ENGINEERING SERVICES REPORT ST. PAULS COLLEGE RESIDENTIAL DEVELOPMENT, SYBIL HILL ROAD,

FOR

Crekav Trading GP Limited

PROJECT NO. N251

OCTOBER 2019

OCSC
O'CONNOR | SUTTON | CRONIN
Multidisciplinary Consulting Engineers

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1.0 INTRODUCTION

1.1 Appointment

O'Connor Sutton Cronin (OCSC) has been instructed to prepare an Engineering Services Report for the proposed development. The proposed development consists of a residential development of 657 apartment units.

The planning applications will also include proposals to address access, roads and drainage infrastructure and water supply for the site.

1.2 Administrative Jurisdiction

The site is located within the administrative jurisdiction of Dublin City Council whose offices are located at Wood Quay, Dublin City.

1.3 Site Location

The site is located at St Paul's College, Sybil Hill Road, Dublin 5. The site is bordered by the Vincentian Community Residence to the West. St Anne's Park to the North, South and East which is owned and managed by Dublin City Council. The Naniken Stream is located approx. 100m north of the site within St Anne's Park. The exact site location is highlighted in **Figure 1** following.

Figure 1: Site Location

The terms Naniken River and Naniken Stream are interchangeable and for the purpose of this planning application and all supporting reports and documentation both names refer to the same waterbody.

1.4 Site Overview

The site is zoned Z15 "To provide for institutional, educational, recreational, community, green infrastructure & health use" in the current Dublin City Development plan 2016-2022. The total development area is approximately 6.4 hectares (15.8 acres). The extent of redline works for the development is 6.7ha.

1.5 Development Description

The development will consist of the construction of a residential development set out in 9 no. blocks, ranging in height from 5 to 9 storeys accommodating 657 no. apartments, residential tenant amenity and a crèche. At basement level the site will accommodate car parking spaces, bicycle parking, storage, services and plant areas. Landscaping will include extensive communal amenity areas, and a proposed significant area of public open space. The proposed development also includes for the widening and realignment of an existing vehicular access onto Sybil Hill Road and the demolition of an existing pre-fab building to facilitate the construction of an access road with from Sybil Hill Road between Sybil Hill House (a Protected Structure) and St Paul's College incorporating upgraded accesses to Sybil Hill House and St Paul's College and a proposed pedestrian crossing on Sybil Hill Road. The proposed development also includes for the laying of a foul water sewer in Sybil Hill Road and the routing of surface water discharge from the site via St Anne's Park to the Naniken River and the demolition and reconstruction of existing pedestrian stream crossing in St Anne's Park with integral surface water discharge to Naniken River.

2.0 SCOPE OF SERVICES REPORT

This report was prepared by reviewing available data from Local Authority records and national bodies, i.e. Dublin City Council, Irish Water and the wider Design Team.

This report provides information on the calculations, estimates and assumptions used to design the surface water sewers, surface water attenuation and SuDs systems, foul water sewers, watermains and road access for the proposed development.

All design and calculations will be in accordance with;

- Local Authority Requirements;
- BS EN 752 – Drainage Outside Buildings;
- The Building Regulations – Technical Guidance Document Part ‘H’;
- The Building Regulations – Technical Guidance Document Part ‘M’;
- Recommendations for Site Development works for Housing Areas, Dept. of Environment, 1998;
- Design Manual for Urban Roads and Streets (DMURS);
- Traffic Signs Manual;
- DETR Guidance on the use of Tactile Paving Surfaces;
- Greater Dublin Strategic Drainage Study (GDSDS);
- BS EN 12056-2:2000 Gravity drainage systems inside buildings;
- The SuDs Manual (Ciria C753);
- Irish Water Code of Practice for Water Infrastructure;
- Irish Water Code of Practice for Wastewater Infrastructure;

Other aspects of the site development strategy relating to architectural design, landscaping, ecology, conservation, visual quality and planning compliance are covered by other members of the design team.

3.0 STORM WATER DRAINAGE

3.1 Overview

Any planning permission sought on the subject lands will be required to adhere to the Local Authority requirements and the Greater Dublin Strategic Drainage Study (Dublin City Council, 2005). The site has a hardstanding area of 2.825ha which is to be drained to the new proposed surface water system. Storm flows will be attenuated and restricted to a specified and agreed discharge.

All proposed developments must ensure that a sustainable urban drainage system (SUDS) is incorporated into the development. SuDs requires that post development run-off rates be maintained at the equivalent to, or lower than, the pre-development run-off levels. Thus, the development must be able to retain, within its boundaries, storm water volumes from extreme storm events up to and including a design for a 1 in 100 year storm event, more commonly expressed as a 1.0% AEP (Annual Exceedance Probability), while also allowing for climate change factors (+CC).

Any new development must have physical capacity to retain storm water volumes as directed under the Greater Dublin Strategic Drainage Study and, if necessary, release this attenuated surface water runoff before it enters a natural watercourse or into a public sewer, which ultimately discharges to a water body. This is to ensure the highest possible standard of storm water quality.

The overall approach to storm drainage design taken by OCSC is as outlined below. OCSC have used MicroDrainage (by Innovyze) to produce a detailed design model of the catchments and network from the ground/roof areas to the outfall from the site, with the design rainfall events simulated to determine the required storage volumes. The GDSDS recommends use of a detailed hydraulic model to demonstrate that the performance criteria (as established in GDSDS) are achieved. As set out in Section 6.6 Attenuation Storage Design in the GDSDS. The method for finding the storm water attenuation volume is:

- Find the greenfield peak runoff rate for the site;
- Apply this rate as a throttle to the model of the development and run it with a range of duration events for design return periods in accordance with the design criteria.

3.2 Site Catchments

The MicroDrainage outputs have been created using storm water modelling software developed by Innovyze. All of the catchment areas will be drawn in MicroDrainage and calculated by the software.

The Surface Water Drainage has been broken up into sub catchments. The below shows the catchment delineated areas. A summary of the Catchment Areas can be found below with the further sub catchments and the corresponding pipe and input areas.

Catchment No.	Area (ha)
Green Roofs	0.700
Podium	1.640
Hardstanding (roads, footpaths, roofs etc.)	0.485
Total	2.825

Table 1 – *Summary of Proposed Surface Water Catchments*

3.3 Storage

Overall site storage requirements have been estimated using the Wallingford IH124 Method attached in ***Appendix B***. The MicroDrainage software Source Control has been utilised as the volume estimation tool is used as a baseline for storage. The Greenfield Run-off Rate is calculated to IH124 in accordance with GDSDS using the Source Control tool within MicroDrainage and the discharge rate is then input into the volume estimation tool.

An integrated drainage model is then developed to verify storage requirements for the site using MicroDrainage provided by Innovyze. The estimation tool is used to gauge the initial storage size for the model and adjustments are made to meet the requirements of the GDSDS. The calculations and output report in ***Appendix B*** has been produced using the Source Control storage volume estimation tool. Please see below a summary of the estimated required and proposed volumes in accordance with GDSDS requirements. It is noted that the storm water network, including manholes, is designed according to the GDSDS and the Greater Dublin Region Code of Practice. The wastewater network, including manholes, are designed according to the Irish Water Code of Practice Wastewater (IW-CDS-5030-03).

Storage	**Required** (m^3)	**Provided** (m^3)
5mm Interception (Green Roofs, landscaping, permeable paving)	141.25	141.25
Attenuation (StormTech Tank & Basin)	1,706.0	1,707.1
Treatment (Open Graded Crushed Rock Sub Base / Filter drains)	26.69	61.9
Total (excluding Treatment)	1,847.25	1,910.25

Table 3 – *Summary of Storage requirements from GDSDS guidance and of provided storage volumes.*

Please note where initial runoff from at least 5mm of rainfall cannot be intercepted, treatment of runoff (treatment volume) is required.

The location of the elements of interception, storage, conveyance and flow control for each are shown on OCSC Drawing No. Drg. No's ***N251-H01 & H02***.

4.0 SPECIFIC SUDS MEASURES PROPOSED

As the existing site is largely soft landscaping, SuDs proposals will be provided to mimic the existing runoff from the site. All SuDs measures will be provided in accordance with the Greater Dublin Strategic Drainage Study Regional Drainage Policy Volume 2 - New Development (GDSDS-RDP Volume 2). Specific design requirements for SuDs systems are established by the Construction Industry Research and Information Association's publication CIRIA C753-SuDs Manual. SuDs systems will deliver the following design criteria;

- Water Quantity
  - Peak runoff rate;
  - Runoff Volume – Interception / Large Events;
- Water Quality;
- Amenity;
- Biodiversity.

Infiltration to ground for surface water runoff will be facilitated underneath SuDs systems. Systems that collect and store runoff allowing it to infiltrate into ground will improve water quality, reduce runoff volumes and discharge rates for small (Interception) and large events.

Soakaway tests have been completed to confirm infiltration below attenuation in accordance with the BRE Digest 365. The results are included in the Site

Investigations Report in **Appendix F**. The water level dropped too slowly to allow calculation of the soil infiltration rate and therefore infiltration has not been input into the Micro Drainage model. The design for the development therefore assumes that Infiltration will not be provided below attenuation areas.

If infiltration is poor across the site, SuDs features will still provide a level of storage, time delay and treatment as surface water flows through the stone medium. The interface between the storage facility and the underlying soil will not be sealed to maximise the environmental benefits of the design but will be designed with overflows to ensure against a level of service failure.

Please note that the GDSDS requires that the 1st 5mm of rainfall is intercepted (Appendix E 2.1.1). The storm water design for this scheme achieves through interception below the attenuation tank and in the permeable paving areas.

Green roofs will provide treatment to rainwater and reduced runoff rates. The removal of pollutants or sediments, ecological value and a reduction of surface water runoff will be provided. The green roofs for this development will typically comprise of a 200mm buildup (100mm substrate & 100mm storage layer), underneath a layer of sedum moss (or similar);

Trees / planting within the soil filled tree pits / intensive podium gardens will collect, store and treat runoff for small events (Interception) while providing amenity and biodiversity;

Permeable Paving will provide a first level of treatment and temporarily store surface water runoff from pedestrian paths and surface parking spaces before infiltration and controlled release via filter drain pipes to downstream drainage network and storage;

Attenuation Storage will be provided to ensure that there is adequate attenuation storage for limited discharge surface water volumes. Attenuation will be provided with a buried Stormtech attenuation tank for the 3% AEP Storm Event(1 in 30) and a basin above the tank for the reaming storage volume to cater for the 1% AEP Storm Event (1 in 100). A 500mm freeboard from the lowest FFL to the top water level of the attenuation storage will be provided;

Open storage attenuation will be provided shallow depression storage in the lower north east landscaped corner of the site. The maximum design storage depth will be set at 250mm Depth with a freeboard of 150mm for a 1% AEP + 20% Climate

Change (CC). The open space will be graded with gently slopes and useable space. Storage will generally be dry and only come into effect during event greater than 3% AEP (1in30) storm events which are rare.

Limiting discharges to ensure that discharge rates are maintained below the greenfield runoff rate of 2.0l/s/ha. A discharge rate of **9.6l/s** has been specified for the residential development;

Catch Pits will remove sediments and silts upstream and downstream of all SuDs systems;

A Full Retention Interceptor will be provided for the treatment of all surface water runoff before it is discharged from site. The oil separator will separate oil and silts in accordance with EN858-1 and PPG3 from surface water. The interceptor is fitted with the oil probe for monitoring the interceptor for presence of hydrocarbons;

In summary, the above SuDs systems will deliver interception, primary treatment, secondary treatment and tertiary treatment in accordance with CIRIA C753-SuDs Manual. It is noted that the variety and volume of SuDs measures incorporated within the storm drainage plan for this development significantly exceed the minimum requirements of the GDSDS.

4.1 Layout

The proposed drainage layout and attenuation arrangements are shown on OCSC Drg. No's ***N251-H01 & H02***.

The proposed main drainage network will consist of a new sewer system designed in accordance with BS EN 752. The drainage network will have pipes with the diameter of 225mm to375mm. All pipes to be taken in charge, will be designed to be compliant with the requirements of the Greater Dublin Regional Code of Practice for Drainage Works and full bore self-cleansing velocities of 1.0m/s. The proposed network has been designed for an increase in surface water flows from potential future development on site.

There is an existing surface water connection to the existing public surface water network for the existing buildings adjacent the site, however, it is proposed to provide a new surface water network connection for the development. The proposed discharge point is located approximately 100m from the northeast boundary.

It is proposed to discharge all surface water to the Naniken Stream and not to the public sewer network as requested by DCC Drainage Division Due to flooding issues downstream of the existing surface water network on Sybil Hill Road. There is flooding issues in the existing public surface water network downstream of the proposed site as shown in the GDSDS 2031 system performance model. All surface water from the proposed development will discharge to the Naniken Stream and not to the public sewer network as directed by Dublin City Council.

As per drawing ***N251-H02***, proposed drainage layout, all impermeable hardstanding areas will be treated via SuDs features before discharging the site via a stormtech attenuation tank / basin and a full retention interceptor. – green roof, podium landscaping / tree pits, permeable paving with and filter drains with infiltration below. Gullies have been provided at the low points at the end of roads to take any runoff direct to the attenuation tanks during an exceedance event. Surface water from apartment block roofs and podium areas will pass through by green roofs, planters / raingardens before discharging the site via stormtech attenuation tank / basin and a full retention interceptor. The main spine access road will discharge to gullies which will discharge the site via stormtech attenuation tank and through a full retention interceptor.

Ground water was monitored in boreholes for seven days in October 2015 and for three days in February 2018. These readings have been reviewed by a Hydrogeologist to give advice on likely long-term term water table level. The advice of the hydro-geologist is that the groundwater is between +24.100m to +19.020m. The opinion of the hydrogeologist is that this is most likely indicative of water seeping through the made ground and across the top of the boulder clay. This is however only a likelihood in the opinion of the Hydrogeologist.

Please find attached a Preliminary Hydrogeological Assessment of the ground water levels completed by OCSC Environmental Division in **Appendix F**.

The base level of the proposed attenuation tank is at +19.032m. As this is within the zone of possible influence of the water-table the tank will be wrapped in an impermeable membrane to prevent ingress of water into the proposed storage.

The boreholes adjacent to the tank have an existing water levels of 1.3m and 1.7m below the existing ground level (See BH01 and BH 02 from the 2018 GII report contained in Appendix A & B of the Preliminary Hydrogeological Assessment). For the purpose of uplift it is assumed that the water level is 1.0m below the ground level. The flotation calculation has shown that the overburden and weight of the stone in the tank are sufficient to resist the uplift force. See the below table which summarises the forces acting on the tank:

FORCES	KN/m²
Upward Force - High Water Table	19.72
Downward Force from column - To pin chamber foot	47.28
Downward Force under chamber - To pin liner	11.77
Downward Force under chamber - To pin liner - with geogrid	59.06

4.2 Consultation

Extensive engagement has taken place with DCC during a previous SHD application process and prior to this new SHD submission.

<u>SHD - PAC 0007/19</u>

OCSC contacted Maria Treacy and Daniel Lowe (DCC Drainage) in February 2019 via email. For the last application at the request of DCC Drainage, O'Connor Sutton Cronin made contact with various DCC departments including: DCC Pollution Control, DCC Regional Projects & Flood Advisory Section and DCC Parks Department to discuss the discharge requirements to the Naniken Stream. During the application process DCC Drainage confirmed that DCC Drainage is the point of contact for correspondence with DCC Flood and DCC Pollution Control.

OCSC met with Dublin City Council (DCC) Engineering Departments in numerous pre-planning meetings in 2015-2017 to discuss the engineering requirements for the project. O'Connor Sutton Cronin met with John Stack (DCC Pollution Control) in July 2017 and met with Kieran O'Neill (DCC Parks Department) in December 2017 to discuss the proposed outfall to the Naniken Stream through DCC lands. Please find attached a record of both meetings included in **Appendix A**. The correspondence included in Appendix A is set out in chronological order with relevant emails between OCSC and DCC since the inception of the project beginning with the most recent correspondence. Further correspondence has been held with Kieran O'Neill in August 2109 and the outfall details amended at DCC Parks Department request to omit the perforated pipe and storage along the outfall pipe route in St Anne's' Park. DCC Pollution control have noted concerns with the proposed maximum allowable discharge rate and pollution risks to the receiving Naniken Stream.

It is proposed to provide a hydrobrake on the last private surface water manhole to restrict the flow to the greenfield runoff rate of 9.6l/s for a 1% AEP (1 in 100) storm event before it leaves the site. All SuDs structures are outside of podium and with the exception of the tank are designed to allow surface water be retained and flow through them and infiltrate to ground. Discharge rates to the Naniken will on average, be below this discharge level.

DCC Pollution Control noted concerns in particular regarding potential scour of the Naniken Stream bed at the discharge point. The velocity rates for the outfall pipe have been assessed and are provided in **Appendix B**. The maximum velocity for the outfall pipe for a 1% AEP (1 in 100) storm event has been estimated at 0.93m/s using Mirco Drainage, velocities will be on average below this figure. There will be no scouring of the river channel or river banks as inflow velocities are estimated below 0.5m/s (or 1.5m/s for the 1% AEP or 1 in 100 year rainfall event) in accordance with the CIRA SuDs Handbook (C753) and scour protection measures provided in the construction of the new outfall underneath the new bridge. The bridge design is subject to agreement with the Office of Public Works (OPW). 'Consent is required to carry out construction/alteration works on bridges and culverts as per Section 50: Arterial Drainage Act and EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010)'.

It should be also noted that the maximum flow rate and velocities for the Naniken Stream will be in excess of the rates from the development. The existing Naniken flow rate and velocities are included in **Appendix B**.

A comparison study of the discharge rates for the provision of SuDs versus no SuDs has been provided in **Appendix B**. There is potential for improvement on the attached proposed discharge figures.

OCSC have assessed the site as low risk for surface water pollution in accordance with the CIRA SuDs guide. The surface water risks have been noted for the development and the proposed SuDs mitigation measures and the merits discussed. This SuDs assessment has been provided to DCC pollution Control and is included in **Appendix B**. No further comments have been received from DCC Pollution control Section via DCC Drainage Department since the tripartite meeting with An Bord Pleanala, DCC, and the Applicant held in June 2019 for this application. The principle drainage proposal remains unchanged.

O'Connor Sutton Cronin also have had correspondence with David Dunne (DCC Regional Projects & Flood Advisory Section) in July 2017 in which they have outlined their requirements regarding the proposals for the proposed development. OCSC have also contacted Noel McEvoy (DCC Parks) in August 2017. Please find correspondences included in **Appendix A**. No further comments have been received from DCC Regional Projects & Flood Advisory Section via DCC Drainage Department since the tripartite meeting held in June 2019 for this application. The principle drainage proposal remains unchanged.

As part of this Strategic Housing Development (SHD) application, OCSC and the Applicant submitted a pre-planning package of documents and drawings and met with An Bord Pleanala (together with DCC) June 2019. A report was issued by DCC in response to this pre-planning package and issues relating to engineering services raised have been addressed in this report.

DCC have noted they would like to see the provision of an Integrated Constructed Wetland (ICW) for the surface water at the tripartite SHD planning meeting in October 2017. No further comments have been received from DCC for the inclusion of an ICW at the tripartite meeting held in June 2019 for this application. The principle drainage proposal remain unchanged since the SHD - PAC 0007/19.

O'Connor Sutton Cronin have assessed the potential provision of an ICW for the development. OCSC has deemed an ICW for surface water not to be appropriate for the development for the following reasons;

- From discussion in meeting with DCC Pollution Control it was noted that DCC Pollution Control are engaged in a study project to examine methods to reduce the overall pollution levels of water entering the Naniken Stream.
- DCC Drainage Department requested that OCSC examine the possibility of providing an ICW within the development as part of the drainage system.
- OCSC investigated the possibility of providing an ICW in St Anne's Park to improve the water quality within the Naniken Stream. This would lead to a basin approximately 2m deep in a large area within St Anne's Park. In

discussions with DCC Parks it was confirmed that the Parks Department would prefer to discuss any provision of potential water quality improvement measures for the river with their colleagues as part of a wider catchment plan rather than piecemeal.

- OCSC investigated the provision of an ICW within the development as part of the treatment train for the storm water drainage system.
- It is not practical to provide an ICW within in the site as the invert levels of the proposed surface water network would require a basin to be approx. 4.5m below the proposed finish levels and as a result the basin would have to be fenced off for safety reasons.
- Excessive construction methods: retaining structures would be required due to the invert levels which is contrary to environmental conservation.
- A greater land take area in excessive of 1600m^2 would be required. This would remove the main portion of available land for the provision of amenities within the development. An ICW has a wet basin and would not be useable space.
- The provision of ICW is normally associated with foul water loadings. It is not proposed to discharge foul water to the Naniken Stream from the development. **The surface water pollution risk has been assessed in accordance with CIRCA SuDs Manual as Low Risk**. The pollution hazard level from residential roofs is very low. The pollution hazard level as categorised by CIRIA SuDs Manual from individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads) is low.
- The pollution risk is further reduced with the provision of extensive SuDs measures as noted above in **section 3.2**. SUD measures will be provided in full compliance and above the minimum requirements of the GDSDS. All surface water will flow through SuDs structures. The interception areas being provided are above the minimum 10mm interception storage requirements in the GDSDS.

SHD2 – PAC

SHD2 is the current Strategic Housing Development (SHD) application. PAC is the pre-planning package of documents and drawings and met with An Bord Pleanala (together with DCC) submitted by the Applicant since the tripartite planning meeting in June 2019.

OCSC met with Mr. Gabriel Koncal form DCC Drainage Department on Friday 13th September 2019 to discuss the revised layout for the new submission.

The results and outcomes of these correspondence and meetings have been incorporated into the engineering design where practical.

OCSC note that DCC did not request an Integrated Constructed Wetland within their consultation process in the 2019 application. At the post tripartite meeting held between OCSC and DCC it was noted that this design solution has not been requested by DCC in either their Drainage Division Report to The Board for the Tripartite Stage in June 2019 or later. It is confirmed that the new storm water network design incorporates other SuDs treatment and attenuation measures and is fully compliant with the GDSDS.

4.3 Calculations

A drainage model has been developed using the design software, Micro Drainage. The rainfall intensity levels have been increased 20% for predicted climate change factors. The surface water pipe calculations are included in ***Appendix B***.

The proposed internal pipe network pipes are to be slung to the underside of the podium slab and will be in accordance with TGD H – Drainage specifications.

The storm system will be fitted with a flow control device (Hydrobrake or similar approved). This will enable the storm water flows to be restricted to pre-development levels. The allowable discharge calculations storage simulations for a 1% and 1.0% AEP rainfall event are included in ***Appendix B***.

Surface water calculations include proposed sedum green roof areas and landscaping on podium. Green roof and landscaping on podium have been calculated using the Green roof Calculator within Micro Drainage. The Green Roof calculator uses a Time Area Diagram feature to calculate the storage capabilities of 'Green Roofs' by auto-calculating the time area diagram with values representative of the depression storage and runoff lag. This results in the rainfall entering the system in a Time Area Diagram method as opposed to a specified time of concentration.

This tool has been developed by MicroDrainage, in collaboration with Sheffield University, in order to best represent the runoff response on a green roof. The tool is based on CIRIA C644 (Green Roof) Guidance, current best practice and research carried out at Sheffield University, the location of the Green Roof Centre. It should be noted that OCSC have used the most conservative input values for the Time Area Diagram method to ensure a more robust design.

As infiltration on site is poor infiltration rates have not been input into the Micro Drainage model.

4.4 GDSDS Storm Water Review

The Greater Dublin Strategic Drainage Study (GDSDS) requires that storm water is reviewed under four Criteria.

(i) Criterion 1 – River Water Quality Protection;
(ii) Criterion 2 – River Regime Protection;
(iii) Criterion 3 – Level of Service (Flooding) site;
(iv) Criterion 4 – River Flood Protection;

4.4.1 Criterion 1 –River Water Quality Protection

The drainage system for this development will contain a range of treatment methods for surface water as outlined above in **Section 3.2** including permeable paving and treatment via open graded crush rock (OGCR) below all SuDs measures. A Full Retention Interceptor will provide treatment of surface water runoff from the site prior to discharge to the Naniken Stream. As standard, the interceptor is fitted with the oil probe for monitoring the interceptor for presence of hydrocarbons.

4.4.2 Criterion 2 – River Regime Protection

Discharge will be made to the Naniken Stream via the proposed attenuation and flow control device (Hydrobrake). The proposed Hydrobrake restricts discharge as specified. The limiting discharge will restrict the discharge to a rate of **9.6l/s** from this development. There will be an increase in discharge rate in the future when consideration for future development of the Sport Hall adjacent the site is taken into account. The proposed development of the Sports Hall on the St Paul's College site adjacent is subject to a separate Planning Application (Planning Reg.

Ref. 3777/17 and under appeal with ABP Reg. Ref. 301482-18). Potential maximum discharge to the Naniken will be 14.84l/s.

The GDSDS-RDP Volume 2, Appendix E Section E2.4 states that this ensures "that sufficient stormwater runoff retention is achieved to protect the river during extreme events."

4.4.3 Criterion 3 – Level of Service (Flooding) Site

There are 4 sub-criteria for level of service, as set out in the GDSDS-RDP Volume 2, Section 6.3.4 (Table 6.3):

- (i) No flooding on site except where planned (30-year high intensity rainfall event);
- (ii) No internal property flooding (100-year high intensity rainfall event);
- (iii) No internal property flooding (100-year river event and critical duration for site) and;
- (iv) No flood routing off site except where specifically planned, (100-year high intensity rainfall event).

It is proposed that storm water runoff from the development will be collected in pipes of diameter 225mm – 375mm. The proposed drainage layout is shown on OCSC Drg. No's ***N251-H01 & H02.*** The proposed surface water long sections are shown in ***Appendix B***.

Calculations for the design of storm drains have been compiled with the Micro Drainage Micro Drainage Program using the Modified Rational Method in accordance with EN752. Calculations for the Storm networks are included in ***Appendix B***.

4.4.3.1 Sub-criterion 3.1

The proposed drainage system has been analysed for a 30-year return period storm event. The analysis show that no flooding will occur in 30-year return period storm events.

4.4.3.2 Sub-criterion 3.2

The proposed drainage system has been analysed for a 100-year return period storm event. The analysis show that no flooding will occur in 100-year return period storm events.

4.4.3.3 Sub-criterion 3.3

The development site topography slopes away from a high point of 24.900m (Malin) AOD at the north-western boundary to a level of 21.280m at the south eastern boundary. The site is not in the vicinity of coastal flooding. The maximum water level in the proposed attenuation will not pose a risk to the proposed buildings. In accordance with the requirements of Sub-Criterion 3.3, all buildings are a minimum of 500mm above the design 100-year water level in the attenuation facility.

4.4.3.4 Sub-criterion 3.4

The performance of the proposed drainage system in the 100-year return period storm events has been analysed. The analysis show that no flooding is expected in the 100-year return period storm event. No off-site overland flow is expected in the 100-year return period storm event, unless in specifically designated areas, i.e. detention basins.

4.4.4 Criterion 4 – River Flood Protection

Discharge for the residential development will be restricted to a rate of **9.6l/s** to the Naniken Stream. Future development adjacent the site for the Sports Hall will result in a total greenfield runoff rate of 14.84l/s (4.8ha+2.62ha = 7.42ha). Please note that the Sports Hall is subject to a separate planning application. By limiting the runoff to this flow rate, the GDSDS-RDP Volume 2, Appendix E Section E2.4 states that this ensures "that sufficient stormwater runoff retention is achieved to protect the river during extreme events." Attenuation storage is provided for the 100-year return period storm event in the proposed attenuation storage facility. Control of runoff rates will be achieved through the use of a vortex control device (e.g. Hydrobrake), which reduces the risk of blockage present with other flow control devices. Calculations of attenuation volume are included in ***Appendix B***.

5.0 FOUL WATER DRAINAGE

5.1 Overview

It is proposed to construct a new foul drainage network in accordance with Irish Water Code of Practice for Wastewater Infrastructure, The Building Regulations 'Part H' & the Regional Code of Practice for Drainage Works.

The sewers will be compliant with the requirements of the Irish Water Code or Practice for Wastewater Infrastructure and will be from 150mm to 225mm in diameter. Foul sewers within the buildings plots may be as small as 100mm dia. In accordance with TGH H – Drainage specifications and with Irish Water Code of Practice.

5.2 Layout

The proposed drainage layout is shown on OCSC Drg. No's ***N251-H01 & H02.*** The proposed foul water long sections are shown are shown in ***Appendix B***.

A new public foul water sewer will be laid along the proposed access road and discharge by gravity to the North Dublin Drainage Scheme Trunk Sewer along Sybil Hill Road. The discharge point is located to the south west of the site approximately 100m from the new site entrance.

It has been confirmed in correspondence with DCC Drainage Division that the existing sewer is of adequate size to accept sewage from this development. As shown in the GDSDS 2031 system performance model, the Foul/combined Sewer surcharges for 1 or 2 year return period events.

5.3 Consultation

Prior to submission, O'Connor Sutton Cronin consulted with Mr. Peter Glynn in Dublin City Council drainage division via email correspondence in April 2016, who informed us that the North Dublin Drainage Scheme Trunk Sewer runs half full during dry weather flow (DWF). Please find correspondence included in ***Appendix A***. The proposed foul outfall connection to this sewer will be made above this water. The pre-connection enquiry feedback and the statement of designs acceptance is included in **Appendix D**. The proposed foul water connection to the Irish Water network can be facilitated subject to connecting downstream to an identified 650mm constraint in the 1350mm wastewater main.

Furthermore, as part of this Strategic Housing Development (SHD) application, OCSC and the Applicant submitted a pre-planning package of documents and drawings and met with An Bord Pleanala (together with DCC) at a tripartite planning meeting in June 2019. A report was issued by DCC in response to this pre-planning package and issues relating to engineering services raised in this report and all meetings have been addressed in this report.

5.4 Calculations

Drainage calculations submitted in ***Appendix C*** have been generated by 'Micro Drainage' flow modelling software, and the 'Hydraulic Design for Gravity Sewers' method to Irish Water Code of Practice for Wastewater Infrastructure.

Sewers carrying wastewater from developments with a population over 1,000 should be designated to carry a minimum wastewater volume of three times dry weather flow (3DWF). Dry weather flows DWF should be taken as 446 litres per dwelling (2.7 persons per house and a per capita wastewater flow of 165 litres per head per day.

Gradients should be selected so that self-cleansing velocities can be maintained under normal operating conditions. The range of flow velocity within the sewers should be between 0.75m/s at low flow and 3m/s, when flowing full.

Subject to the limitations imposed by the foregoing, pipe sizes and gradients should be selected from approved pipe design tables, based on approved design approach, such as the use of the Colebrook White equation. However, to provide a self-cleansing regime within gravity foul sewers, the minimum flow velocity should be 0.75 m per second. Where this requirement cannot be met, then this criterion will be considered to be satisfied if:

- A 150mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150 where there are at least ten dwelling units connected or,
- A service connection with a nominal internal diameter of 100mm laid to a gradient not flatter than 1:80, where here is at least one WC connected and 1:40 if there is no WC connected.

In general, pipes of 100mm diameter should be laid at a minimum gradients of between 1:60 and 1:100. Pipes of 150mm diameter should be laid at a minimum gradient of 1:150. Pipes of 225mm diameter or greater should have a minimum gradient of 1:200. Pipe gradients for private drainage should be constructed in accordance with that indicated above as a minimum, or with Building Regulation requirements.

These parameters should not be taken as a norm when the topography permits steeper gradients. Hydraulic studies indicate that these requirements may not necessarily achieve a self-cleansing regime.

The minimum size for a gravity foul service connection shall be 100mm. The minimum size for a gravity foul sewer serving less than 10 properties (30 P.E.) shall be 150mm diameter. The desirable pipe size for a collection sewer where more than 10 housing units (30 P.E.) are connected is 225mm diameter or greater subject to hydraulic design capacity assessment.

6.0 POTABLE WATER SUPPLY

6.1 Overview

It is proposed to provide a potable water supply in accordance with Irish Water Code of Practice for Water Infrastructure.

6.2 Connection to the existing network

There is an existing water main (228mm dia. Spun Iron 1950) running along Sybil Hill Road. The new development will be serviced with a new 100mm dia. HPPE Class 'C' watermain.

The proposed network connection will be metered, with associated hydrants and valves as per Irish Water requirements. The connection will be metered with ABB Magmaster electromagnetic flow meters or similar approved.

6.3 Water Saving Devices

In accordance with best practice, new water saving devices (low water usage appliances and aerated taps etc.) will be fitted as standard into the proposed new units.

6.4 Water Meters

In accordance with the Dublin City Council and Irish Water regulations, a water meter will be fitted on the incoming watermain into the site and individual buildings will be fitted with a Talbot Matrix meter box for billing purposes.

6.5 Layout

A new watermain will be laid in the new footpath along the new access road. See OCSC Drg. No. ***N251-G01 & G02*** for the proposed new potable water layout.

6.6 Consultation

The pre-connection enquiry feedback and the statement of designs acceptance is included in **Appendix D**. The proposed water connection to the Irish Water network can be facilitated subject to possible network upgrades and or District Metering Area (DMA) reconfiguration.

7.0 ROADS

7.1 Overview

The propsoed main spine road serving the development has been designed in accordance with the classification as a Local Street in accordance with Cl.3.2.1 of the Design Manual for Urban Roads and Streets.

There will be no through traffic, short distances of carriageway (approximately 100m) with visitor parking avaialble to access individual apartments.

Design speeds are low with movements by larger vehicles infrequent and as such junction radii have been designed in accordance with Cl.4.3.3 of DMURS to be between 3-6 metres. Providing reduced corner radii will improve pedestrian and cyclist safety at junctions by lowering the speed at which vehicles can turn corners and by increasing inter-visibility between users. Roads have been designed in accordance with compliance with Design Manual for Urban Roads and Streets (DMURS). Speed limits to be restricted to 30km per hour.

The site is well served by public transport, with the Hamonstown Dart station stop just 1km walk away (12 minutes) and Killester Dart station just 750m (10 minutes) walk away. A number of Dublin Bus services operate within walking distance, with stops on Vernon Avenue and Howth Road. Please refer to the Mobility Management plan which has been submitted seperately with this application for further of existing transport infastructure proximate to the site.

It should be noted that no changes to the external road layout and internal road layout are proposed follwing the completion of the Stage 1 Road Safety Audit (RSA) completed by ILTP Consulting in August 2019.

7.2 Layout

The proposed development will include a new internal access road. The new access road will be provided at the location of the existing entrance gates at Sybil Hill Road. The entrance will remain stepped back from the boundary and existing road. Traffic calming measures have been provided which include, speed limits and speed ramp along the main spine road, stop signs and raised tables at internal junctions. See OCSC Drg. No.'s ***N251-F01 & F02*** for proposed traffic calming measures and junction sightlines.

The internal road layout arrangements and geometry have been designed in accordance with the requirements of DMURS. See OCSC Drg. No.'s ***N251-C01 & C02*** for proposed layout & long sections.

7.3 Consultation

As part of this Strategic Housing Development (SHD) application, OCSC and the Applicant submitted a pre-planning package of documents and drawings and met with An Bord Pleanala (together with DCC) at a tripartite planning meeting in June 2019 to discuss same. A report was issued by DCC in response to this pre-planning package and issues relating to engineering services raised in this report and at the tripartite meeting in June have been addressed in this report.

7.4 Traffic

The entrance and access road for the development off Sybil Hill Road has been designed in accordance with DMURS, Inclusive Mobility and "Guidance on the use of Tactile Paving Surfaces". Please refer to the Traffic Impact Assessment submitted with this application for the anticipated impact on current traffic volumes.

7.5 Accessibility

A vehicle swept path analysis has been carried out for the development layout showing that the required routes for refuse collection and fire tender access are accessible. See OCSC Drg. No.'s ***N251-C05 & C06*** for details of vehicle swept path analysis.

APPENDIX A – LOCAL AUTHORITY CORRESPONDENCE

Jonathan Burke

From:	Jonathan Burke
Sent:	30 September 2019 12:04
To:	Gabriel Koncal
Cc:	John Stack; Anthony Horan
Subject:	RE: St. Paul's - Surface Water Quality

Thank you Gabriel,

The below will be highlighted within the engineering documents.

Regards,
Jonathan Burke

Please consider the environment before printing this email.

From: Gabriel Koncal [mailto:gabriel.koncal@dublincity.ie]
Sent: 27 September 2019 16:29
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Cc: John Stack <john.stack@dublincity.ie>; Anthony Horan <anthony.horan@ocsc.ie>
Subject: RE: St. Paul's - Surface Water Quality

Hi Jonathan,

I have no comments to add at this time. When you are revising the document I think you should also take into account the impact of the proposed new detention basis and the oil probe for monitoring the interceptor for presence of hydrocarbons. This all should all have a positive impact.

John Stack might be in position to give you a more in depth comments / advise on this especially from WFD perspective.

Regards
Gabriel Koncal

| **Gabriel Koncal** | Assistant Engineer | Planning & Developer Services | Asset Management | Environment and Transportation Department | Dublin City Council | Floor 4 Block 1 | Civic Offices | Wood Quay | Dublin 8
| 📫: Dublin City Council | Block 1 Floor 4 | Civic Offices | Fishamble Street | Dublin 8 | Ireland
| ☎: 00353 1 222 2756 | 🖷: 00353 1 222 2300 | gabriel.koncal@dublincity.ie | 🖱: www.dublincity.ie

---

From: Jonathan Burke <jonathan.burke@ocsc.ie>
Sent: 26 September 2019 12:58
To: Gabriel Koncal <gabriel.koncal@dublincity.ie>
Cc: John Stack <john.stack@dublincity.ie>; Anthony Horan <anthony.horan@ocsc.ie>
Subject: RE: St. Paul's - Surface Water Quality

Hi Gabriel,

Do DCC have any comments on the below.

Regards,
Jonathan Burke

Please consider the environment before printing this email.

From: Jonathan Burke
Sent: 13 September 2019 14:38
To: Gabriel Koncal <gabriel.koncal@dublincity.ie>
Cc: John Stack <john.stack@dublincity.ie>; Anthony Horan <anthony.horan@ocsc.ie>
Subject: St. Paul's - Surface Water Quality

Hi Gabriel,

Thank you for meeting us earlier today.

In relation to the quality of surface water discharging from the development.

For the pervious application OCSC completed an assessment of the potential pollution and mitigation measures for surface water and ground water discharge in accordance with CIRIA C753-SuDS Manual. This was discussed and included in the Appendices of submitted Engineering Service Report. It is our intention to submit a revised assessment for this application.

The assessment is simple qualitative approach using indices of the likely pollution levels and proposed SuDS mitigation / performance capacities. Please find attached a revised assessment for comment.

In summary, the residential development is low hazard level and the provision of SuDs measures reduces the low risk further. The drainage design has also been reviewed and in compliance with the four Criteria of The Greater Dublin Strategic Drainage Study (GDSDS).

The design includes two forms of treatment and measures to prevent scoring to Naniken Stream are to be provided as per with the previous application and as per DCC request.

Regards,
Jonathan Burke

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Smaoinigh ar an timpeallacht sula ndéanann tú an ríomhphost seo a phriontáil. Please consider the Environment before printing this mail.

Jonathan Burke

From: Jonathan Burke
Sent: 11 April 2019 17:23
To: Maria Treacy
Cc: Anthony Horan; Daniel Lowe; mary.conway@dublincity.ie; Shaun Thorpe; Emma Gosnell
Subject: FW: St. Paul's SHD - PACSHD002/17 & ABP-300559-18
Attachments: N251_Residential Development Engineering Services Report Rev 3_20180515.pdf

Importance: High

Maria,

Engineering Service Report is attached to this mail as noted below.

Regards,
Jonathan Burke

Please consider the environment before printing this email.

From: Jonathan Burke
Sent: 11 April 2019 17:20
To: 'Maria Treacy' <maria.treacy@dublincity.ie>
Cc: Daniel Lowe <daniel.lowe@dublincity.ie>; Anthony Horan <anthony.horan@ocsc.ie>; 'Shaun Thorpe' <shaun.thorpe@marlet.ie>; 'Emma Gosnell' <emma.gosnell@marlet.ie>; 'mary.conway@dublincity.ie' <mary.conway@dublincity.ie>
Subject: RE: St. Paul's SHD - PACSHD002/17 & ABP-300559-18
Importance: High

Maria,

Following on from the below.

The below contained a link to the documents. Please see the drawings reattached and ESR report will follow in a separate mail due to size.

As per the below we are resubmitting the scheme without any changes since the last application which was accepted by your colleague Peter Glynn. Please see attached report on the same.

DCC Parks & Landscaping have requested a confirmation letter from the developer confirming that DCC Drainage have approved the route and detail of the outfall pipe.

We will require both confirmation letters, from DCC Drainage and DCC Parks & Landscaping for the PAC request to ABP which will be Wednesday 1st May 2019.

Please provide a DCC Drainage confirmation letter asap to enable us to forward to DCC Parks & Landscaping for a new revised approval letter on the route and to meet the above date.

Regards,
Jonathan Burke

Please consider the environment before printing this email.

From: Maria Treacy [mailto:maria.treacy@dublincity.ie]
Sent: 25 February 2019 12:47
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Cc: Daniel Lowe <daniel.lowe@dublincity.ie>
Subject: RE: St. Paul's SHD - PACSHD002/17 & ABP-300559-18

Jonathan,

Please note that your email below did not include any attachments.

Please review submission and address all items on checklist sheet as issued previously, otherwise if there is a concern in relation to the surface water strategy or lack of information, I will have to highlight that to ABP at the Pre SHD Consultation meeting.

DCC Drainage is the point of contact for issues relating to SW, Flooding, WFD and Drainage Pollution Control.

Kind regards,
Maria Treacy

From: Jonathan Burke <jonathan.burke@ocsc.ie>
Sent: 18 February 2019 12:25
To: Maria Treacy <maria.treacy@dublincity.ie>; Daniel Lowe <daniel.lowe@dublincity.ie>
Subject: FW: St. Paul's SHD - PACSHD002/17 & ABP-300559-18

Hi Maria,

Further to the below, Anthony Horan met with Mary Conway as part of a PAC meeting this morning and it is our intention to reapply with an identical drainage design as agreed with DCC. Please see attached documents issued for compliance.

We note that this scheme was accepted by DCC as part of a recent SHD process. See attached report from DCC Drainage Report on the same.

https://we.tl/t-ffZAIegn3s

It is our intention to also contact DCC Flood and DCC Pollution Control with the same information. During the previous application process it was requested that DCC Drainage was the point of contact for correspondence with DCC Flood and DCC Pollution Control.

Shall OCSC issue to DCC Flood and DCC Pollution Control or will DCC Drainage remain the point of contact for all correspondences relating the drainage?

Regards,
Jonathan Burke

From: Maria Treacy [mailto:maria.treacy@dublincity.ie]
Sent: 14 February 2019 15:36
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Subject: RE: St. Paul's SHD - PACSHD002/17 & ABP-300559-18

Jonathan,

The proposal will need to address the items outlined in the attached list.

Kind regards,

Maria Treacy
Senior Executive Engineer (A) | Asset Management | Planning & Developer Services | Environment & Transportation Department | Dublin City Council |

A: Block 1, Floor 4, Civic Offices, Wood Quay, Dublin 8, Ireland
T: +353 1 222 3039 | F: +353 1 222 2300 |
E: maria.treacy@dublincity.ie | www.dublincity.ie

From: Jonathan Burke <jonathan.burke@ocsc.ie>
Sent: 14 February 2019 14:58
To: Daniel Lowe <daniel.lowe@dublincity.ie>; Maria Treacy <maria.treacy@dublincity.ie>
Cc: Anthony Horan <anthony.horan@ocsc.ie>
Subject: St. Paul's SHD - PACSHD002/17 & ABP-300559-18

Hi Maria,

As discussed with Daniel Lowe in your Drainage Department this evening. A new SHD planning application is to be submitted for the above. It is proposed to submit the drainage layout as per the last application. Please advise if DCC Drainage have any views on this proposal.

