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edgeconnex

Ballymakaily to the West of the Newcastle Rd (R120), Lucan, Co. Dublin

Engineering Planning Report

December 2020

P201107

'RUCTURAL · CIVIL · DUE DILIGENCE · ENGINEERING MASTERPLANNING
FLOOD MANAGEMENT · INFRASTRUCTURE DESIGN
PRE-DEVELOPMENT ENGINEERING · BIM · TRANSPORTATION

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APPROVALS

	Name	Signature	Position	Date
Prepared by	S. O'Reilly		Associate	02/12/2020
Reviewed by	J. Mayer		Director	03/12/2020
Approved by	J. Mayer		Director	07/12/2020

REVISIONS

Revision By	Date	Context

VERSIONS

Number	By	Date	Context
1	S. O'Reilly	15/12/2020	Draft Planning Submission
2	S. O'Reilly	17/02/2021	Planning Submission

SOURCES OF DATA

Henry J Lyons Architects Ltd.	Land Survey Services Ltd.
Google	Marston Planning Consultancy

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REPORT CONTENTS

Executive Summary

This report was prepared for South Dublin County Council in connection with the planning application for a data centre development and addresses the existing and proposed civil infrastructure, for the proposed development, located on the Ballymakaily Lands to the West of the Newcastle Road (R120), Lucan, Co. Dublin.

EdgeConneX Ireland Limited are applying for permission for development at this site of 22.1hectares that is located within the townland of Ballymakaily to the west of the Newcastle Road (R120), Lucan, Co. Dublin.

The development will consist of the construction of two no. single storey data centres with associated office and service areas; and three no. gas powered generation plant buildings with an overall gross floor area of 24,624sqm that will comprise of the following:

- Demolition of abandoned single storey dwelling, remaining agricultural shed and derelict former farm building;
- Construction of 2 no. single storey data centres (12,797sqm), both with associated plant at roof level; with 24 no. standby diesel generators with associated flues (each 25m high) that will be attached to a single storey goods receiving area / store and single storey office area (2,404sqm) located to the west of the data centres as well as associated water tower and sprinkler tank and other services;
- amendments to the internal access road and omission of access to loading bay permitted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948 that include the relocation of permitted, and new, internal security gates; and new internal access roads to serve the proposed development that will provide access to 39 no. new car parking spaces (including 4 no. electric and 2 no. disabled spaces) and sheltered bicycle parking to serve the new data centres;
- The development will also include the phased development of 3 no. two storey gas powered generation plants (9,286sqm) within three individual buildings and ancillary development to provide power to facilitate the development of the overall site to be located within the south-west part of the overall site. Gas Plant 1 (3,045sqm) will contain 20 no. generator units (18+2) with associated flues (each 25m high) will facilitate, once operational the decommissioning of the temporary Gas Powered Generation Plant within its open compound as granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948. Gas Plant 2 (3,045sqm) will contain 20 no. generator units (18+2) with associated flues (each 25m high); and Gas Plant 3 (3,196sqm) will contain 21 no. generator units (19+2) with associated flues (each 25m high). These Plants will be built to provide power to each data centre, if and, when required. The Gas Plants will be required as back-up power generation once the permanent power connection via the permitted substation is achieved;
- New attenuation pond to the north of the site;
- Green walls are proposed to the southern elevation of each Power plant, as well as to the northern elevation of the generator compound of the data centres, and enclosing the water tower/pump room compound; and a new hedgerow is proposed linking the east and west of the site; and

- Proposed Above Ground Gas Installation compound to contain single storey kiosk (93sqm) and boiler room (44sqm).

The development will also include ancillary site works, connections to existing infrastructural services as well as fencing and signage. The development will include minor modifications to the permitted landscaping to the west of the site as granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948. The site will remain enclosed by landscaping to all boundaries. The development will be accessed off the R120 via the permitted access granted under SDCC Planning Ref. SD19A/0042 / ABP Ref. PL06S.305948.

An EPA-Industrial Emissions (IE) licence will be applied for to facilitate the operation of the Gas Powered Generation Plant. An Environmental Impact Assessment Report (EIAR) has been submitted with this application.

The report should be read in conjunction with our engineering planning drawings, and deals with existing foul, surface water and water mains present within the surrounding area, and the proposals for the site with regards to these services.

The report also discusses the ground conditions present on the site, the current proposals for achieving the development plateau and sustainability measures incorporated with the development.

The following engineering drawings have been prepared for the proposed development:-

PIN-ZZ-ZZ-DR-DR-0200-P01	Drainage Layout – Gas Plant Area
PIN-ZZ-ZZ-DR-DR-0201-P01	Drainage Layout – Data Centre Area
PIN-ZZ-ZZ-DR-DR-0202-P01	Drainage Layout – Attenuation Pond & Outfall Plan
PIN-ZZ-ZZ-DR-DR-0203-P02	Watermain Layout – Gas Plant Area
PIN-05-ZZ-DR-C-0204-P01	Watermain Layout – Data Hall Area
PIN-ZZ-ZZ-DR-DR-0205-P01	Standard Wastewater Infrastructure Details
PIN-ZZ-ZZ-DR-DR-0206-P01	Standard Water Infrastructure Details
PIN-05-ZZ-DR-C-0211-1 & 2 P01	External Works

1 Introduction

The applicant proposes to construct two single storey data centres and associated office areas, which will be accessed off the R120 (Newcastle Road) to the east.. The purpose of this report is to address the civil infrastructural aspects of the proposed data centre development, located on the Ballymakaily Lands to the West of the Newcastle Road (R120), Lucan, Co. Dublin.

The total subject site area extends to circa 54.59 acres (22.1 ha) and is currently a greenfield site. The new proposed data halls will result in a portion of the western area of the site being developed, comprising an area of circa 29.02 acres (11.75 ha), with associated landscaping elements.

There are no known public sewer drainage pipes or watermains, presently located on the subject site.

This report has been prepared to outline the existing and proposed drainage, pollution control measures and water main infrastructure, in order to support the proposed development application.

The location of the site is indicated on the map extract below - Figure 1.

FIGURE 1 - Site Location (Source Google Maps)

2 Existing Drainage & Watermain Services

2.1 Existing Foul Drainage Networks

South Dublin County Council record drawings have identified 2 No. 450mm Ø spur connections, located along the eastern boundary of the property, within the newly constructed R120 (Newcastle Road) upgrade, adjacent to the subject site. These spur connections were left out to facilitate development of these lands and for the lands further west, known as Grange Castle West. This 450mm Ø sewer then connects into the existing Grange Castle Business Park pumping station, as laid under Reg. Ref. SD16A/0214. The effluent from this pumping station is then pumped via 3 No. rising mains, i.e. 100mm Ø, 200mm Ø & 450mm Ø, into the local infrastructural network.

The existing foul sewer reticulation network has adequate capacity to cater for the proposed effluent discharge from the subject site and there are no known issues noted with the sewer reticulation network.

2.2 Existing Surface Water Drainage Networks

South Dublin County Council record drawings have identified a 900mm Ø road crossing, which was installed as part of the newly constructed R120 (Newcastle Road) upgrade, adjacent to the subject site. This pipe is then connected into a 900mm Ø pipe located along a section of road on the opposite side to the subject site. This gravity sewer then runs in a northerly direction, prior to connecting into a ditch/stream network, which discharges through 3 No. aquaducts / culverts of varying sizes and which are located beneath the Grand Canal to the east. This outfall is then drained via a tributary into the Griffeen River.

The aforementioned sewer / culvert, has been identified as having capacity to accommodate the proposed discharge from the subject site.

2.3 Existing Water Main Network

South Dublin County Council record drawings have identified an existing 16" (400mm) Ø main located along the eastern boundary of the property, within the newly constructed R120 (Newcastle Road) upgrade, adjacent to the subject site. 2No. 300mm Ø capped connections with sluice valves, have been left off the aforementioned trunk water main, in order to facilitate development of these lands and for the lands further west, known as Grange Castle West.

The aforementioned existing watermain is ultimately fed off the existing infrastructure to the north of the 12th Lock Bridge.

From discussions with the South Dublin County Council, it is understood that there is adequate capacity within the existing watermain network to supply the proposed development.

3 Proposed Site Drainage & Water Supply

3.1 Proposed Foul Water Drainage

It is proposed to discharge foul water from the proposed development, via a 225mm Ø gravity foul sewer outfall and discharge into the existing 450mm Ø connection, as granted under Planning Reg. Ref. SD19A/0042.

It is proposed that all foul condensate effluent from the proposed new data halls, will be connected into head manholes adjacent to the data halls. The office building contains 6 No. WC's, with a predicted maximum number of daily staff being in the region of circa 40 people, over a 24hr period. Based on Irish Water's Code of Practice of 200ltr/hd/day, the peak wastewater flow will not be in excess of circa 0.54l/s.

The proposed network connects into the EX FOUL MH, with an invert level of 63.15m, prior to the ultimate outfall discharging into the Grange Castle Pumping Station, which has already been approved under the aforementioned planning grant - refer Drawing No. PIN-ZZ-ZZ-DR-DR-0201-P01.

All on-site foul sewers have been designed to be a minimum 225mm Ø diameter pipes, with gradients designed to achieve self-cleansing velocities.

3.2 Proposed Surface Water Drainage

Storm water from the proposed development has been designed in accordance with the GDSDS and ensures that Best Management Practice has been incorporated into the design.

It should be noted that the subject site currently comprises a greenfield site and the proposed surface water measures are aimed at improving the general surface water management of the site, by introducing interceptors, attenuation measures and by restricting the ultimate discharge, etc.

Storm water from the roof areas of the proposed building units, will be directed via rain water pipes into an on-site reticulation system. The outflow from this system will be connected into the surface water drainage network collecting run-off from the road areas and will be ultimately discharged into a stormwater storage pond / wetland area, located in a landscaped area to the northern end of the site adjacent to the canal - refer Drawing No.'s PIN-ZZ-ZZ-DR-DR-0201-P01 & PIN-ZZ-ZZ-DR-DR-0202-P01.

Based on the hardstanding area for this current application, i.e. circa 117,500m^2 (11.75Ha), the attenuation volume required has been calculated as being circa 2,640m^3, which will be provided for as mentioned above, in a storage pond. Refer Appendix B for Surface Water Calculations.

Storm water from all car park areas and access roads / delivery areas will be drained as follows:-

- A series of on-site gullies and channels draining into a separate system of below ground gravity storm water sewers
- Permeable paving

Prior to discharging into the proposed pond / wetland area, the storm water from the car park and access roads, which is drained via the methods as described above, will be directed through an appropriately sized Conder Separator (or similar approved) petrol interceptor - refer Appendix A for Interceptor Details.

Site investigations have been carried out and the results have shown that the existing sub-soil would provide inadequate soil infiltration rates and thus it is not practical to install a soakaway system.

The storm water drainage within the entire development has been designed to accommodate a 1:2 year storm frequency. The pond and permeable paving, have been designed to accommodate a 1:100 year storm event + 20% climate change.

The outflow from the proposed development, will be restricted by way of a Hydrobrake facility, which will limit the discharge to 24l/s, which is the calculated QBAR greenfield run-off rate - refer Appendix B for Surface Water Calculations.

The surface water discharge for this application will incorporate the road areas, parking, service yard area and the roof water from the proposed data halls, which then ultimately feeds into the existing network as previously mentioned. Refer Appendix C, Dwg. No. PIN-05-ZZ-DR-C-0211-1 & 2 P01, for a drawing indicating the various surface areas of this application; all areas are hardstanding of various types, with the respective coefficients detailed below:-

- Access Road – Tarmac (9,920m^2) / c = 0.80
- Gravel Area (9,323m^2) / c = 0.50
- Data Hall Roof Area (22,625m^2) / c = 1.00
- Yard Slab Area – Concrete (6,753m^2) / c = 0.80
- Open Space / Landscaping (67,960m^2) / c = 0.05
- Permeable Paving (Car Park Area - 900m^2) / c = 0.50

3.3 Proposed Water Mains

It is intended to serve the proposed development via connection off the previously granted 150mm Ø network, as granted under Planning Reg. Ref. SD19A/0042, which has fed off the existing 400mm Ø trunk main located along the R120 (Newcastle Road). Refer Drawing No. PIN-05-ZZ-DR-C-0204-P01.

Hydrants will be installed in accordance with the Requirements of the Building Regulations and in accordance with the recommendations contained in the Technical Guidance Documents, Section B – Fire Safety, dated 2006, and these are detailed on our engineering drawings.

Water demand for the development has been based on Irish Water's criteria, i.e. 150 litres/hd/day = 6,000 litres/hd/day (based on 40 PE) = 0.069 litres/second.

Avg. Demand = 0.069 l/s x 1.25 = 0.086 litres/second

Peak Demand = 0.086 l/s x 5 = 0.43 litres/second

Water meters, sluice valves and hydrants, in line with Irish Water requirements and specifications, will be installed at the connections onto the aforementioned existing water mains, as required. A Pre-Connection Enquiry application has been submitted to Irish Water (CDS21000754) in respect of the water supply and we are still awaiting a response to same.

3.4 Standard Drainage Details

All standard drainage details including manhole details, pipe bedding, channels, hydrants etc. are shown on Drawing No.'s PIN-ZZ-ZZ-DR-DR-0205-P01 and PIN-ZZ-ZZ-DR-DR-0206-P01. Details of the types and construction methods will be agreed with the local authority prior to construction.

Drains generally will consist of PVC (to IS 123) or concrete spigot and socket pipes to (IS 6).

Drains shall be laid to comply with the Requirements of the Building Regulations 1997 and in accordance with the recommendations contained in the Technical Guidance Documents, Section H.

Strict separation of surface water and foul sewerage will be imposed on the development. Drains will be laid out to minimise the risk of inadvertent connections of sinks, dishwashers etc. to the surface water system.

In order to minimise the risk of floating contamination of the surface water system, road gullies will be precast trapped gullies to BS5911:Part2:1982.

