	1500
6.001	o	300	44(HW)	103.250	101.740	1.210	Junction	
6.002	o	300	45(HW)	103.050	101.550	1.200	Junction	
7.000	o	300	55	109.500	108.000	1.200	Open Manhole	1500
7.001	o	300	56(HW)	109.500	107.990	1.210	Junction	
7.002	o	300	57(HW)	107.800	106.300	1.200	Junction	
7.003	o	300	58	107.500	106.150	1.050	Open Manhole	1500
7.004	o	300	59(HW)	107.500	106.000	1.200	Junction	
7.005	o	300	60(HW)	105.500	104.010	1.190	Junction	
7.006	o	300	61	105.500	104.000	1.200	Open Manhole	1500
8.000	o	300	65	106.000	104.620	1.080	Open Manhole	1500
8.001	o	300	62(HW)	106.000	104.610	1.090	Junction	
8.002	o	300	66(HW)	106.000	104.540	1.160	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
5.006	19.796	60.9	37	102.500	101.075	1.125	Open Manhole	1500
5.007	50.007	80.0	38	101.950	100.450	1.200	Open Manhole	1500
5.008	42.989	22.7	39	101.550	98.560	2.690	Open Manhole	1800
6.000	1.513	151.3	44(HW)	103.250	101.740	1.210	Junction	
6.001	50.853	267.6	45(HW)	103.050	101.550	1.200	Junction	
6.002	13.032	260.6	46	103.200	101.500	1.400	Open Manhole	1800
7.000	1.456	145.6	56(HW)	109.500	107.990	1.210	Junction	
7.001	40.896	24.2	57(HW)	107.800	106.300	1.200	Junction	
7.002	3.655	24.4	58	107.500	106.150	1.050	Open Manhole	1500
7.003	3.096	20.6	59(HW)	107.500	106.000	1.200	Junction	
7.004	36.668	18.4	60(HW)	105.500	104.010	1.190	Junction	
7.005	1.835	183.5	61	105.500	104.000	1.200	Open Manhole	1500
7.006	24.032	23.8	62	104.500	102.990	1.210	Open Manhole	1800
8.000	1.151	115.1	62(HW)	106.000	104.610	1.090	Junction	
8.001	19.118	273.1	66(HW)	106.000	104.540	1.160	Junction	
8.002	3.745	187.3	67	106.000	104.520	1.180	Open Manhole	1500

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.003	o	300	67	106.000	104.520	1.180	Open Manhole	1500
8.004	o	300	68(HW)	106.000	104.500	1.200	Junction	
8.005	o	300	69(HW)	105.590	104.090	1.200	Junction	
8.006	o	300	70	105.580	104.080	1.200	Open Manhole	1500
8.007	o	300	71(HW)	105.570	104.070	1.200	Junction	
8.008	o	300	72(HW)	105.500	104.000	1.200	Junction	
8.009	o	300	73	105.500	103.990	1.210	Open Manhole	1500
8.010	o	300	74(HW)	105.300	103.800	1.200	Junction	
8.011	o	300	75(HW)	104.500	103.000	1.200	Junction	
7.007	o	300	62	104.500	102.990	1.210	Open Manhole	1800
7.008	o	300	63	103.700	102.200	1.200	Open Manhole	1500
6.003	o	300	46	103.200	101.500	1.400	Open Manhole	1800
9.000	o	300	76	105.600	103.800	1.500	Open Manhole	1500
9.001	o	300	77(HW)	105.600	103.790	1.510	Junction	
9.002	o	300	78(HW)	105.150	103.650	1.200	Junction	
9.003	o	300	79	104.900	103.400	1.200	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.003	4.773	238.7	68(HW)	106.000	104.500	1.200	Junction	
8.004	23.710	57.8	69(HW)	105.590	104.090	1.200	Junction	
8.005	1.732	173.2	70	105.580	104.080	1.200	Open Manhole	1500
8.006	1.721	172.1	71(HW)	105.570	104.070	1.200	Junction	
8.007	12.955	185.1	72(HW)	105.500	104.000	1.200	Junction	
8.008	1.050	105.0	73	105.500	103.990	1.210	Open Manhole	1500
8.009	8.202	43.2	74(HW)	105.300	103.800	1.200	Junction	
8.010	19.203	24.0	75(HW)	104.500	103.000	1.200	Junction	
8.011	2.020	202.0	62	104.500	102.990	1.210	Open Manhole	1800
7.007	32.210	40.8	63	103.700	102.200	1.200	Open Manhole	1500
7.008	10.270	14.7	46	103.200	101.500	1.400	Open Manhole	1800
6.003	3.547	118.2	47(HW)	103.200	101.470	1.430	Junction	
9.000	1.467	146.7	77(HW)	105.600	103.790	1.510	Junction	
9.001	23.676	169.1	78(HW)	105.150	103.650	1.200	Junction	
9.002	7.903	31.6	79	104.900	103.400	1.200	Open Manhole	1500
9.003	18.964	31.6	80(HW)	104.300	102.800	1.200	Junction	

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.004	o	300	80(HW)	104.300	102.800	1.200	Junction	
9.005	o	300	81(HW)	103.900	102.400	1.200	Junction	
9.006	o	300	82	103.200	101.500	1.400	Open Manhole	1500
9.007	o	300	83	103.200	101.490	1.410	Junction	
6.004	o	450	47(HW)	103.200	101.320	1.430	Junction	
6.005	o	675	48(HW)	102.350	101.230	0.445	Junction	
6.006	o	675	49	102.350	101.220	0.455	Open Manhole	1500
6.007	o	675	50(HW)	102.350	101.210	0.465	Junction	
6.008	o	450	51(HW)	101.850	101.110	0.290	Junction	
6.009	o	450	52	101.850	100.910	0.490	Open Manhole	1500
6.010	o	450	53(J)	101.400	100.425	0.525	Junction	
6.011	o	150	54J	101.400	98.775	2.475	Junction	
5.009	o	375	39	101.550	98.485	2.690	Open Manhole	1800
5.010	o	375	84	99.650	98.075	1.200	Open Manhole	1500
5.011	o	375	40	99.600	97.900	1.325	Open Manhole	1500
5.012	o	375	41	98.800	97.510	0.915	Open Manhole	1500
5.013	o	375	42(HW)	98.800	97.490	0.935	Junction	

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
9.004	31.366	22.4	81(HW)	103.900	101.400	2.200	Junction	
9.005	10.803	12.0	82	103.200	101.500	1.400	Open Manhole	1500
9.006	1.486	148.6	83	103.200	101.490	1.410	Junction	
9.007	2.081	104.1	47(HW)	103.200	101.470	1.430	Junction	
6.004	20.986	233.2	48(HW)	102.350	101.230	0.670	Junction	
6.005	2.543	254.3	49	102.350	101.220	0.455	Open Manhole	1500
6.006	2.706	270.6	50(HW)	102.350	101.210	0.465	Junction	
6.007	22.667	226.7	51(HW)	101.850	101.110	0.065	Junction	
6.008	12.237	61.2	52	101.850	100.910	0.490	Open Manhole	1500
6.009	7.270	15.0	53(J)	101.400	100.425	0.525	Junction	
6.010	9.015	225.4	54J	101.400	100.385	0.565	Junction	
6.011	9.922	152.7	39	101.550	98.710	2.690	Open Manhole	1800
5.009	29.135	71.1	84	99.650	98.075	1.200	Open Manhole	1500
5.010	29.220	167.0	40	99.600	97.900	1.325	Open Manhole	1500
5.011	53.324	136.7	41	98.800	97.510	0.915	Open Manhole	1500
5.012	4.126	206.3	42(HW)	98.800	97.490	0.935	Junction	
5.013	36.898	153.7	22(HW)	98.600	97.250	0.975	Junction	

PIPELINE SCHEDULES for Mainline 2

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.021	o	150	22 (HW)	98.600	97.250	1.200	Junction	
2.022	o	150	23	98.600	97.110	1.340	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
2.021	21.156	151.1	23	98.600	97.110	1.340	Open Manhole	1500
2.022	14.955	24.1	Outfall	97.920	96.490	1.280	Open Manhole	1200

Area Summary for Mainline 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	User	-	100	0.006	0.006	0.006
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
2.003	User	-	100	0.018	0.018	0.018
	User	-	100	0.009	0.009	0.026
2.004	User	-	100	0.039	0.039	0.039
	User	-	100	0.037	0.037	0.076
2.005	-	-	100	0.000	0.000	0.000
2.006	User	-	100	0.028	0.028	0.028
3.000	User	-	100	0.006	0.006	0.006
	User	-	100	0.011	0.011	0.017
3.001	-	-	100	0.000	0.000	0.000
3.002	-	-	100	0.000	0.000	0.000
3.003	User	-	100	0.009	0.009	0.009
	User	-	100	0.011	0.011	0.019
	User	-	100	0.006	0.006	0.026
	User	-	100	0.010	0.010	0.036
	User	-	100	0.006	0.006	0.042
3.004	-	-	100	0.000	0.000	0.000
2.007	-	-	100	0.000	0.000	0.000
2.008	-	-	100	0.000	0.000	0.000
2.009	User	-	100	0.040	0.040	0.040
2.010	-	-	100	0.000	0.000	0.000
2.011	-	-	100	0.000	0.000	0.000
2.012	User	-	100	0.010	0.010	0.010
2.013	-	-	100	0.000	0.000	0.000
2.014	-	-	100	0.000	0.000	0.000
2.015	User	-	100	0.067	0.067	0.067
	User	-	100	0.010	0.010	0.077
	User	-	100	0.010	0.010	0.087
	User	-	100	0.010	0.010	0.097
2.016	User	-	100	0.010	0.010	0.010
	User	-	100	0.010	0.010	0.020
	User	-	100	0.009	0.009	0.030
	User	-	100	0.006	0.006	0.036
2.017	-	-	100	0.000	0.000	0.000
2.018	User	-	100	0.274	0.274	0.274
4.000	User	-	100	0.041	0.041	0.041
	User	-	100	0.009	0.009	0.049
	User	-	100	0.004	0.004	0.054
	User	-	100	0.005	0.005	0.059
	User	-	100	0.007	0.007	0.066
	User	-	100	0.006	0.006	0.072
	User	-	100	0.010	0.010	0.082
	User	-	100	0.006	0.006	0.089
	User	-	100	0.006	0.006	0.095
	User	-	100	0.007	0.007	0.102
	User	-	100	0.006	0.006	0.108
	User	-	100	0.011	0.011	0.119

Area Summary for Mainline 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.009	0.009	0.128
	User	-	100	0.006	0.006	0.134
	User	-	100	0.007	0.007	0.141
	User	-	100	0.006	0.006	0.147
	User	-	100	0.012	0.012	0.159
	User	-	100	0.009	0.009	0.168
	User	-	100	0.012	0.012	0.181
	User	-	100	0.010	0.010	0.190
	User	-	100	0.012	0.012	0.203
	User	-	100	0.007	0.007	0.210
	User	-	100	0.009	0.009	0.219
	User	-	100	0.008	0.008	0.227
	User	-	100	0.005	0.005	0.231
2.019	-	-	100	0.000	0.000	0.000
2.020	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.021	0.021	0.021
	User	-	100	0.056	0.056	0.077
	User	-	100	0.007	0.007	0.084
	User	-	100	0.009	0.009	0.093
	User	-	100	0.016	0.016	0.109
	User	-	100	0.004	0.004	0.113
	User	-	100	0.011	0.011	0.124
5.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
5.003	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
5.005	User	-	100	0.027	0.027	0.027
	User	-	100	0.012	0.012	0.040
	User	-	100	0.006	0.006	0.046
5.006	User	-	100	0.009	0.009	0.009
5.007	User	-	100	0.083	0.083	0.083
	User	-	100	0.011	0.011	0.095
	User	-	100	0.040	0.040	0.135
	User	-	100	0.006	0.006	0.141
	User	-	100	0.020	0.020	0.161
	User	-	100	0.005	0.005	0.167
	User	-	100	0.008	0.008	0.175
	User	-	100	0.006	0.006	0.181
	User	-	100	0.005	0.005	0.186
	User	-	100	0.023	0.023	0.208
	User	-	100	0.029	0.029	0.238
5.008	User	-	100	0.006	0.006	0.006
	User	-	100	0.003	0.003	0.010
	User	-	100	0.070	0.070	0.080
	User	-	100	0.054	0.054	0.134
	User	-	100	0.011	0.011	0.145
	User	-	100	0.008	0.008	0.153
	User	-	100	0.008	0.008	0.161
6.000	User	-	100	0.006	0.006	0.006