Regards,
Jonathan Burke

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Jonathan Burke

From: Anton Lennon
Sent: 20 July 2017 10:04
To: 'Peter Glynn'
Cc: Mark Chambers; Jonathan Burke; Sally Redington; Gerard Doherty
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Categories: Gekko

Thank you for this Peter,

I have contacted all this morning and will revert in due course.

Regards
Anton Lennon

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From: Peter Glynn [mailto:peter.glynn@dublincity.ie]
Sent: 19 July 2017 14:48
To: Anton Lennon
Cc: Mark Chambers; Jonathan Burke; Sally Redington; Gerard Doherty
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Anton,

Consent cannot be given be one party to connect a development to a river. You will need to get permission from the land owner and a wayleave agreement for future maintenance from DCC Parks & Landscapes Services Division (Michael Harvey or Executive Parks Superintendent Noel McEvoy, Phone no.: 2223401, Email: noel.mcevoy@dublincity.ie) for constructing the surface water sewer. You would need to discuss with DCC Flood defence unit (Engineer-in-Charge Gerard O'Connell, Phone no.: 2224302, Email: gerry.oconnell@dublincity.ie) if any flood defence works are proposed on the Naniken River and their consent to discharge this development at green field run off rates. You will also need to discuss and receive consent from Eastern Inland Fisheries (Contact Address: Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin D24Y265 Ireland. Public office hours: 9.15 a.m - 13.00 pm 2.15 pm - 5.30 pm, Email: blackrock@fisheriesireland.ie Phone: +353 (0)1 2787022) for the works on the river bank. You should also notify DCC pollution control (Senior Executive Engineer Pat O'Halloran, Phone no.: 2222930, Email: pat.ohalloran@dublincity.ie) of your intention to discharge storm water to the river (a sampling/monitoring program may be requested before the final connection can be granted). DCC Drainage Planning and Developer services shall issue consent for the supervision of the storm sewer to the Greater Dublin regional code of practise for drainage works.

Regards,
Peter Glynn

| **Peter Glynn** | Executive Engineer | Planning & Developer Services | Asset Management | Environment and Transportation Department | Dublin City Council | Floor 4 Block 1 | Civic Offices | Wood Quay | Dublin 8
| : Dublin City Council | Block 1 Floor 4 | Civic Offices | Fishamble Street | Dublin 8 | Ireland
| : 00353 1 222 3724 | : 00353 1 222 2300 | peter.glynn@dublincity.ie | : www.dublincity.ie

---

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 19 July 2017 10:15
To: Peter Glynn
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Peter,

As per an RFI for a previous application 4185/15 a request was included as follows:

14. The applicant shall submit the following information required by the Drainage Division: The applicant shall consult with the Drainage Division of Dublin City Council prior to the submission of revised plans to ensure all drainage issues are addressed.

-Due to flooding issues downstream of the proposed site as shown in the GDSDS 2031 system performance model the applicant is requested to submitted revised details showing all surface water from the proposed development being discharge to the Naniken river and not to the public sewer network.

The application was subsequently withdrawn by the applicant. A new application is currently being prepared and will be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. As such, the applicant has requested if Dublin City Council can provide a letter of consent for connection of the proposed surface water network to the Naniken River, in accordance with the RFI for the previous application. Attached is the proposed drainage layout for the scheme.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

From:	Anton Lennon
Sent:	04 August 2017 11:44
To:	'David Dunne'
Cc:	Gerard O'Connell; Peter Glynn; Mark Chambers; Jonathan Burke
Subject:	RE: St. Pauls Raheny (N251) - Naniken River
Categories:	Gekko

David,

Thank for the call and reply below. I can confirm that we are complying with your conditions as outlined below. As mentioned, further to a meeting we had with John Stack of DCC Pollution Control we are preparing a response outlining the green infrastructure that will be incorporated as part of the drainage strategy for the proposed development – we will include yourself on this response.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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From: David Dunne [mailto:David.Dunne@dublincity.ie]
Sent: 04 August 2017 11:22
To: Anton Lennon
Cc: Gerard O'Connell; Peter Glynn
Subject: St. Pauls Raheny (N251) - Naniken River

Anton,

I met with the Engineer-in-Charge, Gerry O'Connell, here in the Regional Projects and Flood Advisory Office regarding your query about the discharge of surface water to the River Naniken from the proposed development just off Sybil Rd. Raheny.
At the moment, there is a real danger of road flooding on Clontarf Rd and surface water flooding within Ann's Park from the River Naniken. We have carried out recent re-modelling works on the River Nankien and improvements works are proposed to take place in the not too distant future. Taking this into consideration we believe it would be best if surface water discharge did not exceed current regulations. Normal surface water from the area of the proposed site can be discharged to the River Naniken and any additional surface water, exceeding the permitted allowance of 2 litters/Hector/1 second, is to be contained on site using some form of acceptable rain harvesting.

Regards,
David Dunne

David Dunne | Executive Engineer | **Regional Projects & Flood Advisory Section - Projects Division (FDU)**
Environment and Transportation Department, Dublin City Council,
68/70 Marrowbone Lane, Dublin 8, Ireland.

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E-mail david.dunne@dublincity.ie | Web www.dublincity.ie

Flood Defence Unit

Jonathan Burke

From:	Anton Lennon
Sent:	05 September 2017 16:58
To:	'John Stack'; 'Noel McEvoy'; 'David Dunne'
Cc:	Jonathan Burke; 'Gerry O'Connell'; 'Peter Glynn'; Mark Chambers; Loreto Gonzalez
Subject:	RE: St. Pauls Raheny (N251) - Naniken River
Categories:	Gekko

John/Noel/David,

Just following up on my email below and wondering if there is any feedback from any departments or if a meeting in DCC would be appropriate to discuss with all parties?

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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From: Anton Lennon
Sent: 28 August 2017 15:20
To: John Stack; Noel McEvoy; David Dunne
Cc: Jonathan Burke; Gerry O'Connell; Peter Glynn; Mark Chambers; Loreto Gonzalez
Subject: St. Pauls Raheny (N251) - Naniken River

John/Noel/David,

Firstly thank you all for your feedback in relation to the proposals for this proposed development.

In order to address your queries/questions many of which are similar or linked, we have prepared the attached document outlining the strategy and measures for the proposed surface water outfall of this proposed development.

Upon review of the attached I would appreciate your feedback in relation to this and any outstanding queries that you may have particular to your department. Given the different departments involved I would propose a meeting together to discuss this item, in order to avoid a long trail of email correspondence?

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

From: Jonathan Burke
Sent: 28 August 2017 15:29
To: 'John Stack'; Anton Lennon
Subject: RE: St. Pauls Raheny (N251) - Naniken River
Attachments: Residential_N251-H01 P1.pdf; Residential_N251-H02_P1.pdf; Residential_N251-H05_P1.pdf

Categories: Gekko

John,

Further to Anton Lennon's email, please see a response below in green and find attached the drawings as requested below.

Regards,

Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: John Stack [mailto:john.stack@dublincity.ie]
Sent: 27 July 2017 13:30
To: Anton Lennon <anton.lennon@ocsc.ie>; Jonathan Burke <jonathan.burke@ocsc.ie>
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Anton/Jonathan,

Further to our meeting on the 25th July 2017, can you address the following points please:

- Prevention of scour of the river channel of the Nannikan – scour of the river channel is a concern for the Water Pollution Control Section and I would expect to see measures, up to and including additional attenuation/GI infrastructure, to prevent this from occurring, particularly in light of the proposed flow rate. Please indicate how you propose to prevent scouring of the river channel as a result of the discharge or urban runoff/storm water from the proposed development. Please see attached the proposed headwall outfall detail to the Naniken Stream on N251-H05. The spillway of the proposed headwall will prevent scouring. The headwall/outlet to be agreed with DCC Parks to suit desired visual characteristics. It should be noted that it is proposed to infiltrate surface water to ground on site using a number of SuDs features which will reduced the flow rate.
- Dublin City Council is currently developing a plan for the restoration of the River Santry and Nannikan Stream. The principle aims of the plan are to achieve good status under Water Framework Directive, reduce flooding risk and enhance amenity value of the catchment through the use of Green Infrastructure. In that regard, please note:
    - The Nannikan has a history of flooding near the James Larkin Road. As your site is a green field site, its development as a residential area will increase the flow to the river during wet weather, potentially increasing the flood risk. In light of this, I have concerns about the proposed discharge rate to the River (up to 17.5 l/s). Please comment and explain how the development will *not* contribute an increased flood risk to the Nannikan. Again, as mitigation, additional retention of storm water on site may be required. The discharge rate of 17.5l/s (2.0l/s/ha) is max. allowable Greenfield run off rate for the site (8.73ha) in accordance with the GDSDS. It is proposed to infiltrate surface water to ground on site using a number of SuDs features which will reduced the max. allowable discharge below 17.5l/s. The infiltration rates for the proposed SuDs measures to be

confirmed on site following soakaway testing and detailed design. Please refer to N251-H01 & H02 for the location of the proposed SuDs measures and N251-H05 for proposed details.

- Dublin City Council has identified urban runoff (i.e. contaminated storm runoff) as a significant pressure on urban surface waters. In light of this, please demonstrate that the runoff from the development will not add an increased pollution load to the Nannikan. Factors to consider include the impact of bird and animal faeces, oils, heavy metals and priority substances from vehicles, sediments, etc. A summary of the estimated pollution and the proposed mitigation/control measures in accordance with CIRIA C753 is included with Anton Lennon's email dated 28/08/2017.

- At the meeting on the 25th July 2017, you had drawings showing the detail of some of the Green Infrastructure that you are proposing to use. Can you send those drawings to me please? Electronic copies are fine. Please find attached.

Please be aware that the meeting on the 25th July 2017 addressed *only* those issues raised by the Water Pollution Control Section. As per the e-mail of the Peter Glynn on the 19th July 2017, you will need to discuss the application with various other Sections of Dublin City Council.

Regards,

John

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 21 July 2017 15:54
To: John Stack
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

John,

To confirm 11am on Tuesday – if you could forward a location please?

Regards
Anton Lennon

Associate
Chartered Engineer
BEng CEng MIEI
PH: +353 1 8682000

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Dublin Office
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T: +353 1 868 2000
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From: Anton Lennon
Sent: 21 July 2017 15:19
To: 'John Stack'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

John,

Absolutely, I am available on Monday morning to meet?

Regards
Anton Lennon

Associate
Chartered Engineer
BEng CEng MIEI
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From: John Stack [mailto:john.stack@dublincity.ie]
Sent: 21 July 2017 15:17
To: Anton Lennon
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Anton,

Could we meet next week some time? What would suit you?

Regards,

John

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 20 July 2017 11:38
To: John Stack
Cc: Mark Chambers; Jonathan Burke
Subject: FW: St. Pauls Raheny (N251) - Naniken River

John,

Thank you for taking my call. Please find below email sent to Pat this morning if you could review and comment as appropriate that would be appreciated.

Regards
Anton Lennon

Associate
Chartered Engineer
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From: Anton Lennon
Sent: 20 July 2017 10:02
To: Pat O'Halloran
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Pat,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

14. The applicant shall submit the following information required by the Drainage Division:
The applicant shall consult with the Drainage Division of Dublin City Council prior to the submission of revised plans to ensure all drainage issues are addressed.

-Due to flooding issues downstream of the proposed site as shown in the GDSDS 2031 system performance model the applicant is requested to submitted revised details showing all surface water from the proposed development being discharge to the Naniken river and not to the public sewer network.

That application was subsequently withdrawn by the applicant.

I have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised that in order to progress the investigation of the connection for the surface water discharge to the Naniken River discussion will be required with DCC Pollution Control. To this end please find attached the proposals at this time for your review and comment. I am available to meet and discuss at your convenience.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

From: Anton Lennon
Sent: 09 August 2017 14:14
To: 'Noel McEvoy'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Categories: Gekko

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

FYI – we have met with John Stack (DCC Pollution Control) and had correspondence from David Dunne (DCC Regional Projects & Flood Advisory Section) in which they have outlined their requirements regarding the proposals for the proposed development and for which we are currently addressing.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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From: Anton Lennon
Sent: 03 August 2017 13:43
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Noel,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

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If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

Subject: FW: St. Pauls Raheny (N251) - Naniken River

From: Noel McEvoy [mailto:noel.mcevoy@dublincity.ie]
Sent: 18 August 2017 15:51
To: Anton Lennon
Cc: John Stack
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hello Anton

As you know the Nanakin river frequently floods down onto the James Larkin Road and has indeed blocked the road to traffic and flooded the Chestnut meadow and flooded into the park lodge causing major expense all this without the added volume and load that the proposed development will have.
The Naniken river enters the Bay at the heart of the Dublin Bay Biosphere right into the lagoon of the Bull island Nature Reserve Ramsar site,. Such a proposal I would expect will require an Appropriate assessment and an Environmental impact assessment regarding the additional pollutants being disposed of into the Biosphere.
As a method to mediate against pollution entering into the lagoon there may be the possibility of dealing with the pollutants in St Annes park by creating a Constructed Wetland which if designed and constructed properly could deal with the organic load and other pollutants such a sensitivity and fragile site. However this solution A Constructed Wetland would have to be agreed with Senior Parks Officials and DCC Environmental Biodiversity team and DCC Engineers the necessary resources and finance would also have to be made available to build the system.
Regards

Noel

Noel McEvoy
Act Senior Executive Parks Superintendent
Dublin City Council
Civic Offices
Wood Quay
Dublin 8.

I

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 17 August 2017 15:40
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

Peter Glynn (DCC Drainage) advised that you were the relevant person to contact, however if this is not the case if you could please advise of the more appropriate persons contact details and I will contact?

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

Associate

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From: Anton Lennon
Sent: 09 August 2017 14:14
To: 'Noel McEvoy'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

FYI – we have met with John Stack (DCC Pollution Control) and had correspondence from David Dunne (DCC Regional Projects & Flood Advisory Section) in which they have outlined their requirements regarding the proposals for the proposed development and for which we are currently addressing.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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From: Anton Lennon
Sent: 03 August 2017 13:43
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Noel,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

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If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

From: Kieran O'Neill <kieran.oneill@dublincity.ie>
Sent: 09 November 2017 11:31
To: Jonathan Burke
Cc: 'Thomas Burns'
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Categories: Gekko

Hi Jonathan,

I discussed with Thomas of BSM yesterday,
As there are a number of issues to resolve following the ABP meeting you should prepare your options first and bring to a meeting with us for review.

Regards,

Kieran

From: Jonathan Burke [mailto:jonathan.burke@ocsc.ie]
Sent: 09 November 2017 11:07
To: Kieran O'Neill
Cc: Leslie Moore; Thomas Burns; thetreefile@eircom.net; Anthony Horan
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Kieran,

I tried you at the office regarding the above.

We propose to meet at St. Anne's Park early next week, Tuesday or Wednesday, to walk through the proposed surface water outfall.

Can you confirm your availability next week please?

Please see a response to the below comments in green.

Regards,

Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: Kieran O'Neill [mailto:kieran.oneill@dublincity.ie]
Sent: 25 October 2017 12:23
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Cc: Leslie Moore <leslie.moore@dublincity.ie>
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Jonathan,
With regards to your drawings you will need to clarify the following:

1.For the area below where you are proposing the drain route exiting your application site and alignment to the river you will need to look at the impact of the alignment on existing trees with your arboriculturist . As noted at the ABP pre-app meeting there is to be no adverse impact to trees in St Annes Park.The alignment and method of construction in this area is therefore crucial. We have moved the pipe route to the right side of the existing footpath away from the ditch and trees, between the path & back of the existing goal posts. See attached on dwg. N251-H01. Route to be reviewed on site.

2. The section of peporated pipe within the tree canopy section shown below is not permitted. As per the response above.

3.For the proposed headwall we will need to see a photomontage of what is proposed. It is important that the outfall is not visually poor, please discuss with your landscape architects. I believe there is an existing headwall discharging into the Naniken completed recently, we can review this on site. Please see headwall detail attached on dwg. N251-H05 for discussion.

Please arrange a meeting with us when these issues have been fully considered.

Regards,
Kieran

From: Jonathan Burke [mailto:jonathan.burke@ocsc.ie]
Sent: 20 October 2017 11:36
To: Leslie Moore
Cc: Kieran O'Neill; John Stack; Noel McEvoy
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Leslie,

Please find attached the proposed headwall outfall to the Naniken Stream for review and comment.

Drawing N251-H02 attached shows the outfall route for agreement.

Drawing N251-H05 shows the proposed headwall detail for agreement.

Regards,

Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: Leslie Moore [mailto:leslie.moore@dublincity.ie]
Sent: 20 October 2017 08:47
To: Jonathan Burke <jonathan.burke@ocsc.ie>

Cc: Kieran O'Neill <kieran.oneill@dublincity.ie>; John Stack <john.stack@dublincity.ie>; Noel McEvoy <noel.mcevoy@dublincity.ie>
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Jonathan can you re send drawings pl. Les

Leslie Moore,
City Parks Superintendent.

Parks & Landscape Services
Culture, Recreation & Economic Servicess Department
Block 4, Ground Floor| Civic Offices, Wood Quay, Dublin 8.

T: +353 1 2225049 F: +353 1 2222668
E: leslie.moore@dublincity.ie | W: www.dublincity.ie

From: Noel McEvoy
Sent: 19 October 2017 17:19
To: 'Jonathan Burke'
Cc: Kieran O'Neill; Leslie Moore; John Stack
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hello Jonathan

I am forwarding your drawings onto Kieran O'Neil our Senior landscape Architect and Leslie Moore Senior Parks Superintendent for the city.
Both gentlemen are closely involved with the evolving proposals regarding the St Pauls site .

However my response to Anton Lennon is below and makes reference to the release of waste water into the Dublin Bay Biosphere and possible remediation by creating a Constructed wetland to deal with the pollution load. I have had no response to this and I am afraid your drawings do not allude to this it only shows me how you are going to eventfully dump waste water into the nanakin after it has gone through a suds system it does not offer any solutions to the waste water which will eventually enter into the Nature reserve lagoon until this is sorted out and agreed upon I see little sense in providing such drawings.

Kind Regards

Noel

Noel McEvoy
Executive Parks Superintendent
Dublin City Council
Civic Offices
Wood Quay
Dublin 8.

From: Jonathan Burke [mailto:jonathan.burke@ocsc.ie]
Sent: 19 October 2017 16:20
To: Noel McEvoy
Cc: Anthony Horan
Subject: FW: St. Pauls Raheny (N251) - Naniken River

Noel,

Following on from the below correspondence.

We have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised consent will be required from DCC Parks & Landscape Services Division.

Please find attached the proposed headwall outfall to the Naniken Stream for review and comment.

Drawing N251-H02 attached shows the outfall route for agreement.

Drawing N251-H05 shows the proposed headwall detail for agreement.

Regards,

Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: Noel McEvoy [mailto:noel.mcevoy@dublincity.ie]
Sent: 18 August 2017 15:51
To: Anton Lennon <anton.lennon@ocsc.ie>
Cc: John Stack <john.stack@dublincity.ie>
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hello Anton

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Regards

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Act Senior Executive Parks Superintendent
Dublin City Council
Civic Offices
Wood Quay
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I

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 17 August 2017 15:40
To: Noel McEvoy
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Noel,

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From: Anton Lennon
Sent: 09 August 2017 14:14
To: 'Noel McEvoy'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Noel,

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From: Anton Lennon
Sent: 03 August 2017 13:43
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Noel,

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Jonathan Burke

From: Kieran O'Neill <kieran.oneill@dublincity.ie>
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Categories: Gekko

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Sent: 09 November 2017 11:07
To: Kieran O'Neill
Cc: Leslie Moore; Thomas Burns; thetreefile@eircom.net; Anthony Horan
Subject: RE: St. Pauls Raheny (N251) - Naniken River

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Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: Kieran O'Neill [mailto:kieran.oneill@dublincity.ie]
Sent: 25 October 2017 12:23
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Cc: Leslie Moore <leslie.moore@dublincity.ie>
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Subject: RE: St. Pauls Raheny (N251) - Naniken River

Jonathan can you re send drawings pl. Les

Leslie Moore,
City Parks Superintendent.

Parks & Landscape Services
Culture, Recreation & Economic Servicess Department
Block 4, Ground Floor| Civic Offices, Wood Quay, Dublin 8.

T: +353 1 2225049 F: +353 1 2222668
E: leslie.moore@dublincity.ie | W: www.dublincity.ie

From: Noel McEvoy
Sent: 19 October 2017 17:19
To: 'Jonathan Burke'
Cc: Kieran O'Neill; Leslie Moore; John Stack
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hello Jonathan

I am forwarding your drawings onto Kieran O'Neil our Senior landscape Architect and Leslie Moore Senior Parks Superintendent for the city.
Both gentlemen are closely involved with the evolving proposals regarding the St Pauls site .

However my response to Anton Lennon is below and makes reference to the release of waste water into the Dublin Bay Biosphere and possible remediation by creating a Constructed wetland to deal with the pollution load. I have had no response to this and I am afraid your drawings do not allude to this it only shows me how you are going to eventfully dump waste water into the nanakin after it has gone through a suds system it does not offer any solutions to the waste water which will eventually enter into the Nature reserve lagoon until this is sorted out and agreed upon I see little sense in providing such drawings.

Kind Regards

Noel

Noel McEvoy
Executive Parks Superintendent
Dublin City Council
Civic Offices
Wood Quay
Dublin 8.

From: Jonathan Burke [mailto:jonathan.burke@ocsc.ie]
Sent: 19 October 2017 16:20
To: Noel McEvoy
Cc: Anthony Horan
Subject: FW: St. Pauls Raheny (N251) - Naniken River

Noel,

Following on from the below correspondence.

We have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised consent will be required from DCC Parks & Landscape Services Division.

Please find attached the proposed headwall outfall to the Naniken Stream for review and comment.

Drawing N251-H02 attached shows the outfall route for agreement.

Drawing N251-H05 shows the proposed headwall detail for agreement.

Regards,

Jonathan Burke

Civil Engineer
For O'Connor Sutton Cronin

From: Noel McEvoy [mailto:noel.mcevoy@dublincity.ie]
Sent: 18 August 2017 15:51
To: Anton Lennon <anton.lennon@ocsc.ie>
Cc: John Stack <john.stack@dublincity.ie>
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hello Anton

As you know the Nanakin river frequently floods down onto the James Larkin Road and has indeed blocked the road to traffic and flooded the Chestnut meadow and flooded into the park lodge causing major expense all this without the added volume and load that the proposed development will have.
The Naniken river enters the Bay at the heart of the Dublin Bay Biosphere right into the lagoon of the Bull island Nature Reserve Ramsar site,. Such a proposal I would expect will require an Appropriate assessment and an Environmental impact assessment regarding the additional pollutants being disposed of into the Biosphere.
As a method to mediate against pollution entering into the lagoon there may be the possibility of dealing with the pollutants in St Annes park by creating a Constructed Wetland which if designed and constructed properly could deal with the organic load and other pollutants such a sensitivity and fragile site. However this solution A Constructed Wetland would have to be agreed with Senior Parks Officials and DCC Environmental Biodiversity team and DCC Engineers the necessary resources and finance would also have to be made available to build the system.

Regards

Noel

Noel McEvoy
Act Senior Executive Parks Superintendent
Dublin City Council
Civic Offices
Wood Quay
Dublin 8.

I

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 17 August 2017 15:40
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

Peter Glynn (DCC Drainage) advised that you were the relevant person to contact, however if this is not the case if you could please advise of the more appropriate persons contact details and I will contact?

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

Associate
Chartered Engineer
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Dublin | London | Belfast | Galway | Cork | Glasgow

From: Anton Lennon
Sent: 09 August 2017 14:14
To: 'Noel McEvoy'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

FYI – we have met with John Stack (DCC Pollution Control) and had correspondence from David Dunne (DCC Regional Projects & Flood Advisory Section) in which they have outlined their requirements regarding the proposals for the proposed development and for which we are currently addressing.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

Associate
Chartered Engineer
BEng P. Grad. Dip. (Environmental) CEng MIEI
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From: Anton Lennon
Sent: 03 August 2017 13:43
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Noel,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

14. The applicant shall submit the following information required by the Drainage Division: The applicant shall consult with the Drainage Division of Dublin City Council prior to the submission of revised plans to ensure all drainage issues are addressed.

-Due to flooding issues downstream of the proposed site as shown in the GDSDS 2031 system performance model the applicant is requested to submitted revised details showing all surface water from the proposed development being discharge to the Naniken river and not to the public sewer network.

That application was subsequently withdrawn by the applicant.

I have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised that in order to progress the investigation of the connection for the surface water discharge to the Naniken River consent will be required from DCC Parks & Landscape Services Division. To this end please find attached the proposals at this time for your review and comment. I am available to meet and discuss at your convenience.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Chartered Engineer
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Anton Lennon

From: Conor McLoughlin
Sent: 04 April 2016 16:58
To: Anton Lennon
Cc: Sarah Walsh
Subject: FW: St. Pauls, Sybil hill road, Dublin

Anton/Sarah,

See below response from DCC.

Kind Regards,
Conor Mc Loughlin
B.E(Civil), M.I.E.I
Civil Engineer
Tel: +353 18682000
Ext: 342

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From: Peter Glynn [mailto:peter.glynn@dublincity.ie]
Sent: 04 April 2016 16:16
To: Conor McLoughlin <conor.mcloughlin@ocsc.ie>
Cc: Gerard Doherty <gerry.doherty@dublincity.ie>
Subject: RE: St. Pauls, Sybil hill road, Dublin

Conor,

This is the NDDS trunk sewer according to our maintenance section which runs half full during DWF, so you possibly won't be able to do a CCTV. If alternatively a clear method statement is included with the A.I. request stating that the sewer shall be protecting during construction works by a hoarding to ensure no loading is placed on it. Revised drainage drawings should also be submitted showing the exact location of this existing sewer and the loading/hoarding protection area of 6 meters either side of it (as its pipe diameter is 1.3 meters and there is a five meters clear distance requirement for trunk sewer).

Regards,
Peter

| **Peter Glynn** | Executive Engineer | Planning & Developer Services | Asset Management | Environment and Transportation Department | Dublin City Council | Floor 4 Block 1 | Civic Offices | Wood Quay | Dublin 8
| : Dublin City Council | Block 1 Floor 4 | Civic Offices | Fishamble Street | Dublin 8 | Ireland
| : 00353 1 222 3724 | : 00353 1 222 2300 | peter.glynn@dublincity.ie | : www.dublincity.ie

From: Conor McLoughlin [mailto:conor.mcloughlin@ocsc.ie]
Sent: 04 April 2016 13:00
To: Gerard Doherty; maria.tracey@dublincity.ie
Cc: Anton Lennon; Sarah Walsh
Subject: St. Pauls, Sybil hill road, Dublin

Gerry/Maria,

I am referring to planning application no. 4185/15, decision order P0504, point 14. Which requires a pre-construction CCTV of the NDDS main running through the site. We have commissioned McBreen Environmental to carry out the survey however they were unable to access the sewer due to the fact it is running at full bore. See attached images. Is it possible to temporarily plug the sewer in order to carry out the requested work? Can you advise any other possible solution to this problem.

Kind Regards,

Conor Mc Loughlin
B.E(Civil), M.I.E.I
Civil Engineer
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Jonathan Burke

From: Anton Lennon
Sent: 09 August 2017 14:14
To: 'Noel McEvoy'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Categories: Gekko

Noel,

Just following up on my email below. We are available to meet and discuss at your convenience.

FYI – we have met with John Stack (DCC Pollution Control) and had correspondence from David Dunne (DCC Regional Projects & Flood Advisory Section) in which they have outlined their requirements regarding the proposals for the proposed development and for which we are currently addressing.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

Associate
Chartered Engineer
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From: Anton Lennon
Sent: 03 August 2017 13:43
To: Noel McEvoy
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Noel,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

14. The applicant shall submit the following information required by the Drainage Division: The applicant shall consult with the Drainage Division of Dublin City Council prior to the submission of revised plans to ensure all drainage issues are addressed.

-Due to flooding issues downstream of the proposed site as shown in the GDSDS 2031 system performance model the applicant is requested to submitted revised details showing all surface water from the proposed development being discharge to the Naniken river and not to the public sewer network.

That application was subsequently withdrawn by the applicant.

I have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised that in order to progress the investigation of the connection for the surface water discharge to the Naniken River consent will be required from DCC Parks & Landscape Services Division. To this end please find attached the proposals at this time for your review and comment. I am available to meet and discuss at your convenience.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Jonathan Burke

From: Anton Lennon
Sent: 04 August 2017 11:44
To: 'David Dunne'
Cc: Gerard O'Connell; Peter Glynn; Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Categories: Gekko

David,

Thank for the call and reply below. I can confirm that we are complying with your conditions as outlined below. As mentioned, further to a meeting we had with John Stack of DCC Pollution Control we are preparing a response outlining the green infrastructure that will be incorporated as part of the drainage strategy for the proposed development – we will include yourself on this response.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Chartered Engineer
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From: David Dunne [mailto:David.Dunne@dublincity.ie]
Sent: 04 August 2017 11:22
To: Anton Lennon
Cc: Gerard O'Connell; Peter Glynn
Subject: St. Pauls Raheny (N251) - Naniken River

Anton,

I met with the Engineer-in-Charge, Gerry O'Connell, here in the Regional Projects and Flood Advisory Office regarding your query about the discharge of surface water to the River Naniken from the proposed development just off Sybil Rd. Raheny.
At the moment, there is a real danger of road flooding on Clontarf Rd and surface water flooding within Ann's Park from the River Naniken. We have carried out recent re-modelling works on the River Nankien and improvements works are proposed to take place in the not too distant future. Taking this into consideration we believe it would be best if surface water discharge did not exceed current regulations. Normal surface water from the area of the proposed site can be discharged to the River Naniken and any additional surface water, exceeding the permitted allowance of 2 litters/Hector/1 second, is to be contained on site using some form of acceptable rain harvesting.

Regards,
David Dunne

David Dunne | Executive Engineer | **Regional Projects & Flood Advisory Section - Projects Division (FDU)**
Environment and Transportation Department, Dublin City Council,
68/70 Marrowbone Lane, Dublin 8, Ireland.

Mob +353 87 7809350 | Landline +353 1 222 4432
E-mail david.dunne@dublincity.ie | Web www.dublincity.ie

Jonathan Burke

From:	John Stack <john.stack@dublincity.ie>
Sent:	27 July 2017 13:30
To:	Anton Lennon; Jonathan Burke
Subject:	RE: St. Pauls Raheny (N251) - Naniken River
Categories:	Gekko

Hi Anton/Jonathan,

Further to our meeting on the 25th July 2017, can you address the following points please:

- Prevention of scour of the river channel of the Nannikan – scour of the river channel is a concern for the Water Pollution Control Section and I would expect to see measures, up to and including additional attenuation/GI infrastructure, to prevent this from occurring, particularly in light of the proposed flow rate. Please indicate how you propose to prevent scouring of the river channel as a result of the discharge or urban runoff/storm water from the proposed development.
- Dublin City Council is currently developing a plan for the restoration of the River Santry and Nannikan Stream. The principle aims of the plan are to achieve good status under Water Framework Directive, reduce flooding risk and enhance amenity value of the catchment through the use of Green Infrastructure. In that regard, please note:
    - The Nannikan has a history of flooding near the James Larkin Road. As your site is a green field site, its development as a residential area will increase the flow to the river during wet weather, potentially increasing the flood risk. In light of this, I have concerns about the proposed discharge rate to the River (up to 17.5 l/s). Please comment and explain how the development will *not* contribute an increased flood risk to the Nannikan. Again, as mitigation, additional retention of storm water on site may be required.
    - Dublin City Council has identified urban runoff (i.e. contaminated storm runoff) as a significant pressure on urban surface waters. In light of this, please demonstrate that the runoff from the development will not add an increased pollution load to the Nannikan. Factors to consider include the impact of bird and animal faeces, oils, heavy metals and priority substances from vehicles, sediments, etc.
- At the meeting on the 25th July 2017, you had drawings showing the detail of some of the Green Infrastructure that you are proposing to use. Can you send those drawings to me please? Electronic copies are fine.

Please be aware that the meeting on the 25th July 2017 addressed *only* those issues raised by the Water Pollution Control Section. As per the e-mail of the Peter Glynn on the 19th July 2017, you will need to discuss the application with various other Sections of Dublin City Council.

Regards,

John

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 21 July 2017 15:54
To: John Stack
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

John,

To confirm 11am on Tuesday – if you could forward a location please?

Regards
Anton Lennon

Associate
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BEng CEng MIEI
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Dublin Office
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From: Anton Lennon
Sent: 21 July 2017 15:19
To: 'John Stack'
Cc: Mark Chambers; Jonathan Burke
Subject: RE: St. Pauls Raheny (N251) - Naniken River

John,

Absolutely, I am available on Monday morning to meet?

Regards
Anton Lennon

Associate
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BEng CEng MIEI
PH: +353 1 8682000

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W: www.ocsc.ie

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From: John Stack [mailto:john.stack@dublincity.ie]
Sent: 21 July 2017 15:17
To: Anton Lennon
Subject: RE: St. Pauls Raheny (N251) - Naniken River

Hi Anton,

Could we meet next week some time? What would suit you?

Regards,

John

From: Anton Lennon [mailto:anton.lennon@ocsc.ie]
Sent: 20 July 2017 11:38
To: John Stack
Cc: Mark Chambers; Jonathan Burke
Subject: FW: St. Pauls Raheny (N251) - Naniken River

John,

Thank you for taking my call. Please find below email sent to Pat this morning if you could review and comment as appropriate that would be appreciated.

Regards
Anton Lennon

Associate
Chartered Engineer
BEng CEng MIEI
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From: Anton Lennon
Sent: 20 July 2017 10:02
To: Pat O'Halloran
Cc: Mark Chambers; Jonathan Burke
Subject: St. Pauls Raheny (N251) - Naniken River

Pat,

We are progressing a planning application for a site off Sybil Hill Road in Raheny to be submitted under the Planning and Development (Strategic Housing Development) Regulations 2017. An application was submitted previously (Reg. Ref. 4185/15) during which an RFI was received as follows:

14. The applicant shall submit the following information required by the Drainage Division:
The applicant shall consult with the Drainage Division of Dublin City Council prior to the submission of revised plans to ensure all drainage issues are addressed.

-Due to flooding issues downstream of the proposed site as shown in the GDSDS 2031 system performance model the applicant is requested to submitted revised details showing all surface water from the proposed development being discharge to the Naniken river and not to the public sewer network.

That application was subsequently withdrawn by the applicant.

I have been in contact with Peter Glynn (DCC Drainage Planning) and he has advised that in order to progress the investigation of the connection for the surface water discharge to the Naniken River discussion will be required with

DCC Pollution Control. To this end please find attached the proposals at this time for your review and comment. I am available to meet and discuss at your convenience.

If you have any queries please don't hesitate to contact me.

Regards
Anton Lennon

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Chartered Engineer
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Jonathan Burke

Subject: FW: Irish Water St. Paul's Residential ref

From: newconnections@water.ie [mailto:newconnections@water.ie]
Sent: 03 August 2017 15:36
To: Jonathan Burke <jonathan.burke@ocsc.ie>
Subject: Irish Water Ref: 1000473903

Irish Water Reference Number: 8268701215

Dear Mr Burke,

Thank you for submitting your Pre Connection Enquiry for St. Paul's College, Sybill Hill Road, Dublin 15.

I have passed your request to the relevant department within Irish Water and when further information becomes available a member of our team will be in contact with you. Your Irish Water reference for your request is 8268701215, which you can keep for your own records.

If you have any further queries please contact us on 1850 278 278 (minicom 1890 378 378); alternatively, you can visit the Help Centre on our website, www.water.ie.

Please do not amend this subject line as it will help us deal with your response.

Kind Regards,

Daniel Hyde
Customer Service Advisor

Uisce Éireann
Bosca OP 860, Oifig Sheachadta na Cathrach Theas, Cathair Chorcaí, Éire
Irish Water
PO Box 860, South City Delivery Office, Cork City, Ireland

T: 1890 278 278
Minicom: 1890 378 378
www.water.ie

- Last Email Communication -
From: jonathan.burke@ocsc.ie

To: newconnections@water.ie Cc: Anton Lennon , Mark Chambers

Subject: St. Paul's Residential Development, Sybil Road, Raheny

To Whom it may concern, Please find attached a PCE for the above development. Regards, Jonathan Burke Civil Engineer Ph: +353 (0)1 868 2000 [h] ________________________________ This email is securely filed using Gekko, a Cubic Interactive Ltd product. [OCSC: N251]

APPENDIX B – STORM WATER CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes GDSDS Manhole Sizes GDSDS

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	4.000
M5-60 (mm)	15.600	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.276	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	20	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.000		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.100	4-8	1.795	8-12	0.567

Total Area Contributing (ha) = 2.462

Total Pipe Volume (m^3) = 104.526

Network Design Table for Storm

Network Design Table for Storm

- Indicates pipe length does not match coordinates
« - 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
S1.000	22.741	0.168	135.0	0.069	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	34.761	0.348	100.0	0.051	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	38.051	0.381	100.0	0.049	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	26.400	0.352	75.0	0.060	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	27.924	0.279	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	18.310	0.183	100.0	0.030	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	11.055	0.055	200.0	0.084	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)
S1.000	50.00	4.34	23.650	0.069	0.0	0.0	1.9	1.12	44.7	11.2
S1.001	50.00	4.78	23.482	0.120	0.0	0.0	3.3	1.31	52.0	19.5
S1.002	50.00	5.27	23.134	0.169	0.0	0.0	4.6	1.31	52.0	27.5
S1.003	50.00	5.56	22.753	0.230	0.0	0.0	6.2	1.51	60.1	37.3
S1.004	50.00	5.91	22.401	0.230	0.0	0.0	6.2	1.31	52.0	37.3
S1.005	50.00	6.15	22.122	0.260	0.0	0.0	7.0	1.31	52.0	42.2
S2.000	50.00	4.17	22.290	0.084	0.0	0.0	2.3	1.11	78.3	13.6

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
S2.001	44.835	0.224	200.0	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	8.485	0.042	200.0	0.071	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.003	20.115	0.101	200.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	28.970	0.145	200.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.006	42.522	0.213	200.0	0.067	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.007	23.903	0.120	200.0	0.291	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.008	23.009	0.115	200.1	0.158	0.00	0.0	0.600	o	450	Pipe/Conduit	
S3.000	3.057	0.020	152.9	0.000	4.00	0.0	0.600	o	225	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)
S2.001	50.00	4.84	22.235	0.169	0.0	0.0	4.6	1.11	78.3	27.5
S2.002	50.00	4.97	22.011	0.240	0.0	0.0	6.5	1.11	78.3	38.9
S2.003	50.00	5.27	21.968	0.274	0.0	0.0	7.4	1.11	78.3	44.6
S2.004	50.00	5.71	21.868	0.302	0.0	0.0	8.2	1.11	78.3	49.1
S1.006	50.00	6.70	21.648	0.629	0.0	0.0	17.0	1.28	141.1	102.2
S1.007	50.00	6.98	21.360	0.920	0.0	0.0	24.9	1.43	228.1	149.5
S1.008	50.00	7.25	21.241	1.078	0.0	0.0	29.2	1.43	228.0	175.1
S3.000	50.00	4.05	21.340	0.000	0.0	0.0	0.0	1.06	42.0	0.0

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
S3.001	32.026	0.214	150.0	0.103	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.009	46.658	0.187	249.5	0.130	0.00	0.0	0.600	o	525	Pipe/Conduit	
S4.000	7.971	0.040	200.0	0.000	4.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	2.771	0.042	66.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	27.025	0.180	150.0	0.108	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.010	37.695	0.126	300.0	0.165	0.00	0.0	0.600	o	525	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)
S3.001	50.00	4.55	21.320	0.103	0.0	0.0	2.8	1.07	42.4	16.7
S1.009	48.97	7.80	20.806	1.311	0.0	0.0	34.8	1.41	306.0	208.7
S4.000	50.00	4.12	22.300	0.000	0.0	0.0	0.0	1.11	78.3	0.0
S5.000	50.00	4.03	21.340	0.000	0.0	0.0	0.0	1.61	64.1	0.0
S5.001	50.00	4.45	21.298	0.108	0.0	0.0	2.9	1.07	42.4	17.6
S1.010	47.68	8.28	20.619	1.584	0.0	0.0	40.9	1.29	278.8	245.5

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
S6.000	7.062	0.047	150.0	0.000	4.00	0.0	0.600	o	300	Pipe/Conduit	
S7.000	2.750	0.018	150.0	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
S7.001	34.088	0.227	150.2	0.110	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.011	44.256	0.221	200.3	0.093	0.00	0.0	0.600	o	525	Pipe/Conduit	
S8.000	20.820	0.139	149.8	0.000	4.00	0.0	0.600	o	225	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)
S6.000	50.00	4.09	22.300	0.000	0.0	0.0	0.0	1.28	90.6	0.0
S7.000	50.00	4.04	21.316	0.000	0.0	0.0	0.0	1.07	42.4	0.0
S7.001	50.00	4.58	21.298	0.110	0.0	0.0	3.0	1.06	42.3	17.8
S1.011	46.52	8.75	20.494	1.787	0.0	0.0	45.0	1.58	341.9	270.2
S8.000	50.00	4.33	21.550	0.000	0.0	0.0	0.0	1.07	42.4	0.0

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
S1.012	19.724	0.131	150.0	0.039	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.013	28.184	0.075	375.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.014	2.000#	0.001	2000.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S9.000	42.070	0.210	200.0	0.130	4.00	0.0	0.600	o	300	Pipe/Conduit	
S9.001	52.862	0.264	200.0	0.224	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.002	63.336	0.317	200.0	0.197	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.003	9.016	0.045	200.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S9.004	34.122	0.227	150.0	0.085	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.012	46.09	8.93	20.273	1.826	0.0	0.0	45.6	1.83	395.4	273.5
S1.013	45.23	9.31	20.066	1.826	0.0	0.0	45.6	1.25	353.9	273.5
S1.014	45.06	9.38	19.033	1.826	0.0	0.0	45.6	0.45	70.8«	273.5
S9.000	50.00	4.63	21.400	0.130	0.0	0.0	3.5	1.11	78.3	21.2
S9.001	50.00	5.43	21.190	0.355	0.0	0.0	9.6	1.11	78.3	57.6
S9.002	50.00	6.25	20.850	0.551	0.0	0.0	14.9	1.28	141.1	89.6
S9.003	50.00	6.37	20.534	0.551	0.0	0.0	14.9	1.28	141.1	89.6
S9.004	50.00	6.82	20.564	0.636	0.0	0.0	17.2	1.28	90.6«	103.4

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
S1.015	22.659	0.070	323.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.016	51.193	0.158	325.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.017	41.432	0.127	325.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.018	6.162	0.019	325.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.019	7.266	0.022	325.0	0.000	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)
S1.015	50.00	4.38	19.032	0.000	9.2	0.0	1.5	1.00	110.6	9.2
S1.016	50.00	5.23	18.962	0.000	9.2	0.0	1.8	1.00	110.4	11.0
S1.017	50.00	5.92	18.804	0.000	9.2	0.0	1.8	1.00	110.4	11.0
S1.018	50.00	6.02	18.677	0.000	9.2	0.0	1.8	1.00	110.4	11.0
S1.019	50.00	6.15	18.658	0.000	9.2	0.0	1.8	1.00	110.4	11.0