Concrete bed and surround to the pipe runs will be used where the cover to the pipes is less than 900mm, where the pipes are sufficiently close to the building, or where the pipe runs are below the ground floor slab.

All works are to be carried out in accordance with Irish Water's Code of Practice for Water Infrastructure, dated December 2016 : Document IW-CDS-5020-03 and any subsequent revisions thereof.

4 Surface & Groundwater Impacts

4.1 Construction Phase

Water pollution will be minimised by the implementation of good construction practices. Such practices will include adequate bunding for oil containers, wheel washers and dust suppression on site roads, and regular plant maintenance. The Construction Industry Research and Information Association provides guidance on the control and management of water pollution from construction sites in their publication Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors – C532 CIRIA Report (Masters-Williams *et al*, 2001), which provides information on these issues.

Pollutants can commonly include suspended solids, oil, chemicals, cement, cleaning materials and paints. These can enter controlled waters in various ways:

- directly into a watercourse
- via drains or public sewers
- via otherwise dry ditches
- in old field drains
- by seepage into groundwater systems
- through excavations into underlying aquifers
- by disturbance of an already contaminated site

The proximity of the site to streams, aquifers and water abstractions; potential sources, pathways and impacts of pollution; and the historical uses of the site and nearby areas should be examined early in project planning and design, to ensure that suitable redesign and mitigation measures are undertaken as necessary.

During construction, careful management and planning will help minimise water pollution. This may include adequate bunding of all oil tanks, wheel washers and dust suppression on haul roads, particular care to be taken near watercourses, and regular plant maintenance.

A contingency plan for pollution emergencies should also be developed and regularly updated, which would identify the actions to be taken in the event of a pollution incident.

The CIRIA document (2001), recommends that a contingency plan for pollution emergencies should address the following:

- containment measures
- emergency discharge routes
- list of appropriate equipment and clean-up materials
- maintenance schedule for equipment
- details of trained staff, location, and provision for 24-hour cover
- details of staff responsibilities
- notification procedures to inform the relevant environmental protection authority

- audit and review schedule
- telephone numbers of statutory water undertakers and local water company
- list of specialist pollution clean-up companies and their telephone numbers

4.2 Operational Phase

The sources of pollution that could potentially have an effect on surface or groundwater during the operational phase of the development will be oil and fuel leaks from parked cars, service vehicles, HGV delivery's etc. Hydrocarbon interceptors will be provided on storm water drainage sewers from car parking areas as required.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously.

It is not anticipated that flooding of the site will occur, due to the fact that there is no historical data, which refers to any past flooding on this site.

4.3 Mitigation Measures

The construction management of the building project will incorporate protection measures to minimise as far as possible the risk of spillage that could lead to surface and groundwater contamination.

All appropriate methods will be utilised to ensure that surface water arising during the course of construction activities will contain minimum sediment, prior to the ultimate discharge to the proposed attenuation pond and existing 900mm Ø surface water pipe network.

Storm water attenuation measures will be incorporated into the scheme as mentioned previously. Hydrocarbon interceptors will be provided on storm water drainage sewers from service yard areas as necessary. Grease traps will be installed on foul sewers where necessary.

Best practice in design and construction will be employed for the installation of surface water and sanitary drainage.

5 Sustainability

5.1 Site Development

In order to minimize material export and import to the site and the impact of this on the surrounding road network, we are proposing to maintain existing on-site levels as far as is practical. Where this is not feasible, a terrain model has been produced, which will indicate the volumes of cut/fill material, based on the proposed levels and a levels balance will be struck across the site, thereby mitigating any import/export of material for site development.

5.2 Site Drainage

Storm water drainage proposals for the site have been designed in accordance with the GDSDS and incorporate on site storm water attenuation in order to limit discharge of storm water from the developed site to the equivalent Q-bar run-off rates.

The attenuation system proposed is in keeping with other developments within Grange Castle Business Park. The pond / wetland area not only provides flood storage, but also provides ecological benefits as well.

6 Conclusion

In conclusion, the proposed development of the site by the applicant, for use as a Data Centre development, is considered a suitable use of the site. Local infrastructure has the capacity to serve the proposed development.

The site will be developed in a sustainable manner, in order to minimise the impact of the development during construction and throughout the lifespan of the proposed development.

Accordingly, there are no reasons in relation to the drainage elements as to why this scheme should not be granted planning permission, and with this in mind, the Planning Authority is respectfully requested to recommend a grant of planning permission.

Appendix A

Conder Petrol Interceptor Details

Conder® OIL/WATER SEPARATORS

40 years OF PASSION

CONDER
AQUA SOLUTIONS
A PREMIER TECH AND EPS JOINT COMPANY

THE PARTNER OF CHOICE

The Conder Range of Oil Separators are for installation on surface water drainage systems and are designed to prevent hydrocarbons (e.g. diesel, petrol, engine oil) from mixing with surface water and entering our drainage systems.

Pollution prevention is a critical part of sustainable drainage systems and statutory regulations are in force to control the discharge of hydrocarbons, with severe penalties imposed for non-compliance.

Compliance

The Conder Range of Oil Separators fully conform to both the Environment Agency's latest PPG guidelines and European standard BSEN-858-1-2 and are proven to effectively separate oil and water. Under test, the Conder Bypass performed to less than 1 mg/l and in doing so guarantees minimal environmental impact and ensures public safety.

Classes of Separator

There are two classes of separator which are defined by performance.

Class 1

Class 1 Separators are designed to achieve a concentration of less than 5mg/l of oil under standard test conditions. These conditions are required for discharges to surface water drains and the water environment.

Class 2*

Class 2 Separators are designed to achieve a concentration of less than 100mg/l oil under standard test conditions and are suitable for dealing with discharges where a lower quality requirement applies such as discharges to the foul sewer.

*Class 2 available in forecourt separators only.

Selecting the Right Separator

Conder offers a full range of Separators for varying use and application:

- Bypass Separator
- Full Retention Separator
- Forecourt Separator
- Wash Down and Silt Separators

If you're unsure of what type of Conder Oil Separator you require please use the below chart to help you identify the most suitable product for your project.

The guidance given is for the use of separators in surface water drainage systems that discharge to rivers and soakways.

Is there a risk of oil contaminating the drainage from the site?

YES	YES	YES	YES	NO
Risk of infrequent light contamination and potential for small spills only e.g. car park.	Risk of regular contamination of surface water run off with oil and/ or risk of larger spills e.g. vehicle maintenance area, goods vehicle parking or vehicle manoeuvring.	Risk of regular Drainage will also contain dissolved oils, detergents or degreasers such as vehicle wash water and trade effluents e.g. industrial sites.	Fuel oils are delivered to and dispensed on site e.g. retail fuel forecourts.	Very low risk of oil contamination e.g. roofwater.
YES				YES
Source control SUDS must be considered and incorporated where suitable.				Separator not required.
IF NOT SUITABLE	YES	YES	YES	
By-pass separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Full retention separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Trade effluents must be directed to the foul sewer. It may need to pass through a separator before discharge to sewer to remove.	Full retention 'forecourt' separator with alarm required. Class 1 if discharge to surface water. Class 2 if discharge to foul sewer.	Clean water should not be passed through the separator unless the size of the unit increased accordingly.

The use of SUDS should be considered at all sites and they should be incorporated where suitable. SUDS can be used to polish the effluent from these separators before it enters the environment.

Source control SUDS should be considered where possible.

Separator Alarms

All oil separators are required by legislation to be fitted with an oil level alarm system with recommendations that the alarm is installed, tested, commissioned and regularly serviced by a qualified technician.

The alarm indicates when the separator is in need of immediate maintenance in order for it to continue to work effectively. Conder Aqua Solutions can offer a full technical and service package for a variety of alarm options.

The Conder Range of Bypass Separators

The Conder Range of Bypass Separators are used to fully treat all flows generated by rainfall rates of up to 6.5mm/hr. Bypass Separators are used when it is considered an acceptable risk not to provide full treatment for high flows. for example where only small spillages occur and the risk of spillage is small.

Typical Application

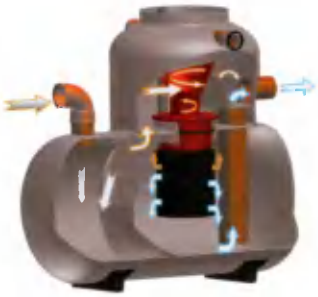
- Car parks
- Roadways and major trunk roads
- Light industrial and goods yards

Features and Benefits

- Innovative design
- Compact and easy to handle/install
- Fully compliant to the Environment Agency's PPG3 guidelines
- Low product and install costs
- Full BSI certification
- Exceeds industry standards
- Easy to service
- Fully tested and verified with a range from CNSB 3 to CNSB 1000 (Class 1)

Performance

Conder Bypass Separators have been designed to treat all flow up to the designed nominal size. Any flow in excess of the nominal size is allowed to bypass the separation chamber thereby keeping the separated and trapped oil safe.



How it Works

Step 1

During the early part of a rain storm, which is a time of high oil contamination, all of the contaminated water flow passes through the sediment collection chamber and enters the separation chamber through a patented oil skimming and filter device.

Step 2

All of the oil then proceeds to the separation chamber where it is separated to the Class 1 standard of 5 mg/l and safely trapped.

Step 3

As the rainstorm builds up to its maximum and the level of oil contamination reduces significantly the nominal size flow continues to pass through the separation chamber and any excess flow of virtually clean water is allowed to bypass directly to the outlet.

Specification Larger models up to CNSB 1000 are available.

Area Drained (m^2)	Tank Code including Silt	Length including Silt (mm)	Silt Capacity (L)	Oil Storage Capacity (L)	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)	Access (mm)
1667	CNSB3s/21	1400	300	45	1026	2200	1730	1680	750
2500	CNSB4.5s/21	1785	450	67.5	1026	1875	1270	1220	600
3333	CNSB6s/21	1975	600	90	1026	1875	1270	1220	600
4444	CNSB8s/21	2165	800	120	1026	1875	1270	1220	600
5555	CNSB10s/21	2485	1000	150	1026	1875	1270	1220	600
8333	CNSB15s/21	2670	1500	225	1210	2150	1450	1400	600
11111	CNSB20s/21	3115	2000	300	1210	2150	1450	1400	600
13889	CNSB25s/21	3555	2500	375	1210	2150	1450	1400	600
16667	CNSB30s/21	3470	3000	450	1510	2690	1770	1720	750
22222	CNSB40s/21	4040	4000	600	1510	2690	1770	1720	750
27778	CNSB50s/21	4655	5000	750	1510	2690	1770	1720	750
33333	CNSB60s/21	4415	6000	900	1880	3300	2025	1975	2 x 600
44444	CNSB80s/21	5225	8000	1200	1880	3300	2025	1975	2 x 600
55556	CNSB100s/21	6010	10,000	1500	1880	3300	2025	1975	2 x 600

Note: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

The Conder Range of Full Retention Separators

The Conder Range of Full Retention Separators are designed to treat the full flow that can be delivered by a drainage system, which is normally equivalent to the flow generated by a rainfall intensity of 65mm/hr. Full Retention Separators are used where there is a risk of regular contamination with oil and a foreseeable risk of significant spillages.

Typical Application

- Sites with hi-risk of oil contamination
- Fuel storage depots
- Refuelling facilities
- Petrol forecourts
- Vehicle maintenance areas/workshops
- Where discharge is to a sensitive environment

Features and Benefits

- All surface water is treated
- Automatic closure device (ACD) fitted as standard

Performance

All Conder Full Retention Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification Larger models available upon request.

Area Drained (m^2)	Tank code Incl. Silt	Length including Silt (mm)	Slit Capacity (L)	Oil Storage Capacity	Diameter (mm)	Height (mm)	Base to inlet Invert (mm)	Base to outlet Invert (mm)
222	CNS4s/11	2319	400	40	1026	1655	1295	1245
333	CNS6s/11	3414	600	60	1026	1655	1295	1245
444	CNS8s/11	3197	800	80	1210	1855	1480	1430
556	CNS10s/11	3957	1000	100	1210	1855	1480	1430
833	CNS15s/11	3870	1500	150	1510	2180	1780	1730
1111	CNS20s/11	5060	2000	200	1510	2180	1780	1730
1667	CNS30s/11	5369	3000	300	1880	2560	2030	1980
2222	CNS40s/11	7059	4000	400	1880	2560	2030	1980
2778	CNS50s/11	4080	5000	500	2600	3315	2730	2680
3333	CNS60s/11	4805	6000	600	2600	3315	2730	2680
3889	CNS70s/11	5529	7000	700	2600	3315	2730	2680
4444	CNS80s/11	6254	8000	800	2600	3315	2730	2680
5556	CNS100s/11	6751	10,000	1,000	2600	3315	2730	2680

e: It is a requirement of PPG3 that you have a silt capacity either in your tank or in an upstream catch pit.

Conder Range of Forecourt Separators

Conder Forecourt Separators have been designed for specific use in petrol filling stations and other similar applications. The size of this separator has been specifically increased in order to retain the possible loss of the contents from one compartment of a road tanker, which could be up to 7,600 litres.

Forecourt separators are an essential infrastructure requirement for all forecourts so as to ensure compliance with both health and safety and environmental legislation.

Application Areas

- Petrol forecourts
- Refuelling facilities
- Fuel storage depot

Features and Benefits

- All surface water is treated
- Available in Class 1 and Class 2
- Automatic Closure Device (ACD) fitted as standard
- Includes 2000L silt capacity

Performance

All Conder Forecourt Separators have an automatic closure device (ACD) fitted as standard. This is compulsory for all PPG3 compliant Full Retention Separators and prevents accumulated pollutants flowing through the unit when maximum storage level is reached.

How it Works

Step 1

Contaminated water enters the separator where the liquid is retained for a sufficient period to ensure that the lighter than water pollutants (such as oil, petrol) separate and rise to the surface of the water.