Area Summary for Mainline 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.011	0.011	0.017
6.001	-	-	100	0.000	0.000	0.000
6.002	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000
7.001	-	-	100	0.000	0.000	0.000
7.002	User	-	100	0.017	0.017	0.017
7.003	-	-	100	0.000	0.000	0.000
7.004	User	-	100	0.025	0.025	0.025
	User	-	100	0.033	0.033	0.058
7.005	User	-	100	0.026	0.026	0.026
7.006	User	-	100	0.003	0.003	0.003
8.000	-	-	100	0.000	0.000	0.000
8.001	-	-	100	0.000	0.000	0.000
8.002	User	-	100	0.014	0.014	0.014
8.003	User	-	100	0.014	0.014	0.014
8.004	-	-	100	0.000	0.000	0.000
8.005	-	-	100	0.000	0.000	0.000
8.006	-	-	100	0.000	0.000	0.000
8.007	User	-	100	0.035	0.035	0.035
	User	-	100	0.014	0.014	0.048
8.008	-	-	100	0.000	0.000	0.000
8.009	-	-	100	0.000	0.000	0.000
8.010	User	-	100	0.014	0.014	0.014
8.011	User	-	100	0.021	0.021	0.021
7.007	-	-	100	0.000	0.000	0.000
7.008	User	-	100	0.023	0.023	0.023
	User	-	100	0.170	0.170	0.192
	User	-	100	0.055	0.055	0.248
	User	-	100	0.010	0.010	0.258
	User	-	100	0.017	0.017	0.274
	User	-	100	0.006	0.006	0.281
	User	-	100	0.004	0.004	0.285
6.003	-	-	100	0.000	0.000	0.000
9.000	-	-	100	0.000	0.000	0.000
9.001	-	-	100	0.000	0.000	0.000
9.002	User	-	100	0.019	0.019	0.019
	User	-	100	0.009	0.009	0.028
9.003	User	-	100	0.055	0.055	0.055
	User	-	100	0.011	0.011	0.066
	User	-	100	0.062	0.062	0.128
	User	-	100	0.011	0.011	0.138
	User	-	100	0.011	0.011	0.150
	User	-	100	0.011	0.011	0.160
	User	-	100	0.007	0.007	0.167
	User	-	100	0.005	0.005	0.172
	User	-	100	0.012	0.012	0.184
9.004	User	-	100	0.012	0.012	0.012
	User	-	100	0.011	0.011	0.023
	User	-	100	0.002	0.002	0.025

Area Summary for Mainline 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
9.005	User	-	100	0.007	0.007	0.007
	User	-	100	0.038	0.038	0.045
	User	-	100	0.008	0.008	0.053
	User	-	100	0.007	0.007	0.060
	User	-	100	0.003	0.003	0.063
	User	-	100	0.007	0.007	0.070
	User	-	100	0.011	0.011	0.081
9.006	-	-	100	0.000	0.000	0.000
9.007	-	-	100	0.000	0.000	0.000
6.004	-	-	100	0.000	0.000	0.000
6.005	-	-	100	0.000	0.000	0.000
6.006	User	-	100	0.062	0.062	0.062
	User	-	100	0.018	0.018	0.079
	User	-	100	0.023	0.023	0.103
	User	-	100	0.021	0.021	0.124
	User	-	100	0.080	0.080	0.204
	User	-	100	0.011	0.011	0.215
	User	-	100	0.013	0.013	0.228
6.007	-	-	100	0.000	0.000	0.000
6.008	-	-	100	0.000	0.000	0.000
6.009	User	-	100	0.035	0.035	0.035
	User	-	100	0.008	0.008	0.043
	User	-	100	0.011	0.011	0.054
	User	-	100	0.009	0.009	0.063
	User	-	100	0.011	0.011	0.074
6.010	-	-	100	0.000	0.000	0.000
6.011	-	-	100	0.000	0.000	0.000
5.009	User	-	100	0.011	0.011	0.011
	User	-	100	0.009	0.009	0.020
	User	-	100	0.011	0.011	0.030
	User	-	100	0.020	0.020	0.051
5.010	-	-	100	0.000	0.000	0.000
5.011	User	-	100	0.082	0.082	0.082
	User	-	100	0.009	0.009	0.091
	User	-	100	0.002	0.002	0.094
	User	-	100	0.006	0.006	0.100
	User	-	100	0.004	0.004	0.103
	User	-	100	0.012	0.012	0.116
	User	-	100	0.006	0.006	0.122
	User	-	100	0.008	0.008	0.129
	User	-	100	0.002	0.002	0.131
5.012	User	-	100	0.010	0.010	0.010
	User	-	100	0.012	0.012	0.022
	User	-	100	0.002	0.002	0.024
	User	-	100	0.010	0.010	0.034
5.013	-	-	100	0.000	0.000	0.000
2.021	-	-	100	0.000	0.000	0.000
2.022	-	-	100	0.000	0.000	0.000
				Total	Total	Total

Area Summary for Mainline 2

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
				2.818	2.818	2.818

Network Classifications for Mainline 2

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type	PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
2.000	1	300	1.200	1.210	Unclassified	1500	0	1.200	Unclassified	7.003	58	300	1.050	1.200	Unclassified	1500	0	1.050	Unclassified
2.001	2(HW)	300	1.200	1.210	Unclassified				Junction	7.004	59(HW)	300	1.190	1.200	Unclassified				Junction
2.002	3(HW)	300	1.200	1.210	Unclassified				Junction	7.005	60(HW)	300	1.190	1.200	Unclassified				Junction
2.003	4	300	0.900	1.210	Unclassified	1500	0	1.210	Unclassified	7.006	61	300	1.200	1.210	Unclassified	1500	0	1.200	Unclassified
2.004	5(HW)	300	0.900	0.900	Unclassified				Junction	8.000	65	300	1.080	1.090	Unclassified	1500	0	1.080	Unclassified
2.005	6(HW)	150	1.050	1.065	Unclassified				Junction	8.001	62(HW)	300	1.090	1.160	Unclassified				Junction
2.006	7	150	1.030	1.065	Unclassified	1500	0	1.065	Unclassified	8.002	66(HW)	300	1.160	1.180	Unclassified				Junction
3.000	24	300	1.000	1.010	Unclassified	1500	0	1.000	Unclassified	8.003	67	300	1.180	1.200	Unclassified	1500	0	1.180	Unclassified
3.001	12(HW)	300	0.980	1.010	Unclassified				Junction	8.004	68(HW)	300	1.200	1.200	Unclassified				Junction
3.002	13(HW)	300	0.980	0.990	Unclassified				Junction	8.005	69(HW)	300	1.200	1.200	Unclassified				Junction
3.003	27	300	0.990	1.000	Unclassified	1500	0	0.990	Unclassified	8.006	70	300	1.200	1.200	Unclassified	1500	0	1.200	Unclassified
3.004	15(HW)	300	1.000	1.035	Unclassified				Junction	8.007	71(HW)	300	1.200	1.200	Unclassified				Junction
2.007	8(J)	300	1.030	1.200	Unclassified				Junction	8.008	72(HW)	300	1.200	1.210	Unclassified				Junction
2.008	9(HW)	300	1.200	1.210	Unclassified				Junction	8.009	73	300	1.200	1.210	Unclassified	1500	0	1.210	Unclassified
2.009	10	300	1.210	1.250	Unclassified	1500	0	1.210	Unclassified	8.010	74(HW)	300	1.200	1.200	Unclassified				Junction
2.010	11(HW)	300	0.900	1.250	Unclassified				Junction	8.011	75(HW)	300	1.200	1.210	Unclassified				Junction
2.011	12(HW)	300	0.900	1.170	Unclassified				Junction	7.007	62	300	1.200	1.210	Unclassified	1800	0	1.210	Unclassified
2.012	13	300	1.170	1.220	Unclassified	1500	0	1.170	Unclassified	7.008	63	300	1.200	1.400	Unclassified	1500	0	1.200	Unclassified
2.013	14(HW)	300	1.220	1.290	Unclassified				Junction	6.003	46	300	1.400	1.430	Unclassified	1800	0	1.400	Unclassified
2.014	15(HW)	300	1.290	1.300	Unclassified				Junction	9.000	76	300	1.500	1.510	Unclassified	1500	0	1.500	Unclassified
2.015	16	300	0.750	1.300	Unclassified	1500	0	1.300	Unclassified	9.001	77(HW)	300	1.200	1.510	Unclassified				Junction
2.016	17	300	0.750	0.760	Unclassified	1500	0	0.750	Unclassified	9.002	78(HW)	300	1.200	1.200	Unclassified				Junction
2.017	18(HW)	300	0.590	0.760	Unclassified				Junction	9.003	79	300	1.200	1.200	Unclassified	1500	0	1.200	Unclassified
2.018	19(HW)	100	0.790	0.810	Unclassified				Junction	9.004	80(HW)	300	1.200	2.200	Unclassified				Junction
4.000	29	300	0.810	1.130	Unclassified	1500	0	1.130	Unclassified	9.005	81(HW)	300	1.200	1.400	Unclassified				Junction
2.019	20	300	0.810	0.820	Unclassified	1500	0	0.810	Unclassified	9.006	82	300	1.400	1.410	Unclassified	1500	0	1.400	Unclassified
2.020	31(HW)	300	0.820	1.050	Unclassified				Junction	9.007	83	300	1.410	1.430	Unclassified				Junction
5.000	30	300	0.965	0.975	Unclassified	1500	0	0.965	Unclassified	6.004	47(HW)	450	0.670	1.430	Unclassified				Junction
5.001	31(J)	300	0.535	0.975	Unclassified				Junction	6.005	48(HW)	675	0.445	0.455	Unclassified				Junction
5.002	32(J)	300	0.535	0.545	Unclassified				Junction	6.006	49	675	0.455	0.465	Unclassified	1500	0	0.455	Unclassified
5.003	33	300	0.545	0.900	Unclassified	1500	0	0.545	Unclassified	6.007	50(HW)	675	0.065	0.465	Unclassified				Junction
5.004	34	300	0.900	1.125	Unclassified	1500	0	0.900	Unclassified	6.008	51(HW)	450	0.290	0.490	Unclassified				Junction
5.005	35	300	1.125	1.200	Unclassified	1500	0	1.125	Unclassified	6.009	52	450	0.490	0.525	Unclassified	1500	0	0.490	Unclassified
5.006	36	300	1.125	1.200	Unclassified	1500	0	1.200	Unclassified	6.010	53(J)	450	0.525	0.565	Unclassified				Junction
5.007	37	300	1.125	1.200	Unclassified	1500	0	1.125	Unclassified	6.011	54J	150	2.475	2.690	Unclassified				Junction
5.008	38	300	1.200	2.690	Unclassified	1500	0	1.200	Unclassified	5.009	39	375	1.200	2.690	Unclassified	1800	0	2.690	Unclassified
6.000	43	300	1.200	1.210	Unclassified	1500	0	1.200	Unclassified	5.010	84	375	1.200	1.325	Unclassified	1500	0	1.200	Unclassified
6.001	44(HW)	300	1.200	1.210	Unclassified				Junction	5.011	40	375	0.915	1.325	Unclassified	1500	0	1.325	Unclassified
6.002	45(HW)	300	1.200	1.400	Unclassified				Junction	5.012	41	375	0.915	0.935	Unclassified	1500	0	0.915	Unclassified
7.000	55	300	1.200	1.210	Unclassified	1500	0	1.200	Unclassified	5.013	42(HW)	375	0.935	0.975	Unclassified				Junction
7.001	56(HW)	300	1.200	1.210	Unclassified				Junction	2.021	22(HW)	150	1.200	1.340	Unclassified				Junction
7.002	57(HW)	300	1.050	1.200	Unclassified				Junction	2.022	23	150	1.280	1.340	Unclassified	1500	0	1.340	Unclassified

Free Flowing Outfall Details for Mainline 2

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.022	Outfall	97.920	96.490	0.000	1200	0

Simulation Criteria for Mainline 2

Volumetric Runoff Coeff	0.750	Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	0.000		
Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	0.000	Run Time (mins)	60		
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800	Output Interval (mins)	5		

Number of Input Hydrographs 0 Number of Online Controls 5 Number of Offline Controls 1 Number of Storage Structures 15 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Catchment	Cv (Winter)	0.750
Return Period (years)	100	Summer Storms	No	Storm Duration (mins)	30
FEH Rainfall Version	2013	Winter Storms	Yes		
Site Location	GB 538700 152900 TQ 38700 52900	Cv (Summer)	1.000		

Online Controls for Mainline 2

Hydro-Brake® Optimum Manhole: 7, DS/PN: 2.006, Volume (m³): 2.2

Unit Reference	MD-CHE-0044-1000-1165-1000	Objective	Minimise upstream storage	Invert Level (m)	102.585
Design Head (m)	1.165	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	1.0	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	44		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.165	1.0	Flush-Flo™	0.104	0.6	Kick-Flo®	0.150	0.4	Mean Flow over Head Range	-	0.7

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.6	0.500	0.7	1.200	1.0	2.000	1.3	3.000	1.6	5.000	2.0	7.000	2.4	9.000	2.7
0.200	0.4	0.600	0.7	1.400	1.1	2.200	1.4	3.500	1.7	5.500	2.1	7.500	2.5	9.500	2.8
0.300	0.5	0.800	0.8	1.600	1.2	2.400	1.4	4.000	1.8	6.000	2.2	8.000	2.6		
0.400	0.6	1.000	0.9	1.800	1.2	2.600	1.5	4.500	1.9	6.500	2.3	8.500	2.7		

Hydro-Brake® Optimum Manhole: 13, DS/PN: 2.012, Volume (m³): 2.8

Unit Reference	MD-CHE-0026-4000-1420-4000	Objective	Minimise upstream storage	Invert Level (m)	101.380
Design Head (m)	1.420	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	0.4	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	26		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.420	0.4	Flush-Flo™	0.060	0.2	Kick-Flo®	0.088	0.1	Mean Flow over Head Range	-	0.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.1	0.500	0.2	1.200	0.4	2.000	0.5	3.000	0.6	5.000	0.7	7.000	0.9	9.000	1.0
0.200	0.2	0.600	0.3	1.400	0.4	2.200	0.5	3.500	0.6	5.500	0.8	7.500	0.9	9.500	1.0
0.300	0.2	0.800	0.3	1.600	0.4	2.400	0.5	4.000	0.7	6.000	0.8	8.000	0.9		
0.400	0.2	1.000	0.3	1.800	0.5	2.600	0.5	4.500	0.7	6.500	0.8	8.500	1.0		