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	25.264	1.614	Open Manhole	1360 x 1360	S1.000	23.650	225				
S2	24.912	1.430	Open Manhole	1360 x 1360	S1.001	23.482	225	S1.000	23.482	225	
S3	24.585	1.451	Open Manhole	1360 x 1360	S1.002	23.134	225	S1.001	23.134	225	
S4	24.412	1.659	Open Manhole	1360 x 1360	S1.003	22.753	225	S1.002	22.753	225	
S5	23.833	1.432	Open Manhole	1360 x 1360	S1.004	22.401	225	S1.003	22.401	225	
S6	23.173	1.051	Open Manhole	1360 x 1360	S1.005	22.122	225	S1.004	22.122	225	
S7	23.500	1.210	Open Manhole	1360 x 1360	S2.000	22.290	300				
S8	24.000	1.765	Open Manhole	1360 x 1360	S2.001	22.235	300	S2.000	22.235	300	
S9	24.000	1.989	Open Manhole	1360 x 1360	S2.002	22.011	300	S2.001	22.011	300	
S10	24.000	2.032	Open Manhole	1360 x 1360	S2.003	21.968	300	S2.002	21.968	300	
S11	24.000	2.132	Open Manhole	1360 x 1360	S2.004	21.868	300	S2.003	21.868	300	
S12	23.202	1.554	Open Manhole	1360 x 1360	S1.006	21.648	375	S1.005	21.939	225	141
								S2.004	21.723	300	
S13	23.206	1.846	Open Manhole	1360 x 1360	S1.007	21.360	450	S1.006	21.435	375	
S14	23.086	1.845	Open Manhole	1360 x 1360	S1.008	21.241	450	S1.007	21.241	450	
S15	23.285	1.945	Open Manhole	1360 x 1360	S3.000	21.340	225				
S16	23.064	1.744	Open Manhole	1360 x 1360	S3.001	21.320	225	S3.000	21.320	225	
S17	23.064	2.258	Open Manhole	1810 x 1810	S1.009	20.806	525	S1.008	21.126	450	244
								S3.001	21.106	225	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S18	23.250	0.950	Open Manhole	1360 x 1360	S4.000	22.300	300				
S19	22.750	1.410	Open Manhole	1360 x 1360	S5.000	21.340	225				
S20	22.750	1.452	Open Manhole	1360 x 1360	S5.001	21.298	225	S5.000	21.298	225	
S21	23.075	2.456	Open Manhole	1810 x 1810	S1.010	20.619	525	S1.009	20.619	525	
								S4.000	22.260	300	1416
								S5.001	21.118	225	198
S22	23.250	0.950	Open Manhole	1360 x 1360	S6.000	22.300	300				
S23	22.750	1.434	Open Manhole	1360 x 1360	S7.000	21.316	225				
S24	22.750	1.452	Open Manhole	1360 x 1360	S7.001	21.298	225	S7.000	21.298	225	
S25	23.075	2.581	Open Manhole	1810 x 1810	S1.011	20.494	525	S1.010	20.494	525	
								S6.000	22.253	300	1534
								S7.001	21.071	225	277
S26	22.750	1.200	Open Manhole	1360 x 1360	S8.000	21.550	225				
S27	23.075	2.802	Open Manhole	1810 x 1810	S1.012	20.273	525	S1.011	20.273	525	
								S8.000	21.411	225	838
S28	23.075	3.009	Open Manhole	1810 x 1810	S1.013	20.066	600	S1.012	20.141	525	
S29	21.937	2.904	Open Manhole	1810 x 1810	S1.014	19.033	450	S1.013	19.991	600	1108
S30	23.400	2.000	Open Manhole	1360 x 1360	S9.000	21.400	300				
S31	23.200	2.010	Open Manhole	1360 x 1360	S9.001	21.190	300	S9.000	21.190	300	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S32	23.000	2.150	Open Manhole	1360 x 1360	S9.002	20.850	375	S9.001	20.925	300	
S33	22.600	2.066	Open Manhole	1360 x 1360	S9.003	20.534	375	S9.002	20.534	375	
S34	22.000	1.511	Open Manhole	1360 x 1360	S9.004	20.564	300	S9.003	20.489	375	
S35	21.730	2.698	Open Manhole	1360 x 1360	S1.015	19.032	375	S1.014	19.032	450	
								S9.004	20.337	300	1230
S36	21.570	2.608	Open Manhole	1360 x 1360	S1.016	18.962	375	S1.015	18.962	375	
S37	21.090	2.286	Open Manhole	1360 x 1360	S1.017	18.804	375	S1.016	18.804	375	
S38	20.150	1.473	Open Manhole	1360 x 1360	S1.018	18.677	375	S1.017	18.677	375	
S39	20.150	1.492	Open Manhole	1360 x 1360	S1.019	18.658	375	S1.018	18.658	375	
S	20.150	1.514	Open Manhole	0		OUTFALL		S1.019	18.636	375	

PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S1	25.264	23.650	1.389	Open Manhole	1360 x 1360
S1.001	o	225	S2	24.912	23.482	1.205	Open Manhole	1360 x 1360
S1.002	o	225	S3	24.585	23.134	1.226	Open Manhole	1360 x 1360
S1.003	o	225	S4	24.412	22.753	1.434	Open Manhole	1360 x 1360
S1.004	o	225	S5	23.833	22.401	1.207	Open Manhole	1360 x 1360
S1.005	o	225	S6	23.173	22.122	0.826	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	22.741	135.0	S2	24.912	23.482	1.205	Open Manhole	1360 x 1360
S1.001	34.761	100.0	S3	24.585	23.134	1.226	Open Manhole	1360 x 1360
S1.002	38.051	100.0	S4	24.412	22.753	1.434	Open Manhole	1360 x 1360
S1.003	26.400	75.0	S5	23.833	22.401	1.207	Open Manhole	1360 x 1360
S1.004	27.924	100.0	S6	23.173	22.122	0.826	Open Manhole	1360 x 1360
S1.005	18.310	100.0	S12	23.202	21.939	1.038	Open Manhole	1360 x 1360

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	o	300	S7	23.500	22.290	0.910	Open Manhole	1360 x 1360
S2.001	o	300	S8	24.000	22.235	1.465	Open Manhole	1360 x 1360
S2.002	o	300	S9	24.000	22.011	1.689	Open Manhole	1360 x 1360
S2.003	o	300	S10	24.000	21.968	1.732	Open Manhole	1360 x 1360
S2.004	o	300	S11	24.000	21.868	1.832	Open Manhole	1360 x 1360
S1.006	o	375	S12	23.202	21.648	1.179	Open Manhole	1360 x 1360
S1.007	o	450	S13	23.206	21.360	1.396	Open Manhole	1360 x 1360
S1.008	o	450	S14	23.086	21.241	1.395	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	11.055	200.0	S8	24.000	22.235	1.465	Open Manhole	1360 x 1360
S2.001	44.835	200.0	S9	24.000	22.011	1.689	Open Manhole	1360 x 1360
S2.002	8.485	200.0	S10	24.000	21.968	1.732	Open Manhole	1360 x 1360
S2.003	20.115	200.0	S11	24.000	21.868	1.832	Open Manhole	1360 x 1360
S2.004	28.970	200.0	S12	23.202	21.723	1.179	Open Manhole	1360 x 1360
S1.006	42.522	200.0	S13	23.206	21.435	1.396	Open Manhole	1360 x 1360
S1.007	23.903	200.0	S14	23.086	21.241	1.395	Open Manhole	1360 x 1360
S1.008	23.009	200.1	S17	23.064	21.126	1.488	Open Manhole	1810 x 1810

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	o	225	S15	23.285	21.340	1.720	Open Manhole	1360 x 1360
S3.001	o	225	S16	23.064	21.320	1.519	Open Manhole	1360 x 1360
S1.009	o	525	S17	23.064	20.806	1.733	Open Manhole	1810 x 1810
S4.000	o	300	S18	23.250	22.300	0.650	Open Manhole	1360 x 1360
S5.000	o	225	S19	22.750	21.340	1.185	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S3.000	3.057	152.9	S16	23.064	21.320	1.519	Open Manhole	1360 x 1360
S3.001	32.026	150.0	S17	23.064	21.106	1.733	Open Manhole	1810 x 1810
S1.009	46.658	249.5	S21	23.075	20.619	1.931	Open Manhole	1810 x 1810
S4.000	7.971	200.0	S21	23.075	22.260	0.515	Open Manhole	1810 x 1810
S5.000	2.771	66.0	S20	22.750	21.298	1.227	Open Manhole	1360 x 1360

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S5.001	o	225	S20	22.750	21.298	1.227	Open Manhole	1360 x 1360
S1.010	o	525	S21	23.075	20.619	1.931	Open Manhole	1810 x 1810
S6.000	o	300	S22	23.250	22.300	0.650	Open Manhole	1360 x 1360
S7.000	o	225	S23	22.750	21.316	1.209	Open Manhole	1360 x 1360
S7.001	o	225	S24	22.750	21.298	1.227	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S5.001	27.025	150.0	S21	23.075	21.118	1.732	Open Manhole	1810 x 1810
S1.010	37.695	300.0	S25	23.075	20.494	2.056	Open Manhole	1810 x 1810
S6.000	7.062	150.0	S25	23.075	22.253	0.522	Open Manhole	1810 x 1810
S7.000	2.750	150.0	S24	22.750	21.298	1.227	Open Manhole	1360 x 1360
S7.001	34.088	150.2	S25	23.075	21.071	1.779	Open Manhole	1810 x 1810

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.011	o	525	S25	23.075	20.494	2.056	Open Manhole	1810 x 1810
S8.000	o	225	S26	22.750	21.550	0.975	Open Manhole	1360 x 1360
S1.012	o	525	S27	23.075	20.273	2.277	Open Manhole	1810 x 1810
S1.013	o	600	S28	23.075	20.066	2.409	Open Manhole	1810 x 1810
S1.014	o	450	S29	21.937	19.033	2.454	Open Manhole	1810 x 1810
S9.000	o	300	S30	23.400	21.400	1.700	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.011	44.256	200.3	S27	23.075	20.273	2.277	Open Manhole	1810 x 1810
S8.000	20.820	149.8	S27	23.075	21.411	1.439	Open Manhole	1810 x 1810
S1.012	19.724	150.0	S28	23.075	20.141	2.409	Open Manhole	1810 x 1810
S1.013	28.184	375.0	S29	21.937	19.991	1.346	Open Manhole	1810 x 1810
S1.014	2.000#	2000.0	S35	21.730	19.032	2.248	Open Manhole	1360 x 1360
S9.000	42.070	200.0	S31	23.200	21.190	1.710	Open Manhole	1360 x 1360

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S9.001	o	300	S31	23.200	21.190	1.710	Open Manhole	1360 x 1360
S9.002	o	375	S32	23.000	20.850	1.775	Open Manhole	1360 x 1360
S9.003	o	375	S33	22.600	20.534	1.691	Open Manhole	1360 x 1360
S9.004	o	300	S34	22.000	20.564	1.136	Open Manhole	1360 x 1360
S1.015	o	375	S35	21.730	19.032	2.323	Open Manhole	1360 x 1360
S1.016	o	375	S36	21.570	18.962	2.233	Open Manhole	1360 x 1360
S1.017	o	375	S37	21.090	18.804	1.911	Open Manhole	1360 x 1360
S1.018	o	375	S38	20.150	18.677	1.098	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S9.001	52.862	200.0	S32	23.000	20.925	1.775	Open Manhole	1360 x 1360
S9.002	63.336	200.0	S33	22.600	20.534	1.691	Open Manhole	1360 x 1360
S9.003	9.016	200.0	S34	22.000	20.489	1.136	Open Manhole	1360 x 1360
S9.004	34.122	150.0	S35	21.730	20.337	1.093	Open Manhole	1360 x 1360
S1.015	22.659	323.7	S36	21.570	18.962	2.233	Open Manhole	1360 x 1360
S1.016	51.193	325.0	S37	21.090	18.804	1.911	Open Manhole	1360 x 1360
S1.017	41.432	325.0	S38	20.150	18.677	1.098	Open Manhole	1360 x 1360
S1.018	6.162	325.0	S39	20.150	18.658	1.117	Open Manhole	1360 x 1360

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.019	o	375	S39	20.150	18.658	1.117	Open Manhole	1360 x 1360

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.019	7.266	325.0	S	20.150	18.636	1.139	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.069	0.069	0.069
1.001	User	-	100	0.051	0.051	0.051
1.002	User	-	100	0.049	0.049	0.049
1.003	User	-	100	0.060	0.060	0.060
1.004	-	-	100	0.000	0.000	0.000
1.005	User	-	100	0.030	0.030	0.030
2.000	User	-	100	0.035	0.035	0.035
	User	-	100	0.049	0.049	0.084
2.001	User	-	100	0.041	0.041	0.041
	User	-	100	0.044	0.044	0.085
2.002	User	-	100	0.071	0.071	0.071
2.003	User	-	100	0.035	0.035	0.035
2.004	User	-	100	0.028	0.028	0.028
1.006	User	-	100	0.067	0.067	0.067
1.007	User	-	100	0.164	0.164	0.164
	User	-	100	0.127	0.127	0.291
1.008	User	-	100	0.158	0.158	0.158
3.000	-	-	100	0.000	0.000	0.000
3.001	User	-	100	0.103	0.103	0.103
1.009	User	-	100	0.018	0.018	0.018
	User	-	100	0.112	0.112	0.130
4.000	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.000	0.000	0.000
5.001	User	-	100	0.108	0.108	0.108
1.010	User	-	100	0.165	0.165	0.165
6.000	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
7.001	User	-	100	0.110	0.110	0.110
1.011	User	-	100	0.093	0.093	0.093
8.000	-	-	100	0.000	0.000	0.000
1.012	User	-	100	0.039	0.039	0.039
1.013	-	-	100	0.000	0.000	0.000
1.014	-	-	100	0.000	0.000	0.000
9.000	User	-	100	0.029	0.029	0.029
	User	-	100	0.101	0.101	0.130
9.001	User	-	100	0.079	0.079	0.079
	User	-	100	0.145	0.145	0.224
9.002	User	-	100	0.087	0.087	0.087
	User	-	100	0.110	0.110	0.197
9.003	-	-	100	0.000	0.000	0.000
9.004	User	-	100	0.085	0.085	0.085
1.015	-	-	100	0.000	0.000	0.000
1.016	-	-	100	0.000	0.000	0.000
1.017	-	-	100	0.000	0.000	0.000
1.018	-	-	100	0.000	0.000	0.000
1.019	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				2.462	2.462	2.462

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)
S1.019	S	20.150	18.636	0.000	0	0

Simulation Criteria for Storm

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	10
Number of Online Controls	1	Number of Storage Structures	3	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	15.600	Cv (Summer)	0.750
Return Period (years)	5	Ratio R	0.276	Cv (Winter)	0.840
Region	Scotland and Ireland	Profile Type	Summer	Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S35, DS/PN: S1.015, Volume (m³): 7.4

Unit Reference	MD-SHE-0131-9600-1800-9600	Sump Available	Yes
Design Head (m)	1.800	Diameter (mm)	131
Design Flow (l/s)	9.6	Invert Level (m)	19.032
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1500
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	9.6	Kick-Flo®	1.091	7.6
Flush-Flo™	0.526	9.6	Mean Flow over Head Range	-	8.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.600	9.6	1.600	9.1	2.600	11.4	5.000	15.6	7.500	18.9
0.200	8.3	0.800	9.2	1.800	9.6	3.000	12.2	5.500	16.3	8.000	19.5
0.300	9.1	1.000	8.4	2.000	10.1	3.500	13.1	6.000	17.0	8.500	20.1
0.400	9.5	1.200	7.9	2.200	10.5	4.000	14.0	6.500	17.7	9.000	20.6
0.500	9.6	1.400	8.5	2.400	11.0	4.500	14.8	7.000	18.3	9.500	21.2

Storage Structures for Storm

Complex Manhole: S13, DS/PN: S1.007

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	0.6	Slope (1:X)	0.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	15.0	Cap Volume Depth (m)	0.000
Safety Factor	2.0	Pipe Diameter (m)	0.300	Cap Infiltration Depth (m)	0.000
Porosity	0.30	Pipe Depth above Invert (m)	0.000		
Invert Level (m)	21.435	Number of Pipes	1		

Cellular Storage

Invert Level (m)	21.435	Infiltration Coefficient Side (m/hr)	0.00000	Porosity	0.30
Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	70.0	0.0	0.450	70.0	0.0	0.451	0.0	0.0

Complex Manhole: S16, DS/PN: S3.001

Cellular Storage

Invert Level (m) 21.320 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.30
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	388.0	0.0	0.450	388.0	0.0	0.451	0.0	0.0

Filter Drain

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	0.6	Slope (1:X)	0.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	80.0	Cap Volume Depth (m)	0.000
Safety Factor	2.0	Pipe Diameter (m)	0.300	Cap Infiltration Depth (m)	0.000
Porosity	0.30	Pipe Depth above Invert (m)	0.075		
Invert Level (m)	21.320	Number of Pipes	1		

Complex Manhole: S35, DS/PN: S1.015

Cellular Storage

Invert Level (m) 19.032 Infiltration Coefficient Side (m/hr) 0.00000 Porosity 0.60
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	1252.0	0.0	1.740	1252.0	0.0	1.741	0.0	0.0

Tank or Pond

Invert Level (m) 21.072

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1600.0	0.250	1600.0	0.251	0.0

Time Area Diagram for Green Roof at Pipe Number S2.001 (Storm)

Area (m³) 420 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.013847	20	24	0.001874	40	44	0.000254	60	64	0.000034	80	84	0.000005	100	104	0.000001
4	8	0.009282	24	28	0.001256	44	48	0.000170	64	68	0.000023	84	88	0.000003	104	108	0.000000
8	12	0.006222	28	32	0.000842	48	52	0.000114	68	72	0.000015	88	92	0.000002	108	112	0.000000
12	16	0.004171	32	36	0.000564	52	56	0.000076	72	76	0.000010	92	96	0.000001	112	116	0.000000
16	20	0.002796	36	40	0.000378	56	60	0.000051	76	80	0.000007	96	100	0.000001	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S2.004 (Storm)

Area (m³) 445 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.014671	8	12	0.006592	16	20	0.002962	24	28	0.001331	32	36	0.000598	40	44	0.000269
4	8	0.009834	12	16	0.004419	20	24	0.001985	28	32	0.000892	36	40	0.000401	44	48	0.000180

Time Area Diagram for Green Roof at Pipe Number S2.004 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
48	52	0.000121	60	64	0.000036	72	76	0.000011	84	88	0.000003	96	100	0.000001	108	112	0.000000
52	56	0.000081	64	68	0.000024	76	80	0.000007	88	92	0.000002	100	104	0.000001	112	116	0.000000
56	60	0.000054	68	72	0.000016	80	84	0.000005	92	96	0.000001	104	108	0.000000	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S3.000 (Storm)

Area (m³) 1376 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.045364	20	24	0.006139	40	44	0.000831	60	64	0.000112	80	84	0.000015	100	104	0.000002
4	8	0.030409	24	28	0.004115	44	48	0.000557	64	68	0.000075	84	88	0.000010	104	108	0.000001
8	12	0.020383	28	32	0.002759	48	52	0.000373	68	72	0.000051	88	92	0.000007	108	112	0.000001
12	16	0.013663	32	36	0.001849	52	56	0.000250	72	76	0.000034	92	96	0.000005	112	116	0.000001
16	20	0.009159	36	40	0.001240	56	60	0.000168	76	80	0.000023	96	100	0.000003	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S4.000 (Storm)

Area (m³) 1376 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.045364	4	8	0.030409	8	12	0.020383	12	16	0.013663	16	20	0.009159	20	24	0.006139

Time Area Diagram for Green Roof at Pipe Number S4.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
24	28	0.004115	40	44	0.000831	56	60	0.000168	72	76	0.000034	88	92	0.000007	104	108	0.000001
28	32	0.002759	44	48	0.000557	60	64	0.000112	76	80	0.000023	92	96	0.000005	108	112	0.000001
32	36	0.001849	48	52	0.000373	64	68	0.000075	80	84	0.000015	96	100	0.000003	112	116	0.000001
36	40	0.001240	52	56	0.000250	68	72	0.000051	84	88	0.000010	100	104	0.000002	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S5.000 (Storm)

Area (m³) 620 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.020440	20	24	0.002766	40	44	0.000374	60	64	0.000051	80	84	0.000007	100	104	0.000001
4	8	0.013702	24	28	0.001854	44	48	0.000251	64	68	0.000034	84	88	0.000005	104	108	0.000001
8	12	0.009184	28	32	0.001243	48	52	0.000168	68	72	0.000023	88	92	0.000003	108	112	0.000000
12	16	0.006156	32	36	0.000833	52	56	0.000113	72	76	0.000015	92	96	0.000002	112	116	0.000000
16	20	0.004127	36	40	0.000559	56	60	0.000076	76	80	0.000010	96	100	0.000001	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S7.000 (Storm)

Area (m³) 620 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time Area Diagram for Green Roof at Pipe Number S7.000 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.020440	20	24	0.002766	40	44	0.000374	60	64	0.000051	80	84	0.000007	100	104	0.000001
4	8	0.013702	24	28	0.001854	44	48	0.000251	64	68	0.000034	84	88	0.000005	104	108	0.000001
8	12	0.009184	28	32	0.001243	48	52	0.000168	68	72	0.000023	88	92	0.000003	108	112	0.000000
12	16	0.006156	32	36	0.000833	52	56	0.000113	72	76	0.000015	92	96	0.000002	112	116	0.000000
16	20	0.004127	36	40	0.000559	56	60	0.000076	76	80	0.000010	96	100	0.000001	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S9.000 (Storm)

Area (m^3) 230 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.007583	20	24	0.001026	40	44	0.000139	60	64	0.000019	80	84	0.000003	100	104	0.000000
4	8	0.005083	24	28	0.000688	44	48	0.000093	64	68	0.000013	84	88	0.000002	104	108	0.000000
8	12	0.003407	28	32	0.000461	48	52	0.000062	68	72	0.000008	88	92	0.000001	108	112	0.000000
12	16	0.002284	32	36	0.000309	52	56	0.000042	72	76	0.000006	92	96	0.000001	112	116	0.000000
16	20	0.001531	36	40	0.000207	56	60	0.000028	76	80	0.000004	96	100	0.000001	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S9.001 (Storm)

Area (m^3) 680 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time Area Diagram for Green Roof at Pipe Number S9.001 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.022418	20	24	0.003034	40	44	0.000411	60	64	0.000056	80	84	0.000008	100	104	0.000001
4	8	0.015027	24	28	0.002034	44	48	0.000275	64	68	0.000037	84	88	0.000005	104	108	0.000001
8	12	0.010073	28	32	0.001363	48	52	0.000184	68	72	0.000025	88	92	0.000003	108	112	0.000000
12	16	0.006752	32	36	0.000914	52	56	0.000124	72	76	0.000017	92	96	0.000002	112	116	0.000000
16	20	0.004526	36	40	0.000613	56	60	0.000083	76	80	0.000011	96	100	0.000002	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S9.002 (Storm)

Area (m^3) 680 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.022418	20	24	0.003034	40	44	0.000411	60	64	0.000056	80	84	0.000008	100	104	0.000001
4	8	0.015027	24	28	0.002034	44	48	0.000275	64	68	0.000037	84	88	0.000005	104	108	0.000001
8	12	0.010073	28	32	0.001363	48	52	0.000184	68	72	0.000025	88	92	0.000003	108	112	0.000000
12	16	0.006752	32	36	0.000914	52	56	0.000124	72	76	0.000017	92	96	0.000002	112	116	0.000000
16	20	0.004526	36	40	0.000613	56	60	0.000083	76	80	0.000011	96	100	0.000002	116	120	0.000000

Time Area Diagram for Green Roof at Pipe Number S9.004 (Storm)

Area (m^3) 538 Depression Storage (mm) 1 Evaporation (mm/day) 1 Decay Coefficient 0.100

Time Area Diagram for Green Roof at Pipe Number S9.004 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.017737	20	24	0.002400	40	44	0.000325	60	64	0.000044	80	84	0.000006	100	104	0.000001
4	8	0.011889	24	28	0.001609	44	48	0.000218	64	68	0.000029	84	88	0.000004	104	108	0.000001
8	12	0.007970	28	32	0.001079	48	52	0.000146	68	72	0.000020	88	92	0.000003	108	112	0.000000
12	16	0.005342	32	36	0.000723	52	56	0.000098	72	76	0.000013	92	96	0.000002	112	116	0.000000
16	20	0.003581	36	40	0.000485	56	60	0.000066	76	80	0.000009	96	100	0.000001	116	120	0.000000

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 10
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.600 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 10, 30, 100
Climate Change (%) 20, 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 1 year Winter I+20%	25.264	23.723	-0.152	0.000	0.23	0.125	4.097	9.3	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.001	S2	15 minute 1 year Winter I+20%	24.912	23.567	-0.140	0.000	0.30	0.221	7.166	14.7	OK
S1.002	S3	15 minute 1 year Winter I+20%	24.585	23.234	-0.125	0.000	0.40	0.241	10.095	19.8	OK
S1.003	S4	15 minute 1 year Winter I+20%	24.412	22.862	-0.116	0.000	0.46	0.271	13.692	25.7	OK
S1.004	S5	15 minute 1 year Winter I+20%	23.833	22.519	-0.107	0.000	0.53	0.284	13.693	25.8	OK
S1.005	S6	15 minute 1 year Winter I+20%	23.173	22.250	-0.097	0.000	0.61	0.356	15.487	28.5	OK
S2.000	S7	15 minute 1 year Summer I+20%	23.500	22.377	-0.213	0.000	0.19	0.152	4.451	11.4	OK
S2.001	S8	15 minute 1 year Winter I+20%	24.000	22.323	-0.212	0.000	0.18	0.256	7.046	13.3	OK
S2.002	S9	15 minute 1 year Winter I+20%	24.000	22.133	-0.178	0.000	0.34	0.502	11.253	20.2	OK
S2.003	S10	15 minute 1 year Winter I+20%	24.000	22.091	-0.177	0.000	0.35	0.346	13.317	23.9	OK
S2.004	S11	15 minute 1 year Winter I+20%	24.000	21.994	-0.174	0.000	0.37	0.490	15.492	26.0	OK
S1.006	S12	15 minute 1 year Winter I+20%	23.202	21.829	-0.193	0.000	0.46	0.542	34.970	59.9	OK
S1.007	S13	15 minute 1 year Winter I+20%	23.206	21.568	-0.242	0.000	0.44	4.216	52.300	82.8	OK
S1.008	S14	15 minute 1 year Winter I+20%	23.086	21.468	-0.223	0.000	0.50	1.592	61.709	95.2	OK
S3.000	S15	30 minute 1 year Winter I+20%	23.285	21.427	-0.138	0.000	0.32	0.151	9.787	8.5	OK
S3.001	S16	60 minute 1 year Winter I+20%	23.064	21.396	-0.149	0.000	0.25	10.120	24.458	10.0	OK
S1.009	S17	15 minute 1 year Winter I+20%	23.064	21.037	-0.295	0.000	0.39	0.739	82.224	107.0	OK
S4.000	S18	30 minute 1 year Winter I+20%	23.250	22.376	-0.224	0.000	0.15	0.131	9.787	8.5	OK
S5.000	S19	15 minute 1 year Winter I+20%	22.750	21.400	-0.165	0.000	0.13	0.102	3.040	3.7	OK
S5.001	S20	15 minute 1 year Winter I+20%	22.750	21.394	-0.129	0.000	0.37	0.185	9.479	14.7	OK
S1.010	S21	30 minute 1 year Winter I+20%	23.075	20.908	-0.236	0.000	0.58	4.165	150.230	139.9	OK
S6.000	S22	360 minute 1 year Winter I+20%	23.250	22.300	-0.300	0.000	0.00	0.000	0.000	0.0	OK
S7.000	S23	15 minute 1 year Winter I+20%	22.750	21.396	-0.145	0.000	0.14	0.139	3.040	3.8	OK
S7.001	S24	15 minute 1 year Winter I+20%	22.750	21.394	-0.129	0.000	0.38	0.184	9.572	15.0	OK
S1.011	S25	30 minute 1 year Winter I+20%	23.075	20.765	-0.254	0.000	0.53	3.690	171.202	158.3	OK
S8.000	S26	360 minute 1 year Winter I+20%	22.750	21.550	-0.225	0.000	0.00	0.000	0.000	0.0	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.012	S27	30 minute 1 year Winter I+20%	23.075	20.559	-0.239	0.000	0.58	3.622	174.380	160.7	OK
S1.013	S28	30 minute 1 year Winter I+20%	23.075	20.389	-0.278	0.000	0.56	2.202	174.377	160.6	OK
S1.014	S29	960 minute 1 year Winter I+20%	21.937	19.578	0.095	0.000	0.23	1.770	670.207	29.5	SURCHARGED
S9.000	S30	30 minute 1 year Winter I+20%	23.400	21.428	-0.272	0.000	0.02	0.042	1.636	1.4	OK
S9.001	S31	30 minute 1 year Winter I+20%	23.200	21.244	-0.246	0.000	0.08	0.173	6.472	5.6	OK
S9.002	S32	30 minute 1 year Winter I+20%	23.000	20.917	-0.308	0.000	0.07	0.117	11.307	9.6	OK
S9.003	S33	30 minute 1 year Winter I+20%	22.600	20.648	-0.261	0.000	0.09	0.470	11.219	9.6	OK
S9.004	S34	30 minute 1 year Winter I+20%	22.000	20.642	-0.222	0.000	0.15	0.493	14.776	12.7	OK
S1.015	S35	960 minute 1 year Winter I+20%	21.730	19.577	0.170	0.000	0.10	410.697	704.237	9.6	SURCHARGED
S1.016	S36	960 minute 1 year Winter I+20%	21.570	19.039	-0.298	0.000	0.09	0.324	704.146	9.6	OK
S1.017	S37	960 minute 1 year Winter I+20%	21.090	18.882	-0.298	0.000	0.10	0.356	704.055	9.6	OK
S1.018	S38	960 minute 1 year Winter I+20%	20.150	18.768	-0.284	0.000	0.13	0.422	703.959	9.6	OK
S1.019	S39	960 minute 1 year Winter I+20%	20.150	18.748	-0.285	0.000	0.13	0.209	703.886	9.6	OK

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 10
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.600 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 10, 30, 100
Climate Change (%) 20, 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 10 year Winter I+20%	25.264	23.749	-0.126	0.000	0.40	0.174	7.180	16.4	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.001	S2	15 minute 10 year Winter I+20%	24.912	23.605	-0.101	0.000	0.57	0.377	12.557	27.7	OK
S1.002	S3	15 minute 10 year Winter I+20%	24.585	23.288	-0.071	0.000	0.79	0.477	17.691	38.8	OK
S1.003	S4	15 minute 10 year Winter I+20%	24.412	22.929	-0.049	0.000	0.92	0.576	23.997	51.1	OK
S1.004	S5	15 minute 10 year Winter I+20%	23.833	22.657	0.030	0.000	0.99	0.854	23.996	48.0	SURCHARGED
S1.005	S6	15 minute 10 year Winter I+20%	23.173	22.383	0.036	0.000	1.11	1.016	27.139	51.9	SURCHARGED
S2.000	S7	15 minute 10 year Summer I+20%	23.500	22.408	-0.182	0.000	0.33	0.209	7.806	20.1	OK
S2.001	S8	15 minute 10 year Winter I+20%	24.000	22.354	-0.181	0.000	0.32	0.373	12.683	23.7	OK
S2.002	S9	15 minute 10 year Winter I+20%	24.000	22.191	-0.120	0.000	0.66	1.004	20.058	39.0	OK
S2.003	S10	15 minute 10 year Winter I+20%	24.000	22.150	-0.118	0.000	0.67	0.576	23.673	46.0	OK
S2.004	S11	15 minute 10 year Winter I+20%	24.000	22.056	-0.112	0.000	0.70	0.916	27.838	50.0	OK
S1.006	S12	15 minute 10 year Winter I+20%	23.202	21.918	-0.104	0.000	0.85	1.242	61.976	109.8	OK
S1.007	S13	15 minute 10 year Winter I+20%	23.206	21.669	-0.141	0.000	0.80	8.080	92.350	152.7	OK
S1.008	S14	15 minute 10 year Winter I+20%	23.086	21.586	-0.104	0.000	0.94	2.962	108.835	176.8	OK
S3.000	S15	30 minute 10 year Winter I+20%	23.285	21.460	-0.105	0.000	0.55	0.212	18.181	14.8	OK
S3.001	S16	60 minute 10 year Winter I+20%	23.064	21.430	-0.115	0.000	0.48	14.900	43.400	19.2	OK
S1.009	S17	15 minute 10 year Winter I+20%	23.064	21.240	-0.091	0.000	0.72	1.930	146.003	195.6	OK
S4.000	S18	30 minute 10 year Winter I+20%	23.250	22.402	-0.198	0.000	0.25	0.180	18.181	14.8	OK
S5.000	S19	15 minute 10 year Winter I+20%	22.750	21.456	-0.109	0.000	0.24	0.206	5.822	7.3	OK
S5.001	S20	15 minute 10 year Winter I+20%	22.750	21.453	-0.070	0.000	0.79	0.310	17.109	31.0	OK
S1.010	S21	15 minute 10 year Winter I+20%	23.075	21.144	0.000	0.000	1.00	9.972	193.297	241.5	OK
S6.000	S22	360 minute 10 year Winter I+20%	23.250	22.300	-0.300	0.000	0.00	0.000	0.000	0.0	OK
S7.000	S23	15 minute 10 year Winter I+20%	22.750	21.456	-0.085	0.000	0.27	0.249	5.822	7.3	OK
S7.001	S24	15 minute 10 year Winter I+20%	22.750	21.453	-0.070	0.000	0.79	0.309	17.269	31.6	OK
S1.011	S25	15 minute 10 year Winter I+20%	23.075	20.892	-0.127	0.000	0.92	6.422	220.274	277.4	OK
S8.000	S26	360 minute 10 year Winter I+20%	22.750	21.550	-0.225	0.000	0.00	0.000	0.000	0.0	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.012	S27	30 minute 10 year Winter I+20%	23.075	20.706	-0.092	0.000	1.00	7.141	308.561	278.2	OK
S1.013	S28	30 minute 10 year Winter I+20%	23.075	20.537	-0.129	0.000	0.98	4.035	308.517	278.2	OK
S1.014	S29	960 minute 10 year Winter I+20%	21.937	20.042	0.559	0.000	0.36	3.354	1051.632	46.2	SURCHARGED
S9.000	S30	30 minute 10 year Winter I+20%	23.400	21.436	-0.264	0.000	0.03	0.057	3.038	2.5	OK
S9.001	S31	30 minute 10 year Winter I+20%	23.200	21.262	-0.228	0.000	0.13	0.235	12.021	9.8	OK
S9.002	S32	30 minute 10 year Winter I+20%	23.000	20.939	-0.286	0.000	0.13	0.160	21.005	16.9	OK
S9.003	S33	30 minute 10 year Winter I+20%	22.600	20.678	-0.231	0.000	0.17	0.764	20.922	16.9	OK
S9.004	S34	30 minute 10 year Winter I+20%	22.000	20.669	-0.195	0.000	0.27	0.615	27.751	22.3	OK
S1.015	S35	960 minute 10 year Winter I+20%	21.730	20.041	0.634	0.000	0.10	759.791	936.231	9.6	SURCHARGED
S1.016	S36	480 minute 10 year Summer I+20%	21.570	19.039	-0.298	0.000	0.09	0.324	464.236	9.6	OK
S1.017	S37	2880 minute 10 year Summer I+20%	21.090	18.882	-0.298	0.000	0.10	0.356	1458.749	9.6	OK
S1.018	S38	2880 minute 10 year Summer I+20%	20.150	18.768	-0.284	0.000	0.13	0.422	1458.743	9.6	OK
S1.019	S39	2880 minute 10 year Summer I+20%	20.150	18.748	-0.285	0.000	0.13	0.209	1458.717	9.6	OK

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 10
Number of Online Controls 1 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.600 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 10, 30, 100
Climate Change (%) 20, 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 30 year Winter I+20%	25.264	23.764	-0.111	0.000	0.51	0.201	9.086	20.7	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.001	S2	15 minute 30 year Winter I+20%	24.912	23.626	-0.080	0.000	0.72	0.489	15.890	35.1	OK
S1.002	S3	15 minute 30 year Winter I+20%	24.585	23.384	0.025	0.000	0.91	0.962	22.387	45.0	SURCHARGED
S1.003	S4	15 minute 30 year Winter I+20%	24.412	23.094	0.116	0.000	0.98	1.477	30.366	54.6	SURCHARGED
S1.004	S5	15 minute 30 year Winter I+20%	23.833	22.768	0.141	0.000	1.10	1.368	30.365	53.1	SURCHARGED
S1.005	S6	15 minute 30 year Winter I+20%	23.173	22.432	0.085	0.000	1.23	1.285	34.342	57.4	SURCHARGED
S2.000	S7	15 minute 30 year Summer I+20%	23.500	22.424	-0.166	0.000	0.41	0.239	9.878	25.4	OK
S2.001	S8	15 minute 30 year Winter I+20%	24.000	22.370	-0.165	0.000	0.41	0.449	16.168	30.0	OK
S2.002	S9	15 minute 30 year Winter I+20%	24.000	22.222	-0.089	0.000	0.83	1.304	25.499	49.2	OK
S2.003	S10	15 minute 30 year Winter I+20%	24.000	22.183	-0.085	0.000	0.85	0.700	30.073	58.1	OK
S2.004	S11	15 minute 30 year Winter I+20%	24.000	22.094	-0.073	0.000	0.88	1.182	35.470	62.2	OK
S1.006	S12	15 minute 30 year Winter I+20%	23.202	21.997	-0.026	0.000	0.99	1.978	78.671	127.2	OK
S1.007	S13	15 minute 30 year Winter I+20%	23.206	21.788	-0.022	0.000	0.89	12.906	117.106	169.9	OK
S1.008	S14	15 minute 30 year Winter I+20%	23.086	21.691	0.000	0.000	1.01	3.989	137.974	190.9	OK
S3.000	S15	30 minute 30 year Winter I+20%	23.285	21.480	-0.085	0.000	0.71	0.250	23.571	18.9	OK
S3.001	S16	30 minute 30 year Winter I+20%	23.064	21.457	-0.088	0.000	0.67	18.843	42.174	26.5	OK
S1.009	S17	30 minute 30 year Winter I+20%	23.064	21.418	0.087	0.000	0.83	4.744	256.143	226.1	SURCHARGED
S4.000	S18	30 minute 30 year Winter I+20%	23.250	22.417	-0.183	0.000	0.32	0.207	23.571	18.9	OK
S5.000	S19	15 minute 30 year Winter I+20%	22.750	21.495	-0.070	0.000	0.31	0.277	7.541	9.3	OK
S5.001	S20	15 minute 30 year Winter I+20%	22.750	21.491	-0.032	0.000	1.00	0.392	21.825	39.1	OK
S1.010	S21	30 minute 30 year Winter I+20%	23.075	21.296	0.151	0.000	1.19	12.188	340.073	286.6	SURCHARGED
S6.000	S22	360 minute 30 year Winter I+20%	23.250	22.300	-0.300	0.000	0.00	0.000	0.000	0.0	OK
S7.000	S23	15 minute 30 year Winter I+20%	22.750	21.494	-0.047	0.000	0.34	0.319	7.541	9.3	OK
S7.001	S24	15 minute 30 year Winter I+20%	22.750	21.490	-0.033	0.000	1.00	0.389	22.026	39.8	OK
S1.011	S25	30 minute 30 year Winter I+20%	23.075	21.116	0.098	0.000	1.08	9.772	387.577	326.3	SURCHARGED
S8.000	S26	360 minute 30 year Winter I+20%	22.750	21.550	-0.225	0.000	0.00	0.000	0.000	0.0	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.012	S27	30 minute 30 year Winter I+20%	23.075	20.855	0.057	0.000	1.19	10.183	394.672	332.0	SURCHARGED
S1.013	S28	15 minute 30 year Summer I+20%	23.075	20.666	0.000	0.000	1.04	5.478	254.167	296.7	OK
S1.014	S29	1440 minute 30 year Winter I+20%	21.937	20.363	0.880	0.000	0.33	8.192	1461.274	42.8	SURCHARGED
S9.000	S30	30 minute 30 year Winter I+20%	23.400	21.440	-0.260	0.000	0.04	0.065	3.939	3.1	OK
S9.001	S31	30 minute 30 year Winter I+20%	23.200	21.272	-0.218	0.000	0.17	0.271	15.586	12.5	OK
S9.002	S32	30 minute 30 year Winter I+20%	23.000	20.952	-0.274	0.000	0.16	0.183	27.234	21.5	OK
S9.003	S33	30 minute 30 year Winter I+20%	22.600	20.694	-0.214	0.000	0.21	0.929	27.151	21.5	OK
S9.004	S34	30 minute 30 year Winter I+20%	22.000	20.685	-0.179	0.000	0.34	0.684	36.087	28.5	OK
S1.015	S35	1440 minute 30 year Winter I+20%	21.730	20.363	0.956	0.000	0.10	1002.175	1394.074	9.6	SURCHARGED
S1.016	S36	5760 minute 30 year Summer I+20%	21.570	19.039	-0.298	0.000	0.09	0.324	2165.200	9.6	OK
S1.017	S37	5760 minute 30 year Winter I+20%	21.090	18.882	-0.298	0.000	0.10	0.356	2429.658	9.6	OK
S1.018	S38	5760 minute 30 year Winter I+20%	20.150	18.768	-0.284	0.000	0.13	0.422	2429.657	9.6	OK
S1.019	S39	5760 minute 30 year Winter I+20%	20.150	18.748	-0.285	0.000	0.13	0.209	2429.631	9.6	OK

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

Simulation Criteria

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

Number of Input Hydrographs 0 | Number of Offline Controls 0 | Number of Time/Area Diagrams 10
Number of Online Controls 1 | Number of Storage Structures 3 | Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.600 Cv (Summer) 0.750
Region Scotland and Ireland Ratio R 0.276 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1, 10, 30, 100
Climate Change (%) 20, 20, 20, 20