Step 2

The decontaminated water then passes through the coalescing filter before it is safely discharged from the separator, with the remaining pollutants being retained in the separator.

Step 3

Retained pollutants must be emptied from the separator once the level of oil is reached, or the oil level alarm is activated. This waste should be removed from the separator under the terms of The Waste Management Code of Practice.

Specification

Tank Code	Volume (L)	Length (mm)	Diameter (mm)	Height (mm)	Base to inlet (mm)	Base to outlet (mm)	Access (mm)
ANO/11*	10000	4250	1800	2100	1600	1550	750
ANT/12**	10000	4250	1800	2100	1600	1550	750
LNO/11***	10000	4250	1800	2100	1600	1550	750

*Class 1 Forecourt Separator suitable for discharging to surface water drains

**Class 2 Forecourt Separator suitable for discharging to foul drains only

*** Class 1 Forecourt Separator suitable for installation in granular materials

Conder Range of Washdown and Silt Separators

Conder Washdown and Silt Separators are for use in areas such as car washes, pressure wash facilities or other cleaning facilities and must be discharged to the foul water drainage system in accordance with PPG13.

Application Areas

- Car wash facilities
- Tool hire depots
- Pressure washer facilities

Features and Benefits

- Available in 1,2 and 3 stage options
- Efficient silt and hydrocarbon removal

Performance

The Environment Agency's PPG13 requires that discharge from pressure washers must discharge to a foul drainage system. Where there is no foul drainage available, the effluent must be contained within a sealed drainage system or catchpit for disposal by a licenced waste contractor.

Silt build-up is the primary concern with washdown facilities and so the Conder range of washdown and silt separators are used to remove the silt and will allow some separation of hydrocarbons.

Detergents that are used in wash down areas will break down and disperse hydrocarbons (hindering the separation process). Therefore it is important to remember the main function of wash down separators is to remove silt.

How it Works

Step 1

Contaminated wash down water enters the unit where the heavier solids, silts, settle to the bottom of the tank.

Step 2

The lighter liquids, hydrocarbons, will rise to the surface and be retained within the tank.

Step 3

Treated water will exit the separator via the dipped outlet.

Specification

Although it is recognised that single stage separators give the most efficient separation, 2 and 3 chamber Conder Washdown and Silt Separators are available on request.

Tank Code	Capacity (L)	Silt Storage	Diameter (mm)	Length (mm)	Access Diameter (mm)	Base to Inlet Invert (mm)	Base to Outlet Invert (mm)
CWS2/12	2000	1000	1000	2713	600	1290	1240
CWS3/12	3000	1500	1200	2853	600	1475	1425
CWS4/12	4000	2000	1200	3737	600	1475	1425
CWS6/12	6000	3000	1500	3636	600	1775	1725
CWS8/12	8000	4000	1800	3443	600	2030	1980
CWS10/12	10000	5000	1800	4250	600	2030	1980

FST Silt Trap

Large quantities of silt can be associated with washdown areas. The Conder FST silt trap is ideal for easy removal of silt either manually or by a waste disposal contractor.

The FST range of silt traps are available with varying grades of covers from B125 up to E600 to allow installation in all types of vehicle or plant washdown facilities.

Conder Range of Alarm Systems

All separators must be fitted with an alarm in order to provide visual and audible warning when the level of oil reaches 90% of its storage volume, as required by The Environment Agency's PPG3.

The alarm system will then be triggered to indicate that the separator is in need of immediate emptying, in order to continue effective operation.

Features and Benefits

- Option for installation at a remote supervisory point
- Audible and visual
- Eliminates unnecessary waste management visits
- Easy installation
- Audible, visual and text message alert alarm systems available

Mains Powered System

Mains powered alarm systems are best suited to new build situations or sites where installation of the necessary cabling and ducting is straight forward and economical. The probe located in the separator will, when surrounded by floating hydrocarbons, activate an alarm condition on the remote panel to advise that the unit requires emptying.

Solar Powered System (Flashing Beacon)

This option requires no mains power supply or any significant cabling and ducting, making it extremely economical for large sites and retro fitting alarms to existing oil separators. A High Intensity Beacon will flash when a problem is detected.

Solar GSM Alarm

The Solar GSM alarm sends a status report on your separator to a mobile phone number of your choice. The status of the GSM alarm can also be tested at any time by simply sending a pre-recorded text message, via your directed mobile phone, for added peace of mind.

Peripherals

Coalescing Filters

The Conder Coalescing Filter is designed to separate residual oil in already separated oil/water and ensures a discharge quality of less than 5mg/litre of oil in water.

Features and Benefits

- Handle for easy removal and cleaning
- Flashing beacons (with option of siren kit)
- Kiosks
- Probe brackets
- Bas 1000 intrinsically safe junction box
- High level probe
- Silt level probe
- Oil level probe

Servicing

The Environmental Agency's PPG3 guidelines stipulate that every 6 months, and in accordance with manufacturer's instructions, experienced personnel should carry out maintenance to both the separator and alarm.

Conder and our service partners can offer a full technical and service package including separator and alarm installation, commissioning, oil and silt removal and routine service contracts.

CONDER AQUA SOLUTIONS
A PREMIER TECH AND EPS JOINT COMPANY

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Appendix B

Surface Water Calculations

Qbar Calculation
Using IOH Report 124 for Sites < 25 km²

Catchment Name
Ballymakaily Lands Catchment

$^{1}Q_{bar} = 0.00108 * (AREA)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$

Estimation of QBAR from IOH Report 124 for catchments less than 25 km² using the 3 variable equation

AREA = 11.75 Ha — Overall Catchment Area (Hectares) For catchments < 50 hectares in area, flow rates are linearly interpolated for smaller areas

AREA = 0.117 km² — Area of the Catchment (km²)

SAAR = 771 mm — Standard Annual Average Rainfall (mm)

SOIL = 0.30

Soil Type Expressed as a Percentage	Soil 1	Soil 2	Soil 3	Soil 4	Soil 5
	0	100	0	0	0
SOIL Value	0.15	0.30	0.40	0.45	0.50

$M5_{60}$ = 16.6 mm

$M5_{2day}$ = 61 mm

Ratio $M5_{60}/M5_{2d}$ = 0.272

Soil index value (SPR) calculated from Flood Studies Report Vol V Fig I 4 18(1) - The Classification of Soils from Winter Rainfall Acceptance Rate

Flood Return Event	[5]Growth Factor	Permitted Flow (l/s)
1	0.85	20.4
QBAR	1	24.0
10	1.67	40.0
30	2.1	50.3
50	2.33	55.9
100	2.6	62.3
200	2.85	68.3
1000	3.5	83.9

[6]QBar from Site with Factorial Error Allowance

r^2 =	0.847
n =	71
fse =	1.651

Q'_{bar} = 39.58 l/s

(With Allowance for the standard factorial error)

Pro-rata based on 50 Ha Site area to calculate Qbar

Q_{bar} = 0.00004 cumecs/Ha

Q_{bar} = 2.0 l/s/Ha

$Q_{bar[rural]}$ = 24.0 l/s

Block A - Catchment Characteristics

Ballymakaily Lands Catchment	Area (m²)	Runoff Coeff.	Effective Area (m²)
Roofs - Type 1 (Draining to gullies)	22,625	1.00	22625.0
Roofs - Type 2 (Draining to SUDS features)	-	0.70	0.0
Roofs - Type 3 (Draining to Back Gardens)	-	0.00	0.0
Green Roofs	-	0.70	0.0
Yard Slabs - Type 1 (Draining to gullies)	6,753	0.80	5402.4
Roads and Footpaths - Type 1 (Draining to gullies)	9,920	0.80	7936.0
Roads and Footpaths - Type 2 (Draining to Suds features)	-	0.70	0.0
Porous Asphalt/Permeable Paving	900	0.50	450.0
Gravel Access/Parking Areas	9,323	0.50	4661.5
Verges	-	0.15	0.0
Parks	-	0.15	0.0
Public Open Space	67,960	0.05	3398.0

Impermeable Contributing Area: 4.447 Hectares

Effective Catchment Runoff Coefficient: 0.38

Irish Grid: Easting: 302701, Northing: 231893,

	Interval		Years												
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.3,	3.4,	4.0,	5.0,	5.6,	6.1,	7.8,	9.7,	11.1,	12.9,	14.6,	15.9,	18.0,	19.6,	21.0,	N/A ,
10 mins	3.3,	4.8,	5.6,	6.9,	7.8,	8.5,	10.9,	13.6,	15.4,	18.0,	20.4,	22.2,	25.1,	27.3,	29.2,	N/A ,
15 mins	3.8,	5.6,	6.6,	8.2,	9.2,	10.0,	12.8,	16.0,	18.1,	21.2,	24.0,	26.1,	29.5,	32.2,	34.4,	N/A ,
30 mins	5.0,	7.3,	8.6,	10.5,	11.9,	12.9,	16.3,	20.3,	23.0,	26.7,	30.2,	32.8,	37.0,	40.2,	42.9,	N/A ,
1 hours	6.6,	9.6,	11.2,	13.6,	15.3,	16.6,	20.9,	25.8,	29.1,	33.8,	38.0,	41.2,	46.3,	50.3,	53.6,	N/A ,
2 hours	8.7,	12.4,	14.5,	17.5,	19.6,	21.3,	26.6,	32.8,	36.8,	42.6,	47.8,	51.8,	58.0,	62.9,	66.9,	N/A ,
3 hours	10.2,	14.5,	16.9,	20.4,	22.8,	24.6,	30.7,	37.7,	42.3,	48.8,	54.7,	59.2,	66.2,	71.6,	76.2,	N/A ,
4 hours	11.4,	16.2,	18.8,	22.6,	25.3,	27.3,	34.0,	41.6,	46.7,	53.8,	60.1,	65.1,	72.7,	78.6,	83.5,	N/A ,
6 hours	13.4,	18.9,	21.9,	26.3,	29.3,	31.6,	39.3,	47.9,	53.6,	61.6,	68.8,	74.3,	82.9,	89.5,	95.1,	N/A ,
9 hours	15.7,	22.1,	25.5,	30.5,	34.0,	36.6,	45.3,	55.1,	61.6,	70.6,	78.7,	85.0,	94.6,	102.0,	108.2,	N/A ,
12 hours	17.6,	24.6,	28.4,	33.9,	37.7,	40.6,	50.1,	60.9,	67.9,	77.8,	86.6,	93.4,	103.8,	111.9,	118.6,	N/A ,
18 hours	20.7,	28.7,	33.0,	39.4,	43.7,	47.0,	57.8,	70.0,	78.0,	89.2,	99.1,	106.7,	118.5,	127.6,	135.1,	N/A ,
24 hours	23.1,	32.0,	36.8,	43.8,	48.5,	52.2,	64.0,	77.3,	86.0,	98.2,	109.0,	117.3,	130.1,	139.9,	148.1,	176.5,
2 days	29.1,	39.1,	44.3,	52.0,	57.1,	61.0,	73.5,	87.4,	96.3,	108.7,	119.5,	127.8,	140.4,	150.1,	158.1,	185.6,
3 days	33.8,	44.8,	50.4,	58.6,	64.0,	68.2,	81.3,	95.7,	104.9,	117.6,	128.6,	137.1,	149.8,	159.5,	167.5,	194.9,
4 days	38.0,	49.8,	55.7,	64.4,	70.1,	74.4,	88.1,	103.0,	112.5,	125.5,	136.7,	145.3,	158.2,	168.0,	176.1,	203.5,
6 days	45.4,	58.4,	65.0,	74.4,	80.6,	85.3,	99.9,	115.6,	125.6,	139.1,	150.8,	159.7,	172.9,	183.0,	191.2,	219.1,
8 days	52.0,	66.1,	73.1,	83.2,	89.8,	94.7,	110.2,	126.6,	137.0,	151.1,	163.1,	172.2,	185.9,	196.2,	204.5,	232.8,
10 days	58.0,	73.0,	80.5,	91.2,	98.1,	103.3,	119.4,	136.6,	147.3,	161.8,	174.2,	183.6,	197.5,	208.1,	216.6,	245.3,
12 days	63.6,	79.5,	87.4,	98.6,	105.8,	111.2,	128.0,	145.7,	156.8,	171.7,	184.5,	194.0,	208.3,	219.0,	227.7,	256.9,
16 days	74.1,	91.5,	100.1,	112.2,	119.9,	125.7,	143.6,	162.4,	174.1,	189.8,	203.1,	213.0,	227.8,	238.9,	247.9,	277.9,
20 days	83.8,	102.6,	111.7,	124.6,	132.8,	139.0,	157.9,	177.5,	189.8,	206.1,	219.9,	230.2,	245.4,	256.9,	266.1,	296.8,
25 days	95.2,	115.5,	125.3,	139.0,	147.8,	154.3,	174.3,	195.0,	207.7,	224.8,	239.1,	249.8,	265.6,	277.4,	286.9,	318.4,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	60.489	0.403	150.0	0.065	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	28.294	0.169	167.9	0.240	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	88.398	0.287	307.8	0.510	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	88.218	0.254	347.5	0.520	0.00	0.0	0.600	o	450	Pipe/Conduit	
3.000	89.989	0.373	241.6	0.440	5.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	58.840	0.183	321.0	0.230	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.002	17.632	0.055	321.0	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.003	19.165	0.060	321.0	0.024	0.00	0.0	0.600	o	375	Pipe/Conduit	
3.004	33.806	0.105	321.0	0.058	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	37.673	0.075	500.0	0.038	0.00	0.0	0.600	o	600	Pipe/Conduit	
1.004	12.874	0.026	500.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
4.000	44.331	0.296	150.0	0.045	5.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	19.400	0.129	150.0	0.032	0.00	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)
1.000	46.46	5.95	65.780	0.065	0.0	0.0	1.6	1.07	42.4	9.8
2.000	47.99	5.47	66.375	0.240	0.0	0.0	6.2	1.01	40.0	37.4
1.001	42.51	7.38	65.227	0.815	0.0	0.0	18.8	1.03	113.5	112.6
1.002	39.47	8.74	64.865	1.335	0.0	0.0	28.5	1.08	172.5	171.2
3.000	44.86	6.49	66.300	0.440	0.0	0.0	10.7	1.01	71.2	64.1
3.001	42.30	7.46	65.852	0.670	0.0	0.0	15.4	1.01	111.1	92.1
3.002	41.61	7.76	65.669	0.699	0.0	0.0	15.8	1.01	111.1	94.5
3.003	40.88	8.07	65.614	0.723	0.0	0.0	16.0	1.01	111.1	96.1
3.004	39.68	8.63	65.555	0.781	0.0	0.0	16.8	1.01	111.1	100.7
1.003	38.33	9.32	64.461	2.154	0.0	0.0	44.7	1.08	306.0	268.3
1.004	37.95	9.51	64.385	2.154	0.0	0.0	44.7	1.08	306.0	268.3
4.000	47.25	5.69	66.500	0.045	0.0	0.0	1.2	1.07	42.4	6.9
4.001	46.30	6.00	66.204	0.077	0.0	0.0	1.9	1.07	42.4	11.6