Hydro-Brake® Optimum Manhole: 33, DS/PN: 5.003, Volume (m³): 1.5

Unit Reference	MD-CHE-0030-4000-0795-4000	Objective	Minimise upstream storage	Invert Level (m)	103.405
Design Head (m)	0.795	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	0.4	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	30		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.795	0.4	Flush-Flo™	0.070	0.2	Kick-Flo®	0.103	0.2	Mean Flow over Head Range	-	0.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.2	0.500	0.3	1.200	0.5	2.000	0.6	3.000	0.8	5.000	1.0	7.000	1.2	9.000	1.3
0.200	0.2	0.600	0.3	1.400	0.5	2.200	0.7	3.500	0.8	5.500	1.0	7.500	1.2	9.500	1.4
0.300	0.2	0.800	0.4	1.600	0.6	2.400	0.7	4.000	0.9	6.000	1.1	8.000	1.2		
0.400	0.3	1.000	0.4	1.800	0.6	2.600	0.7	4.500	0.9	6.500	1.1	8.500	1.3		

Hydro-Brake® Optimum Manhole: 73, DS/PN: 8.009, Volume (m³): 2.7

Unit Reference	MD-CHE-0041-1000-1460-1000	Objective	Minimise upstream storage	Invert Level (m)	103.990
Design Head (m)	1.460	Application	Surface	Minimum Outlet Pipe Diameter (mm)	75
Design Flow (l/s)	1.0	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	41		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.460	1.0	Flush-Flo™	0.099	0.5	Kick-Flo®	0.143	0.3	Mean Flow over Head Range	-	0.7

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	0.500	0.6	1.200	0.9	2.000	1.2	3.000	1.4	5.000	1.8	7.000	2.2	9.000	2.4
0.200	0.4	0.600	0.6	1.400	1.0	2.200	1.2	3.500	1.5	5.500	1.9	7.500	2.2	9.500	2.5
0.300	0.5	0.800	0.7	1.600	1.0	2.400	1.3	4.000	1.6	6.000	2.0	8.000	2.3		
0.400	0.5	1.000	0.8	1.800	1.1	2.600	1.3	4.500	1.7	6.500	2.1	8.500	2.4		

Hydro-Brake® Optimum Manhole: 23, DS/PN: 2.022, Volume (m³): 3.0

Unit Reference	MD-CHE-0125-9000-1440-9000	Objective	Minimise upstream storage	Invert Level (m)	97.110
Design Head (m)	1.440	Application	Surface	Minimum Outlet Pipe Diameter (mm)	150
Design Flow (l/s)	9.0	Sump Available	No	Suggested Manhole Diameter (mm)	1200
Flush-Flo™	Calculated	Diameter (mm)	125		

Hydro-Brake® Optimum Manhole: 23, DS/PN: 2.022, Volume (m³): 3.0

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.440	9.0	Flush-Flo™	0.303	9.0	Kick-Flo®	0.426	5.0	Mean Flow over Head Range	-	6.7

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.500	5.4	1.200	8.2	2.000	10.6	3.000	12.9	5.000	16.6	7.000	19.5	9.000	22.1
0.200	7.1	0.600	5.9	1.400	8.9	2.200	11.1	3.500	13.9	5.500	17.4	7.500	20.2	9.500	22.7
0.300	9.0	0.800	6.7	1.600	9.5	2.400	11.6	4.000	14.8	6.000	18.1	8.000	20.9		
0.400	5.2	1.000	7.5	1.800	10.0	2.600	12.0	4.500	15.7	6.500	18.8	8.500	21.5		

Offline Controls for Mainline 2

Pipe Manhole: 76, DS/PN: 9.000, Loop to PN: 5.000

Diameter (m)	0.300	Slope (1:X)	133.8	Roughness k (mm)	0.600	Coefficient of Contraction	0.600
Section Type	Pipe/Conduit	Length (m)	48.846	Entry Loss Coefficient	0.500	Upstream Invert Level (m)	103.800

Storage Structures for Mainline 2

Tank or Pond Manhole: 6(HW), DS/PN: 2.005

Invert Level (m) 102.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	28.3	1.200	136.9

Tank or Pond Manhole: 12(HW), DS/PN: 2.011

Invert Level (m) 101.650

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.1	1.200	905.1

Tank or Pond Manhole: 19(HW), DS/PN: 2.018

Invert Level (m) 98.660

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	166.0	0.890	310.3

Porous Car Park Manhole: 30, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	1.0	Width (m)	5.0	Depression Storage (mm)	0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	40.0	Evaporation (mm/day)	3
Max Percolation (l/s)	55.6	Invert Level (m)	104.270	Slope (1:X)	200.0	Membrane Depth (mm)	130

Cellular Storage Manhole: 32(J), DS/PN: 5.002

Invert Level (m)	102.150	Infiltration Coefficient Side (m/hr)	0.91800	Porosity	0.95		
Infiltration Coefficient Base (m/hr)	0.91800	Safety Factor	5.0				

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	54.0	54.0	1.600	54.0	106.8	1.601	0.0	106.8

Cellular Storage Manhole: 37, DS/PN: 5.007

Invert Level (m) 98.550 Infiltration Coefficient Side (m/hr) 0.91800 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.91800 Safety Factor 5.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	27.0	27.0	2.400	27.0	84.6	2.401	0.0	84.6

Porous Car Park Manhole: 66(HW), DS/PN: 8.002

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	1.0	Width (m)	5.0	Depression Storage (mm)	0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	10.0	Evaporation (mm/day)	3
Max Percolation (l/s)	13.9	Invert Level (m)	105.570	Slope (1:X)	200.0	Membrane Depth (mm)	130

Porous Car Park Manhole: 67, DS/PN: 8.003

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	1.0	Width (m)	5.0	Depression Storage (mm)	0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	10.0	Evaporation (mm/day)	3
Max Percolation (l/s)	13.9	Invert Level (m)	105.570	Slope (1:X)	200.0	Membrane Depth (mm)	130

Porous Car Park Manhole: 71(HW), DS/PN: 8.007

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	1.0	Width (m)	5.0	Depression Storage (mm)	0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	40.0	Evaporation (mm/day)	3
Max Percolation (l/s)	55.6	Invert Level (m)	105.140	Slope (1:X)	200.0	Membrane Depth (mm)	130

Tank or Pond Manhole: 72(HW), DS/PN: 8.008

Invert Level (m) 104.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	25.8	0.600	68.4

Porous Car Park Manhole: 81(HW), DS/PN: 9.005

Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	1.0	Width (m)	5.0	Depression Storage (mm)	0
Membrane Percolation (mm/hr)	1000	Porosity	0.30	Length (m)	40.0	Evaporation (mm/day)	3
Max Percolation (l/s)	55.6	Invert Level (m)	103.470	Slope (1:X)	200.0	Membrane Depth (mm)	130

Swale Manhole: 48(HW), DS/PN: 6.005

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00	Length (m)	19.4	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.00000	Invert Level (m)	101.750	Side Slope (1:X)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	2.0	Base Width (m)	0.5	Slope (1:X)	0.0	Include Swale Volume	No

Swale Manhole: 51(HW), DS/PN: 6.008

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.91800	Porosity	1.00	Length (m)	19.4	Cap Volume Depth (m)	0.000
Infiltration Coefficient Side (m/hr)	0.91800	Invert Level (m)	101.250	Side Slope (1:X)	3.0	Cap Infiltration Depth (m)	0.000
Safety Factor	5.0	Base Width (m)	0.5	Slope (1:X)	0.0	Include Swale Volume	No

Cellular Storage Manhole: 54J, DS/PN: 6.011

Invert Level (m) 98.500 Infiltration Coefficient Side (m/hr) 0.91800 Porosity 0.95
Infiltration Coefficient Base (m/hr) 0.91800 Safety Factor 5.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	170.0	170.0	2.400	170.0	299.6	2.401	0.0	299.6

Tank or Pond Manhole: 22(HW), DS/PN: 2.021

Invert Level (m) 97.250

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	802.8	1.350	1261.1

Manhole Headloss for Mainline 2

PN	US/MH Name	US/MH Headloss
2.000	1	0.500
2.001	2(HW)	0.000
2.002	3(HW)	0.000
2.003	4	0.500
2.004	5(HW)	0.000
2.005	6(HW)	0.000
2.006	7	0.500
3.000	24	0.500
3.001	12(HW)	0.000
3.002	13(HW)	0.000
3.003	27	0.500
3.004	15(HW)	0.000
2.007	8(J)	0.000
2.008	9(HW)	0.000
2.009	10	0.500
2.010	11(HW)	0.000
2.011	12(HW)	0.000
2.012	13	0.500
2.013	14(HW)	0.000
2.014	15(HW)	0.000
2.015	16	0.500
2.016	17	0.500
2.017	18(HW)	0.000
2.018	19(HW)	0.000
4.000	29	0.500
2.019	20	0.500
2.020	31(HW)	0.000
5.000	30	0.500
5.001	31(J)	0.000
5.002	32(J)	0.000
5.003	33	0.500
5.004	34	0.500
5.005	35	0.500
5.006	36	0.500
5.007	37	0.500
5.008	38	0.500
6.000	43	0.500
6.001	44(HW)	0.000
6.002	45(HW)	0.000
7.000	55	0.500
7.001	56(HW)	0.000
7.002	57(HW)	0.000
7.003	58	0.500
7.004	59(HW)	0.000
7.005	60(HW)	0.000
7.006	61	0.500
8.000	65	0.500
8.001	62(HW)	0.000
8.002	66(HW)	0.000

Manhole Headloss for Mainline 2

PN	US/MH Name	US/MH Headloss
8.003	67	0.500
8.004	68(HW)	0.000
8.005	69(HW)	0.000
8.006	70	0.500
8.007	71(HW)	0.000
8.008	72(HW)	0.000
8.009	73	0.500
8.010	74(HW)	0.000
8.011	75(HW)	0.000
7.007	62	0.500
7.008	63	0.500
6.003	46	0.500
9.000	76	0.500
9.001	77(HW)	0.000
9.002	78(HW)	0.000
9.003	79	0.500
9.004	80(HW)	0.000
9.005	81(HW)	0.000
9.006	82	0.500
9.007	83	0.000
6.004	47(HW)	0.000
6.005	48(HW)	0.000
6.006	49	0.500
6.007	50(HW)	0.000
6.008	51(HW)	0.000
6.009	52	0.500
6.010	53(J)	0.000
6.011	54J	0.000
5.009	39	0.500
5.010	84	0.500
5.011	40	0.500
5.012	41	0.500
5.013	42(HW)	0.000
2.021	22(HW)	0.000
2.022	23	0.500

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
2.000	1	2.651	0.101	0.000	2.752
2.001	2(HW)	0.000	1.153	0.000	1.153
2.002	3(HW)	0.000	0.192	0.000	0.192
2.003	4	2.668	1.310	0.000	3.978
2.004	5(HW)	0.000	1.486	0.000	1.486
2.005	6(HW)	0.000	0.026	90.980	91.006
2.006	7	2.147	0.286	0.000	2.433
3.000	24	2.297	0.104	0.000	2.401
3.001	12(HW)	0.000	1.921	0.000	1.921
3.002	13(HW)	0.000	0.173	0.000	0.173
3.003	27	2.280	0.159	0.000	2.438
3.004	15(HW)	0.000	1.214	0.000	1.214
2.007	8(J)	0.000	1.363	0.000	1.363
2.008	9(HW)	0.000	0.119	0.000	0.119
2.009	10	2.668	0.736	0.000	3.404
2.010	11(HW)	0.000	3.440	0.000	3.440
2.011	12(HW)	0.000	0.247	690.549	690.796
2.012	13	2.598	0.104	0.000	2.702
2.013	14(HW)	0.000	1.681	0.000	1.681
2.014	15(HW)	0.000	0.102	0.000	0.102
2.015	16	2.827	4.414	0.000	7.242
2.016	17	1.856	0.105	0.000	1.961
2.017	18(HW)	0.000	3.741	0.000	3.741
2.018	19(HW)	0.000	0.013	208.650	208.663
4.000	29	2.527	0.464	0.000	2.991
2.019	20	1.962	0.111	0.000	2.073
2.020	31(HW)	0.000	4.656	0.000	4.656
5.000	30	2.235	0.097	17.265	19.598
5.001	31(J)	0.000	0.850	0.000	0.850
5.002	32(J)	0.000	0.098	82.097	82.195
5.003	33	1.493	1.428	0.000	2.921
5.004	34	2.121	3.503	0.000	5.623
5.005	35	2.518	2.105	0.000	4.623
5.006	36	2.651	1.399	0.000	4.050
5.007	37	2.518	3.535	61.569	67.621
5.008	38	2.651	3.039	0.000	5.689
6.000	43	2.651	0.107	0.000	2.758
6.001	44(HW)	0.000	3.595	0.000	3.595
6.002	45(HW)	0.000	0.921	0.000	0.921
7.000	55	2.651	0.103	0.000	2.754
7.001	56(HW)	0.000	2.891	0.000	2.891
7.002	57(HW)	0.000	0.258	0.000	0.258
7.003	58	2.386	0.219	0.000	2.604
7.004	59(HW)	0.000	2.592	0.000	2.592
7.005	60(HW)	0.000	0.130	0.000	0.130
7.006	61	2.651	1.699	0.000	4.349

