Foul and Surface Water Drainage Strategy
Kingfisher Drive, Canterbury
130084-REP-001
October 2019

FAIRHURST

CONTROL SHEET

CLIENT: **Coombs (Canterbury) Limited.**

PROJECT TITLE: **Kingfisher Drive, Canterbury**

REPORT TITLE: **Foul and Surface Water Drainage Strategy**

PROJECT REFERENCE: **130084-REP-001**

Issue and Approval Schedule:

ISSUE 1	Name	Signature	Date
Prepared by	Taurai Harahwa		Nov 2019
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This report has been prepared in accordance with procedure OP/P02 of Fairhurst's integrated Quality and Environmental Management System (QEMS)

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APPENDICES:

1.0 INTRODUCTION

1.1 Fairhurst have been commissioned by Coombs (Canterbury) Limited to provide a drainage strategy for a proposed housing site. This report will incorporate a SuDS Assessment and will be used as an amendment to the existing planning application.

1.2 The proposed site comprises 16 terraced residential units forming 2 flats, 11 two-storey dwellings, and 3 three-storey dwellings. The site has one access road with an adjacent close.

1.3 This report references a Site Investigation prepared by Soiltec (Ref. Phase II Environmental Assessment (Intrusive Site Investigation) Report) Appendix A.

2.0 SITE DESCRIPTION

2.1 The site is situated to the East of the existing Kingsmead Playing Field, with Kingsmead Road on the west side, Ambleside Place to the South, Stonebridge Road to the North-East, and Great Stour (river) beyond to the North. The site can be found at grid reference E:615225 N:158721.

2.2 Available site history suggests that the site was previously a greenfield site, although ground investigations have returned information that suggests that the site may be classified as brownfield. Please see Appendix A for the ground investigation information.

2.3 The total area of the site equates to 0.448 hectares.

2.4 A copy of the Site Layout is included within Appendix B.

3.0 TOPOGRAPHY

3.1 A topographical survey was undertaken by East Kent Engineering Partnership in April 2018 and issued under the title Kingsmead Survey.

3.2 The topographical survey indicates existing levels ranging from 9.713 in the South-East corner at the back of an existing Sub-station and 8.509 to the North-East of the site; 7.771 in the northwest corner to the back of the footpath of Stonebridge Road; with a level of 8.694 in the southeast corner. This gives the site an effective general fall from southeast to northwest of 1:55.

3.3 A copy of the topographical survey is included within Appendix C.

4.0 EXISTING FOUL AND SURFACE WATER DRAINAGE

4.1 Sewer records showing foul water have been obtained from Southern Water and are contained within Appendix D.

4.2 Southern Water's records show a Ø150mm foul pipe running East to West within Ambleside Place to the South of the Site.

4.3 Research has suggested that there is additional Southern Water (SW) plant in Stonebridge Road.

4.4 Topographical survey information in Appendix C indicates Great Stour to the North of the site.

Surface Water

4.5 The Surface water plant in Stonebridge Road was found to be too high to service our proposed site.

4.6 An asset search carried out by Coombs (Canterbury) Limited (CCL) has not turned up any other statutory surface water services within reasonable reach of the site.

Foul

4.7 Southern Water asset plans indicate a manhole (2601) to the South of the site, with an incoming and outgoing 150Ø pipe running East to West.

5.0 FLOOD RISK

5.1 Flood maps indicate that the site is located in Flood Zone 1.

5.2 It should be noted, however, that the River Great Stour is prone to rising tide.

5.3 Further flooding considerations have been omitted, as the site falls below the 1ha threshold, and is located in Flood Zone 1.

6.0 GEOTECHNICAL (DRAINAGE RELATED)

6.1 The Phase II Environmental Assessment by Soiltec, reported significant levels of contamination. Please refer to Appendix A for specific detail.

6.2 The above observations mean that infiltration on the site is not a viable solution due to the potential percolation of contamination.

7.0 PROPOSED FOUL AND SURFACE WATER DRAINAGE STRATEGY

Proposed Foul Strategy

7.1 The proposed connection to Southern Water public systems will be at manhole 2601 located in Ambleside Place to the South of the site.

7.2 Based on guidance outlined in Sewers for Adoption and BS 752-4, the flow generated by the site can be calculated as follows:

Flow rate per unit:

4000liters per unit per day

Domestic flow rate:

∑flows = 16 units x 4000litres = 64000litres per day

∴ flows per second:

64000litres ÷ (3600second x 24hours) = **0.74ls[1]**

7.3 A section 106 application has been submitted to Southern Water is currently being processed.

7.4 The foul drainage strategy can be seen on drawings 130084 – C01 to C03 and is included in Appendix E.

Proposed Surface Water Strategy

7.5 While the original architect's proposals by Churchill Hui indicated permeable paving, no such SuDS features will be incorporated in this design due to the underlying ground conditions.

7.6 The impermeable areas are given in the table below:

Table 1

Description	Area (ha)
Permeable	0.19
Impermeable	0.26
Total Area	**0.45**

7.7 Prior communications with Kent County Council's Flood Water Management team had suggested that storm water discharge should be set to a greenfield runoff rate calculated to 4l/s/ha (in accordance with Canterbury County Council's drainage policy), with calculations for critical durations for the 1, 30, and 100 year + 20% and 30% storm events.

7.8 Upon further liaising, it was discovered that these recommendations were made under the assumption that the target water body for discharge (the Great Stour) was a **watercourse** as opposed to being a **main river** as defined by the Environment Agency.

7.9 As the Great Stour is indeed recognised as a main river, KCC's Flood Management Officer then recommended that the discharge rate be determined by the Environment Agency.

7.10 The Environment Agency was subsequently consulted; their stance was that they were only concerned with water quality and construction works leading up to the final outfall location. They also stated that they would hear advice from the KCC (being the Lead Local Flood Authority or LLFA) on possible discharge rates.

7.11 As stated above, the Environment Agency would take advice on discharge rates from KCC, but KCC have advised that they themselves would not impose a limit on discharge to a main river. As such, our design does not adhere to any discharge limitation.

7.12 Based on the above, the surface water system has been designed to an unrestricted discharge rate, comprising a series of pipes and manholes, with no storage or flow control devices.

7.13 Generated surface water run-off will be conveyed to the River Great Stour via a gravity system.

7.14 In order to meet the Environment Agency hydrocarbon mitigation requirements, the strategy makes use of a “Downstream Defender” by Hydro International to intercept any pollutants in the surface water run-off.

7.15 While the flood maps show that the position of the last manhole prior to the outfall headwall (S9) is positioned in flood zone 1, this location is in abeyance pending receipt of flood levels from the Environment Agency.

7.16 The outfall headwall will be fitted with a non-return flap valve, as the water level of the Great Stour is prone to rising in times of extreme rainfall.

7.17 Stormwater manhole S9 is to be fitted with a grated cover to act as an overflow outlet during times of flood (when the flap valve in the headwall will be shut).

7.18 Permission is required from the Environment Agency for the construction of the outfall headwall and all works within 8 metres from said headwall.

8.0 SURFACE WATER DRAINAGE MAINTENANCE SCHEDULES

8.1 Operation and Maintenance

There are three types of maintenance activities associated with surface water drainage Systems. The SuDS Manual, CIRIA C753, defines these as:

- Regular Maintenance – 'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'

- Occasional Maintenance – '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 – 'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. 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.'

Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

The table below gives an overview of the maintenance required for each of the SuDS elements used on the site.

Operation and Maintenance Activity	SuDS Component	
	Piped Network / Inspection Chambers	~~Porous Pavement~~
Inspection	■	■
Litter and debris removal	■	■

Operation and Maintenance Activity	SuDS Component	
	Piped Network / Inspection Chambers	~~Porous Pavement~~
Grass Cutting		■
Weed / invasive plant control		■
Shrub management		■
Sediment management[1]	■	■
Vacuum sweeping and brushing		■
Structure rehabilitation / repair	□	
Infiltration surface reconditioning	□	■

Table 1 - Extracted and adapted from The SuDS Manual (C697, 20071) Table 22.1: Typical key SuDS components operation and maintenance activities.

8.2 Other Components - Manholes (including catchpits), Gullies and Channels

Source: Various guidance

In addition to the aforementioned SuDS components of the network, the network also consists of gullies, channels and other components to collect the flow into the network. It is at these locations that silt is most likely to enter the system.

Table 2 outlines the maintenance required for the effective operation of the other surface water drainage network components.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove debris from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from manholes and catchpits	Annually or as required

Maintenance Schedule	Required Action	Typical Frequency
Remedial actions	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, manholes and catchpits to ensure that they are in good condition and operating as designed.	Annually and after large storm events
	Inspect and identify any features that are not operating correctly. If required take remedial action	Monthly for three months, then six monthly

Table 2 - Other drainage components maintenance requirements

8.3 Health, Safety and Welfare

All those responsible for maintenance should take appropriate health, safety and welfare Precautions for all activities including lone working, if relevant. Risk assessments should always be undertaken before carrying out any works either inside or outside of the site.

The requirements of the Health and Safety at Work Act 1974 and The Construction (Design And Management) Regulations 2015 should be adhered to and any residual risks identified in the Health and Safety File should be managed and information passed on to maintenance operatives through task specific risk assessments.

9.0 CONCLUSIONS

9.1 The site is located in Flood Zone 1 with a total site area of 0.45ha, and therefore is subject to less than 1:1000 chance of flooding and exempt from Flood Risk Assessment requirement.

9.2 The Phase II Environmental Assessment by Soiltec has reported significant levels of contamination, meaning that infiltration is not a viable option.

9.3 The storm water is to discharge into the main River Great Stour.

9.4 Correspondence with the Environment Agency has lead to an unrestricted discharge rate.

9.5 Permission from the Environment Agency is required for the construction works leading up to the proposed outfall headwall, as well as approval of evidence that adequate contamination mitigation measures are to be implemented.

9.6 The foul water is to discharge into existing Southern Water infrastructure in Ambleside Place to the south of the site.

9.7 A Section 106 application for the foul water outfall has been submitted to Southern Water.

9.8 It is understood that the surface water system will remain private and as such will be maintained by a management company

APPENDIX A

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PHASE II ENVIRONMENTAL ASSESSMENT (INTRUSIVE SITE INVESTIGATION) REPORT

Site: Land at Kingsmead, Canterbury, Kent CT2 7LN

Prepared for: Canterbury City Council

Date: 8th May 2018

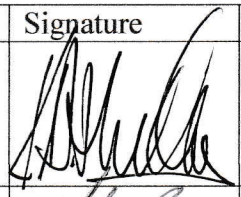
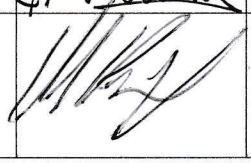
Registered in England. Company Registration No: 3014370
Registered Office: 7 Clarendon Place, King Street, Maidstone, Kent ME14 1BQ

CLIENT: Canterbury City Council

SITE: Land at Kingsmead, Canterbury, Kent CT2 7LN

JOB NUMBER: 07821/23

DATE: 8th May 2018

	Name	Position	Signature	Date
Prepared by	Keith Huxley	Head of Environmental Division		08/05/18
Checked by	Martin King	Managing Director		8/5/18.
On behalf of Soiltec Laboratories Limited				

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Executive Summary

Soiltec Laboratories Limited was instructed by Canterbury City Council to carry out a Phase II Environmental Assessment (Site Investigation) of the site at

Land at Kingsmead, Canterbury, Kent CT2 7LN

A planning application has not been submitted to Canterbury City Council at this juncture. Soiltec carried out a desk study of the site during November 2017 and the report of the findings was issued on the 1st December 2017. The desk study concluded that the site posed a very low to high environmental risk and that a phase II intrusive investigation of the site was required.

The site covers an area of approximately 0.44ha (4400m^2) and is off the south side of Stonebridge Road, in Canterbury.

The site is currently an area of redundant land that was part of a playing field and located in an area of residential and commercial use. It is proposed to develop the site with residential dwellings with off road parking and private gardens.

The nature of the soils encountered was predominantly made ground of gravelly ash at each borehole location with occasional brick, concrete, slate, charcoal, glass, chalk, rubber, ceramic/pottery pieces at some locations that extended to depths from 1.8m to 2.8m below existing ground level beneath the grass, felled trees and cut brambles/weeds that covered most of the site.

The stratum encountered below the made ground was silty clay, clayey silt, sand and or sandy gravel – alluvium drift deposits. The alluvium drift deposits extended to the base of each borehole (maximum depth 4.0m). The expected bedrock geology of The Seaford Chalk Formation was not encountered at the depths drilled.