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.002	29.494	0.197	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	22.367	0.149	150.0	0.280	5.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	32.814	0.219	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.003	57.198	0.237	241.6	0.060	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.004	56.910	0.236	241.6	0.045	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	10.096	0.016	650.0	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
6.000	65.975	0.273	241.9	0.340	5.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	6.183	0.026	241.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	35.358	0.146	241.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	50.282	0.084	600.0	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
7.000	37.667	0.188	200.0	0.080	5.00	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)
4.002	44.94	6.46	66.075	0.077	0.0	0.0	1.9	1.07	42.4	11.6
5.000	48.59	5.29	66.375	0.280	0.0	0.0	7.4	1.28	90.6	44.2
5.001	47.17	5.72	66.226	0.280	0.0	0.0	7.4	1.28	90.6	44.2
4.003	42.45	7.41	65.804	0.417	0.0	0.0	9.6	1.01	71.2	57.5
4.004	40.28	8.35	65.567	0.462	0.0	0.0	10.1	1.01	71.2	60.5
1.005	37.65	9.68	64.285	2.616	0.0	0.0	53.4	1.02	365.2	320.1
6.000	46.01	6.09	66.300	0.340	0.0	0.0	8.5	1.01	71.1	50.8
6.001	45.71	6.19	66.027	0.340	0.0	0.0	8.5	1.01	71.1	50.8
6.002	44.05	6.78	66.002	0.340	0.0	0.0	8.5	1.01	71.1	50.8
1.006	36.29	10.47	64.269	2.956	0.0	0.0	58.1	1.06	380.3	348.6
7.000	47.29	5.68	65.213	0.080	0.0	0.0	2.0	0.92	36.6	12.3

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
8.000	40.401	0.202	200.0	0.080	5.00	0.0	0.600	o	225	Pipe/Conduit	
7.001	3.279	0.016	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	7.312	0.037	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.003	6.639	0.033	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.007	20.868	0.042	500.0	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
9.000	53.663	0.268	200.0	0.032	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	16.988	0.100	169.9	0.000	0.00	0.0	0.600	o	675	Pipe/Conduit	
10.000	68.555	0.196	350.0	0.620	5.00	0.0	0.600	o	375	Pipe/Conduit	
10.001	36.563	0.200	182.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	39.575	0.079	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.010	10.945	0.022	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
8.000	47.13	5.73	65.213	0.080	0.0	0.0	2.0	0.92	36.6	12.3
7.001	46.94	5.79	65.011	0.160	0.0	0.0	4.1	0.92	36.6	24.4
7.002	46.53	5.92	64.995	0.160	0.0	0.0	4.1	0.92	36.6	24.4
7.003	46.16	6.04	64.958	0.160	0.0	0.0	4.1	0.92	36.6	24.4
1.007	35.80	10.77	64.185	3.116	0.0	0.0	60.4	1.17	417.0	362.5
9.000	46.38	5.97	65.276	0.032	0.0	0.0	0.8	0.92	36.6	4.8
1.008	35.58	10.91	64.144	3.148	0.0	0.0	60.7	2.01	718.6	364.0
10.000	45.73	6.19	66.225	0.620	0.0	0.0	15.4	0.96	106.3	92.1
10.001	44.43	6.64	66.029	0.620	0.0	0.0	15.4	1.34	147.6	92.1
1.009	34.77	11.44	63.969	3.768	0.0	0.0	71.0	1.24	549.9	425.7
1.010	34.55	11.58	63.889	3.768	0.0	0.0	71.0	1.24	549.9	425.7

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
11.000	37.391	0.187	200.0	0.080	5.00	0.0	0.600	o	225	Pipe/Conduit	
12.000	42.254	0.211	200.0	0.080	5.00	0.0	0.600	o	225	Pipe/Conduit	
11.001	3.279	0.016	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.002	7.312	0.037	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.003	7.154	0.036	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.011	25.471	0.051	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.012	23.043	0.046	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.013	40.603	0.068	600.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
13.000	76.407	0.382	200.0	0.073	5.00	0.0	0.600	o	225	Pipe/Conduit	
14.000	31.880	0.159	200.0	0.120	5.00	0.0	0.600	o	225	Pipe/Conduit	
13.001	24.480	0.122	200.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
13.002	32.420	0.162	200.0	0.000	0.00	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)
11.000	47.31	5.68	65.158	0.080	0.0	0.0	2.0	0.92	36.6	12.3
12.000	47.02	5.76	64.948	0.080	0.0	0.0	2.0	0.92	36.6	12.2
11.001	46.84	5.82	64.737	0.160	0.0	0.0	4.1	0.92	36.6	24.4
11.002	46.43	5.96	64.720	0.160	0.0	0.0	4.1	0.92	36.6	24.4
11.003	46.03	6.09	64.684	0.160	0.0	0.0	4.1	0.92	36.6	24.4
1.011	34.06	11.92	63.867	3.928	0.0	0.0	72.5	1.24	549.9	434.8
1.012	33.63	12.23	63.816	3.928	0.0	0.0	72.5	1.24	549.9	434.8
1.013	32.84	12.83	63.770	3.928	0.0	0.0	72.5	1.14	501.5	434.8
13.000	45.16	6.38	65.855	0.073	0.0	0.0	1.8	0.92	36.6	10.7
14.000	47.63	5.58	65.855	0.120	0.0	0.0	3.1	0.92	36.6	18.6
13.001	43.93	6.83	65.473	0.193	0.0	0.0	4.6	0.92	36.6	27.6
13.002	42.43	7.41	65.351	0.193	0.0	0.0	4.6	0.92	36.6	27.6

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for SW_1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
13.003	78.788	0.326	241.6	0.310	0.00	0.0	0.600	o	300	Pipe/Conduit	
13.004	28.962	0.120	241.6	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
13.005	46.826	0.187	250.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.014	72.081	0.144	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.015	7.362	0.015	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.016	78.528	0.157	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.017	3.219	0.006	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.018	67.266	0.135	500.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
1.019	66.291	0.133	500.0	0.000	0.00	0.0	0.600	o	750	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)
13.003	39.51	8.72	65.113	0.503	0.0	0.0	10.8	1.01	71.2	64.6
13.004	38.56	9.20	64.787	0.513	0.0	0.0	10.8	1.01	71.2	64.6
13.005	37.11	9.98	64.667	0.513	0.0	0.0	10.8	0.99	70.0	64.6
1.014	31.66	13.79	63.702	4.441	0.0	0.0	76.1	1.24	549.9	456.9
1.015	31.54	13.89	63.558	4.441	0.0	0.0	76.1	1.24	549.9	456.9
1.016	30.38	14.94	63.543	4.441	0.0	0.0	76.1	1.24	549.9	456.9
1.017	30.33	14.99	63.386	4.441	0.0	0.0	76.1	1.24	549.9	456.9
1.018	29.42	15.89	63.380	4.441	0.0	0.0	76.1	1.24	549.9	456.9
1.019	28.58	16.78	63.245	4.441	0.0	0.0	76.1	1.24	549.9	456.9

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Manhole Schedules for SW_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SWMH	67.800	2.020	Open Manhole	1200	1.000	65.780	225				
SWMH1	67.800	1.425	Open Manhole	1200	2.000	66.375	225				
SWMH3	67.800	2.573	Open Manhole	1350	1.001	65.227	375	1.000	65.377	225	
								2.000	66.206	225	830
SWMH4	67.800	2.935	Open Manhole	1350	1.002	64.865	450	1.001	64.940	375	
SWMH5	67.800	1.500	Open Manhole	1200	3.000	66.300	300				
SWMH6	67.800	1.948	Open Manhole	1350	3.001	65.852	375	3.000	65.927	300	
SWMH7	67.800	2.131	Open Manhole	1350	3.002	65.669	375	3.001	65.669	375	
SWMH8	67.800	2.186	Open Manhole	1350	3.003	65.614	375	3.002	65.614	375	
SWMH10	67.800	2.245	Open Manhole	1350	3.004	65.555	375	3.003	65.555	375	
SWMH11	67.800	3.339	Open Manhole	1500	1.003	64.461	600	1.002	64.611	450	
								3.004	65.449	375	763
SWMH12	67.800	3.415	Open Manhole	1500	1.004	64.385	600	1.003	64.385	600	
SWMH13	67.800	1.300	Open Manhole	1200	4.000	66.500	225				
SWMH14	67.800	1.596	Open Manhole	1200	4.001	66.204	225	4.000	66.204	225	
SWMH15	67.800	1.725	Open Manhole	1200	4.002	66.075	225	4.001	66.075	225	
SWMH16	67.800	1.425	Open Manhole	1200	5.000	66.375	300				
SWMH17	67.800	1.574	Open Manhole	1200	5.001	66.226	300	5.000	66.226	300	
SWMH18	67.800	1.997	Open Manhole	1200	4.003	65.804	300	4.002	65.879	225	
								5.001	66.007	300	204
SWMH19	67.800	2.233	Open Manhole	1200	4.004	65.567	300	4.003	65.567	300	
SWMH20	67.800	3.515	Open Manhole	1500	1.005	64.285	675	1.004	64.360	600	
								4.004	65.331	300	672
SWMH21	67.800	1.500	Open Manhole	1200	6.000	66.300	300				
SWMH22	67.800	1.773	Open Manhole	1200	6.001	66.027	300	6.000	66.027	300	
SWMH23	67.800	1.798	Open Manhole	1200	6.002	66.002	300	6.001	66.002	300	
SWMH24	67.800	3.531	Open Manhole	1500	1.006	64.269	675	1.005	64.269	675	
								6.002	65.856	300	1211
SWMH25	67.800	2.587	Open Manhole	1200	7.000	65.213	225				
SWMH26	67.800	2.587	Open Manhole	1200	8.000	65.213	225				
SWMH27	67.800	2.789	Open Manhole	1200	7.001	65.011	225	7.000	65.025	225	14
								8.000	65.011	225	
SWMH28	67.800	2.805	Open Manhole	1200	7.002	64.995	225	7.001	64.995	225	
SWMH29	67.800	2.842	Open Manhole	1200	7.003	64.958	225	7.002	64.958	225	

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Manhole Schedules for SW_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)
SWMH30	67.800	3.615	Open Manhole	1500	1.007	64.185	675	1.006	64.185	675
								7.003	64.925	225
SWMH31	67.800	2.524	Open Manhole	1200	9.000	65.276	225			
SWMH32	67.800	3.656	Open Manhole	1500	1.008	64.144	675	1.007	64.144	675
								9.000	65.008	225
SWMH33	67.800	1.575	Open Manhole	1350	10.000	66.225	375			
SWMH34	67.800	1.771	Open Manhole	1350	10.001	66.029	375	10.000	66.029	375
SWMH35	67.800	3.831	Open Manhole	1800	1.009	63.969	750	1.008	64.044	675
								10.001	65.829	375
SWMH36	67.800	3.911	Open Manhole	1800	1.010	63.889	750	1.009	63.889	750
SWMH37	67.800	2.642	Open Manhole	1200	11.000	65.158	225			
SWMH39	67.800	2.852	Open Manhole	1200	12.000	64.948	225			
SWMH40	67.800	3.063	Open Manhole	1200	11.001	64.737	225	11.000	64.971	225
								12.000	64.737	225
SWMH41	67.800	3.080	Open Manhole	1200	11.002	64.720	225	11.001	64.720	225
SWMH42	67.800	3.116	Open Manhole	1200	11.003	64.684	225	11.002	64.684	225
SWMH43	67.800	3.933	Open Manhole	1800	1.011	63.867	750	1.010	63.867	750
								11.003	64.648	225
SWMH44	67.800	3.984	Open Manhole	1800	1.012	63.816	750	1.011	63.816	750
SWMH45	67.800	4.030	Open Manhole	1800	1.013	63.770	750	1.012	63.770	750
SWMH46	67.800	1.945	Open Manhole	1200	13.000	65.855	225			
SWMH46A	67.800	1.945	Open Manhole	1200	14.000	65.855	225			
SWMH47	67.800	2.327	Open Manhole	1200	13.001	65.473	225	13.000	65.473	225
								14.000	65.696	225
SWMH48	67.800	2.449	Open Manhole	1200	13.002	65.351	225	13.001	65.351	225
SWMH49	67.800	2.687	Open Manhole	1200	13.003	65.113	300	13.002	65.188	225
SWMH50	67.800	3.013	Open Manhole	1200	13.004	64.787	300	13.003	64.787	300
SWMH51	67.800	3.133	Open Manhole	1200	13.005	64.667	300	13.004	64.667	300
SWMH52	67.800	4.098	Open Manhole	1800	1.014	63.702	750	1.013	63.702	750
								13.005	64.480	300
SWMH53	67.800	4.242	Open Manhole	1800	1.015	63.558	750	1.014	63.558	750
HW1	65.113	1.570	Open Manhole	1800	1.016	63.543	750	1.015	63.543	750
HW2	63.763	0.377	Open Manhole	1800	1.017	63.386	750	1.016	63.386	750
SWMH54	67.800	4.420	Open Manhole	1800	1.018	63.380	750	1.017	63.380	750