Volume Summary (Static)

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
8.000	65	2.439	0.081	0.000	2.520
8.001	62(HW)	0.000	1.351	0.000	1.351
8.002	66(HW)	0.000	0.265	4.500	4.765
8.003	67	2.615	0.337	4.500	7.453
8.004	68(HW)	0.000	1.676	0.000	1.676
8.005	69(HW)	0.000	0.122	0.000	0.122
8.006	70	2.651	0.122	0.000	2.772
8.007	71(HW)	0.000	0.916	17.265	18.181
8.008	72(HW)	0.000	0.074	27.239	27.313
8.009	73	2.668	0.580	0.000	3.248
8.010	74(HW)	0.000	1.357	0.000	1.357
8.011	75(HW)	0.000	0.143	0.000	0.143
7.007	62	3.842	2.277	0.000	6.119
7.008	63	2.651	0.726	0.000	3.377
6.003	46	4.326	0.251	0.000	4.577
9.000	76	3.181	0.104	0.000	3.285
9.001	77(HW)	0.000	1.674	0.000	1.674
9.002	78(HW)	0.000	0.559	0.000	0.559
9.003	79	2.651	1.341	0.000	3.991
9.004	80(HW)	0.000	2.217	0.000	2.217
9.005	81(HW)	0.000	0.764	17.265	18.029
9.006	82	3.004	0.105	0.000	3.109
9.007	83	0.000	0.147	0.000	0.147
6.004	47(HW)	0.000	3.338	0.000	3.338
6.005	48(HW)	0.000	0.910	0.000	0.910
6.006	49	1.997	0.968	0.000	2.965
6.007	50(HW)	0.000	8.111	0.000	8.111
6.008	51(HW)	0.000	1.946	0.000	1.946
6.009	52	1.661	1.156	0.000	2.817
6.010	53(J)	0.000	1.434	0.000	1.434
6.011	54J	0.000	0.175	387.654	387.829
5.009	39	7.799	3.218	0.000	11.017
5.010	84	2.783	3.227	0.000	6.011
5.011	40	3.004	5.889	0.000	8.894
5.012	41	2.280	0.456	0.000	2.735
5.013	42(HW)	0.000	4.075	0.000	4.075
2.021	22(HW)	0.000	0.374	1381.548	1381.921
2.022	23	2.633	0.264	0.000	2.897
Total		105.191	110.721	2991.080	3206.992

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
2.000	1	2.651	0.048	0.000	2.699
2.001	2(HW)	0.000	1.153	0.000	1.153
2.002	3(HW)	0.000	0.139	0.000	0.139
2.003	4	2.668	1.257	0.000	3.925
2.004	5(HW)	0.000	1.486	0.000	1.486
2.005	6(HW)	0.000	0.013	90.980	90.993
2.006	7	2.147	0.272	0.000	2.420
3.000	24	2.297	0.051	0.000	2.348
3.001	12(HW)	0.000	1.921	0.000	1.921
3.002	13(HW)	0.000	0.120	0.000	0.120
3.003	27	2.280	0.106	0.000	2.385
3.004	15(HW)	0.000	1.214	0.000	1.214
2.007	8(J)	0.000	1.363	0.000	1.363
2.008	9(HW)	0.000	0.066	0.000	0.066
2.009	10	2.668	0.683	0.000	3.351
2.010	11(HW)	0.000	3.440	0.000	3.440
2.011	12(HW)	0.000	0.194	690.549	690.743
2.012	13	2.598	0.051	0.000	2.649
2.013	14(HW)	0.000	1.681	0.000	1.681
2.014	15(HW)	0.000	0.049	0.000	0.049
2.015	16	2.827	4.308	0.000	7.136
2.016	17	1.856	0.052	0.000	1.908
2.017	18(HW)	0.000	3.741	0.000	3.741
2.018	19(HW)	0.000	0.007	208.650	208.658
4.000	29	2.527	0.358	0.000	2.885
2.019	20	1.962	0.058	0.000	2.020
2.020	31(HW)	0.000	4.656	0.000	4.656
5.000	30	2.235	0.044	17.265	19.545
5.001	31(J)	0.000	0.850	0.000	0.850
5.002	32(J)	0.000	0.045	82.097	82.142
5.003	33	1.493	1.322	0.000	2.815
5.004	34	2.121	3.397	0.000	5.517
5.005	35	2.518	1.998	0.000	4.517
5.006	36	2.651	1.293	0.000	3.944
5.007	37	2.518	3.429	61.569	67.515
5.008	38	2.651	2.922	0.000	5.573
6.000	43	2.651	0.054	0.000	2.705
6.001	44(HW)	0.000	3.595	0.000	3.595
6.002	45(HW)	0.000	0.858	0.000	0.858
7.000	55	2.651	0.050	0.000	2.701
7.001	56(HW)	0.000	2.891	0.000	2.891
7.002	57(HW)	0.000	0.205	0.000	0.205
7.003	58	2.386	0.166	0.000	2.551
7.004	59(HW)	0.000	2.592	0.000	2.592
7.005	60(HW)	0.000	0.077	0.000	0.077
7.006	61	2.651	1.582	0.000	4.233

Volume Summary (Static)

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
8.000	65	2.439	0.028	0.000	2.467
8.001	62(HW)	0.000	1.351	0.000	1.351
8.002	66(HW)	0.000	0.212	4.500	4.712
8.003	67	2.615	0.284	4.500	7.400
8.004	68(HW)	0.000	1.676	0.000	1.676
8.005	69(HW)	0.000	0.069	0.000	0.069
8.006	70	2.651	0.069	0.000	2.719
8.007	71(HW)	0.000	0.916	17.265	18.181
8.008	72(HW)	0.000	0.021	27.239	27.260
8.009	73	2.668	0.527	0.000	3.195
8.010	74(HW)	0.000	1.357	0.000	1.357
8.011	75(HW)	0.000	0.079	0.000	0.079
7.007	62	3.842	2.160	0.000	6.003
7.008	63	2.651	0.609	0.000	3.260
6.003	46	4.326	0.187	0.000	4.513
9.000	76	3.181	0.051	0.000	3.232
9.001	77(HW)	0.000	1.674	0.000	1.674
9.002	78(HW)	0.000	0.506	0.000	0.506
9.003	79	2.651	1.287	0.000	3.938
9.004	80(HW)	0.000	2.217	0.000	2.217
9.005	81(HW)	0.000	0.711	17.265	17.976
9.006	82	3.004	0.052	0.000	3.056
9.007	83	0.000	0.147	0.000	0.147
6.004	47(HW)	0.000	3.338	0.000	3.338
6.005	48(HW)	0.000	0.642	0.000	0.642
6.006	49	1.997	0.700	0.000	2.697
6.007	50(HW)	0.000	8.111	0.000	8.111
6.008	51(HW)	0.000	1.827	0.000	1.827
6.009	52	1.661	1.037	0.000	2.698
6.010	53(J)	0.000	1.434	0.000	1.434
6.011	54J	0.000	0.159	387.654	387.813
5.009	39	7.799	3.036	0.000	10.835
5.010	84	2.783	3.062	0.000	5.845
5.011	40	3.004	5.724	0.000	8.728
5.012	41	2.280	0.373	0.000	2.652
5.013	42(HW)	0.000	4.075	0.000	4.075
2.021	22(HW)	0.000	0.361	1381.548	1381.908
2.022	23	2.633	0.240	0.000	2.873
Total		105.191	106.167	2991.080	3202.438

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

Simulation Criteria

Areal Reduction Factor 1.000 | Manhole Headloss Coeff (Global) 0.500 | MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 | Foul Sewage per hectare (l/s) 0.000 | Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 | Additional Flow - % of Total Flow 0.000 | Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 | Number of Online Controls 5 | Number of Offline Controls 1 | Number of Storage Structures 15 | Number of Time/Area Diagrams 0 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH | Site Location GB 538700 152900 TQ 38700 52900 | Cv (Winter) 0.840
Return Period (years) 2 | Data Type Catchment
FEH Rainfall Version 2013 | Cv (Summer) 0.750

Margin for Flood Risk Warning (mm) 300.0 | DTS Status ON | Inertia Status ON
Analysis Timestep 2.5 Second Increment (Extended) | DVD Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Sensitivity flows(s) (%) 0

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.000	1	30 minute 2 year Winter Q+0%	105.750	104.263	-0.287	0.000			0.015		0.5	OK
2.001	2(HW)	30 minute 2 year Winter Q+0%	105.750	104.244	-0.296	0.000			0.000		0.5	OK*
2.002	3(HW)	15 minute 2 year Winter Q+0%	105.150	103.674	-0.276	0.000			0.024		0.6	OK*
2.003	4	15 minute 2 year Winter Q+0%	105.150	103.673	-0.267	0.000			0.056		3.8	OK
2.004	5(HW)	15 minute 2 year Winter Q+0%	104.450	103.302	-0.248	0.000			0.065		13.6	OK*
2.005	6(HW)	360 minute 2 year Winter Q+0%	103.800	103.066	0.316	0.000			21.464		0.7	SURCHARGED*
2.006	7	360 minute 2 year Winter Q+0%	103.800	103.070	0.335	0.000			0.862		0.7	SURCHARGED
3.000	24	30 minute 2 year Winter Q+0%	103.300	102.032	-0.268	0.000			0.048		1.4	OK
3.001	12(HW)	30 minute 2 year Winter Q+0%	103.300	102.020	-0.270	0.000			0.028		1.4	OK*
3.002	13(HW)	15 minute 2 year Winter Q+0%	103.180	101.958	-0.242	0.000			0.190		1.7	OK*
3.003	27	15 minute 2 year Winter Q+0%	103.180	101.958	-0.232	0.000			0.125		6.1	OK
3.004	15(HW)	15 minute 2 year Winter Q+0%	103.180	101.943	-0.237	0.000			0.069		6.1	OK*
2.007	8(J)	15 minute 2 year Winter Q+0%	103.150	101.887	-0.233	0.000			0.205		6.4	OK*
2.008	9(HW)	2880 minute 2 year Winter Q+0%	103.250	101.846	-0.204	0.000			0.296		1.0	OK*
2.009	10	2880 minute 2 year Winter Q+0%	103.250	101.847	-0.193	0.000			0.192		1.2	OK
2.010	11(HW)	2880 minute 2 year Winter Q+0%	103.250	101.847	-0.153	0.000			0.379		1.2	OK*
2.011	12(HW)	2880 minute 2 year Winter Q+0%	102.850	101.846	-0.104	0.000			68.451		2.1	OK*
2.012	13	2880 minute 2 year Winter Q+0%	102.850	101.875	0.195	0.000			1.053		0.2	SURCHARGED
2.013	14(HW)	2880 minute 2 year Winter Q+0%	102.850	101.333	-0.297	0.000			0.000		0.2	OK*
2.014	15(HW)	15 minute 2 year Winter Q+0%	102.600	101.058	-0.252	0.000			0.071		0.4	OK*
2.015	16	15 minute 2 year Winter Q+0%	102.600	101.058	-0.242	0.000			0.099		12.7	OK
2.016	17	15 minute 2 year Winter Q+0%	100.750	99.814	-0.186	0.000			0.249		17.3	OK
2.017	18(HW)	15 minute 2 year Winter Q+0%	100.750	99.756	-0.234	0.000			0.067		17.0	OK*
2.018	19(HW)	120 minute 2 year Winter Q+0%	99.550	98.863	0.103	0.000			37.115		10.0	SURCHARGED*
4.000	29	30 minute 2 year Winter Q+0%	99.900	98.603	-0.167	0.000			0.226		19.1	OK
2.019	20	30 minute 2 year Winter Q+0%	99.550	98.587	-0.153	0.000			0.375		26.6	OK

