2.3 Planning, Health & Safety (CDM), Setting Out & Services

Unless otherwise stated, the investigation has been planned on a scope of works agreed with the Client which is typically based on multiples of one day on-Site with various drilling and sampling equipment, or a measured amount of drilling and testing.

For most projects Delta-Simons adopts a role equivalent to principal contractor (PC) where none exists for the project and complies a construction phase plan (CPP) The CPP is incorporated into a comprehensive Health and Safety Plan with relevant information, risk assessments and method statements where applicable intended to keep the field staff safe.

Clients are requested to provide all service plans in original form from suppliers so a service avoidance risk assessment (SARA) can be undertaken as part of a formal Site-specific Health and Safety Plan. The SARA is based on guidance provided in HSG47 Avoiding danger from underground services.

Exploratory hole and subsequent sample locations are selected to provide suitable coverage of the Site, having regard for the likely presence of services and any other constraints such as existing structures and sub-structures. Where applicable, suspected emissions locations, or geological variations may have been targeted.

The locations of the investigations are shown on Figure 3 and the field records are provided in Appendix C.

2.4 Dynamic Sampler Boreholes

Dynamic sampler borehole systems are not explicitly described in Eurocodes, or in the relevant British Standard BSENISO 22475-1:2006 Geotechnical investigation and testing – Sampling methods and groundwater measurements – Part 1: Technical principles for execution.

The dynamic sampler system comprises a series of varying diameter metal tubes of 1 m or 2 m length, which allows a liner to be inserted. The tubes are driven into the ground using a percussive weight falling through a standard drop onto an anvil attached to solid rods, and withdrawn by use of a hydraulic jack. The soil is pushed into the tube/liner during the driving, and samples are recovered from the tube once it has been split for description. Alternatively, liners are omitted and the metal tubes have slots or windows cut into the sides where samples can be taken directly by hand. The liner method potentially offers a lower degree of sample disturbance.

The system can achieve typical depths of around 3 m to 5 m in favourable soil conditions. The system is limited by coarse gravel or other large fragments, and also in wet sands where the hole collapses. Some casing systems exist. The details of the ground conditions encountered are presented on the relevant field record sheets, which also detail the type and depths of samples taken and the results of any in-situ tests. Other relevant information may also be recorded including groundwater levels and details of any standpipe installations.

2.5 Standpipe Installations

Three of the dynamic sampler boreholes has been fitted with a gas/water monitoring standpipe of 50 mm internal diameter UPVC slotted and plain casing to the required depth as appropriate, capped by a gas tap bung and cover generally in accordance with BSENISO 22475-1:2006 for an open standpipe. The locations of the monitoring installations are shown on Figure 3.

2.6 Standard Penetration Tests

Standard penetration testing is undertaken generally in accordance with BS EN ISO 22476-2:2005+A1:2011 *Geotechnical investigation and testing. Field testing. Standard probing*

2.7 Monitoring Groundwater & Ground Gas

Groundwater monitoring is undertaken using an electronic dip meter, which records the depth to water in a standpipe. Ground gas composition and flow monitoring is undertaken where standpipes have been installed. Both flow (litres per hour) and composition (%) are measured using an infra-red gas monitor, calibrated for methane, carbon dioxide & oxygen. Records are also taken of atmospheric pressure. The monitoring field records are presented in Appendix D.

2.8 Chemical Analysis

The results of the chemical analysis are presented in Appendix E.

2.9 Generic Quantitative Risk Assessment (GQRA)

Human Health

In the absence of a statutory contamination thresholds in the UK a set of Generic Assessment Criteria (GAC derived principally using the Contaminated Land Exposure Assessment (CLEA) Framework have been adopted to assess the significance of the contamination encountered. The values adopted are for a residential without plant uptake end-use.

The Delta-Simons methodology for GQRA comprises comparison of limited chemical analysis results with the criteria for the most sensitive plausible end-use scenario in the proposed scheme.

Exceedance of criteria indicates that risk above “minimal” level may exist in a worst-case scenario across the whole Site. The precautionary principle is applied with respect to protection of human health recommending; further risk assessment (increased characterisation including extents/zones), or site-wide remediation.

If no criteria exceedance is observed, recommendations for further risk assessment, or remediation due to uncertainty over full characterisation of the Site.

Post-report action should be Site-specific and based on a Client’s resource/risk profile in undertaking developments in accordance with any regulator requirements. Under the planning control, the responsibility for a safe development remains with the Developer.

Controlled Waters

For the purposes of assessment of risks to controlled waters, where water samples have been obtained these have been compared to appropriate water quality standards.

Ground Gas

Two rounds of ground gas monitoring have been undertaken as part of this assessment, the results of which are provided in Appendix D.

3.0 Results & Interpretation

3.1 Desk Study

A brief desk study is provided below using readily available online resources and a review of existing Third-Party information for the Site, which should be read in conjunction with this Report.

Site Description & Walkover (Reconnaissance, Internet Air Photography)	Delta-Simons undertook a Site visit on 6th March 2020. A Site Layout Plan is included as Figure 2. Relevant Features identified during the walkover are summarised below. The Site was occupied by an active YMCA Hostel comprising a mixture of one and two storey buildings of brick construction. No access was afforded inside the existing buildings. Vehicular access and parking was noted along the northern area of the Site. The Site surfacing was noted to mainly comprise of either concrete and macadam in pedestrian and vehicular routes. The remainder of the Site comprised two soft landscaped courtyards in the central areas and soft landscaped areas along western, northern and eastern boundaries. A number of mature trees were noted along the eastern boundary. A number of manhole covers indicating buried utilities were noted across the Site. The car parking area in the north was noted to be raised by approximately 0.5 m above the remaining Site topography. In addition, a retaining wall approximately 1.0 m high was noted along the western area of the Site as part of a raised soft landscaped area. No evidence was observed during the Site walkover of potential Asbestos Containing Materials (ACMs), however, the presence within existing building construction cannot be discounted. The presence for plant/ boiler rooms within buildings cannot be discounted.
Proposed Development	It is understood that the proposed development of the Site comprises the demolition of all structures and the construction of a four-storey 100 bed YMCA Hostel and a 2, 3 and 4 storey building providing up to 43 residential apartments. The Proposed Site Layout is included as Drawing 1.
Environmental Setting	From the British Geological Survey (BGS) Geology of Britain Viewer the Site is indicated as being underlain by superficial Diamicton deposits of the Lowestoft Formation. In addition, superficial sand and gravel deposits of the Kesgrave Catchment Subgroup may encroach onto Site in the northern area. The underlying bedrock is mapped as the Lewes Nodular Chalk Formation and Seaford Chalk Formation (Undifferentiated). Given the current developed nature of the Site, Made Ground is likely to be present, however, is anticipated to be limited in thickness. The EA classify the superficial deposits of the Lowestoft Formation and Kesgrave Catchment Subgroup as Secondary A and Secondary Undifferentiated Aquifers, respectively. The bedrock is classified as a Principal Aquifer. The EA data also indicates that the Site is located within a Zone III Total Catchment Source Protection Zone (SPZ).
Previous Report Review (Argyle Environmental, 2018)	Delta-Simons has been provided with the following Third-Party report: ▲ Argyle Environmental, SiteSolutions Combined, (Ref. AEL-0046-TSC-959119), dated 7th December 2018. Historically the Site formed part of Peartree Farm comprising farmyard buildings in the northern area of the Site from the earliest map edition dated 1878. The Site remained in agricultural use until circa 1938 when a building is noted in the southern area of the Site mapped as a Youth Hostel and Club. Alterations to the farm buildings in the north of the Site are noted circa 1985. The farm buildings are assumed demolished prior to

	1990 as they are no longer mapped and the Youth Hostel is noted to occupy the majority of the Site area. The Site remains consistent until present day. The surrounding area has historically comprised a number of industrial uses with associated tanks, most notable a chemical works located 30 m to the north, a garage warehouse and corporation yard. There are five licenced abstractions located within 1 km of the Site, the closest of which is located approximately 360 m west, relating to the abstraction from groundwater for chemicals: process water. The nearest surface water feature is located approximately 240 m south-west of the Site. Pertinent entries within 250 m of the Site include; ▲ Six Registered Radioactive Substances, all of which relate to Roche Products Ltd, the closest is located approximately 180 m west; ▲ A Registered Landfill Site located approximately 200 m north west of the Site relating to a Landfill accepting aqueous effluent waste and industrial effluent treatment sludge, the input rate is noted as small (<10,000 tonnes per year); ▲ One Registered Waste Treatment or Disposal Site located approximately 160 m west of the Site relating to the above Landfill Site; ▲ Thirty-eight Contemporary Trade Directory Entries, the closest of which is an active tyre repair and rereading entry located approximately 25 m north of the Site; and ▲ Five areas of potentially infilled land (water), the closest of which is located approximately 30 m south west of the Site, recorded in 1939 mapping. The Site was considered to have a moderate to high environmental sensitivity and the risk of contaminants being present was considered low to moderate. No further recommendations were required in terms of contamination. The Site was also considered at low to moderate risk of flooding.
Key Contaminants and Initial CSM Aspects	The Site has historically been in agricultural use, including farm yard prior to redevelopment as a Youth Hostel. On-Site potential sources of contamination include: ▲ Made Ground associated with historical construction/demolition; ▲ Small-scale oil/fuel spills from parked vehicles/plant and machinery related to the historical development and agricultural use; ▲ Potential plant/boiler rooms within existing buildings; ▲ Potential asbestos within existing building construction; and ▲ Unrecorded sources. Off-Site potential sources of contamination are limited to infilled land (water) in the surrounding area and industrial uses a chemical works. The off-Site infilled land and landfill may represent potential sources of ground gas, however, underlying cohesive deposits would mitigate migration. The presence of Made Ground is suspected given the current development. Deep Made Ground may be considered as a gas source, if present. The Site overlies a Secondary A Aquifer, Secondary Undifferentiated Aquifer and Principal Aquifer with respect to the superficial and bedrock geology. The Site is located within a Zone III Source Protection Zone. There is uncertainty because unrecorded potentially contaminative activities could have taken place.