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Manhole Schedules for SW_1

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SWMH55	67.800	4.555	Open Manhole	1800	1.019	63.245	750	1.018	63.245	750	
S100	67.800	4.687	Open Manhole	1200		OUTFALL		1.019	63.113	750	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH	702385.317	731738.468	702385.317	731738.468	Required	
SWMH1	702470.591	731713.752	702470.591	731713.752	Required	
SWMH3	702443.407	731721.601	702443.407	731721.601	Required	
SWMH4	702468.044	731806.497	702468.044	731806.497	Required	
SWMH5	702381.973	731760.604	702381.973	731760.604	Required	
SWMH6	702407.511	731846.894	702407.511	731846.894	Required	
SWMH7	702423.663	731903.473	702423.663	731903.473	Required	
SWMH8	702441.268	731902.504	702441.268	731902.504	Required	
SWMH10	702460.356	731900.781	702460.356	731900.781	Required	
SWMH11	702492.770	731891.179	702492.770	731891.179	Required	
SWMH12	702529.242	731881.744	702529.242	731881.744	Required	

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Manhole Schedules for SW_1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH13	702404.505	731987.135	702404.505	731987.135	Required	
SWMH14	702391.992	731944.606	702391.992	731944.606	Required	
SWMH15	702393.805	731925.291	702393.805	731925.291	Required	
SWMH16	702419.157	731978.569	702419.157	731978.569	Required	
SWMH17	702412.814	731957.120	702412.814	731957.120	Required	
SWMH18	702423.289	731926.023	702423.289	731926.023	Required	
SWMH19	702478.205	731910.024	702478.205	731910.024	Required	
SWMH20	702532.843	731894.105	702532.843	731894.105	Required	
SWMH21	702432.510	731930.198	702432.510	731930.198	Required	
SWMH22	702495.823	731911.644	702495.823	731911.644	Required	
SWMH23	702501.692	731913.589	702501.692	731913.589	Required	
SWMH24	702535.667	731903.797	702535.667	731903.797	Required	
SWMH25	702527.570	731911.682	702527.570	731911.682	Required	
SWMH26	702549.453	731986.620	702549.453	731986.620	Required	

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Manhole Schedules for SW_1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH27	702538.165	731947.828	702538.165	731947.828	Required	
SWMH28	702541.313	731946.909	702541.313	731946.909	Required	
SWMH29	702543.359	731953.929	702543.359	731953.929	Required	
SWMH30	702549.732	731952.072	702549.732	731952.072	Required	
SWMH31	702607.091	731957.096	702607.091	731957.096	Required	
SWMH32	702555.569	731972.107	702555.569	731972.107	Required	
SWMH33	702459.400	732017.821	702459.400	732017.821	Required	
SWMH34	702525.218	731998.645	702525.218	731998.645	Required	
SWMH35	702560.321	731988.417	702560.321	731988.417	Required	
SWMH36	702571.392	732026.413	702571.392	732026.413	Required	
SWMH37	702552.412	731996.772	702552.412	731996.772	Required	
SWMH39	702574.736	732073.224	702574.736	732073.224	Required	
SWMH40	702562.930	732032.653	702562.930	732032.653	Required	
SWMH41	702566.077	732031.734	702566.077	732031.734	Required	

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Manhole Schedules for SW_1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SWMH42	702568.123	732038.754	702568.123	732038.754	Required	
SWMH43	702574.991	732036.749	702574.991	732036.749	Required	
SWMH44	702583.366	732060.803	702583.366	732060.803	Required	
SWMH45	702601.768	732074.673	702601.768	732074.673	Required	
SWMH46	702413.139	732012.543	702413.139	732012.543	Required	
SWMH46A	702465.119	732076.982	702465.119	732076.982	Required	
SWMH47	702434.512	732085.900	702434.512	732085.900	Required	
SWMH48	702442.630	732108.994	702442.630	732108.994	Required	
SWMH49	702475.016	732110.490	702475.016	732110.490	Required	
SWMH50	702550.658	732088.451	702550.658	732088.451	Required	
SWMH51	702578.838	732081.764	702578.838	732081.764	Required	
SWMH52	702613.125	732113.654	702613.125	732113.654	Required	
SWMH53	702665.906	732162.744	702665.906	732162.744	Required	
HW1	702673.047	732164.534	702673.047	732164.534	Required	

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Manhole Schedules for SW_1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
HW2	702751.345	732170.522	702751.345	732170.522	Required	
SWMH54	702754.110	732168.874	702754.110	732168.874	Required	
SWMH55	702811.861	732134.383	702811.861	732134.383	Required	
S100	702868.918	732100.635			No Entry	

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PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	225	SWMH	67.800	65.780	1.795	Open Manhole	1200
2.000	o	225	SWMH1	67.800	66.375	1.200	Open Manhole	1200
1.001	o	375	SWMH3	67.800	65.227	2.198	Open Manhole	1350
1.002	o	450	SWMH4	67.800	64.865	2.485	Open Manhole	1350
3.000	o	300	SWMH5	67.800	66.300	1.200	Open Manhole	1200
3.001	o	375	SWMH6	67.800	65.852	1.573	Open Manhole	1350
3.002	o	375	SWMH7	67.800	65.669	1.756	Open Manhole	1350
3.003	o	375	SWMH8	67.800	65.614	1.811	Open Manhole	1350
3.004	o	375	SWMH10	67.800	65.555	1.870	Open Manhole	1350
1.003	o	600	SWMH11	67.800	64.461	2.739	Open Manhole	1500
1.004	o	600	SWMH12	67.800	64.385	2.815	Open Manhole	1500
4.000	o	225	SWMH13	67.800	66.500	1.075	Open Manhole	1200
4.001	o	225	SWMH14	67.800	66.204	1.371	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	60.489	150.0	SWMH3	67.800	65.377	2.198	Open Manhole	1350
2.000	28.294	167.9	SWMH3	67.800	66.206	1.369	Open Manhole	1350
1.001	88.398	307.8	SWMH4	67.800	64.940	2.485	Open Manhole	1350
1.002	88.218	347.5	SWMH11	67.800	64.611	2.739	Open Manhole	1500
3.000	89.989	241.6	SWMH6	67.800	65.927	1.573	Open Manhole	1350
3.001	58.840	321.0	SWMH7	67.800	65.669	1.756	Open Manhole	1350
3.002	17.632	321.0	SWMH8	67.800	65.614	1.811	Open Manhole	1350
3.003	19.165	321.0	SWMH10	67.800	65.555	1.870	Open Manhole	1350
3.004	33.806	321.0	SWMH11	67.800	65.449	1.976	Open Manhole	1500
1.003	37.673	500.0	SWMH12	67.800	64.385	2.815	Open Manhole	1500
1.004	12.874	500.0	SWMH20	67.800	64.360	2.840	Open Manhole	1500
4.000	44.331	150.0	SWMH14	67.800	66.204	1.371	Open Manhole	1200
4.001	19.400	150.0	SWMH15	67.800	66.075	1.500	Open Manhole	1200

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PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
4.002	o	225	SWMH15	67.800	66.075	1.500	Open Manhole	1200
5.000	o	300	SWMH16	67.800	66.375	1.125	Open Manhole	1200
5.001	o	300	SWMH17	67.800	66.226	1.274	Open Manhole	1200
4.003	o	300	SWMH18	67.800	65.804	1.697	Open Manhole	1200
4.004	o	300	SWMH19	67.800	65.567	1.933	Open Manhole	1200
1.005	o	675	SWMH20	67.800	64.285	2.840	Open Manhole	1500
6.000	o	300	SWMH21	67.800	66.300	1.200	Open Manhole	1200
6.001	o	300	SWMH22	67.800	66.027	1.473	Open Manhole	1200
6.002	o	300	SWMH23	67.800	66.002	1.498	Open Manhole	1200
1.006	o	675	SWMH24	67.800	64.269	2.856	Open Manhole	1500
7.000	o	225	SWMH25	67.800	65.213	2.362	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
4.002	29.494	150.0	SWMH18	67.800	65.879	1.696	Open Manhole	1200
5.000	22.367	150.0	SWMH17	67.800	66.226	1.274	Open Manhole	1200
5.001	32.814	150.0	SWMH18	67.800	66.007	1.493	Open Manhole	1200
4.003	57.198	241.6	SWMH19	67.800	65.567	1.933	Open Manhole	1200
4.004	56.910	241.6	SWMH20	67.800	65.331	2.169	Open Manhole	1500
1.005	10.096	650.0	SWMH24	67.800	64.269	2.856	Open Manhole	1500
6.000	65.975	241.9	SWMH22	67.800	66.027	1.473	Open Manhole	1200
6.001	6.183	241.9	SWMH23	67.800	66.002	1.498	Open Manhole	1200
6.002	35.358	241.9	SWMH24	67.800	65.856	1.644	Open Manhole	1500
1.006	50.282	600.0	SWMH30	67.800	64.185	2.940	Open Manhole	1500
7.000	37.667	200.0	SWMH27	67.800	65.025	2.550	Open Manhole	1200

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PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	o	225	SWMH26	67.800	65.213	2.362	Open Manhole	1200
7.001	o	225	SWMH27	67.800	65.011	2.564	Open Manhole	1200
7.002	o	225	SWMH28	67.800	64.995	2.580	Open Manhole	1200
7.003	o	225	SWMH29	67.800	64.958	2.617	Open Manhole	1200
1.007	o	675	SWMH30	67.800	64.185	2.940	Open Manhole	1500
9.000	o	225	SWMH31	67.800	65.276	2.299	Open Manhole	1200
1.008	o	675	SWMH32	67.800	64.144	2.981	Open Manhole	1500
10.000	o	375	SWMH33	67.800	66.225	1.200	Open Manhole	1350
10.001	o	375	SWMH34	67.800	66.029	1.396	Open Manhole	1350
1.009	o	750	SWMH35	67.800	63.969	3.081	Open Manhole	1800
1.010	o	750	SWMH36	67.800	63.889	3.161	Open Manhole	1800

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	40.401	200.0	SWMH27	67.800	65.011	2.564	Open Manhole	1200
7.001	3.279	200.0	SWMH28	67.800	64.995	2.580	Open Manhole	1200
7.002	7.312	200.0	SWMH29	67.800	64.958	2.617	Open Manhole	1200
7.003	6.639	200.0	SWMH30	67.800	64.925	2.650	Open Manhole	1500
1.007	20.868	500.0	SWMH32	67.800	64.144	2.981	Open Manhole	1500
9.000	53.663	200.0	SWMH32	67.800	65.008	2.567	Open Manhole	1500
1.008	16.988	169.9	SWMH35	67.800	64.044	3.081	Open Manhole	1800
10.000	68.555	350.0	SWMH34	67.800	66.029	1.396	Open Manhole	1350
10.001	36.563	182.8	SWMH35	67.800	65.829	1.596	Open Manhole	1800
1.009	39.575	500.0	SWMH36	67.800	63.889	3.161	Open Manhole	1800
1.010	10.945	500.0	SWMH43	67.800	63.867	3.183	Open Manhole	1800

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PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
11.000	o	225	SWMH37	67.800	65.158	2.417	Open Manhole	1200
12.000	o	225	SWMH39	67.800	64.948	2.627	Open Manhole	1200
11.001	o	225	SWMH40	67.800	64.737	2.838	Open Manhole	1200
11.002	o	225	SWMH41	67.800	64.720	2.855	Open Manhole	1200
11.003	o	225	SWMH42	67.800	64.684	2.891	Open Manhole	1200
1.011	o	750	SWMH43	67.800	63.867	3.183	Open Manhole	1800
1.012	o	750	SWMH44	67.800	63.816	3.234	Open Manhole	1800
1.013	o	750	SWMH45	67.800	63.770	3.280	Open Manhole	1800
13.000	o	225	SWMH46	67.800	65.855	1.720	Open Manhole	1200
14.000	o	225	SWMH46A	67.800	65.855	1.720	Open Manhole	1200
13.001	o	225	SWMH47	67.800	65.473	2.102	Open Manhole	1200
13.002	o	225	SWMH48	67.800	65.351	2.224	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
11.000	37.391	200.0	SWMH40	67.800	64.971	2.604	Open Manhole	1200
12.000	42.254	200.0	SWMH40	67.800	64.737	2.838	Open Manhole	1200
11.001	3.279	200.0	SWMH41	67.800	64.720	2.855	Open Manhole	1200
11.002	7.312	200.0	SWMH42	67.800	64.684	2.891	Open Manhole	1200
11.003	7.154	200.0	SWMH43	67.800	64.648	2.927	Open Manhole	1800
1.011	25.471	500.0	SWMH44	67.800	63.816	3.234	Open Manhole	1800
1.012	23.043	500.0	SWMH45	67.800	63.770	3.280	Open Manhole	1800
1.013	40.603	600.0	SWMH52	67.800	63.702	3.348	Open Manhole	1800
13.000	76.407	200.0	SWMH47	67.800	65.473	2.102	Open Manhole	1200
14.000	31.880	200.0	SWMH47	67.800	65.696	1.879	Open Manhole	1200
13.001	24.480	200.0	SWMH48	67.800	65.351	2.224	Open Manhole	1200
13.002	32.420	200.0	SWMH49	67.800	65.188	2.387	Open Manhole	1200