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.020	31(HW)	30 minute 2 year Winter Q+0%	99.550	98.515	-0.215	0.000			0.088		26.7	OK*
5.000	30	30 minute 2 year Winter Q+0%	104.700	103.544	-0.191	0.000		0.000	0.184	12	10.3	OK
5.001	31(J)	30 minute 2 year Winter Q+0%	104.700	103.542	-0.183	0.000			0.122		10.3	OK*
5.002	32(J)	120 minute 2 year Winter Q+0%	104.250	102.302	-1.413	0.000		20.317	7.952	43	0.0	OK*
5.003	33	15 minute 2 year Summer Q+0%	104.250	103.405	-0.300	0.000			0.000		0.0	OK
5.004	34	15 minute 2 year Summer Q+0%	104.100	102.900	-0.300	0.000			0.000		0.0	OK
5.005	35	15 minute 2 year Winter Q+0%	103.750	102.361	-0.264	0.000			0.076		5.9	OK
5.006	36	15 minute 2 year Winter Q+0%	102.900	101.446	-0.254	0.000			0.084		7.0	OK
5.007	37	240 minute 2 year Winter Q+0%	102.500	99.824	-1.551	0.000		59.553	34.928	158	0.0	OK
5.008	38	15 minute 2 year Winter Q+0%	101.950	100.512	-0.238	0.000			0.139		20.9	OK
6.000	43	30 minute 2 year Winter Q+0%	103.250	101.782	-0.268	0.000			0.047		1.4	OK
6.001	44(HW)	15 minute 2 year Winter Q+0%	103.250	101.770	-0.270	0.000			0.027		1.3	OK*
6.002	45(HW)	15 minute 2 year Winter Q+0%	103.050	101.716	-0.134	0.000			0.967		4.7	OK*
7.000	55	15 minute 2 year Summer Q+0%	109.500	108.000	-0.300	0.000			0.000		0.0	OK
7.001	56(HW)	15 minute 2 year Summer Q+0%	109.500	107.990	-0.300	0.000			0.000		0.0	OK*
7.002	57(HW)	15 minute 2 year Winter Q+0%	107.800	106.331	-0.269	0.000			0.031		2.3	OK*
7.003	58	15 minute 2 year Winter Q+0%	107.500	106.181	-0.269	0.000			0.051		2.2	OK
7.004	59(HW)	15 minute 2 year Winter Q+0%	107.500	106.038	-0.262	0.000			0.037		9.7	OK*
7.005	60(HW)	15 minute 2 year Winter Q+0%	105.500	104.105	-0.205	0.000			0.104		13.1	OK*
7.006	61	15 minute 2 year Winter Q+0%	105.500	104.051	-0.249	0.000			0.088		13.6	OK
8.000	65	240 minute 2 year Winter Q+0%	106.000	104.725	-0.195	0.000			0.178		0.1	OK
8.001	62(HW)	240 minute 2 year Winter Q+0%	106.000	104.725	-0.185	0.000			0.117		0.1	OK*
8.002	66(HW)	240 minute 2 year Winter Q+0%	106.000	104.726	-0.114	0.000		0.000	0.837	76	0.5	OK*
8.003	67	240 minute 2 year Winter Q+0%	106.000	104.726	-0.094	0.000		0.000	0.479	90	1.1	OK
8.004	68(HW)	240 minute 2 year Winter Q+0%	106.000	104.726	-0.074	0.000			0.408		1.0	OK*
8.005	69(HW)	15 minute 2 year Summer Q+0%	105.590	104.390	0.000	0.000			1.097		1.5	SURCHARGED*
8.006	70	240 minute 2 year Winter Q+0%	105.580	104.726	0.346	0.000			1.202		0.6	SURCHARGED
8.007	71(HW)	240 minute 2 year Winter Q+0%	105.570	104.726	0.356	0.000		0.000	0.720	188	1.3	SURCHARGED*
8.008	72(HW)	240 minute 2 year Winter Q+0%	105.500	104.726	0.426	0.000			1.636		1.0	SURCHARGED*
8.009	73	240 minute 2 year Winter Q+0%	105.500	104.726	0.436	0.000			1.313		0.7	SURCHARGED
8.010	74(HW)	15 minute 2 year Winter Q+0%	105.300	103.814	-0.286	0.000			0.012		2.2	OK*
8.011	75(HW)	15 minute 2 year Winter Q+0%	104.500	103.063	-0.237	0.000			0.070		4.9	OK*
7.007	62	15 minute 2 year Winter Q+0%	104.500	103.058	-0.232	0.000			0.181		18.6	OK
7.008	63	15 minute 2 year Winter Q+0%	103.700	102.305	-0.195	0.000			0.209		54.9	OK
6.003	46	15 minute 2 year Winter Q+0%	103.200	101.717	-0.083	0.000			1.139		52.7	OK
9.000	76	15 minute 2 year Summer Q+0%	105.600	103.800	-0.300	0.000	0.000		0.000		0.0	OK
9.001	77(HW)	15 minute 2 year Summer Q+0%	105.600	103.790	-0.300	0.000			0.000		0.0	OK*
9.002	78(HW)	15 minute 2 year Winter Q+0%	105.150	103.684	-0.266	0.000			0.071		3.7	OK*
9.003	79	15 minute 2 year Winter Q+0%	104.900	103.480	-0.220	0.000			0.152		27.5	OK
9.004	80(HW)	15 minute 2 year Winter Q+0%	104.300	102.872	-0.228	0.000			0.085		30.6	OK*
9.005	81(HW)	15 minute 2 year Winter Q+0%	103.900	102.484	-0.216	0.000		0.000	2.553		41.2	OK*
9.006	82	15 minute 2 year Winter Q+0%	103.200	101.695	-0.105	0.000			0.380		41.5	OK
9.007	83	15 minute 2 year Winter Q+0%	103.200	101.671	-0.119	0.000			0.201		41.5	OK*
6.004	47(HW)	15 minute 2 year Winter Q+0%	103.200	101.580	-0.190	0.000			0.328		93.4	OK*
6.005	48(HW)	15 minute 2 year Winter Q+0%	102.350	101.525	-0.380	0.000		0.000	2.150	7	93.9	OK*
6.006	49	15 minute 2 year Winter Q+0%	102.350	101.523	-0.372	0.000			0.720		120.4	OK
6.007	50(HW)	15 minute 2 year Winter Q+0%	102.350	101.442	-0.443	0.000			0.358		120.4	OK*

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
6.008	51(HW)	15 minute 2 year Winter Q+0%	101.850	101.328	-0.232	0.000		0.403	1.536	7	118.5	OK*
6.009	52	15 minute 2 year Winter Q+0%	101.850	101.086	-0.274	0.000			0.557		126.8	OK
6.010	53(J)	15 minute 2 year Winter Q+0%	101.400	100.719	-0.156	0.000			0.476		127.3	OK*
6.011	54J	120 minute 2 year Winter Q+0%	101.400	99.009	0.084	0.000		115.142	82.766	67	22.3	SURCHARGED*
5.009	39	120 minute 2 year Winter Q+0%	101.550	98.577	-0.283	0.000			0.222		28.7	OK
5.010	84	120 minute 2 year Winter Q+0%	99.650	98.191	-0.259	0.000			0.293		28.7	OK
5.011	40	15 minute 2 year Winter Q+0%	99.600	98.034	-0.241	0.000			0.569		43.2	OK
5.012	41	15 minute 2 year Winter Q+0%	98.800	97.719	-0.166	0.000			1.083		47.4	OK
5.013	42(HW)	15 minute 2 year Winter Q+0%	98.800	97.628	-0.237	0.000			0.213		47.1	OK*
2.021	22(HW)	240 minute 2 year Winter Q+0%	98.600	97.493	0.093	0.000			206.008		7.7	SURCHARGED*
2.022	23	240 minute 2 year Winter Q+0%	98.600	97.453	0.193	0.000			0.959		7.7	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

Simulation Criteria

Areal Reduction Factor 1.000 | Manhole Headloss Coeff (Global) 0.500 | MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 | Foul Sewage per hectare (l/s) 0.000 | Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 | Additional Flow - % of Total Flow 0.000 | Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 | Number of Online Controls 5 | Number of Offline Controls 1 | Number of Storage Structures 15 | Number of Time/Area Diagrams 0 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH | Site Location GB 538700 152900 TQ 38700 52900 | Cv (Winter) 0.840
Return Period (years) 30 | Data Type Catchment
FEH Rainfall Version 2013 | Cv (Summer) 0.750

Margin for Flood Risk Warning (mm) 300.0 | DTS Status ON | Inertia Status ON
Analysis Timestep 2.5 Second Increment (Extended) | DVD Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Sensitivity flows(s) (%) 0, +35

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.000	1	30 minute 30 year Winter Q+35%	105.750	104.284	-0.266	0.000			0.051		1.7	OK
2.001	2(HW)	30 minute 30 year Winter Q+35%	105.750	104.252	-0.288	0.000			0.008		1.7	OK*
2.002	3(HW)	15 minute 30 year Winter Q+35%	105.150	103.705	-0.245	0.000			0.062		1.6	OK*
2.003	4	15 minute 30 year Winter Q+35%	105.150	103.704	-0.236	0.000			0.119		14.3	OK
2.004	5(HW)	960 minute 30 year Winter Q+35%	104.450	103.550	0.000	0.000			0.801		3.6	SURCHARGED*
2.005	6(HW)	480 minute 30 year Winter Q+35%	103.800	103.585	0.835	0.000			66.788		1.0	FLOOD RISK*
2.006	7	480 minute 30 year Winter Q+35%	103.800	103.585	0.850	0.000			1.772		0.9	FLOOD RISK
3.000	24	2880 minute 30 year Winter Q+35%	103.300	102.127	-0.173	0.000			0.215		0.2	OK
3.001	12(HW)	2880 minute 30 year Winter Q+35%	103.300	102.127	-0.163	0.000			0.148		0.2	OK*
3.002	13(HW)	2880 minute 30 year Winter Q+35%	103.180	102.127	-0.073	0.000			1.380		0.2	OK*
3.003	27	2880 minute 30 year Winter Q+35%	103.180	102.127	-0.063	0.000			0.494		0.8	OK
3.004	15(HW)	2880 minute 30 year Winter Q+35%	103.180	102.127	-0.053	0.000			0.320		0.8	OK*
2.007	8(J)	2880 minute 30 year Winter Q+35%	103.150	102.120	0.000	0.000			1.482		1.6	SURCHARGED*
2.008	9(HW)	2880 minute 30 year Summer Q+35%	103.250	102.050	0.000	0.000			1.609		1.9	SURCHARGED*
2.009	10	2880 minute 30 year Winter Q+35%	103.250	102.127	0.087	0.000			0.740		2.1	SURCHARGED
2.010	11(HW)	2880 minute 30 year Summer Q+35%	103.250	102.000	0.000	0.000			1.045		2.6	SURCHARGED*
2.011	12(HW)	2880 minute 30 year Winter Q+35%	102.850	102.127	0.177	0.000			193.131		2.1	SURCHARGED*
2.012	13	2880 minute 30 year Winter Q+35%	102.850	102.166	0.486	0.000			1.574		0.3	SURCHARGED
2.013	14(HW)	2880 minute 30 year Winter Q+35%	102.850	101.333	-0.297	0.000			0.000		0.3	OK*
2.014	15(HW)	15 minute 30 year Winter Q+35%	102.600	101.116	-0.194	0.000			0.169		0.7	OK*
2.015	16	15 minute 30 year Summer Q+35%	102.600	101.116	-0.184	0.000			0.208		48.7	OK
2.016	17	15 minute 30 year Summer Q+35%	100.750	100.057	0.057	0.000			1.292		62.3	SURCHARGED
2.017	18(HW)	15 minute 30 year Winter Q+35%	100.750	99.829	-0.161	0.000			0.151		65.0	OK*
2.018	19(HW)	120 minute 30 year Winter Q+35%	99.550	99.217	0.457	0.000			117.359		19.3	SURCHARGED*
4.000	29	30 minute 30 year Winter Q+35%	99.900	98.880	0.110	0.000			0.716		60.6	SURCHARGED
2.019	20	30 minute 30 year Winter Q+35%	99.550	98.807	0.067	0.000			0.998		75.9	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.020	31(HW)	30 minute 30 year Winter Q+35%	99.550	98.582	-0.148	0.000			0.168		75.9	OK*
5.000	30	30 minute 30 year Winter Q+35%	104.700	103.792	0.057	0.000		0.000	0.623	8	32.2	SURCHARGED
5.001	31(J)	30 minute 30 year Winter Q+35%	104.700	103.707	-0.018	0.000			0.315		31.6	OK*
5.002	32(J)	120 minute 30 year Winter Q+35%	104.250	102.851	-0.864	0.000		45.781	36.670	103	0.0	OK*
5.003	33	15 minute 30 year Summer Q+0%	104.250	103.405	-0.300	0.000			0.000		0.0	OK
5.004	34	15 minute 30 year Summer Q+0%	104.100	102.900	-0.300	0.000			0.000		0.0	OK
5.005	35	15 minute 30 year Winter Q+35%	103.750	102.396	-0.229	0.000			0.164		22.9	OK
5.006	36	15 minute 30 year Winter Q+35%	102.900	101.495	-0.205	0.000			0.183		27.4	OK
5.007	37	60 minute 30 year Winter Q+35%	102.500	101.230	-0.145	0.000		25.302	66.498		55.9	OK
5.008	38	60 minute 30 year Winter Q+35%	101.950	100.585	-0.165	0.000			0.377		88.6	OK
6.000	43	15 minute 30 year Winter Q+35%	103.250	102.841	0.791	0.000			1.920		11.4	SURCHARGED
6.001	44(HW)	15 minute 30 year Summer Q+0%	103.250	102.040	0.000	0.000			0.646		10.2	SURCHARGED*
6.002	45(HW)	15 minute 30 year Summer Q+0%	103.050	101.850	0.000	0.000			4.375		25.8	SURCHARGED*
7.000	55	15 minute 30 year Summer Q+0%	109.500	108.000	-0.300	0.000			0.000		0.0	OK
7.001	56(HW)	15 minute 30 year Summer Q+0%	109.500	107.990	-0.300	0.000			0.000		0.0	OK*
7.002	57(HW)	15 minute 30 year Winter Q+35%	107.800	106.360	-0.240	0.000			0.067		8.7	OK*
7.003	58	15 minute 30 year Summer Q+35%	107.500	106.211	-0.239	0.000			0.108		8.7	OK
7.004	59(HW)	15 minute 30 year Summer Q+35%	107.500	106.076	-0.224	0.000			0.081		37.9	OK*
7.005	60(HW)	15 minute 30 year Winter Q+35%	105.500	104.220	-0.090	0.000			0.292		51.2	OK*
7.006	61	15 minute 30 year Winter Q+35%	105.500	104.103	-0.197	0.000			0.188		52.8	OK
8.000	65	240 minute 30 year Winter Q+35%	106.000	105.259	0.339	0.000			1.120		0.0	SURCHARGED
8.001	62(HW)	2880 minute 30 year Summer Q+35%	106.000	104.910	0.000	0.000			0.364		0.1	SURCHARGED*
8.002	66(HW)	240 minute 30 year Winter Q+35%	106.000	105.259	0.419	0.000		0.000	2.065		0.9	SURCHARGED*
8.003	67	240 minute 30 year Winter Q+35%	106.000	105.259	0.439	0.000		0.000	1.508		2.0	SURCHARGED
8.004	68(HW)	2880 minute 30 year Summer Q+35%	106.000	104.800	0.000	0.000			0.731		0.5	SURCHARGED*
8.005	69(HW)	15 minute 30 year Summer Q+0%	105.590	104.390	0.000	0.000			2.363		1.2	SURCHARGED*
8.006	70	240 minute 30 year Winter Q+35%	105.580	105.259	0.879	0.000			2.143		1.5	SURCHARGED
8.007	71(HW)	240 minute 30 year Winter Q+35%	105.570	105.259	0.889	0.000		0.000	3.359	103	6.0	SURCHARGED*
8.008	72(HW)	240 minute 30 year Winter Q+35%	105.500	105.258	0.958	0.000			15.303		1.5	FLOOD RISK*
8.009	73	180 minute 30 year Winter Q+35%	105.500	105.262	0.972	0.000			2.260		0.9	FLOOD RISK
8.010	74(HW)	15 minute 30 year Winter Q+35%	105.300	103.836	-0.264	0.000			0.041		7.7	OK*
8.011	75(HW)	15 minute 30 year Summer Q+35%	104.500	103.300	0.000	0.000			0.848		17.0	SURCHARGED*
7.007	62	15 minute 30 year Winter Q+35%	104.500	103.484	0.194	0.000			1.855		64.1	SURCHARGED
7.008	63	15 minute 30 year Winter Q+35%	103.700	103.322	0.822	0.000			4.125		177.5	SURCHARGED
6.003	46	15 minute 30 year Winter Q+35%	103.200	102.869	1.069	0.000			4.937		158.5	SURCHARGED
9.000	76	15 minute 30 year Summer Q+0%	105.600	103.800	-0.300	0.000	0.000		0.000		0.0	OK
9.001	77(HW)	15 minute 30 year Summer Q+0%	105.600	103.790	-0.300	0.000			0.000		0.0	OK*
9.002	78(HW)	15 minute 30 year Winter Q+35%	105.150	103.754	-0.196	0.000			0.242		14.2	OK*
9.003	79	15 minute 30 year Winter Q+35%	104.900	103.751	0.051	0.000			0.977		103.1	SURCHARGED
9.004	80(HW)	30 minute 30 year Winter Q+35%	104.300	103.100	0.000	0.000			0.749		90.0	SURCHARGED*
9.005	81(HW)	15 minute 30 year Winter Q+35%	103.900	103.269	0.569	0.000		0.000	4.081		135.2	SURCHARGED*
9.006	82	15 minute 30 year Winter Q+35%	103.200	102.969	1.169	0.000			3.298		131.8	FLOOD RISK
9.007	83	15 minute 30 year Summer Q+0%	103.200	101.790	0.000	0.000			0.815		106.1	SURCHARGED*
6.004	47(HW)	15 minute 30 year Summer Q+0%	103.200	101.770	0.000	0.000			1.099		235.6	SURCHARGED*
6.005	48(HW)	15 minute 30 year Winter Q+35%	102.350	102.262	0.357	0.000		0.000	4.365	7	281.7	FLOOD RISK*
6.006	49	15 minute 30 year Winter Q+35%	102.350	102.258	0.363	0.000			2.467		365.0	FLOOD RISK
6.007	50(HW)	30 minute 30 year Winter Q+35%	102.350	101.885	0.000	0.000			1.445		335.8	SURCHARGED*