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.000	S1	15 minute 100 year Winter I+20%	25.264	23.831	-0.044	0.000	0.65	0.326	11.762	26.7	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.001	S2	15 minute 100 year Winter I+20%	24.912	23.786	0.080	0.000	0.82	1.325	20.570	40.2	SURCHARGED
S1.002	S3	15 minute 100 year Winter I+20%	24.585	23.623	0.264	0.000	0.96	2.159	28.978	47.0	SURCHARGED
S1.003	S4	15 minute 100 year Winter I+20%	24.412	23.305	0.327	0.000	1.08	2.429	39.305	59.9	SURCHARGED
S1.004	S5	15 minute 100 year Winter I+20%	23.833	22.912	0.286	0.000	1.20	1.906	39.304	57.8	SURCHARGED
S1.005	S6	15 minute 100 year Winter I+20%	23.173	22.514	0.167	0.000	1.37	1.662	44.451	64.1	SURCHARGED
S2.000	S7	15 minute 100 year Summer I+20%	23.500	22.447	-0.143	0.000	0.54	0.280	12.785	32.9	OK
S2.001	S8	15 minute 100 year Winter I+20%	24.000	22.414	-0.121	0.000	0.53	0.651	21.057	38.5	OK
S2.002	S9	15 minute 100 year Winter I+20%	24.000	22.378	0.068	0.000	0.95	3.159	33.133	56.1	SURCHARGED
S2.003	S10	15 minute 100 year Winter I+20%	24.000	22.354	0.086	0.000	0.97	1.202	39.054	66.1	SURCHARGED
S2.004	S11	15 minute 100 year Winter I+20%	24.000	22.299	0.132	0.000	0.89	2.115	46.183	62.9	SURCHARGED
S1.006	S12	15 minute 100 year Winter I+20%	23.202	22.205	0.182	0.000	1.07	3.458	102.114	138.3	SURCHARGED
S1.007	S13	15 minute 100 year Winter I+20%	23.206	21.983	0.173	0.000	1.03	17.319	151.856	196.3	SURCHARGED
S1.008	S14	15 minute 100 year Winter I+20%	23.086	21.856	0.165	0.000	1.22	4.714	178.852	230.3	SURCHARGED
S3.000	S15	30 minute 100 year Winter I+20%	23.285	21.608	0.043	0.000	0.91	0.486	31.193	24.4	SURCHARGED
S3.001	S16	30 minute 100 year Winter I+20%	23.064	21.597	0.052	0.000	1.08	39.638	55.540	42.8	SURCHARGED
S1.009	S17	15 minute 100 year Winter I+20%	23.064	21.687	0.355	0.000	0.87	7.452	240.767	236.6	SURCHARGED
S4.000	S18	30 minute 100 year Winter I+20%	23.250	22.436	-0.164	0.000	0.42	0.242	31.191	24.7	OK
S5.000	S19	30 minute 100 year Winter I+20%	22.750	21.690	0.125	0.000	0.45	0.639	14.054	13.4	SURCHARGED
S5.001	S20	30 minute 100 year Winter I+20%	22.750	21.685	0.162	0.000	1.00	0.763	39.700	39.4	SURCHARGED
S1.010	S21	15 minute 100 year Winter I+20%	23.075	21.559	0.414	0.000	1.36	13.781	319.586	326.7	SURCHARGED
S6.000	S22	360 minute 100 year Winter I+20%	23.250	22.300	-0.300	0.000	0.00	0.000	0.000	0.0	OK
S7.000	S23	15 minute 100 year Winter I+20%	22.750	21.637	0.096	0.000	0.50	0.585	9.952	13.6	SURCHARGED
S7.001	S24	15 minute 100 year Winter I+20%	22.750	21.633	0.110	0.000	1.22	0.666	28.700	48.7	SURCHARGED
S1.011	S25	15 minute 100 year Winter I+20%	23.075	21.333	0.314	0.000	1.27	11.291	364.225	382.3	SURCHARGED
S8.000	S26	360 minute 100 year Winter I+20%	22.750	21.550	-0.225	0.000	0.00	0.000	0.000	0.0	OK

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

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Maximum Vol (m³)	Discharge Vol (m³)	Pipe Flow (l/s)	Status
S1.012	S27	30 minute 100 year Winter I+20%	23.075	20.969	0.171	0.000	1.40	11.371	516.547	388.2	SURCHARGED
S1.013	S28	1440 minute 100 year Winter I+20%	23.075	20.765	0.099	0.000	0.19	6.122	1813.038	53.2	SURCHARGED
S1.014	S29	1440 minute 100 year Winter I+20%	21.937	20.763	1.280	0.000	0.41	13.052	1810.657	53.0	SURCHARGED
S9.000	S30	30 minute 100 year Winter I+20%	23.400	21.446	-0.254	0.000	0.06	0.075	5.213	4.1	OK
S9.001	S31	30 minute 100 year Winter I+20%	23.200	21.285	-0.205	0.000	0.22	0.315	20.626	16.2	OK
S9.002	S32	30 minute 100 year Winter I+20%	23.000	20.967	-0.258	0.000	0.21	0.246	36.039	28.0	OK
S9.003	S33	1440 minute 100 year Winter I+20%	22.600	20.764	-0.145	0.000	0.04	1.796	128.499	3.8	OK
S9.004	S34	1440 minute 100 year Winter I+20%	22.000	20.764	-0.100	0.000	0.06	1.047	171.735	5.1	OK
S1.015	S35	1440 minute 100 year Winter I+20%	21.730	20.762	1.355	0.000	0.10	1305.032	1434.049	9.6	SURCHARGED
S1.016	S36	8640 minute 100 year Winter I+20%	21.570	19.039	-0.298	0.000	0.09	0.324	3276.460	9.6	OK
S1.017	S37	8640 minute 100 year Winter I+20%	21.090	18.882	-0.298	0.000	0.10	0.356	3276.459	9.6	OK
S1.018	S38	8640 minute 100 year Winter I+20%	20.150	18.768	-0.284	0.000	0.13	0.422	3276.459	9.6	OK
S1.019	S39	8640 minute 100 year Winter I+20%	20.150	18.748	-0.285	0.000	0.13	0.209	3276.434	9.6	OK

Designer's Assessment of Site Specific SuDS Systems		
Designer Company: O'Connor Sutton Cronin	Project: St. Paul's Ref No: N251	
Designer: Jonathan Burke	Date: September 2019	
Checker: Patrick Ragget	Design Stage: Planning	

No.	Design Criteria	Evaluations. Design decisions made (or alternative actions)
1	Discharging to a receiving surface water	The minimum quality management requirements for the discharge to a receiving water and groundwater from the proposed development have been set out as per **table 4.3** of CIRIA C753-SuDS Manual and as contained in **Appendix A**. The proposed development land use is residential with individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads. Residential Roofs: The pollution hazard level is very low. The requirements for discharge to surface waters and groundwater, including coasts and estuaries requires the removal of gross solids and sediments only. Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access road: The pollution hazard level is low for discharge to surface waters and groundwater, including coasts and estuaries. A simple index approach isrequired. No extra measures are required for discharges as the receiving surface water Naniken Stream is not a protected resource. A simple qualitative approach using indices of the likely pollution levels and proposed SuDS performance capacities has been assessed below (Item No. 2) in accordance with *'Approaches to water quality risk management'*, **table 26.1** of CIRIA C753-SuDS Manual.
2	Pollution hazard Indices for different land use	The pollution hazard indices for the proposed development have been analysed as set out as per **table 26.2** of CIRIA C753-SuDS Manual and as contained in **Appendix A**. Residential Roofs: The pollution hazard level is very low. Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access road: The pollution hazard level is low.
3	Source of pollution for the proposed development	Sources of pollution for the development from impermeable surface water as set out as per **table 4.1** of CIRIA C753-SuDS Manual and as contained in **Appendix A** are as follows; Leaks and spillages (e.g. from road vehicles) with hydrocarbons, phosphates, heavy metals, glycols, alcohols. Heavy metals include: lead, cadmium, copper, chromium, nickel and zinc. Not all heavy metals are present in all cases. Accidental spillages from engines and de-icing fluids may be washed into surface water drainage system; Litter/animal faeces with bacteria, viruses, phosphorous, nitrogen. Litter typically include items such as drinks cans, paper, food, cigarettes, plastic and glass. Pets and other animals leave faeces that wash into the drainage system. Some of this will break down and cause pollutants to be washed off urban surfaces;

No.	Design Criteria	Evaluations. Design decisions made (or alternative actions)
		Vegetation/ landscape maintenance may introduce phosphorous, nitrogen, herbicides, organic matter insecticides and fungicides into the surface water drainage system. Leaves and grass cuttings are an organic source. Herbicides and pesticides used for weed and pest control in landscaped areas such as gardens, parks and recreation areas can be a major source of pollution. Cleaning activities such as washing vehicles, windows, bins may introduce sediment, phosphorous, nitrogen, detergents, and hydrocarbons. Pressure washing hardstanding leads to silt, organic matter, detergents and hydrocarbons (mobilised by the detergents) entering the surface water drainage. De-Icing Salt is commonly used for de-icing roads and car parks. Rock salt used for this purpose comprises sodium chloride and grit. It can also include cyanide and phosphates for anti-calking and as corrosion inhibitors, heavy metals, urea and ethylene glycol. Illegal disposal of chemicals and oils can occur at small domestic scales.
4	SuDs measures	As the existing site is largely soft landscaping, the soft landscaping proposals will be provided to mimic the existing runoff from the site. All SuDS measures will be provided in accordance with the Greater Dublin Strategic Drainage Study Regional Drainage Policy Volume 2 - New Development (GDSDS-RDP Volume 2). Specific design requirements for SuDS systems are established by the Construction Industry Research and Information Association's publication CIRIA C753-SuDS Manual. The following SuDS systems will deliver the design criteria as per CIRIA **table 7.1** in CIRIA C753-SuDS Manual and as contained in **Appendix A**; • Water Quantity o Peak runoff rate; o Runoff Volume – Interception / Large Events; • Water Quality • Amenity • Biodiversity; Green roofs will provide a first level of treatment and storage at roof level of apartment blocks. The removal of pollutants or sediments, ecological value and a reduction of surface water runoff volumes and discharge rates for small events (Interception) will be provided; Infiltration to ground for surface water runoff will be facilitated underneath SuDS systems in areas with acceptable infiltration rates with exception of tank due to water table levels, i.e. the interface between the storage facility and the underlying soil will not be sealed in accordance with guidance. Systems that collect and store runoff allowing it to infiltrate into ground will improve water quality, reduce runoff volumes and discharge rates for small (Interception) and large events; Filter drains underneath permeable paving will likely provide attenuation, conveyance and treatment runoff; Landscaping on podium will allow runoff from for small (Interception) and large events to pond temporarily in tree pits, shallow landscape depressions before filtering through vegetation and discharging to the downstream SuDs components;

No.	Design Criteria	Evaluations. Design decisions made (or alternative actions)
		Trees/planting within the soil filled tree pits/raingardens will collect, store and treat runoff for small events (Interception) while providing amenity and biodiversity; Permeable Paving will provide a first level of treatment and temporarily store surface water runoff from car parking areas before infiltration/controlled release to SuDS systems downstream; Attenuation Storage – Tank & Baisn will be provided to ensure that there is adequate attenuation storage for limited discharge surface water volumes. Attenuation will be provided with a buried StormTech tank and cellular storage for events up to, and including, the 1.0% AEP rainfall event. A 500mm freeboard from the lowest FFL to the top water level of the attenuation storage will be provided; Limiting discharges from attenuation tanks will ensure that discharge rates are maintained below the greenfield runoff rate of 2.0l/s/ha; Catch Pits will remove sediments and silts upstream and downstream of all SuDS systems. The storm tech isolator row will capture any sediment which is not removed by catch pits upstream; A Full Retention Interceptor will be provided for the treatment of all surface water runoff before it is discharged from site. A full retention oil separator (NSFA020) will separate oil and silts in accordance with EN858-1 and PPG3 from surface water before it discharges to the Naniken stream. The interceptor is fitted with the oil probe for monitoring the interceptor for presence of hydrocarbons. In summary, the above SuDS systems will deliver interception, primary treatment, secondary treatment and tertiary treatment, as per CIRIA **table 26.7** in CIRIA C753-SuDS Manual and as contained in **Appendix A**.
5	Pollution Risk Assessment	The pollution risk has been estimated for the development as per the Risk matrix as set out as per **table 26.5** of CIRIA C753-SuDS Manual and as contained in **Appendix A**. Risk has been estimated following a desk study using available groundwater mapping, soil data/mapping and from site investigation data etc. contained in **Appendix B & C**. 1. Pollution hazard Traffic density = Standard urban excluding roads etc. - 'low risk' (1x15=15) 2. Standard Average Annual Rainfall depth = 750mm (SAAR Mapping & GDSDS) - 'medium risk' (2x15=30) 3. Type of SuDS = As proposed above (Item 4) - 'low risk' (1x15=15) 4. Unsaturated zone depth = Varies (SI) - 'medium risk' (2x20=40) 5. Predominant flow type through soils between infiltration surface and groundwater – Sandy Gravelly SILT/CLAY Soil, Type 2 with Low Permeability (SI & GDSDS) -'medium risk' (2x20=40) 6. Unsaturated zone material: clay content = 43% (Teagasc) 'Low risk' (1x5=15) 7. Unsaturated zone organic carbon content: soil organic matter (SOM) content = 1.6% (SI) - 'medium risk' (2x5=10) 8. Unsaturated zone material: soil pH = 8.5 (SI) - 'low risk' (1x5=5) Estimated Pollution Risk score = 170 < 180 It is determined that the risks to ground water is 'low or medium' in accordance with CIRIA **table 26.6** as contained in **Appendix A**. A simple index approach is required. No extra measures may be required for discharges to groundwater bodies as groundwater is not a protected at this site.

No.	Design Criteria	Evaluations. Design decisions made (or alternative actions)
6	Groundwater Risk	Analysis of groundwater risk mapping from the EPA attached in **Appendix B** notes that the ground water on site is 'not at risk'.
7	SuDS mitigation indices for discharges to surface waters	Achieving zero runoff from the first 5mm or 10mm of rainfall is often not practicable, and therefore emphasis is also needed on achieving some treatment of the storm water run-off. This ensures that any runoff discharged to the river is of significantly better quality than direct runoff from a pipe network. The proposed SuDS systems provide a reduction in Total Suspended Solids (TSS), metals and hydrocarbons for discharge to the receiving surface water body. Indicative SuDS mitigation indices for discharges to surface waters as per CIRIA **table 26.3** in CIRIA C753-SuDS Manual and as contained in **Appendix A**.
8	SuDS mitigation indices for discharges to groundwater	It is proposed to infiltrate surface water runoff to ground underneath SuDS systems where suitable. SuDS mitigation indices for discharge to groundwater in accordance with CIRIA **table 26.4** as contained in **Appendix A** are as follows; Filter drains with filtration material that provides treatment and underlain by a soil with good contaminant attenuation potential of at least 300 mm in depth; Swales with a layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300 mm in depth; Bioretention system underlain by a soil with good contaminant attenuation potential of at least 300mm in depth. Trees/planting layer of dense vegetation underlain by a soil with good contaminant attenuation potential of at least 300mm in depth; Permeable Paving with filtration layer that provides treatment with a geotextile at the base separating the foundation from the subgrade and underlain by a soil with good contaminant attenuation potential of at least 300mm in depth; Attenuation with filtration layer that provides treatment with a geotextile at the base separating the foundation from the subgrade and underlain by a soil with good contaminant attenuation potential of at least 300mm in depth;
9	Performance of SuDS components in reducing urban runoff contamination	The proposed SuDS systems will reduce the contamination in accordance with CIRIA table **26.13** as contained in **Appendix A.**

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APPENDIX A – CIRIA C753 SUDS MANUAL TABLES

TABLE 4.1	Sources of pollution from impermeable surfaces (after Wilson et al, 2004)	
Source	**Typical pollutants**	**Source details**
Atmospheric deposition	Phosphorous, nitrogen, Sulphur, heavy metals', hydrocarbons, particulates	Industrial activities, traffic air pollution and agricultural activities all contribute to atmospheric pollution. Rain also absorbs atmospheric pollutants, which are then present in runoff. Atmospheric pollutants can be deposited on, or absorbed by roofing materials and discharged into roof runoff - flat urban roofs are particularly vulnerable.
Traffic - exhausts	Hydrocarbons, MTBE[2],cadmium, platinum, palladium, rhodium	Vehicle emissions include polycyclic aromatic hydrocarbons (PAH) and unburnt fuel and particles from catalytic converters.
Traffic - wear and corrosion	Particulates, heavy metals'	Abrasion of tyres and corrosion of vehicles deposit pollutants onto the road or car parking surfaces.
Leaks and spillages (eg from road vehicles)	Hydrocarbons, phosphates, heavy metals, glycols, alcohols	Engines leak oil, hydraulic and de-icing fluids and spillages occur when refueling. Lubricating oil can contain phosphates and metals. Accidental spillages also occur.
Litter/animal faeces	Bacteria, viruses, phosphorous, nitrogen	Littler typically includes item s such as drinks cans, paper, food, cigarettes, animal excreta, plastic and glass. Some of this will break down and cause pollutants to be washed off urbaan surfaces. Dead animals on roads decompose and release pollutants including bacteria. Pets and other animals leave faeces that wash into the drainage system.
Vegetation/ landscape maintenance	Phosphorous, nitrogen, herbicides, insecticides and fungicides, organic matter	Leaves and grass cuttings are an organic source. Herbicides and pesticides used for weed and pest control in landscaped areas such as gardens, parks, recreation areas and golf courses can be a major source of pollution.
Soil erosion	Sediment, phosphorous, nitrogen, herbicides, insecticides and fungicides	Runoff from poorly detailed landscaped or other areas can wash onto impervious surfaces and cause pollution of runoff.
De-icing activities	Grit, chloride, sulphate, heavy metals', glycol, cyanide, phosphate	Salt is commonly used for de-icing roads and car parks. Rock salt used for this purpose comprises sodium chloride and grit. It can also include cyanide and phosphates for anti-- calking and as corrosion inhibitors, heavy metals, urea and ethylene glycol.
Cleaning activities	Sediment, phosphorous, nitrogen, detergents, hydrocarbons	Washing vehicles, windows, bins or pressure washing
Sewer misconnections	Bacteria (including pathogens), detergents, organic matter and textiles	Sewer misconnections
Illegal disposal of chemicals and oil	Hydrocarbons, various chemicals	Illegal disposal of used engine oils or other chemicals can occur at small (domestic) or large (industrial) scales.

Note

1 Heavy metals include: lead, cadmium, copper, chromium, nickel, zinc, mercury. Not all heavy metals are present in all cases.

2 Methyl tert-butyl ether.

TABLE 4.3 Minimum water quality management requirements for discharge to receiving surface water and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (e.g. cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (e.g. schools, offices)	Low	Simple index approach Note: extra measures may be required for discharges to protected resources	
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	

Notes

The minimum water quality management requirements for discharges to receiving surface waters and groundwater are presented here. (For Northern Ireland, this guidance should be considered as interim until such time as Northern Ireland publishes its own legislation/policy/guidance.)

1 These are not required in Scotland and Northern Ireland. For England and Wales, see Step 3 of the simple index approach (Section26.7.1).Protected surface water resources will include those designated for drinking water abstraction or for other environmental protection reasons. Protected groundwater resources are represented by SPZ1s in England and Wales.

2 In Scotland, the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 20 1 1 General Building Rules, Rule 10 (d) (iv) effectively provides an exemption from requiring SuDS for coastal discharges. However, control of any contaminants likely to be present in surface water runoff is still required, but can be delivered using alternative methods such as proprietary treatment products. As the term 'SuDS' in this manual includes proprietary treatment products, this exemption is not valid in this context.

3 The application of the simple index approach should follow the approach outlined in Section 26.7.1 (or equivalent app roved).

4 Risk screening is an assessment to identify high risk scenarios; where the Environment Agency or Natural Resources Wales (NRW) would wish to be consulted regarding infiltration of water from surface runoff in order to agree the proposed design approach. The risk screening method is provided in Section 2ti.7.2.

5 The risk assessment not should determine the appropriate design approach to mitigate risk to acceptable levels following the guidance outlined in Section 26.7.3. This assessment should be approved by the environmental regulator.

TABLE 7.1 SuDS component delivery of design criteria

Component type	Description	Collection mechanism	Design criteria: Water quantity (Chapter 3)						Further information (Chapter ref)
				Runoff volumes					
			Peak runoff rate	Small events (interception)	Large events	Water quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity	
Rain water harvesting systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●		11
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●	12
Infiltration systems	Systems that collect and store runoff, all owing it to infiltrate into the ground	P	●	●	●	●	●	●	13
Proprietary treatment systems	Subsurface structures designed to provide treatment of runoff	P				●			14
Filter strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○	15
Filter drains	Shallow stone -filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○	16
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	●	17
Bioretention systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface , before filtering through vegetation and underlying soils	P	●	●	●	●	●	●	18
Trees	Trees within soil -filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	●	19
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/ or allowed to infiltrate into the ground below	S	●	●	●	●	○	○	20
Attenuation storage tanks	Large, below ground voided spaces used to temporarily store runoff before infiltration, controlled release	P	●						21
Detention basins	Vegetated depressions that store and treat runoff	P	●	●	○	●	●	●	22
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff - runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●	23

TABLE 26.1	Approaches to water quality risk management		
Design method	**Hazard characterisation**	**Risk Reduction**	
		For surface water	**For groundwater**
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)
Risk screening'	Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent)
Detailed risk assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system	

Note

1 Risk assessment may be required as a result of the risk screening process.

TABLE 26.2	Pollution hazard Indices for different land use classifications			
Land use	**Pollution hazard level**	**Total suspended solids (TSS)**	**Metals**	**Hydro-carbons**
Residential roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non- residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways'	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk<assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriates part of a detailed risk assessment - required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

TABLE 26.3	Indicative SuDS mitigation indices for discharges to surface waters		
Types of SuDS Components	**TSS**	**Metals**	**Hydro-carbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5 6]	These must demonstrate, that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: http://tinyurl.com/qf7yuj7

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

TABLE 26.4	Indicative SuDS mitigation indices for discharges to groundwater		
Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	**TSS**	**Metals**	**Hydrocarbons**
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8	0.7	0.6
Proprietary treatment systems[5 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area		

Notes

All designs must include a minimum of 1m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required in infiltration design - Chapter 25).

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

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

4 If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.

TABLE 26.5	Risk matrix (from Highways Agency, 2009, after Scott Wilson, 2010)				
Risk elements (RE)		**Risk score (RS)**			**Weighting factor (WF)**
Element number	**Element description**	**Low risk (score1)**	**Medium risk (score2)**	**High risk (score3)**	
1	Pollution hazard Traffic density	All standard urban land use types (excluding high hazard and trunk roads/motorway			15
2	Standard Average Annual Rainfall depth	< 740 mm	740- 1060 mm	> 1060mm	15
3	Type of SuDS	Continuous unlined linear collection and conveyance components (eg filter strips, swales)	Shallow soakaway Continuous unlined (eg infiltration basin/trench, permeable pavement) draining components (eg < 5000 m^2 runoff area		15
4	Unsaturated zone depth (ie depth of between infiltration surface and groundwater table)	> 15 m	5 -15 m	1 - 5 m	20
5	Predominant flow type through soils between infiltration surface and groundwater	intergranular flow (occurs in unconsolidated or non-fractured consolidated deposits and fine or medium sands)	Mixed fracture and intergranular flow (occurs in fractured consolidated deposits and medium or coarse sands)	Fractured flow (occurs in heavily consolidated sedimentary deposits, igneous and metamorphic rocks and very coarse sands)	20
6	Unsaturated zone material: clay content	> 15% clay	1- 15% clay	< 1% clay	5
7	Unsaturated zone organic carbon content: soil organic matter (SOM) content	> 15% SOM	1- 15% SOM	< 1% SOM	5
8	Unsaturated zone material: soil pH	> 8	5- 8	< 5	5

TABLE 26.6	How to interpret the groundwater risk screening result	
Total Risk Score	**Risks to groundwater**	**Interpretation**
< 180	Low or medium	Use simple index approach Note: For discharges to protected groundwater bodies, implementing upstream treatment component that will provide groundwater protection in the event of an unexpected pollution event or poor system performance
180-250	High	Discharges may require an environmental licence or permit. Obtain pre-permitting advice first from the environmental regulator. Risk assessment likely to be required
> 250	Very high	Unacceptable

TABLE 26.7	Indicative suitability of SuDS components within the Management Train			
SuDS Component	**Interception[1]**	**Close to source/ primary treatment**	**Secondary treatment**	**Tertiary treatment**
Rainwater harvesting	y			
Filter strip	y	y		
Swale	y	y	y	
Filter drain	y		y	
Pervious pavements	y	y		
Bioretention	y	y	y	
Green roof	y	y		
Detention basin	y	y	y	
Pond	[3]	Y[2]	y	y
Wetland	[3]	Y[2]	y	y
Infiltration system (soakaways/ trenches/ blankets/basins)	y	y	y	y
Attenuation storage tanks	Y[4]			
Proprietary treatment systems		Y[5]	Y[5]	Y[5]

Notes

1 Interception components are also normally also a treatment component (excluding rainwater harvesting which only removes runoff from the system)

2 for roof runoff only

3 Interception design may be possible in certain scenarios, but would require detailed justification

4 if unlined and design performance can be demonstrated (noting the need to protect groundwater)

5 where design performance can be demonstrated

TABLE 26.13	Performance of SuDS components in reducing urban runoff contamination					
		Concentration ranges: 25%ile – 75%ile				
		TSS (µg/l)	**Total cadmium (µg/l)**	**Total copper (µg/l)**	**Total zinc (µg/l)**	**Total nickel (µg/l)**
Inflow from urban surface (average values)		20-114	0.2-0.6	6-22	29-112	3-8
Selected environmental standards (Tables 26.1 to 26.5):						
Surface water>		25	0.6[6]	66	50[6]	20[6]
Groundwater[5]			0.1	1.5	5	15
Outflows from sue s components:						
Vegetated/ surface SuDS components'	Filter strips	10-35	0.1-0.3	5-12	11-53	2-4
	Bioretention	5-20	0.04-0.1	4-10	5-29	3-8
	Swales	10-43	0.2-0.3	4-15	18-55	2-5
	Detention basins	10-47	0.1-0.4	2-12	6-58	2- 4
	Retention ponds	4-28	0.1-0.4	3-7	11-39	2-6
	Wetland basins	4-21	0.1-0.4	2- 6	11-33	
	Permeable pavements	14-44	0.3-0.5	4-11	2-29	1- 3
Manufactured treatment components[2]	Biological filtration	2-5		N/A[4]	38-221	
	Filtration	7-26		3-10	19-59	
	Hydrodynamic or vortex separators[3]	10-71		6-17	34-107	
	Oil separators	16-87		6-18	60-121	
	Multi-process	2-8		3-16	9-27	

Notes

1 Leisenring et al (2014).

2 The above figures for manufactured products are based on a summary of 61 different proprietary systems (Leisenring et al, 2012) that passed the stormwater BMP database proprietary device policy. These figures are intended to be indicative of the likely performance of a particular category of proprietary devices. It is recommended that evidence is obtained to support any performance claims of an individual device as outlined in Section 14.5.

3 Referred to as manufactured device - physical in WERF (2014).

4 NIA - not available, or fewer than three studies for system.

5 For relevant sources, see Annex 1 Tables 26.8 to 26.12.

6 Standard is for the dissolved metal at 50- 100 mg/l CaCo concentration.

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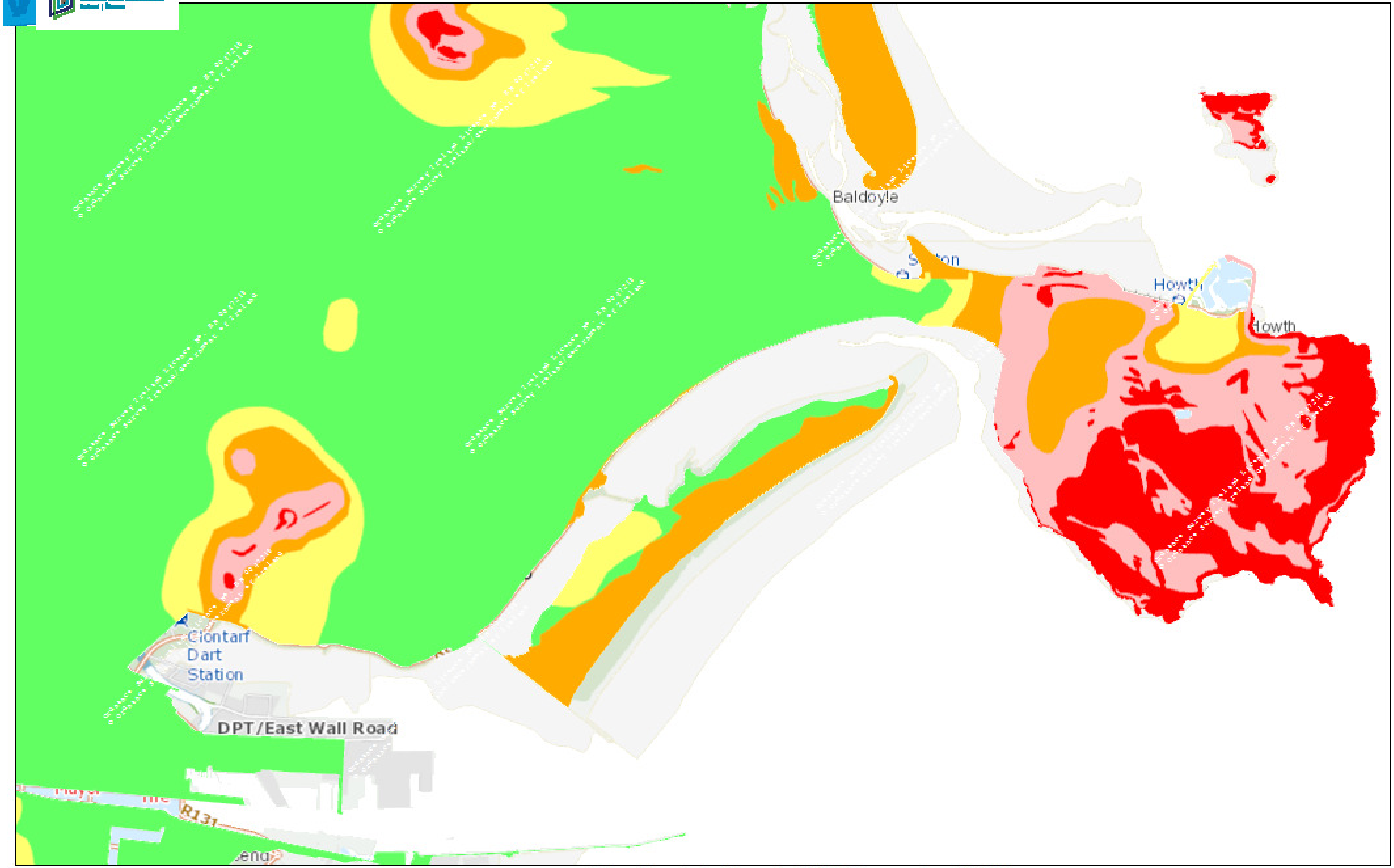
APPENDIX B – MAPPING

GSI Groundwater Vulnerability (Rest)

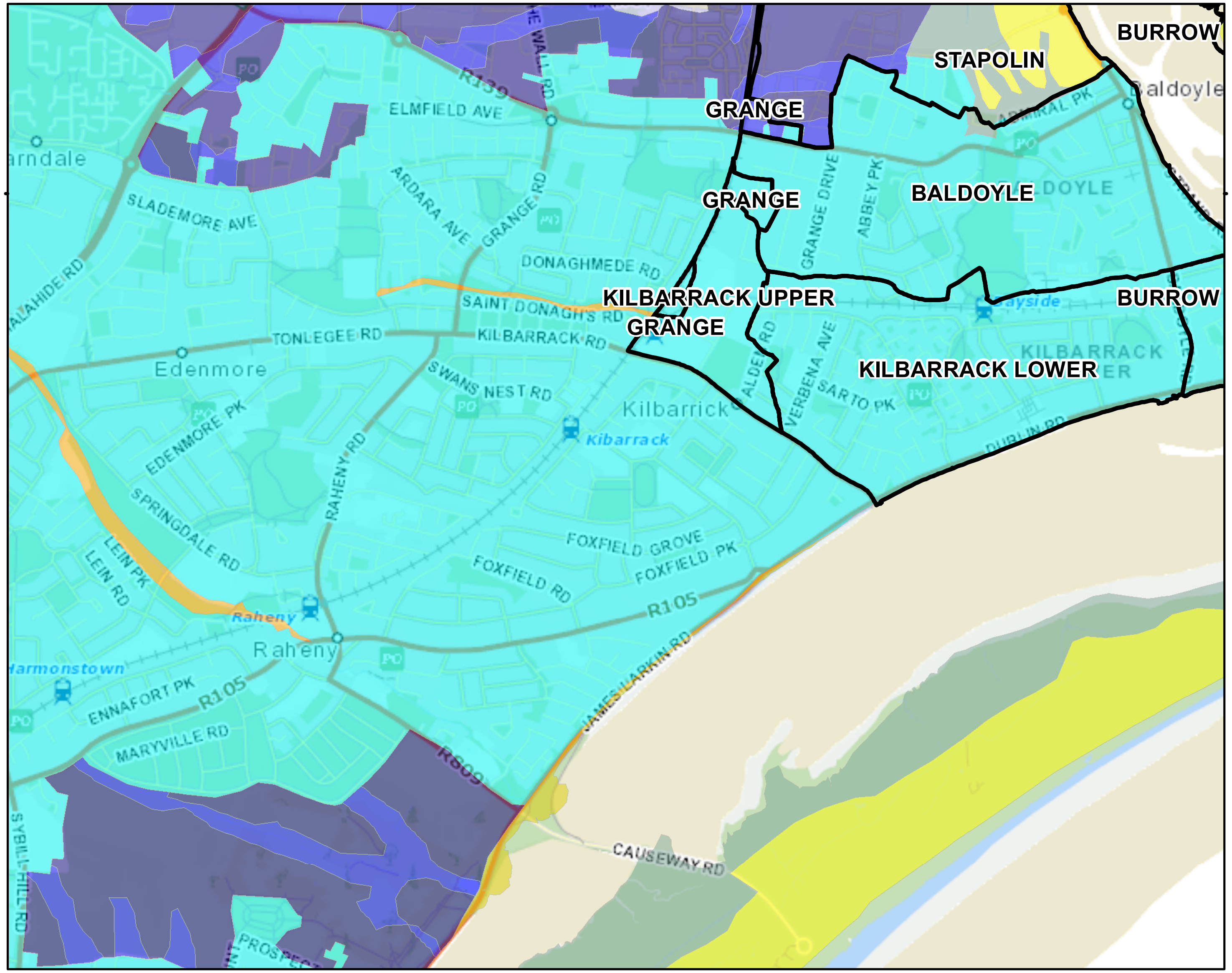


GSI Administrator

August 24, 2017

0 0.35 0.7 1.4 mi
0 0.5 1 2 km

St. Paul's Teagasc Soils



Legend

Teagasc Soils

- BminDW - Deep well drained mineral (Mainly basic)
- BminPD - Mineral poorly drained (Mainly basic)
- BminSW - Shallow well drained mineral (Mainly basic)
- AlluvMIN - Alluvial (mineral)
- AeoUND - Aeolian undifferentiated
- MarSands - Marine sand and gravel
- MarSed - Marine/estuarine sediments
- Made - Made ground
- OSI Basemap

Scale: 1:25,000

Geological Survey Ireland

0 0.175 0.35 0.7 mi
0 0.275 0.55 1.1 km

Map Centre Coordinates (ITM) 722,513 738,840
Snapshot Date: August 24, 2017

APPENDIX C – SI INFORMATION

SERIES: CROSSTOWN (1030CO) - REPRESENTATIVE PROFILE DESCRIPTION - **PDF version available**

Reference profile: RPT01BR01
Weather: Overcast

TOPOGRAPHY
Position: Middle slope
Form: Straight
Aspect: NW

PARENT MATERIAL
Substrate type: Drift
Substrate subgroup: Siliceous stones

TEXTURAL CRITERIA
Texture 1: Fine loamy
Texture 2: -

LAND USE
Land use: Grassland improved
Human technologies: Fertilizer applications

ROCK OUTCROPS - (-)

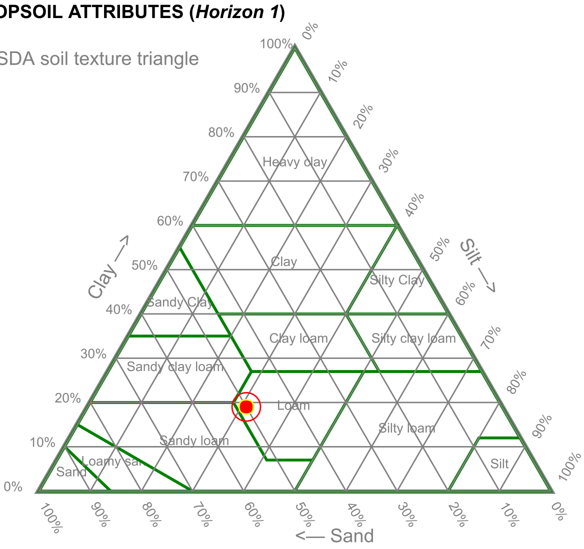
SURFACE STONE - (-)

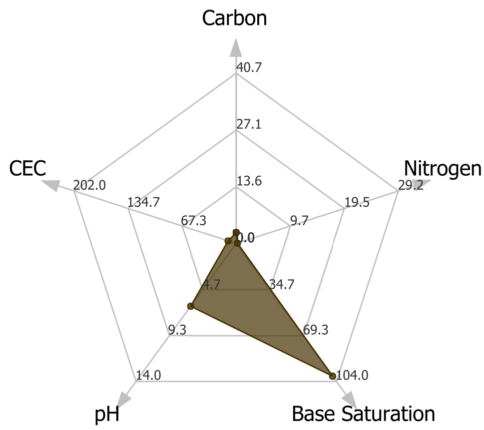
IRISH CLASSIFICATION (2013)
Soil subgroup: 1030 Stagnic Luvisols
National Soil Series: Crosstown
Definition: Fine loamy drift with siliceous stones

Download a PDF version of this profile description here

TOPSOIL ATTRIBUTES (*Horizon 1*)

USDA soil texture triangle





Horizon 1: 0 - 25 cm

Humose: No
Matrix colour (moist): 75YR43
Texture: Coarse loamy

Stones (% total): Very few (0-2 %)
Stones details: Medium gravels (6mm -2 cm)
Stickiness: Non-sticky

HCL reaction: -
Packing density: Low
Plasticity: Slightly plastic

TOTAL %
Nitrogen: 0.22
Carbon: 2.65
Organic carbon: 2.10
Loss on ignition: -

PARTICLE SIZE %
Sand: 50%
Silt: 31%
Clay: 19%

Textural Class (USDA): Loam
Bulk density: -
pH: 6.36

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: 0.08
K: 0.22
Mg: 3.05
Ca: 8.35

CEC (cmol kg^{-1}): 10.14
Base saturation: 100%

Horizon 2: 25 - 60 cm

Humose: No
Matrix colour (moist): 75YR44
Texture: Fine loamy

Stones (% total): Few (2-5 %)
Stones details: Medium gravels (6mm -2 cm)
Stickiness: Slightly sticky

HCL reaction: No reaction
Packing density: Medium
Plasticity: Slightly plastic

TOTAL %
Nitrogen: 0.10
Carbon: 0.87
Organic carbon: 0.57
Loss on ignition: -

PARTICLE SIZE %
Sand: 43%
Silt: 36%
Clay: 21%

Textural Class (USDA): Loam
Bulk density: -
pH: 6.61

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})

CEC (cmol kg^{-1}): 6.38

Na: 0.09
K: 0.54
Mg: 3.70
Ca: 8.97

Base saturation: 100%

Horizon 3: 60 - - cm

Humose: No
Matrix colour (moist): 5YR54
Texture: Fine loamy

Stones (% total): Very few (0-2 %)
Stones details: Fine gravels (2-6 mm)
Stickiness: Slightly sticky

HCL reaction: No reaction
Packing density: Medium
Plasticity: Plastic

TOTAL %
Nitrogen: 0.06
Carbon: 0.31
Organic carbon: 0.23
Loss on ignition: -

PARTICLE SIZE %
Sand: 6%
Silt: 51%
Clay: 43%

Textural Class (USDA): Silty Clay
Bulk density: -
pH: 6.60

EXCHANGEABLE COMPLEX
Exchangeable Bases (cmol kg^{-1})
Na: 0.08
K: 0.16
Mg: 2.19
Ca: 4.78

CEC (cmol kg^{-1}): 13.12
Base saturation: 55%

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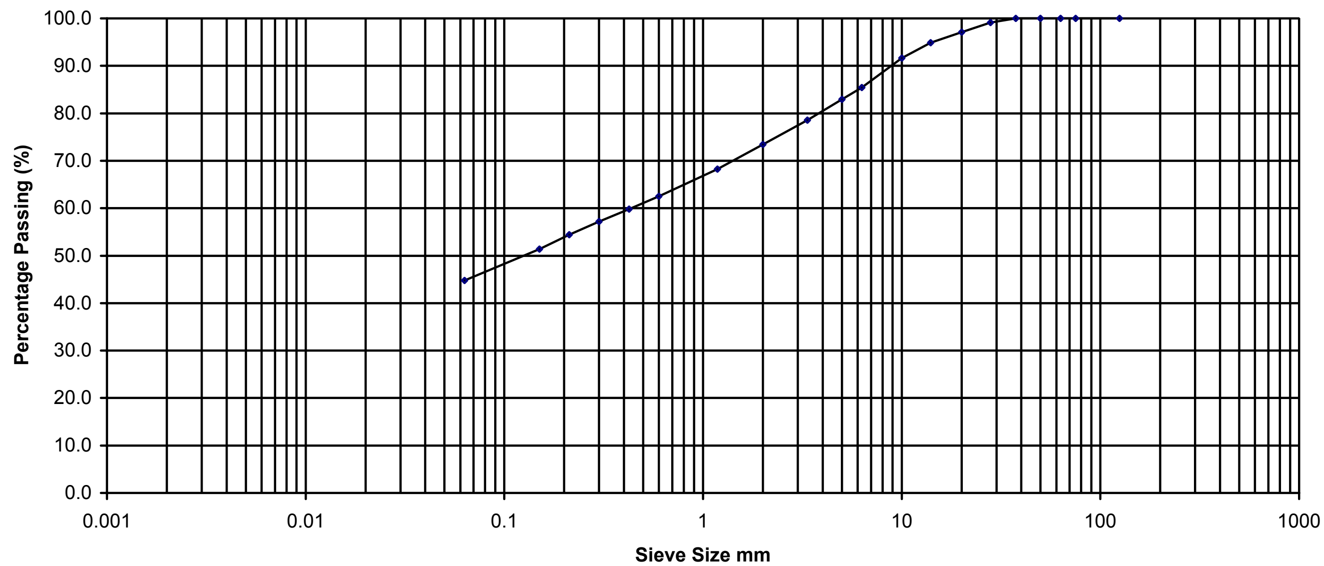
Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	99.1
20.000	97.1
14.000	94.9
10.000	91.6
6.300	85.4
5.000	82.9
3.350	78.5
2.000	73.4
1.180	68.3
0.600	62.5
0.425	59.8
0.300	57.2
0.212	54.4
0.150	51.4
0.063	44.8

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
0.0	44.8	28.6	26.6	0.0	0.0

Sample Description: Dark grey slightly gravelly slightly sandy SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489
BH/TP No.	BH5
Sample No.	B
Depth	2.50m

NM TL Ltd

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

		Total depth of standpipe (mbgl)	Response Zone (mOD)			12/10/2015		19/10/2015			
Borehole ID	GL (mOD)		Bottom	Top	Response strata	WL bGL	WL(mOD)	WL bGL	WLmOD	WL bGL	WLmOD
BH1	24.852	5.25	19.252	23.852	CLAY	1.15	23.702	1.08	23.772		
BH2	22.489	4	17.489	20.489	CLAY	1.78	20.709	1.79	20.699		
BH3	21.943	5.8	16.943	19.943	CLAY	2.13	19.813	2.17	19.773		
BH6	23.223	5	17.623	21.223	CLAY	Dry	Dry	Dry	Dry		
BH9	21.421	4.72	16.421	19.421	CLAY	2.3	19.121	2.4	19.021		