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PIPELINE SCHEDULES for SW_1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
13.003	o	300	SWMH49	67.800	65.113	2.387	Open Manhole	1200
13.004	o	300	SWMH50	67.800	64.787	2.713	Open Manhole	1200
13.005	o	300	SWMH51	67.800	64.667	2.833	Open Manhole	1200
1.014	o	750	SWMH52	67.800	63.702	3.348	Open Manhole	1800
1.015	o	750	SWMH53	67.800	63.558	3.492	Open Manhole	1800
1.016	o	750	HW1	65.113	63.543	0.820	Open Manhole	1800
1.017	o	750	HW2	63.763	63.386	-0.373	Open Manhole	1800
1.018	o	750	SWMH54	67.800	63.380	3.670	Open Manhole	1800
1.019	o	750	SWMH55	67.800	63.245	3.805	Open Manhole	1800

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)
13.003	78.788	241.6	SWMH50	67.800	64.787	2.713	Open Manhole	1200
13.004	28.962	241.6	SWMH51	67.800	64.667	2.833	Open Manhole	1200
13.005	46.826	250.0	SWMH52	67.800	64.480	3.020	Open Manhole	1800
1.014	72.081	500.0	SWMH53	67.800	63.558	3.492	Open Manhole	1800
1.015	7.362	500.0	HW1	65.113	63.543	0.820	Open Manhole	1800
1.016	78.528	500.0	HW2	63.763	63.386	-0.373	Open Manhole	1800
1.017	3.219	500.0	SWMH54	67.800	63.380	3.670	Open Manhole	1800
1.018	67.266	500.0	SWMH55	67.800	63.245	3.805	Open Manhole	1800
1.019	66.291	500.0	S100	67.800	63.113	3.937	Open Manhole	1200

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Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	63.600	0.300	24.0	780.9	O K
30 min Summer	63.712	0.412	24.0	1071.9	O K
60 min Summer	63.826	0.526	24.0	1368.7	O K
120 min Summer	63.944	0.644	24.0	1674.0	O K
180 min Summer	64.012	0.712	24.0	1851.5	O K
240 min Summer	64.058	0.758	24.0	1971.6	O K
360 min Summer	64.113	0.813	24.0	2114.6	O K
480 min Summer	64.142	0.842	24.0	2188.3	O K
600 min Summer	64.155	0.855	24.0	2221.8	O K
720 min Summer	64.158	0.858	24.0	2229.8	O K
960 min Summer	64.150	0.850	24.0	2211.3	O K
1440 min Summer	64.137	0.837	24.0	2176.6	O K
2160 min Summer	64.113	0.813	24.0	2114.9	O K
2880 min Summer	64.082	0.782	24.0	2033.5	O K
4320 min Summer	64.002	0.702	24.0	1824.2	O K
5760 min Summer	63.903	0.603	24.0	1567.2	O K
7200 min Summer	63.811	0.511	24.0	1327.7	O K
8640 min Summer	63.725	0.425	24.0	1105.4	O K
10080 min Summer	63.648	0.348	24.0	904.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	86.704	0.0	806.2	19
30 min Summer	60.113	0.0	1117.7	34
60 min Summer	39.120	0.0	1455.0	64
120 min Summer	24.753	0.0	1842.3	122
180 min Summer	18.772	0.0	2095.0	182
240 min Summer	15.405	0.0	2293.9	242
360 min Summer	11.622	0.0	2596.6	362
480 min Summer	9.503	0.0	2830.2	482
600 min Summer	8.124	0.0	3024.0	600
720 min Summer	7.146	0.0	3192.1	720
960 min Summer	5.834	0.0	3473.9	898
1440 min Summer	4.382	0.0	3748.5	1142
2160 min Summer	3.289	0.0	4405.5	1540
2880 min Summer	2.681	0.0	4792.0	1960
4320 min Summer	2.006	0.0	5379.0	2808
5760 min Summer	1.632	0.0	5835.9	3576
7200 min Summer	1.391	0.0	6210.0	4328
8640 min Summer	1.220	0.0	6536.8	5096
10080 min Summer	1.092	0.0	6825.8	5760

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Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	63.638	0.338	24.0	877.8	O K
30 min Winter	63.764	0.464	24.0	1207.0	O K
60 min Winter	63.894	0.594	24.0	1544.5	O K
120 min Winter	64.032	0.732	24.0	1903.1	O K
180 min Winter	64.111	0.811	24.0	2109.8	O K
240 min Winter	64.166	0.866	24.0	2251.8	O K
360 min Winter	64.235	0.935	24.0	2431.5	O K
480 min Winter	64.275	0.975	24.0	2535.8	O K
600 min Winter	64.299	0.999	24.0	2596.5	O K
720 min Winter	64.311	1.011	24.0	2628.7	O K
960 min Winter	64.316	1.016	24.0	2640.6	O K
1440 min Winter	64.286	0.986	24.0	2563.0	O K
2160 min Winter	64.251	0.951	24.0	2472.3	O K
2880 min Winter	64.200	0.900	24.0	2340.6	O K
4320 min Winter	64.073	0.773	24.0	2010.2	O K
5760 min Winter	63.909	0.609	24.0	1584.5	O K
7200 min Winter	63.758	0.458	24.0	1191.5	O K
8640 min Winter	63.628	0.328	24.0	852.6	O K
10080 min Winter	63.518	0.218	24.0	567.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	86.704	0.0	902.6	19
30 min Winter	60.113	0.0	1252.1	33
60 min Winter	39.120	0.0	1629.9	62
120 min Winter	24.753	0.0	2063.2	122
180 min Winter	18.772	0.0	2347.9	180
240 min Winter	15.405	0.0	2569.2	238
360 min Winter	11.622	0.0	2906.2	356
480 min Winter	9.503	0.0	3168.0	470
600 min Winter	8.124	0.0	3387.8	584
720 min Winter	7.146	0.0	3574.8	696
960 min Winter	5.834	0.0	3854.4	914
1440 min Winter	4.382	0.0	3779.5	1300
2160 min Winter	3.289	0.0	4938.1	1644
2880 min Winter	2.681	0.0	5364.7	2128
4320 min Winter	2.006	0.0	6023.4	3064
5760 min Winter	1.632	0.0	6531.3	3864
7200 min Winter	1.391	0.0	6957.2	4616
8640 min Winter	1.220	0.0	7327.6	5352
10080 min Winter	1.092	0.0	7645.4	5960

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.600	Shortest Storm (mins)	15
Ratio R	0.272	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 4.965

Time (mins) From:	To:	Area (ha)
0	4	4.965

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Model Details

Storage is Online Cover Level (m) 65.500

Tank or Pond Structure

Invert Level (m) 63.300

Depth (m)	Area (m²)
0.000	2600.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0208-2400-1500-2400
Design Head (m)	1.500
Design Flow (l/s)	24.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	208
Invert Level (m)	63.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	24.0	Kick-Flo®	1.000	19.8
Flush-Flo™	0.457	24.0	Mean Flow over Head Range	-	20.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.1	1.200	21.6	3.000	33.4	7.000	50.3
0.200	20.0	1.400	23.2	3.500	36.0	7.500	52.0
0.300	23.3	1.600	24.7	4.000	38.4	8.000	53.7
0.400	23.9	1.800	26.2	4.500	40.6	8.500	55.3
0.500	24.0	2.000	27.5	5.000	42.8	9.000	56.9
0.600	23.7	2.200	28.8	5.500	44.8	9.500	58.4
0.800	22.7	2.400	30.0	6.000	46.7		
1.000	19.9	2.600	31.2	6.500	48.6		

Appendix C

Dwg. No. PIN-05-ZZ-DR-C-0211-2 P01

External Works

Appendix D

Permeable Paving

Clima-Pave™

Permeable Paving Solutions

Kilsaran

ideas taking shape

Carrickmacross Civic Offices & Library, Co. Monaghan

Clima-Pave™

The rapid development of previously green-field sites and the associated creation of impermeable areas such as roofs, car parks and footpaths will mean that at project conception stage there will be potentially large volumes of surface water to be dealt with. Traditionally this has been done by piping the surface water into storage tanks or discharging it into nearby streams or surface water drainage. This method of drainage is not currently favoured by planners and designers, as it simply moves the surface water downstream where it still has to be dealt with. This is especially important where large volumes of water need to be dealt with during heavy rainfall events. Piping large volumes of water into streams and rivers increases the risk of flooding and also allows for the potential pollution of local water courses and drinking water supplies.

Sustainable Urban Drainage Systems (SUDS) and Water Source Control

Planners are encouraging the use of Sustainable Urban Drainage Systems (SUDS) in all new developments, in particular the use of appropriate source control techniques is important as this allows for the containment of the surface water collected on the site and for this surface water to be dealt with on-site as opposed to traditionally draining it off-site. SUDS, as a sustainable development approach to Surface Water Design Techniques, has the aim of balancing the following:

1. **To manage water run-off from developed areas to similar quantities prior to development (Source Control)**
2. **Reduce and avoid incidences of downstream flooding**
3. **To protect or enhance water quality of the run-off**
4. **To improve or enhance the amenity where possible**

Advantages of Permeable Paving

- Permeable Paving is a 'source control' method. Water is managed and dealt with on-site without piping off to storage tanks or surface water treatment systems
- The Water Framework Directive (Directive 2000/60/EC) requires that surface water discharges are managed to ensure that risk of contamination or pollution are mitigated. Permeable paving systems filter contaminants by microbial action. There is no requirement for additional filtering/polishing with Permeable Paving in normal use
- Separate attenuation tank systems are not required
- No need for gullies or channels or conventional drainage
- Recharges ground water
- Roofs, roads and other non-permeable areas can be discharged into permeable paving (No gullies required)
- No ponding or surface water
- Collected water can potentially be re-used for non-potable purposes
- Improves water quality

Clima-Pave™, the permeable paving solution from Kilsaran, offers an advantage over traditional SUDS techniques, such as storm water attenuation tanks. This is because the stone based sub-base, which needs to be installed for any type of surfacing material, is adapted to an open graded material in permeable paving systems. This allows the water collected from the site to be stored in the pavement and either infiltrated back into the ground or discharged at a controlled rate into the surface water drainage system.

The Clima-Pave™ system is constructed using our specially engineered permeable paving block, which has enlarged joints on all sides, typically 4-8mm in width. When the blocks have been laid, a corresponding slot is formed between the paving blocks which are then filled with a clean 3mm aggregate. This allows water to rapidly drain from the surface down into the pavement.

Traditional block paving is laid on a sand bedding layer and a Type 1/CL. 804 sub-base. To allow for storage and infiltration of the surface water percolating through the block, permeable block paving is laid on a grit laying course instead of sand and an open-graded stone sub-base instead of Type 1/CL. 804.

Clima-Pave™
Permeable Paving Solutions

Advantages of Clima-Pave™ for your project

Clima-Pave™ from Kilsaran offers the widest range of permeable paving products for use in commercial, retail and civic projects.

Kilsaran can also offer a full site-specific permeable paving design for your project, taking into account the site ground conditions, drainage requirements and structural and traffic loading requirements for the site. This is a chargeable service and Kilsaran will provide an indemnified design provided by our nominated Consulting Engineer who will visit the site if required to appraise the installation.

Clima-Pave™
Technical Information

- Design Guidance
- Permeable Paving Aggregates
- Materials for HGV Trafficked Pavements
- Typical Design Diagrams
- Construction & Maintenance Guidelines

Clima-Pave™

Design Guidance

Clima-Pave™ permeable paving provides a structural pavement suitable for both pedestrian and vehicular traffic depending on design. The water management and permeable functionality of the pavement is largely dependent on the correct specification and design of the pavement to meet the unique requirements of the individual site. The correct specification, testing and installation of aggregates is of paramount importance with any permeable paving system to ensure the finished pavement meets both initial and long term design requirements.

We advise that all permeable pavements require a site-specific design which should be carried out in accordance with BS 7533-13:2009 'Pavements constructed with clay, natural stone of concrete pavers. Part 13 Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers'.

We can provide a design service to customers who require a site specific design to be carried out for their project. In order to carry out this, we require a completed Clima-Pave™ Permeable Paving Design form available to download from our website, from our Sales team or can be requested by emailing technical@kilsaran.ie. This form should be returned via email with the supporting information about the site to enable a design to be carried out.

The information required includes:

- **Drawings of proposed site layout in AutoCad**
- **Full existing and proposed site levels for the pavement**
- **Full site investigation report to establish ground conditions and soaked CBR values of the sub-grade at formation level**
- **Infiltration values from soak-pit testing to BRE 365**
- **Overall drainage design strategy for the site**
- **Planning requirements or conditions for the site relating to paving and drainage (e.g. discharge limits)**
- **Any other pertinent site specific information or client / contractor requirements**

Design Guidance Basics

The below information is provided for guidance purposes only at project conception stage to allow appraisal of a permeable pavement system. Full independent advice should be sought from both the Consulting Engineer and the Contractor prior to the commencement of works. A full site-specific design will always be required in accordance with the above guidelines and BS 7533-13:2009.

The design information below is based on BS 7533-13:2009 which should also be consulted at project appraisal stage.

Types of Permeable Pavement

There are three main types of permeable pavement commonly used on sites:

System A – Full Infiltration: All water from the pavement is infiltrated to the ground

Suitable for sites with good ground conditions, higher CBR values and soils which will readily allow water to dissipate through the ground. These favourable conditions are rarely encountered on larger sites.

System B – Partial Infiltration: Most water infiltrated to ground with excess water piped off

Suitable for sites with medium ground conditions. The soil will infiltrate some of the water in the system. When storm events occur and water builds up in the system due to the soil being at capacity for drainage, perforated pipes are laid in the bottom of the sub-base to deal with the excess, taking it to the surface water drainage system. This is the most commonly used type of permeable pavement.

System C – Fully Tanked System: No water is allowed to infiltrate to ground

This type of system is used where poor sub-grade drainage conditions exist (heavy clays), where the stability of the sub-grade would diminish if extra surface water was introduced, or where ground water levels are within 1 metre of the formation level (system could gain water). In this system the sub-base acts essentially as an attenuation tank, wrapped in an impermeable polythene membrane and all water is piped out.