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
6.008	51(HW)	30 minute 30 year Winter Q+35%	101.850	101.850	0.290	0.000		2.803	8.929	7	327.1	FLOOD
6.009	52	15 minute 30 year Winter Q+35%	101.850	101.748	0.388	0.000			3.300		381.9	FLOOD RISK
6.010	53(J)	15 minute 30 year Summer Q+0%	101.400	100.875	0.000	0.000			1.528		294.8	SURCHARGED*
6.011	54J	60 minute 30 year Winter Q+35%	101.400	100.118	1.193	0.000		75.314	262.951	46	63.2	SURCHARGED*
5.009	39	60 minute 30 year Winter Q+35%	101.550	98.773	-0.087	0.000			0.862		150.4	OK
5.010	84	60 minute 30 year Winter Q+35%	99.650	98.595	0.145	0.000			3.247		138.8	SURCHARGED
5.011	40	60 minute 30 year Winter Q+35%	99.600	98.416	0.141	0.000			3.941		158.4	SURCHARGED
5.012	41	240 minute 30 year Winter Q+35%	98.800	98.221	0.336	0.000			6.930		106.9	SURCHARGED
5.013	42(HW)	60 minute 30 year Summer Q+35%	98.800	97.865	0.000	0.000			0.738		144.6	SURCHARGED*
2.021	22(HW)	480 minute 30 year Winter Q+35%	98.600	98.201	0.801	0.000			916.132		7.8	SURCHARGED*
2.022	23	480 minute 30 year Winter Q+35%	98.600	98.161	0.901	0.000			2.209		7.7	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

Simulation Criteria

Areal Reduction Factor 1.000 | Manhole Headloss Coeff (Global) 0.500 | MADD Factor * 10m³/ha Storage 0.000
Hot Start (mins) 0 | Foul Sewage per hectare (l/s) 0.000 | Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 | Additional Flow - % of Total Flow 0.000 | Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 | Number of Online Controls 5 | Number of Offline Controls 1 | Number of Storage Structures 15 | Number of Time/Area Diagrams 0 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH | Site Location GB 538700 152900 TQ 38700 52900 | Cv (Winter) 0.840
Return Period (years) 100 | Data Type Catchment
FEH Rainfall Version 2013 | Cv (Summer) 0.750

Margin for Flood Risk Warning (mm) 300.0 | DTS Status ON | Inertia Status ON
Analysis Timestep 2.5 Second Increment (Extended) | DVD Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Sensitivity flows(s) (%) 0, +45

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.000	1	30 minute 100 year Winter Q+45%	105.750	104.289	-0.261	0.000			0.060		2.3	OK
2.001	2(HW)	30 minute 100 year Winter Q+45%	105.750	104.257	-0.283	0.000			0.013		2.3	OK*
2.002	3(HW)	720 minute 100 year Winter Q+45%	105.150	103.803	-0.147	0.000			0.219		0.4	OK*
2.003	4	720 minute 100 year Winter Q+45%	105.150	103.803	-0.137	0.000			0.337		1.9	OK
2.004	5(HW)	2880 minute 100 year Summer Q+45%	104.450	103.550	0.000	0.000			1.180		3.0	SURCHARGED*
2.005	6(HW)	720 minute 100 year Winter Q+45%	103.800	103.802	1.052	0.000			93.974		1.2	FLOOD
2.006	7	720 minute 100 year Winter Q+45%	103.800	103.802	1.067	1.863			4.014		1.0	FLOOD
3.000	24	2880 minute 100 year Winter Q+45%	103.300	102.259	-0.041	0.000			0.449		0.3	OK
3.001	12(HW)	2880 minute 100 year Winter Q+45%	103.300	102.259	-0.031	0.000			0.305		0.3	OK*
3.002	13(HW)	2880 minute 100 year Summer Q+45%	103.180	102.200	0.000	0.000			2.009		0.5	SURCHARGED*
3.003	27	2880 minute 100 year Winter Q+45%	103.180	102.259	0.069	0.000			0.761		1.2	SURCHARGED
3.004	15(HW)	2880 minute 100 year Summer Q+45%	103.180	102.180	0.000	0.000			0.419		1.6	SURCHARGED*
2.007	8(J)	2880 minute 100 year Summer Q+45%	103.150	102.120	0.000	0.000			1.653		2.4	SURCHARGED*
2.008	9(HW)	2880 minute 100 year Summer Q+45%	103.250	102.050	0.000	0.000			1.812		2.4	SURCHARGED*
2.009	10	2880 minute 100 year Winter Q+45%	103.250	102.259	0.219	0.000			0.974		2.7	SURCHARGED
2.010	11(HW)	2880 minute 100 year Summer Q+45%	103.250	102.000	0.000	0.000			1.181		3.5	SURCHARGED*
2.011	12(HW)	2880 minute 100 year Winter Q+45%	102.850	102.259	0.309	0.000			263.655		2.7	SURCHARGED*
2.012	13	2880 minute 100 year Winter Q+45%	102.850	102.279	0.599	0.000			1.774		0.3	SURCHARGED
2.013	14(HW)	2880 minute 100 year Winter Q+45%	102.850	101.334	-0.296	0.000			0.000		0.3	OK*
2.014	15(HW)	15 minute 100 year Winter Q+45%	102.600	101.139	-0.171	0.000			0.249		1.2	OK*
2.015	16	15 minute 100 year Winter Q+45%	102.600	101.139	-0.161	0.000			0.252		66.5	OK
2.016	17	15 minute 100 year Winter Q+45%	100.750	100.108	0.108	0.000			1.553		90.3	SURCHARGED
2.017	18(HW)	15 minute 100 year Winter Q+45%	100.750	99.855	-0.135	0.000			0.183		89.5	OK*
2.018	19(HW)	60 minute 100 year Winter Q+45%	99.550	99.409	0.649	0.000			169.672		22.5	FLOOD RISK*
4.000	29	30 minute 100 year Winter Q+45%	99.900	98.989	0.219	0.000			0.908		83.6	SURCHARGED
2.019	20	30 minute 100 year Winter Q+45%	99.550	98.877	0.137	0.000			1.130		100.7	SURCHARGED