3.2 Fieldworks Interpretation

<table>
<tr><td>Scope of Investigation</td><td>Dynamic Sampler Boreholes– 5 No.
Monitoring Well Installs – 3 No.
Monitoring rounds – 2 No.
Site Area = 0.67 hectares.</td></tr>
<tr><td>Site Specific Investigation Limitations</td><td>Intrusive locations were set out to avoid underground services.</td></tr>
<tr><td>Geology from the Investigation Works</td><td>Made Ground was encountered across the Site generally comprising a limited thickness of gravelly clayey sandy Topsoil with brick and flint underlain by gravelly clay with brick fragments. Made Ground was identified to a maximum depth of 0.68 m bgl.
The underlying natural soils comprised soft to firm light brown slightly sandy gravelly clay and clayey gravelly sands with flints. Coarse sandy flint gravel was identified within DS103 between 3.40 m bgl and 4.00 m bgl.
There were no visual or olfactory indications of significant contamination.
The natural soil was considered to be generally representative of the published superficial geology for the Site of the Lowestoft Formation.
Bedrock (chalk) was not encountered.
Groundwater was identified during drilling within DS105 only at 3.50 m bgl.
See Appendix C for further details.</td></tr>
<tr><td>Groundwater in Standpipes</td><td>Two monitoring visits were completed on 10th and 17th March 2020.
A summary of the readings is provided below:
<table>
<tr><th>Borehole</th><th>Maximum Depth to Water (m bgl)</th><th>Minimum Depth to water (m bgl)</th><th>Response Zone</th></tr>
<tr><td>DS101</td><td>Dry</td><td>Dry</td><td>Lowestoft Formation</td></tr>
<tr><td>DS103</td><td>Dry</td><td>Dry</td><td>Lowestoft Formation</td></tr>
<tr><td>DS105</td><td>1.51</td><td>1.47</td><td>Lowestoft Formation</td></tr>
</table>
See Appendix D for further details.</td></tr>
<tr><td>Gas in Standpipes</td><td>Two monitoring visits were completed on 10th and 17th March 2020.
The worst-case gas scenario is summarised below.
<table>
<tr><th rowspan="2">Borehole</th><th>Methane (%v/v)</th><th>Carbon Dioxide (%v/v)</th><th>Oxygen (%v/v)</th><th>Steady Flow (l/hr)</th><th colspan="2">GSV/CS</th></tr>
<tr><th>Max</th><th>Max</th><th>Min</th><th>Max</th><th>GSV</th><th>CS</th></tr>
<tr><td>DS102</td><td><0.1</td><td>1.4</td><td>17.4</td><td>0.1</td><td>0.0014</td><td>1</td></tr>
<tr><td>DS103</td><td><0.1</td><td>0.8</td><td>18.2</td><td><0.1</td><td>0.0008</td><td>1</td></tr>
<tr><td>DS105</td><td><0.1</td><td>0.5</td><td>19.2</td><td><0.1</td><td>0.0005</td><td>1</td></tr>
<tr><td rowspan="2">Date</td><td colspan="5">Conditions During Monitoring Round</td></tr>
<tr><td colspan="4">Atmospheric Pressure (mb) (Trend)</td><td colspan="2">Weather Conditions</td></tr>
<tr><td>10/03/20</td><td colspan="4">994 (Steady)</td><td colspan="2">Dry</td></tr>
<tr><td>17/03/20</td><td colspan="4">1022 (Rising)</td><td colspan="2">Dry</td></tr>
</table>
Note:
GSV = Gas Screening Value as per CIRIA C665</td></tr>
</table>

CS = Characteristic Situation as per CIRIA C665

See Appendix D for further details.

Chemical Analysis

Five samples were scheduled for the following analytes: selected heavy metals suite, Total Petroleum Hydrocarbons (TPH) (total), TPH CWG, BTEX, MTBE, speciated Polycyclic Aromatic Hydrocarbons (PAH) (EPA-16), leachable metals and asbestos screen.

Slight exceedances of arsenic and lead have been identified above the applied Generic assessment Criteria (GAC) for residential without plant uptake end use within shallow Made Ground from a single location (DS101 at 0.15 m bgl). Arsenic has been identified at 41 mg/kg marginally above the stringent GAC of 40 mg/kg and lead recorded at 330 mg/kg marginally above the GAC of 310 mg/kg.

Slightly elevated individual PAH compounds above the applied GAC have also been identified within a single sample collected from DS104 at 0.30 m bgl, summarised in the table below.

Parameter	Maximum Concentration (Mg/kg)	Screening Value (Source)	Volatile	Location
PAHs				
Benzo(b)fluoranthene	5.1	3.9[LQM]	N	DS104
Benzo(a)pyrene	4.3	3.2[LQM]	N	DS104
Dibenzo(a,h)anthracene	0.66	0.31[LQM]	N	DS104

Further elevated concentrations of hydrocarbons, sPAH and heavy metals were not identified above their respective GAC.

Asbestos has been identified within one sample from DS105 at 0.5 m bgl as Chrysotile, quantified as <0.001%.

The leachable metal results have been compared against the GAC for Potable Waters given the underlying Secondary A and Principal Aquifers. Concentrations of lead have been identified marginally above very stringent GAC of 10 µg/l in two samples; DS103 (0.20 m bgl) at 13 µg/l and DS104 (0.30 m bgl) at 11 µg/. However, the results are not considered representative of real-life processes and represent a worst-case laboratory conditions.

See Appendix E for further details.

Contamination

The Site has historically been in agricultural use, including farm yard prior to redevelopment as a Youth Hostel.

Marginally elevated individual PAH compounds, arsenic and lead have been identified above the stringent applied GAC and slightly elevated leachable lead has also been identified in two locations. Further concentrations of heavy metals, PAHs and TPH was not identified above generic assessment criteria.

Asbestos fibres have been identified within one location (DS105) as Chrysotile, quantified as <0.001%.

Given the identified concentrations of arsenic, lead and sPAH are marginally above stringent GAC, the risk to Human Health (construction workers/ future maintenance workers and future Site users) is considered low. Furthermore, the Site is to be covered predominantly in buildings or hardstanding, effectively encapsulating the soils and preventing direct contact.

It is recommended that proposed new landscaped areas have a minimum 450 mm clean certified layer of topsoil. Should landscaped areas be proposed for the growing of fresh produce, the depth of clean cover should be increased to 600 mm, with appropriate geotextile membrane.

	Given significantly elevated concentrations of contaminants have not been identified, and the geology has been identified as predominantly cohesive, the risk to controlled waters is considered very low risk.
Fresh Water Pipes	The Local Water Authority should be contacted at an early stage in order that any abnormal costs can be calculated, if required.
Ground Gas	Potential sources of ground gas are limited to Made Ground and off-Site infilled land and landfill. The gas monitoring recorded low concentrations of ground gases and low flow. Methane was not detected above 0.1 %v/v and carbon dioxide was identified at a maximum concentration of 1.4 %v/v. The ground gas regime beneath the Site has been classified as a Characteristic Situation 1, in line with CIRIA C665.
Groundwater/ Drainage	The natural ground conditions at the Site were found to be variable sandy clays and clayey sand. Groundwater was encountered at approximately 1.50 m bgl within one location during return monitoring visits. BRE365 Infiltration testing has been undertaken at the Site. This is reported under sperate cover and should be read in conjunction with this Report.
Conclusions and Recommendations	The Site has historically been in agricultural use prior to redevelopment as a Youth Hostel. The Site is proposed for the demolition of existing buildings and the construction of a four-storey 100 bed YMCA Hostel and a 2, 3 and 4 storey building providing up to 43 residential apartments. It is also understood that the development will comprise surface water drainage to two soakaways in the central area of the Site, via interceptors. Significant contamination has not been identified in the shallow soils, however, elevated PAHs, arsenic and lead have been identified within shallow Made Ground. It is considered that the risk to future Site users will be mitigated through hardstanding and clean cover. The risk to controlled water is also considered low, given the following; ▲ Marginal exceedances of PAHs, arsenic and lead have been identified within shallow soils above stringent guidance values and are not considered significantly elevated; ▲ The shallow Made Ground is likely to be excavated and removed from Site in the areas of proposed surface water drainage, as such removing the identified source; ▲ Interceptors are proposed prior to water entering the proposed soakaways; ▲ Cohesive clay deposits have been identified above the mapped chalk, effectively limiting vertical migration of contamination; and ▲ There are no Licensed Abstraction Records from groundwater for potable water supply within 250 m of the Site. The following development abnormals should be considered appropriate at this stage: ▲ A ‘hotspot’ protocol to be put in place during any sub-surface works for groundworkers to act upon should potential contamination be identified; ▲ Consultation with the Local Water Authority to confirm the requirements for upgraded potable water pipes; ▲ Additional soil testing (WAC) may be required to optimise off-Site disposal of soils;

	▲ An asbestos survey of the current buildings should be undertaken prior to demolition; and ▲ Importation of suitable certified topsoil for any proposed for any proposed landscaped areas.

Pollutant Linkage Assessment				
Source(s)	**Pathway(s)**	**Receptor(s)**	**Risk Rating**	**Justification & Mitigation (if required)**
Marginally elevated concentrations of PAHs within shallow Made Ground in DS104 0.3 m bgl. Marginally elevated arsenic and lead within Made Ground in DS101 at 0.15 m bgl. Slightly elevated leachable lead within Made Ground from DS103, DS104 and DS105. Detectable concentrations of heavy metals, PAHs and TPH in shallow soils. Potential contamination in areas not directly investigated.	Direct contact, ingestion or inhalation of soil bound contaminants / dust during redevelopment and the inhalation of vapours	Construction workers. Third parties during construction (adjacent site users and adjacent residents). Future residents.	**Low Risk**	Detectable concentrations of heavy metals and PAHs have been identified in shallow Made Ground. However, the Site is to mainly be covered in hardstanding, as such, the risk to future Site users is considered low. Should areas of landscaping be proposed a clean certified layer of suitable for use topsoil will be required. Given the identified elevated PAHs, arsenic and lead, the short-term risk to construction workers would be mitigated by the use of PPE and provision of suitable welfare facilities. This recommendation should be captured in Site health and safety documentation and in maintenance plans. A hotspot protocol should be in place for groundworkers to act upon should potential contamination be identified.
	Direct contact between aggressive ground conditions and new infrastructure.	The Built Environment (new buildings and infrastructure)	**Low Risk**	The Local Water Authority should be contacted to understand their requirements for upgraded water pipes.
	Leaching of contamination into groundwater followed by migration of groundwater to the wider groundwater environment or surface waters.	The underlying Secondary A Aquifer, Secondary Undifferentiated and Principal Aquifer/ Controlled waters.	**Very Low Risk**	Significant contamination has not been identified at the Site within shallow soils. However, marginally elevated PAHs, arsenic and lead have been identified above stringent guidance values. Hardstanding within the development will further mitigate the risk by restricting any infiltration and subsequent mobilisation of any soil contaminants. In addition, leachable lead has been marginally identified above the guidance value for potable water, however, is not considered representative of general environmental conditions, as such the risk is considered low. The Site is located within a Zone III Source Protection Zone.
Hazardous Ground Gas.	Migration of ground gas into on-site buildings causing asphyxiation or risk of explosion.	The Built Environment (new buildings and infrastructure) Future residents.	**Very Low Risk**	Following two rounds of ground gas monitoring, low concentrations of Carbon dioxide were recorded at a maximum concentration of 1.4%v/v. The Site can provisionally be classified as a Characteristic Situation 1.

Standard risk definitions and matrices are presented in Appendix D.

Pollutant Linkage Assessment				
Source(s)	**Pathway(s)**	**Receptor(s)**	**Risk Rating**	**Justification & Mitigation (if required)**
Chrysotile Asbestos identified within shallow Made Ground form DS105 and 0.5 m bgl. Potential ACMs within existing building construction.	Direct contact of inhalation of Asbestos fibres.	Future Site users. Groundworkers during the redevelopment or during any subsurface maintenance works.	**Low to Moderate Risk**	Asbestos has been identified within a single location (DS105 at 0.5 m bgl), quantified as <0.001%. The risk for further asbestos to be present within Made Ground cannot be discounted. A full asbestos survey should be undertaken prior to demolition of the current buildings and structures.