Analyte	LOD/LOR	Unit	A1 Inert Reuse	A2 Inert Landfill	B Non-Haz	C1 Stable Non-reactive	C2 Hazardous	Job No.	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318	15/14318
								Sample Identity	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4	BH4
								Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00	3.00-4.00
								Sampled Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015	03/10/2015
								Sample Nos.	1	2	3	4	5	6	7	8	9	10	11
								Method No.											
Total Organic Carbon #	<0.02	%	3	3	NA	5	6	TM21/PM24	0.5	1.03	1.2	0.44	0.53	0.53	2.27	2.02	0.34	0.38	0.65
Sum of BTEX	<0.025	mg/kg	6	6	see Haz Tool	see Haz Tool	see Haz Tool	TM31/PM12	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sum of 7 PCBs #	<0.035	mg/kg	1	1	see Haz Tool	see Haz Tool	see Haz Tool	TM17/PM8	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035	<0.035
PAH Sum of 6 #	<0.22	mg/kg	-	-	see Haz Tool	see Haz Tool	see Haz Tool	TM4/PM8	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22
PAH Sum of 17	<0.64	mg/kg	6	100	see Haz Tool	see Haz Tool	see Haz Tool	TM4/PM8	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64
Mineral Oil C10-C40		mg/kg	500	Not defined	Not defined	Not defined	Not defined	TM5/PM8	<45	87	<45	<45	<45	132	<45	<45	<45	<45	<45
CEN 10:1 Leachate																			
Dissolved Antimony (A10)	<0.02	mg/kg	0.06	0.06	0.7	0.7	5	TM30/PM17	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.02	<0.02	<0.02
Dissolved Arsenic (A10)	<0.025	mg/kg	0.5	0.5	2	2	25	TM30/PM17	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Dissolved Barium (A10)	<0.03	mg/kg	20	20	100	100	300	TM30/PM17	0.15	0.12	<0.03	<0.03	0.11	0.51	<0.03	<0.03	0.05	0.04	0.17
Dissolved Cadmium (A10)	<0.005	mg/kg	0.04	0.04	1	1	5	TM30/PM17	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dissolved Chromium (A10)	<0.015	mg/kg	0.5	0.5	10	10	70	TM30/PM17	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Dissolved Copper (A10)	<0.07	mg/kg	2	2	50	50	100	TM30/PM17	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07
Dissolved Lead (A10)	<0.05	mg/kg	0.5	0.5	10	10	50	TM30/PM17	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dissolved Molybdenum (A10)	<0.02	mg/kg	0.5	0.5	10	10	30	TM30/PM17	0.35	0.37	0.13	0.21	0.29	0.2	0.06	0.11	0.29	0.28	0.43
Dissolved Nickel (A10)	<0.02	mg/kg	0.4	0.4	10	10	40	TM30/PM17	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dissolved Selenium (A10)	<0.03	mg/kg	0.1	0.1	0.5	0.5	7	TM30/PM17	<0.03	0.27	<0.03	<0.03	<0.03	0.28	<0.03	<0.03	<0.03	<0.03	<0.03
Dissolved Zinc (A10)	<0.03	mg/kg	4	4	50	50	200	TM30/PM17	<0.03	<0.03	0.04	0.04	<0.03	0.04	0.05	0.04	0.05	0.04	0.03
Mercury Dissolved by CVAF	<0.0001	mg/kg	0.01	0.01	0.2	0.2	2	TM61/PM38	<0.0001	<0.0001	0.0028	0.0006	<0.0001	<0.0001	0.0029	0.0007	0.0003	0.0002	<0.0001
Phenol	<0.1	mg/kg	1	nd	nd	nd	nd	TM26/PM0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Fluoride	<3	mg/kg	10	10	150	150	500	TM27/PM0	<3	<3	3	<3	<3	<3	5	5	<3	<3	3
Chloride	<3	mg/kg	800	800	15000	15000	25000	TM27/PM0	11	<3	<3	<3	<3	<3	<3	4	<3	<3	<3
Sulphate	<0.5	mg/kg	1000	1000	20000	20000	50000	TM27/PM0	35.9	165.5	2.8	5.2	46.7	296.8	3.2	8.2	5	6.1	33.8
Mass of raw test portion	-	kg	-	-	-	-	-	NONE/PM17	0.1051	0.1036	0.1056	0.1003	0.1011	0.1003	0.105	0.1133	0.1007	0.1022	0.1008
Leachant Volume	-	l	-	-	-	-	-	NONE/PM17	0.885	0.887	0.885	0.89	0.889	0.889	0.885	0.877	0.889	0.887	0.889
Eluate Volume	-	l	-	-	-	-	-	NONE/PM17	0.65	0.75	0.83	0.83	0.85	0.6	0.8	0.75	0.85	0.83	0.63
Dissolved Organic Carbon	<20	mg/kg	500	500	800	800	1000	TM60/PM0	30	20	70	40	30	30	70	60	40	40	30
pH	<0.01	pH units	nd	nd	nd	nd	nd	TM73/PM0	-	-	-	-	-	-	-	-	-	-	-
Total Dissolved Solids	<100	mg/kg	4000	4000	60000	60000	100000	TM20/PM0	750	1191	710	970	800	1489	560	1800	1070	980	940

NOTES:

Categories explained in OCSC Waste Catagories Table

Hazardous classes subject to confirmation with waste facility

Where TOC is slightly elevated above inert landfill it is possible that it may still be acceptable when material is excavated

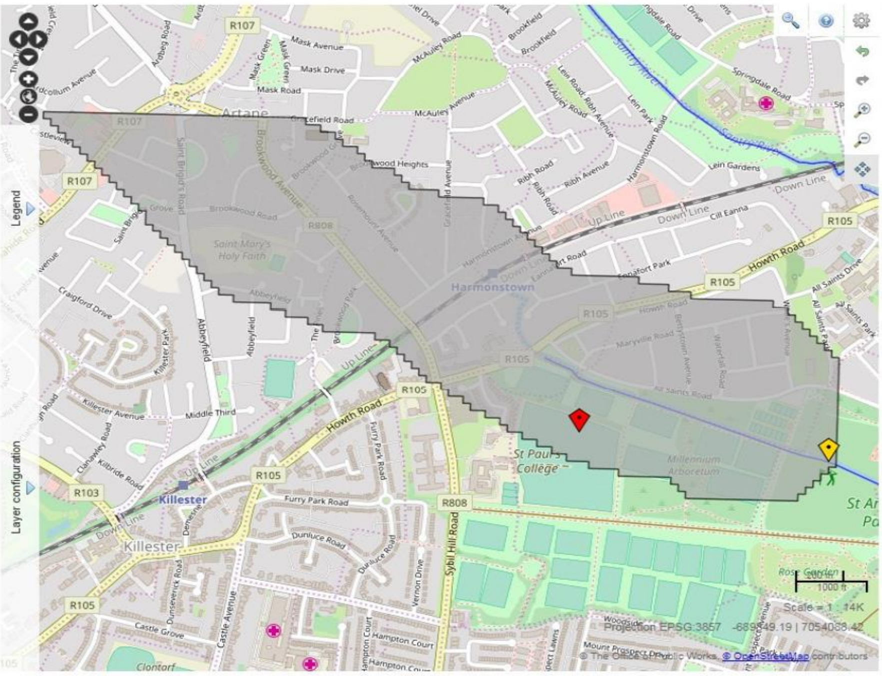
Elevated Selenium level is likely to be naturally occuring and is likely that it can be accepted at a inert facility (eg. Behan's W0247-01)

N251 St. Paul's Sports Complex, Sybil Road, Dublin

EXISTING NANIKEN FLOW RATES

Naniken Dimensions:	1 Year	30 Year	100 Year
Bed Width (m)	1.335	1.335	1.335
Depth (m)	0.2829	0.42826	0.44703
Side Slope (1 in)	1.2	1.2	1.2
Mannings n	0.03	0.03	0.03
Length of Channel (m)	33	33	33
Upstream Bed Level (m AOD)	18.58	18.58	18.58
Downstream Bed Level (m AOD)	18.35	18.35	18.35
Channel Gradient	0.00697	0.00697	0.00697
Flow (l/s)	470.9	979.2	1057.8
Velocity (m/s)	1.1	1.4	1.4

Date: 26/02/2018
Calcs by: JB
Checked by: RG



Subject site 09_1469_1

Reset

Clicked coordinates:
[-688972.1498, 7052510.1942]

Subject site properties

Location Number	09_1469_1
Contributing Catchment Area	1.033 km^2
BFISOIL	0.4919
SAAR	695.8 mm
FARL	1
DRAIND	0.795 km/km^2
S1085	11.2147 m/km
ARTDRAIN2	0
URBEXT	0.8287
Centroid distance	1122.718 km
Coordinates	[-687858.1684, 7052370.4047]

QMED values

PCD estimate	0.1829m^3/s
PCD urban estimate	0.4474m^3/s

Pivotal site

Rural Runoff Calculator

Micro Drainage

IH 124

IH 124 Input

Return Period (Years): 100
Area (ha): 103.300
SAAR (mm): 659 [Map]
Soil: 0.300
Growth Curve: GDSDS [Calculate]

Partly Urbanised Catchment (QBAR)

Urban: 0.750
Region: Ireland Greater Dubli

Results

QBAR rural (l/s): 162.0
QBAR urban (l/s): 554.0

IH 124
ICP SUDS
ADAS 345
FEH
ReFH2
Greenfield Volume
Greenfield Volume (ReFH2)

Return Period Flood

Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (2 yrs) (l/s)	Q (5 yrs) (l/s)	Q (10 yrs) (l/s)	Q (20 yrs) (l/s)	Q (25 yrs) (l/s)	Q (30 yrs) (l/s)	Q (50 yrs) (l/s)	Q (100 yrs) (l/s)	Q (200 yrs) (l/s)	Q (250 yrs) (l/s)	Q (1000 yrs) (l/s)
Region 1	554.0	943.6	470.9	558.0	691.5	761.0	819.4	834.5	846.4	883.5	943.6	986.6	1000.1	1078.8
Region 2	554.0	961.6	482.0	554.9	678.7	744.9	806.7	822.7	835.3	876.2	961.6	998.9	1011.9	1081.6
Region 3	554.0	894.4	476.5	583.3	714.2	770.8	818.9	831.3	841.1	866.6	894.4	958.1	976.8	1088.7
Region 4	554.0	976.5	459.9	558.7	709.7	783.6	845.5	861.4	874.1	915.0	976.5	1058.6	1083.9	1233.9
Region 5	554.0	1171.9	482.0	568.0	753.0	854.1	946.9	970.8	989.8	1052.0	1171.9	1246.2	1266.7	1411.4
Region 6/Region 7	554.0	1112.8	470.9	562.5	745.8	841.7	924.2	945.4	962.3	1016.8	1112.8	1190.8	1213.0	1360.5
Region 8	554.0	958.6	432.2	556.3	709.7	783.6	845.5	861.4	874.1	909.3	958.6	1049.1	1072.3	1232.9
Region 9	554.0	893.8	487.6	569.1	693.7	754.2	802.3	814.7	824.5	853.8	893.8	947.1	965.1	1060.0
Region 10	554.0	869.0	482.0	566.0	679.3	732.0	780.1	792.5	802.3	827.9	869.0	925.5	942.0	1040.1
Ireland National	554.0	816.6	470.9	580.1	681.5	724.7	759.6	769.0	776.4	797.0	816.6	839.2	n/a	n/a
Ireland East	554.0	843.7	470.9	582.1	689.2	738.2	776.8	786.6	794.4	816.0	843.7	865.1	n/a	n/a
Ireland South	554.0	816.6	470.9	578.1	677.0	723.1	759.6	769.0	776.4	797.0	816.6	839.2	n/a	n/a
Ireland West	554.0	806.4	470.9	576.1	670.4	713.6	747.4	755.8	762.4	781.0	806.4	825.8	n/a	n/a
Ireland Greater Dublin	554.0	1057.8	470.9	600.2	792.3	878.7	947.4	965.2	979.2	1018.3	1057.8	1093.0	n/a	n/a
User Defined	554.0	n/a	470.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	n/a	n/a	n/a	n/a

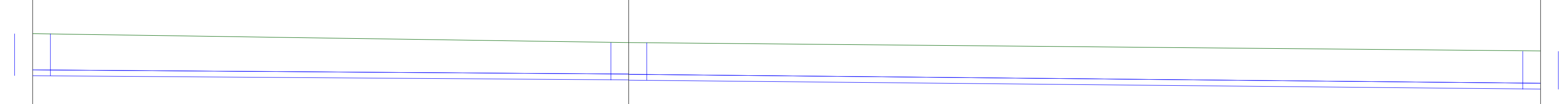
APPENDIX C – FOUL WATER CALCULATIONS

O'Connor Sutton Cronin		Page 1
9 Prussia Street Dublin 7 Ireland	ST Pauls Residential Development Sybilhill Riad, Dublin	
Date 14/10/2019 14:07 File N251-20191011.mdx	Designed by DOM Checked by AH	
XP Solutions	Network 2018.1	

Hor Scale 250

Ver Scale 250

Datum (m)18.000

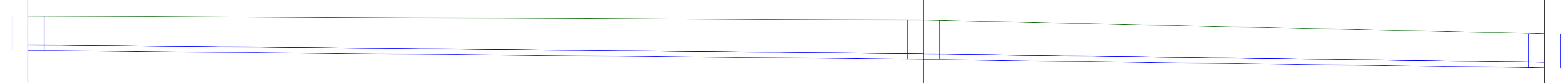


MH Name	S1		S2		S3
PN		S1.000		S1.001	
Dia (mm)		225		225	
Slope (1:X)		135.0		100.0	
Cover Level (m)	25.264		24.912		24.585
Invert Level (m)	23.650		23.482 23.482		23.134
Length (m)		22.741		34.761	

Hor Scale 250

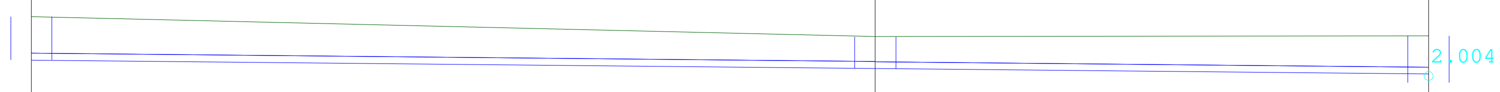
Ver Scale 250

Datum (m)18.000

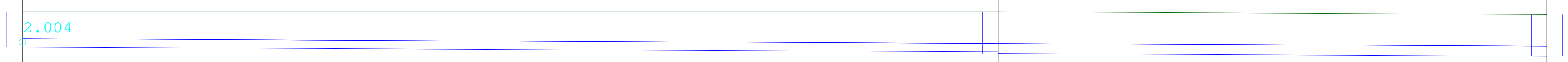


MH Name	S3		S4		S5
PN		S1.002		S1.003	
Dia (mm)		225		225	
Slope (1:X)		100.0		75.0	
Cover Level (m)	24.585		24.412		23.833
Invert Level (m)	23.134		22.753 22.753		22.401
Length (m)		38.051		26.400	

MH Name		S5	S6	S12
Hor Scale 250 Ver Scale 250 Datum (m)17.000				
PN		S1.004	S1.005	
Dia (mm)		225	225	
Slope (1:X)		100.0	100.0	
Cover Level (m)		23.833	23.173	23.202
Invert Level (m)		22.401 / 22.122	22.122 / 21.939	
Length (m)		27.924	18.310	



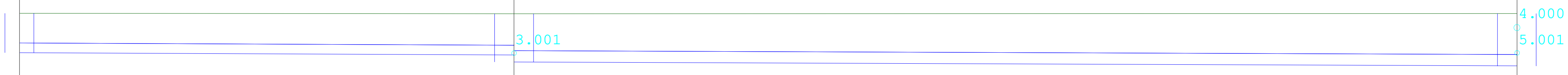
MH Name		S12	S13	S14
Hor Scale 250 Ver Scale 250 Datum (m)16.000				
PN		S1.006	S1.007	
Dia (mm)		375	450	
Slope (1:X)		200.0	200.0	
Cover Level (m)		23.202	23.206	23.086
Invert Level (m)		21.648 / 21.435	21.360 / 21.241	
Length (m)		42.522	23.903	



Hor Scale 250

Ver Scale 250

Datum (m)16.000

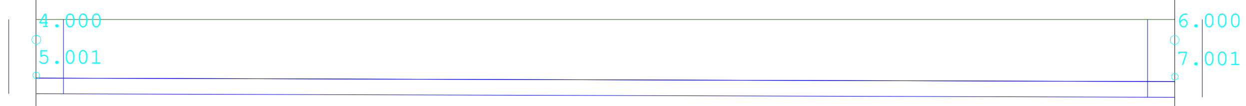


MH Name	S14		S17		S21
PN		S1.008		S1.009	
Dia (mm)		450		525	
Slope (1:X)		200.1		249.5	
Cover Level (m)	23.086		23.064		23.075
Invert Level (m)	21.241		21.126 20.806		20.619
Length (m)		23.009		46.658	

Hor Scale 250

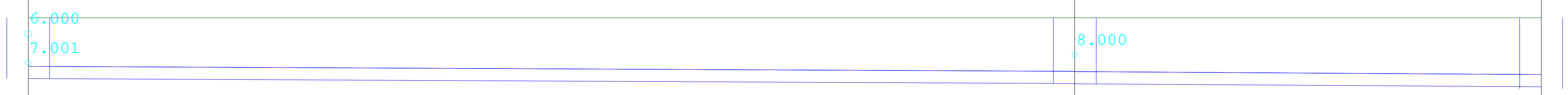
Ver Scale 250

Datum (m)16.000

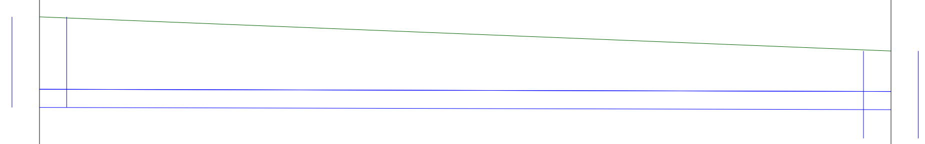


MH Name	S21		S25
PN		S1.010	
Dia (mm)		525	
Slope (1:X)		300.0	
Cover Level (m)	23.075		23.075
Invert Level (m)	20.619		20.494
Length (m)		37.695	

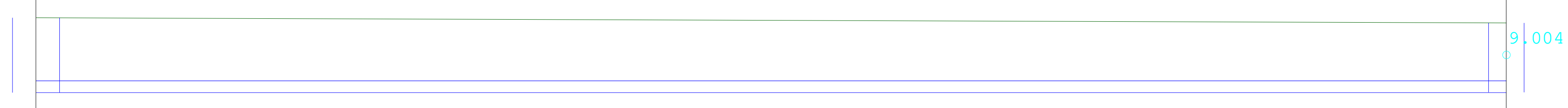
MH Name	S25		S27		S28
Hor Scale 250 Ver Scale 250 Datum (m)16.000					
PN		S1.011		S1.012	
Dia (mm)		525		525	
Slope (1:X)		200.3		150.0	
Cover Level (m)	23.075		23.075		23.075
Invert Level (m)	20.494		20.273 / 20.273		20.141
Length (m)		44.256		19.724	



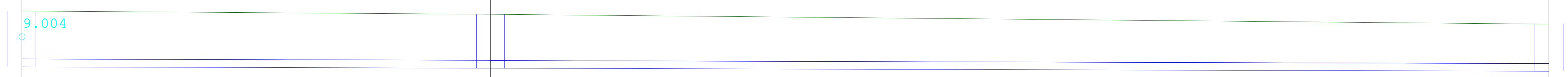
MH Name	S28		S29
Hor Scale 250 Ver Scale 250 Datum (m)15.000			
PN		S1.013	
Dia (mm)		600	
Slope (1:X)		375.0	
Cover Level (m)	23.075		21.937
Invert Level (m)	20.066		19.991
Length (m)		28.184	



MH Name		S29	S35
Hor Scale 250 Ver Scale 250 Datum (m)15.000			
PN		S1.014	
Dia (mm)		450	
Slope (1:X)		56548.0	
Cover Level (m)		21.937	21.730
Invert Level (m)		19.033 19.032	
Length (m)		56.548	

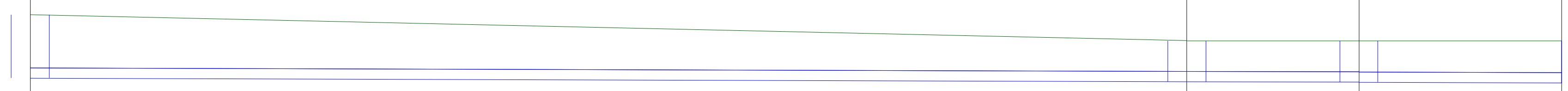


MH Name		S35	S36	S37
Hor Scale 250 Ver Scale 250 Datum (m)15.000				
PN		S1.015	S1.016	
Dia (mm)		375	375	
Slope (1:X)		323.7	325.0	
Cover Level (m)		21.730	21.570	21.090
Invert Level (m)		19.032 18.962	18.962 18.804	
Length (m)		22.659	51.193	

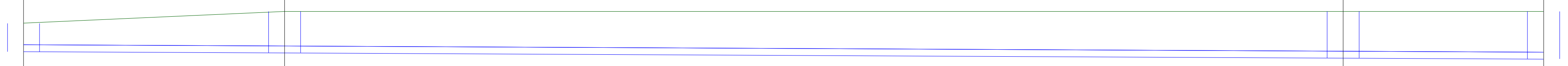


O'Connor Sutton Cronin		Page 6
9 Prussia Street Dublin 7 Ireland	ST Pauls Residential Development Sybilhill Riad, Dublin	
Date 14/10/2019 14:07 File N251-20191011.mdx	Designed by DOM Checked by AH	
XP Solutions	Network 2018.1	

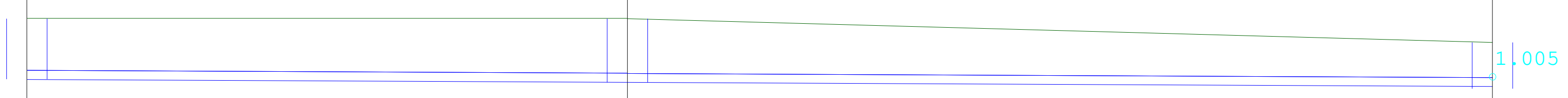
MH Name		S37	S38	S39	S
Hor Scale 250 Ver Scale 250 Datum (m)14.000					
PN		S1.017	S1.018	S1.019	
Dia (mm)		375	375	375	
Slope (1:X)		325.0	325.0	325.0	
Cover Level (m)		21.090	20.150	20.150	20.150
Invert Level (m)		18.804	18.677 18.677	18.658 18.658	18.636
Length (m)		41.432	6.162	7.266	



MH Name		S7	S8	S9	S10
Hor Scale 250 Ver Scale 250 Datum (m)17.000					
PN		S2.000	S2.001	S2.002	
Dia (mm)		300	300	300	
Slope (1:X)		200.0	200.0	200.0	
Cover Level (m)		23.500	24.000	24.000	24.000
Invert Level (m)		22.290	22.235 22.235	22.011 22.011	21.968
Length (m)		11.055	44.835	8.485	

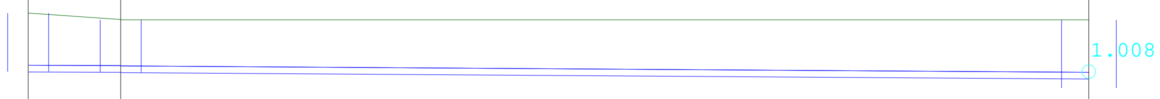


MH Name		S10	S11	S12
Hor Scale 250 Ver Scale 250 Datum (m)17.000				

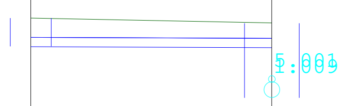


PN		S2.003	S2.004	
Dia (mm)		300	300	
Slope (1:X)		200.0	200.0	
Cover Level (m)		24.000	24.000	23.202
Invert Level (m)		21.968	21.868 21.868	21.723
Length (m)		20.115	28.970	

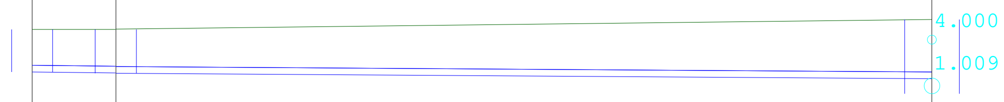
MH Name		S15	S16	S17
Hor Scale 250 Ver Scale 250 Datum (m)16.000				



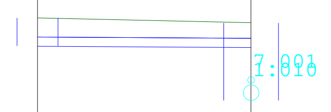
PN		S3.000	S3.001	
Dia (mm)		225	225	
Slope (1:X)		152.9	150.0	
Cover Level (m)		23.285	23.064	23.064
Invert Level (m)		21.340	21.320 21.320	21.106
Length (m)		3.057	32.026	

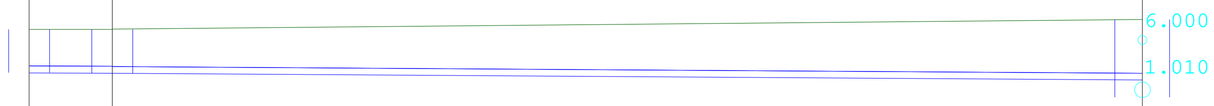


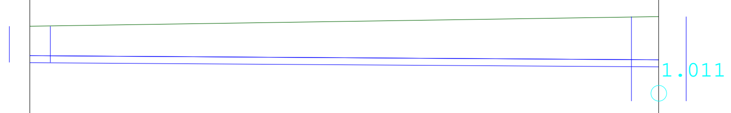
MH Name		S18	S21
Hor Scale 250 Ver Scale 250 Datum (m)16.000			
PN		S4.000	
Dia (mm)		300	
Slope (1:X)		200.0	
Cover Level (m)		23.250	23.075
Invert Level (m)		22.300	22.260
Length (m)		7.971	

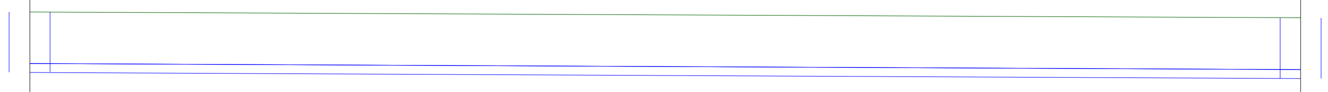


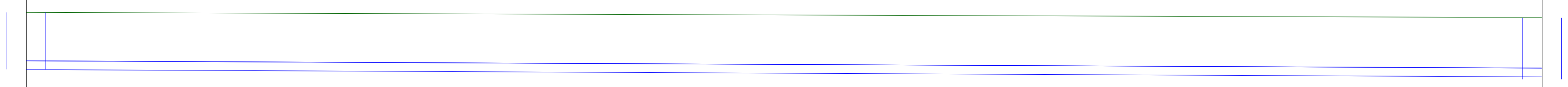
MH Name			S20	S21
Hor Scale 250 Ver Scale 250 Datum (m)16.000				
PN			S5.001	
Dia (mm)			225	
Slope (1:X)			150.0	
Cover Level (m)		22.750	22.750	23.075
Invert Level (m)		21.340 21.298	21.298 21.118	
Length (m)			27.025	

MH Name		S22	S25
Hor Scale 250 Ver Scale 250 Datum (m)16.000			
PN		S6.000	
Dia (mm)		300	
Slope (1:X)		150.0	
Cover Level (m)		23.250	23.075
Invert Level (m)		22.300	22.253
Length (m)		7.062	

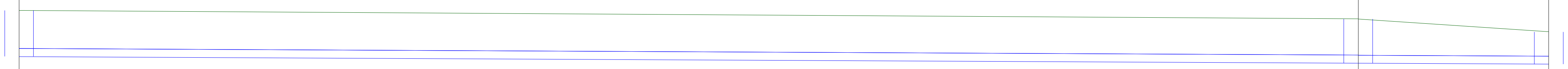
MH Name			S24	S25
Hor Scale 250 Ver Scale 250 Datum (m)16.000				
PN			S7.001	
Dia (mm)			225	
Slope (1:X)			150.2	
Cover Level (m)		22.750	22.750	23.075
Invert Level (m)		21.316	21.298 21.298	21.071
Length (m)			34.088	

MH Name		S26	S27
Hor Scale 250 Ver Scale 250 Datum (m)16.000			
PN		S8.000	
Dia (mm)		225	
Slope (1:X)		149.8	
Cover Level (m)		22.750	23.075
Invert Level (m)		21.550	21.411
Length (m)		20.820	

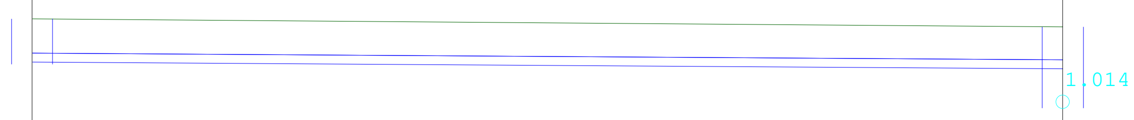
MH Name		S30	S31
Hor Scale 250 Ver Scale 250 Datum (m)17.000			
PN		S9.000	
Dia (mm)		300	
Slope (1:X)		200.0	
Cover Level (m)		23.400	23.200
Invert Level (m)		21.400	21.190
Length (m)		42.070	



MH Name		S31	S32
Hor Scale 250 Ver Scale 250 Datum (m)16.000			
PN		S9.001	
Dia (mm)		300	
Slope (1:X)		200.0	
Cover Level (m)		23.200	23.000
Invert Level (m)		21.190	20.925
Length (m)		52.862	



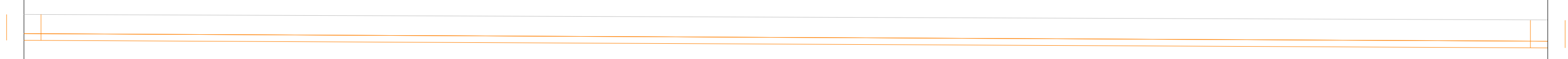
MH Name		S32	S33	S34
Hor Scale 250 Ver Scale 250 Datum (m)16.000				
PN		S9.002	S9.003	
Dia (mm)		375	375	
Slope (1:X)		200.0	200.0	
Cover Level (m)		23.000	22.600	22.000
Invert Level (m)		20.850	20.534 20.534	20.489
Length (m)		63.336	9.016	



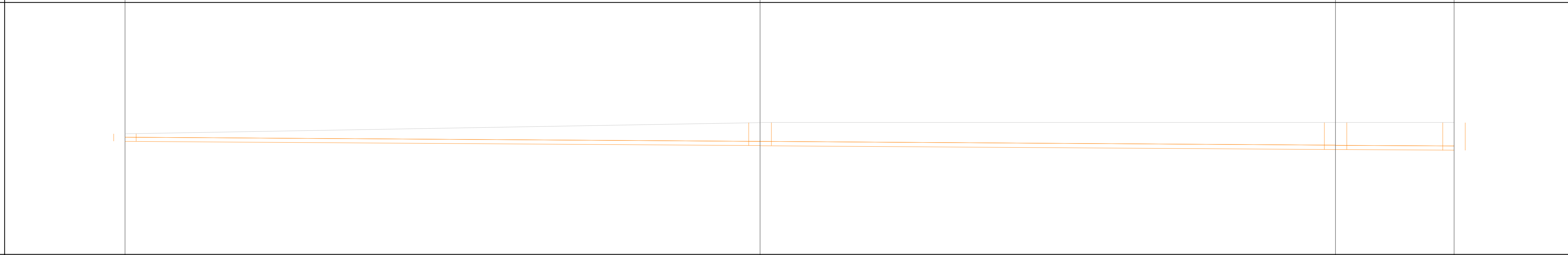
MH Name		S34	S35
Hor Scale 250 Ver Scale 250 Datum (m)15.000			
PN		S9.004	
Dia (mm)		300	
Slope (1:X)		150.0	
Cover Level (m)		22.000	21.730
Invert Level (m)		20.564	20.337
Length (m)		34.122	

MH Name	F1.0	F1.1
Hor Scale 250 Ver Scale 250 Datum (m)16.000		
PN	F1.000	
Dia (mm)	225	
Slope (1:X)	145.0	
Cover Level (m)	23.500	23.200
Invert Level (m)	22.575	22.300
Length (m)	39.870	

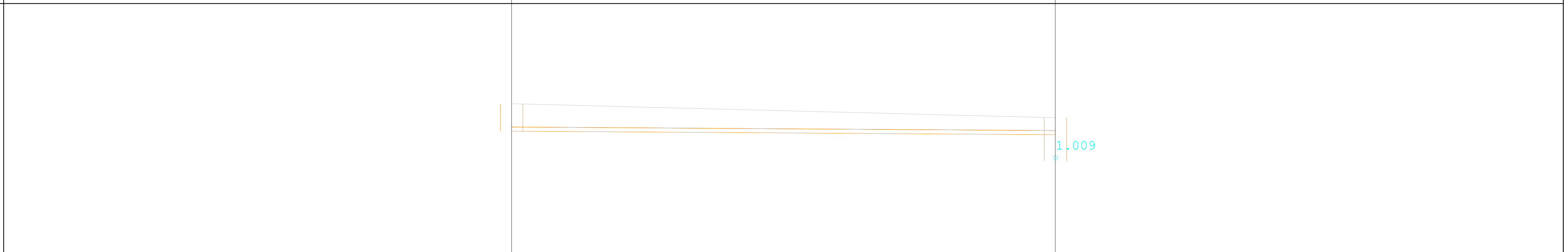
MH Name	F1.1	F1.2
Hor Scale 250 Ver Scale 250 Datum (m)16.000		
PN	F1.001	
Dia (mm)	225	
Slope (1:X)	199.8	
Cover Level (m)	23.200	23.000
Invert Level (m)	22.300	22.035
Length (m)	52.952	



MH Name	F2.0	F2.1	F2.2	F2.3
Hor Scale 250 Ver Scale 250 Datum (m)17.000				
PN	F2.000	F2.001	F2.002	
Dia (mm)	225	225	225	
Slope (1:X)	150.0	150.0	150.0	
Cover Level (m)	23.400	24.000	24.000	24.000
Invert Level (m)	23.000	22.774 22.774	22.570 22.570	22.528
Length (m)	33.826	30.655	6.311	



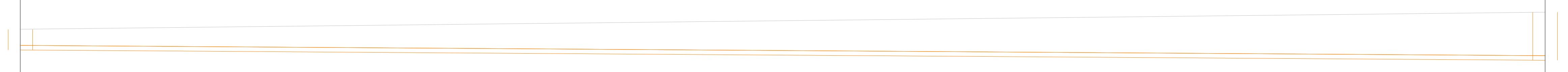
MH Name	F2.3	F1.10
Hor Scale 250 Ver Scale 250 Datum (m)16.000		
PN	F2.003	
Dia (mm)	225	
Slope (1:X)	150.0	
Cover Level (m)	24.000	23.245
Invert Level (m)	22.528	22.334
Length (m)	29.150	



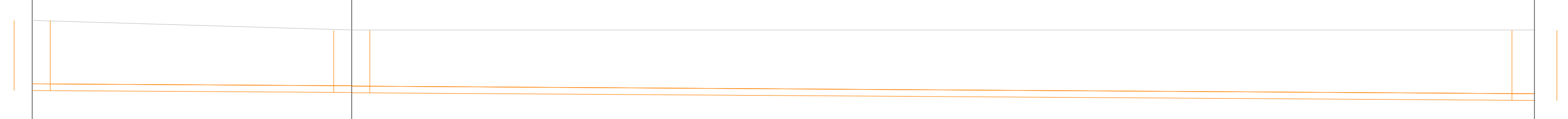
O'Connor Sutton Cronin		Page 1
9 Prussia Street Dublin 7 Ireland	St. Pauls Residential Development Sybil Road, Dublin	
Date 18/09/2019 12:09 File N251-20190815.mdx	Designed by JB Checked by AH	
XP Solutions	Network 2018.1	

MH Name	F1.2		F1.3		F1.4
Hor Scale 250 Ver Scale 250 Datum (m)16.000					
PN		F1.002		F1.003	
Dia (mm)		225		225	
Slope (1:X)		199.8		200.0	
Cover Level (m)	23.000		22.600		22.667
Invert Level (m)	22.035		21.718 / 21.718		21.668
Length (m)		63.334		9.967	

MH Name	F1.4		F1.5
Hor Scale 250 Ver Scale 250 Datum (m)16.000			
PN		F1.004	
Dia (mm)		225	
Slope (1:X)		150.1	
Cover Level (m)	22.667		23.500
Invert Level (m)	21.668		21.170
Length (m)		74.737	



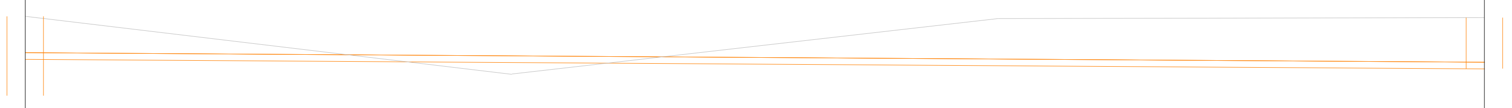
MH Name	F1.5		F1.6		F1.7
Hor Scale 250 Ver Scale 250 Datum (m)15.000					
PN		F1.005		F1.006	
Dia (mm)		225		225	
Slope (1:X)		150.5		149.9	
Cover Level (m)	23.500		23.175		23.175
Invert Level (m)	21.170	21.099	21.099		20.835
Length (m)		10.688		39.566	



MH Name	F1.7		F1.8
Hor Scale 250 Ver Scale 250 Datum (m)15.000			
PN		F1.007	
Dia (mm)		225	
Slope (1:X)		150.0	
Cover Level (m)	23.175		23.175
Invert Level (m)	20.835		20.537
Length (m)		44.697	

O'Connor Sutton Cronin		Page 3
9 Prussia Street Dublin 7 Ireland	St. Pauls Residential Development Sybil Road, Dublin	
Date 18/09/2019 12:09 File N251-20190815.mdx	Designed by JB Checked by AH	
XP Solutions	Network 2018.1	

MH Name		F1.8			F1.9
Hor Scale 250 Ver Scale 250 Datum (m)15.000					
PN		F1.008			
Dia (mm)		225			
Slope (1:X)		149.8			
Cover Level (m)		23.175	21.244	23.094	23.126
Invert Level (m)		21.745		21.423	
Length (m)		48.239			



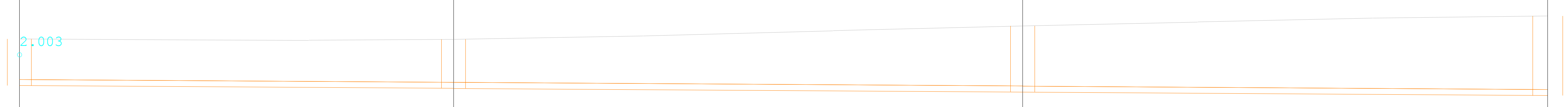
MH Name		F1.9			F1.10
Hor Scale 250 Ver Scale 250 Datum (m)15.000					
PN		F1.009			
Dia (mm)		225			
Slope (1:X)		149.8			
Cover Level (m)		23.126	23.235	23.340	23.245
Invert Level (m)		21.423		20.997	
Length (m)		63.828			

MH Name	F1.10			F1.11			F1.12			F1.13

Hor Scale 250

Ver Scale 250

Datum (m)16.000



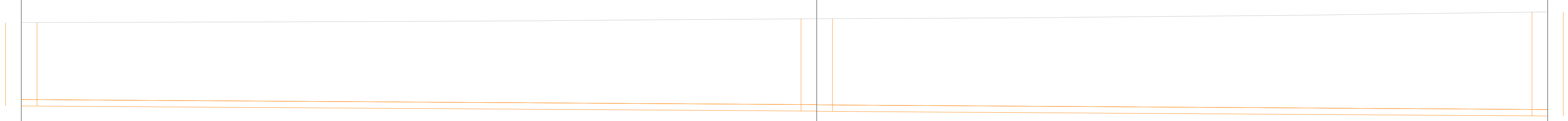
PN	F1.010			F1.011			F1.012				
Dia (mm)	300			300			300				
Slope (1:X)	150.0			150.0			150.0				
Cover Level (m)	23.245	23.199	23.164	23.215	23.388	23.645	23.881	24.078	24.275	24.382	
Invert Level (m)	20.922			20.778 / 20.778			20.589 / 20.589			20.415	
Length (m)	21.598			28.314			26.126				

MH Name	F1.13			F1.14			F1.15

Hor Scale 250

Ver Scale 250

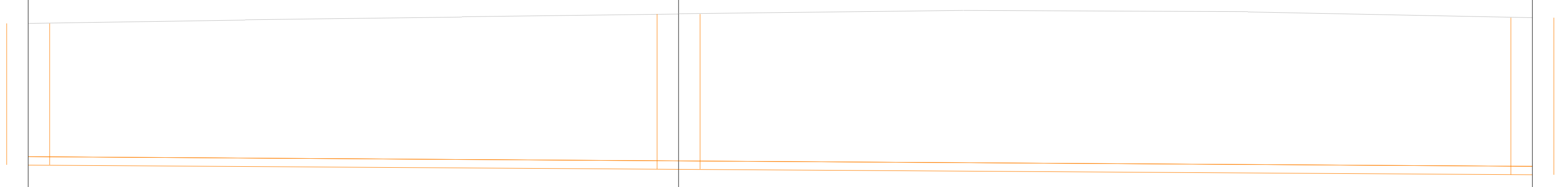
Datum (m)16.000



PN	F1.013			F1.014			
Dia (mm)	300			300			
Slope (1:X)	150.0			150.0			
Cover Level (m)	24.382	24.420	24.481	24.568	24.624	24.739	24.903
Invert Level (m)	20.415			20.162 / 20.162			19.929
Length (m)	37.983			34.901			

O'Connor Sutton Cronin		Page 5
9 Prussia Street Dublin 7 Ireland	St. Pauls Residential Development Sybil Road, Dublin	Micro Drainage
Date 18/09/2019 12:09 File N251-20190815.mdx	Designed by JB Checked by AH	
XP Solutions	Network 2018.1	

MH Name		F1.15			F1.16			F1.17
Hor Scale 250 Ver Scale 250 Datum (m)16.000								
PN		F1.015			F1.016			
Dia (mm)		300			300			
Slope (1:X)		150.0			150.0			
Cover Level (m)		24.903	25.022	25.124	25.226	25.353	25.306	25.100
Invert Level (m)		19.929		19.778	19.778		19.578	
Length (m)		22.740			29.862			



MH Name		F1.17	F1.18
Hor Scale 250 Ver Scale 250 Datum (m)15.000			
PN		F1.017	
Dia (mm)		300	
Slope (1:X)		150.0	
Cover Level (m)		25.100	23.815
Invert Level (m)		19.578	19.081
Length (m)		74.532	

MH Name		F1.18	F1.19	F1.20	FTrunk Sewer
Hor Scale 250 Ver Scale 250 Datum (m)5.731				3.000	
PN		F1.018	F1.019	F1.020	
Dia (mm)		300	300	225	
Slope (1:X)		150.0	150.0	150.0	
Cover Level (m)		23.815	23.300	23.238	1.024
Invert Level (m)		19.081 / 18.862	18.862 / 18.823	18.724 / 18.506	
Length (m)		32.843	5.866	32.760	

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APPENDIX E – PRE-CONNECTION FEEDBACK FORM & STATEMENT OF DESIGN ACCEPTANCE

Alexandre Baraona,
OCSC,
9 Prussia Street,
Dublin 7
D07KT57

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

1 October 2019

Dear Alexandre Baraona,

Re: Connection Reference No CDS19006864 pre-connection enquiry - Subject to contract | Contract denied

Connection for Mixed Use Development of 657 No. Units and 1 No. Crèche at St. Pauls College, Sybill Hill Road, Dublin 5.