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
2.020	31(HW)	30 minute 100 year Winter Q+45%	99.550	98.611	-0.119	0.000			0.204		100.7	OK*
5.000	30	15 minute 100 year Summer Q+45%	104.700	103.933	0.198	0.000		0.000	0.871	13	57.0	SURCHARGED
5.001	31(J)	30 minute 100 year Winter Q+45%	104.700	103.725	0.000	0.000			0.387		60.2	SURCHARGED*
5.002	32(J)	120 minute 100 year Winter Q+45%	104.250	103.186	-0.529	0.000		51.980	54.186	122	0.0	OK*
5.003	33	15 minute 100 year Summer Q+0%	104.250	103.405	-0.300	0.000			0.000		0.0	OK
5.004	34	15 minute 100 year Summer Q+0%	104.100	102.900	-0.300	0.000			0.000		0.0	OK
5.005	35	15 minute 100 year Winter Q+45%	103.750	102.409	-0.216	0.000			0.196		31.3	OK
5.006	36	30 minute 100 year Winter Q+45%	102.900	101.539	-0.161	0.000			0.301		29.2	OK
5.007	37	30 minute 100 year Winter Q+45%	102.500	101.513	0.138	0.000		12.901	67.823		123.0	SURCHARGED
5.008	38	30 minute 100 year Winter Q+45%	101.950	100.880	0.130	0.000			2.263		172.8	SURCHARGED
6.000	43	15 minute 100 year Winter Q+45%	103.250	103.212	1.162	0.000			2.575		15.7	FLOOD RISK
6.001	44(HW)	15 minute 100 year Summer Q+0%	103.250	102.040	0.000	0.000			0.969		13.8	SURCHARGED*
6.002	45(HW)	15 minute 100 year Summer Q+0%	103.050	101.850	0.000	0.000			4.695		25.4	SURCHARGED*
7.000	55	15 minute 100 year Summer Q+0%	109.500	108.000	-0.300	0.000			0.000		0.0	OK
7.001	56(HW)	15 minute 100 year Summer Q+0%	109.500	107.990	-0.300	0.000			0.000		0.0	OK*
7.002	57(HW)	15 minute 100 year Winter Q+45%	107.800	106.369	-0.231	0.000			0.078		11.9	OK*
7.003	58	15 minute 100 year Summer Q+45%	107.500	106.220	-0.230	0.000			0.125		11.9	OK
7.004	59(HW)	15 minute 100 year Summer Q+45%	107.500	106.091	-0.209	0.000			0.097		51.8	OK*
7.005	60(HW)	15 minute 100 year Winter Q+45%	105.500	104.310	0.000	0.000			0.658		70.4	SURCHARGED*
7.006	61	15 minute 100 year Winter Q+45%	105.500	104.144	-0.156	0.000			0.272		71.3	OK
8.000	65	360 minute 100 year Winter Q+45%	106.000	105.380	0.460	0.000			1.334		0.0	SURCHARGED
8.001	62(HW)	15 minute 100 year Summer Q+0%	106.000	104.910	0.000	0.000			0.338		0.2	SURCHARGED*
8.002	66(HW)	360 minute 100 year Winter Q+45%	106.000	105.380	0.540	0.000		0.000	2.186		1.0	SURCHARGED*
8.003	67	360 minute 100 year Winter Q+45%	106.000	105.380	0.560	0.000		0.000	1.722		2.2	SURCHARGED
8.004	68(HW)	15 minute 100 year Summer Q+0%	106.000	104.800	0.000	0.000			0.705		10.8	SURCHARGED*
8.005	69(HW)	15 minute 100 year Summer Q+0%	105.590	104.390	0.000	0.000			2.507		1.5	SURCHARGED*
8.006	70	360 minute 100 year Winter Q+45%	105.580	105.380	1.000	0.000			2.357		2.0	FLOOD RISK
8.007	71(HW)	360 minute 100 year Winter Q+45%	105.570	105.380	1.010	0.000		0.000	9.753	195	6.0	FLOOD RISK*
8.008	72(HW)	360 minute 100 year Winter Q+45%	105.500	105.379	1.079	0.000			21.899		1.3	FLOOD RISK*
8.009	73	180 minute 100 year Winter Q+45%	105.500	105.379	1.089	0.000			2.466		1.0	FLOOD RISK
8.010	74(HW)	15 minute 100 year Winter Q+45%	105.300	104.066	-0.034	0.000			0.556		11.7	OK*
8.011	75(HW)	60 minute 100 year Summer Q+45%	104.500	103.300	0.000	0.000			1.225		17.2	SURCHARGED*
7.007	62	15 minute 100 year Winter Q+45%	104.500	104.028	0.738	0.000			4.082		90.4	SURCHARGED
7.008	63	15 minute 100 year Winter Q+45%	103.700	103.709	1.209	9.203			14.005		198.8	FLOOD
6.003	46	15 minute 100 year Winter Q+45%	103.200	103.200	1.400	0.026			5.803		181.9	FLOOD
9.000	76	15 minute 100 year Winter Q+45%	105.600	104.061	-0.039	0.000	4.831		0.453		0.0	OK
9.001	77(HW)	15 minute 100 year Summer Q+45%	105.600	104.090	0.000	0.000			0.402		0.3	SURCHARGED*
9.002	78(HW)	30 minute 100 year Summer Q+45%	105.150	103.950	0.000	0.000			2.186		18.7	SURCHARGED*
9.003	79	15 minute 100 year Winter Q+45%	104.900	104.295	0.595	0.000			2.079		115.9	SURCHARGED
9.004	80(HW)	15 minute 100 year Summer Q+0%	104.300	103.100	0.000	0.000			1.538		102.4	SURCHARGED*
9.005	81(HW)	15 minute 100 year Winter Q+45%	103.900	103.593	0.893	0.000		0.000	6.658	7	152.9	SURCHARGED*
9.006	82	15 minute 100 year Winter Q+45%	103.200	103.203	1.403	3.421			7.097		137.3	FLOOD
9.007	83	15 minute 100 year Summer Q+0%	103.200	101.790	0.000	0.000			1.066		123.6	SURCHARGED*
6.004	47(HW)	15 minute 100 year Summer Q+0%	103.200	101.770	0.000	0.000			1.264		282.5	SURCHARGED*
6.005	48(HW)	30 minute 100 year Summer Q+45%	102.350	102.350	0.445	0.000		0.000	4.489	11	311.2	FLOOD RISK*
6.006	49	15 minute 100 year Winter Q+45%	102.350	102.362	0.467	12.252			14.652		390.9	FLOOD
6.007	50(HW)	15 minute 100 year Summer Q+0%	102.350	101.885	0.000	0.000			1.454		341.2	SURCHARGED*

Summary of Critical Results by Maximum Level (Rank 1) for Mainline 2

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Overflow Vol (m³)	Infil. Vol (m³)	Maximum Vol (m³)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
6.008	51(HW)	15 minute 100 year Summer Q+0%	101.850	101.850	0.290	0.000		1.768	8.936	4	331.6	FLOOD
6.009	52	15 minute 100 year Summer Q+45%	101.850	101.850	0.490	0.322			3.801		400.6	FLOOD
6.010	53(J)	15 minute 100 year Summer Q+0%	101.400	100.875	0.000	0.000			1.761		347.2	SURCHARGED*
6.011	54J	60 minute 100 year Winter Q+45%	101.400	100.901	1.976	0.000		85.327	391.581	53	82.6	SURCHARGED*
5.009	39	60 minute 100 year Winter Q+45%	101.550	99.845	0.985	0.000			5.351		188.5	SURCHARGED
5.010	84	60 minute 100 year Winter Q+45%	99.650	99.531	1.081	0.000			5.600		182.5	FLOOD RISK
5.011	40	60 minute 100 year Winter Q+45%	99.600	99.219	0.944	0.000			5.383		221.5	SURCHARGED
5.012	41	360 minute 100 year Winter Q+45%	98.800	98.602	0.717	0.000			7.645		107.2	FLOOD RISK
5.013	42(HW)	2880 minute 100 year Summer Q+45%	98.800	97.865	0.000	0.000			1.087		32.3	SURCHARGED*
2.021	22(HW)	600 minute 100 year Winter Q+45%	98.600	98.598	1.198	0.000			1388.587		9.0	FLOOD RISK*
2.022	23	600 minute 100 year Winter Q+45%	98.600	98.543	1.283	0.000			2.885		9.0	FLOOD RISK

Appendix J

Drainage Management and Maintenance Plan

Stoneyfields, Oxted,
RH8 0NN

Drainage Management & Maintenance Plan

For

Croudace Homes Limited

motion

Document Control Sheet

Stoneyfields, Oxted,
RH8 0NN

Croudace Homes Limited

This document has been issued and amended as follows:

Date	Issue	Prepared by	Approved by
27/11/2024	Draft	Chris Gray	Neil Jaques
29/11/2024	Final	Chris Gray	Neil Jaques
19/12/2024	Final B	Chris Gray	Neil Jaques

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Contents

1.0 Introduction

1.1 This document sets out the principles for the long-term management and maintenance of the proposed surface water drainage system at the Land South of Barrow Green Road development.

1.2 The purpose of this document is to ensure that the site management company or their agents have a robust inspection and maintenance plan going forwards. This ensures the optimum operation of the surface water drainage system and that it will be continually maintained for the lifetime of the development. This will contribute to reducing the risk of surface water flooding both on- and off-site.

1.3 All those responsible for maintenance should follow relevant health and safety legislation for all activities listed within this report (including lone working, if relevant). Method statements and risk assessments should always be undertaken and made available, if requested.

1.4 This document has been produced by Motion on behalf of their client, Croudace Homes Limited. This document describes the typical management and maintenance tasks that are known at the outline design stage (maintenance frequencies and typical tasks, for example). These have been drawn from industry guidance such as CIRIA C753 - The SuDS Manual – and manufacturer's own guidance.

1.5 Maintenance is considered as a construction activity under the CDM Regulations 2015. Under the CDM Regulations, it is a requirement that a competent person be appointed to carry out a required role. CDM defines a competent person as an individual with sufficient knowledge of the specific tasks to be undertaken, as well as sufficient experience and ability to carry out their duties in relation to the task in a way that secures health and safety on site.

1.6 In recognition of the requirements of the CDM Regulations 2015, this surface water management and maintenance plan expects that the maintenance work will be carried out by a competent person who must have prior knowledge of the drainage components and SuDS systems on site.

1.7 There are limitations on what this document can prescribe at this time. At this stage this document cannot name the specific individuals who will carry out the maintenance and what equipment is to be used. Related to this, this document is unable to provide method statements for exactly how maintenance practices will be carried out. These can only be determined at the time of the maintenance being carried out and the exact maintenance need. Therefore, this is to be the responsibility of the site management company and/or the individuals carrying out the work. We urge those who are carrying out the maintenance to record this information and make it available to the Local Planning Authority (LPA), if required to do so. This drainage management and maintenance plan needs to be a living document that is owned and maintained by the adopting site management company. The intention of the report is to set out the principles for the long-term management and maintenance of the proposed surface water drainage system at the Land South of Barrow Green Road development.

2.0 Maintenance Categories

2.1 There are three categories of maintenance activities referred to in this report. These are:

Regular maintenance (including inspections and monitoring)

- Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including inspections, vegetation management, and litter, silt and debris removal.

Occasional maintenance

- Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example).

Remedial maintenance

- Remedial maintenance comprises of intermittent tasks that may be required to rectify faults associated with the system. The likelihood of faults can be minimised by correct installation, regular inspection and timely maintenance. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events and, as such, timings are difficult to predict.
- This document should be read in conjunction with the design drawings of the drainage system, so that the location and type of each feature can be recognised and understood.

3.0 The Surface Water Drainage System

3.1 The proposed surface water drainage system is made up of a number of components. These include:

- Permeable paving
- Geocellular attenuation storage/Soakaway
- Swale/Detention Basin/Infiltration Basin
- Pond
- Catchpit manholes/Silt traps
- Hydrobrake/Flow Control
- Water Butts
- Manholes
- Pipes.

3.2 All components should be installed in accordance with the manufacturer's instructions and to the levels/arrangement as defined on the designer's drawings. Not doing so will invalidate any warranty provided by the manufacturer.

3.3 All maintenance and cleaning must be carried out in accordance with manufacturer's recommendations and by competent and suitably qualified staff, as defined in the CDM regulations 2015.

4.0 General Maintenance Principles

4.1 All surface water drainage systems, whether piped gravity systems, Sustainable Drainage Systems (SuDS), or flow control devices and pumps, require regular maintenance to keep them working at optimum efficiency and capacity. The maintenance of the surface water drainage system on the development should be carried out alongside other regular maintenance tasks on site.

4.2 Timely and adequate maintenance will increase the lifespan of all the drainage components. Inadequate maintenance will do the reverse. Therefore, the projected lifespan and anticipated replacement date of each drainage component cannot be forecast at the time of this document being produced.

4.3 The site management company and/or their agents are responsible for the maintenance of the surface water drainage system.

4.4 Construction activities can create and discharge significant quantities of sediment that will quickly clog the surface water drainage system. Therefore, construction-stage sediment removal is required immediately post-construction. This may require several cleans of the system during the first year after installation. The construction site manager should assess this and carry out cleaning as necessary.

4.5 Catchpit manholes/silt traps will be specified upstream of the SuDS. They will remove gross solids and the majority of silts. It is important that any debris build-up in the catchpit manholes/silt traps is removed at regular intervals. This will reduce the risk of the permeable paving becoming silted up. It will maintain its design capacity and function.

4.6 Cleaning should also take place after large storms when there have been increased surface water flows and visible entrainment and deposition of debris.

4.7 An increased frequency of inspection and maintenance should be programmed into the autumn and winter months in acknowledgement that:

- Leaf fall from deciduous trees in autumn will result in an increased amount of leaf litter and an elevated blockage risk of drainage infrastructure.
- Increased rainfall during winter months will result in greater quantities of water moving through the drainage system and a greater input of silt and other debris.

4.8 Table 4.1, below, gives an overview of typical maintenance tasks and the frequency with which they need to be undertaken. Section 5 – Inspection and Maintenance Frequency of Components – will assign typical maintenance frequencies and tasks to the specific components used within the surface water drainage system used on the development.

Table 4.1: Typical maintenance tasks and frequencies

Activity	Indicative Frequency	Typical Tasks
Routine/regular maintenance	Monthly to annually	▸ Litter picking ▸ Silt removal ▸ Inspection of all inlets, outlets and control structures ▸ Weed removal and invasive plant control
Occasional maintenance	Annually up to 25 years	▸ Silt control around components ▸ Vegetation management around components ▸ Sweeping of pavement areas to remove surface silt ▸ Silt removal from catchpits, cellular storage structures
Remedial maintenance	As required	▸ Inlet/outlet repairs ▸ Erosion repairs ▸ Reinstatement of edgings ▸ Reinstatement following pollution ▸ Removal of silt build-up and leaf litter after storms ▸ Repair of vandalism ▸ Replacement of any blocked filter ▸ membranes/materials

5.0 Inspection and Maintenance Frequency of Components

5.1 Table 5.1 below lists each of the components used within the site's surface water drainage system. It suggests an indicative maintenance frequency for each component and ascribes typical maintenance tasks to them.

5.2 This list is not exhaustive, nor is it prescriptive. As mentioned in Section 3, additional, unscheduled maintenance may be required following adverse weather conditions or after autumn leaf falls. Additional maintenance tasks may be required to adequately clean and maintain individual components.

5.3 The list of components should be cross-referenced with the designer's drawings so that the location of each component can be identified.

5.4 It is the responsibility of the site management company and/or their agents to ensure that all necessary maintenance activities are carried out in a timely manner and that the design performance of each drainage component is preserved.

5.5 If there is any uncertainty regarding the correct and safe methods of cleaning, or what equipment should be used, the manufacturer should be consulted.

5.6 Upon completion of maintenance activities, a record should be kept of the work carried out. This should be retained and an annual maintenance report should be compiled, which should include the following:

- Observations resulting from inspections
- Maintenance and operation activities undertaken during the year
- Recommendations for inspections and maintenance programmes for the following year

5.7 On the last page is a table with suggested information should be recorded and included with the maintenance plan. As mentioned in the introduction to this document, this should be a living document and regularly updated, as required.

5.8 The Local Planning Authority Tandridge District Council (TDC) may request to check and sign off any maintenance activities. Therefore, it is recommended that the LPA is contacted prior to any scheduled routine maintenance. Also, with reference to Table 5.1, the annual maintenance report, including a completed version of the table on the last page, should be offered to the LPA for their records and approval.