Figure 1 – Site Location Map

Scale: 1 / 500,000 @ A4

LEGEND

Site Boundary

Scale: 1 / 10,000 @ A4

deltasimons
Environment - Health & Safety - Sustainability

TITLE:
Site Location Map
WCG- One YMCA
Peartree Lane, Welwyn Garden City

DRAWN BY: JR	SCALE: To Scale@A4
CHECKED BY: AH	REVISION: 1
DATE: 13th March 2020	

PROJECT NO: 20-0093

FIGURE NO: 1

Figure 2 – Site Layout Plan

deltasimons
Environment - Health & Safety - Sustainability

TITLE:
Site Layout Plan
WCG-One YMCA
PeartreeLane, Welwyn Garden City

DRAWN BY: JR	SCALE: Not to Scale	PROJECT NO: 20-0093.01	
CHECKED BY: RPD	REVISION: 1	FIGURE NO: 2	
DATE: 24th March 2020			

Figure 3 – Approximate Intrusive Location Plan

LEGEND

- Site Boundary
- DSx Dynamic Sampler Borehole
- (s) Standpipe Installation

FOR PLANNING

REV	DATE	NOTE	IN

Project

YMCA
PEARTREE LANE
WELWYN GARDEN CITY

Title

PROPOSED SITE LAYOUT

Scale 1:500 @A3 | Date SEPT 2019
Drawn SD | Checked AL
Drawing Number 8057 / P101 | Revision -

Saunders Architecture + Urban Design

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Site Plan provided by Client

deltasimons
Environment - Health & Safety - Sustainability

TITLE:
Approximate Intrusive Location Plan
WCG-One YMCA
PeartreeLane, Welwyn Garden City

DRAWN BY:	SCALE:	PROJECT NO:
JR	Not to Scale	20-0093.01
CHECKED BY:	REVISION:	FIGURE NO:
AH	1	3
DATE: 13th March 2020		

Drawing 1 – Proposed Development Plan

NOTES ©

This drawing to be read in accordance with the specification/Bills of Quantities and related drawings. No Dimensions to be scaled from this drawing. All stated dimensions to be verified on site and the Architect notified of any discrepancies.

0 50

Scale bar 50mm at 1:1

FOR PLANNING

REV	DATE	NOTE	IN

Project

YMCA
PEARTREE LANE
WELWYN GARDEN CITY

Title

PROPOSED SITE LAYOUT

Scale	Date
1:500 @A3	SEPT 2019
Drawn	Checked
SD	AL
Drawing Number	Revision
8057 / P101	-

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Architecture + Urban Design
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Appendix A - Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B - Risk Definitions

Contaminated Land Risk Definitions

The following methodology is based on the methodology presented in CIRIA C552 Contaminated Land Risk Assessment: A Guide to Good Practice 2001. It requires the classification of the:

- Magnitude of the potential consequence (severity) of the Risk occurring: and
- Magnitude of the Probability (likelihood) of the Risk occurring.

The classifications are then compared to indicate the risk presented by each pollutant linkage.

Consequence to Receptor Definition Matrix

	Human Health	Controlled Waters	Buildings/Services
Severe Consequence	Acute or chronic permanent impact on human health.	Sensitive controlled water pollution ongoing, or just about to occur.	Catastrophic collapse
Medium Consequence	Chronic permanent impact on human health	Gradual pollution of sensitive controlled water	Degradation of materials
Mild Consequence	Chronic temporary impact on human health	Gradual pollution of non-sensitive controlled water	Damage to building rendering it unsafe.to occupy (eg foundation damage resulting in instability).
Minor Consequence	Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc).	Slight discoloration of water	Easily repairable effects of damage to buildings, structures and services, i.e discoloration of concrete

Probability Definitions

Probability	Definition in Context
Higher	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution. Positive evidence of source, pathway and receptor.
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. Suspect source, pathway, and receptor
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term No evidence of hazard, pathway, and receptor

Standard Risk Matrix

		Consequence/Magnitude of impact			
		Severe	Medium	Mild	Minor
Probability	**High**	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/low	Low
	Low Likelihood	Moderate	Moderate/low	Low	Very Low
	Unlikely	Moderate/low	Low	Very Low	Very Low

Classified risks and likely action

Significance Level	Definition/Comments
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required. Demonstrable contaminated land situation, highest threat & liability level, urgent action recommended.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term. Likely contaminated land situation, risk assessment and action recommended.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, if is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term. Plausible contaminated land situation, risk assessment and possible action recommended.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild. Unlikely contaminated land situation, possible risk assessment and possible action.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe. Negligible risk, no action recommended except vigilance for changes in conditions.

Geotechnical Risk Classification

The geohazards listed in the report within Section 4 follow guidance presented in Clayton, C.R.I. (2001) *Managing Geotechnical Risk*, Thomas Telford and the Highways Agency document HD22/08 '*Managing Geotechnical Risk*' (2008) which aims to identify and manage the geotechnical risks associated with a scheme throughout its lifespan, from planning to construction to maintenance.

For each geohazard the probability of the hazard occurring (P) has been considered together with the impact it would have (I) if it were to happen to calculate the risk rating between 1 and 25.

Risks that fall within Moderate, Significant and Severe categories below are considered to be ***substantial*** and are therefore listed within the report.

Probability	**(P)**
Very Likely (VLk)	5
Likely (Lk)	4
Plausible (P)	3
Unlikely (U)	2
Very Unlikely (VU)	1

X

Impact	**(I)**
Very High (VH)	5
High (H)	4
Medium (M)	3
Low (L)	2
Very Low (VL)	1

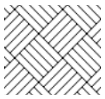
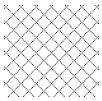
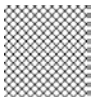
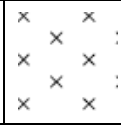
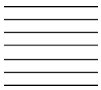
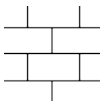
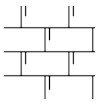
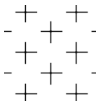
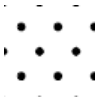
=

(R)	**Risk**
20 – 25	Severe
15 – 19	Substantial
10 – 14	Moderate
5 – 9	Minor
1 – 4	Negligible

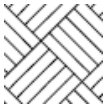
Appendix C - Key to Logs, Field Records & Compliance Certificates

KEY TO BOREHOLE AND TRIAL PIT LOGS

MATERIAL LEGENDS

	Topsoil		Made Ground		Bituminous Material
	Concrete		Clay		Silt
	Sand		Gravel		Peat
	Cobbles		Boulders		Mudstone
	Siltstone		Sandstone		Limestone
	Chalk		Coal		Breccia
	Conglomerate		Igneous		Metamorphic
	Pyroclastic (volcanic ash)		Gypsum		Shale
	Ironstone		Bedrock (Unidentified)		Void

INSTALLATION/BACKFILL LEGENDS

	Sand		Gravel		Bentonite/Grout
	Arisings		Concrete		Plain Pipe
	Slotted Pipe				

Legend symbols in general accordance with BS 5930:1999+A2:2010 and standard industry practice.

KEY TO BOREHOLE AND TRIAL PIT LOGS

SAMPLE TYPES

ACM	Asbestos Containing Material Sample
B	Bulk Disturbed Sample
BLK	Block Sample
C	Core Sample
CBR	Undisturbed Sample for California Bearing Ratio Test – 154mm diameter
D	Disturbed Sample - Tub
ES	Soil Sample for Environmental Testing
EW	Water Sample for Environmental Testing
G	Gas Sample
U	Undisturbed Driven Tube Sample – 70/102mm diameter, 450mm long
W	Water Sample

TEST TYPES

CPT	Cone Penetrometer Test (kN/m^2)
FID	Flame Ionisation Detector Test (ppm)
HV	In-Situ Hand Sheer Vane Test (kN/m^2)
PID	Photoionisation Detector Test (ppm)
SPT (S)	Standard Penetration Test – Split Spoon Sampler
SPT (C)	Standard Penetration Test – Solid 60 Degree Cone

CORE DETAILS

If	Fracture Spacing (mm) – Minimum, Average, Maximum
NI	Non-Intact where >25 fracture spacings per metre
TCR	Total Core Recovery (%)
SCR	Solid Core Recovery (%)
RQD	Rock Quality Designation (%)
AF	Air Flush Return (%)
WF	Water Flush Return (%)

WATER COLUMN DETAILS

	Water Strike
	Water Level

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Project No: 20-0093.01 | Hole ID: DS101 | Page: 1 of 1

Project: WGC-One YMCA, Peartree Lane, Welwyn Garden City

Dynamic Sampler Log

Date: 06/03/2020 | Client: Pinnacle Consulting Engineers

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details: Depth (m)	Sample Details: Type	Sample Details: Ref	Test Details: Depth (m)	Test Details: Results	Backfill
MADE GROUND: Grass over dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to medium subangular to subrounded flint and brick fragments. (TOPSOIL).		0.20	(0.20)	82.89			0.15	ES	ES1			
MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint and occasional brick fragments.		0.60	(0.40)	82.49								
Soft dark brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangualr to subrounded flint. (LOWESTOFT FORMATION)		0.80	(0.20)	82.29								
Soft to firm light orangish brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to medium angular to subrounded flint. (LOWESTOFT FORMATION)		1.20	(0.40)	81.89						1.20	SPT(S) N=23 (4,5/5,6,6,6)	
Medium dense light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse angular to rounded flint. (LOWESTOFT FORMATION)		3.00	(1.80)	80.09						2.00	SPT(S) N=17 (4,5/4,5,4,4)	
Firm light brown slightly sandy gravelly CLAY. Gravel is fine to medium subangular to subrounded flint. Sand is fine to medium (LOWESTOFT FORMATION)		3.33	(0.33)	79.76						3.00	SPT(S) N=16 (4,4/4,4,4,4)	
Firm light brown slightly sandy CLAY. Sand is fine to medium. Including rare medium subrounded flints. (LOWESTOFT FORMATION)		4.50	(1.17)	78.59						4.00	SPT(S) N=15 (3,4/4,3,4,4)	
Firm dark brown slighly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint and chalk nodules. (LOWESTOFT FORMATION)		5.00	(0.50)	78.09						5.00	SPT(S) 50 (25 for 140mm/50 for 190mm)	
Borehole complete at 5.00 m bgl.												

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Borehole installed to 5 m bgl, with 50mm diameter standpipe, gas bung and traffic strength flush cover.3. Borehole remained dry upon completion.

Water Strike			Water Level		Borehole Diameter	
Date	Time	Depth Strike	Duration (min)	Depth Water	Depth Base	Diameter

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E524385.37 N212618.12	83.09	Dynamic Sampling	Premier 110	AH	JR	PH	1:30

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Project No: 20-0093.01 | Hole ID: DS102 | Page: 1 of 1

Project: WGC-One YMCA, Peartree Lane, Welwyn Garden City

Dynamic Sampler Log

Date: 06/03/2020 | Client: Pinnacle Consulting Engineers

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details: Depth (m)	Sample Details: Type	Sample Details: Ref	Test Details: Depth (m)	Test Details: Results	Backfill
MADE GROUND: Grass over dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to medium subangular to subrounded flint and brick fragments. (TOPSOIL).		0.30	(0.30)	82.68								
MADE GROUND: Light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint and brick fragments.		0.68	(0.38)	82.30			0.60	ES	ES1			
Firm brown mottled grey slightly sandy CLAY. Sand is fine to medium. Including occasional fine to medium subangular to subrounded flints. (LOWESTOFT FORMATION)		2.00	(1.32)	80.98								
Dark brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse angular to subangular flint. (LOWESTOFT FORMATION)		2.85	(0.85)	80.13								
Firm dark brown slighly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		5.00	(2.15)	77.98								
Borehole complete at 5.00 m bgl.												