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at St. Pauls College, Sybill Hill Road, Dublin 5.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the networks, as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water networks can be facilitated.

Water: The trunk main which supplies the Sybill Hill District Metered Area (DMA) requires significant upgrades due to high headloss experienced along it. To address this, the proposed development will require an upgrade of the existing 12" ID and 250mm ID pipes servicing the Sybill Hill DMA. In addition a new booster pump on the upgraded trunk main will also be required to be installed.

Specifically the upgrades required are 12" CI to be upgraded to 400mm ID pipe over a length of 2km, a 250mm uPVC to be upgraded to 300mm ID pipe over a length of 200m and a booster pump to be installed on a bypass off new the 400mm. Irish Water currently does not have any plans to upgrade the network in this area. If you wish to consider upgrading the existing network, please contact Irish Water.

Wastewater: Based on the capacity currently available as assessed by Irish Water, we wish to advise you that, subject to connecting downstream of the identified 650mm diameter constraint in the 1350mm diameter foul sewer pipe south east of the proposed development site, your proposed wastewater connection to the Irish Water network can be facilitated.

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore in advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services. All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details.

You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed at a later date.

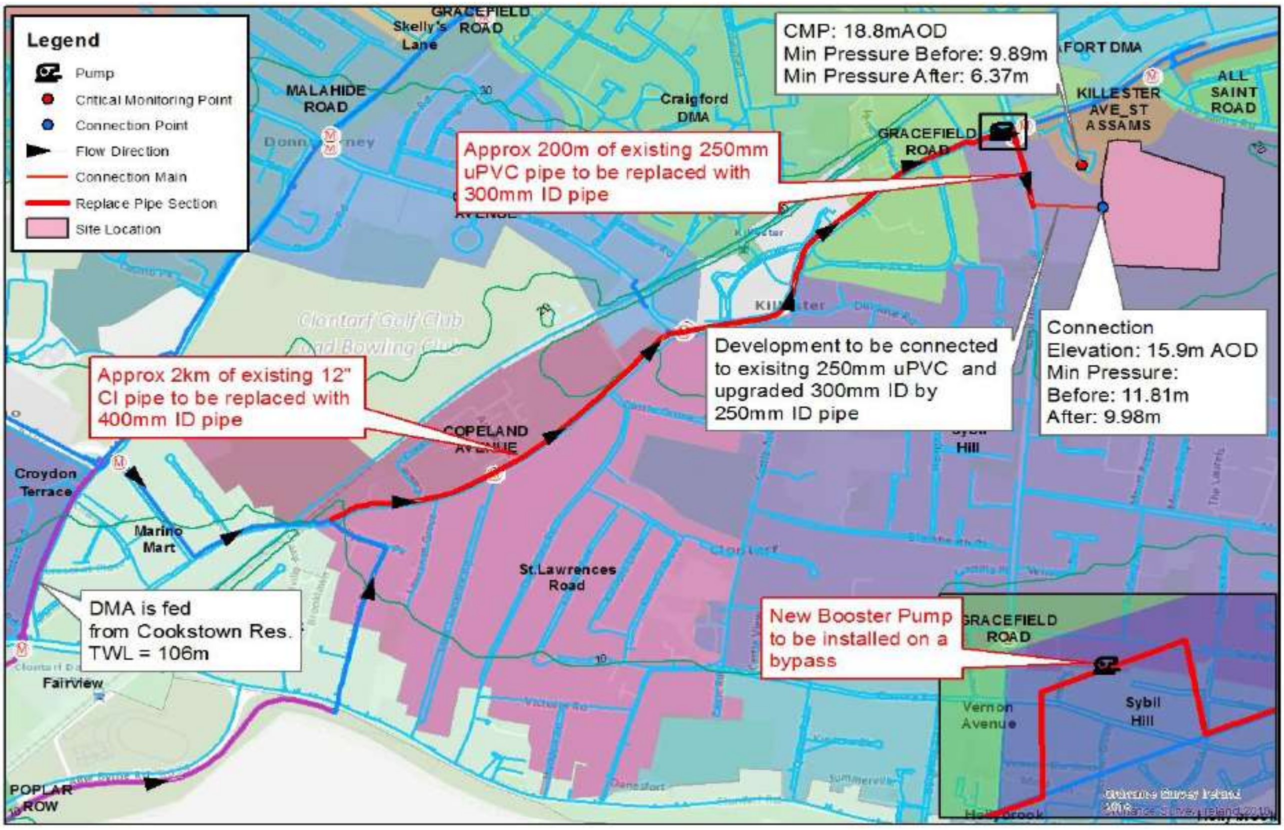
A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact Aidan Tierney from the design team on 022 52257 or email aitierney@water.ie. For further information, visit **[www.water.ie/connections.](http://www.water.ie/connections)**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services



Niall O' Byrne
8-10 Hanover Street East
Grand Canal Dock
Dublin 22
Co. Dublin

Uisce Éireann
Bosca OP 448
Oifig Sheachadta na
Cathrach Theas
Cathair Chorcaí

Irish Water
PO Box 448,
South City
Delivery Office,
Cork City.

www.water.ie

1 October 2019

Re: Design Submission for St. Pauls College, Sybill Hill Road, Co. Dublin (the "Development")
(the "Design Submission") / Connection Reference No: CDS19005716

Dear Niall O' Byrne,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:
Name: Aidan Tierney
Phone: 022 52257
Email: aitierney@water.ie

Yours sincerely,

M O'Dwyer

Maria O'Dwyer
Connections and Developer Services

Appendix A

Document Title & Revision

- JB – C01 Rev.P9
- N251 - C02 Rev.P9
- N251 - C04 Rev.P4
- N251 - G01 Rev.P6
- N251 - G02 Rev.P6
- N251 - H01 Rev.P9
- N251-H02 Rev.P10
- N251-20190815

Standard Details/Code of Practice Exemption: N/A

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

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APPENDIX F – PRELIMINARY HYDROGEOLOGICAL

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Multidisciplinary Consulting Engineers

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

ST PAUL'S, RAHENY, DUBLIN

CREKAV LIMITED PARTNERSHIP

PROJECT NO. N288

FEBRUARY 2018

PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

St Paul's Raheny, Dublin

for

Crekav Limited Partnership

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DOCUMENT CONTROL & HISTORY

OCSC Job No.: N288	Project Code	Originator	Zone Volume	Level	File Type	Role Type	Number	Status / Suitability Code	Revision
	N288	OCSC	ZZ	ZZ	RP	ENV	0001	S2	P01

Rev.	Status	Authors	Checked	Authorised	Issue Date
DRAFT	S2 E Burke	IW	EB	AH	23.02.18

1.0 INTRODUCTION

1.1 Site Setting

The site topography is generally level at c. 24.9m in the northwest to 21.28m OD in the southeast corner. The ground level falls gradually away to the east through St. Anne's Park (c. 13mOD) and then to the sea at Dollymount (c.1mOD). Beyond Dollymount is Bull Island and then Dublin Bay which is c. 2.5km to the southeast of the site boundary.

The majority of the site is currently occupied by a number of sports fields associated with St Paul's College.

Figure 6.3: Aerial Image of Site (Bing Maps)

As shown on Figure 6.3 site is bounded to the south and the east by St. Anne's Park which comprises a large area of open green space with mature tree lines and a number of sports pitches. Beyond the northern pitches is the Naniken River which flows eastwards discharging to Dublin Bay at Dollymount. There are 2 no. sports pitches to the east of the site and a further 2 no. to the north of the site. There is a residential development (The Meadows) to the west of the site (from the northwest corner). St Paul's college campus is to the west as is Sybil Hill Road, the main road.

1.2 Regional Soils

The general lithological/geological sequence of the overburden within the Dublin area comprises the following units:

Superficial Deposits

Made Ground
Estuarine/alluvial clays and silts
Estuarine/alluvial gravels and sands
Glaciomarine clays, silts and sands
Glacial Till (drift)
Glacial gravels and sands

Table 1: Superficial Deposits in Dublin Region

Made ground, concrete and tarmac covers the majority of central Dublin as a result of development through the years. As the city has developed large parts of the tidal areas along the natural shoreline and along the course of the River Liffey and its tributaries have been reclaimed and modified. The majority of central Dublin has had some anthropogenic influence with made ground covering almost all of the central city and stretching out to the suburbs.

The St Paul's Campus and adjoining St. Anne's has not been subject to significant development and hence made ground is absent on the Teagasc Soils Map. The topsoil at the site is classified as "deep well drained material derived from mainly basic parent material (calcareous) – BminDW". Some poorly drained areas are also mapped to the east of the project site within St. Anne's Park.

The subsoil has been classified as Limestone Till (Carboniferous). This is the dominant subsoil type in the region and is a glacial deposit which is known as Dublin Boulder Clay. This till resulted from glaciations which covered the region during the Pleistocene and Quaternary periods. It is known that the ice thickness in Dublin was c. 1km. The grinding action of this ice sheet as it eroded the underlying limestone and shale, together with the loading effect, resulted in the formation of a very dense/hard low-permeability deposit with pockets or lenses of coarse gravel (Long et al, 2012). The lenses are generally less than 2m wide and less than 0.5m thick. They are generally self-draining within 24hrs and have poor interconnectivity.

Local withdrawal and recedence of the ice sheet led to the formation of fluvioglacial sediments (gravel and sand lenses) and glaciomarine sediments (stiff/firm laminated clays, silts and sands). The glacial deposits can exhibit significant lateral and vertical variations in grain size distribution over short distances.

The Dublin Boulder Clay has been extensively studied and there are many publications describing its properties. Additionally there are numerous examples of deep excavations (up to 25m) and constructions within the Dublin Boulder Clay (e.g. Dublin Port Tunnel, Trinity College Library and Leinster House). Data and case history from these site has shown that the behaviour of the walls in Dublin Boulder are very rigid due to the inherent natural strength and stiffness of the material and the slow dissipation of excavation-induced depressed pore pressure or suctions (Long et al, 2012).

The recent construction of the Dublin Port Tunnel has allowed extensive study of the Dublin Boulder Clay and four distinct formations within the clay have been identified namely; the upper brown boulder clay (UBrBC), the upper black boulder clay (UBkBC), the lower brown boulder clay (LBrBC) and the lower black boulder clay (LBkBC) (Skipper at al. 2005). The upper two units are the most commonly encountered in excavations and hence are the most important from the point of view of retaining structures and basements.

The boulder clays generally exhibit very low permeability in the order of $1x10^{-7}$ to $1x10^{-9}$ m/s or lower. The glacial boulder clay will tend to act as an aquitard or aquiclude between the other more permeable formations including the limestone bedrock.

1.3 Regional Geology

The bedrock of the greater Dublin region consists of Dinantian Upper Impure Limestone which is part of the Lucan Formation. The limestone is colloquially known as Calp and is estimated to be up to 800m thick. The homogeneous sequence has been described as dark grey to black limestone and shale. The homogeneous sequence consists of dark grey massive limestones, shaley limestones and massive mudstones. The average bed thickness is less than 1 metre, but these normally thin-bedded lithologies can reach thicknesses of 2m or more. The older Malahide Formation which is described as argillaceous bioclastic limestone, shale and is a Dinantian Lower Impure Limestone is located to the north of the project site. The local geology mapped by the GSI is illustrated on Figure 6.4.

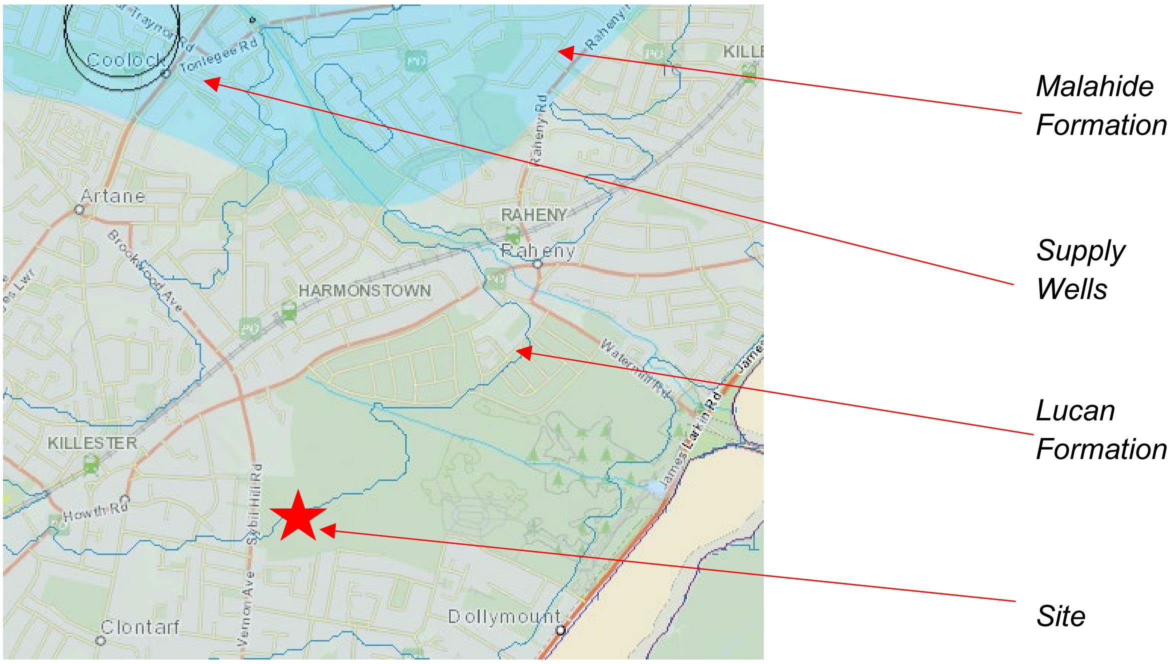


Figure 1: Local Bedrock Geology

The Calp is almost completely obscured across central Dublin under the Dublin Boulder Clay. A number of outcrops are recorded to the west of the project site (Collins Avenue West and Abbyfield). There are no faults mapped in the vicinity of the site.

1.4 Regional Hydrogeology

The primary Groundwater Body (GWB) in the region is the Dublin Urban GWB. The Dublin Urban GWB covers some 470km^2 and includes most of Dublin City to the eastern seaboard and extends west to include parts of Kildare and Meath. In addition to the Carboniferous limestones and shales, there are also some sandstones present. The bedrock aquifer is a fracture system i.e. it is dominated by secondary (fracture or fissure) flow with very little to no flow within the matrix i.e. the bedrock is largely impermeable. The limestone aquifer has low storage capacity in the order of 1 – 2%.
The Dublin Urban GWB comprises:

- LI: Locally important aquifer, moderately productive only in local zones, and;
- PI: Poor aquifer, generally unproductive except for local zones.

The Lucan Formation in the vicinity of the St Paul's site is classified by the GSI as a Locally Important (LI) aquifer which is moderately productive in local zones only. In general, permeability in the

Lucan Formation is low (1-10m^2/day) (Creighton et al). Fracture flow dominates and there is a distinct reduction in permeability with depth. Packer tests show permeabilities reduce an order of magnitude for each five metres of depth in the limestone (Aspinwall & Company, 1979). The majority of flow is in the upper weathered bedrock and is common within fractures and fissures at depths of up to 50metres below ground level (mBGL). Regional groundwater flow is towards Dublin Bay and the Irish Sea to the east.

1.5 Groundwater Vulnerability

Vulnerability mapping of the study area have been published by the GSI and ranges from extreme to low. Vulnerability ratings are related to a function of overburden thickness and permeability which might offer a degree of protection and/or attenuation to the underlying aquifer from surface activities and pollution. A rating of extreme indicates a very thin overburden depth or highly permeable strata such as gravels. A rating of low indicates a thick overburden depth (<10m) of low permeability strata such as clay or glacial till. The groundwater vulnerability in the vicinity of the St Paul's site has been classified as LOW.

1.6 Groundwater Status

An assessment carried out under the Water Framework Directive has concluded that the groundwater within the Dublin Urban GWB is presently of "Good status". The objective to the end of 2015 is to protect the "Good status" by recognizing that the quality of the groundwater in the Dublin Urban GWB is at risk due to point and diffuse sources of pollution which are normally found in an urban environment such as contaminated land and leaking sewer networks.

1.7 Groundwater Recharge

Dublin City is generally made up of a cement and tarmacked impermeable cap which limits recharge to the bedrock. The only open areas where recharge may occur are at parks and gardens. It is conservatively estimated that 10% of the city area is available for recharge. Some recharge occurs from leaking sewers, mains and storm drains. Elsewhere diffuse recharge will occur via rainfall percolating through the subsoil. The proportion of the effective rainfall that recharges the aquifer is largely determined by the thickness and permeability of the soil and subsoil, and by the slope. Due to the generally low permeability of the aquifers within the Dublin Urban GWB, a high proportion of the recharge will run off and discharge rapidly to surface watercourses via the upper layers of the aquifer, effectively reducing further the available groundwater recharge to the aquifer.

Based on the GSI website the effective rainfall in the vicinity of St Paul's campus is 296mm/year. Recharge to the aquifer can only occur where rainfall can percolate through any subsoil to the aquifer. However, given the thickness of low permeability boulder clay, any water which percolates through the subsoil is likely to be perched on the significant thickness of Dublin Boulder Clay and consequently it is likely that recharge to the Lucan Formation is minimal to insignificant in the area of St Paul's and St. Anne's Park. The GSI have designated that the recharge coefficient in the immediate area of the site as 7.5%. Based on the GSI's Recharge Model the total recharge would be equivalent to approximately 200mm/year.

1.8 Groundwater Abstractions

There are two recorded wells on the GSI database which are located c. 1.5km north of the site (see Figure 6.4). Both are groundwater monitoring wells associated with an industrial site. There are no recorded groundwater abstractions/users within the study area and the there are no source protection zones mapped in the area.

All groundwater users in the vicinity are serviced by the mains water supply and the proposed development will also rely on mains water.

1.9 Groundwater Dependent Terrestrial Ecosystems

Groundwater dependent terrestrial ecosystems (GWDTE's) are those ecosystems which are dependent on the groundwater either partially or completely for survival. They are designated for protection under Article 1 of Water Framework Directive. The closest GWDTE is the North bull Island Special Protection Area (SPA) with code name 004006 which is located c.1.5km northeast of the site.

2.0 SITE INVESTIGATION

2.1 Local Soils & Geology

The site-specific site investigations have proven the topsoil and subsoil formations. In-situ testing and characterisation of the boulder clay in terms of geotechnical properties was carried out during the site investigations (see Appendix 6.1 and 6.2). A summary of the soils encountered is detailed in Table 6.3.

Typical Depth Proven (mbgl)	Geological Unit/Strata	Typical information	General Geotechnical Description
0 – 1.5	Made Ground	N=15 to 33	MADE GROUND comprising brown sandy gravelly clay fill. This appeared to be reworked native material and there was no evidence of any waste elements or indications that the material was imported onto the site.
0.8 – 1.2	Dublin Boulder Clay 1 (Upper Brown)	N=15 to 36	Stiff brown sandy gravelly CLAY with occasional cobbles
2.2 – 3.0	Dublin Boulder Clay 2 (Upper Black)	N=29 to 50 (refusal)	Stiff black sandy gravelly CLAY with occasional cobbles and boulders

Table 2: Site Soil Summary

During the site investigations made ground was encountered at an average thickness of c. 1.2m across the site. This material appeared to be reworked native material (brown Dublin Boulder Clay) and there was no evidence that the material had been imported from off site. No waste elements or discoloured soil was observed. For contamination/environmental risk purposes the site can be classified as green-field as opposed to brownfield.

The upper made ground was underlain by Upper Brown Dublin Boulder Clay. This is described as stiff brown sandy gravelly CLAY with occasional cobbles. This was in turn underlain by Upper Black Dublin Boulder Clay which becomes stiffer with depth. In one location (BH3) there was a stiff grey sandy slightly gravelly CLAY recorded beneath the Black Boulder Clay at 6mBGL. This displayed similar stiffness to the Black Boulder Clay and is likely to exert similar geotechnical and hydrogeological properties.

The strength and stiffness of the Dublin Boulder Clay increased considerably with depth. Regarding excavatability of the soil, it is likely that hard digging will be required.

Bedrock was not proven in any boreholes and all locations were progressed to a depth of 8mBGL with the exception of BH1 which met refusal at 5.5m (presumed to be a boulder). The GSI's geo-urban County Dublin Rock Head model indicates that rock head in the vicinity of the site can be expected to be 5 – 10m BGL. The St Paul's site investigation in conjunction with investigations to the east in St. Anne's Park, indicated that rock head is at least 8mBGL on the project site and may be deeper.

2.2 Local Hydrogeology - Methodology

The bedrock aquifer was not encountered during the site investigations with depth to rock being greater than 8mBGL. There were no significant gravel lenses or other water bearing units encountered in the superficial deposits.

Standpipes were installed in a number of the boreholes and water levels were measured during October 2015. These installations are measuring perched water levels which ranged from 1.08mBGL (23.77mOD) to 2.4mBGL (19.02mOD) with one installation remaining dry. The water level measured is perched water within the glacial till rather than groundwater within the underlying aquifer (Refer to Appendix A for a copy of the site investigation report 2015).

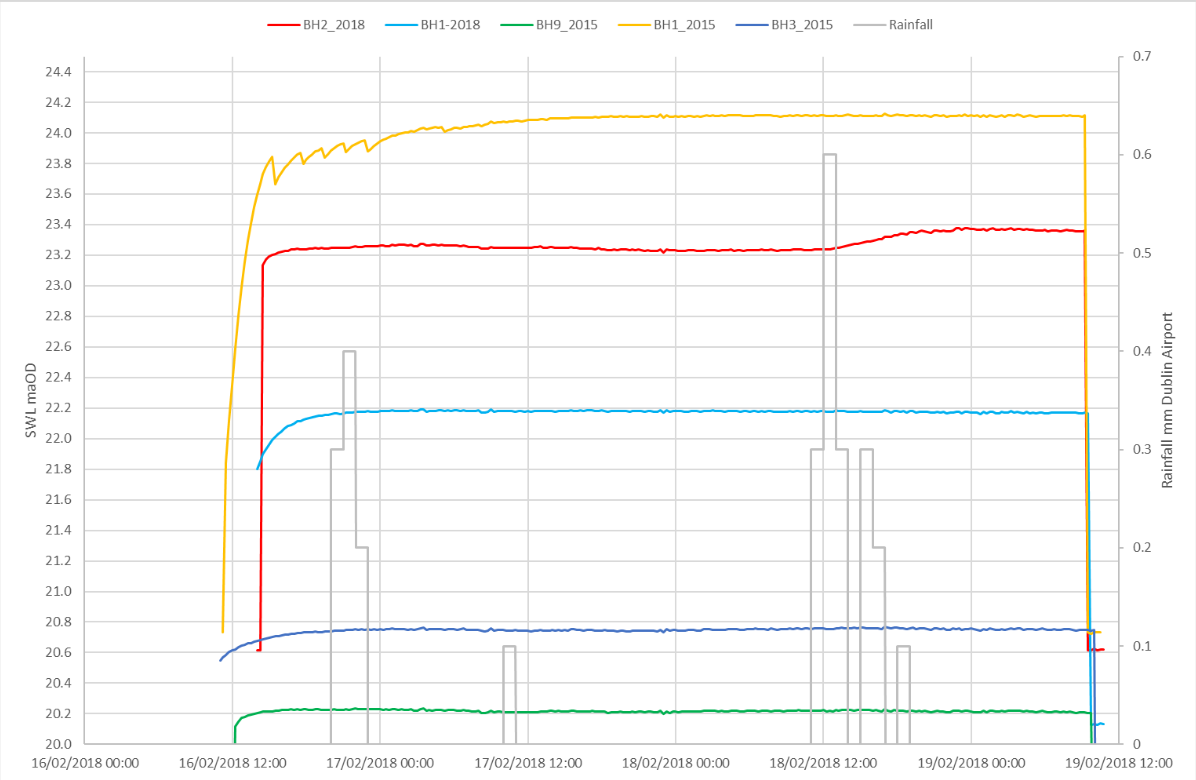
Additional drilling (4No. locations) and follow up monitoring using level loggers was undertaken by GII in February 2018 to identify the source of perched water observed in the boreholes (Refer to Appendix B for a copy of the site investigation report 2018). The following methodology was employed:

1) Standing water level (SWL) in individual monitoring wells measured with manual dip meter.
2) Full depth of monitoring well measured.
3) Monitoring well bailed in 10 litre increments using a 1 litre Bailer to a water level in the borehole of around 2.5m below ground level or lower.
4) Rising water level in Monitoring well (ΔWL) measured with manual dip meter.
5) Rugged troll 100 submersible water level logger (9m range) installed in monitoring well.
6) SWL in Monitoring wells measured every 15 mins from Friday 16/02 to Monday 19/02
7) Standing water level in Monitoring well (SWL) measured with manual dip meter
8) Full depth of monitoring well measured

3.0 DISCUSSION

Data from the level loggers were compensation using the installed barologger and compared to rainfall events during the time period. Graph 1 below illustrates the initial response from bailing the well with the quick recovery and the response or lack thereof to rainfall events.

Graph 1 – Level logger data from St Paul's



As can be seen from the graph, water levels recovered quickly after bailing i.e. within a 24hour period. Water levels within the weathered boulder clay lies between 20.2 and 24.1maOD depending on location within the site.

Standing Water Level (SWL) elevation observed within the constructed boreholes is indicative of a relatively uniform slightly radial hydraulic gradient groundwater flow from northwest to south east, following natural contours, centred northwest of BH1-2015.

Only BH2_2018 shows any response to rainfall event. That response is muted and shows a significant lag time. It can be concluded that these monitoring wells did not suffer surface water inflow during this monitoring event.

There is no immediately apparent reason not to accept that the monitoring wells are measuring groundwater within upper weathered boulder clay. Note, the clay beneath will act as a protective and confining layer over the underlying bedrock aquifer.

4.0 CONCLUSIONS

The following can be concluded from this preliminary assessment:

- Groundwater wells were installed in both 2015 and 2018.
- The bedrock aquifer was not encountered during either investigation as is estimated to be at least 8mbGL.
- Level loggers installed within the wells in 2018 indicated a perched water present within the weathered boulder clay overlain by reworked material.
- Groundwater levels on site vary between 20.2 and 24.1maOD depending on location within the site.

Respectfully submitted

on behalf of OCSC Multidisciplinary Consulting Engineers

IAIN WILLIAMS **MSc DIC PGEO, EURGEOL, CGEOL**

HYDROGEOLOGIST

O'CONNOR | SUTTON | CRONIN

Multidisciplinary Consulting Engineers

Appendix A

GII REPORT 2015

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GROUND INVESTIGATIONS IRELAND LTD

DEVELOPMENT AT ST PAULS RAHENY

GROUND INVESTIGATION REPORT

DOCUMENT CONTROL SHEET

Engineer	OCSC
Project Title	St Paul's Raheny
Project No	5228-07-15
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
B	Final	C Finnerty	F McNamara	F McNamara	Dublin	30th October 2015

St Paul’s Raheny –Ground Investigation Report

Appendices

1.0 Preamble

On the instructions of OCSC Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between September and October 2015 at the site at St Paul's College in Raheny in North Dublin.

2.0 Overview

2.1 Background

It is proposed to construct a residential development with associated access roads and car parking at the proposed site and develop some playing pitches. The site is currently in use as playing fields for St Paul's College. The proposed development consists of a mix of residential buildings with multi-storey over basement proposed over a portion of the site with the remaining area containing two/three storey residential dwellings.

2.2 Purpose and Scope

The purpose of the site investigation was to investigate subsurface soil conditions by means of cable percussion boreholes. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 10 No. Cable Percussion boreholes to a maximum depth of 8.0m BGL
- Standpipe installations and groundwater monitoring
- Laboratory testing
- Report with recommendations

3.0 Subsurface Exploration

3.1 General

During the ground investigation a programme of cable percussion boring was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during drilling.

3.2 Cable Percussion Boreholes

Ten Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular insitu testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.

The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason thin lenses of granular material may not be noticed.

Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata.

Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone.

The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil.

The Cable Percussion borehole logs are provided in Appendix 2 of this Report.

The above notes outline the procedures used in this site investigation and are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:1999 + A2:2010.

3.3 Laboratory Testing

Samples were selected from the boreholes for a range of geotechnical classification testing to provide information for the proposed design. The environmental testing, including Waste Acceptance Criteria (WAC) was carried out by OCSC and is discussed under the cover of a separate report.

The results of the geotechnical laboratory testing are included in Appendix 3 of this Report.

4.0 Ground Conditions

4.1 Ground Conditions

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally consisted of;

- Made Ground
- Cohesive Deposits

Made Ground Deposits: Made Ground deposits were encountered beneath the ground surface or Topsoil and were present to a depths of between 0.8 and 1.5m BGL in the boreholes. These deposits were described generally consisted of *brown/grey sandy gravelly CLAY.*

Cohesive Deposits: Stiff brown cohesive deposits were present below the Made Ground deposits in the boreholes and were typically described as brown *sandy gravelly CLAY with occasional cobbles.* This stratum was present to a depth of up to 2.3m BGL and was underlain by a *stiff to very stiff black slightly sandy gravelly CLAY with occasional cobbles and boulders* to a maximum depth of 8.0m BGL.

4.2 Groundwater

The groundwater strikes were generally not encountered during the investigation in the cohesive deposits. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the time of year, tidal influence, rainfall, nearby construction and other factors. For this reason standpipes were installed in BH1, BH2, BH3, BH6 and BH9 to allow the equilibrium groundwater level to be determined. The groundwater monitoring is included in Appendix 6 of this Report.

5.0 Recommendations and Conclusions

5.1 General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided on the proposed building, excavations and loading and assumptions have been made based on discussions on site and the nature of the development.

5.2 Foundations

An allowable bearing capacity of 150kN/m^2 is recommended for the stiff brown cohesive deposits below the made ground depths of 0.80 – 1.50m BGL. An allowable bearing capacity of 300kN/m^2 is recommended for deeper foundations based on the stiff black cohesive deposits in the vicinity of the proposed basement.

5.3 Excavations

Excavations in the areas where deeper Made Ground deposits were encountered may require to be appropriately battered or the sides supported due to the variable strength of these deposits. Reference should be made to the OCSC environmental report and the testing completed to inform the disposal of any material to be excavated.

5.4 External Pavement

The proposed access roads and car parking are proposed to be founded on the firm to stiff cohesive deposits or on compacted imported fill material depending on the final level of the proposed roads. CBR testing should be undertaken prior to or at the time of construction to verify the design assumptions and the proposed pavement make up. An average value of 2.0% would be recommended for outline design on the firm to stiff cohesive deposits with pavement options presented for less than 2%, 5.0% and 10.0% where verified during the construction phase.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

Appendix 1: Site Location Plan


HOWTH ROAD
BH1
BH2
BH3
BH4
BH5
BH6
BH7
BH8
BH9
BH10

Appendix 2: Cable Percussion Borehole Records

Project Name: St. Paul's Raheny

Hole ID: BH1

Client:	New Generation	Co-ordinates:	720366.38 737591.04
Consultant:	OCSC	Elevation:	24.852
Location:	Raheny	Project no.	5228-07-15
Start date:	28/09/2015	Drilled by:	F McArdle
End date:	29/09/2015	Logged by:	James Dunn
Type of drilling:	CP	Hole diameter:	200 mm

Strata Description	Depth	Level (mOD)
TOPSOIL	0.10	24.75
MADE GROUND comprising brown sandy gravelly Clay FILL	1.00	23.85
Stiff brown sandy gravelly CLAY with occassional cobbles	2.30	22.55
Stiff black sandy gravelly CLAY with occassional cobbles and boulders	5.50	19.35
Obstruction: Presumed Boulder	5.60	19.25

End of Borehole at 5.60 m

Samples / tests

Type	Depth	Result
SPT-C B+T	0.50 0.50	N=21
SPT-C B+T	1.00 1.00	N=15
SPT-C B+T	2.00 2.00	N=20
SPT-C	2.50	N=29
SPT-C B+T	3.00 3.00	N=41
SPT-C B+T	4.00 4.00	50/300mm
SPT-C B+T	5.10 5.10	N=40

Water Depth	Date
5.00	
5.60	29/09/2015

Remarks:
Chiselling from 3.6m to 3.8m BGL for 30 mins, from 4.7m to 4.8m BGL for 60 mins from 4.8m to 5.1m BGL for 35mins and from 5.5m to 5.6m BGL for 30mins
50mm standpipe with flush cover installed. Slotted with gravel response zone from 1.0m to 5.6m BGL and sealed from 0.0m to 1.0m BGL

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: St. Paul's Raheny

Hole ID: BH2

Client:	New Generation	Co-ordinates:	720501.93 737565.25
Consultant:	OCSC	Elevation:	22.489
Location:	Raheny	Project no.	5228-07-15
Start date: 30/09/2015	End date: 01/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description

Strata Description	Depth	Level (mOD)
TOPSOIL	0.20	22.29
MADE GROUND comprising brown sandy gravelly Clay FILL	0.80	21.69
Stiff brown sandy gravelly CLAY with occassional cobbles	2.20	20.29
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders	8.00	14.49
End of Borehole at 8.00 m		

Samples / tests

Type	Depth	Result	Water Depth	Date
SPT-C B+T	0.50 0.50	N=33		
SPT-C B+T	1.00 1.00	N=22		
SPT-C B+T	2.00 2.00	N=36		
SPT-C B+T	3.00 3.00	N=41		
SPT-C B+T	4.00 4.00	N=43		
SPT-C B+T	5.00 5.00	N=39		
SPT-C B+T	6.00 6.00	50/300mm		
SPT-C B+T	7.00 7.00	N=47		
SPT-C B+T	8.00 8.00	N=46		

Remarks:

50mm standpipe with flush cover installed. Slotted with gravel response zone from 2.0m to 5.0m BGL and sealed from 0.0m to 2.0m BGL

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: St. Paul's Raheny

Hole ID: BH3

Client:	New Generation	Co-ordinates:	720600.88 737513.70
Consultant:	OCSC	Elevation:	21.943
Location:	Raheny	Project no.	5228-07-15
Start date: 30/09/2015	End date: 01/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.10	21.84					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL				SPT-C B+T	0.50 0.50	N=23		
		1		SPT-C B+T	1.00 1.00	N=29		
Stiff brown sandy gravelly CLAY with occassional cobbles		1.50	20.44	SPT-C	1.50	N=18		
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders		2.00	19.94	SPT-C B+T	2.00 2.00	N=46		
		3		SPT-C B+T	3.00 3.00	N=37		
		4		SPT-C B+T	4.00 4.00	N=37		
		5		SPT-C B+T	5.00 5.00	N=42		
Stiff grey sandy slightly gravelly CLAY		6.00	15.94	SPT-C B+T	6.00 6.00	50/300mm		
		7		SPT-C B+T	7.00 7.00	50/300mm		
							7.80	
End of Borehole at 8.00 m		8.00	13.94	B+T	8.00		8.00	02/10/2015
		9						

Remarks:

50mm standpipe with flush cover installed. Slotted with gravel response zone from 2.0m to 5.0m BGL and sealed from 0.0m to 2.0m BGL

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: St. Paul's Raheny

Hole ID: BH4

Client: New Generation
Consultant: OCSC
Location: Raheny
Start date: 29/09/2015 End date: 30/09/2015
Type of drilling: CP Hole diameter: 200 mm

Co-ordinates: 720484.56 737484.02
Elevation: 23.349
Project no. 5228-07-15
Drilled by: F McArdle
Logged by: James Dunn

Strata Description	Depth	Level (mOD)	Samples / tests Type	Depth	Result	Water Depth	Date
TOPSOIL	0.10	23.25					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles			SPT-C B+T	0.50 0.50	N=23		
			SPT-C B+T	1.00 1.00	N=17		
	1.40	21.95					
Stiff brown sandy gravelly CLAY with occassional cobbles			SPT-C B+T	2.00 2.00	N=33		
	2.20	21.15					
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders			SPT-C B+T	3.00 3.00	N=38		
			SPT-C B+T	4.00 4.00	N=38		
			SPT-C B+T	5.00 5.00	N=43		
			SPT-C B+T	6.00 6.00	N=45		
			SPT-C B+T	7.00 7.00	N=45		
	8.00	15.35	SPT-C B+T	8.00 8.00	N=48		

End of Borehole at 8.00 m

Remarks:
Chiselling from 4.7m to 4.9m BGL for 30mins
Borehole backfilled on completion

KEY
B Bulk disturbed sample.
D Small disturbed sample
U Undisturbed sample
SPT-S Standard Penetration Test, split spoon.
SPT-C Standard Penetration Test, solid cone.
▽ Groundwater strike
▼ Water level 20mins after strike.

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Project Name: St. Paul's Raheny — Hole ID: BH5

Client:	New Generation	Co-ordinates:	720591.52 737402.83
Consultant:	OCSC	Elevation:	22.407
Location:	Raheny	Project no.	5228-07-15
Start date: 02/10/2015	End date: 05/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
TOPSOIL	0.20	22.21					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles			SPT-C B+T	0.50 0.50	N=20		
			SPT-C B+T	1.00 1.00	N=21		
	1.30	21.11					
Stiff grey/brown sandy gravelly CLAY with occassional cobbles			SPT-C B+T	2.00 2.00	N=24		
	2.20	20.21					
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders			SPT-C	2.50	N=46		
			SPT-C B+T	3.00 3.00	N=43		
			SPT-C B+T	4.00 4.00	N=49		
			SPT-C B+T	5.00 5.00	N=38		
			SPT-C B+T	6.00 6.00	N=37		
			SPT-C B+T	7.00 7.00	N=45		
	8.00	14.41	SPT-C B+T	8.00 8.00	N=40		
End of Borehole at 8.00 m							

Remarks:
Borehole backfilled on completion

KEY
- B — Bulk disturbed sample.
- D — Small disturbed sample
- U — Undisturbed sample
- SPT-S — Standard Penetration Test, split spoon.
- SPT-C — Standard Penetration Test, solid cone.
- ▽ — Groundwater strike
- ▼ — Water level 20mins after strike.

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Project Name: St. Paul's Raheny

Hole ID: BH6

Client:	New Generation	Co-ordinates:	720466.04 737407.03
Consultant:	OCSC	Elevation:	23.223
Location:	Raheny	Project no.	5228-07-15
Start date: 08/10/2015	End date: 08/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Depth	Level (mOD)
TOPSOIL	0.10	23.12
MADE GROUND comprising brown sandy gravelly Clay FILL with cobbles	1.30	21.92
Stiff brown sandy gravelly CLAY with occassional cobbles	2.30	20.92
Stiff black sandy gravelly CLAY with occassional cobbles and boulders	7.80	15.42
Obstruction: Presumbed Boulder	7.90	15.32

End of Borehole at 7.90 m

Samples / tests: Type	Depth	Result	Water Depth	Date
SPT-C B+T	0.50 0.50	N=21		
SPT-C B+T	1.00 1.00	N=17		
SPT-C B	1.50 1.50	N=21		
SPT-C B+T	2.00 2.00	N=32		
SPT-C	2.50	N=33		
SPT-C B+T	3.00 3.00	N=35		
SPT-C B+T	4.00 4.00	N=40		
SPT-C B+T	5.00 5.00	N=39		
SPT-C B+T	6.00 6.00	N=42		
SPT-C B+T	7.00 7.00	N=45		

Remarks:

Chiselling from 7.8m to 7.9m BGL for 60mins
50mm standpipe with flush cover installed. Slotted with gravel response zone from 2.0m to 5.6m BGL and sealed from 0.0m to 2.0m BGL

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

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Project Name: St. Paul's Raheny

Hole ID: BH7

Client: New Generation		Co-ordinates:	720347.86 737449.43
Consultant: OCSC		Elevation:	23.972
Location: Raheny		Project no.	5228-07-15
Start date: 09/10/2015	End date: 09/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Legend	Depth	Level (mOD)	Samples / tests Type	Samples / tests Depth	Samples / tests Result	Water Depth	Date
TOPSOIL		0.20	23.77					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles				SPT-C B+T	0.50 0.50	N=20		
		0.90	23.07					
Stiff brown sandy gravelly CLAY with occassional cobbles				SPT-C B+T	1.00 1.00	N=17		
				SPT-C B+T	2.00 2.00	N=30		
		2.20	21.77					
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders				SPT-C B+T	3.00 3.00	N=36		
				SPT-C B+T	4.00 4.00	N=38		
				SPT-C B+T	5.00 5.00	N=37		
				SPT-C B+T	6.00 6.00	N=41		
				SPT-C B+T	7.00 7.00	50/180mm		
				SPT-C B+T	8.00 8.00	N=45		
End of Borehole at 8.50 m		8.50	15.47					

Remarks:

Chiselling from 7.4m to 7.6m BGL for 30mins
Borehole backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND

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Project Name: St. Paul's Raheny

Hole ID: BH8

Client:	New Generation	Co-ordinates:	720443.89 737307.54
Consultant:	OCSC	Elevation:	22.279
Location:	Raheny	Project no.	5228-07-15
Start date: 06/10/2015	End date: 06/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Legend	Depth	Level (mOD)	Samples / tests: Type	Samples / tests: Depth	Samples / tests: Result	Water Depth	Date
TOPSOIL		0.20	22.08					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles and fragments of plastic				SPT-C B+T	0.50 0.50	N=25		
				SPT-C B+T	1.00 1.00	N=20		
Stiff grey brown sandy gravelly CLAY with occassional cobbles		1.20	21.08					
				SPT-C B+T	2.00 2.00	N=18		
				SPT-C	2.50	N=23		
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders		3.00	19.28	SPT-C B+T	3.00 3.00	N=28		
				SPT-C B+T	4.00 4.00	N=37		
				SPT-C B+T	5.00 5.00	N=38		
				SPT-C B+T	6.00 6.00	N=38		
				SPT-C B+T	7.00 7.00	N=45		
End of Borehole at 8.00 m		8.00	14.28	SPT-C B+T	8.00 8.00	50/300mm		

Remarks:
Borehole backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: St. Paul's Raheny — Hole ID: BH9

Client:	New Generation	Co-ordinates:	720588.42 737295.98
Consultant:	OCSC	Elevation:	21.421
Location:	Raheny	Project no.	5228-07-15
Start date: 05/10/2015	End date: 06/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Depth	Level (mOD)	Sample Type	Sample Depth	Result	Water Depth	Date
TOPSOIL	0.10	21.32					
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles			SPT-C B+T	0.50 0.50	N=19		
Stiff brown sandy gravelly CLAY with occassional cobbles	1.00	20.42	SPT-C B+T	1.00 1.00	N=18		
			SPT-C B+T	2.00 2.00	N=15		
Firm to stiff black slightly silty gravelly CLAY with occassional cobbles	2.20	19.22					
			SPT-C B	2.50 2.50	N=14		
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders	3.00	18.42	SPT-C B+T	3.00 3.00	N=28		
			SPT-C B+T	4.00 4.00	N=37		
			SPT-C B+T	5.00 5.00	N=41		
			SPT-C B+T	6.00 6.00	N=37		
			SPT-C B+T	7.00 7.00	N=38		
End of Borehole at 8.00 m	8.00	13.42	SPT-C B+T	8.00 8.00	N=38		

Remarks:
50mm standpipe with flush cover installed. Slotted with gravel response zone from 2.0m to 5.0m BGL and sealed from 0.0m to 2.0m BGL

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Project Name: St. Paul's Raheny

Hole ID: BH10

Client:	New Generation	Co-ordinates:	720389.97 737509.16
Consultant:	OCSC	Elevation:	24.554
Location:	Raheny	Project no.	5228-07-15
Start date: 07/10/2015	End date: 07/10/2015	Drilled by:	F McArdle
Type of drilling: CP	Hole diameter: 200 mm	Logged by:	James Dunn

Strata Description	Depth	Level (mOD)
TOPSOIL	0.10	24.45
MADE GROUND comprising brown/grey sandy gravelly Clay FILL with cobbles	1.50	23.05
Stiff brown sandy gravelly CLAY with occassional cobbles	2.30	22.25
Stiff black sandy gravelly CLAY with occassional cobbles and rare boulders and gravell lenses from 8.0m to 8.1m BGL	8.10	16.45
Obstruction: Presumed Boulder	8.20	16.35

End of Borehole at 8.20 m

Samples / tests Type	Depth	Result
SPT-C B+T	0.50 0.50	N=14
SPT-C B+T	1.00 1.00	N=12
SPT-C B	1.50 1.50	N=18
SPT-C B+T	2.00 2.00	N=29
SPT-C B	2.50 2.50	N=17
SPT-C B+T	3.00 3.00	N=30
SPT-C B+T	4.00 4.00	N=37
SPT-C B+T	5.00 5.00	N=40
SPT-C B+T	6.00 6.00	N=39
SPT-C B+T	7.00 7.00	N=43
SPT-C B+T	8.00 8.00	50/180mm

Water Depth	Date
7.70 (water level 20mins after strike)	
8.00 (groundwater strike)	07/10/2015

Remarks:
Chiselling from 8.1m to 8.2m BGL for 30mins
Borehole backfilled on completion

KEY

B	Bulk disturbed sample.
D	Small disturbed sample
U	Undisturbed sample
SPT-S	Standard Penetration Test, split spoon.
SPT-C	Standard Penetration Test, solid cone.
▽	Groundwater strike
▼	Water level 20mins after strike.