Table 5.1: Maintenance Frequency and Task for Drainage Components

Activity	Indicative Frequency	Anticipated Tasks
Pipes	As required	▸ Identify any pipes that may not be operating properly and employ a competent, qualified contractor to inspect using CCTV. ▸ If the pipe is blocked with silt or debris, the pipe should be jetted clean from an upstream access point. All silt and debris should be captured and removed at a downstream access point. ▸ Inspect once clean. ▸ If any other defects are encountered (cracks, displaced joints, root ingress), appropriate solutions should be discussed with a competent and qualified contractor. These services are usually provided by the same

		companies that offer CCTV surveys and pipe jetting services.
Manholes	Annually	▸ Inspect/identify any damage or areas that are not operating correctly ▸ Remove silt, litter, leaves and other detritus. ▸ Inspect once clean.
Catchpit Manholes/Silt Traps	Twice a year, before and after autumn/winter	▸ Inspect/identify any damage or areas that are not operating correctly ▸ Remove silt, litter, leaves and other detritus. ▸ Inspect once clean.
Geocellular attenuation storage/Soakaway	Every three months for the first year, then annually thereafter	▸ Contact manufacturer for instruction on approved and safe inspection and maintenance practices ▸ Inspect/identify any areas that are not operating correctly ▸ Remove debris from catchment surface ▸ Remove sediment from pre-treatment structures ▸ Check for silt build-up and flush and remove as required (in accordance with manufacturer's instructions). ▸ Inspect once clean. ▸ See Table 21.3 of CIRIA C753 for more information. ▸ Most geocellular units have a 60 year creep limited life expectancy, so they should be planned for replacement by 2081 (approx.).
Swale/Detention Basin/Infiltration Basin	Monthly in Summer, as required in Winter	▸ Responsibility should be with landscape contractors. ▸ Maintenance tasks are not that different from standard public open space. ▸ Adequate access needs to be provided to the area. ▸ Regular mowing should take place across maintenance access routes, amenity areas, across embankments and the main storage area. Remaining areas can remain as 'meadow'. Mowed grass lengths of 75 – 100mm are appropriate. ▸ Grass clippings should be disposed of off-site. ▸ Any dead growth should be cleared before the start of the growing season. ▸ Any permanently wet areas with emergent aquatic vegetation should be managed as ponds or wetlands. ▸ Remove any sediment build-up as required. ▸ Check any inlets and outlets for blockages and clear as required. ▸ Check any flow control devices, if present.
Pond	As required	▸ Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and or physical damage / monthly

		▸ Remove sediment and planting from one quadrant of the main body of ponds without sediment forebays / Every 5 years, or as required ▸ Repair erosion or other damage, Replant, where necessary, Aerate pond when signs of eutrophication are detected, Realign rip-rap or repair other damage, Repair / rehabilitate inlets, outlets and overfows / as required
Hydrobrake chamber	Every three months for the first year, then annually thereafter	▸ Contact manufacturer for instruction on approved and safe inspection and maintenance practices. ▸ Inspect Hydrobrake and check functionality. Remove any detritus as required. ▸ Inspect once clean.
Water Butts	Annually in Autumn to Winter	▸ Remove falling leaves and seeds from guttering or those that have found their way into the water butt. ▸ Water may stagnate slightly. If so, use a water butt cleaning disc into the tank. ▸ In autumn and winter, drain water off every 10 days (or less) to make sure that water butts don't overflow and that water is kept moving. This will stop larvae and flies from using the water butt. ▸ Use safe products such as vinegar to clean the outside of the tank and the inside of the lid and be careful not to contaminate water with chemicals. ▸ At least once a year, completely empty the water butt and scrub it out with warm soapy water and then rinse thoroughly. This is best done at a time when the water butt is already nearly empty (end of summer) or when it can readily refill (winter).
Permeable paving	Once a year after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations.	▸ Agitate surface by means of mechanical sweeping or vacuuming to ensure no vegetation or moss is allowed to establish and grow in the joints. ▸ Mechanical sweeping of paviours and refilling of joints with the correct aggregate need only be carried out at intervals of 5 years or so ▸ Remove weeds from the surface through the application of glyphosate-based weed killers ▸ Stabilise and mow contributing and adjacent areas. ▸ Inspect once clean. ▸ See Table 20.15 of CIRIA C753 for more information. ▸ Permeable paving has a nominal 25 year lifespan, if correctly and regularly maintained.

		▸ When subjected to low level oil drips permeable paviours can continue to biodegrade hydrocarbons indefinitely. ▸ Major oil spills have the potential to contaminate the surface and the underlying crushed stone. In the event of a major oil spill, the area of block paviours and crushed stone that is affected should be removed, cleaned and reinstalled.

Date	Component requiring maintenance	Issues prompting maintenance	Scheduled maintenance (Y/N)	Maintenance carried out	Additional works required (Y/N). If yes, please detail	Next scheduled date of inspection and maintenance

Appendix K

Completed LLFA SuDS Proforma

Surface Water Drainage Summary Pro-forma

Introduction

Surrey County Council (SCC) as Lead Local Flood Authority (LLFA) recommends this pro-forma is completed in full and should be submitted with any planning application which seeks permission for 'major' development. The information contained in this form will be used by SCC in its role as LLFA as a 'statutory consultee' on Sustainable Drainage Systems (SuDS) for all 'major' planning applications. The pro-forma should be completed in conjunction with the SCC SuDS Design Guidance. The pro-forma will accompany the site-specific Flood Risk Assessment and Drainage Strategy submitted as part of the planning application.

Please complete this pro-forma in full for full applications and the coloured sections for outline applications. This will help us identify what information has been included and will assist in our review process.

All bracketed numbers refer to the relevant note on page 5 of this document.

Site Details

1.0 Site Detail Questions

Question number	Question	Answer (to be completed or delete as applicable)	Required
1.1	Planning application reference (if known)	Not Known	Outline & Full
1.2	Site name	Land South of Barrow Green Road, Oxted, RH8 0NN	Outline & Full
1.3	Total application site area (1) (in hectares)	9.7	Outline & Full
1.4	Predevelopment use (4)	Greenfield	Outline & Full
1.5	Urban Creep applicable	Yes/~~No~~	Outline & Full
1.6	If Urban Creep required, factor applied (percentage)	10	Outline & Full
1.7	Proposed design life / planning application life (in years)	100	Outline & Full
1.9	Have agreements in principle (where applicable) for discharge been provided	Yes/~~No~~	Outline & Full

2.0 Method(s) of Discharge (5)

Question number	Question	Answer (delete as applicable)	Required

2.1	Reuse	Yes/~~No~~	Full
2.2	Infiltration	Yes/~~No~~	Full
2.3	Hybrid	Yes/~~No~~	Full
2.4	Watercourse	Yes/~~No~~	Full
2.5	Surface Water Sewer	~~Yes~~/No	Full
2.6	Combined sewer	~~Yes~~/No	Full

Calculation Inputs

3.0 Calculation input questions

Question number	Question	Answer (to be completed or delete as applicable)	Required
3.1	Area within proposed site which is drained by SuDS (2) (in hectares)	3.527	Outline & Full
3.2	Impermeable area drained predevelopment (3) (in hectares)	0	Outline & Full
3.3	Impermeable area drained post development (3) (in hectares)	3.527	Outline & Full
3.4	Additional impermeable area (Question 3.3 minus Question 3.2) (in hectares)	3.527	Outline & Full
3.5	Method for assessing greenfield runoff rate	FEH	Outline & Full
3.6	Method for assessing brownfield runoff rate (if applicable)	NA	Outline & Full
3.7	Coefficient of runoff (6) (Cv)	75% Summer / 84% Winter.	Outline & Full
3.8	Source of rainfall data (FEH Preferred)	FEH	Outline & Full
3.9	Climate change factor applied (percentage)	45%	Full

4.0 Attenuation (positive outlet) (13)

Question number	Question	Answer (to be completed or delete as applicable)	Required
4.1	Drainage outlet at risk of drowning (elevated water levels in watercourse/sewer)	~~Yes~~/No	Full
4.2	Invert level at final outlet (in metres above ordnance datum)	96.12/96.49	Full
4.3	Design level used for surcharged water level at outlet (13) (in metres above ordnance datum)	NA	Full

5.0 Infiltration (Discharge to Ground)

Question number	Question	Answer (to be completed or	Required

		delete as applicable)	
5.1	Have infiltration tests been undertaken	Yes/~~No~~	Outline & Full
5.2	If yes, which method has been used	BRE365	Outline & Full
5.3	Infiltration rate (where applicable) (in metres per second)	$2.55x10^{-4}$	Outline & Full
5.4	Depth to highest known ground water table (in metres above ordnance datum)		Full
5.5	Depth of infiltration feature (in metres above ordnance datum)		Full
5.6	Factor of safety used for sizing infiltration storage		Full

Calculation Outputs

Section 6.0, 7.0 and 8.0 refer to sites where storage is provided by full attenuation or partial infiltration. For sites where all flows are infiltrated to ground go straight to Section 9.0.

6.0 Greenfield runoff rates

Question number	Question	Answer (to be completed)	Required
6.1	1 in 1 year rainfall (in litres per second)	NA	Outline & Full
6.2	1 in 30 year rainfall (in litres per second)	NA	Outline & Full
6.3	1 in 100 year rainfall (in litres per second)	NA	Outline & Full
6.4	Qbar (in litres per second)	10.1 (QMED)	Outline & Full

7.0 Brownfield runoff rates (if applicable)

Question number	Question	Answer (to be completed)	Required
7.1	1 in 1 year rainfall (in litres per second)	NA	Outline & Full
7.2	1 in 30 year rainfall (in litres per second)	NA	Outline & Full
7.3	1 in 100 year rainfall (in litres per second)	NA	Outline & Full

8.0 Proposed maximum rate of runoff from site (incl. Urban Creep) (7)

Question number	Question	Answer (to be completed)	Required
8.1	1 in 1 year rainfall (in litres per second)	8.4(2Y)	Outline & Full
8.2	1 in 30 year rainfall (in litres per second)	8.5(+35%CC)	Outline & Full

8.3	1 in 100 year rainfall plus climate change allowance (in litres per second)	10	Outline & Full

9.0 Attenuation storage to manage flow rates from site (inclusive of Climate Change Allowance and Urban Creep)

Question number	Question	Answer (to be completed)	Required
9.1	Volume of Storage for the 1 in 100 year plus Climate Change Allowance (9) (in metres cubed)		Full
9.2	50% storage drain down time for 1 in 30 year rainfall (in hours)		Full

10.0 Volume control provision

Question number	Question	Answer (to be completed)	Required
10.1	Interception losses (11) (in metres cubed)		Full
10.2	Rain harvesting (in metres cubed)		Full
10.3	Infiltration (in metres cubed)		Full
10.4	Attenuation (in metres cubed)		Full
10.5	Separate volume designated as long-term storage (12) (in metres cubed)		Full
10.6	Total volume control (sum of inputs for Questions 10.1 to 10.5) (in metres cubed)		Full

11.0 Site storage volumes (for sites proposing full infiltration only)

Question number	Question	Answer (to be completed)	Required
11.1	Volume of Storage for the 1 in 30 year (8)		Full
11.2	Volume of Storage for the 1 in 100 year plus Climate Change Allowance (10)		Full

Notes

1. All area within the proposed application site boundary to be included.

2. The site area which is positively drained includes all green areas which drain to the SuDS system and area of surface SuDS features. It excludes large open green spaces which do not drain to the SuDS system.

3. Impermeable area should be measured pre and post development. Impermeable surfaces include roofs, pavements, driveways and paths; where runoff is conveyed to the drainage system.

4. Predevelopment use may impact on the allowable discharge rate. The LLFA will seek for reduction in flow rates to greenfield (SCC SuDS Design Guidance).

5. Runoff may be discharged via one or more methods.

6. Sewers for Adoption 7th Edition recommends a Cv of 100% when designing drainage for impermeable area (assumes no loss of runoff from impermeable surfaces) and 0% for permeable areas. Where lower Cv's are used the applicant should justify the selection of Cv.

7. It is Surrey County Council's preference that discharge rates for all events up to the 1 in 100 year rainfall event plus climate change match the greenfield rate for the same rainfall event.

8. Storage for the 1 in 30 year rainfall event must be fully contained within the SuDS components. Note that standing water within SuDS components such as ponds, basins and swales is not classified as flooding. Storage should be calculated for the critical duration rainfall event.

9. Runoff generated from rainfall events up to the 1 in 100 year rainfall event will not be allowed to leave the site in an uncontrolled way. Temporary flooding of designated areas to shallow depths and velocities may be acceptable.

10. Climate change is specified between 10% and 40% increase to rainfall intensity depending upon the design life of the development. Sensitivity testing should be carried out up to the 40% climate change allowance.

11. Where Source Control is provided Interception losses will occur. An allowance of 5mm rainfall depth can be subtracted from the net inflow to the storage calculation where interception losses are demonstrated. The Applicant should demonstrate use of sub-catchments and source control techniques. Further information is available in the SCC SuDS Design Guide.

12. Flows within long term storage areas should be infiltrated to the ground or discharged at low flow rate of maximum 2 l/s/ha.

13. Careful consideration should be used for calculations where flow control / storage is likely to be influenced by surcharged sewer or peak levels within a watercourse. Calculations should demonstrate that risk of drowned outlet has been taken into consideration. Vortex controls require conditions of free discharge to operate as per specification.