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Borehole backfilled with arisings.3. Borehole remained dry upon completion.

Water Strike			Water Level		Borehole Diameter	
Date	Time	Depth Strike	Duration (min)	Depth Water	Depth Base	Diameter

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E524377.53 N212604.54	82.98	Dynamic Sampling	Premier 110	AH	JR	PH	1:30

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Project No: 20-0093.01 | Hole ID: DS103 | Page: 1 of 1

Project: WGC-One YMCA, Peartree Lane, Welwyn Garden City

Dynamic Sampler Log

Date: 06/03/2020 | Client: Pinnacle Consulting Engineers

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details: Depth (m)	Sample Details: Type	Sample Details: Ref	Test Details: Depth (m)	Test Details: Results	Backfill
MADE GROUND: Gravel over dark brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular flint, brick fragments and glass.		0.30	(0.30)	82.84			0.20	ES	ES1			
MADE GROUND: Light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint and brick fragments.		0.60	(0.30)	82.54								
Soft light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint. (LOWESTOFT FORMATION)		1.20	(0.60)	81.94						1.20	SPT(S) N=5 (1,1/1,2,1,1)	
Soft light brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		2.60	(1.40)	80.54						2.00	SPT(S) N=10 (2,3/2,3,2,3)	
Light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		3.00	(0.40)	80.14						3.00	SPT(S) N=16 (3,4/4,4,4,4)	
Firm light brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		3.40	(0.40)	79.74								
Brown sandy subangular to subrounded fine to coarse flint GRAVEL. Sand is fine to coarse. (LOWESTOFT FORMATION)		4.00	(0.60)	79.14						4.00	SPT(S) N=22 (4,4/5,5,6,6)	
Firm to stiff dark brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint and rare chalk nodules. (LOWESTOFT FORMATION)		5.00	(1.00)	78.14						5.00	SPT(S) N=37 (8,8/9,9,9,10)	
Borehole complete at 5.00 m bgl.												

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Borehole installed to 5 m bgl, with 50mm diameter standpipe, gas bung and traffic strength flush cover.3. Borehole remained dry upon completion.

Water Strike			Water Level		Borehole Diameter	
Date	Time	Depth Strike	Duration (min)	Depth Water	Depth Base	Diameter

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E524382.40 N212584.51	83.14	Dynamic Sampling	Premier 110	AH	JR	PH	1:30

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Project No:	Hole ID:	Page:
20-0093.01	DS104	1 of 1

Project: WGC-One YMCA, Peartree Lane, Welwyn Garden City

Dynamic Sampler Log

Date: 06/03/2020

Client: Pinnacle Consulting Engineers

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details: Depth (m)	Sample Details: Type	Sample Details: Ref	Test Details: Depth (m)	Test Details: Results	Backfill
MADE GROUND: Grass over dark brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to medium subangular to subrounded flint.(TOPSOIL)		0.15	(0.15)	82.80								
MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and brick fragments. Sand is fine to coarse.		0.50	(0.35)	82.45			0.30	ES	ES1			
Soft light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint. (LOWESTOFT FORMATION)		1.12	(0.62)	81.83								
Firm light brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		3.10	(1.98)	79.85								
Firm light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint. (LOWESTOFT FORMATION)		5.00	(1.90)	77.95								
Borehole complete at 5.00 m bgl.												

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Borehole backfilled with arisings.3. Borehole remained dry upon completion.

Water Strike			Water Level		Borehole Diameter	
Date	Time	Depth Strike	Duration (min)	Depth Water	Depth Base	Diameter

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E524415.42 N212595.37	82.95	Dynamic Sampling	Premier 110	AH	JR	PH	1:30

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Project No:	Hole ID:	Page:
20-0093.01	DS105	1 of 1

Project: WGC-One YMCA, Peartree Lane, Welwyn Garden City

Dynamic Sampler Log

Date: 06/03/2020

Client: Pinnacle Consulting Engineers

Description of Strata	Legend	Strata Depth (m bgl)	Strata Thickness (m)	Reduced Level (mAOD)	Casing Diameter (mm)	Water	Sample Details: Depth (m)	Sample Details: Type	Sample Details: Ref	Test Details: Depth (m)	Test Details: Results	Backfill
MADE GROUND: Grass over dark brown slightly gravelly clayey fine to medium SAND. Gravel is fine to medium subangular flint and brick fragments. (TOPSOIL).		0.15	(0.15)	83.14								
MADE GROUND: Dark brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded flint and brick fragments. Sand is fine to coarse.		0.60	(0.45)	82.69			0.50	ES	ES1			
Soft light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint. (LOWESTOFT FORMATION)		1.00	(0.40)	82.29								
Firm light brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to coarse angular to subrounded flint. (LOWESTOFT FORMATION)		3.00	(2.00)	80.29						1.20	SPT(S) N=27 (4,5/5,7,7,8)	
										2.00	SPT(S) N=30 (5,6/7,7,8,8)	
Firm light brown slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium subangular to subrounded flint. (LOWESTOFT FORMATION)		5.00	(2.00)	78.29		3.50 ▼				3.00	SPT(S) N=30 (5,6/7,7,8,8)	
										4.00	SPT(S) N=11 (3,2/3,2,3,3)	
Borehole complete at 5.00 m bgl.										5.00	SPT(S) N=23 (5,5/5,6,6,6)	

Remarks:
1. Logged in general accordance with BS 5930:2015.2. Borehole installed to 5 m bgl, with 50mm diameter standpipe, gas bung and traffic strength flush cover.3. Groundwater was encountered at 3.50 m bgl.

Water Strike			Water Level		Borehole Diameter	
Date	Time	Depth Strike	Duration (min)	Depth Water	Depth Base	Diameter
		3.50 m				

Coordinates:	Elevation (mAOD):	Drilled By:	Plant Used:	Logged:	Checked:	Approved:	Scale:
E524431.20 N212575.46	83.29	Dynamic Sampling	Premier 110	AH	JR	PH	1:30

Appendix D - Monitoring Records

Site Name	WGC-One YMCA, Peartree Lane, Welwyn Garden City				**Job number**		20-0093.01				**WEATHER**	**Start**	**End**						
											Time	10.15	10.45						
Client	Pinnacle Consulting Engineers				**Recorded by**		LD				**Pressure (mb)**	994	994						
											Wind speed (m/s)	11.00	11.00						
Date (DD/MM/YYYY)	10/03/2020										**Wind Dir. (from)**	W	W						
Gas Analyser	GFM435 (Gas Kit 5) - 12233				**Visit Number**		1				**Temperature (°C)**	11.00	11.00						
Readings at start	**CH_4 (% v/v)**	<0.1	**CO_2 (% v/v)**	<0.1	**O_2 (% v/v)**		20.2	**H_2S (ppm)**	0		**Dry/Rain/Snow/Ice**	DRY	DRY						
Instrument used			Dip meter		**Water levels measured to**		Ground Level												
General comments											**Rising/Falling Trend (for the three days before visit)**	STEADY							

Ref	GROUND GAS													GROUNDWATER			Notes
	Flow		CH_4		CO_2		O_2		H_2S	CO	VOC	Differential (Relative) Pressure	Atmos. Pressure	Depth to free product	Depth to water	Depth to base	(e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) For Depth to Product state: Not detected is product looked for but absent Not applicable if the instrument used is not capable of detecting product
	l/hr		% v/v		% v/v		% v/v		ppm								
	Max	Steady	Max	Steady	Max	Steady	Min	Steady	Max	Max	Max	mb	mb	m	m	m	
	The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet																
BH101	<0.1	<0.1	<0.1	<0.1	0.8	0.8	18.5	18.5	0.0	0.0	NR	0.0	994	NR	NR	4.92	DRY AT BASE
BH103	0.1	<0.1	<0.1	<0.1	0.8	0.8	18.2	18.2	0.0	0.0	NR	0.0	993	NR	NR	4.90	DRY AT BASE
BH105	<0.1	<0.1	<0.1	<0.1	0.5	0.5	19.4	19.4	0.0	0.0	NR	1.0	993	NR	1.51	4.94	

Site Name	WGC-One YMCA, Peartree Lane, Welwyn Garden City	Job number	20-0093.01	WEATHER	Start	End
				Time	12.10	12.40
Client	Pinnacle Consulting Engineers	Recorded by	LD	Pressure (mb)	1022	1022
				Wind speed (m/s)	6.00	6.00
Date (DD/MM/YYYY)	17/03/2020			Wind Dir. (from)	SW	SW
Gas Analyser	GFM435 (Gas Kit 5) - 12233	Visit Number	2	Temperature (°C)	13.00	13.00

Readings at start	CH_4 (% v/v)	<0.1	CO_2 (% v/v)	<0.1	O_2 (% v/v)		19.8	H_2S (ppm)	0		Dry/Rain/Snow/Ice	DRY	DRY
Instrument used			Dip meter		Water levels measured to		Ground Level						
General comments											Rising/Falling Trend (for the three days before visit)	RISING	

Ref	GROUND GAS													GROUNDWATER			Notes
	Flow		CH_4		CO_2		O_2		H_2S	CO	VOC	Differential (Relative) Pressure	Atmos. Pressure	Depth to free product	Depth to water	Depth to base	(e.g. water colour, sheen, odour, damage to well or gas tap, flooded ground etc.) For Depth to Product state: Not detected is product looked for but absent Not applicable if the instrument used is not capable of detecting product
	l/hr		% v/v		% v/v		% v/v		ppm			mb	mb	m	m	m	
	Max	Steady	Max	Steady	Max	Steady	Min	Steady	Max	Max	Max						
	The formulae require that only numbers, "<0.1" for ground gas and flow or "DRY" for groundwater are entered in the sheet																
BH101	0.1	0.1	<0.1	<0.1	1.4	1.4	17.4	17.4	0.0	0.0	NR	1.0	1018	-	NR	4.93	DRY AT BASE
BH103	<0.1	<0.1	<0.1	<0.1	0.6	0.6	19.7	19.7	0.0	0.0	NR	1.0	1018	-	NR	4.92	DRY AT BASE
BH105	<0.1	<0.1	<0.1	<0.1	0.4	0.4	19.2	19.2	0.0	0.0	NR	1.0	1018	-	1.47	4.94	

Appendix E - Chemical Analysis

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Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 20-91543

Project / Site name:	Peartree Lane, Welwyn	**Samples received on:**	09/03/2020
Your job number:	20-0093.01	**Samples instructed on:**	10/03/2020
Your order number:	DS53453	**Analysis completed by:**	16/03/2020
Report Issue Number:	1	**Report issued on:**	16/03/2020
Samples Analysed:	5 leachate samples - 5 soil samples		

Signed:

Zina Abdul Razzak
Senior Quality Specialist

For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement. Application of uncertainty of measurement would provide a range within which the true result lies. An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 20-91543