GROUND INVESTIGATIONS IRELAND
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Appendix 3: Laboratory Testing

National Materials Testing Laboratory Ltd.

SUMMARY OF TEST RESULTS

			Particle			Index Properties		Bulk	Cell	Undrained Triaxial Tests		Shear Strength	
BH/TP	Depth	Moisture	Density	<425um	LL	PL	PI	Density	Presssure	Compressive	Strain at	Cu	Mode of
No	m	%	Mg/m3	%	%	%	%	Mg/m3	kPa	Stress kPa	Failure %	kPa	Failure
BH5	2.50	12.3		59.8	30	15	15						
BH5	5.60	11.0		58.7	28	15	13						
BH5	8.00	8.6		57.5	28	14	14						
BH7	1.00	14.5		64.2	31	17	14						
BH7	4.00	13.3		57.3	28	15	13						
BH9	0.50	22.9		48.9	55	30	25						
BH9	1.00	14.5		58.8	34	18	16						
BH9	2.00	13.3		62.3	30	16	14						

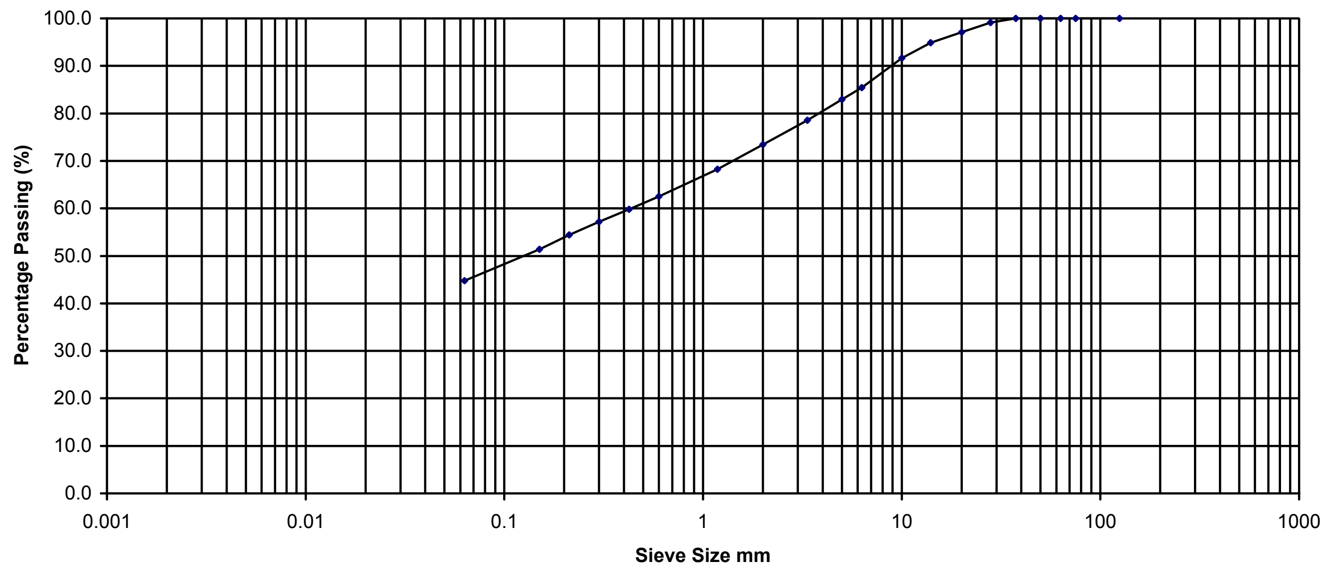
NMTL	Notes :	Job ref No.	NMTL 1489	Table
	1. All BS tests carried out using preferred (definitive) method unless otherwise stated.	Location	St Paul's Rahney	

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	99.1
20.000	97.1
14.000	94.9
10.000	91.6
6.300	85.4
5.000	82.9
3.350	78.5
2.000	73.4
1.180	68.3
0.600	62.5
0.425	59.8
0.300	57.2
0.212	54.4
0.150	51.4
0.063	44.8



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
0.0	44.8	28.6	26.6	0.0	0.0

Sample Description	Dark grey slightly gravelly slightly sandy SILT/CLAY.	Project No.	NMTL 1489
		BH/TP No.	BH5
Project	St Paul's Rahney	Sample No.	B

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015	Depth	2.50m

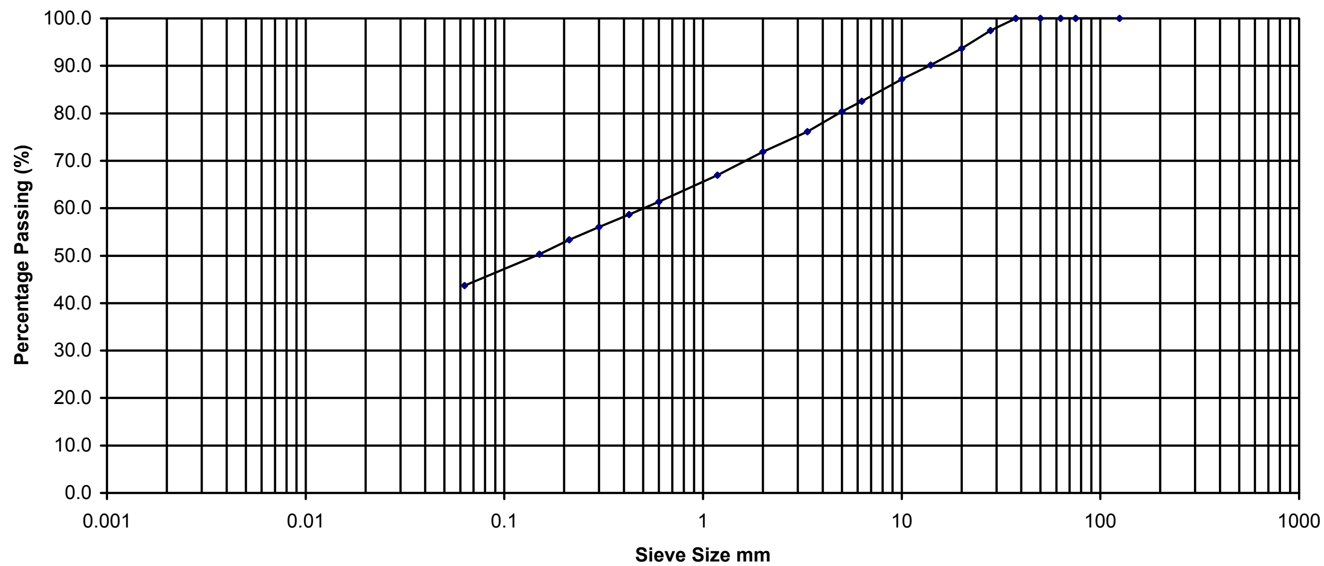
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	97.5
20.000	93.7
14.000	90.1
10.000	87.2
6.300	82.5
5.000	80.4
3.350	76.1
2.000	71.8
1.180	67.0
0.600	61.3
0.425	58.7
0.300	56.1
0.212	53.3
0.150	50.3
0.063	43.7



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
	Silt			Sand			Gravel				
0.0	43.7			28.2			28.2			0.0	0.0

Sample Description: Dark grey slightly gravelly slightly sandy SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489
BH/TP No.	BH5
Sample No.	B
Depth	5.60m

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

NM TL Ltd

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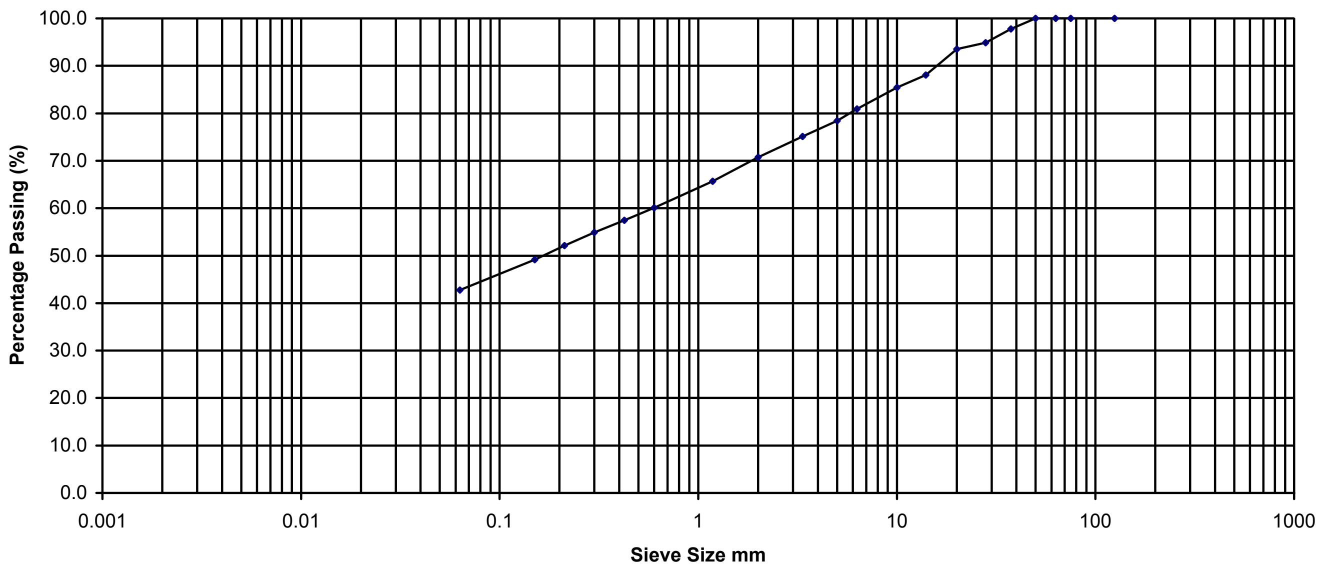
Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	97.8
28.000	94.9
20.000	93.5
14.000	88.1
10.000	85.5
6.300	80.9
5.000	78.4
3.350	75.1
2.000	70.7
1.180	65.7
0.600	60.1
0.425	57.5
0.300	54.9
0.212	52.2
0.150	49.2
0.063	42.8

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
0.0	42.8	28.0	29.3	0.0	0.0

Sample Description: Dark grey slightly gravelly slightly sandy SILT/CLAY.

Project: St Paul's Rahney

Project No.: NMTL 1489
BH/TP No.: BH5
Sample No.: B
Depth: 8.00m

NM TL Ltd

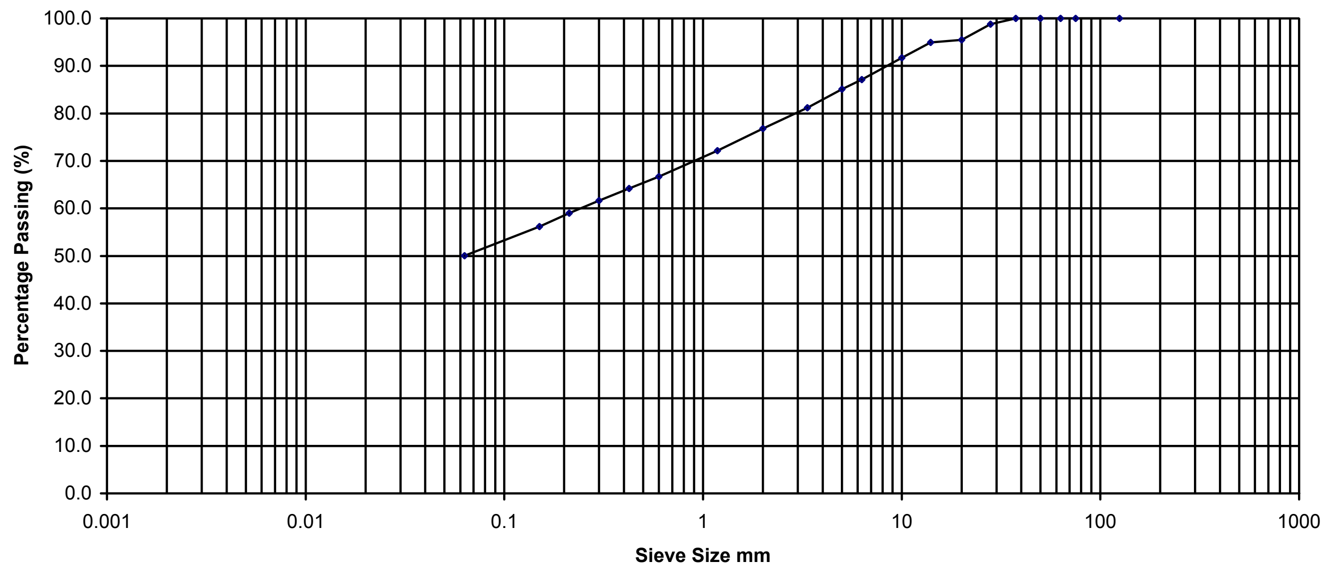
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	98.8
20.000	95.5
14.000	95.0
10.000	91.7
6.300	87.2
5.000	85.1
3.350	81.2
2.000	76.8
1.180	72.1
0.600	66.7
0.425	64.2
0.300	61.6
0.212	59.0
0.150	56.2
0.063	50.1



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
0.0	50.1	26.7	23.2	0.0	0.0

Sample Description: Dark grey slightly gravelly slightly sandy SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489
BH/TP No.	BH7
Sample No.	B
Depth	1.00m

NM TL Ltd

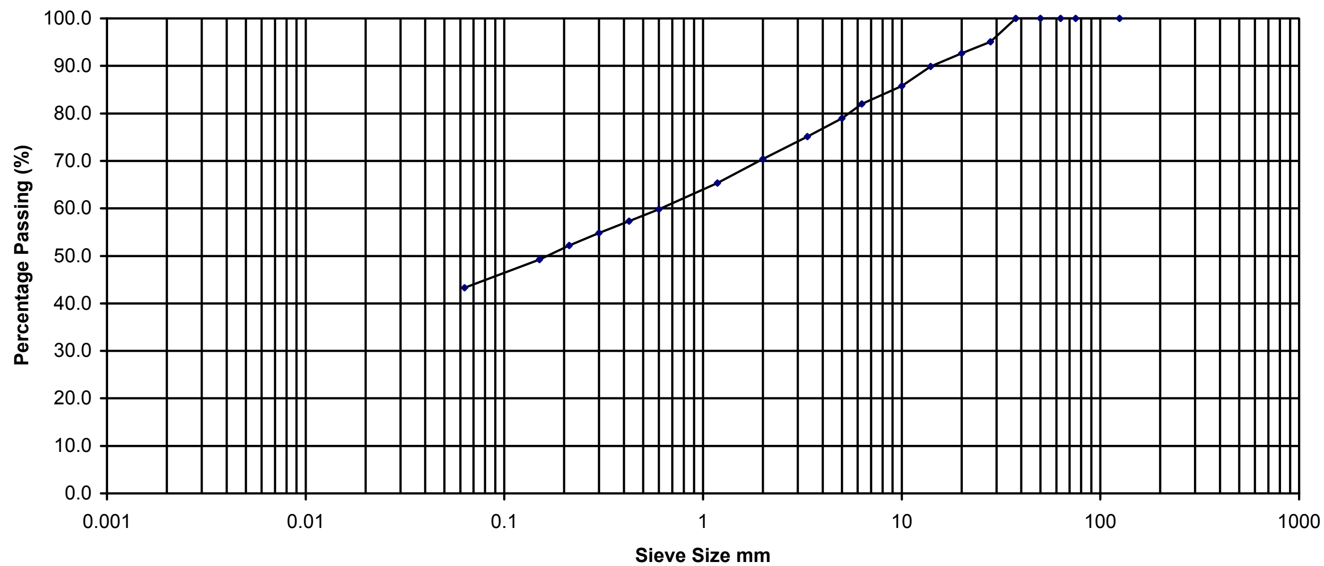
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	95.1
20.000	92.7
14.000	89.9
10.000	85.8
6.300	82.0
5.000	78.9
3.350	75.1
2.000	70.4
1.180	65.3
0.600	59.8
0.425	57.3
0.300	54.8
0.212	52.2
0.150	49.2
0.063	43.3



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
	Silt			Sand			Gravel				
0.0	43.3			27.1			29.6			0.0	0.0

Sample Description: Dark grey slightly sandy slightly gravelly SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489
BH/TP No.	BH7
Sample No.	B
Depth	4.00m

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

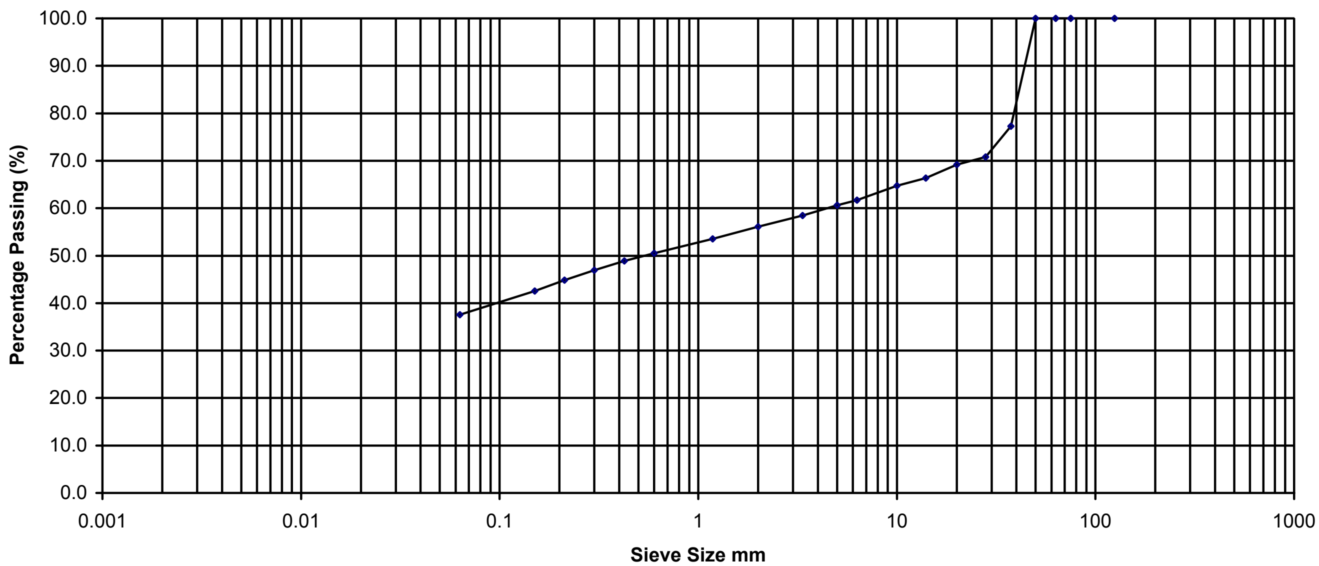
NM TL Ltd

NMTL Ltd

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	77.3
28.000	70.8
20.000	69.2
14.000	66.3
10.000	64.7
6.300	61.7
5.000	60.6
3.350	58.4
2.000	56.1
1.180	53.5
0.600	50.5
0.425	48.9
0.300	46.9
0.212	44.9
0.150	42.5
0.063	37.6

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
	Silt			Sand			Gravel				
0.0	37.6			18.5			43.9			0.0	0.0

Sample Description: Brown slightly sandy gravelly SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489
BH/TP No.	BH9
Sample No.	B
Depth	0.50m

NM TL Ltd

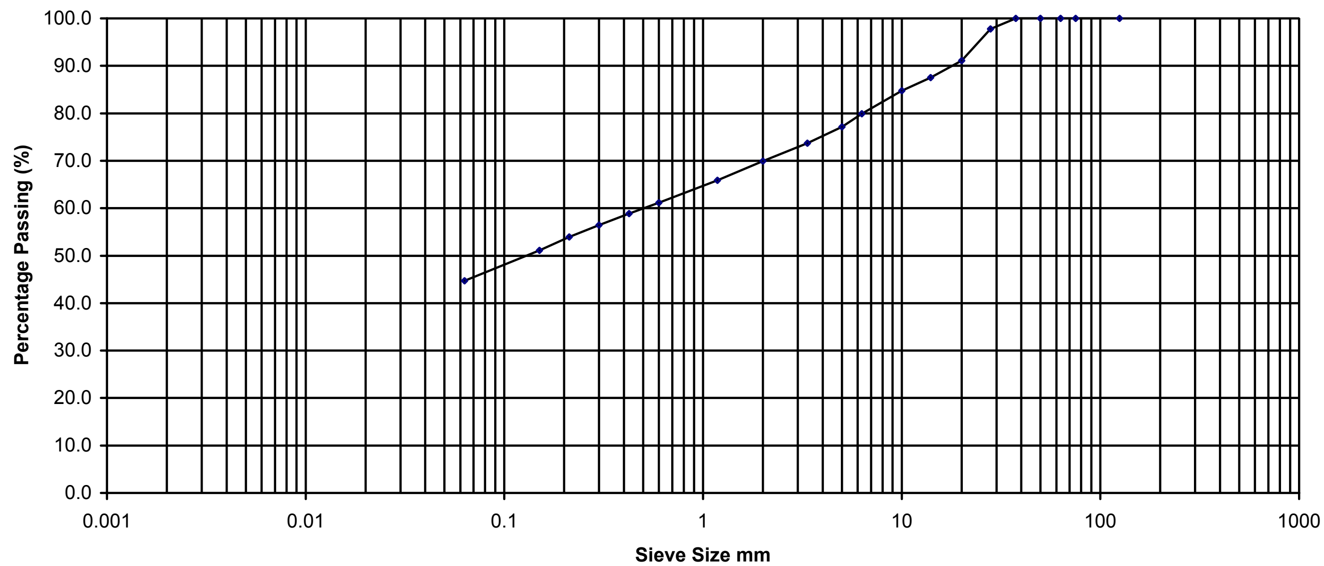
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	22/10/2015

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	97.8
20.000	91.1
14.000	87.5
10.000	84.7
6.300	79.9
5.000	77.1
3.350	73.7
2.000	69.9
1.180	65.9
0.600	61.1
0.425	58.8
0.300	56.5
0.212	54.0
0.150	51.1
0.063	44.7



Percentage Particle Size

Clay	Silt (Fine, Medium, Coarse)	Sand (Fine, Medium, Coarse)	Gravel (Fine, Medium, Coarse)	Cobbles	Boulder
0.0	44.7	25.2	30.1	0.0	0.0

Sample Description: Brown slightly sandy slightly gravelly SILT/CLAY.

Project: St Paul's Rahney

Project No.	NMTL 1489	BH/TP No.	BH9
Sample No.	B	Depth	1.00m

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	23/10/2015

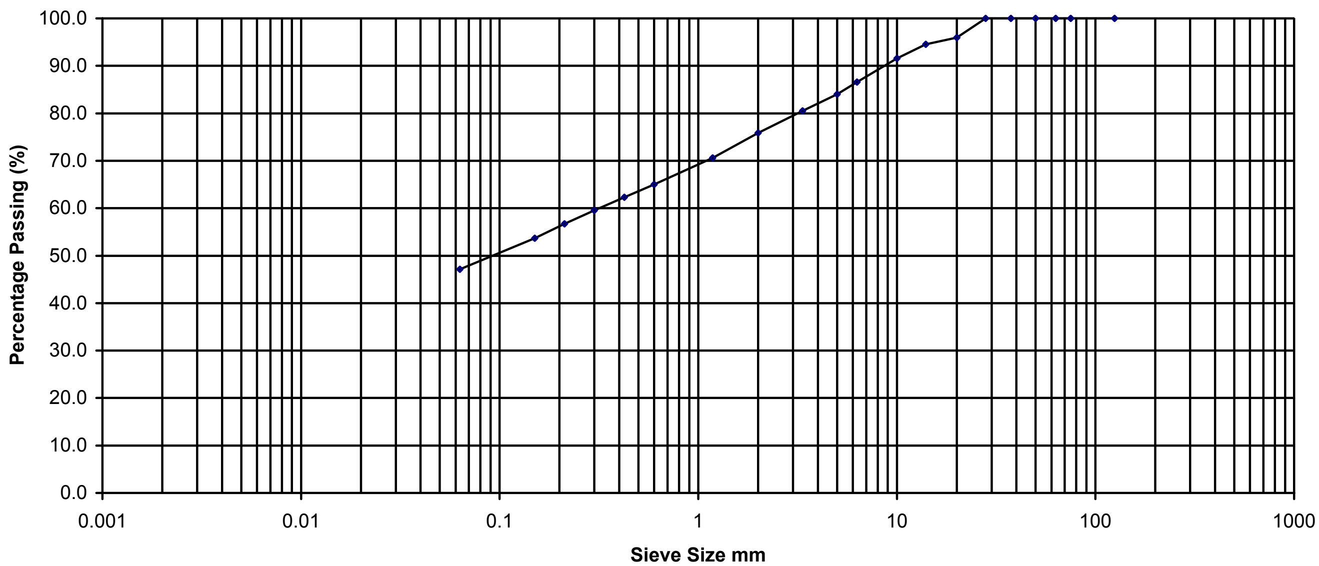
NM TL Ltd

NMTL Ltd

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	96.0
14.000	94.5
10.000	91.6
6.300	86.6
5.000	84.0
3.350	80.5
2.000	75.8
1.180	70.6
0.600	65.0
0.425	62.3
0.300	59.6
0.212	56.7
0.150	53.7
0.063	47.1

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
	Silt			Sand			Gravel				
0.0	47.1			28.7			24.2			0.0	0.0

Sample Description: Brown/dark brown slightly gravelly slightly sandy SILT/CLAY.

Project: St Paul's Rahney

Project No.: NMTL 1489
BH/TP No.: BH9
Sample No.: B

Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	23/10/2015	Depth	2.00m

NM TL Ltd

Jones Environmental Laboratory

Registered Address : Unit 3 Deeside Point, Zone 3, Deeside Industrial Park, Deeside, CH5 2UA. UK

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
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Tel: +44 (0) 1244 833780
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O'Connor Sutton Cronin & Assoc. Ltd
9 Prussia Street
Dublin 7
Ireland

UKAS TESTING 4225

Attention :	Cian O'Hora
Date :	14th October, 2015
Your reference :	
Our reference :	Test Report 15/14318 Batch 1
Location :	St Pauls
Date samples received :	6th October, 2015
Status :	Final report
Issue :	1

Eleven samples were received for analysis on 6th October, 2015 of which eleven were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Where Waste Acceptance Criteria Suite (EC Decision of 19 December 2002 (2003/33/EC)) has been requested, all analyses have been performed using the relevant EN methods where they exist.

Compiled By:

Bruce Leslie
Project Co-ordinator

Jones Environmental Laboratory

Client Name:	O'Connor Sutton Cronin & Assoc. Ltd	**Report :**	**Solid**
Reference:			
Location:	St Pauls	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Cian O'Hora		
JE Job No.:	15/14318		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1	2	3	4	5	6	7	8	9	10	LOD/LOR	Units	Method No.
Sample ID	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4			
Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015			
Antimony	<1	4	3	4	2	2	-	3	2	2	<1	mg/kg	TM30/PM15
Arsenic #	6.9	13.0	20.0	13.2	10.9	8.6	-	16.1	10.0	10.6	<0.5	mg/kg	TM30/PM15
Barium #	135	72	132	69	131	107	-	124	102	100	<1	mg/kg	TM30/PM15
Cadmium #	1.5	1.3	2.2	2.7	3.2	1.5	-	2.7	1.7	1.7	<0.1	mg/kg	TM30/PM15
Chromium #	28.0	33.2	60.6	31.4	34.0	34.0	-	58.0	30.0	28.4	<0.5	mg/kg	TM30/PM15
Copper #	20	25	33	22	27	22	-	36	23	24	<1	mg/kg	TM30/PM15
Lead #	15	19	48	18	18	22	-	59	19	19	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum #	2.6	6.1	4.9	7.7	4.5	2.9	-	3.7	3.7	4.1	<0.1	mg/kg	TM30/PM15
Nickel #	22.0	39.5	49.7	36.2	47.6	35.2	-	49.6	37.3	35.1	<0.7	mg/kg	TM30/PM15
Selenium #	<1	6	2	1	3	3	-	2	2	1	<1	mg/kg	TM30/PM15
Zinc #	49	62	109	67	91	63	-	101	75	70	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	<0.03	0.05	<0.03	<0.03	0.04	0.16	0.06	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.05	<0.03	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	<0.02	<0.02	0.02	<0.02	<0.02	0.03	0.07	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total #	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	99	106	95	101	99	102	106	103	95	101	<0	%	TM4/PM8
Mineral Oil >C8-C10	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	mg/kg	TM5/PM16
Mineral Oil >C10-C12	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C12-C16	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C16-C21	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C21-C40	<10	87	<10	<10	<10	132	<10	<10	<10	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C8-C40	<45	87	<45	<45	<45	132	<45	<45	<45	<45	<45	mg/kg	TM5/PM16

Client Name:	O'Connor Sutton Cronin & Assoc. Ltd	**Report :**	**Solid**
Reference:			
Location:	St Pauls	**Solids:**	V=60g VOC jar, J=250g glass jar, T=plastic tub
Contact:	Cian O'Hora		
JE Job No.:	15/14318		

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1	2	3	4	5	6	7	8	9	10	LOD/LOR	Units	Method No.
Sample ID	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4			
Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015			
TPH CWG													
Aliphatics													
>C5-C6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C6-C8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4	<4	<4	-	<4	<4	<4	<4	mg/kg	TM5/PM16
>C16-C21 #	<7	<7	<7	<7	<7	<7	-	<7	<7	<7	<7	mg/kg	TM5/PM16
>C21-C35 #	<7	87	<7	<7	8	132	-	<7	<7	<7	<7	mg/kg	TM5/PM16
>C35-C40 #	<7	<7	<7	<7	<7	<7	-	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aliphatics C5-40	<26	87	<26	<26	<26	132	-	<26	<26	<26	<26	mg/kg	TM5/TM36/PM12/PM16
>C6-C10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>C10-C25	<10	<10	<10	<10	<10	17	-	<10	<10	<10	<10	mg/kg	TM5/PM16
>C25-C35	<10	76	<10	<10	<10	115	-	<10	<10	<10	<10	mg/kg	TM5/PM16
Aromatics													
>C5-EC7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4	<4	<4	<4	<4	<4	-	<4	<4	<4	<4	mg/kg	TM5/PM16
>EC16-EC21	<7	<7	<7	<7	<7	<7	-	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC21-EC35	<7	32	<7	<7	<7	55	-	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC35-EC40	<7	<7	<7	<7	<7	<7	-	<7	<7	<7	<7	mg/kg	TM5/PM16
Total aromatics C5-40	<26	32	<26	<26	<26	55	-	<26	<26	<26	<26	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52	119	<52	<52	<52	187	-	<52	<52	<52	<52	mg/kg	TM5/TM36/PM12/PM16
>EC6-EC10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10	<10	<10	<10	<10	<10	-	<10	<10	<10	<10	mg/kg	TM5/PM16
>EC25-EC35	<10	32	<10	<10	<10	53	-	<10	<10	<10	<10	mg/kg	TM5/PM16
MTBE	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Benzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Toluene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Ethylbenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
m/p-Xylene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
o-Xylene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
PCB 28 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 52 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 101 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 118 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 138 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 153 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
PCB 180 #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	<35	ug/kg	TM17/PM8

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1	2	3	4	5	6	7	8	9	10			
Sample ID	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4			
Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015			
Natural Moisture Content	9.7	8.9	17.7	12.5	10.6	8.2	13.4	22.3	10.7	10.9	<0.1	%	PM4/PM0
% Dry Matter 105°C	85.9	86.9	85.4	89.6	88.8	89.6	85.5	79.7	88.9	87.7	<0.1	%	NONE/PM4
Hexavalent Chromium #	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	<0.3	<0.3	<0.3	<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	0.0516	-	<0.0015	-	-	-	0.0027	0.0224	-	-	<0.0015	g/l	TM38/PM20
Chromium III	28.0	33.2	60.6	31.4	34.0	34.0	-	58.0	30.0	28.4	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.50	1.03	1.20	0.44	0.53	0.53	2.27	2.02	0.34	0.38	<0.02	%	TM21/PM24
pH #	8.65	-	8.50	-	-	-	8.36	8.56	-	-	<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1051	0.1036	0.1056	0.1003	0.1011	0.1003	0.105	0.1133	0.1007	0.1022		kg	NONE/PM17
Mass of dried test portion	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09		kg	NONE/PM17

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Jones Environmental Laboratory

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	11	LOD/LOR	Units	Method No.
Sample ID	BH4			
Depth	3.00-4.00			
COC No / misc				
Containers	T			
Sample Date	03/10/2015			
Sample Type	Soil			
Batch Number	1			
Date of Receipt	06/10/2015			
Antimony	2	<1	mg/kg	TM30/PM15
Arsenic#	10.0	<0.5	mg/kg	TM30/PM15
Barium#	121	<1	mg/kg	TM30/PM15
Cadmium#	2.0	<0.1	mg/kg	TM30/PM15
Chromium#	33.4	<0.5	mg/kg	TM30/PM15
Copper#	25	<1	mg/kg	TM30/PM15
Lead#	20	<5	mg/kg	TM30/PM15
Mercury#	<0.1	<0.1	mg/kg	TM30/PM15
Molybdenum#	4.2	<0.1	mg/kg	TM30/PM15
Nickel#	39.8	<0.7	mg/kg	TM30/PM15
Selenium#	9	<1	mg/kg	TM30/PM15
Zinc#	86	<5	mg/kg	TM30/PM15
PAH MS				
Naphthalene#	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene#	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene#	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene#	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene#	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene#	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene#	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene#	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene#	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene#	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene#	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene#	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene#	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene#	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	<0.04	<0.04	mg/kg	TM4/PM8
PAH 6 Total#	<0.22	<0.22	mg/kg	TM4/PM8
PAH 17 Total	<0.64	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	99	<0	%	TM4/PM8
Mineral Oil >C8-C10	<5	<5	mg/kg	TM5/PM16
Mineral Oil >C10-C12	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C12-C16	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C16-C21	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C21-C40	<10	<10	mg/kg	TM5/PM16
Mineral Oil >C8-C40	<45	<45	mg/kg	TM5/PM16

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	11										LOD/LOR	Units	Method No.
Sample ID	BH4												
Depth	3.00-4.00												
COC No / misc													
Containers	T												
Sample Date	03/10/2015												
Sample Type	Soil												
Batch Number	1												
Date of Receipt	06/10/2015												
TPH CWG													
Aliphatics													
>C5-C6	<0.1										<0.1	mg/kg	TM36/PM12
>C6-C8	<0.1										<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1										<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2										<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4										<4	mg/kg	TM5/PM16
>C16-C21 #	<7										<7	mg/kg	TM5/PM16
>C21-C35 #	<7										<7	mg/kg	TM5/PM16
>C35-C40 #	<7										<7	mg/kg	TM5/PM16
Total aliphatics C5-40	<26										<26	mg/kg	TM5/TM36/PM12/PM16
>C6-C10	<0.1										<0.1	mg/kg	TM36/PM12
>C10-C25	<10										<10	mg/kg	TM5/PM16
>C25-C35	<10										<10	mg/kg	TM5/PM16
Aromatics													
>C5-EC7	<0.1										<0.1	mg/kg	TM36/PM12
>EC7-EC8	<0.1										<0.1	mg/kg	TM36/PM12
>EC8-EC10	<0.1										<0.1	mg/kg	TM36/PM12
>EC10-EC12	<0.2										<0.2	mg/kg	TM5/PM16
>EC12-EC16	<4										<4	mg/kg	TM5/PM16
>EC16-EC21	<7										<7	mg/kg	TM5/PM16
>EC21-EC35	<7										<7	mg/kg	TM5/PM16
>EC35-EC40	<7										<7	mg/kg	TM5/PM16
Total aromatics C5-40	<26										<26	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-40)	<52										<52	mg/kg	TM5/TM36/PM12/PM16
>EC6-EC10	<0.1										<0.1	mg/kg	TM36/PM12
>EC10-EC25	<10										<10	mg/kg	TM5/PM16
>EC25-EC35	<10										<10	mg/kg	TM5/PM16
MTBE	<5										<5	ug/kg	TM31/PM12
Benzene	<5										<5	ug/kg	TM31/PM12
Toluene	<5										<5	ug/kg	TM31/PM12
Ethylbenzene	<5										<5	ug/kg	TM31/PM12
m/p-Xylene	<5										<5	ug/kg	TM31/PM12
o-Xylene	<5										<5	ug/kg	TM31/PM12
PCB 28 #	<5										<5	ug/kg	TM17/PM8
PCB 52 #	<5										<5	ug/kg	TM17/PM8
PCB 101 #	<5										<5	ug/kg	TM17/PM8
PCB 118 #	<5										<5	ug/kg	TM17/PM8
PCB 138 #	<5										<5	ug/kg	TM17/PM8
PCB 153 #	<5										<5	ug/kg	TM17/PM8
PCB 180 #	<5										<5	ug/kg	TM17/PM8
Total 7 PCBs #	<35										<35	ug/kg	TM17/PM8

Jones Environmental Laboratory

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : **Solid**

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	11	LOD/LOR	Units	Method No.
Sample ID	BH4			
Depth	3.00-4.00			
COC No / misc				
Containers	T			
Sample Date	03/10/2015			
Sample Type	Soil			
Batch Number	1			
Date of Receipt	06/10/2015			
Natural Moisture Content	11.9	<0.1	%	PM4/PM0
% Dry Matter 105°C	89.0	<0.1	%	NONE/PM4
Hexavalent Chromium #	<0.3	<0.3	mg/kg	TM38/PM20
Sulphate as SO4 (2:1 Ext) #	-	<0.0015	g/l	TM38/PM20
Chromium III	33.4	<0.5	mg/kg	NONE/NONE
Total Organic Carbon #	0.65	<0.02	%	TM21/PM24
pH #	-	<0.01	pH units	TM73/PM11
Mass of raw test portion	0.1008		kg	NONE/PM17
Mass of dried test portion	0.09		kg	NONE/PM17

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Jones Environmental Laboratory

Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1	2	3	4	5	6	7	8	9	10			
Sample ID	BH1	BH1	BH2	BH2	BH2	BH2	BH3	BH4	BH4	BH4			
Depth	0.00-1.00	1.00-2.00	0.50	1.00	2.00	3.00	0.50	0.00-1.00	1.00-2.00	2.00-3.00			
COC No / misc													
Containers	T	T	T	T	T	T	T	T	T	T			
Sample Date	28/09/2015	28/09/2015	30/09/2015	30/09/2015	30/09/2015	30/09/2015	01/10/2015	03/10/2015	03/10/2015	03/10/2015			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1	LOD/LOR	Units	Method No.
Date of Receipt	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015			
Dissolved Antimony #	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.015	0.012	<0.003	<0.003	0.011	0.051	<0.003	<0.003	0.005	0.004	<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.15	0.12	<0.03	<0.03	0.11	0.51	<0.03	<0.03	0.05	0.04	<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.035	0.037	0.013	0.021	0.029	0.020	0.006	0.011	0.029	0.028	<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.35	0.37	0.13	0.21	0.29	0.20	0.06	0.11	0.29	0.28	<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003	0.027	<0.003	<0.003	<0.003	0.028	<0.003	<0.003	<0.003	<0.003	<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03	0.27	<0.03	<0.03	<0.03	0.28	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	<0.003	<0.003	0.004	0.004	<0.003	0.004	0.005	0.004	0.005	0.004	<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	<0.03	<0.03	0.04	0.04	<0.03	0.04	0.05	0.04	0.05	0.04	<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001	<0.00001	0.00028	0.00006	<0.00001	0.00001	0.00029	0.00007	0.00003	0.00002	<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	<0.0001	<0.0001	0.0028	0.0006	<0.0001	<0.0001	0.0029	0.0007	0.0003	0.0002	<0.0001	mg/kg	TM61/PM38
Phenol	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/l	TM26/PM0
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM26/PM0
Fluoride	<0.3	<0.3	0.3	<0.3	<0.3	0.3	0.5	0.5	<0.3	<0.3	<0.3	mg/l	TM27/PM0
Fluoride	<3	<3	3	<3	<3	<3	5	5	<3	<3	<3	mg/kg	TM27/PM0
Chloride	1.1	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.4	<0.3	<0.3	<0.3	mg/l	TM27/PM0
Chloride	11	<3	<3	<3	<3	<3	<3	4	<3	<3	<3	mg/kg	TM27/PM0
Sulphate	3.59	16.54	0.28	0.52	4.67	29.70	0.32	0.82	0.50	0.61	<0.05	mg/l	TM27/PM0
Sulphate	35.9	165.5	2.8	5.2	46.7	296.8	3.2	8.2	5.0	6.1	<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1051	0.1036	0.1056	0.1003	0.1011	0.1003	0.105	0.1133	0.1007	0.1022		kg	NONE/PM17
Leachant Volume	0.885	0.887	0.885	0.89	0.889	0.889	0.885	0.877	0.889	0.887		l	NONE/PM17
Eluate Volume	0.65	0.75	0.83	0.83	0.85	0.6	0.8	0.75	0.85	0.83		l	NONE/PM17
Dissolved Organic Carbon	3	2	7	4	3	3	7	6	4	4	<2	mg/l	TM60/PM0
Dissolved Organic Carbon	30	20	70	40	30	30	70	60	40	40	<20	mg/kg	TM60/PM0
Total Dissolved Solids #	75	119	71	97	80	149	56	180	107	98	<10	mg/l	TM20/PM0
Total Dissolved Solids #	750	1191	710	970	800	1489	560	1800	1070	980	<100	mg/kg	TM20/PM0

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Client Name: O'Connor Sutton Cronin & Assoc. Ltd
Reference:
Location: St Pauls
Contact: Cian O'Hora
JE Job No.: 15/14318