There are contaminants on the site within the soils analysed that are likely to impact human health on this proposed residential site and the risk to the end users on site is deemed to be very low to high. The aesthetic nature of the made ground would also deem it necessary to be removed from garden areas.

The risk to the new buildings is deemed to be very low to low/moderate.

The risk to below ground services is deemed to be very low (low/moderate within the existing made ground).

The risk to groundwater and surface water now and following the development is deemed to be very low.

Gas protection measures are also required in the new dwellings.

The findings of this report indicate that the site represents an overall **very low to high environmental risk** and that remediation work is required on the site.

Soiltec Laboratories Limited

1. Introduction

Soiltec Laboratories Limited was instructed by Canterbury City Council to carry out an intrusive site investigation at: Land at Kingsmead, Canterbury, Kent CT2 7LN (grid reference at the site centre 615240 158703). The site is approximately 8 metres above ordnance datum (AOD) in the city of Canterbury, Kent.

The site covers an area of approximately 0.44ha (4400m^2) and is off the south side of Stonebridge Road, in Canterbury.

The site is currently an area of redundant land that was part of a playing field. It is proposed to develop the site with residential dwellings with off road parking and private gardens.

Site plans showing the site location, existing layout and proposed layout are shown in appendix 1, site plans (p1 and p2).

Soiltec carried out a desk study of the site during November 2017 and the report of the findings was issued on the 1st December 2017. The desk study concluded that the site posed a very low to high environmental risk and that a phase II intrusive investigation of the site was required.

It should be noted that the proposed layout of the site has changed slightly since the desk study was carried out.

A brief summary of the desk study is outlined below.

2. Summary of the Desk Study

2.1 The Site, Surrounding Areas and History

The site is off the south side of Stonebridge Road and is currently an area of redundant land that was part of a playing field and located in an area of residential and commercial use.

Immediately to the north of the site are Stonebridge Road and the Great Stour River approximately 25m from the site. Beyond the river is Broad Oak Road with its associated residential houses and residential houses beyond.

Immediately to the west of the site is a playing field/public open space that extends to at least 180m from the site. Beyond the playing field are residential houses, the junction of Broad Oak Road, Kingsmead Road and St Stephen's Road with residential houses beyond. Immediately to the west at the south end of the site are the grounds of a children's centre. The building is approximately 50m from the site.

Immediately to the south of the site are an access drive/path and soft landscaped areas from Kingsmead Road that leads to Ambleside Place that is to the east of the site. Beyond the access drive approximately 40m from the site is the Great Stour River. Beyond the river are Kingsmead Road, a large supermarket, residential houses and the city centre.

Immediately to the east of the site are the private gardens and residential houses in Ambleside Place with residential houses in Westwood Drive and the river, which is approximately 240m from the site. Beyond the river are commercial businesses and residential houses.

The site was undeveloped and within an area of possibly farmland from at least the mid 1870's until at least the late 1930's. A surface water drainage ditch ran across the north area of the site from the adjacent river. By the mid 1950's the drainage ditch is no longer on the site and the site is within a playing field. By the early 1970's a sports stadium had been built immediately to the east, part of which occupied the east area of the site with buildings in the south area. The stadium site was redeveloped with the residential houses and landscaped areas between 2002 and 2010. The site is also within a former landfill site that extended further to the east and west.

The immediate surrounding areas were also possibly farmland from at least the mid 1870's until at least the late 1930's. Industrial sites were beyond the river to the south/southwest with an allotment garden and houses beyond the river to the north from at least the mid 1950's that remain to date. The children's centre just to the southwest was built between 2002 and 2010. A landfill site was also immediately beyond Kingsmead Road further to the west.

2.2 Hydrology

There are no current surface water features on the site although the Great Stour River is approximately 25m to the north at the nearest point. The river is also just to the south of the site.

2.3 Geology/ Hydrogeology

Based on the British Geological Survey information The Seaford Chalk Formation (chalk) is the bedrock geology on the site of very low high permeability with alluvium/river terrace drift deposits (clay silt and gravel).

The site overlies a secondary/primary aquifer and is within a groundwater source protection zone (SPZ).

2.4 On-Site Contamination Impact

From the investigations carried out for the desk study it is possible that the site has been impacted from its former uses.

There are no recorded pollution incidents on the site that could have impacted the site.

It is possible that landfill gases are impacting the site from on site sources.

2.5 Off-Site Contamination Impact

The findings of the desk study indicated that contamination impact to the site from the immediate surrounding areas is possible.

There are no recorded pollution incidents near the site that could have impacted the site.

It is also possible that landfill gases are impacting the site from off site sources.

2.6 Conceptual Model

Using the Contaminated Land Exposure Assessment (CLEA) model and associated Contaminated Land Report (CLR11, Model Procedures for the Management of Land Contamination) framework to assess sites, a Source (contaminant) – Pathway – Receptor approach is used.

Source – (contaminant) "a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters"
Pathway – e.g. via air, soil or water "route or means by which a receptor can be exposed to, or affected by, a contaminant"
Receptor – e.g. humans, buildings and services, groundwater or surface waters "in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body"

If any of the above elements are missing i.e. there is no pollution linkage, then it is considered that there is no significant risk associated with contamination. If there is a pollution linkage the potential risks to the identified receptors need to be assessed.

2.6.1 Source(s)

Using the CLR framework, the potential sources of contamination on this site from the outcome of the desk study as outlined above could be:
Heavy metals (made ground/landfill, former stadium grounds and buildings)
Polyaromatic hydrocarbons (made ground/landfill, former stadium grounds and buildings)
Total petroleum hydrocarbons (inc BTEX) (made ground/landfill, former stadium grounds and buildings)
VOC's and SVOC's (made ground/landfill, former stadium grounds and buildings)
Asbestos (made ground/landfill, former stadium grounds and buildings)
Landfill gases (made ground/landfill, former stadium grounds and buildings)

2.6.2 Pathway(s)

It is intended to develop the site with residential dwellings with off road parking and private gardens.

Using the CLEA model the potential pathways for this residential site are:
Ingestion of soils
Ingestion of dusts, gases and vapours (indoors and outdoors)
Dermal contact with soils
Dermal contact with groundwater (during construction)
Ingestion of contaminated vegetables and or soils attached to vegetables (if applicable)
Leachates via infiltration and direct contact with groundwater

2.6.3 Receptor(s)

The potential receptors and associated risks for this site are:
Construction staff – very low to moderate risk
Residents on site – very low to high risk
Residents off site – very low risk (no apparent current impact)
Buildings off site (existing residential houses and children's centre appear to be not impacted) – very low risk
New dwellings and below ground services – very low to high risk
Groundwater (secondary/principal aquifer and SPZ) – very low to high risk
Surface water – adjacent primary river from leachable contamination – very low to high risk (no current visual impact)

3. Objectives

3.1 Soils

The scope of this intrusive investigation work is to take samples of soils from different locations on the site i.e. the proposed location of the new buildings, the footprint of the former buildings, former stadium and proposed gardens

Soil samples will be taken and the strata logged to assess the strata on the site.

The soils will be analysed for a general suite of determinands that should include heavy metals, polyaromatic hydrocarbons (PAH's), additional inorganic compounds (including cyanides), phenol, total petroleum hydrocarbons (TPH's C_5-C_{35}) fractions and BTEX compounds (benzene, toluene, ethylbenzene and xylenes) as well as MTBE (methyl tertiary butyl ether). BTEX and MTBE are found in petrol (BTEX to a lesser extent in diesel) and toluene and xylenes are also found in some paint thinners.

Surface/near surface soils should also be screened for the presence of asbestos fibres.

Soil samples from the proposed gardens and from immediately above the saturated zone (groundwater) should also be analysed for leachable contaminants. The suite of tests carried out on the prepared soil leachate should be those outlined above as a minimum.

Selected soils should also be analysed for VOC's and SVOC's.

Landfill gas monitoring should be carried out over a minimum period of eight weeks with at least six rounds of monitoring carried out during that period.

These contaminants were those that could be on the site following outcome of the desk study.

As well as the suites of analysis outlined above an EU Landfill Directive Waste Acceptance Criteria (WAC) analysis will be carried out on the soil from the former stadium embankments and made ground should these soils need to be removed from the site to landfill.

3.2 General

Following the intrusive investigation work the conceptual model can be revised as appropriate.

4. Methodology

4.1 Soil Sampling

The site covers an area of approximately 0.44ha (4400m^2). The former, existing and proposed site layout is shown on the site plan in appendix 1 (p3). The site investigation works will be carried out in accordance with BS10175:2011 (Investigation of potentially contaminated sites – Code of Practice).

It was decided by Soiltec to take the soil samples for chemical analysis using windowless sampler boreholes. The drilled boreholes would also be used to install the semi permanent piezometers for gas and groundwater monitoring.

The borehole locations are shown on the site plan (p3) in appendix 1.

4.2 Chemical Analysis

The chemical analysis on the excavated soils is an analytical suite consisting of heavy metals, polyaromatic hydrocarbons (PAH's), additional inorganic compounds (including cyanides), phenol, total petroleum hydrocarbons, C_5-C_{35} fractions, BTEX compounds (benzene, toluene, ethylbenzene, xylenes) and MTBE (methyl tertiary butyl ether).

Near surface soils would also be analysed for the presence of asbestos fibres.

Soil samples from the proposed gardens and from immediately above the saturated zone (groundwater) should also be analysed for leachable contaminants. The suite of tests carried out on the prepared soil leachate is those outlined above. The leachates are prepared to NRA leaching test methodology.

Selected soils should also be analysed for VOC's and SVOC's.

All chemical analysis will be carried out by a UKAS/MCERTS accredited testing laboratory.

The above analytical suites on the soils would cover the contaminants that could be on the site. However, if contaminants outside these suites of tests were suspected during the excavation of the samples, additional analysis would be carried out.

4.3 Landfill Gas Measurement

As mentioned in sections 2.4 and 2.5 above, landfill gases could be impacting the site. Therefore semi permanent piezometer tubes would be installed on the site for landfill gas monitoring.

The semi-permanent piezometer tubes are PVC, 50mm ID, perforated from the base to within 1m of the top, encased with pea shingle, sealed with a minimum of 200mm of bentonite and fitted with a bung and valve fitting beneath a lockable cover.

The analytical instrument (Gas Data GFM 436, which is MCERTS accredited), which withdraws gas from the piezometer using an integral pump, will be connected to the piezometer valve fitting. The levels of methane, carbon dioxide and oxygen as well as hydrogen sulphide, carbon monoxide and hexane will then be recorded.

Before the gas is withdrawn from the piezometer for analysis, the gas flow, if any, will also be measured at each piezometer using the GFM 436.

Following the gas analysis and flow measurements, the depth to the groundwater, if any, will be measured using a sonic level indicator dip meter.

5. Work Carried Out

The site was attended on the 6th March 2018 to drill the boreholes to extract the soil samples for the chemical analysis as outlined above. At the time of the site attendance for the site investigation the site had changed little since the desk study was carried out apart from the removal of the trees in the east area of the site.

Photographs of the site and the sampling locations are shown in appendix 2.

5.1 Boreholes

A total of eight boreholes were used for soil sampling. The boreholes were drilled using a Premier 110 series drilling rig.

The locations of the boreholes are shown on the site plan in appendix 1 (p3).

Tabulated below are the borehole locations with the existing/past uses and proposed uses.

Borehole	Existing/Past Use	Proposed Use
BH1	Soft landscaped/former landfill	Soft landscaped area adjacent to the new road
BH2	Soft landscaped, within area of former landfill and former drainage ditch	New building footprint
BH3	Former wooded area/former landfill	Private garden
BH4	Soft landscaped/former landfill	New road or soft landscaped area adjacent to new road
BH5	Former overgrown area/former stadium building/former landfill	New building footprint
BH6	Former stadium embankment/former landfill	Private garden
BH7	Former stadium embankment/former landfill	Private garden
BH8	Soft landscaped, within area of former landfill	Private garden

The strata encountered at each sampling location are found in the borehole logs in appendix 3, which also shows the sample type taken for analysis, sample depths, an outline of the analysis carried out and identification references.

5.2 Sampling and Analysis

All logging and soil sub-sampling from the boreholes was carried out at on site where the samples were placed in the appropriate glass jars, vials or bags and kept cool before being despatched to the UKAS/MCERTS accredited laboratories for the respective analysis.

The windowless sampler tubes used were of the closed type with disposable plastic insert liners thus eliminating the possibility of any onsite cross contamination during drilling and/or sub-sampling.