Project / Site name: Peartree Lane, Welwyn

Your Order No: DS53453

Lab Sample Number				1466933	1466934	1466935	1466936	1466937
Sample Reference				DS101	DS102	DS103	DS104	DS105
Sample Number				ES1	ES1	ES1	ES1	ES1
Depth (m)				0.15	0.60	0.20	0.30	0.50
Date Sampled				06/03/2020	06/03/2020	06/03/2020	06/03/2020	06/03/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	15	12	21	12	9.4
Total mass of sample received	kg	0.001	NONE	1.3	1.4	1.1	0.98	1.2
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	-	-	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	-	-	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	-	-	< 0.001
General Inorganics								
pH - Automated	pH Units	N/A	MCERTS	7.2	8.0	8.0	8.8	8.1
Water Soluble Sulphate as SO_4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	34	16	37	270	40
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.017	0.0081	0.019	0.13	0.020
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	16.9	8.1	18.7	134	20.1
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.62	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.15	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.39	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.38	< 0.05	1.3	5.2	0.41
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	1.4	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.75	< 0.05	1.7	11	1.1
Pyrene	mg/kg	0.05	MCERTS	0.66	< 0.05	1.5	9.2	1.1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.39	< 0.05	0.95	4.9	0.78
Chrysene	mg/kg	0.05	MCERTS	0.49	< 0.05	1.0	4.3	0.85
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.48	< 0.05	0.98	5.1	0.91
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.21	< 0.05	0.55	2.6	0.54
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.35	< 0.05	0.72	4.3	0.78
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.24	< 0.05	0.39	2.6	0.57
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.66	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.31	< 0.05	0.51	2.8	0.68
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.26	< 0.80	9.64	55.2	7.68
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	41	23	28	28	21
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	1.0	0.4	1.5	0.6	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	37	31	28	32	28
Copper (aqua regia extractable)	mg/kg	1	MCERTS	59	24	79	42	27
Lead (aqua regia extractable)	mg/kg	1	MCERTS	330	110	270	180	170
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	40	29	33	35	27
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	260	130	190	170	170

Analytical Report Number: 20-91543

Project / Site name: Peartree Lane, Welwyn
Your Order No: DS53453

Lab Sample Number				1466933	1466934	1466935	1466936	1466937
Sample Reference				DS101	DS102	DS103	DS104	DS105
Sample Number				ES1	ES1	ES1	ES1	ES1
Depth (m)				0.15	0.60	0.20	0.30	0.50
Date Sampled				06/03/2020	06/03/2020	06/03/2020	06/03/2020	06/03/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics & Oxygenates								
Benzene	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
p & m-xylene	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
o-xylene	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
MTBE (Methyl Tertiary Butyl Ether)	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC35 - EC40	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	< 2.0	< 2.0	2.4	13	< 2.0
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	< 10	< 10	< 10	70	< 10
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	17	< 10	18	120	11
TPH-CWG - Aromatic >EC35 - EC40	mg/kg	10	NONE	< 10	< 10	< 10	< 10	< 10
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	24	< 10	30	200	15
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	< 10	< 10

Analytical Report Number: 20-91543
Project / Site name: Peartree Lane, Welwyn
Your Order No: DS53453

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1466937	DS105	0.50	147	Loose Fibres	**Chrysotile**	< 0.001	**< 0.001**

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Analytical Report Number: 20-91543

Project / Site name: Peartree Lane, Welwyn

Your Order No: DS53453

Lab Sample Number				1466938	1466939	1466940	1466941	1466942
Sample Reference				DS101	DS102	DS103	DS104	DS105
Sample Number				ES1	ES1	ES1	ES1	ES1
Depth (m)				0.15	0.60	0.20	0.30	0.50
Date Sampled				06/03/2020	06/03/2020	06/03/2020	06/03/2020	06/03/2020
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	1.1	ISO 17025	6.8	9.1	2.3	6.6	7.6
Boron (dissolved)	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.4	1.0	2.1	6.2	3.4
Copper (dissolved)	µg/l	0.7	ISO 17025	11	4.9	14	19	9.1
Lead (dissolved)	µg/l	1	ISO 17025	2.8	3.8	13	11	10
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	2.1	< 0.3	0.8	0.8	1.7
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	11	8.2	58	32	78

Analytical Report Number : 20-91543

Project / Site name: Peartree Lane, Welwyn

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1466933	DS101	ES1	0.15	Brown clay and loam with gravel and vegetation.
1466934	DS102	ES1	0.60	Brown clay and loam with gravel and vegetation.
1466935	DS103	ES1	0.20	Brown clay and loam with gravel.
1466936	DS104	ES1	0.30	Brown loam and clay with gravel and vegetation.
1466937	DS105	ES1	0.50	Brown clay and sand with gravel.

Analytical Report Number : 20-91543

Project / Site name: Peartree Lane, Welwyn

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
Boron in leachate	Determination of boron in leachate. Sample acidified and followed by ICP-OES.	In-house method based on MEWAM	L039-PL	W	ISO 17025
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Hexavalent chromium in soil (Lower Level)	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
NRA Leachate Prep	10:1 extract with de-ionised water shaken for 24 hours then filtered.	In-house method based on National Rivers Authority	L020-PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
TPH Chromatogram in Soil	TPH Chromatogram in Soil.	In-house method	L064-PL	D	NONE
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	MCERTS

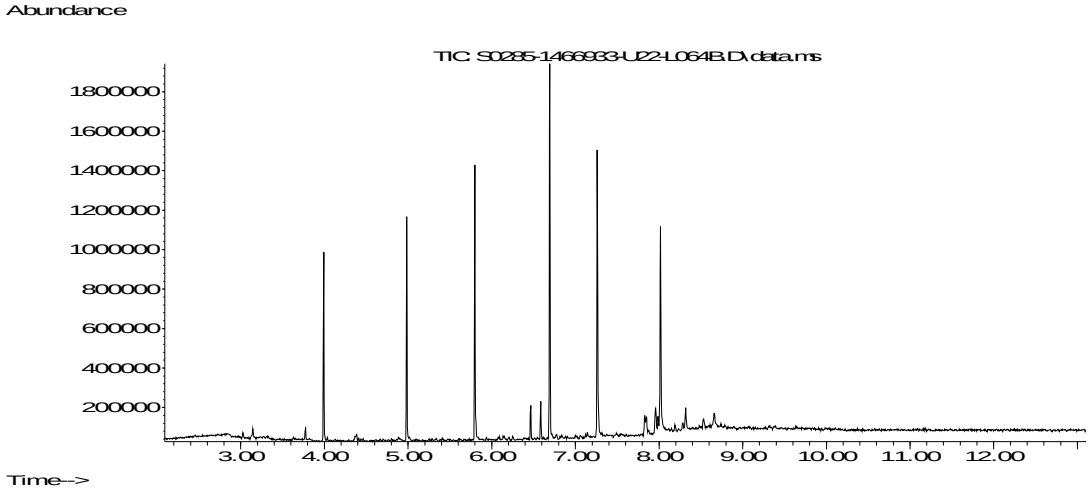
Analytical Report Number : 20-91543

Project / Site name: Peartree Lane, Welwyn

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.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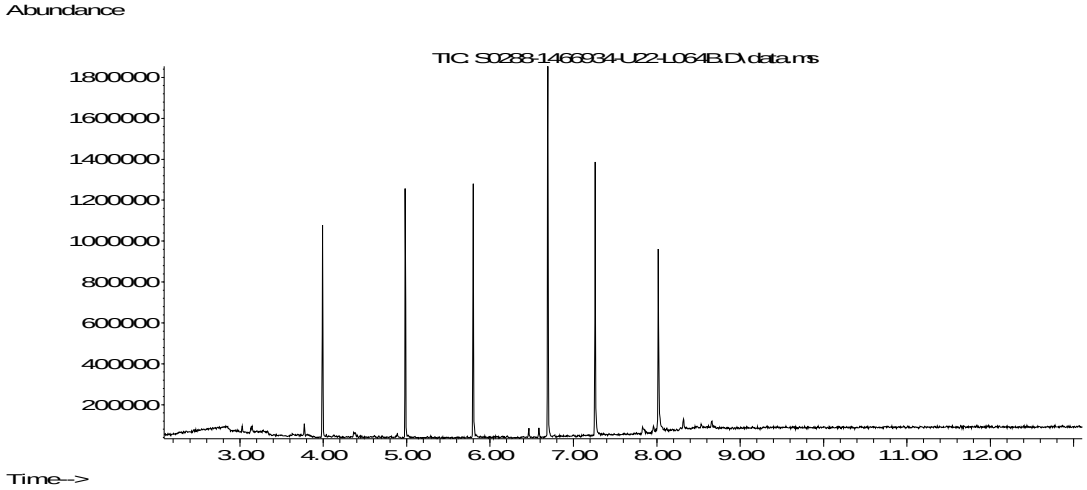
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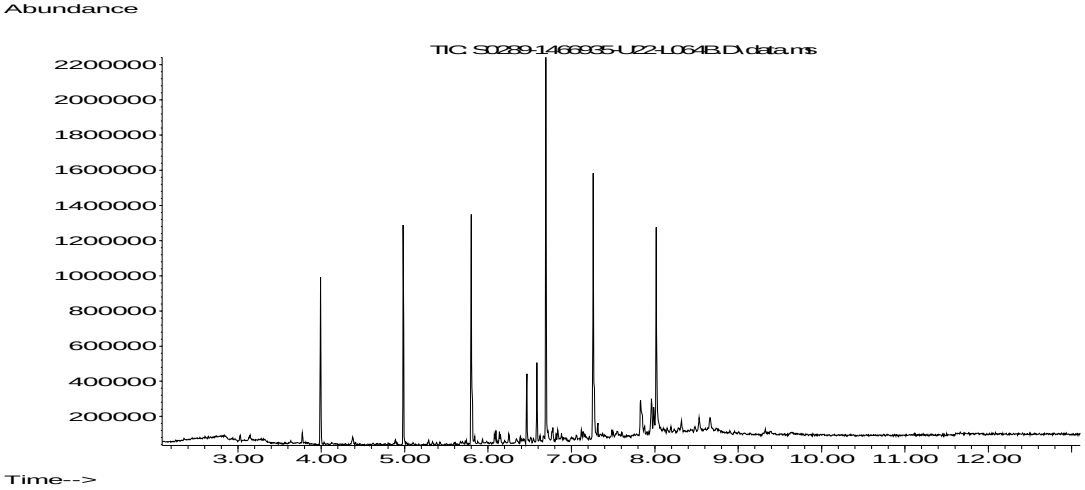
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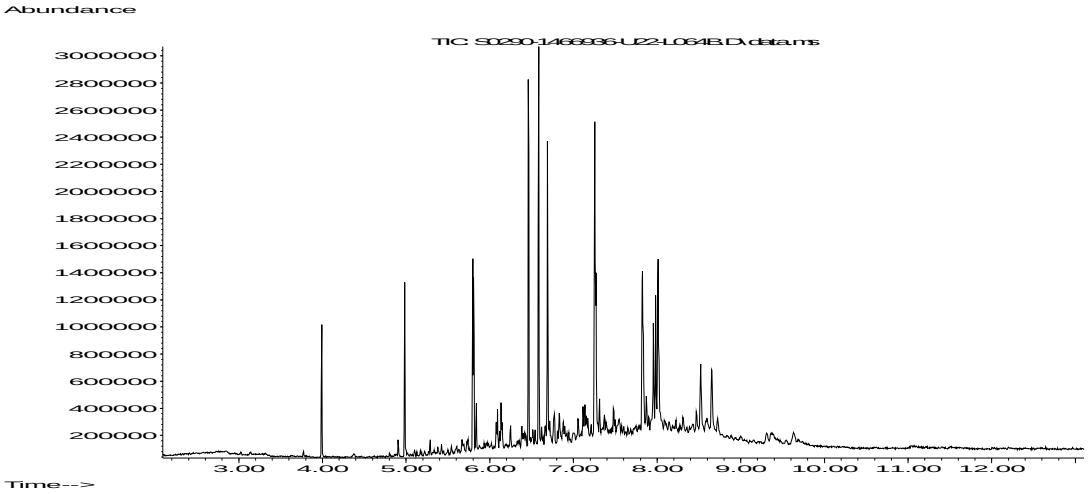
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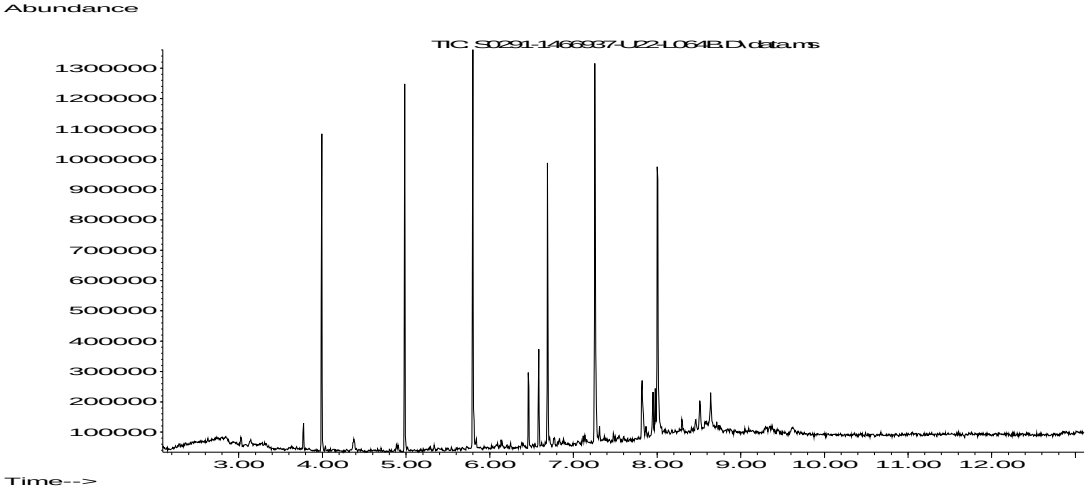
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Appendix K – Thames Water Confirmation Letter

