
DRAINAGE STRATEGY AND FLOOD RISK

for

DEVELOPMENT AT CAE NANT TERRACE, SKEWEN

REF: IR20018-DS1

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1. Introduction

Intrado Consulting Engineers have been appointed to prepare an engineering report for the development of 10 apartments and associated parking at Cae Nant Terrace, Skewen.

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2. The Site

The proposals are for the construction of 10 apartments on a site that is currently a snooker club with a well compacted granular fill car park. The address is Skewen Snooker Club, Cae Nant Terrace, SA10 6UP.

The site is approximately 0.154 hectares.



Figure 1 – Site Location

3. Existing Drainage and Flood Risk

The existing car park is a mixture of permeable and impermeable surfacing with no positive drainage system, the surface water from the car park finds its way to the sub surface/watercourse.

The rain water pipes from the building discharge to a stop above ground and discharge across the car park.

The Natural Resources Wales flood maps show the site is not in an area at risk of flooding from the rivers/seas or surface water (see extract in Figure 2).

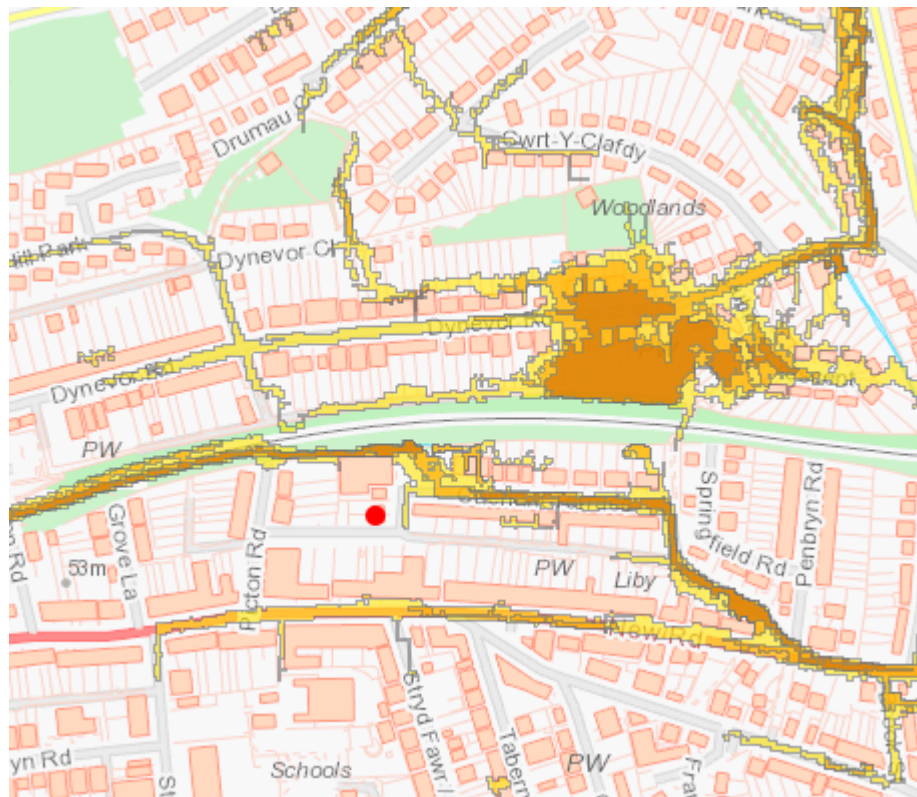


Figure 2 – Extract from Natural Resources Wales Flood Maps

The map does show surface water flooding across the car park and towards the watercourse, this would be consistent with the lack of formal surface water drainage serving the building.