Report : CEN 10:1 1 Batch

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	11										LOD/LOR	Units	Method No.
Sample ID	BH4												
Depth	3.00-4.00												
COC No / misc													
Containers	T												
Sample Date	03/10/2015												
Sample Type	Soil												
Batch Number	1												
Date of Receipt	06/10/2015												
Dissolved Antimony #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Antimony (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Arsenic #	<0.0025										<0.0025	mg/l	TM30/PM17
Dissolved Arsenic (A10) #	<0.025										<0.025	mg/kg	TM30/PM17
Dissolved Barium #	0.017										<0.003	mg/l	TM30/PM17
Dissolved Barium (A10) #	0.17										<0.03	mg/kg	TM30/PM17
Dissolved Cadmium #	<0.0005										<0.0005	mg/l	TM30/PM17
Dissolved Cadmium (A10) #	<0.005										<0.005	mg/kg	TM30/PM17
Dissolved Chromium #	<0.0015										<0.0015	mg/l	TM30/PM17
Dissolved Chromium (A10) #	<0.015										<0.015	mg/kg	TM30/PM17
Dissolved Copper #	<0.007										<0.007	mg/l	TM30/PM17
Dissolved Copper (A10) #	<0.07										<0.07	mg/kg	TM30/PM17
Dissolved Lead #	<0.005										<0.005	mg/l	TM30/PM17
Dissolved Lead (A10) #	<0.05										<0.05	mg/kg	TM30/PM17
Dissolved Molybdenum #	0.043										<0.002	mg/l	TM30/PM17
Dissolved Molybdenum (A10) #	0.43										<0.02	mg/kg	TM30/PM17
Dissolved Nickel #	<0.002										<0.002	mg/l	TM30/PM17
Dissolved Nickel (A10) #	<0.02										<0.02	mg/kg	TM30/PM17
Dissolved Selenium #	<0.003										<0.003	mg/l	TM30/PM17
Dissolved Selenium (A10) #	<0.03										<0.03	mg/kg	TM30/PM17
Dissolved Zinc #	0.003										<0.003	mg/l	TM30/PM17
Dissolved Zinc (A10) #	0.03										<0.03	mg/kg	TM30/PM17
Mercury Dissolved by CVAF #	<0.00001										<0.00001	mg/l	TM61/PM38
Mercury Dissolved by CVAF #	<0.0001										<0.0001	mg/kg	TM61/PM38
Phenol	<0.01										<0.01	mg/l	TM26/PM0
Phenol	<0.1										<0.1	mg/kg	TM26/PM0
Fluoride	0.3										<0.3	mg/l	TM27/PM0
Fluoride	3										<3	mg/kg	TM27/PM0
Chloride	<0.3										<0.3	mg/l	TM27/PM0
Chloride	<3										<3	mg/kg	TM27/PM0
Sulphate	3.38										<0.05	mg/l	TM27/PM0
Sulphate	33.8										<0.5	mg/kg	TM27/PM0
Mass of raw test portion	0.1008											kg	NONE/PM17
Leachant Volume	0.889											l	NONE/PM17
Eluate Volume	0.63											l	NONE/PM17
Dissolved Organic Carbon	3										<2	mg/l	TM60/PM0
Dissolved Organic Carbon	30										<20	mg/kg	TM60/PM0
Total Dissolved Solids #	94										<10	mg/l	TM20/PM0
Total Dissolved Solids #	940										<100	mg/kg	TM20/PM0

Mass of sample taken (kg)	0.1051	Dry Matter Content Ratio (%) =	85.9
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.65

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**1**			
Client Sample No	**BH1**			
Depth/Other	**0.00-1.00**			
Sample Date	**28/09/2015**			
Batch No	**1**	**Inert**	**Stable Non-reactive**	**Hazardous**
Solid Waste Analysis				
Total Organic Carbon (%)	0.50	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.15	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.35	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	11	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	35.9	1000	20000	50000
Total Dissolved Solids	750	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	30	500	800	1000

Mass of sample taken (kg)	0.1036	Dry Matter Content Ratio (%) =	86.9
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.887
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**2**			
Client Sample No	**BH1**			
Depth/Other	**1.00-2.00**			
Sample Date	**28/09/2015**			
Batch No	**1**			
Solid Waste Analysis		**Inert**	**Stable Non-reactive**	**Hazardous**
Total Organic Carbon (%)	1.03	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	87	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.12	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.37	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.03	0.06	0.7	5
Selenium	0.27	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	165.5	1000	20000	50000
Total Dissolved Solids	1191	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	20	500	800	1000

Mass of sample taken (kg)	0.1056	Dry Matter Content Ratio (%) =	85.4
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**3**			
Client Sample No	**BH2**			
Depth/Other	**0.50**			
Sample Date	**30/09/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	1.20	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	<0.03	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0028	0.01	0.2	2
Molybdenum	0.13	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.04	4	50	200
Chloride	<3	800	15000	25000
Fluoride	3	10	150	500
Sulphate as SO4	2.8	1000	20000	50000
Total Dissolved Solids	710	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	70	500	800	1000

Mass of sample taken (kg)	0.1003	Dry Matter Content Ratio (%) =	89.6
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.89
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**4**			
Client Sample No	**BH2**			
Depth/Other	**1.00**			
Sample Date	**30/09/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.44	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	<0.03	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0006	0.01	0.2	2
Molybdenum	0.21	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.04	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	5.2	1000	20000	50000
Total Dissolved Solids	970	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

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Mass of sample taken (kg)	0.1011	Dry Matter Content Ratio (%) =	88.8
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889
Particle Size <4mm =	>95%	Eluate Volume (l)	0.85

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**5**			
Client Sample No	**BH2**			
Depth/Other	**2.00**			
Sample Date	**30/09/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.53	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.11	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.29	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	<0.03	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	46.7	1000	20000	50000
Total Dissolved Solids	800	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	30	500	800	1000

Mass of sample taken (kg)	0.1003	Dry Matter Content Ratio (%) =	89.6
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889
Particle Size <4mm =	>95%	Eluate Volume (l)	0.6

JEFL Job No	**15/14318**	**Landfill Waste Acceptance Criteria Limits**		
Sample No	**6**			
Client Sample No	**BH2**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**3.00**			
Sample Date	**30/09/2015**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.53	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	132	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.51	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.20	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	0.28	0.1	0.5	7
Zinc	0.04	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	296.8	1000	20000	50000
Total Dissolved Solids	1489	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	30	500	800	1000

Mass of sample taken (kg)	0.105	Dry Matter Content Ratio (%) =	85.5
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.885
Particle Size <4mm =	>95%	Eluate Volume (l)	0.8

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**7**			
Client Sample No	**BH3**	**Inert**	**Stable Non-reactive**	**Hazardous**
Depth/Other	**0.50**			
Sample Date	**01/10/2015**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	2.27	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	<0.03	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0029	0.01	0.2	2
Molybdenum	0.06	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.05	4	50	200
Chloride	<3	800	15000	25000
Fluoride	5	10	150	500
Sulphate as SO4	3.2	1000	20000	50000
Total Dissolved Solids	560	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	70	500	800	1000

Please include all sections of this report if it is reproduced
All solid results are expressed on a dry weight basis unless stated otherwise.

Mass of sample taken (kg)	0.1133	Dry Matter Content Ratio (%) =	79.7
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.877
Particle Size <4mm =	>95%	Eluate Volume (l)	0.75

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**8**			
Client Sample No	**BH4**			
Depth/Other	**0.00-1.00**			
Sample Date	**03/10/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	2.02	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	<0.03	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0007	0.01	0.2	2
Molybdenum	0.11	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.04	4	50	200
Chloride	4	800	15000	25000
Fluoride	5	10	150	500
Sulphate as SO4	8.2	1000	20000	50000
Total Dissolved Solids	1800	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	60	500	800	1000

Mass of sample taken (kg)	0.1007	Dry Matter Content Ratio (%) =	88.9
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889
Particle Size <4mm =	>95%	Eluate Volume (l)	0.85

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**9**			
Client Sample No	**BH4**			
Depth/Other	**1.00-2.00**			
Sample Date	**03/10/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.34	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-
Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.05	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0003	0.01	0.2	2
Molybdenum	0.29	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.05	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	5.0	1000	20000	50000
Total Dissolved Solids	1070	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.1022	Dry Matter Content Ratio (%) =	87.7
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.887
Particle Size <4mm =	>95%	Eluate Volume (l)	0.83

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**10**			
Client Sample No	**BH4**			
Depth/Other	**2.00-3.00**			
Sample Date	**03/10/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.38	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.04	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	0.0002	0.01	0.2	2
Molybdenum	0.28	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.04	4	50	200
Chloride	<3	800	15000	25000
Fluoride	<3	10	150	500
Sulphate as SO4	6.1	1000	20000	50000
Total Dissolved Solids	980	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	40	500	800	1000

Mass of sample taken (kg)	0.1008	Dry Matter Content Ratio (%) =	89.0
Mass of dry sample (kg) =	0.09	Leachant Volume (l)	0.889
Particle Size <4mm =	>95%	Eluate Volume (l)	0.63

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**15/14318**			
Sample No	**11**			
Client Sample No	**BH4**			
Depth/Other	**3.00-4.00**			
Sample Date	**03/10/2015**	**Inert**	**Stable Non-reactive**	**Hazardous**
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	0.65	3	5	6
Sum of BTEX (mg/kg)	<0.025	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	<45	500	-	-
PAH Sum of 6 (mg/kg)	<0.22	-	-	-
PAH Sum of 17 (mg/kg)	<0.64	100	-	-

Eluate Analysis	**10:1 concn leached**	**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	A10			
	mg/kg	**mg/kg**		
Arsenic	<0.025	0.5	2	25
Barium	0.17	20	100	300
Cadmium	<0.005	0.04	1	5
Chromium	<0.015	0.5	10	70
Copper	<0.07	2	50	100
Mercury	<0.0001	0.01	0.2	2
Molybdenum	0.43	0.5	10	30
Nickel	<0.02	0.4	10	40
Lead	<0.05	0.5	10	50
Antimony	<0.02	0.06	0.7	5
Selenium	<0.03	0.1	0.5	7
Zinc	0.03	4	50	200
Chloride	<3	800	15000	25000
Fluoride	3	10	150	500
Sulphate as SO4	33.8	1000	20000	50000
Total Dissolved Solids	940	4000	60000	100000
Phenol	<0.1	1	-	-
Dissolved Organic Carbon	30	500	800	1000

Client Name: O'Connor Sutton Cronin & Assoc. Ltd **Matrix : Solid**
Reference:
Location: St Pauls
Contact: Cian O'Hora

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
15/14318	1	BH1	0.00-1.00	1	EPH	Sample received in inappropriate container
15/14318	1	BH1	1.00-2.00	2	EPH	Sample received in inappropriate container
15/14318	1	BH2	0.50	3	EPH	Sample received in inappropriate container
15/14318	1	BH2	1.00	4	EPH	Sample received in inappropriate container
15/14318	1	BH2	2.00	5	EPH	Sample received in inappropriate container
15/14318	1	BH2	3.00	6	EPH	Sample received in inappropriate container
15/14318	1	BH4	0.00-1.00	8	EPH	Sample received in inappropriate container
15/14318	1	BH4	1.00-2.00	9	EPH	Sample received in inappropriate container
15/14318	1	BH4	2.00-3.00	10	EPH	Sample received in inappropriate container
15/14318	1	BH4	3.00-4.00	11	EPH	Sample received in inappropriate container

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

JE Job No.: 15/14318

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 (UKAS) accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS) accredited - UK.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID.	PM12/PM16	CWG GC-FID			AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified USEPA 8163. Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.	Yes		AR	Yes
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM27	Modified US EPA method 9056.Determination of water soluble anions using Dionex (Ion-Chromatography).	PM0	No preparation is required.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.			AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AD	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground samples with deionised water in a 2:1 water to solid ratio for anions. Extraction of as received samples with deionised water in a 2:1 water to solid ratio for ammoniacal nitrogen. Samples are extracted using an orbital shaker.	Yes		AR	Yes

JE Job No: 15/14318

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.			AR	Yes
TM61	Modified US EPA methods 245.7 and 200.7. Determination of Mercury by Cold Vapour Atomic Fluorescence.	PM38	Samples are brominated to reduce all mercury compounds to Mercury (II) which is analysed using method TM061.	Yes		AR	Yes
TM73	Modified US EPA methods 150.1 and 9045D. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
NONE	No Method Code	NONE	No Method Code			AR	Yes
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.				
NONE	No Method Code	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.			AR	
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

Appendix - Methods used for WAC (2003/33/EC)

Leachate tests	
10l/kg; 4mm	I.S. EN 12457-2:2002 Specified particle size; water added to L/S ratio; capped; agitated for 24 ± 0.5 hours; eluate settled and filtered over 0.45 µm membrane filter.
Eluate analysis	
As	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ba	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cd	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cr total	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Cu	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Hg	I.S. EN 13370 rec. EN 1483 (CVAAS)
Mo	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Ni	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Pb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Sb	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Se	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Zn	I.S. EN 12506 : EN ISO 11885 (ICP-OES)
Chloride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Fluoride	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Sulphate	I.S. EN 12506 rec. EN ISO 10304-part 1 (liquid chromatography of ions)
Phenol index	I.S. EN 13370 rec. ISO 6439 (4-Aminoantipyrine spectrometic methods after distillation)* (BY HPLC - Jones Env)
DOC	I.S. EN 1484
TDS	I.S. EN 15216
Compositional analysis	
TOC	I.S. EN 13137 Method B: carbonates removed with acid; TOC by combustion.
BTEX	GC-FID
PCB7**	I.S. EN 15308 analysis by GC-ECD.
Mineral oil	I.S. EN 14039 C10 to C40 analysis by GC-FID.
PAH17***	I.S. EN 15527 PAH17 analysis by GC-MS
Metals	I.S. EN 13657 - Aqua regia digestion: EN ISO 11885 (ICP-OES)
Other	
Dry matter	I.S. EN 14346 sample is dried to a constant mass in an oven at 105 ± 3 °C; Method B Water content by direct Karl-Fischer-titration and either volumetric or coulometric detection.
LOI	I.S. EN 15169 Difference in mass after heating in a furnace up to 550 ± 25 °C.
ANC	CEN/TS 15364 Determined by amouns of acid or base needed to cover the pH range

Notes:

*If not suitable due to LOD, precision, etc., any other suitable method can be used, e.g. AFS, ICP-MS

**PCB-28, PCB-52, PCB-101, PCB-118, PCB-138, PCB-153 and PCB-180

***Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Chrysene, Coronene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Phenanthrene and Pyrene.

Appendix 4: Groundwater Monitoring

GROUNDWATER MONITORING

St Pauls Raheny

BOREHOLE	DATE	GROUNDWATER		Comments
		m BGL	m OD	
BH1	19/10/2015	1.08	23.772	
BH2	19/10/2015	1.79	20.699	
BH3	19/10/2015	2.17	19.773	
BH6	19/10/2015	Dry	**-**	
BH9	19/10/2015	2.40	19.021	

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Multidisciplinary
Consulting Engineers

Appendix B

GII REPORT 2018

GROUND INVESTIGATIONS IRELAND

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Ground Investigations Ireland

St Pauls Raheny - 2018

Ground Investigation Report

DOCUMENT CONTROL SHEET

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Engineer	OCSC
Client	Marlet
Project No	7476-01-18
Document Title	Ground Investigation Report

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
A	Final	R O'Toole	C Finnerty	F McNamara	Dublin	22 February 2018

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CONTENTS

APPENDICES

1.0 Preamble

On the instructions of OCSC Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., in February 2018 at the site of the existing playing pitches to the rear of St. Pauls in Raheny in Dublin 5.

2.0 Overview

2.1. Background

It is proposed to construct a new residential development with associated services, access roads and car parking at the proposed site. The site is currently occupied by playing pitches and is situated to the rear of the existing school buildings. The proposed construction is envisaged to consist of conventional foundations and pavement make up with some local excavations for services and plant. Cable Percussion boreholes completed in 2015 were also surveyed and monitored during these works.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 4 No. Soakaways to determine a soil infiltration value to BRE digest 365
- Carry out 4 No. Cable Percussion boreholes to a maximum depth of 5.0m BGL
- Installation of 4 No. Groundwater monitoring wells
- Surveying and groundwater monitoring
- Report with recommendations

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing was undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Soakaway Testing

The soakaway pits were excavated using a JCB 3CX excavator at the locations shown in the exploratory hole location plan in Appendix 1. The locations were checked using a CAT scan to minimise the potential for encountering services during the excavation. The trial pits were sampled, logged and photographed by a Geotechnical Engineer/Engineering Geologist prior to backfilling with arisings. The soakaway testing was carried out in the trial pits which were carefully excavated and filled with water to assess the infiltration characteristics of the proposed site. The pits were allowed to drain and the drop in water level was recorded over time as required by BRE Digest 365. The pits were logged prior to completing the soakaway test and were backfilled with arising's upon completion. The soakaway test results are provided in Appendix 2 of this Report.

3.3. Cable Percussion Boreholes

The Cable Percussion Boreholes were drilled using a Dando 2000 drilling rig with regular in-situ testing and sampling undertaken to facilitate the production of geotechnical logs and laboratory testing.
The standard method of boring in soil for site investigation is known as the Cable Percussion method. It consists of using a Shell in non cohesive soils and a clay cutter in cohesive soils, both operated on a wire cable. Very hard soils, boulders and other hard obstructions are broken up by chiselling and the fragments removed with the Shell. Where ground conditions made it necessary, the borehole was lined with 200mm diameter steel casing. While the use of the Cable Percussion method of boring gives the maximum data on soil conditions, some mixing of laminated soil is inevitable. For this reason, thin lenses of granular material may not be noticed. Disturbed samples were taken from the boring tools at suitable depths, so that there is a representative sample at the top of each change in stratum and thereafter at regular intervals down the borehole until the next stratum was encountered. The disturbed samples were then sealed and sent to the laboratory where they were visually examined to confirm the description of the relevant strata.
Standard Penetration Tests were carried out in the boreholes. The results of these tests, together with the depths at which the tests were taken are shown on the accompanying borehole records. The test consists of a thick wall sampler tube, 50mm external diameter, being driven into the soil by a monkey weighing 63.5kg and with a free drop of 760mm. For gravels and glacial till the driving shoe was replaced by a solid 60º cone. The Standard Penetration Test number referred to as the 'N' value is the number of blows required to drive the tube 300mm, after an initial penetration of 150mm. The number gives a guide to the consistency of the soil and can also be used to estimate the relative strength/density at the depth of the test and also to estimate the bearing capacity and compressibility of the soil. The cable percussion borehole logs are provided in Appendix 3 of this Report.

3.4. Surveying

The exploratory hole locations have been recorded using a GPS GNSS System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.5. Groundwater/Gas Monitoring Installations

Groundwater and or Gas Monitoring Installation were installed upon the completion of the boreholes to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the appendices of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- Topsoil/Surfacing
- Made Ground
- Cohesive Deposits

TOPSOIL: Topsoil was encountered in all the exploratory holes and was present to a maximum depth of 0.3m BGL. Tarmac surfacing was present typically to a depth of 0.05m BGL.

MADE GROUND: Made Ground deposits were encountered beneath the Topsoil/Surfacing and was present to a relatively consistent depth of between 0.6m and 1.0m BGL. These deposits were described generally as *brown sandy slightly gravelly CLAY with frequent cobbles and boulders and contained occasional fragments of concrete, red brick, glass and plastic.*

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath the Made Ground and were described typically as *brown sandy gravelly CLAY with occasional cobbles and boulders* overlying a *black sandy gravelly CLAY with occasional cobbles and boulders*. The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix. These deposits had some, occasional or frequent cobble and boulder content where noted on the exploratory hole logs.

4.2. Groundwater

Groundwater strikes are noted on the exploratory hole logs where they occurred and where possible drilling was suspended for twenty minutes to allow the subsequent rise in groundwater to be recorded. We would point out that these exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime and groundwater levels would be expected to vary with the tide, time of year, rainfall, nearby construction and other factors. For this reason, standpipes were installed in BH1, BH2, BH3 and BH4 to allow the equilibrium groundwater level to be determined. In addition, boreholes completed in 2015 were also surveyed and monitored. The groundwater monitoring is included in Appendix 4 of this Report. OCSC deployed groundwater monitoring data loggers into selected boreholes and the results of this monitoring are presented under the cover of a separate report.

5.0 Recommendations & Conclusions

5.1. General

The recommendations given and opinions expressed in this report are based on the findings as detailed in the exploratory hole records. Where an opinion is expressed on the material between exploratory hole locations, this is for guidance only and no liability can be accepted for its accuracy. No responsibility can be accepted for conditions which have not been revealed by the exploratory holes. Limited information has been provided at the ground investigation stage and any designs based on the recommendations or conclusions should be completed in accordance with the current design codes, taking into account the variation and the specific details contained within the exploratory hole logs.

5.1. Groundwater Monitoring

The groundwater monitoring undertaken indicates the water level varied from 0.2m to 1.0m BGL across the site.

5.2. Soakaway Design

At the locations of SA01 to SA04 the water level dropped too slowly to allow calculation of ‘f’ the soil infiltration rate. These locations are therefore not recommended as suitable for soakaway design and construction.

The recommendations provided in this report should be verified in the design of the proposed buildings, using the full details of the loading conditions and taking into consideration the allowable tolerable settlements/movements that the building can accommodate. The founding strata should be inspected and verified by a suitably qualified engineer prior to construction of the building foundations.

APPENDIX 1 - Site Location Plan

NOTES

1. For setting out refer to Engineer's drawings.
2. This drawing to be read in conjunction with all other Engineering drawings and all other relevant drawings and Specifications.
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Rev. No.	Date	REVISION NOTE	Drn. By	Chkd. By
A	13/02/2018	Additional Site Investigations	JB	AH

Rev. No.	Date	REVISION NOTE	Drn. By	Chkd. By

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ISO 9001:2008 QUALITY | OHSAS 18001:2007 HEALTH & SAFETY | ISO 14001:2004 ENVIRONMENTAL

Client	Crekav Landbank Investments Ltd.
Project	Residential Development St. Paul's College
Title	Site investigation - Borehole & Soakaway Locations

Drn by	Chkd by	Aprvd by	Dwg. No.	Revision
IK	JS	PC	N251 -SK05	A
Date: 20/10/15	Scale: NTS			

Office Locations | Dublin (Head Office) | London | Cork | Galway | Belfast | Warsaw | Bucharest | Moscow | Abu Dhabi | Libya |

APPENDIX 2 – Soakaway Records

Ground Investigations Ireland Ltd www.gii.ie			Site: St Pauls Raheny	Trial Pit Number: SA01
Excavation Method: Trial Pit	Dimensions: L x W x D 3.50 x 0.60 x 1.70m	Ground Level (mOD): 23.29	Client: Marlet	Job Number: 7476-02-18
	Location: 720473.9 E 737416.1 N	Dates: 14/02/2018	Engineer: OCSC	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL: Dark brown sandy gravelly Clay		
				22.99	0.30 (0.20)	MADE GROUND consistign of brown sandy gravelly Clay with fragments of red brick. Gravel is fine to coarse and rounded to sub-rounded		
				22.79	0.50 (0.60)	Soft brown mottled grey gravelly CLAY with occasional sub-rounded to sub-angular cobbles. Gravel is fine to coarse and sub-rounded to sub-angular		
				22.19	1.10 (0.60)	Soft grey mottled brown gravelly CLAY with occasional rounded to sub-rounded cobbles. Gravel is fine to coarse rounded to sub-rounded		
			Slow seepage(1) at 1.70m.	21.59	1.70	Complete at 1.70m		∇1

Plan

Remarks

Trial pit stable
Groundwater encountered at 1.70mBGL as slow seepage
Soakaway completed in pit

Scale (approx)	Logged By	Figure No.
1:25	R'OT	7476-02-18.SA01

Ground Investigations Ireland Ltd
www.gii.ie

Site	St Pauls Raheny		**Trial Pit Number**	**SA02**
Excavation Method Trial Pit	**Dimensions** L x W x D 3.20 x 0.60 x 1.70m	**Ground Level (mOD)** 22.78	**Client** Marlet	**Job Number** 7476-02-18
	Location 720543.9 E 737408.1 N	**Dates** 14/02/2018	**Engineer** OCSC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
				22.48	(0.30) 0.30	TOPSOIL: Dark brown sandy gravelly Clay with rootlets		
				22.18	(0.30) 0.60	MADE GROUND consisting of brown sandy gravelly Clay with rare sub-rounded cobbles and fragments of red brick. Gravel is fine to coarse and rounded to sub-rounded		
				21.98	(0.20) 0.80	Soft brown slightly sandy gravelly CLAY with occasional sub-rounded to sub-angular cobbles. Gravel is fine to coarse and sub-rounded to sub-angular		
				21.08	(0.90) 1.70	Soft to firm grey mottled brown gravelly CLAY with occasional sub-rounded to sub-angular cobbles. Gravel is fine to coarse sub-rounded to sub-angular		
						Complete at 1.70m		

Plan

Remarks

Trial pit stable
No groundwater encountered
Soakaway completed in pit
Land drain encountered in TP between 0.1m and 0.5m BGL

Scale (approx)	Logged By	Figure No.
1:25	R'OT	7476-02-18.SA02

Ground Investigations Ireland Ltd www.gii.ie		Site St Pauls Raheny	Trial Pit Number **SA03**
Excavation Method Trial Pit	**Dimensions** L x W x D 3.30 x 0.60 x 1.70m	**Ground Level (mOD)** 22.35	**Client** Marlet	**Job Number** 7476-02-18
	Location 720471.9 E 737352.9 N	**Dates** 14/02/2018	**Engineer** OCSC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL: Brown sandy gravelly Clay		
				22.05	0.30 (1.20)	Firm brown mottled grey slightly sandy gravelly CLAY with occasional sub-rounded to sub-angular cobbles. Gravel is fine to coarse and rounded to sub-rounded		
				20.85	1.50 (0.20)	Medium dense grey gravelly fine to coarse SAND. Gravel is fine to coarse sub-rounded to sub-angular		∇1
			Slow trickle(1) at 1.70m.	20.65	1.70	Complete at 1.70m		

Plan

Remarks

Trial pit stable
Groundwater encountered at 1.70mBGL as slow-medium flow
Soakaway completed in pit

Scale (approx)	Logged By	Figure No.
1:25	R'OT	7476-02-18.SA03

Ground Investigations Ireland Ltd www.gii.ie	Site: St Pauls Raheny	Trial Pit Number: SA04

Excavation Method	Dimensions	Ground Level (mOD)	Client	Job Number
Trial Pit	L x W x D 3.50 x 0.60 x 1.70m	21.79	Marlet	7476-02-18
	Location 720538.6 E 737346.7 N	**Dates** 14/02/2018	**Engineer** OCSC	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	TOPSOIL: Brown sandy gravelly Clay		
				21.49	0.30 (0.20)	MADE GROUND consisting of grey slightly sandy gravelly Clay with fragments of red brick. Gravel is fine to coarse and sub-angular to sub-rounded		
				21.29	0.50 (0.70)	Firm brown mottled grey slightly sandy gravelly CLAY with occasional sub-rounded cobbles. Gravel is fine to coarse and sub-rounded to sub-angular		
				20.59	1.20 (0.50)	Firm to stiff grey mottled brown sandy gravelly CLAY with occasional sub-rounded to sub-angular cobbles. Gravel is fine to coarse sub-rounded to sub-angular		
				20.09	1.70	Complete at 1.70m		

Plan

Remarks

Trial pit stable
No groundwater encountered
Soakaway completed in pit

Scale (approx)	Logged By	Figure No.
1:25	R'OT	7476-02-18.SA04

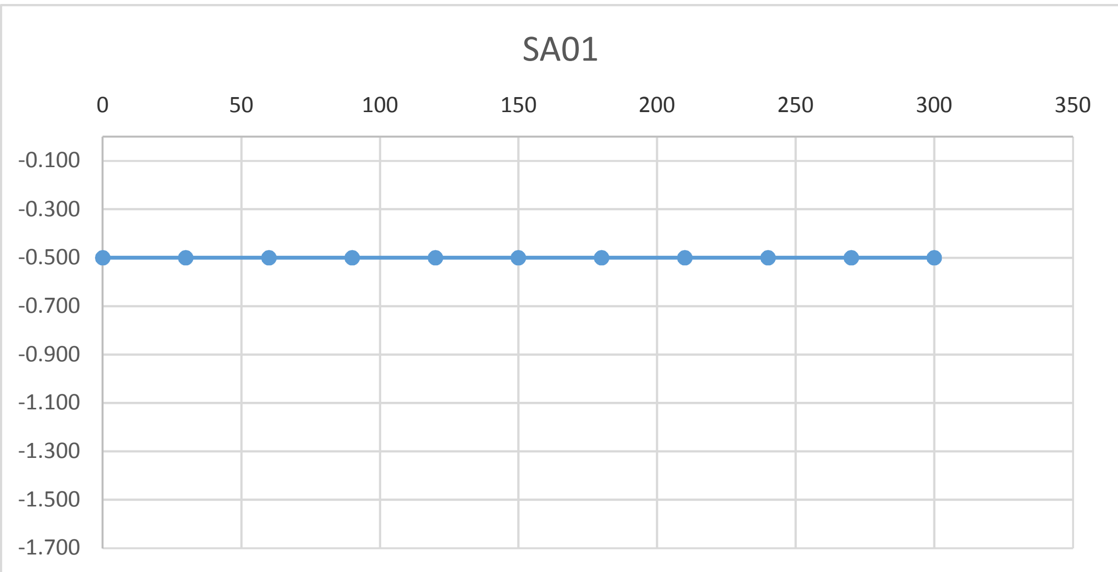
SA01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 3.50m x 0.60m x 1.70m (L x W x D)

Date	Time	Water level (m bgl)
14/02/2018	0	-0.500
14/02/2018	30	-0.500
14/02/2018	60	-0.500
14/02/2018	90	-0.500
14/02/2018	120	-0.500
14/02/2018	150	-0.500
14/02/2018	180	-0.500
14/02/2018	210	-0.500
14/02/2018	240	-0.500
14/02/2018	270	-0.500
14/02/2018	300	-0.500

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	1.700	1.200	0.8	1.4



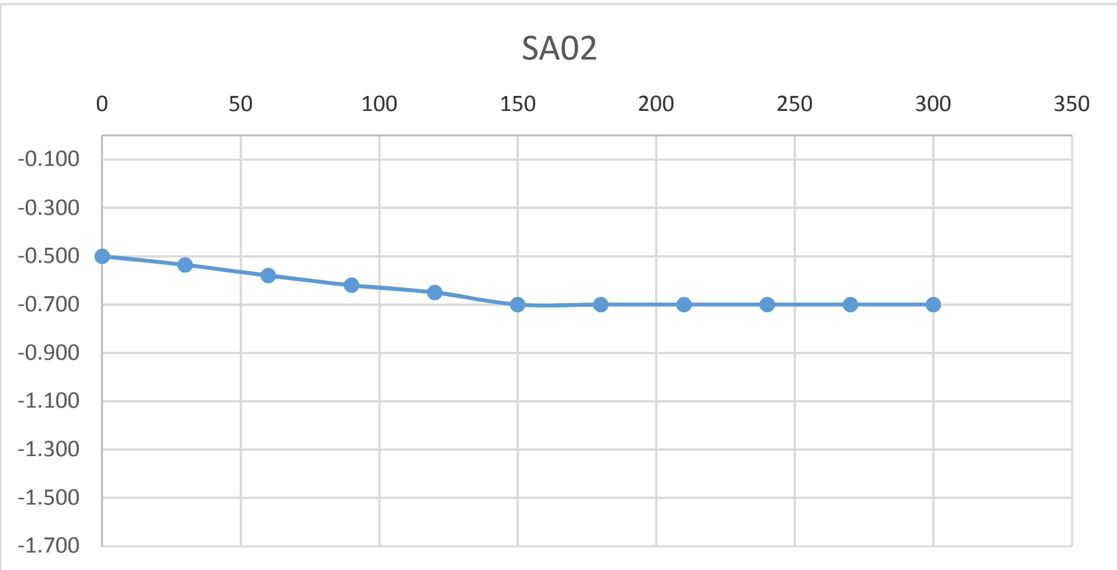
SA02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 3.20m x 0.60m x 1.70m (L x W x D)

Date	Time	Water level (m bgl)
14/02/2018	0	-0.500
14/02/2018	30	-0.536
14/02/2018	60	-0.580
14/02/2018	90	-0.620
14/02/2018	120	-0.650
14/02/2018	150	-0.700
14/02/2018	180	-0.700
14/02/2018	210	-0.700
14/02/2018	240	-0.700
14/02/2018	270	-0.700
14/02/2018	300	-0.700

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.50	1.700	1.200	0.8	1.4



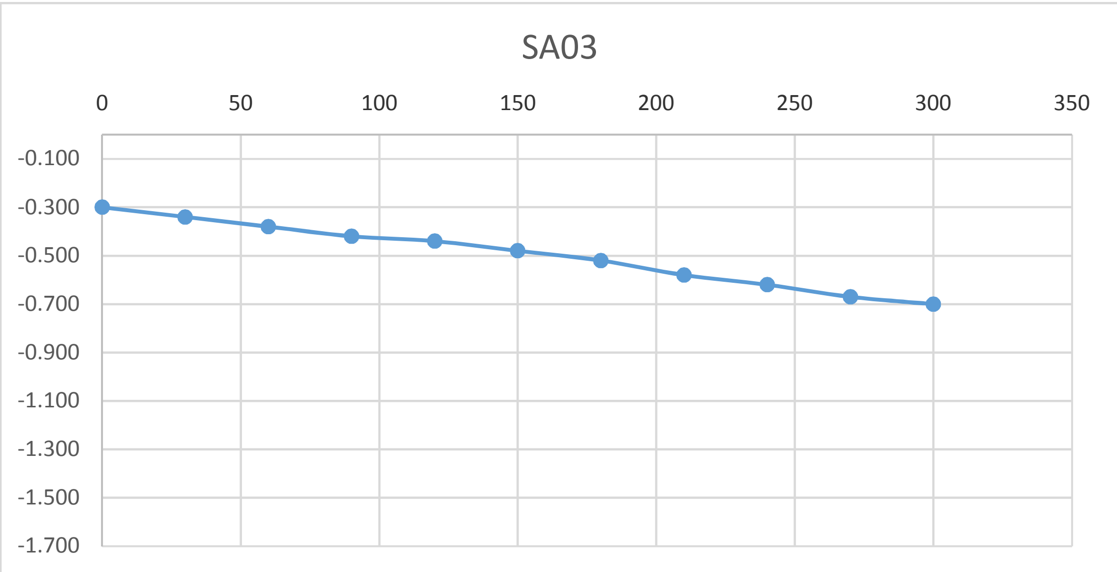
SA03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 3.30m x 0.60m x 1.70m (L x W x D)

Date	Time	Water level (m bgl)
14/02/2018	0	-0.300
14/02/2018	30	-0.340
14/02/2018	60	-0.380
14/02/2018	90	-0.420
14/02/2018	120	-0.440
14/02/2018	150	-0.480
14/02/2018	180	-0.520
14/02/2018	210	-0.580
14/02/2018	240	-0.620
14/02/2018	270	-0.670
14/02/2018	300	-0.700

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.30	1.700	1.400	0.65	1.35



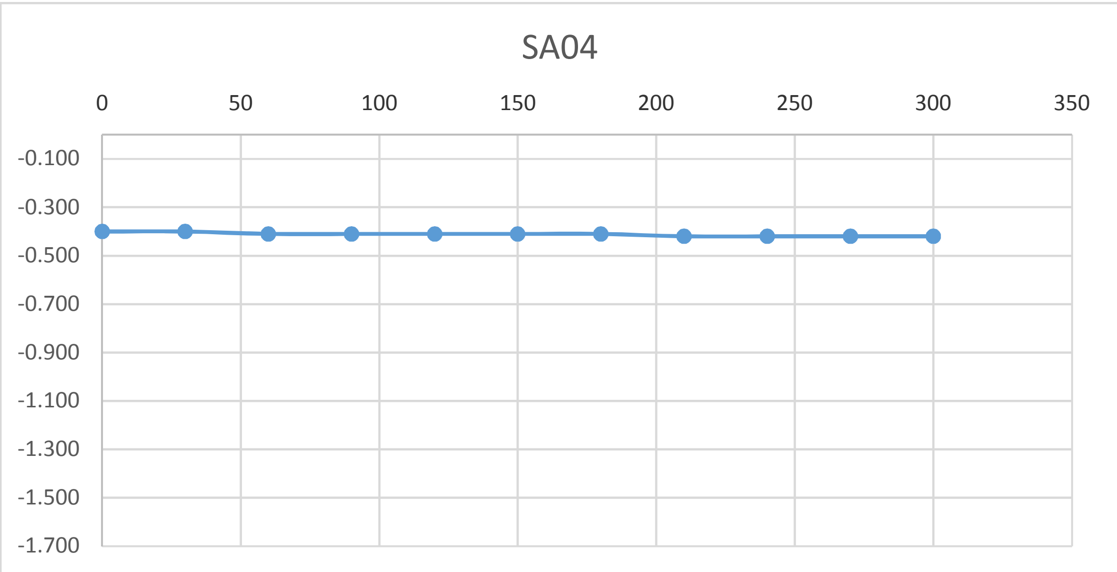
SA04

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 3.50m x 0.60m x 1.70m (L x W x D)

Date	Time	Water level (m bgl)
14/02/2018	0	-0.400
14/02/2018	30	-0.400
14/02/2018	60	-0.410
14/02/2018	90	-0.410
14/02/2018	120	-0.410
14/02/2018	150	-0.410
14/02/2018	180	-0.410
14/02/2018	210	-0.420
14/02/2018	240	-0.420
14/02/2018	270	-0.420
14/02/2018	300	-0.420

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.40	1.700	1.300	0.725	1.375



APPENDIX 3 – Cable Percussion Borehole Records

Ground Investigations Ireland Ltd
www.gii.ie

Site	St Pauls Raheny		**Borehole Number**	BH1 2018
Machine : Dando 2000	**Casing Diameter** 200mm cased to 5.00m	**Ground Level (mOD)** 23.15	**Client** Marlet	**Job Number** 7476-02-18
Method : Cable Percussion	**Location** 720443.5 E 737379.8 N	**Dates** 15/02/2018	**Engineer** OCSC	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					22.85	(0.30) 0.30	TOPSOIL			
0.50	B				22.65	(0.20) 0.50	MADE GROUND: Brown sandy gravelly Clay with occasioal fragments of red brick			
1.00	B			Water strike(1) at 1.60m, rose to 1.30m in 20 mins, sealed at 2.30m.	20.75	(1.90) 2.40	Brown sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.		▼1 ▽1	
2.00	B									
					20.55	(0.20) 2.60	Brown slightly gravelly fine to coarse SAND			
3.00	B									
4.00	B									
5.00	B				18.15	(2.40) 5.00	Black silghtly sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.			
							Complete at 5.00m			

Remarks
Borehole to install standpipe - No SPT's undertaken.
Slotted standpipe installed with gravel response zone and geosock from 5.0m to 1.0m BGL with bentonite seal and flush cover from 1.0m to ground level.
Borehole terminated at scheduled depth

Scale (approx)	Logged By
1:50	C Finnerty

Figure No. 7476-02-18.BH1

Ground Investigations Ireland Ltd
www.gii.ie

Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 200mm cased to 5.00m	**Ground Level (mOD)** 23.70	**Client** Marlet	**Job Number** 7476-02-18
	Location 720449.9 E 737437.3 N	**Dates** 15/02/2018	**Engineer** OCSC	**Sheet** 1/1

Site: St Pauls Raheny

Borehole Number: BH2 2018

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
						(0.30)	TOPSOIL			
					23.40	0.30	Brown sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.			
1.00	B									
						(1.90)				
									▼1 ▽1	
2.00	B			Water strike(1) at 1.90m, rose to 1.70m in 20 mins, sealed at 2.40m.						
					21.50	2.20	Black silghtly sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.			
3.00	B									
						(2.80)				
4.00	B									
5.00	B				18.70	5.00	Complete at 5.00m			

Remarks
Borehole to install standpipe - No SPT's undertaken.
Slotted standpipe installed with gravel response zone and geosock from 5.0m to 1.0m BGL with bentonite seal and flush cover from 1.0m to ground level.
Borehole terminated at scheduled depth

Scale (approx)	Logged By
1:50	C Finnerty

Figure No. 7476-02-18.BH1

Ground Investigations Ireland Ltd www.gii.ie		Site St Pauls Raheny	Borehole Number BH3 2018
Machine : Dando 2000 **Method :** Cable Percussion	**Casing Diameter** 200mm cased to 3.80m	**Ground Level (mOD)** 22.29	**Client** Marlet	**Job Number** 7476-02-18
	Location 720513.7 E 737392.4 N	**Dates** 14/02/2018	**Engineer** OCSC	**Sheet** 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description
					22.19	0.10	TOPSOIL
					22.09	0.20	Brown slightly gravelly fine to coarse SAND
							Brown sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.
1.00	B					(1.90)	
2.00	B			Water strike(1) at 2.00m, rose to 1.60m in 20 mins.	20.19	2.10	Black silghtly sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.
3.00	B					(1.65)	
					18.54	3.75	OBSTRUCTION: Presumed Boulder or Rock
3.80	B				18.49	3.80	
							Complete at 3.80m

Remarks
Borehole to install standpipe - No SPT's undertaken.
Slotted standpipe installed with gravel response zone and geosock from 3.8m to 1.0m BGL with bentonite seal and flush cover from 1.0m to ground level.
Borehole terminated at scheduled depth
Chiselling from 3.75m to 3.80m for 2 hours.

Scale (approx)	Logged By
1:50	C Finnerty

Figure No. 7476-02-18.BH1

Ground Investigations Ireland Ltd www.gii.ie	Site St Pauls Raheny	Borehole Number BH4 2018

Machine : Dando 2000 Method : Cable Percussion	Casing Diameter 200mm cased to 3.80m	Ground Level (mOD) 21.30	Client Marlet	Job Number 7476-02-18
	Location 720571.9 E 737305.4 N	Dates 14/02/2018	Engineer OCSC	Sheet 1/1

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					21.20	0.10	TOPSOIL			
					21.10	0.20	Brown slightly gravelly fine to coarse SAND			
							Brown sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.			
						(1.60)				
1.00	B									
									▼1	
									▽1	
				Water strike(1) at 1.70m, rose to 1.50m in 20 mins.	19.50	1.80	Black silghtly sandy gravelly CLAY with occasional cobbles. Gravel is sub angular to sub rounded fine to coarse.			
2.00	B									
						(1.20)				
3.00	B				18.30	3.00	Complete at 3.00m			

Remarks
Borehole to install standpipe - No SPT's undertaken.
Slotted standpipe installed with gravel response zone and geosock from 3.0m to 1.0m BGL with bentonite seal and flush cover from 1.0m to ground level.
Borehole terminated at scheduled depth

Scale (approx)	Logged By
1:50	C Finnerty

Figure No.
7476-02-18.BH1

APPENDIX 4 – Groundwater Monitoring

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GROUNDWATER MONITORING

St Pauls Raheny

BOREHOLE	DATE	TIME	GROUNDWATER (mBGL)	Comments
BH1 2015	14/02/2018	13.00	0.70	
BH3 2015	14/02/2018	13.00	1.00	
BH09 2015	14/02/2018	13.00	0.20	
BH1 2015	19/02/2018	15.00		Data logger
BH3 2015	19/02/2018	15.00	1.00	
BH09 2015	19/02/2018	15.00		Data logger
BH1 2018	19/02/2018	15.00		Data logger
BH2 2018	19/02/2018	15.00		Unable to open
BH3 2018	19/02/2018	15.00	0.55	
BH4 2018	19/02/2018	15.00	0.55	