Mr Sudeep Chongbang

Pinnacle Consulting Engineers
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

Wastewater pre-planning
Our ref **DS6074438**

04 June 2020

Pre-planning enquiry: Capacity Confirmation

Dear Sudeep,

Thank you for providing information on your development.

Site: 1 YMCA, 90 Peartree Lane, Welwyn Garden City, Hertfordshire - AL7 3UL

Existing site: Brownfield.
Proposed site: Hostel (100 beds), Flats (43 units) & day Nursery.
Proposed foul water discharge by gravity into foul sewer downstream of manhole TL24124501
Proposed surface water discharge via soakaways for catchment A (Impermeable Area-1,356m2) & for 5.0 l/s for catchment B (Impermeable Area-2,523m2) into surface sewer manhole TL24124504.

We're pleased to confirm that there will be sufficient foul water and surface water capacity in our sewerage network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

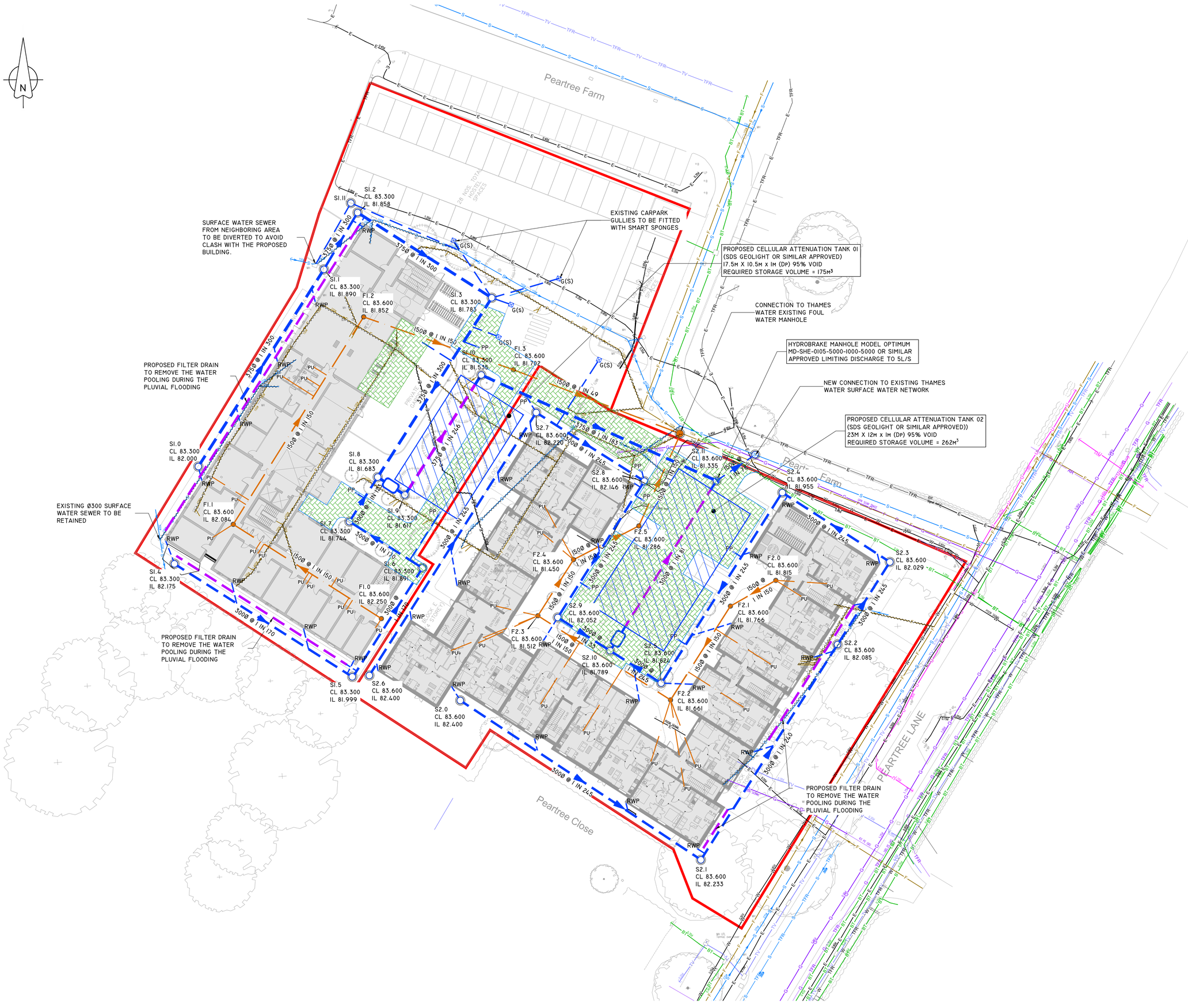
If you've any further questions, please contact me on 0800 009 3921.

Yours sincerely

Zaid Kazi

Thames Water
Developer Services – Sewer Adoptions Team

Appendix L – Proposed Alternative Drainage Strategy



GENERAL NOTES

1. DO NOT SCALE THIS DRAWING. WORK ONLY TO FIGURED DIMENSIONS.
2. FOR ALL RELEVANT NOTES, REFER TO STRUCTURAL AND CIVIL ENGINEERING PERFORMANCE SPECIFICATION.
3. ANY DISCREPANCIES ARE TO BE REPORTED TO PINNACLE CONSULTING ENGINEERS IMMEDIATELY.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ENGINEERS, ARCHITECTS AND SUB-CONTRACTORS DRAWINGS AND DETAILS.

LEGEND

- SITE BOUNDARY
- PROPOSED BUILDING
- PROPOSED SURFACE WATER
- PROPOSED FOUL WATER
- PROPOSED PERFORATED PIPE
- EXISTING SURFACE WATER
- EXISTING FOUL WATER
- EXISTING DRIANAGE SEWER TO BE ABANDONED
- PROPOSED PETROL INTERCEPTOR
- PROPOSED SURFACE WATER CELLULAR ATTENUATION TANK
- PROPOSED PERMEABLE PAVING
- G(S) PROPOSED GULLY WITH SMART SPONGE
- PU POP-UP
- RWP RAIN WATER PIPE
- PP PERMEABLE PAVING OUTLET
- E EXISTING ELECTRICAL CABLES
- W EXISTING WATER PIPES
- TV EXISTING CABLE TV
- G EXISTING GAS PIPES
- U UNIDENTIFIED EXISTING GPR OR ELECTRO LOCATION TRACE

0 50MM ON A1 DWG. 50

REV	DESCRIPTION	BY	CHK	DATE
P01	FIRST ISSUE	IL	JJ	03.12.2020

CLIENT
SAUNDERS ARCHITECTS ON BEHALF OF YMCA

PROJECT
WGC-ONE YMCA
PEARTREE LANE

DRAWING TITLE
PROPOSED ALTERNATIVE DRAINAGE STRATEGY

PINNACLE CONSULTING ENGINEERS
ALCHEMY,
BESSEMER ROAD,
WELWYN GARDEN CITY,
HERTS,
AL7 1HE. TELEPHONE: 01707 527 630
NORWICH | LONDON | DUBLIN | THE HAGUE

DRAWING STATUS			
INFORMATION			
SCALE @ A1	DATE	DRAWN BY	CHECKED
1:250	DEC '20	IL	JJ
DRG NO.			REVISION
C190906-PIN-XX-XX-DR-C-0210			P01

REF: 190906

Appendix M – Proposed Alternative Drainage Calculations

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
FEH Rainfall Version	1999
Site Location	GB 524500 212550 TL 24500 12550
C (1km)	-0.028
D1 (1km)	0.293
D2 (1km)	0.320
D3 (1km)	0.277
E (1km)	0.321
F (1km)	2.481
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	0.000
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.323	4-8	0.157

Total Area Contributing (ha) = 0.480

Total Pipe Volume (m³) = 41.737

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	40.922	0.167	245.0	0.009	4.00	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	4.68	82.400	0.009	0.0	0.0	0.0	1.00	70.7	1.2