The chemical analysis carried out on each sample taken from the boreholes was a general suite of determinands that includes heavy metals, polyaromatic hydrocarbons (PAH's), additional inorganic compounds (including cyanides), phenol, total petroleum hydrocarbons (TPH's), C_5-C_{35} fractions, BTEX compounds and MTBE.

Shallow soil samples were taken from the boreholes and screened for asbestos fibres.

A total of six samples were taken from the locations of the proposed soft landscaped areas, gardens and from immediately above the saturated zone and analysed for leachable contaminants. The suite of tests carried out on the prepared soil leachate was those outlined above.

Four soil samples were also analysed for VOC's and SVOC's (3N^{o} of made ground, 1N^{o} natural ground).

The depth of the samples taken for chemical analysis and the associated analysis results can be seen in appendix 4, chemical analysis results and certificates.

5.3 Groundwater/Perched Water

Groundwater was encountered at three of the borehole locations (BH1, BH2 and BH8) at the depths drilled (maximum 4.0m). Groundwater was struck at depths from 2.8m (BH2) to 3.75m (BH8).

The depth of groundwater was also monitored during the period of landfill gas monitoring. The depth of groundwater below existing ground level was as follows at the three locations monitored:
BH2 2.40m to 2.20m
BH4 Dry to 2.45m
BH5 2.89m to 2.67m

5.4 General

No contamination was observed or suspected during the drilling of the boreholes that required the need for chemical analysis in addition to the suites of analysis proposed.

6. Chemical Analysis Results

6.1 Chemical Analysis (soils)
All the chemical analysis results are shown in appendix 4, which also contains copies of the analysis certificates from the UKAS/MCERTS laboratory.

The nature of the soils encountered was predominantly made ground of gravelly ash at each borehole location with occasional brick, concrete, slate, charcoal, glass, chalk, rubber, ceramic/pottery pieces at some locations that extended to depths from 1.8m to 2.8m below existing ground level beneath the grass, felled trees and cut brambles/weeds that covered most of the site.

The stratum encountered below the made ground was silty clay, clayey silt, sand and or sandy gravel – alluvium drift deposits. The alluvium drift deposits extended to the base of each borehole (maximum depth 4.0m). The expected bedrock geology of The Seaford Chalk Formation was not encountered at the depths drilled.

6.1.1 Organic Content
The measured organic content (%) of the soils encountered is as follows:

The average organic content of the made ground tested was 4.3% (with a range of 0.9% to 10.9% of the eleven samples tested).

The average organic content of the alluvium drift deposits tested was 4.1% (with a range of 3.3% to 4.7% of the three samples tested).

The organic content results are corrected for the stone content i.e. the value reported is for the soil including the stone, if applicable. The organic content was determined in accordance with BS1377:Part 3:1990, dichromate oxidation.

6.2 Criteria for Assessment
The assessment of the chemical analysis results for the contaminants of concern (COC's) have been based on the published Land Quality Management (LQM)/Chartered Institute of Environmental Health (CIEH) suitable for use levels (S4UL's) using a soil organic matter level of 2.5%*.

The S4UL values are based on a residential site with homegrown produce, a small terraced house, calculated using the contaminated land exposure assessment (CLEA) model and a sandy loam soil.

These parameters will give conservative SGV's.

However, if using the assessment criteria outlined the calculated levels are exceeded, a more detailed site specific assessment with further adjustments to the CLEA model may need to be carried out e.g. change the soil type, organic content and building details (area, living space height, floor crack area).

6.2.1 Published Human Health LQM/CIEH S4UL's for residential use with homegrown produce based on sandy loam soil with a 2.5% soil organic content.

TPH fraction aliphatic and aromatic – S4UL (mg/kg)

TPH Fraction	Sandy Loam Organic Content 2.5%
AROMATIC	
C_5-C_7	140
C_7-C_8	290
C_8-C_{10}	83
C_{10}-C_{12}	180
C_{12}-C_{16}	330
C_{16}-C_{21}	540
C_{21}-C_{35}	1500
ALIPHATIC	
C_5-C_6	78
C_6-C_8	230
C_8-C_{10}	65
C_{10}-C_{12}	330[a]
C_{12}-C_{16}	2400[b]
C_{16}-C_{35}	92000[c]

a – Exceeds the soil vapour saturation limit of 118mg/kg.

b – Exceeds the soil solubility saturation limit of 59mg/kg.

c – Exceeds the soil solubility saturation limit of 21mg/kg.

BTEX Compounds – S4UL (mg/kg)

Compound	Sandy Loam Organic Content 2.5%
Benzene	0.17
Toluene	290
Ethylbenzene	110
o-Xylene	140
m-Xylene	140
p-Xylene	130

Sixteen most common PAH's – S4UL (mg/kg)

PAH	Sandy Loam Organic Content 2.5%
Naphthalene	5.6
Acenaphthylene	420
Acenaphthene	510
Fluorene	400
Phenanthrene	220
Anthracene	5400
Fluoranthene	560
Pyrene	1200
Benz(a)anthracene	11
Chrysene	22
Benzo(b)fluoranthene	3.3
Benzo(k)fluoranthene	93
Benzo(a)pyrene	2.7
Indeno(123-cd)pyrene	36
Dibenz(ah)anthracene	0.28
Benzo(ghi)perylene	340

Metals – S4UL (mg/kg)

Arsenic – 37mg/kg
Cadmium – 11mg/kg
Mercury – 1.2mg/kg (elemental), 40mg/kg (inorganic) and 11mg/kg (methyl)
Nickel – 180mg/kg
Selenium – 250mg/kg
Phenol – 550mg/kg
Lead – 200mg/kg (C4SL 2014)
Chromium – 6mg/kg (based on hexavalent chromium)
Chromium – 910mg/kg (based on trivalent chromium)

Copper – 2400mg/kg
Zinc – 3700mg/kg
Boron – 290mg/kg

For Guidance (Plant Growth):
Copper – 200mg/kg (phytotoxic, pH>7, BS3882:2007 Topsoil Specification)
Zinc – 300mg/kg (phytotoxic, pH>7, BS3882:2007 Topsoil Specification)
Boron – UK average 4.7mg/kg – 21 mg/kg UKSHS report No7 (EA 2007)

6.2.2 Summary of Results

Compound	Residential with Homegrown Produce S4UL mg/kg	N° of Tests	Min	Max	N° Exceeding S4UL (HH)
METALS (zootoxic)					
Arsenic	37	14	4	59	1
Cadmium	11	14	<0.2	5.5	0
Chromium (III)	910	14	14	57	0
Chromium (VI)	6	14	<2	<2	0
Lead	200	14	67	8160	9
Mercury	1.2 (elemental)	14	<1	67.3	2
Nickel	180	14	10	205	1
Selenium	250	14	<3	<3	0
METALS (zootoxic/phytotoxic)					
Copper	2400/200	14	17	13300	1
Zinc	3700/300	14	62	2930	0
Water soluble Boron	290/21	14	<1	5.9	0
ORGANICS					
Phenol	550	14	<2	<2	0
Benzo(a)pyrene	2.7	14	<0.1	45	5
Aromatic TPH C_5-C_7	140	14	<0.01	<0.01	0
Aromatic TPH C_7-C_8	290	14	<0.05	<0.05	0
Aromatic TPH C_8-C_{10}	83	14	<2	<2	0
Aromatic TPH C_{10}-C_{12}	180	14	<2	4	0
Aromatic TPH C_{12}-C_{16}	330	14	<2	8	0
Aromatic TPH C_{16}-C_{21}	540	14	<3	157	0
Aromatic TPH C_{21}-C_{35}	1500	14	<10	1365	0
Aliphatic TPH C_5-C_6	78	14	<0.01	<0.01	0
Aliphatic TPH C_6-C_8	230	14	<0.05	<0.05	0
Aliphatic TPH C_8-C_{10}	65	14	<2	<2	0
Aliphatic TPH C_{10}-C_{12}	330	14	<2	<2	0
Aliphatic TPH C_{12}-C_{16}	2400	14	<3	<3	0
Aliphatic TPH C_{16}-C_{35}	92000	14	<13	118	0

ORGANICS cont	Residential with Homegrown Produce S4UL mg/kg	N° of Tests	Min	Max	N° Exceeding S4UL
Benzene	0.17	14	<0.002	<0.002	0
Toluene	290	14	<0.005	<0.005	0
Ethylbenzene	110	14	<0.002	<0.002	0
Xylenes	130 (p)	14	<0.002	<0.002	0

6.2.3 Assessment of Risk

The assessment of the associated risk is based on the CIRIA (Construction Industry Research and Information Association) C552 methodology, contaminated land risk assessment, a guide to good practice (2001), tabulated below and overleaf.
(SH = Significant Harm, SPOSH = Significant Possibility of Significant Harm).

Classification of Consequence

Classification	Definition
Severe	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. **Highly elevated** concentrations **likely** to result in 'significant harm' to human health as defined by the EPA 1990 Part 2A, if exposure occurs i.e. SH/SPOSH concentrations are high enough to cause acute (short term) effects. Equivalent to an EA category 1 pollution incident including **persistent and/or extensive** effects on water quality (controlled waters); leading to a closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. **Major damage** to aquatic or other ecosystems, which is **likely** to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long term maintenance of the population. **Catastrophic** damage to buildings or property.
Medium	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. **Elevated** concentrations which could result in 'significant harm' to human health as defined by the EPA 1990 Part 2A, if exposure occurs i.e. greater than SH/SPOSH Equivalent to an EA category 2 pollution incident including **a significant** effect on water quality (controlled waters); notification required to abstractors; reduction on amenity value or significant damage to agriculture or commerce. **Significant damage** to aquatic or other ecosystems, which **may** result in a substantial adverse change in its functioning or harm to a species of special interest that **may** endanger the long term maintenance of the population. **Significant** damage to buildings or property.

Classification of Consequence (cont)

Classification	Definition
Mild	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of no harm but not unacceptable intake or contact. Exposure to human health **unlikely** to lead to 'significant harm' i.e. concentrations are greater than SGV/GAC but less than SH/SPOSH. Equivalent to an EA category 3 pollution incident including **minimal or short term** effects on water quality (controlled waters); minor impact on amenity value, agriculture or commerce. **Minor damage or short term damage** to aquatic or other ecosystems, which is **unlikely** to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long term maintenance of the population. **Minor** damage to buildings or property.
Minor	Concentration of contaminants is likely to (or is known from previous data to) be less than that indicative of no harm. No measurable effect on humans i.e. less than SGV/GAC. Equivalent to an unsubstantial pollution incident with **no observed** effect on water quality (controlled waters); no reduction on amenity value or damage to agriculture or commerce. **No observed effect** to aquatic or other ecosystems. **Repairable effects of damage** to buildings or property.

Classification of Probability

Classification	Definition
High Likelihood	There is a pollution linkage and an event that appears **very likely** in the short term and **almost inevitable** in the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is **probable** that an event will occur. Circumstances are such that an event is **not inevitable** but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event **could occur**. However, it is **no means certain** that even over a longer period such event could take place, and it is less likely in the shorter term.
Unlikely	There is a pollution linkage but the circumstances are such that it is **improbable** that an event would occur even in the very long term.

Matrix of Consequence against Probability to determine Risk Classification

	Consequence			
Probability	Severe	Medium	Mild	Minor
High Likelihood	Very High Risk	High Risk	Moderate Risk	Low Risk
Likely	High Risk	Moderate Risk	Low Risk	Very Low Risk
Low Likelihood	Moderate Risk	Low Risk	Low Risk	Very Low Risk
Unlikely	Low Risk	Very Low Risk	Very Low Risk	Very Low Risk

6.3 TPH Results

All the levels of TPH's found (aliphatic and aromatic) are all below published LQM/CIEH S4UL's for residential use as shown above and are therefore unlikely to impact human health. Most of the levels determined are below the detection limit for the analytical procedure at <0.01mg/kg (C_5-C_7), <0.05mg/kg (C_6-C_8), <2mg/kg/<3mg/kg (C_8-C_{16}), <3mg/kg (C_{16}-C_{21}) and <10mg/kg for (C_{21}-C_{35}) fractions.

The maximum total TPH (total of all fractions determined) was 1590mg/kg, which were mainly the heavier C_{21}-C_{35} aromatic fractions at BH2 0.7m-0.8m, made ground.

6.4 PAH Results

Most of the levels of PAH's found are significantly below the published LQM/CIEH S4UL's for residential use as shown above and are therefore unlikely to impact human health.