Selection of Pavement Type

The type of permeable pavement system to be adapted is based primarily on site ground conditions, site suitability and the permeability values of the sub-grade encountered on site from infiltration soak-pit testing. Table 1 gives guidance on the suitability of the three types of permeable pavement system.

Table 1: Guidance on selection of a pavement system

		System A - total infiltration	System B - partial infiltration	System C - no infiltration
Permeability of subgrade defined by coefficient of permeability, k (m/s)	10^{-4} to 10^{-3}	✓	✓	✓
	10^{-6} to 10^{-5}	✗	✓	✓
	10^{-10} to 10^{-9}	✗	✗	✓
Highest recorded water table within 1000mm of formation level		✗	✗	✓
Pollutants present in subgrade		✗	✗	✓

Selection of Pavement Sub-Base Thickness

The design of the sub-base for the permeable pavement should take into account the traffic loadings likely to use the pavement. It is essential to take into account any future increase in traffic volume and any HGV traffic which may use the pavement irrespective of how frequent. The correct loading category should be then selected from Table 2 taking into account the above considerations. It should be noted that no layers of the permeable pavement are designed for site traffic to use them and when finished the permeable pavement surface should not be trafficked by site traffic vehicles which are heavier than that for which the pavement was designed. It is advisable to complete paving works after all other work in the vicinity has been completed.

Typical build up details for each traffic category are illustrated on page 20 and 21 for guidance purposes.

Table 2: Loading Categories

1 DOMESTIC PARKING	2 CAR	3 PEDESTRIAN	4 SHOPPING	5 COMMERCIAL	6 HEAV TRAFF
No Large Goods Vehicles	Emergency Large Goods Vehicles only	One Large Goods Vehicles per week	Ten Large Goods Vehicles per week	100 Large Goods Vehicles per week	1000 La Goods Ve per we
Zero standard axles	**100 standard axles**	**0.015msa**	**0.15msa**	**1.5msa**	**15ms**
Patio	Car Parking Bays and Aisles	Town/city Pedestrian Street	Retail development delivery access route	Industrial Premises	Main ro
Private Drive	Railway Station platform	Nursery Access	School/college access road	Lightly Trafficked Public Road	Distribut Centr
Decorative feature	External Car Showroom	Parking area to residential development	Office block delivery route	Light Industrial development	Bus Statio every 5 m
Enclosed Playground	Sports Stadium Pedestrian route	Garden centre external display area	Deliveries to small residential development	Mixed retail/ industrial development	Motorw Truck St
Footway with zero vehicle overrun	Footway with occasional overrun	Cemetery Crematorium	Garden centre delivery route	Town Square	Bus St
	Private drive/ footway crossover	Hotel Parking	Fire Station Yard	Footway with regular overrun	Roundab
		Airport Car Park with no bus pickup	Airport Car Park with bus to terminal	Airport landside roads	Bus La
		Sports Centre	Sports Stadium access route/ forecourt		

msa = millions of standard 8,000 kg

Sub-Base Thickness For Water Storage

The sub base depth must also take into consideration the water storage requirements for the site. The depth of sub-bas may have to be adjusted to allow for increased site specific water storage. Further guidance on hydraulic factors can be found in BS 7533-13:2009 section 5.4.

Adjustment To Pavement Design For Low CBR Sub-Grade

In the case of CBR values below 5%, either ground improvement work will be required for the site, or the thickness of th coarse graded aggregate sub-base will have to be adjusted in accordance with 5.6.3 and table 9 of BS 7533-13:2009

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Permeable Paving Aggregates

All materials used as permeable paving aggregate must comply to the grading and physical requirements below, as well at the general requirements of BS EN 12620 and BS EN 13242. Sub-base laying course materials should be clean, sound, non-friable and sound crushed rock material. Rounded gravel materials are not recommended for sub-base layers. The jointing material may be either clean crushed material or clean gravel material. The materials should be tested to confirm that it meets the requirements below.

The contractor shall also ensure that on-going deliveries to site are checked frequently for grading, shape and inspected to ensure cleanliness.

During installation on site, great care and attention must be paid to ensure that the aggregates are kept free of contamination and deleterious matter. Construction traffic cannot be allowed to traverse the layers of permeable paving aggregates during installation.

4/40mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
80	100
63	98-100
40	90-99
31,5	-
20	25-70
10	-
4	0-15
2	0-5

4/20mm Coarse Graded Permeable Paving Aggregate

Sieve Size (mm)	Percentage Passing
40	100
31,5	98-100
20	90-99
10	25-70
4	0-15
2	0-5

2/6.3mm Laying Course Paving Aggregate

Sieve Size (mm)	Percentage Passing
14	100
10	98-100
6.3	80-99
2	0-20
1	0-5

3mm Jointing Grit

Sieve Size (mm)	Percentage Passing
40	100
8	100
6.3	95-100
4	85-99
2	15-35
1	0-10
0.063	0.0-1.5

Property	Category to BS EN 13242 or BS EN 12620
Grading	4/20 (preferred) or 4/40 as per table above
Fines Content	F4
Shape	FI20
Resistance to Fragmentation	LA30
Water Absorption to BS EN 1097-6:2000	WA2
For water absorption > 2% Magnesium Sulfate Soundness	MS18
Resistance to Wear	MDE20
Acid Soluble Sulfate Content	AS0.2
Total Sulfur	≤1% by mass
Recycled Aggregates	Seek guidance from Kilsaran Technical Department

Materials for HGV Trafficked Areas

For loading category 3 and above as detailed in Table 2 page 17, these pavement types are designed to accommodate HGV traffic either on an occasional or more frequent basis. The pavement structure therefore requires a 'stiffening layer' to accommodate the HGV traffic which exerts significantly increased loading on the pavement. This stiffening layer can be either a hydraulically-bound coarse graded aggregate (porous no fines concrete) as detailed below and shown on the section details on pages 20 and 21 or alternatively a 80mm thick layer of DBM macadam as detailed below.

DBM Macadam Material

The DBM material should be an AC 32 Dense Base complying with the requirements of BS EN 13108-1 and should be supplied and installed to meet the requirements of BS 594987:2010. The DBM should be punctured after installation at 750mm centres with 100mm diameter holes. The holes should be fully filled and compacted with the appropriate coarse graded permeable paving aggregate as used in the layer underneath.

Hydraulically-Bound Coarse Graded Aggregate (Porous No Fines Concrete)

Porous concrete provides a stiffening transfer layer in concrete block permeable pavements which are to receive heavier traffic loads. The lack of sand (fines) in the mixture allows the material to act as a transfer drainage layer, whereby the open-graded matrix of the material allows for 20%-30% voids within the compacted volume of the material. Special measures are to be taken in the production, installation and curing of this material. Kilsaran can provide information and guidance on this upon request.

Product Standard	BS EN 14227-1
Material Compositon	Hydraulically Bound Coarse Graded Aggregate is a mixture of a coarse aggregate (usually 20mm nominal size), cement and water.
Typical Compressive Strength	Class C5/6 in accordance with IS EN 14227-1,Table 2 Line 4. Other strength classes available upon request from supplier.

Typical Design Diagrams

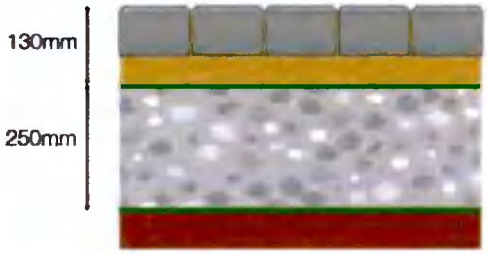
Below are typical build-up details for permeable pavement systems based on BS 7533-13:2009. These diagrams are based on ideal site conditions for drainage and CBR values of 5% or greater. The diagrams are for project appraisal purposes only and in all cases a site specific design in accordance with BS 7533-13:2009 will be required.

Key:

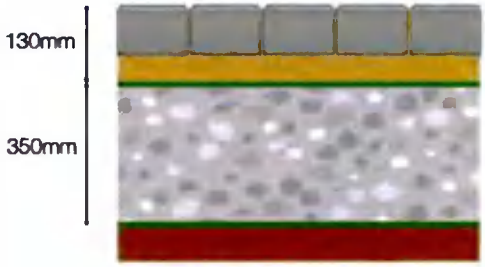
- 2 / 6.3mm Laying Course
- Hydraulically-Bound Coarse Graded Aggregate or 80mm of DBM Macadam
- 4 / 20mm Coarse Graded Aggregate and /or 4/40mm Coarse Graded Aggregate
- Capping Material
- Approved Geotextile
- Approved Impermeable Membrane

System A & B (Infiltrating & Partial Infiltration Systems)

LOAD CATEGORY 1



LOAD CATEGORY 2



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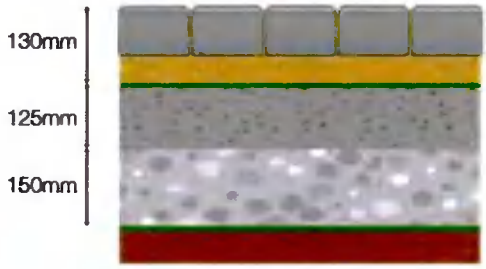

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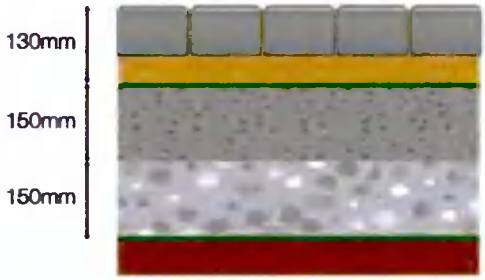
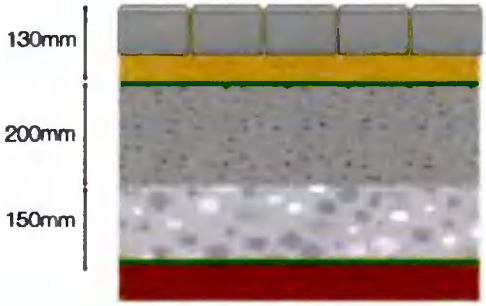
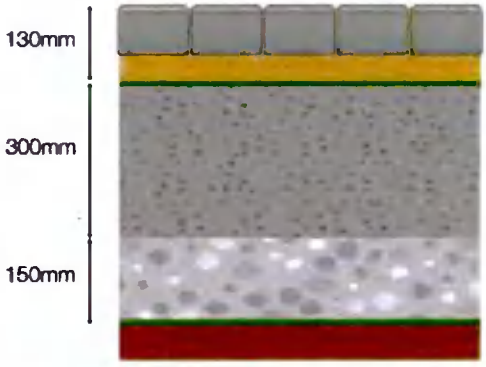


LOAD CATEGORY 5



LOAD CATEGORY 6



Alternative build up / materials may be used depending on project specific details.

For load categories 3-6 the hydraulically-bound coarse graded aggregate (porous no fines concrete) layer may be replaced with 80mm depth of DBM Macadam to act as a stiffening layer. The macadam layer should be punctured at 750mm centres on grid. Further details on the DBM macadam layer are given on page 19.

Where the depth of aggregate sub-base is in excess of 350mm for the given loading category, it may be possible to reduce the depth of aggregate required and provide a more cost effective design with the use of an appropriate and approved geo-grid. This can be appraised at design stage.

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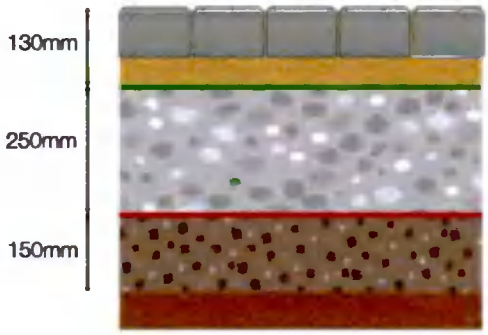
System C (Fully Tanked/Bunded)

LOAD CATEGORY 1



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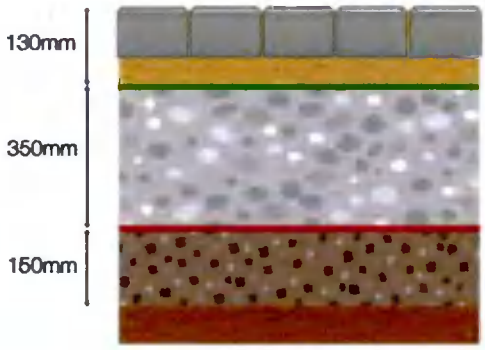

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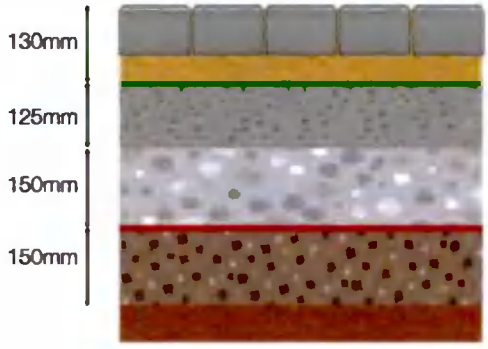

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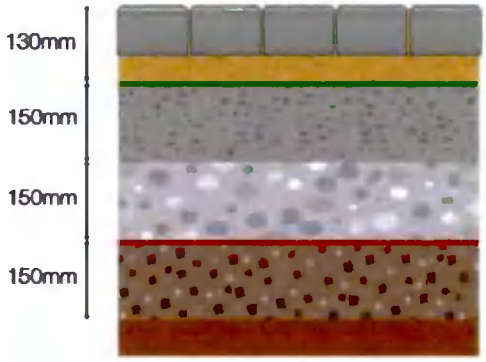

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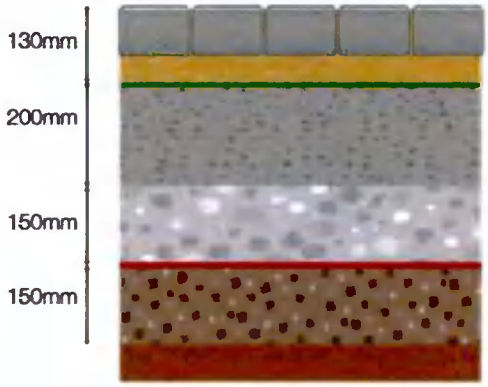