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
1.001	36.156	0.148	245.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	13.856	0.057	245.0	0.030	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	18.151	0.074	245.0	0.011	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	32.014	0.131	245.0	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	8.576	0.035	245.0	0.056	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	44.144	0.180	245.0	0.008	4.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	18.167	0.074	245.0	0.039	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	22.890	0.093	245.0	0.017	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	8.790	0.263	33.4	0.047	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	2.522	0.010	245.0	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	25.907	0.319	81.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	33.136	0.110	300.0	0.034	4.00	0.0	0.600	o	375	Pipe/Conduit	
3.001	9.358	0.031	300.0	0.022	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.002	22.536	0.075	300.0	0.014	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.003	30.131	0.100	300.0	0.095	0.00	0.0	0.600	o	375	Pipe/Conduit	
4.000	29.876	0.176	170.0	0.025	4.00	0.0	0.600	o	300	Pipe/Conduit	
4.001	18.356	0.108	170.0	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.002	12.258	0.072	170.0	0.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.003	7.472	0.061	122.5	0.006	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.001	50.00	5.28	82.233	0.023	0.0	0.0	0.0	1.00	70.7	3.1
1.002	50.00	5.52	82.085	0.052	0.0	0.0	0.0	1.00	70.7	7.1
1.003	50.00	5.82	82.029	0.064	0.0	0.0	0.0	1.00	70.7	8.6
1.004	50.00	6.35	81.955	0.071	0.0	0.0	0.0	1.00	70.7	9.6
1.005	50.00	6.49	81.824	0.128	0.0	0.0	0.0	1.00	70.7	17.3
2.000	50.00	4.74	82.400	0.008	0.0	0.0	0.0	1.00	70.7	1.1
2.001	50.00	5.04	82.220	0.047	0.0	0.0	0.0	1.00	70.7	6.4
2.002	50.00	5.42	82.146	0.064	0.0	0.0	0.0	1.00	70.7	8.6
2.003	50.00	5.47	82.052	0.111	0.0	0.0	0.0	2.73	192.9	15.0
1.006	50.00	6.54	81.789	0.252	0.0	0.0	0.0	1.00	70.7	34.1
1.007	50.00	6.78	81.729	0.252	0.0	0.0	0.0	1.75	123.4	34.1
3.000	50.00	4.53	82.000	0.034	0.0	0.0	0.0	1.04	115.0	4.6
3.001	50.00	4.68	81.890	0.056	0.0	0.0	0.0	1.04	115.0	7.6
3.002	50.00	5.04	81.858	0.070	0.0	0.0	0.0	1.04	115.0	9.5
3.003	50.00	5.52	81.783	0.165	0.0	0.0	0.0	1.04	115.0	22.3
4.000	50.00	4.41	82.175	0.025	0.0	0.0	0.0	1.20	85.0	3.4
4.001	50.00	4.67	81.999	0.039	0.0	0.0	0.0	1.20	85.0	5.3
4.002	50.00	4.84	81.891	0.051	0.0	0.0	0.0	1.20	85.0	6.9
4.003	50.00	4.91	81.744	0.057	0.0	0.0	0.0	1.64	180.7	7.7

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
3.004	2.305	0.008	288.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.005	2.305	0.008	300.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.006	20.166	0.082	245.9	0.006	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.007	36.574	0.200	182.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	6.609	0.085	77.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.004	50.00	5.56	81.683	0.222	0.0	0.0	0.0	1.06	117.3	30.1
3.005	50.00	5.60	81.625	0.222	0.0	0.0	0.0	1.04	115.0	30.1
3.006	50.00	5.89	81.617	0.228	0.0	0.0	0.0	1.15	127.1	30.9
3.007	50.00	6.34	81.535	0.228	0.0	0.0	0.0	1.34	147.6	30.9
1.008	50.00	6.88	81.335	0.480	0.0	0.0	0.0	1.14	20.2«	65.0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.009	0.009	0.009
1.001	User	-	100	0.014	0.014	0.014
1.002	User	-	100	0.021	0.021	0.021
	User	-	100	0.009	0.009	0.030
1.003	User	-	100	0.005	0.005	0.005
	User	-	100	0.006	0.006	0.011
1.004	User	-	100	0.001	0.001	0.001
	User	-	100	0.006	0.006	0.007
1.005	User	-	100	0.022	0.022	0.022
	User	-	100	0.021	0.021	0.044
	User	-	100	0.010	0.010	0.054
	User	-	100	0.003	0.003	0.056
2.000	User	-	100	0.008	0.008	0.008
2.001	User	-	100	0.015	0.015	0.015
	User	-	100	0.001	0.001	0.016
	User	-	100	0.002	0.002	0.019
	User	-	100	0.005	0.005	0.024
	User	-	100	0.002	0.002	0.026
	User	-	100	0.013	0.013	0.039
2.002	User	-	100	0.003	0.003	0.003
	User	-	100	0.005	0.005	0.008
	User	-	100	0.006	0.006	0.014
	User	-	100	0.002	0.002	0.017
2.003	User	-	100	0.019	0.019	0.019
	User	-	100	0.023	0.023	0.041
	User	-	100	0.006	0.006	0.047
1.006	User	-	100	0.012	0.012	0.012
	User	-	100	0.002	0.002	0.013
1.007	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.034	0.034	0.034
3.001	-	-	100	0.022	0.022	0.022
3.002	-	-	100	0.014	0.014	0.014
3.003	-	-	100	0.095	0.095	0.095
4.000	-	-	100	0.025	0.025	0.025
4.001	-	-	100	0.014	0.014	0.014
4.002	-	-	100	0.012	0.012	0.012
4.003	-	-	100	0.006	0.006	0.006
3.004	-	-	100	0.000	0.000	0.000
3.005	-	-	100	0.000	0.000	0.000
3.006	-	-	100	0.006	0.006	0.006
3.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.480	0.480	0.480

Network Classifications for Storm

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	S2.0	300	0.900	1.067	Unclassified	1200	0	0.900	Unclassified
1.001	S2.1	300	1.067	1.215	Unclassified	1200	0	1.067	Unclassified
1.002	S2.2	300	1.215	1.271	Unclassified	1200	0	1.215	Unclassified
1.003	S2.3	300	1.271	1.345	Unclassified	1200	0	1.271	Unclassified
1.004	S2.4	300	1.345	1.476	Unclassified	1200	0	1.345	Unclassified
1.005	S2.5	300	1.476	1.511	Unclassified	1200	0	1.476	Unclassified
2.000	S2.6	300	0.900	1.080	Unclassified	1200	0	0.900	Unclassified
2.001	S2.7	300	1.080	1.154	Unclassified	1200	0	1.080	Unclassified
2.002	S2.8	300	1.154	1.248	Unclassified	1200	0	1.154	Unclassified
2.003	S2.9	300	1.248	1.511	Unclassified	1200	0	1.248	Unclassified
1.006	S2.10	300	1.511	1.521	Unclassified	1200	0	1.511	Unclassified
1.007	P2	300	1.571	1.890	Unclassified	1200	0	1.571	Unclassified
3.000	S1.0	375	0.925	1.035	Unclassified	1350	0	0.925	Unclassified
3.001	S1.1	375	1.035	1.067	Unclassified	1350	0	1.035	Unclassified
3.002	S1.2	375	1.067	1.142	Unclassified	1350	0	1.067	Unclassified
3.003	S1.3	375	1.142	1.242	Unclassified	1350	0	1.142	Unclassified
4.000	S1.4	300	0.825	1.001	Unclassified	1200	0	0.825	Unclassified
4.001	S1.5	300	1.001	1.109	Unclassified	1200	0	1.001	Unclassified
4.002	S1.6	300	1.109	1.181	Unclassified	1200	0	1.109	Unclassified
4.003	S1.7	375	1.181	1.242	Unclassified	1350	0	1.181	Unclassified
3.004	S1.8	375	1.242	1.250	Unclassified	1350	0	1.242	Unclassified
3.005	P1	375	1.300	1.308	Unclassified	1350	0	1.300	Unclassified
3.006	S1.9	375	1.308	1.390	Unclassified	1350	0	1.308	Unclassified
3.007	S1.10	375	1.390	1.890	Unclassified	1350	0	1.390	Unclassified
1.008	S2.11	150	2.115	2.200	Unclassified	1350	0	2.115	Unclassified

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)
1.008	TW SW	83.600	81.250	81.250	1200	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 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	Site Location GB 524500 212550 TL 24500 12550	
Return Period (years)	2	C (1km)	-0.028
FEH Rainfall Version	1999	D1 (1km)	0.293

Synthetic Rainfall Details

D2 (1km)	0.320	Winter Storms	Yes
D3 (1km)	0.277	Cv (Summer)	0.750
E (1km)	0.321	Cv (Winter)	0.840
F (1km)	2.481	Storm Duration (mins)	30
Summer Storms	Yes		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S2.11, DS/PN: 1.008, Volume (m³): 8.9

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	81.335
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0	Kick-Flo®	0.637	4.1
Flush-Flo™	0.296	5.0	Mean Flow over Head Range	-	4.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	0.800	4.5	2.000	6.9	4.000	9.6	7.000	12.5
0.200	4.8	1.000	5.0	2.200	7.2	4.500	10.1	7.500	12.9
0.300	5.0	1.200	5.4	2.400	7.5	5.000	10.6	8.000	13.3
0.400	4.9	1.400	5.8	2.600	7.8	5.500	11.1	8.500	13.7
0.500	4.7	1.600	6.2	3.000	8.4	6.000	11.6	9.000	14.1
0.600	4.3	1.800	6.6	3.500	9.0	6.500	12.1	9.500	14.5

Storage Structures for Storm

Cellular Storage Manhole: S1.10, DS/PN: 3.007

Invert Level (m) 81.535 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	183.8	183.8	1.000	183.8	183.8	1.001	0.0	183.8

Cellular Storage Manhole: S2.11, DS/PN: 1.008

Invert Level (m) 81.335 Safety Factor 5.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	276.0	276.0	1.000	276.0	276.0	1.001	0.0	276.0

1 year Return Period 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 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.277
FEH Rainfall Version	1999	E (1km)	0.321
Site Location	GB 524500 212550 TL 24500 12550	F (1km)	2.481
C (1km)	-0.028	Cv (Summer)	0.750
D1 (1km)	0.293	Cv (Winter)	0.840
D2 (1km)	0.320		

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 1, 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	S2.0	15 Winter	1	+0%	100/15 Summer				82.428	-0.272	0.000
1.001	S2.1	15 Winter	1	+0%	100/15 Summer				82.274	-0.259	0.000
1.002	S2.2	15 Winter	1	+0%	30/15 Winter				82.151	-0.234	0.000
1.003	S2.3	15 Winter	1	+0%	30/15 Summer				82.099	-0.229	0.000
1.004	S2.4	15 Winter	1	+0%	30/15 Summer				82.027	-0.228	0.000
1.005	S2.5	15 Winter	1	+0%	30/15 Summer				81.959	-0.165	0.000
2.000	S2.6	15 Winter	1	+0%	100/15 Summer				82.428	-0.272	0.000
2.001	S2.7	15 Winter	1	+0%	100/15 Summer				82.282	-0.237	0.000
2.002	S2.8	15 Winter	1	+0%	100/15 Summer				82.216	-0.230	0.000
2.003	S2.9	15 Winter	1	+0%	100/15 Summer				82.117	-0.236	0.000
1.006	S2.10	15 Winter	1	+0%	30/15 Summer				81.947	-0.142	0.000
1.007	P2	15 Winter	1	+0%	100/15 Summer				81.832	-0.197	0.000
3.000	S1.0	15 Winter	1	+0%	100/15 Summer				82.054	-0.321	0.000
3.001	S1.1	15 Winter	1	+0%	100/15 Summer				81.969	-0.295	0.000
3.002	S1.2	15 Winter	1	+0%	100/15 Summer				81.944	-0.289	0.000
3.003	S1.3	15 Winter	1	+0%	100/15 Summer				81.898	-0.260	0.000
4.000	S1.4	15 Winter	1	+0%	100/15 Summer				82.218	-0.257	0.000
4.001	S1.5	15 Winter	1	+0%	100/15 Summer				82.053	-0.246	0.000
4.002	S1.6	15 Winter	1	+0%	100/15 Summer				81.955	-0.236	0.000
4.003	S1.7	15 Winter	1	+0%	100/15 Summer				81.832	-0.287	0.000
3.004	S1.8	15 Winter	1	+0%	100/15 Summer				81.826	-0.232	0.000
3.005	P1	15 Winter	1	+0%	100/15 Summer				81.769	-0.231	0.000
3.006	S1.9	15 Winter	1	+0%	100/15 Summer				81.746	-0.246	0.000
3.007	S1.10	30 Winter	1	+0%	100/30 Winter				81.600	-0.311	0.000