However, there are exceedances of some of the PAH's including benzo(a)pyrene (BaP) ($5N^o$ exceedances) and dibenz(ah)anthracene ($6N^o$ exceedances), which are considered two of the more toxic PAH's to human health.

The maximum BaP found was 45mg/kg (S4UL 2.7mg/kg) and the maximum dibenz(ah)anthracene found was 5.5mg/kg (S4UL 0.28mg/kg). The maximum total PAH (total of all sixteen determined) was 349mg/kg. The levels found and those of the other PAH's that exceeded their respective S4UL could impact human health particularly at the shallower depths within the proposed gardens and soft landscaped areas and therefore remediation will be required in these areas.

6.5 Heavy Metals, pH and Phenol

The chemical analysis results show that many of the determinands analysed in the soil samples taken are significantly below the published LQM/CIEH S4UL'sfor residential use as shown above, and are therefore unlikely to impact human health, the new buildings or below ground services.

However, the following exceedances must be noted:-

Arsenic (BH2 2.5m-2.6m, made ground) – exceeds the S4UL of 37mg/kg, level found 59mg/kg. However at this location (proposed building footprint) and at this depth this level is unlikely to pose a risk to human health.

Lead (BH1 0.5m-0.7m, BH2 0.7m-0.8m, BH2 2.5m-2.6m, BH3 1.1m-1.2m, BH4 GL-0.3m, BH4 1.6m-1.8m, BH5 1.6m-1.8m, BH5 2.6m-2.8m and BH6 2.8m-3.0m). With the exception of samples BH5 2.6m-2.8m and BH6 2.8m-3.0m all the samples were made ground. The levels found could impact human health particularly at the shallower depths in the proposed private garden areas and to a lesser extent in communal soft landscaped areas. Remediation of the proposed private garden areas and communal soft landscaped areas will be required.

Mercury (BH5 1.6m-1.8m and BH5 2.6m-2.8m, made ground and alluvium respectively). The levels both exceed the 1.2mg/kg S4UL for elemental mercury at 67.4mg/kg and 3.0mg/kg. There was no evidence for the presence of elemental mercury. The level of 67.4mg/kg was found at the shallower depth and exceeds the inorganic mercury S4UL of 40mg/kg. However at this location (proposed building footprint) and at this depth this level is unlikely to pose a risk to human health.

Copper (BH1 0.5m-0.7m, made ground) – exceeds the S4UL of 2400mg/kg, level found 13000mg/kg. At this location (proposed soft landscaping) this level could to pose a risk to human health and would also be detrimental to plant growth and therefore remediation will be required in this area.

Nickel (BH2 2.5m-2.6m, made ground) – exceeds the S4UL of 180mg/kg, level found 205mg/kg. However at this location (proposed building footprint) and at this depth this level is unlikely to pose a risk to human health.

The zinc levels found in all the samples analysed do not exceed the S4UL for human health although the levels found within the made ground at the shallower depths at some locations could have a detrimental effect on plant growth.

A very slightly alkaline soil pH was determined ranging from 7.3 to 8.2. These levels are unlikely to impact human health, the new buildings or below ground services.

6.6 Asbestos Results

Nine samples of made ground were analysed for asbestos (one from each borehole location and two samples taken for the EU Landfill Directive Waste Acceptance Criteria suite of tests). The results show that no asbestos fibres were found in eight of the samples tested indicating that asbestos has not impacted the site from the former uses, former buildings, structures or other sources at the locations tested.

However, the sample taken from BH4 (GL-0.3m) had a bundle of chrysotile fibres present.

No visible asbestos containing material was noted on the site or within the strata excavated at all locations and this is most likely an isolated hot spot and is unlikely to impact human health and the overall risk is low, but the on site development contractors should be aware and the appropriate site procedures in place e.g. dust suppression measures and correct PPE.

6.7 BTEX Compounds Results

All the levels of BTEX compounds found are all significantly below the published LQM/CIEH S4UL's for residential use as shown above and are therefore unlikely to impact human health, new buildings or below ground services. All the levels determined are below the detection limit for the analytical procedure at <0.002mg/kg to <0.005mg/kg.

6.8 VOC and SVOC Results

Four samples (3N^{o} made ground and 1N^{o} natural ground) were analysed for VOC (volatile organic compounds) and SVOC (semi volatile organic compounds). With the exception of two results all the levels of VOC's and SVOC's found are below the detection limit for the analytical procedure at <0.005mg/kg to <0.01mg/kg for VOC's and <0.1 to <0.15mg/kg for SVOC's.

The results for 4-nitrophenol and carbazol found for the sample of made ground taken from BH6 (1.5m-1.7m) were 0.5mg/kg and 0.1mg/kg respectively and at these levels are unlikely to impact human health, the new buildings or below ground services.

6.9 Soil Leachate

Six soil samples were analysed for potential leachable contaminants. The samples analysed were from BH1 (1.8m to 2.0m and 3.4m to 3.6m), BH3 (3.5m to 3.7m), BH7 (2.8m to 3.0m), BH8 (2.7m to 3.0m and 3.5m to 3.8m), which were all above or at/immediately above the saturated zone (groundwater).

6.9.1 Soil Leachate Assessment Criteria

The chemical analysis results from the prepared leachate were assessed against published drinking water inspectorate (DWI) threshold values, or former Environment Agency guidance values, or other published values as shown on the result sheets in appendix 4. The DWI threshold values are very conservative although the published values cover a wide range of common contaminants. Any exceedances will be further assessed using other published databases that may be more applicable e.g. river basin typology standards.

6.9.2 Soil Leachate Results

The results show that with the exception of one result all the determinands analysed are below the published threshold values indicating that these compounds are unlikely to leach from the below ground strata and impact the groundwater or surface water at the locations tested.

The arsenic result in the sample taken at BH7 (2.8m to 3.0m) marginally exceeds the DWI threshold value of 10ug/l. The value determined was 11ug/l, which is significantly below the river basin typology standard minimum threshold value for groundwater impact on surface water of 51.6ug/l.

Therefore all the values determined are unlikely to impact the groundwater or surface water.

7. Landfill Gas

7.1 Gas Readings and Flowrates

Following the installation of the piezometers the first of the readings were taken on the 16th March 2018. Subsequent readings were taken at intervals thereafter with a total of six sets of readings taken. The results are shown in appendix 5.

7.2 Results

The landfill gas analysis results obtained during the monitoring period from the 16th March 2018 to the 3rd May 2018 inclusive are as follows (the readings below are all stable readings): The atmospheric pressure at the time of the monitoring was carried out ranged from 996mb to 1019mb.

7.2.1 Methane

The **maximum** levels of methane detected during the monitoring period were as follows:
Borehole 2 0.0% by volume (0%LEL) (within new building footprint)
Borehole 4 0.0% by volume (0%LEL) (within new road/soft landscaping)
Borehole 5 0.0% by volume (0%LEL) (within new building footprint)

7.2.2 Carbon Dioxide

The **maximum** levels of carbon dioxide detected during the monitoring period were as follows:
Borehole 2 12.4% by volume (within new building footprint)
Borehole 4 7.0% by volume (within new road/soft landscaping)
Borehole 5 14.6% by volume (within new building footprint)

7.2.3 Oxygen

The **minimum** levels of oxygen detected during the monitoring period were as follows:
Borehole 2 3.5% by volume (within new building footprint)
Borehole 4 6.4% by volume (within new road/soft landscaping)
Borehole 5 4.0% by volume (within new building footprint)

7.2.4 Flowrates

The **maximum** flowrate levels detected during the monitoring period were as follows:
Borehole 2 0.0l/hr (within new building footprint)
Borehole 4 0.0l/hr (within new road/soft landscaping)
Borehole 5 0.0l/hr (within new building footprint)

7.2.5 Calculated Gas Screening Values (GSV's)

Gas screening values were calculated from the analysis results obtained for methane and carbon dioxide during the monitoring period. The maximum levels of methane and carbon dioxide found during the monitoring period have been used in the calculation, as well as the maximum flowrate measured. Where no flowrate was detected over the monitoring period a value of 0.1l/hour has been used to calculate the GSV's. The calculated GSV's are shown in appendix 5.

7.3 Assessment of Results

The assessment of the landfill gas analysis results has been carried out using BS8485:2015 (Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings).

The calculated GSV's give a characteristic gas situation of CS1 (GSV's <0.07) from table 2 in BS8485:2015.

However, the concentrations of methane and carbon dioxide must be considered when assessing the results. The worse case results (maximum levels found) of methane and carbon dioxide have been used for the assessment and thus a CS2 must be used.

A CS2 for a private dwelling dictates that a minimum gas protection score of 3.5 from table 3 in BS8485:2015 must be used.

Thus using the subsequent tables in BS8485:2015 the following gas protection measures incorporated in the new buildings must be used:

A cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations,
PLUS:
A passive sub floor dispersal layer of good performance e.g. clear void,
PLUS:
A suitable gas resistant membrane to meet all the criteria in column 1, table 7 in BS8485:2015 e.g. a minimum 0.4mm thickness (equivalent to 370g/m^2 for polyethylene) reinforced membrane (virgin polymer) meets all the criteria in column 1, table 7.

8. Revised Conceptual Model

8.1 General

The outcome of this investigation has enabled the initial conceptual model, which is outlined in section 2.6 above, to be revised.

8.2 Source(s)

The contaminants (sources of contamination) that have been found to be present on this site following this investigation are:
Lead (mainly within the made ground)
Mercury (mainly within the made ground)
Copper (within the made ground)
Polyaromatic hydrocarbons (mainly within the made ground)
Asbestos fibres (trace in the made ground at one location only)

8.3 Pathway(s)

The potential pathways for this site following this investigation are:
Ingestion of dusts and gases (indoors)
Ingestion of dusts (outdoors)
Dermal contact with soils
Dermal contact with groundwater (during construction)
Ingestion of contaminated vegetables and or soils attached to vegetables (if applicable)
Leachates via infiltration and direct contact with groundwater

8.4 Receptor(s)

The potential receptors and associated risks for this site following this investigation are:
Construction staff – very low risk (with correct PPE)
Residents on site – very low to high risk (without remediation)
Residents and staff off site – very low risk (no apparent current impact)
Buildings off site (existing residential houses and children's centre appear to be not impacted) – very low risk
New dwellings and below ground services – very low risk with remediation (low/moderate risk within the made ground)
Groundwater (secondary/principal aquifer and SPZ) – very low risk
Surface water – adjacent primary river from leachable contamination – very low risk

A schematic diagram of the conceptual model for the site second edition dated 08/05/18 is shown in appendix 6, conceptual model.

9. Conclusions

9.1 Results and Recommendations

There are contaminants on the site within the soils analysed that are likely to impact human health on this proposed residential site and the risk to the end users on site is deemed to be very low to high. The aesthetic nature of the made ground would also deem it necessary to be removed from garden areas.

The risk to the new buildings is deemed to be very low to low/moderate.

The risk to below ground services is deemed to be very low (low/moderate within the existing made ground).

The risk to groundwater and surface water now and following the development is deemed to be very low.

It is recommended that the existing made ground is removed from all proposed garden and soft landscaped areas to a depth of one metre below final ground level. At a depth of one metre a fabric membrane should be placed before the areas are backfilled, and it should be documented that the quality of strata beneath the membrane cannot be guaranteed. The soils used for backfilling must be analysed to ensure that they are completely suitable for use on this site. This should be carried out following delivery to the site but before being used for backfill i.e. sampled from the site stockpile (also see comments in section 9.2.2 below).

The made ground could remain beneath permanent hard cover (roads and buildings) although the new below ground services if placed within the existing made ground as well as building foundations should be suitably protected. The new water main supply should be laid in barrier pipe if placed within the existing made ground.

9.2 Notes

During the groundworks including the excavation of made ground, dust suppression measures must be in place to protect the site personnel and adjacent public.

If during the development works any unforeseen contamination is encountered analysis must be carried out to identify the type and extent of the contamination.

If no unforeseen contamination is encountered during the development works a statement to this affect must be submitted to the local authority by the main contractor on completion of the development. It would be prudent to have a watching brief in place should any unexpected contaminants be encountered during the development works. Should contamination be encountered the development works should cease and the watching brief (suitably qualified environmental consultant) contacted immediately.

Photographic evidence of the excavated areas to remove the made ground from the garden areas and the placement of the protective membrane laid over the made ground at depth of one metre must also be kept for inclusion in a validation/closure report. Also to be included within the report should be all the documentary and photographic evidence for the gas protection measures as outlined in section 7.3. Additional information to be included within the report should be all the muck away information for the removal of the made ground.