4. Proposed Drainage

a. Surface Water

The surface water run-off is to be managed through the use of Sustainable Drainage Systems (SuDS) integrated with the landscape strategy. The scheme will be subject to Schedule 3 of the Flood and Water Management Act 2010. To comply with this, the developer must follow the following guidelines:

- Water to be managed on or as close to the surface and source of the runoff as possible.
- Ensure pollution is prevented at source, not rely on the drainage system to treat it.
- Protect people from increased flood risk, and the environment from ecological changes in flow rates, patterns and sediment movement caused by the development
- Use a Management Train in series across a site rather than a single "end of pipe" feature, such as a pond, to serve the whole development
- SuDS should perform safely, reliably and effectively over the design life of the development. They must take into account the need for reasonable levels of maintenance
- Avoid the need for pumping where possible.
- Be affordable, taking into account both construction and long-term maintenance costs and the additional environmental and social benefits afforded by the system.

4.1 Surface water run-off destination

With reference to Schedule 3 the hierarchy of preferred disposal options are as Standard 1 which are as follows:

Priority Level 1 – Surface water is collected for reuse

Priority Level 2 - Surface water is infiltrated to the ground

Priority Level 3 - Surface water run-off is discharged to a surface water body

Priority Level 4 - Surface water run-off is discharged to a surface water sewer, highway drain, or another drainage system

Priority Level 5 - Surface water run-off is discharged to a surface water combined sewer.

Priority Level 1 – Collection for reuse

Rainwater has been discounted as the payback period on properties of this size is 30 years which is in excess of the lifetime of the unit. Refer to Appendix A for the calculation.

Priority Level 2 – Infiltration

A site investigation was carried out by Spectrum Geo Services ref 2004/R1 which concluded infiltration is suitable to discharge the surface water from the development.

Table 4-1 summarises the suitability of the disposal methods in the context of the site and the proposed development.

Surface water disposal method	Suitability Description	Method Suitable? (Y/N)
Priority Level 1 - Collection for reuse.	The use of recycled water at the site is very limited and it is not a viable solution.	N
Priority Level 2 - Infiltration to ground	The infiltration testing carried out by Spectrum Geo Services 2004/R1 advised infiltration is suitable.	Y

Table 4-1 – Suitability of Surface Water Disposal Methods

It is therefore proposed to comply with standard S1 Priority Level 2.

4.2 Surface water run-off hydraulic control

It is proposed to discharge the surface water from the development to ground via soakaway and permeable paving.

In an aim to as far as practicably possible, prevent discharge from the site for the majority of rainfall events less than 5mm the drainage strategy uses swales, house soakaways and permeable paving.

It is proposed to manage the surface water run-off from the development via the following interception mechanisms as summarised in Table 4-3.

SuDS Management Train Mechanism	Application	Potential Suitable Suds Features
Source Control	For the interception of surface water run-off at the source of the roof and drives.	Swales, soakaways Pervious pavement
Conveyance	To convey surface water run-off from 'Source Control' mechanisms to 'Site Control'	Swales
Site Control	Provides the required surface water attenuation prior to controlled discharge to the culvert	Swales Pervious pavement subbase Soakaways

Table 4-3 Summary of Surface Water Management Strategy SuDS Options

Should a storm event occur which exceeds that of the 100 year storm event including for climate change, initially the surface water would hold on the surface of the garden and the car park. Once this volume has been exceeded the surface water will follow the existing contours and flow to the watercourse to the north of the site.

The Micro-drainage model for the surface water design can be found in Appendix B.

4.3 Water Quality

Standard S3 requires the design to minimise the potential pollution risk posed by the surface water to the receiving water body.

Table 4-4 sets out the Pollution Hazard Indices for land use in the proposed development as taken from Section 26 of The SuDS Manual the surface.

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Individual Property Drives < 300 movements per day	Low	0.5	0.4	0.4
Residential Roofs	Very Low	0.2	0.2	0.05

Table 4-4 - Pollution Hazard Potential for Proposed Development

The proposed drainage is required to demonstrate sufficient treatment capability to manage the specified Pollution Hazard Indices.

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required. The Mitigation Indices are in Table 4-5.

Type of SuDS component	Mitigation Indices		
	Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Pervious Pavement	0.7	0.6	0.7
Swale	0.5	0.6	0.6

Table 4-5 - Mitigation Indices

The drainage train for the surface water from Block B is through the swale and into the sub structure of the permeable car park. The swale and the pervious pavement will provide the necessary treatment and prevent discharge from the site for the majority of rainfall events less than 5mm.