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

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2.0	0.02		1.2	OK	
1.001	S2.1	0.04		2.9	OK	
1.002	S2.2	0.11		6.4	OK	
1.003	S2.3	0.13		7.6	OK	
1.004	S2.4	0.13		8.3	OK	
1.005	S2.5	0.27		14.3	OK	
2.000	S2.6	0.02		1.2	OK	
2.001	S2.7	0.10		5.9	OK	
2.002	S2.8	0.12		7.7	OK	
2.003	S2.9	0.10		13.2	OK	
1.006	S2.10	0.54		28.3	OK	
1.007	P2	0.26		28.3	OK	
3.000	S1.0	0.05		5.1	OK	
3.001	S1.1	0.09		7.7	OK	
3.002	S1.2	0.09		9.2	OK	
3.003	S1.3	0.19		19.8	OK	
4.000	S1.4	0.05		3.8	OK	
4.001	S1.5	0.07		5.4	OK	
4.002	S1.6	0.10		6.9	OK	
4.003	S1.7	0.07		7.5	OK	
3.004	S1.8	0.31		26.7	OK	
3.005	P1	0.31		26.7	OK	
3.006	S1.9	0.26		27.5	OK	
3.007	S1.10	0.07		9.2	OK	

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

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 (m^3)
1.008	S2.11	240 Winter	1	+0%	30/15 Summer				81.479	-0.006	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.008	S2.11	0.27		4.6	OK	

30 year Return Period 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 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.277
FEH Rainfall Version	1999	E (1km)	0.321
Site Location	GB 524500 212550 TL 24500 12550	F (1km)	2.481
C (1km)	-0.028	Cv (Summer)	0.750
D1 (1km)	0.293	Cv (Winter)	0.840
D2 (1km)	0.320		

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 1, 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	S2.0	15 Winter	30	+0%	100/15 Summer				82.451	-0.249	0.000
1.001	S2.1	15 Winter	30	+0%	100/15 Summer				82.397	-0.136	0.000
1.002	S2.2	15 Winter	30	+0%	30/15 Winter				82.388	0.002	0.000
1.003	S2.3	15 Winter	30	+0%	30/15 Summer				82.358	0.029	0.000
1.004	S2.4	15 Winter	30	+0%	30/15 Summer				82.339	0.085	0.000
1.005	S2.5	15 Winter	30	+0%	30/15 Summer				82.288	0.164	0.000
2.000	S2.6	15 Winter	30	+0%	100/15 Summer				82.450	-0.250	0.000
2.001	S2.7	15 Winter	30	+0%	100/15 Summer				82.357	-0.163	0.000
2.002	S2.8	15 Winter	30	+0%	100/15 Summer				82.325	-0.120	0.000
2.003	S2.9	15 Winter	30	+0%	100/15 Summer				82.296	-0.056	0.000
1.006	S2.10	15 Winter	30	+0%	30/15 Summer				82.209	0.120	0.000
1.007	P2	15 Winter	30	+0%	100/15 Summer				81.942	-0.087	0.000
3.000	S1.0	15 Winter	30	+0%	100/15 Summer				82.138	-0.237	0.000
3.001	S1.1	15 Winter	30	+0%	100/15 Summer				82.122	-0.142	0.000
3.002	S1.2	15 Winter	30	+0%	100/15 Summer				82.112	-0.122	0.000
3.003	S1.3	15 Winter	30	+0%	100/15 Summer				82.079	-0.079	0.000
4.000	S1.4	15 Winter	30	+0%	100/15 Summer				82.257	-0.218	0.000
4.001	S1.5	15 Winter	30	+0%	100/15 Summer				82.107	-0.192	0.000
4.002	S1.6	15 Winter	30	+0%	100/15 Summer				82.066	-0.125	0.000
4.003	S1.7	15 Winter	30	+0%	100/15 Summer				82.048	-0.071	0.000
3.004	S1.8	15 Winter	30	+0%	100/15 Summer				82.027	-0.030	0.000
3.005	P1	15 Summer	30	+0%	100/15 Summer				81.927	-0.073	0.000
3.006	S1.9	15 Winter	30	+0%	100/15 Summer				81.879	-0.114	0.000
3.007	S1.10	180 Winter	30	+0%	100/30 Winter				81.727	-0.183	0.000

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2.0	0.06		4.3	OK	
1.001	S2.1	0.14		9.3	OK	
1.002	S2.2	0.30		17.6	SURCHARGED	
1.003	S2.3	0.35		21.3	SURCHARGED	
1.004	S2.4	0.39		24.9	SURCHARGED	
1.005	S2.5	0.78		41.9	SURCHARGED	
2.000	S2.6	0.06		4.2	OK	
2.001	S2.7	0.38		23.0	OK	
2.002	S2.8	0.47		29.2	OK	
2.003	S2.9	0.37		47.1	OK	
1.006	S2.10	1.78		93.6	SURCHARGED	
1.007	P2	0.85		93.5	OK	
3.000	S1.0	0.17		17.0	OK	
3.001	S1.1	0.27		22.5	OK	
3.002	S1.2	0.29		28.6	OK	
3.003	S1.3	0.67		68.1	OK	
4.000	S1.4	0.17		12.9	OK	
4.001	S1.5	0.27		19.7	OK	
4.002	S1.6	0.36		24.0	OK	
4.003	S1.7	0.23		24.4	OK	
3.004	S1.8	1.00		85.9	OK	
3.005	P1	1.00		85.9	OK	
3.006	S1.9	0.82		88.0	OK	
3.007	S1.10	0.12		15.9	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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 (m^3)
1.008	S2.11	180 Winter	30	+0%	30/15 Summer				81.726	0.241	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.008	S2.11	0.29		5.0	SURCHARGED	

100 year Return Period 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 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.277
FEH Rainfall Version	1999	E (1km)	0.321
Site Location	GB 524500 212550 TL 24500 12550	F (1km)	2.481
C (1km)	-0.028	Cv (Summer)	0.750
D1 (1km)	0.293	Cv (Winter)	0.840
D2 (1km)	0.320		

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 1, 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	S2.0	15 Winter	100	+40%	100/15 Summer				83.479	0.779	0.000
1.001	S2.1	15 Winter	100	+40%	100/15 Summer				83.473	0.940	0.000
1.002	S2.2	15 Winter	100	+40%	30/15 Winter				83.456	1.071	0.000
1.003	S2.3	15 Winter	100	+40%	30/15 Summer				83.387	1.058	0.000
1.004	S2.4	15 Winter	100	+40%	30/15 Summer				83.310	1.055	0.000
1.005	S2.5	15 Winter	100	+40%	30/15 Summer				83.228	1.104	0.000
2.000	S2.6	15 Winter	100	+40%	100/15 Summer				83.429	0.729	0.000
2.001	S2.7	15 Winter	100	+40%	100/15 Summer				83.421	0.901	0.000
2.002	S2.8	15 Winter	100	+40%	100/15 Summer				83.347	0.902	0.000
2.003	S2.9	15 Winter	100	+40%	100/15 Summer				83.269	0.916	0.000
1.006	S2.10	15 Winter	100	+40%	30/15 Summer				83.104	1.015	0.000
1.007	P2	15 Winter	100	+40%	100/15 Summer				82.559	0.530	0.000
3.000	S1.0	15 Winter	100	+40%	100/15 Summer				82.918	0.543	0.000
3.001	S1.1	15 Winter	100	+40%	100/15 Summer				82.894	0.630	0.000
3.002	S1.2	15 Winter	100	+40%	100/15 Summer				82.876	0.642	0.000
3.003	S1.3	15 Winter	100	+40%	100/15 Summer				82.792	0.634	0.000
4.000	S1.4	15 Winter	100	+40%	100/15 Summer				82.898	0.423	0.000
4.001	S1.5	15 Winter	100	+40%	100/15 Summer				82.871	0.572	0.000
4.002	S1.6	15 Winter	100	+40%	100/15 Summer				82.776	0.585	0.000
4.003	S1.7	15 Winter	100	+40%	100/15 Summer				82.683	0.563	0.000
3.004	S1.8	15 Winter	100	+40%	100/15 Summer				82.588	0.530	0.000
3.005	P1	15 Winter	100	+40%	100/15 Summer				82.361	0.361	0.000
3.006	S1.9	15 Winter	100	+40%	100/15 Summer				82.140	0.148	0.000
3.007	S1.10	240 Winter	100	+40%	100/30 Winter				82.085	0.175	0.000

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S2.0	0.12		7.8	FLOOD RISK	
1.001	S2.1	0.28		18.4	FLOOD RISK	
1.002	S2.2	0.60		35.1	FLOOD RISK	
1.003	S2.3	0.73		44.5	FLOOD RISK	
1.004	S2.4	0.81		52.0	FLOOD RISK	
1.005	S2.5	1.58		84.6	SURCHARGED	
2.000	S2.6	0.11		7.5	FLOOD RISK	
2.001	S2.7	0.59		35.7	FLOOD RISK	
2.002	S2.8	0.76		47.5	FLOOD RISK	
2.003	S2.9	0.69		88.0	SURCHARGED	
1.006	S2.10	3.43		180.1	SURCHARGED	
1.007	P2	1.64		180.9	SURCHARGED	
3.000	S1.0	0.30		30.4	SURCHARGED	
3.001	S1.1	0.58		48.4	SURCHARGED	
3.002	S1.2	0.60		58.7	SURCHARGED	
3.003	S1.3	1.42		144.7	SURCHARGED	
4.000	S1.4	0.32		24.9	SURCHARGED	
4.001	S1.5	0.40		29.5	SURCHARGED	
4.002	S1.6	0.58		38.7	SURCHARGED	
4.003	S1.7	0.41		43.6	SURCHARGED	
3.004	S1.8	2.12		182.4	SURCHARGED	
3.005	P1	2.13		183.0	SURCHARGED	
3.006	S1.9	1.73		185.2	SURCHARGED	
3.007	S1.10	0.11		14.1	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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 (m^3)
1.008	S2.11	240 Winter	100	+40%	30/15 Summer				82.084	0.599	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.008	S2.11	0.29		5.0	SURCHARGED	

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