During the construction work exposed soils should be protected from any accidental leakage or spillages from stored oils or chemicals used in the construction work, if any, to prevent any potential impact to the site or controlled waters.

9.2.1 Excavated Soils

Excavated soils that are produced as part of the construction work that are to be removed from the site to landfill, chemical analysis will be required to classify the 'waste' in conjunction with the EU Landfill Directive, which defines the criteria for the chemical analysis and classification of materials that are to be disposed to landfill.

Should soils need to be removed from the site to landfill, a European Landfill Directive Waste Acceptance Criteria (WAC) analysis will be required on the material to be disposed to be submitted to the proposed receiving tip before the soil is removed from the site.

The made ground that is on the site has been analysed for the WAC suite of tests. The made ground analysed was from the locations of BH6 and BH8. BH6 is at the location of the former stadium embankment, which will be removed and the made ground from BH8 is typical of the made ground that covers the whole site (former landfill). The results show that the material from both locations would be classed as stable non reactive hazardous waste and could be disposed in a non hazardous landfill at a landfill site that is licensed to accept such waste.

Should any natural ground be excavated as part of the development works that will need to be removed to a landfill site, further WAC testing should be carried out on this material at the time of excavation.

9.2.2 Imported Soils

It must be noted that chemical analysis must be carried out on all imported soil used in the development works to confirm that it is suitable for use on this site. The results of the chemical analysis must be included within the closure report.

9.2.3 Local Authority Approval

A copy of this report should be forwarded to Canterbury City Council (Planning case officer and Environmental Health) or other regulators/insurers if applicable for their consideration and approval prior to the commencement of any further site works.

K.D.Huxley CSci CChem MRSC MIEnvSc RSoBRA
Date: 08/05/18

[Please see full report for appendices]

APPENDIX B

Site Plan as Proposed

1:200

SCALE 1 : 200

0 4 8 12

NOTES:

Do Not Scale.

Report all discrepancies, errors and omissions.

Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

No.	Date	Description
P1	02.10.2019	Work in Progress -Preliminary Issue
P2	16.10.2019	Amendments following co-ordination with Fairhurst
P3	01.11.2019	Levels amended to correspond with Fairhurst Levels

Project Title

Land at Kingsmead Field

Stonebridge Road
Canterbury
Kent

Drawing Description

Site Plan as Proposed

Proposed Site Plan

Scale	Drawn by
1 : 200	NP
Date	Checked by
October 2019	CC

CLAGUE ARCHITECTS

62 Burgate, Canterbury
Kent CT1 2BH 01227 762060

1 Kinsbourne Court, Luton Road,
Harpenden, Hertfordshire Al5 3BL 01582 765102

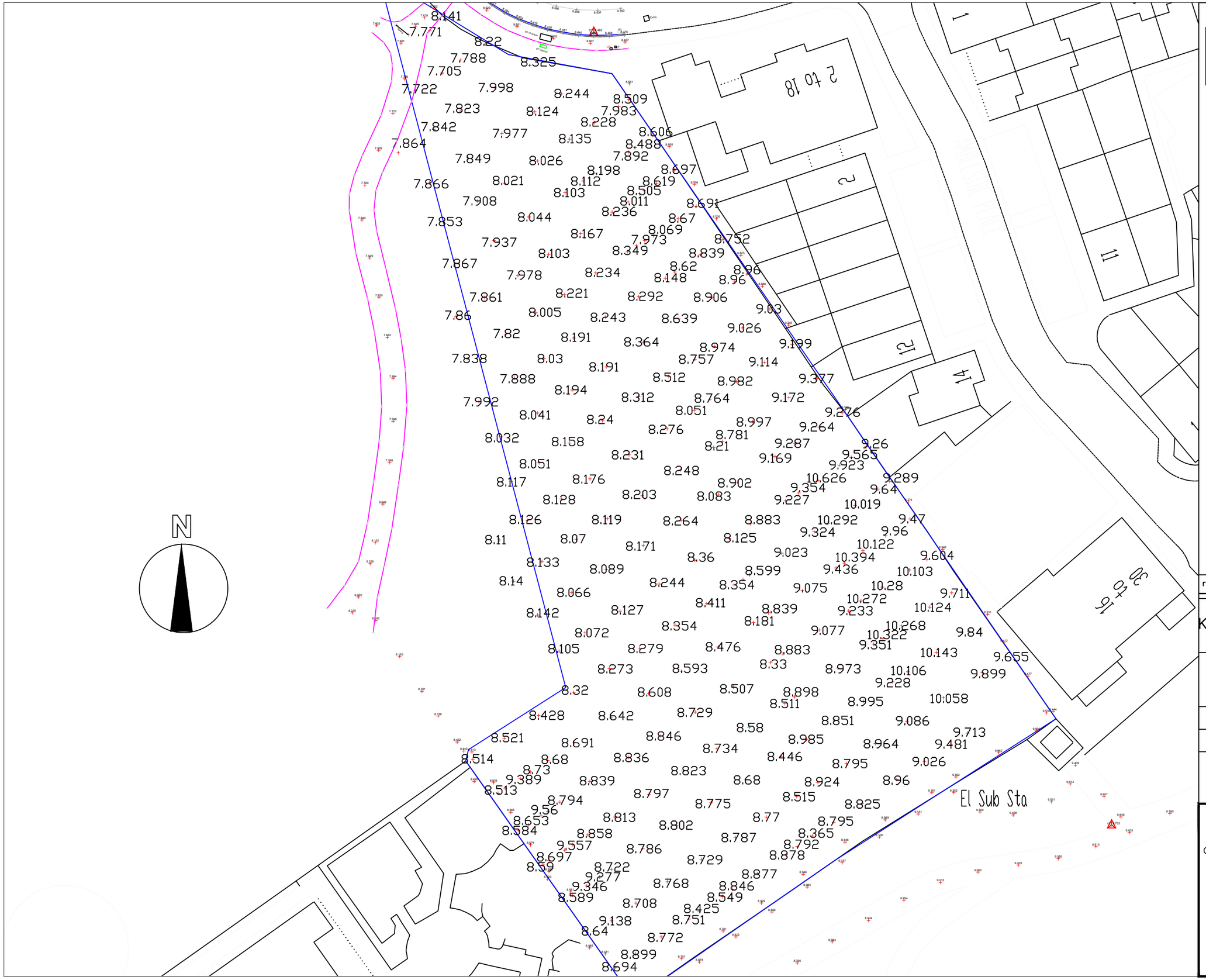
8, Disney Street
London SE1 1JF 0203 597 6112

CANTERBURY LONDON HARPENDEN

Drawing Number: 29384A_ CLA_ 00_ XX_ DR_ A_ 0100

Revision: P3

APPENDIX C



notes

CAD

8.888 Elevation (mOD)

rev/date		checked

project

Kingsmead Field – Canterbury

drawing title

Kingsmead Field – Topographic Survey

project ref.	scale
Kingsmead_Field	NTS@A3

drawn	checked	date
RT	SPCS	Apr 2018

drawing number	revision
1A	

Consultant:

Canterbury City Council
Military Road
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www.canterbury.gov.uk

Engineering Services

APPENDIX D

SEWER RECORDS PAGE 1 OF 2

158851

158563

615012

615484

O.S. REF. TR1558NW	Drawn by: kumaria	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 determnined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may Include Bonded Asbestos Cement
	Scale: 1:1250	
Title: 242682_Kingsmead Field, Canter	Date: 27/04/2017	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.

N

Southern Water

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	
0601X	6.53	4.872	800	CI	CIRC	
0602X	6.609	4.819	800	CI	CIRC	
061DX			UNK	UNK	UNK	
0651X	7.61	5.73	450	CP	CIRC	
0701X	6.79	4.6	800	CI	CIRC	
0702X	7.41	4.7	800	CI	CIRC	
070DX			800	CI	CIRC	
0752X			OTHER	BRC	CIRC	
0801X	11.82	8.8	225	VC	CIRC	
0802X	10.8	9.29	300	VC	CIRC	
0805X	11.41	10.14	150	VC	CIRC	
0806X	12	9.405	225	VC	CIRC	
0850X	10.84	9.38	375	CP	CIRC	
0851X	11.65	9.89	225	CP	CIRC	*
0851Y	11.65	9.9	225	VC	CIRC	*
0852X			OTHER	BRC	CIRC	
0855X	11.67	10	300	VC	CIRC	
0857X	11.43	9.785	225	CP	CIRC	
1501X	6.598	5.008	300	VC	CIRC	
1502X	6.556	5	150	VC	EGG	
1601X	8.612	7.752	150	VC	CIRC	
1602X	8.725	6.045	150	VC	CIRC	
1604X	9.27	4.96	375	CI	CIRC	*
1604Y	9.27	4.96	375	CI	CIRC	*
1605X	9.18	4.94	700	BRC	EGG	
1606X	9.1	5.063	150	VC	CIRC	
1607X	8.81	5.138	150	VC	CIRC	
1608X	9.4	5	150	VC	EGG	
161DX			700	BRE	EGG	
1701X			800	CI	CIRC	
1702X	7.09	4.55	800	CI	CIRC	
1750X			225	VC	CIRC	
1854X			OTHER	BRC	CIRC	
1856X			OTHER	BRC	CIRC	
2501X	8.22	3.85	825	CP	CIRC	
2601X	8.795	5.697	150	VC	CIRC	
2602X	9.75	5.94	150	VC	CIRC	
2603X	9.37	8.27	150	VC	CIRC	
2701X	8.59	6.85	150	VC	CIRC	
2702X	8.78	6.777	150	VC	CIRC	
2703X	9.095	6.576	150	VC	CIRC	
2704X	9.32	6.381	150	VC	CIRC	
2705X	8.65	8.07	150	VC	CIRC	
2706X			150	VC	CIRC	
2707X	8.9	8.11	150	VC	CIRC	
2708X	9.2	6.8	150	VC	CIRC	
2709X	9.15	7.85	150	VC	CIRC	
2801X	7.59	4.44	800	CI	CIRC	
2850X			225	VC	CIRC	
3601X	6.89	3.856	825	CP	CIRC	
3602X	9.22	6.443	150	VC	CIRC	
3603X	9.85	6.15	150	VC	CIRC	
3701X	8.925	7.465	150	VC	CIRC	
3702X	10.01	6.786	150	VC	CIRC	
3703X	10.165	6.652	150	VC	CIRC	
3704X	10.4	6.568	150	VC	CIRC	
3705X	10.29	7.14	150	VC	CIRC	
3706X	9.47	7.36	150	VC	CIRC	
3707X	9.75	7.5	150	VC	CIRC	
3708X			150	VC	CIRC	
3709X	10.42	7.84	150	VC	CIRC	
3710X			150	VC	CIRC	
3711X	9	7.68	150	VC	CIRC	
4601X	7.33		825	CP	CIRC	
4602X	6.87		825	CP	CIRC	
4603X	7.32	6.16	225	VC	CIRC	
4605X			225	VC	CIRC	
4606X	7.33	3.896	825	CP	CIRC	
4607X	7.659	3.8	800	DI	CIRC	
4608X	7.71	5.817	225	PE	CIRC	
4609X	8	4.05	800	DI	CIRC	
460PY			800	DI	CIRC	*
460PX			225	PE	CIRC	*
4650X	11.113	5.843	1000	CP	CIRC	
4651X	8.124	5.414	1000	CP	CIRC	
4701X	8.915	7.463	150	VC	CIRC	
4702Y	9.315	7.117	150	VC	CIRC	
4703X	9.17	7.241	150	VC	CIRC	
4704X	9.52	7.034	150	VC	CIRC	
4705X	9.99	6.854	150	VC	CIRC	
4706X	9.25	8.055	150	VC	CIRC	
4707X			150	VC	CIRC	
4708X			150	VC	CIRC	
4709X	9.2	8	150	VC	CIRC	
4710X	9.1	7.865	150	VC	CIRC	
4801X	8.71	7.624	150	VC	CIRC	
4802X	8.78	7.564	150	VC	CIRC	
4803X	8.85	7.514	150	VC	CIRC	
4804X	8.475	7.74	150	VC	CIRC	
4805X	9.1	7.84	150	VC	CIRC	
4806X	9.235	7.94	150	VC	CIRC	
4807X	9.1	8.08	150	VC	CIRC	
4808X	7.91	8	150	VC	CIRC	