The drainage train for the surface water from Block A is through oversized ACO channels filled with 4/6mm clean stone and terram and onto the soakaway. This will aim to, as far as practicably possible, prevent discharge from the site for the majority of rainfall events less than 5mm. The ACO Channels with stone fill will also treat the surface water from the roof.

The ACO channel has not been used in the Micro drainage model for Block A, instead 100mm diameter pipes have been used. Using pipe number 2.000 as an example, it is 21m long, 100mm diameter and has a volume of 0.16m³. Taken from the ACO calculations the volume in F900 Road drain is 1.04m³, if it is assumed only 30% of this volume is available due to free draining granular material this provides 0.31m³ which is in excess of a 100mm pipe. Refer to figure 3 for the ACO dimensions and volume.

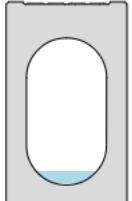
CATCHMENT INFORMATION		DESIGN SPECIFICATION	
Channel Length	17.00 m	Load Class	F900
Drainage Width & Area	5.00 m 85.00 m ²	Peak Velocity	0.32 m/s
Upstream/Downstream Area	0.00 m ² 0.00 m ²	Total Flow	0.94 l/s
Channel Slope	2.00 %	Max. Flow	0.94 l/s
Apply Advanced Catchment	ADD / EDIT	 Critical Flow ~5% Full	
[RUN-OFF COEFFICIENT]	1.00		
Location / Rainfall Intensity	39.65 mm/h ADD / EDIT		
Add Point Inflows	0 Inflows ADD / EDIT	CHANNEL SIZE :- ROADRAIN	
		PD200F 30.1	
		Total Volume	1.04 m ³

Figure 3 – Extract from ACO calculations.

Soakaways treat the surface water by physical filtration to remove the solids, adsorption onto the material and biochemical reactions involving micro organisms within the granular fill or soil.

The SuDS Mitigation Indices provided by the proposed 'Source Control', 'Conveyance' and 'Site Control' measures for a discharge to surface waters have been compared against the Pollution Hazard Indices and are deemed sufficient.

The SuDS Tool

The proposed drainage layout and construction details are shown on IR20018/SK101 P1 and SK102 P1 in Appendix C

4.4 Amenity and Biodiversity

The drainage design will be carried out in conjunction with the landscaping scheme by KJG architects to ensure the SuDS scheme makes the best contribution to the development by maximising the benefits for amenity as well as for biodiversity, water quantity and quality.

The proposed planting strategy seeks to enhance the landscape setting for this site.

The proposed landscape design in co-ordination with the drainage proposals seeks to utilise swales that will offer opportunities for a variety of plant species associated with wetter soils. The consideration of these features within the open space areas will allow for residents within the community to be able to benefit from a diverse planting mix and the benefits that will attract local wildlife.

Additionally, there will also be new tree planting within the open space areas.

The landscape areas, within the public open spaces, will be subject to routine maintenance and aftercare visits to ensure that the long-term landscape character retains a pleasant setting for the local residents and its beneficial to the wildlife.

The SuDS management train will consist of the following:

- Discharge to swales. These areas will clean and filter out/absorb the pollutants and provide attenuation. Some of the run-off will also be lost in these areas due to up take by the vegetation and evaporating excess water into the atmosphere
- The paving to the car parking spaces is to be porous blocks to allow the water to be stored in the sub-base and thus reduce the peak flows from these areas.

Refer to drawings IR20018/SK101 P1 and SK102 P1 in Appendix C which further illustrates the drainage strategy for the development and drawing 1428 PA 02 Site Plan by KJG in Appendix D.

5. Principal Operation and Maintenance Requirements.

To comply with Standard S6 the following sections outline recommended maintenance requirements for the various aspects of the drainage system for the development.

The construction of the swale and permeable car park only required the use of standard civil engineering and landscaping operations such as excavation, filling, grading, pipe laying, top soiling, seeding and planting they can all be constructed by a competent contractor with minimal risk in terms of health & safety.