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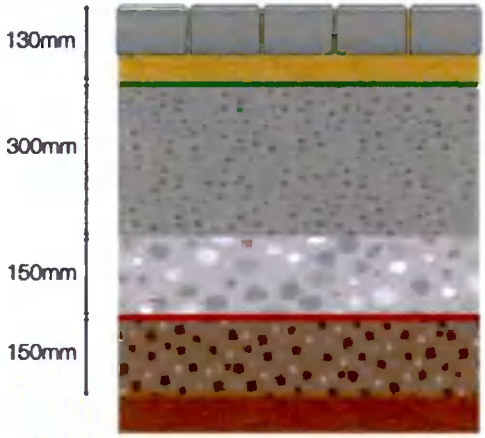
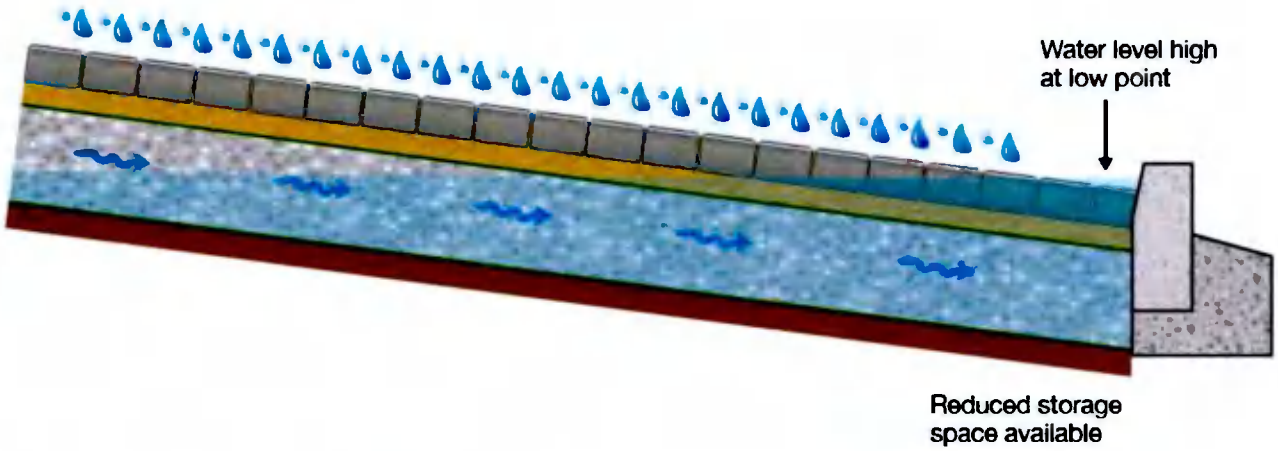


In the case of System C (fully tanked permeable pavements) there is always a requirement for 150mm depth of capping to be used beneath the impermeable membrane as shown above. The capping material should be approved by the Engineer and should comply with either the NRA Specification for Roadworks Series 600 or the Specification for Highway Works Series 600. The material should be tested before and during supply for full compliance, and should be compacted in accordance with the series 600 requirements. The capping layer should be blinded immediately before laying the impermeable membrane to prevent puncturing the membrane.

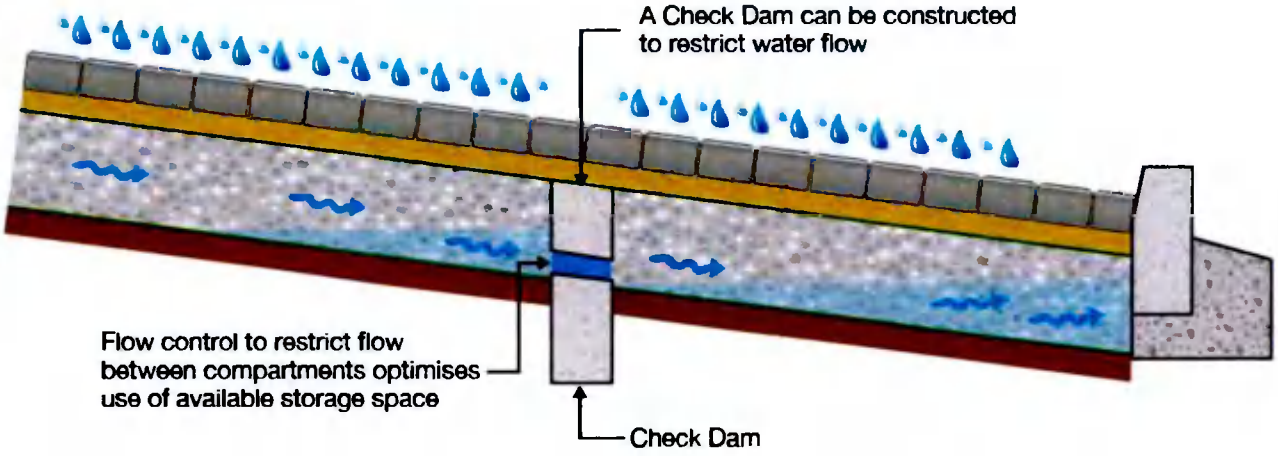
The requirement for using capping material may be eliminated by carrying out a design using an appropriate geo-grid which would negate the requirement for both the capping material and may also reduce the total depth of sub-base stone required.

Sloping Sites

On sloping sites water will naturally collect at the lowest point of the pavement. If sharp falls are allowed on site this will reduce the effective water storage capacity of the sub-base aggregate. In order to minimise this effect, gradients should be at a maximum 1 in 20 and preferably 1 in 30 or better.



Where sloping sites are unavoidable due to site layout, it will be necessary to reduce any sharp falls to maintain the water attenuation capacity of the system. This can be achieved by creating 'dams' in the sub-base of the pavement which will 'step' the pavement sub-base and reduce the overall falls. On extreme slopes, the pavement can be terraced with a step down and a dam between the two levels to restrict water flow.



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Construction & Maintenance Guidelines

Construction

To ensure correct performance and durability of a permeable pavement, a fully detailed design should be carried out in accordance with BS 7533-13:2009 taking into account all site specific requirements for the project. Construction should be carried out strictly in accordance with BS 7533-13:2009 and BS 7533-3. All materials to be used shall be tested for full compliance to the above standard both before supply and during construction. It is also advised not to use any of the layers of permeable pavement construction for site traffic unless the build-up has been specifically designed to accommodate this. Additionally site equipment such as tele-handlers and forklifts should not be used on the paving surface after construction has been completed unless the pavement has been designed to accommodate this.

Maintenance

Permeable pavements should not be contaminated with soft landscaping materials, soil, detritus or general dirt as this may wash into the pavement. Also the pavement should not be trafficked by construction traffic or unsuitably heavy vehicles above that for which the pavement was designed.

To keep any growths or weeds to a minimum it is advised that the installed permeable paving be sealed with an appropriate sealer. Where the paved area is beneath overhanging trees or in a very damp area, an annual treatment of an environmentally friendly weed killer can be applied. Note the weed killer should be applied as directed by the supplier and only in very dry weather where rain is not expected, active weed killer could be washed into the sub-system otherwise. The manufacturer's instructions for all treatment products should be followed in detail.

The pavement should be inspected on a routine basis and carefully swept as required using a mechanical sweeper or by hand for smaller areas. The sweeping action may remove some of the jointing grit from the surface, the joints must be topped up after sweeping if required.

Should silting or blocking of the joints occur after a period of years, the use of a suitable jet wash and suction sweeper should be used to remove the defective material. It is likely that the jetting of the pavement will remove some grit. This grit should be replaced as required.

As with conventional block pavements, depressions, rutting and cracked or broken blocks which may be a structural concern or a hazard to users should be remedied as soon as possible. All joints must be maintained full at all times.

Permeable pavements will drain relatively quickly compared with other types of surfacing, and are not as liable to freezing over of standing water, hoar frosts may occur which can cause surface slip on any material. The use of de-icing salts on permeable pavements, as with any other concrete surface, should be kept to a minimum as the chlorides in the salt will penetrate the concrete and excessive use will damage the surface. Any de-icing material applied should not cause blockage or clogging of the permeable pavement joints (if blockage occurs in localised areas this will need to be removed by suction sweeper and joints topped up with appropriate jointing grit). It should also be considered that any de-icing material used will drain into either the sub-grade or the drainage system through the permeable pavement. Care should be taken to ensure no contamination of water courses or drainage systems. De-icing materials should be applied to the paving surface before ice or snow covers the surface to prevent damage.

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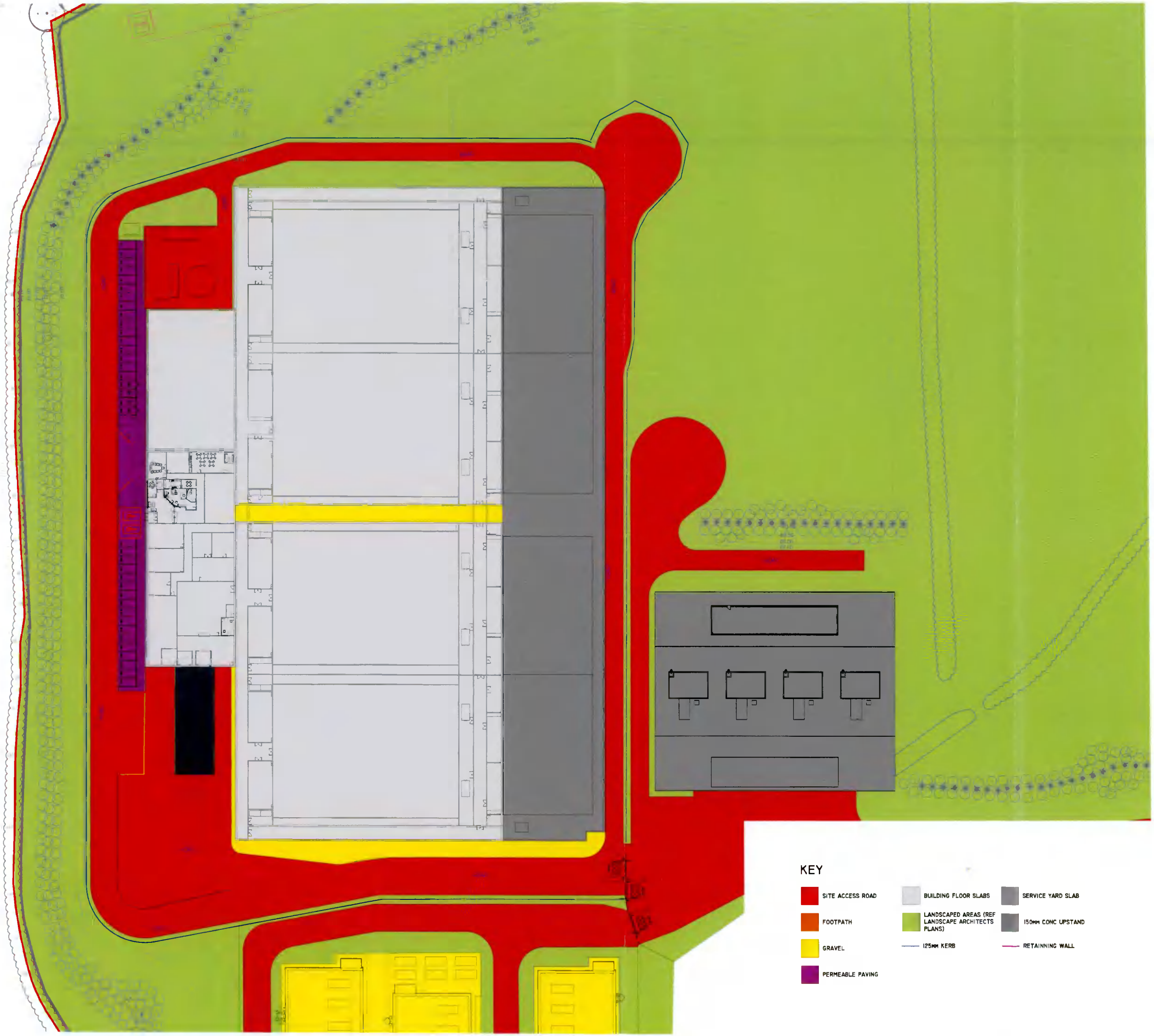

GENERAL NOTES

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

DESCRIPTION	AREAS (m²)	CO-EFFICIENT
ACCESS ROAD	9,920.00	0.80
ROOFS	22,625.00	1.00
YARD SLABS	6,753.00	0.80
GRAVEL AREAS	9,323.00	0.50
PERMEABLE PAVING	900.00	0.50
OPEN SPACE (LANDSCAPING)	67,960.00	0.05

NOTE: THESE AREAS COVER ALL SURFACES ON THIS DRAWINGS & DRAWING PIN-05-ZZ-DR-C-0211-1

KEY

- SITE ACCESS ROAD
- FOOTPATH
- GRAVEL
- PERMEABLE PAVING
- BUILDING FLOOR SLABS
- LANDSCAPED AREAS (REF LANDSCAPE ARCHITECTS PLANS)
- 125MM KERB
- SERVICE YARD SLAB
- 150MM CONC UPSTAND
- RETAINNING WALL

REV	DESCRIPTION	BY	CHK	DATE

CLIENT
EDGECONNEX

PROJECT
EDCDUB05
& GAS PLANT
-

DRAWING TITLE
EXTERNAL WORKS
-
-

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DRAWING STATUS
PLANNING

SCALE @ A1	DATE	DRAWN BY	CHECKED
1:500	DEC '20	JM	JKM

DRG NO: PIN-05-ZZ-DR-C-0211-2
REVISION: P01

REF: P20107