LINE STYLES / COLOURS

- Brown — Foul
- Foul Syphon Sewer
- Foul Vacuum Main
- Foul Rising Main
- Red — Combined
- Combined Syphon Sewer
- Combined Rising Main
- Lateral Drain
- Orange — Building Over Agreement Area
- Dark Blue — Treated Effluent
- Purple — Sludge
- Sewer Catchment
- Section 104 Area
- Light Blue — Surface Water
- Surface Water Rising Main
- Yellow — Private
- Green — Access Shaft
- Decommissioned

MATERIALS

AK	Alkathene
BAC	Bonded Asbestos Cement
BRC	Brick (Common)
BRE	Brick (Engineering)
CC	Concrete Box Culvert
CI	Cast Iron
CO	Concrete (In-Situ)
CP	Concrete (Pre-Cast)
CSB	Concrete Segments (bolted)
CSU	Concrete Segments (unbolted)
DI	Ductile Iron
GRC	Glass Reinforced Concrete
GRP	Glass Reinforced Plastic
MAC	Masonry in regular Courses
MAR	Masonry in random Courses
PE	Polyethylene
PF	Pitch Fibre
PP	Polypropylene
PVC	Polyvinyl Chloride
RPM	Reinforced Plastic Matrix
SI	Spun Iron
ST	Steel
VC	Vitrified Clay
XXX	Other
ZZZ	Unknown

LEGEND - SEWERS

- Manhole (SW)
- Manhole (F&C)
- Lamp hole (SW)
- Lamp hole (F&C)
- Pumping Station (SW)
- Pumping Station (F&C)
- Side entry manhole (SW)
- Side entry Manhole (F&C)
- Blind shaft (SW)
- Blind shaft (F&C)
- Ejector station (SW)
- Ejector station (F&C)
- Watertight door (SW)
- Watertight door (F&C)
- Flushing ch. Mn-e (SW)
- Flushing ch. Mn-e (F&C)
- Flushing ch. No-e (SW)
- Flushing ch. No-e (F&C)
- Demarcation Chamber
- Washout (SW)
- Washout (F&C)
- Rodding Eye (SW)
- Rodding Eye (F&C)
- Gauging point (SW)
- Gauging point (F&C)
- Intercept chamber (SW)
- Intercept chamber (F&C)
- Storm Tank (SW)
- Storm Tank (F&C)
- Vortex chamber (SW)
- Vortex chamber (F&C)
- Label ellipse
- Dummy/S24 manhole
- Outfall
- Penstock chamber
- Damboards
- Storm Overflow
- Backdrop manhole
- Other (s)
- Other
- Change in sewer (s)
- Change in sewer
- Reflux valve
- Flap valve
- Cascade
- Anode
- Valve
- Closed Valve
- Air Valve
- Hatch box (SW)
- Hatch box (F&C)
- Direction arrow
- Emptying valve
- Catchpit
- Soakaway
- Inlet
- Balancing Pond
- Wastewater treatment works
- Marine treatment works
- Outfall headworks
- Vent
- Vent column
- Tidal storage tank
- Blank end
- Head of Public Sewer
- Micro Pumping Station

SHAPES (S)

A	Arched	R	Rectangular
B	Barrel	S	Square
C	Circular	T	Trapezoidal
E	Egg	U	U Shape
H	Horseshoe	X	Other

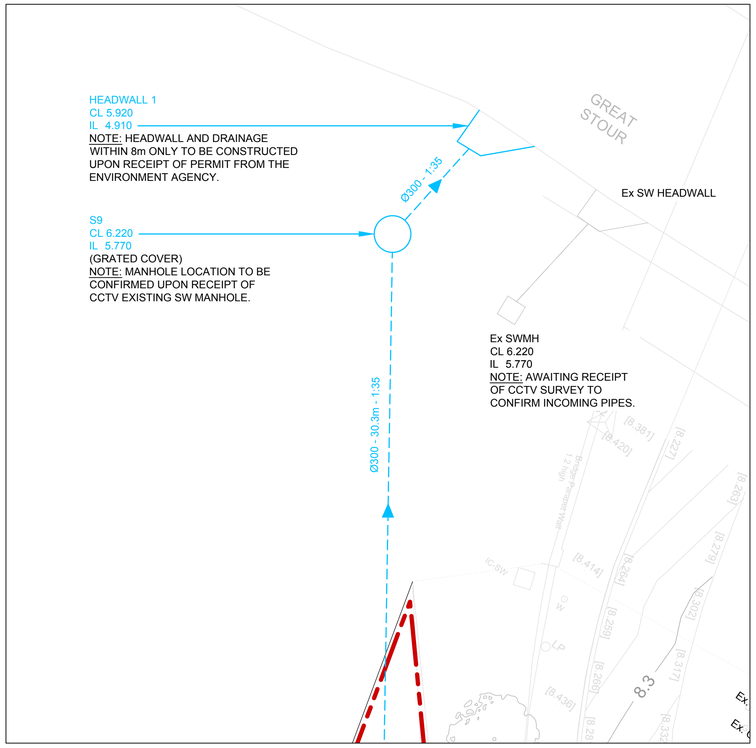
NODE REFERENCING SYSTEM

- 1st digit: hundred metre easting identifier
- 2nd digit: hundred metre northing identifier
- 3rd digit: sewer type identifier
  - 0-4 = Foul/Combined
  - 5-9 = Surface Water
- 4th digit: next sequential node

Drawn by:	kumaria
Title:	242682_Kingsmead Field, Canter
Date:	27/04/2017

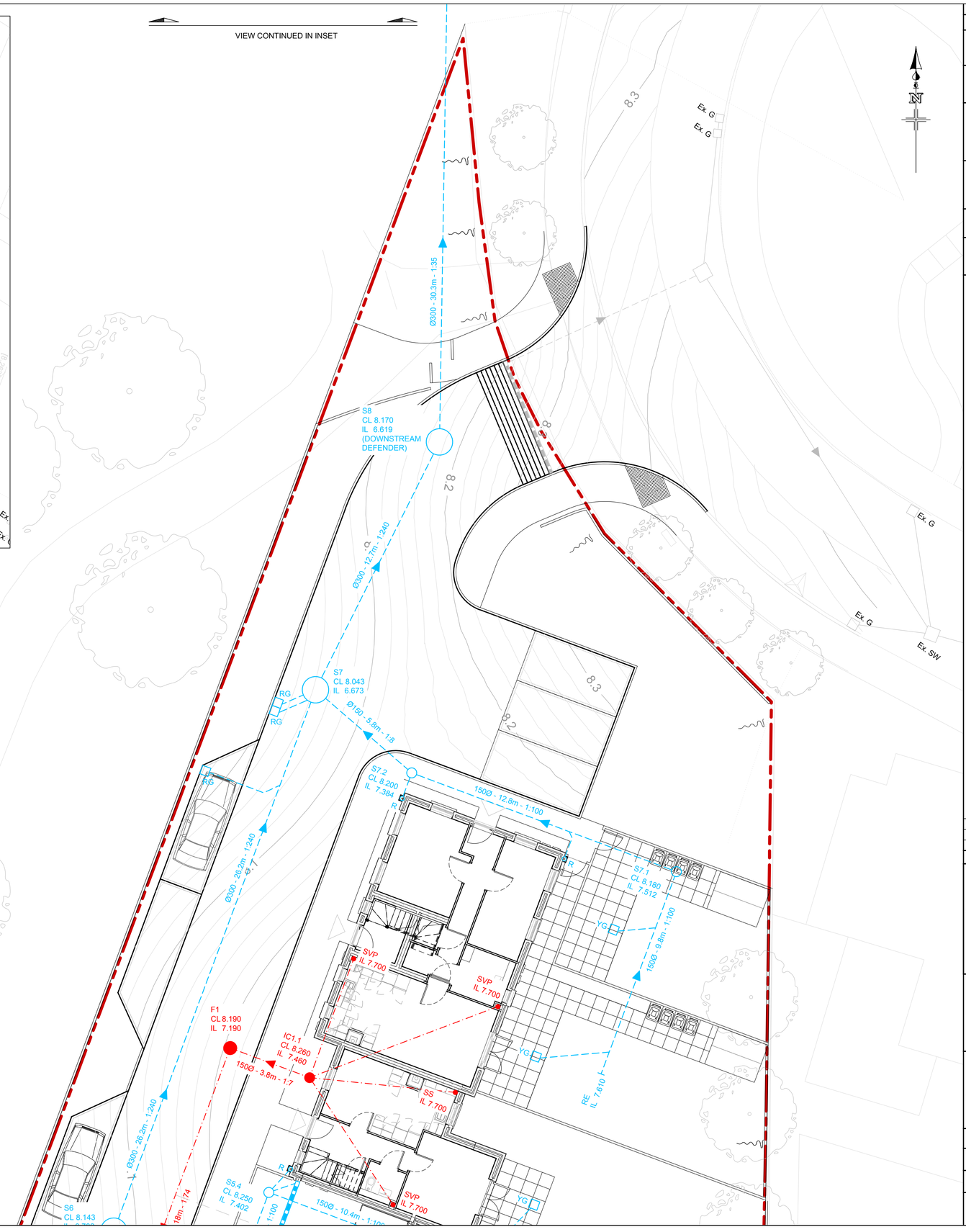
Southern Water

APPENDIX E



INSET

VIEW CONTINUED IN INSET



NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEER'S AND ARCHITECT'S DRAWINGS AND SPECIFICATIONS.
2. ALL FOUL WATER PIPES FROM BELOW BUILDING SLABS TO BE NO SHALLOWER THAN 1:40.
3. ALL FOUL WATER PIPES TO BE 100Ø UNLESS OTHERWISE STATED.
4. ALL SURFACE WATER PIPES TO BE 150Ø UNLESS OTHERWISE STATED.
5. WHERE POSSIBLE, INSPECTION CHAMBERS IN GARDENS HAVE BEEN LOCATED 5m FROM BUILDINGS TO ACCOMMODATE FUTURE CONSERVATORIES.
6. DRAINAGE IS IN ACCORDANCE WITH *SfA* 6TH EDITION.
7. INVERT LEVELS OF EXISTING DRAINAGE AT PROPOSED OUTFALL TO BE VERIFIED ON SITE BY CONTRACTOR PRIOR TO CONSTRUCTION OF ANY DRAINAGE. THIS INFORMATION IS THEN TO BE GIVEN TO THE ENGINEER SO THAT ADJUSTMENTS TO THE DETAILED DESIGN CAN BE COMPLETED.
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9. EXISTING LEVELS TAKEN FROM TOPOGRAPHIC SURVEY, TO BE CHECKED ON SITE AND ANY DISCREPANCIES REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION OF TIE IN BETWEEN EXISTING AND PROPOSED HIGHWAY.
10. APPROVAL FROM THE ENVIRONMENT AGENCY IS REQUIRED BEFORE THE OUTFALL RUN TO THE HEADWALL CAN BE CONSTRUCTED.
11. SECTION 106 AGREEMENT TO BE FINALISED BEFORE THE FOUL WATER SYSTEM CAN BE CONNECTED TO THE OUTFALL.

Do not scale from this drawing.

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION

IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING RISKS AND INFORMATION.

RISKS LISTED HERE ARE NOT EXHAUSTIVE. REFER TO DESIGN ASSESSMENT FORM NO.

CONSTRUCTION

DEMOLITION

FOR INFORMATION RELATING TO USE, CLEANING AND MAINTENANCE SEE THE HEALTH AND SAFETY FILE

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT.

KEY:

GENERAL

-SITE BOUNDARY

PUBLIC DRAINAGE

-S278 SURFACE WATER DRAIN.
-EXISTING SURFACE WATER DRAIN.
Ex. SW -EXISTING SURFACE WATER CHAMBER.
Ex. G -EXISTING SURFACE WATER GULLY.

PRIVATE DRAINAGE

150Ø, 1:80 S1 -SURFACE WATER DRAIN.
-SURFACE WATER CHAMBER.
-HYDROBRAKE CHAMBER.
R -RAIN WATER DOWN PIPE.
RE -RODDING EYE.
YG -YARD GULLY, 100Ø OUTLET.
RG -ROAD GULLY, 150Ø OUTLET.
SU -CHANNEL DRAIN AND SUMP/GULLY UNIT.
-BELOW GROUND GEOLIGHT SURFACE WATER ATTENUATION STORAGE SYSTEM BY SDS (TEL: 01934 751 303).
150Ø, 1:80 F1 -FOUL WATER DRAIN. (pipe dia. & gradient)
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SVP -SOIL AND VENT PIPE.
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F1 -FOUL WATER MANHOLE.

FOR APPROVAL

Rev.	Date	Description	Drwn.	Chkd.	Appd.
P03	14/11/19	LAYOUT REVISED FOR PLANNING RESUBMISSION.	TH	DAP	X
P02	31/10/19	PRELIMINARY ISSUE	TH	SJO	X
P01	24/10/19	PRELIMINARY ISSUE	TH	SJO	X

FAIRHURST
160 LONDON ROAD
SEVENOAKS
TN13 2JA
Tel: 01732 460 142
Fax: 01732 459 249

Client: COOMBS

Project Title:
KINGSMEAD - CANTERBURY
KENT - CT2 7LN

Drawing Title:
PROPOSED DRAINAGE
SHEET 1 OF 3

Scale at A1:	Status:	
1:100	APPROVAL	
Drawn: TH	Checked: SJO	Approved: -
Date: OCT '19	Date: OCT '19	Date: -

Drawing No.: **130084_C01**
Revision: **P03**

NOTES:

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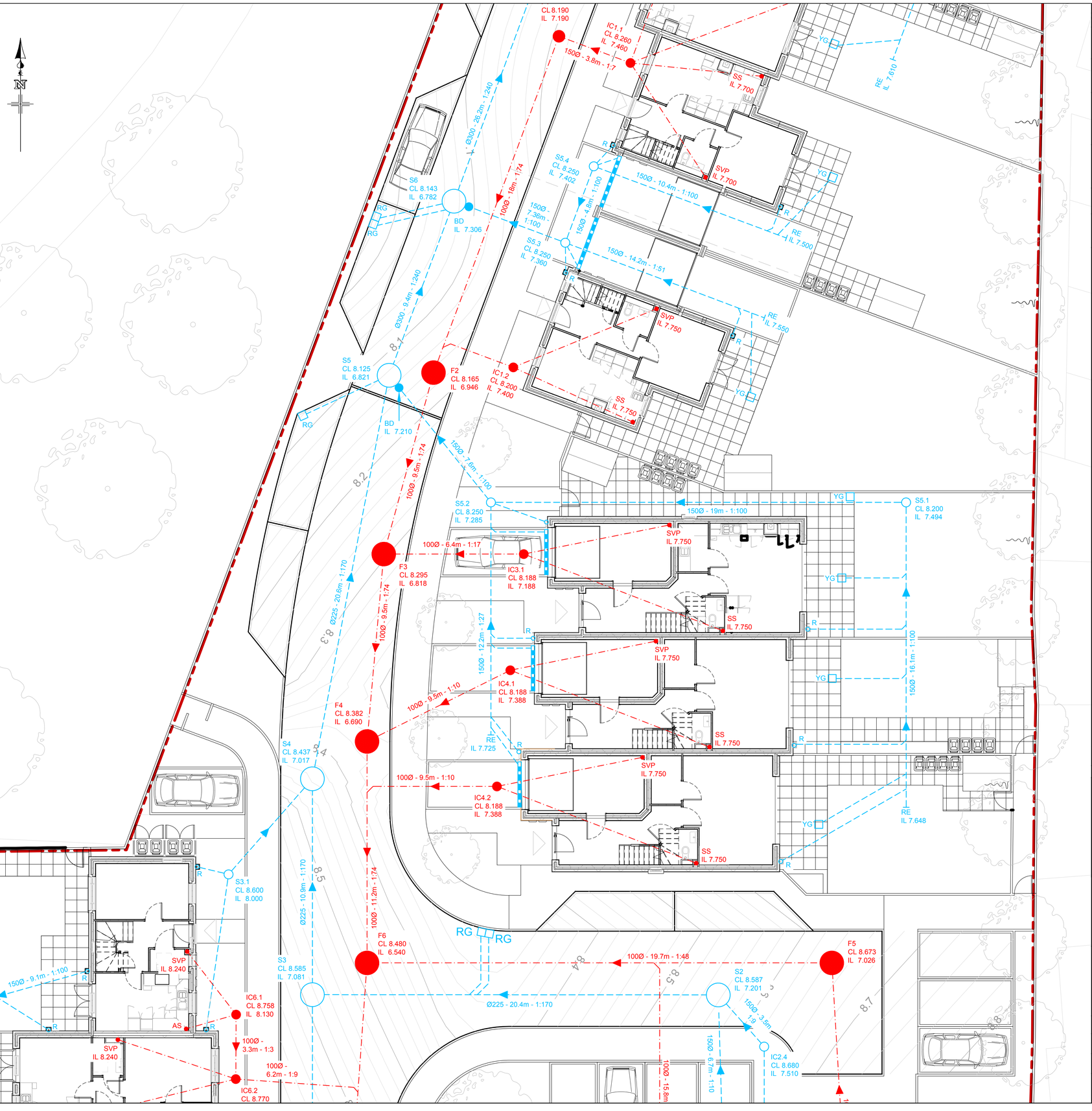

Do not scale from this drawing.

SAFETY HEALTH AND ENVIRONMENTAL INFORMATION

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RISKS LISTED HERE ARE NOT EXHAUSTIVE. REFER TO DESIGN ASSESSMENT FORM NO.

CONSTRUCTION

DEMOLITION

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KEY:

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-SITE BOUNDARY

PUBLIC DRAINAGE

-S278 SURFACE WATER DRAIN.
-EXISTING SURFACE WATER DRAIN.
Ex. SW -EXISTING SURFACE WATER CHAMBER.
Ex. G -EXISTING SURFACE WATER GULLY.

PRIVATE DRAINAGE

150Ø, 1:80 S1 -SURFACE WATER DRAIN.
-SURFACE WATER CHAMBER.
-HYDROBRAKE CHAMBER.
R -RAIN WATER DOWN PIPE.
RE -RODDING EYE.
YG -YARD GULLY, 100Ø OUTLET.
RG -ROAD GULLY, 150Ø OUTLET.
SU -CHANNEL DRAIN AND SUMP/GULLY UNIT.
-BELOW GROUND GEOLIGHT SURFACE WATER ATTENUATION STORAGE SYSTEM BY SDS (TEL: 01934 751 303).
150Ø, 1:80 F1 -FOUL WATER DRAIN. (pipe dia. & gradient)
-FOUL WATER CHAMBER.
AS -ASSUMED STACK POSITION. ARCHITECT TO CONFIRM.
SS -STUB STACK.
SVP -SOIL AND VENT PIPE.
150Ø, 1:80 -FOUL WATER SEWER. (pipe dia. & gradient)
F1 -FOUL WATER MANHOLE.

FOR APPROVAL

Rev.	Date	Description	Drwn.	Chkd.	Appd.
P03	14/11/19	LAYOUT REVISED FOR PLANNING RESUBMISSION.	TH	DAP	X
P02	31/10/19	PRELIMINARY ISSUE	TH	SJO	X
P01	10/19	PRELIMINARY ISSUE	TH	SJO	X

FAIRHURST
160 LONDON ROAD
SEVENOAKS
TN13 2JA
Tel: 01732 460 142
Fax: 01732 459 249

Client: COOMBS

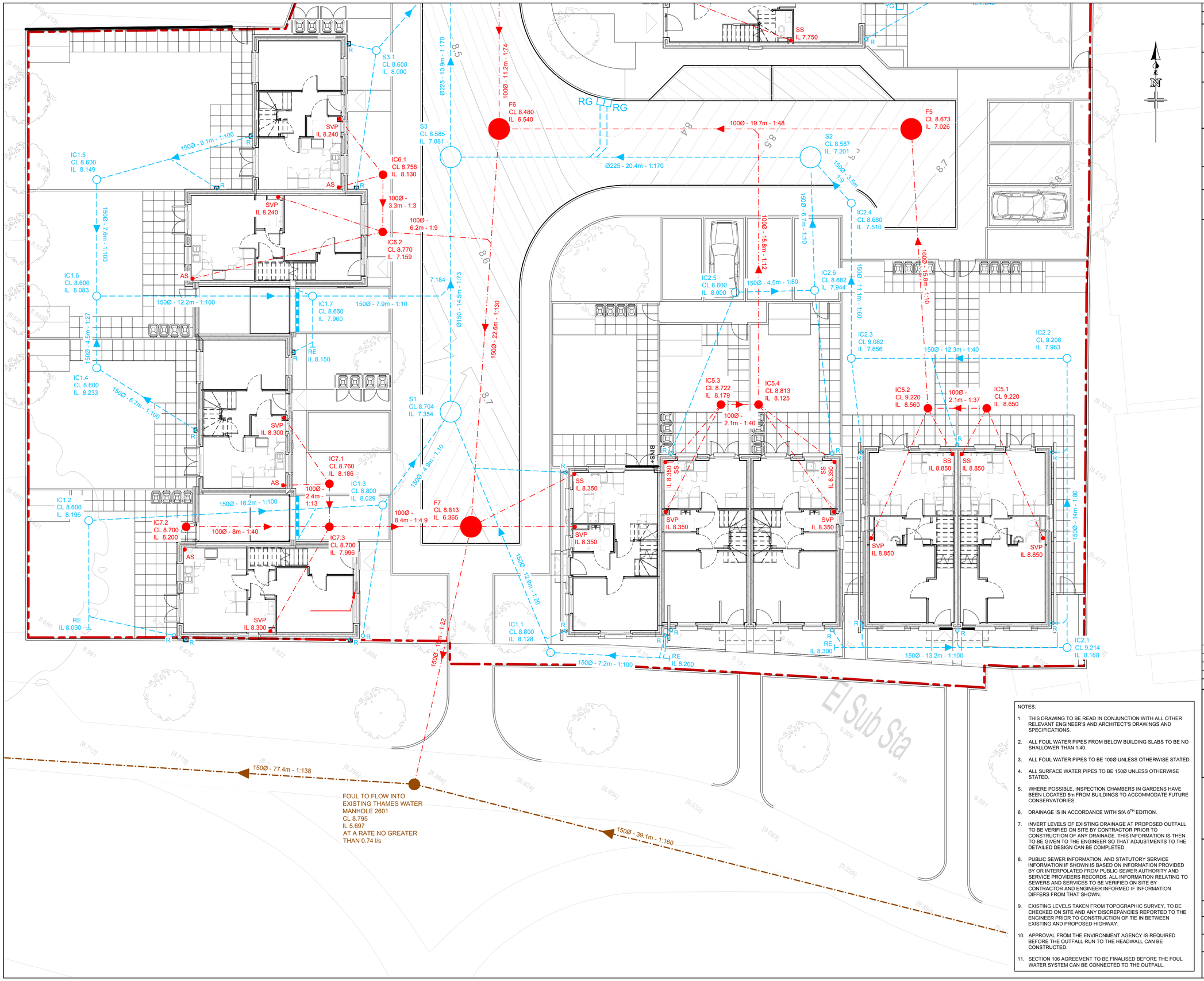
Project Title:
KINGSMEAD - CANTERBURY
KENT - CT2 7LN

Drawing Title:
PROPOSED DRAINAGE
SHEET 2 OF 3

Scale at A1:	Status:	
1:100	APPROVAL	
Drawn:	Checked:	Approved:
TH	SJO	-
Date:	Date:	Date:
OCT '19	OCT '19	-

Drawing No.: 130084_C02

Revision: P03



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FOR APPROVAL

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Rev.	Date	Description	Drwn.	Chkd.	Appd.
P04	14/11/19	LAYOUT REVISED FOR PLANNING RESUBMISSION.	TH	DAP	X
P03	04/11/19	EXISTING FOUL DRAINAGE ALIGNMENT UPDATED.	TH	SJO	X
P02	31/10/19	PRELIMINARY ISSUE	TH	SJO	X
P01	10/19	PRELIMINARY ISSUE	TH	SJO	X

FAIRHURST
160 LONDON ROAD
SEVENOAKS
TN13 2JA
Tel: 01732 460 142
Fax: 01732 459 249

Client: COOMBS

Project Title:
KINGSMEAD - CANTERBURY
KENT - CT2 7LN

Drawing Title:
PROPOSED DRAINAGE
SHEET 3 OF 3

Scale at A1:	Status:	
1:100	APPROVAL	
Drawn: TH	Checked: SJO	Approved: -
Date: SEP '19	Date: SEP '19	Date: -

Drawing No.: **130084_C03**
Revision: **P04**

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2	Volumetric Runoff Coeff.	0.750
		PIMP (%)	100
FEH Rainfall Version	2013	Add Flow / Climate Change (%)	0
Site Location	GB 615216 158736	Minimum Backdrop Height (m)	0.200
Data Type	Point	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
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)	500

Designed with Level Soffits

Network Design Table for Storm

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	14.465	0.198	73.0	0.032	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	20.376	0.120	169.8	0.076	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	10.888	0.064	170.0	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	20.585	0.121	170.0	0.043	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	9.481	0.040	240.0	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	26.154	0.109	240.0	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	12.699	0.053	240.0	0.022	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	30.223	0.849	35.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	4.014	0.450	8.9	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)
1.000	50.00	5.20	7.354	0.032	0.0	0.0	0.0	1.18	20.8	4.3
2.000	50.00	5.34	7.201	0.076	0.0	0.0	0.0	1.00	39.8	10.3
1.001	50.00	5.52	7.081	0.133	0.0	0.0	0.0	1.00	39.8	18.0
1.002	50.00	5.86	7.017	0.176	0.0	0.0	0.0	1.00	39.8	23.8
1.003	50.00	6.02	6.821	0.213	0.0	0.0	0.0	1.01	71.4	28.8
1.004	50.00	6.45	6.781	0.234	0.0	0.0	0.0	1.01	71.4	31.7
1.005	50.00	6.66	6.672	0.256	0.0	0.0	0.0	1.01	71.4	34.7
1.006	50.00	6.85	6.619	0.256	0.0	0.0	0.0	2.64	186.9	34.7
1.007	50.00	6.86	5.770	0.256	0.0	0.0	0.0	5.29	374.3	34.7

Manhole Schedules for Storm

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)
SS1	8.704	1.350	Open Manhole	1500	1.000	7.354	150				
SS1A	8.587	1.386	Open Manhole	1500	2.000	7.201	225				
SS2	8.575	1.494	Open Manhole	1500	1.001	7.081	225	1.000	7.156	150	
								2.000	7.081	225	
SS3	8.437	1.420	Open Manhole	1500	1.002	7.017	225	1.001	7.017	225	
SS5	8.125	1.304	Open Manhole	1500	1.003	6.821	300	1.002	6.896	225	
SS6	8.143	1.362	Open Manhole	1500	1.004	6.781	300	1.003	6.781	300	
SS7	8.043	1.371	Open Manhole	1500	1.005	6.672	300	1.004	6.672	300	
SS8	8.250	1.631	Open Manhole	1500	1.006	6.619	300	1.005	6.619	300	
SS9	6.220	0.450	Open Manhole	1200	1.007	5.770	300	1.006	5.770	300	
S	5.920	0.600	Open Manhole	0		OUTFALL		1.007	5.320	300	

PIPELINE SCHEDULES for Storm

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	150	SS1	8.704	7.354	1.200	Open Manhole	1500
2.000	o	225	SS1A	8.587	7.201	1.161	Open Manhole	1500
1.001	o	225	SS2	8.575	7.081	1.269	Open Manhole	1500
1.002	o	225	SS3	8.437	7.017	1.195	Open Manhole	1500
1.003	o	300	SS5	8.125	6.821	1.004	Open Manhole	1500
1.004	o	300	SS6	8.143	6.781	1.062	Open Manhole	1500
1.005	o	300	SS7	8.043	6.672	1.071	Open Manhole	1500
1.006	o	300	SS8	8.250	6.619	1.331	Open Manhole	1500
1.007	o	300	SS9	6.220	5.770	0.150	Open Manhole	1200

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	14.465	73.0	SS2	8.575	7.156	1.269	Open Manhole	1500
2.000	20.376	169.8	SS2	8.575	7.081	1.269	Open Manhole	1500
1.001	10.888	170.0	SS3	8.437	7.017	1.195	Open Manhole	1500
1.002	20.585	170.0	SS5	8.125	6.896	1.004	Open Manhole	1500
1.003	9.481	240.0	SS6	8.143	6.781	1.062	Open Manhole	1500
1.004	26.154	240.0	SS7	8.043	6.672	1.071	Open Manhole	1500
1.005	12.699	240.0	SS8	8.250	6.619	1.331	Open Manhole	1500
1.006	30.223	35.6	SS9	6.220	5.770	0.150	Open Manhole	1200
1.007	4.014	8.9	S	5.920	5.320	0.300	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.032	0.032	0.032
2.000	-	-	100	0.076	0.076	0.076
1.001	-	-	100	0.025	0.025	0.025
1.002	-	-	100	0.043	0.043	0.043
1.003	-	-	100	0.037	0.037	0.037
1.004	-	-	100	0.021	0.021	0.021
1.005	-	-	100	0.022	0.022	0.022
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.256	0.256	0.256

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007	S	5.920	5.320	5.720	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FEH	Summer Storms	Yes
Return Period (years)	100	Winter Storms	No
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 615216 158736	Cv (Winter)	0.840
Data Type	Point	Storm Duration (mins)	30

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	SS1	15 Winter	2	+0%					7.406	-0.098	0.000	0.25
2.000	SS1A	15 Winter	2	+0%					7.289	-0.137	0.000	0.32
1.001	SS2	15 Winter	2	+0%					7.205	-0.101	0.000	0.59
1.002	SS3	15 Winter	2	+0%					7.155	-0.086	0.000	0.68
1.003	SS5	15 Winter	2	+0%					6.978	-0.143	0.000	0.53
1.004	SS6	15 Winter	2	+0%					6.931	-0.150	0.000	0.49
1.005	SS7	15 Winter	2	+0%					6.838	-0.135	0.000	0.58
1.006	SS8	15 Winter	2	+0%					6.710	-0.209	0.000	0.20
1.007	SS9	15 Winter	2	+0%					5.861	-0.209	0.000	0.20

PN	US/MH Name	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1		4.9	OK	
2.000	SS1A		11.5	OK	
1.001	SS2		19.7	OK	
1.002	SS3		24.7	OK	
1.003	SS5		29.4	OK	
1.004	SS6		31.6	OK	
1.005	SS7		34.0	OK	
1.006	SS8		34.0	OK	
1.007	SS9		34.0	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SS1	15 Winter	30	+0%	30/15 Winter				7.536	0.032	0.000
2.000	SS1A	15 Winter	30	+0%	30/15 Summer				7.559	0.133	0.000
1.001	SS2	15 Winter	30	+0%	30/15 Summer				7.495	0.190	0.000
1.002	SS3	15 Winter	30	+0%	30/15 Summer				7.411	0.169	0.000
1.003	SS5	15 Winter	30	+0%	30/15 Summer				7.175	0.054	0.000
1.004	SS6	15 Winter	30	+0%	30/15 Winter				7.099	0.018	0.000
1.005	SS7	15 Winter	30	+0%	30/15 Summer				6.982	0.010	0.000
1.006	SS8	15 Winter	30	+0%					6.753	-0.166	0.000
1.007	SS9	15 Winter	30	+0%					5.904	-0.166	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1	0.52		10.0	SURCHARGED	
2.000	SS1A	0.65		23.4	SURCHARGED	
1.001	SS2	1.15		38.4	SURCHARGED	
1.002	SS3	1.39		50.2	SURCHARGED	
1.003	SS5	1.07		59.4	SURCHARGED	
1.004	SS6	1.00		64.2	SURCHARGED	
1.005	SS7	1.18		68.9	SURCHARGED	
1.006	SS8	0.41		68.9	OK	
1.007	SS9	0.41		69.2	OK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SS1	15 Winter	100	+0%	100/15 Summer				7.814	0.310	0.000
2.000	SS1A	15 Winter	100	+0%	100/15 Summer				7.824	0.398	0.000
1.001	SS2	15 Winter	100	+0%	100/15 Summer				7.750	0.444	0.000
1.002	SS3	15 Winter	100	+0%	100/15 Summer				7.626	0.385	0.000
1.003	SS5	15 Winter	100	+0%	100/15 Summer				7.288	0.167	0.000
1.004	SS6	15 Winter	100	+0%	100/15 Summer				7.201	0.120	0.000
1.005	SS7	15 Winter	100	+0%	100/15 Summer				7.029	0.057	0.000
1.006	SS8	15 Winter	100	+0%					6.771	-0.148	0.000
1.007	SS9	15 Winter	100	+0%					5.923	-0.148	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1	0.64		12.2	SURCHARGED	
2.000	SS1A	0.76		27.4	SURCHARGED	
1.001	SS2	1.40		46.9	SURCHARGED	
1.002	SS3	1.67		60.1	SURCHARGED	
1.003	SS5	1.31		72.3	SURCHARGED	
1.004	SS6	1.24		79.2	SURCHARGED	
1.005	SS7	1.48		86.6	SURCHARGED	
1.006	SS8	0.51		86.5	OK	
1.007	SS9	0.51		86.1	FLOOD RISK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SS1	15 Winter	100	+20%	100/15 Summer				8.113	0.609	0.000
2.000	SS1A	15 Winter	100	+20%	100/15 Summer				8.110	0.684	0.000
1.001	SS2	15 Winter	100	+20%	100/15 Summer				8.010	0.705	0.000
1.002	SS3	15 Winter	100	+20%	100/15 Summer				7.850	0.608	0.000
1.003	SS5	15 Winter	100	+20%	100/15 Summer				7.408	0.287	0.000
1.004	SS6	15 Winter	100	+20%	100/15 Summer				7.294	0.213	0.000
1.005	SS7	15 Winter	100	+20%	100/15 Summer				7.068	0.096	0.000
1.006	SS8	15 Winter	100	+20%					6.785	-0.135	0.000
1.007	SS9	15 Winter	100	+20%					5.936	-0.134	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1	0.73		14.0	SURCHARGED	
2.000	SS1A	0.90		32.5	SURCHARGED	
1.001	SS2	1.62		54.3	SURCHARGED	
1.002	SS3	1.92		69.3	SURCHARGED	
1.003	SS5	1.50		83.0	SURCHARGED	
1.004	SS6	1.42		91.0	SURCHARGED	
1.005	SS7	1.71		99.7	SURCHARGED	
1.006	SS8	0.59		99.7	OK	
1.007	SS9	0.59		99.4	FLOOD RISK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SS1	15 Winter	100	+30%	100/15 Summer				8.269	0.765	0.000
2.000	SS1A	15 Winter	100	+30%	100/15 Summer				8.265	0.839	0.000
1.001	SS2	15 Winter	100	+30%	100/15 Summer				8.155	0.849	0.000
1.002	SS3	15 Winter	100	+30%	100/15 Summer				7.967	0.725	0.000
1.003	SS5	15 Winter	100	+30%	100/15 Summer				7.472	0.351	0.000
1.004	SS6	15 Winter	100	+30%	100/15 Summer				7.345	0.263	0.000
1.005	SS7	15 Winter	100	+30%	100/15 Summer				7.091	0.118	0.000
1.006	SS8	15 Winter	100	+30%					6.791	-0.128	0.000
1.007	SS9	15 Winter	100	+30%					5.943	-0.128	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1	0.78		15.0	SURCHARGED	
2.000	SS1A	0.96		34.7	SURCHARGED	
1.001	SS2	1.72		57.9	SURCHARGED	
1.002	SS3	2.04		73.7	SURCHARGED	
1.003	SS5	1.60		88.2	SURCHARGED	
1.004	SS6	1.51		96.7	SURCHARGED	
1.005	SS7	1.82		105.9	SURCHARGED	
1.006	SS8	0.62		105.9	OK	
1.007	SS9	0.63		105.7	FLOOD RISK	

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FEH	Data Type	Point
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location GB 615216 158736		Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SS1	15 Winter	100	+40%	30/15 Winter				8.430	0.926	0.000
2.000	SS1A	15 Winter	100	+40%	30/15 Summer				8.429	1.003	0.000
1.001	SS2	15 Winter	100	+40%	30/15 Summer				8.304	0.998	0.000
1.002	SS3	15 Winter	100	+40%	30/15 Summer				8.088	0.846	0.000
1.003	SS5	15 Winter	100	+40%	30/15 Summer				7.538	0.418	0.000
1.004	SS6	15 Winter	100	+40%	30/15 Winter				7.396	0.315	0.000
1.005	SS7	15 Winter	100	+40%	30/15 Summer				7.113	0.141	0.000
1.006	SS8	15 Winter	100	+40%					6.798	-0.122	0.000
1.007	SS9	15 Winter	100	+40%					5.949	-0.121	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SS1	0.83		15.9	FLOOD RISK	
2.000	SS1A	1.02		36.9	FLOOD RISK	
1.001	SS2	1.83		61.4	FLOOD RISK	
1.002	SS3	2.16		78.0	SURCHARGED	
1.003	SS5	1.69		93.2	SURCHARGED	
1.004	SS6	1.60		102.3	SURCHARGED	
1.005	SS7	1.92		112.0	SURCHARGED	
1.006	SS8	0.66		112.0	OK	
1.007	SS9	0.67		111.8	FLOOD RISK	

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