The contractor, once appointed, will need to programme the works to ensure the car park sub base is protected until the development is completed.

Under the CDM Regulations 2015, Castell Group will ensure they appoint a contractor who is competent, at this point the method of construction and programming will be developed.

All features are easily accessible for future maintenance.

5.1 Pervious Pavement

Permeable paving lasts 20-25 years before requiring replacement of filter material. This is one of the longest lifespans of all SUDS options (Understanding permeable and impermeable surfaces, 2009, p.25).

Construction considerations

Sub-base material (coarse graded aggregate) should be placed in layers not exceeding 150mm in thickness or twice the nominal maximum aggregate size. Unlike traditional pavement construction, the open-graded materials should not be fully compacted to eliminate any voids, as this will compromise the performance of the system.

It is likely that excessive compaction will result in the displacement of the open graded aggregate by the compaction equipment. The open-graded material should be compacted such that its maximum density is achieved for the particular aggregate type and grading without compromising the final void percentage offered by the material.

Each layer should be suitably compacted before the next layer is placed to prevent any potential settlement of the pavement after completion.

Due to the nature of the sub-layers care should be taken during the construction process to prevent dirt or detritus contaminating the sub-base and compromising the permeability of the system. For example, the trafficking of the sub-base as a site access route should not be undertaken. Should other construction or maintenance work take place close to the pavement which may affect the infiltration of the pavement, suitable protective measures should be implemented.

Further site-specific requirements will be provided to the contractor once the order has been placed.

A recommended operation and maintenance plan for areas of pervious pavement is summarised in Table 5-1.

Maintenance Schedule	Required Action	Minimum Frequency
Routine visual inspections	In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required. Any infiltration issues are shown up by water ponding on the surface. If ponding is not visible, then remedial action is not required. If ponding is visible see section on Remedial Action for ponding.	Once a year during or following heavy rainfall.
Regular Maintenance	A pressure washer set to a light / medium pressure should be all that is required to remove general dirt and grime.	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue, they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed, and adequate Health & Safety measures should also be put in place when handling chemicals.	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection.	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually

Table 5-1 - Typical Pervious Pavement Operation and Maintenance Requirements

Pre- construction (Design stage)

It is essential that the system is designed correctly by a qualified engineer. Refer to BS 7533 Part 13

The design and detailing of the project should ensure that soil from soft landscaping is prevented from spilling onto the surface.

During construction.

Mud / soil and other contaminants should be prevented from entering the sub-base, bedding course and jointing aggregates.

Do not allow muddy construction traffic to use the area once completed.

Do not allow soft landscaping to spill onto the paving surface

After construction.

Do not store materials which may clog up the surface such as soil and mulch.

5.2 Filter and Channel Drains

A recommended operation and maintenance plan for filter and channel drains is summarised in Table5-3

Maintenance Schedule	Required Action	Minimum Frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter and channel drain surface, inlet/outlet pipework and control systems for blockage, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required.

Table 5-3 - Typical Pipe System Operation and Maintenance Requirements

5.3 Underground Piped Systems

A recommend operation and maintenance plan for the piped drainage network is summarised in Table 5-4

Maintenance Schedule	Required Action	Minimum Frequency
Regular maintenance	Ensure drainage intakes are clear of debris/silt	Monthly (or as required)
Occasional Maintenance	Clear gully pots	6 monthly
	Jet clean sewer lines, gully tails and kerb channels to remove grease, grit, sediment and other debris to ensure conveyance capacity is not compromised	Every 2 years
	Clear perforated pipework of blockages	As required.
Intermittent Maintenance	CCTV survey of sewer lines to identify any defects/sign of performance degradation such as: Cracked/deteriorating pipes; Leaking joints/seals at manholes; High water line showing regular high stage in pipes (sign of lack of capacity or downstream constraint); and Suspected infiltration or exfiltration.	Every 2 – 5 years
Remedial Actions	Repair defects using suitable methods. Effective temporary repairs may be sufficient in short term until scheduled, capital improvements can be made.	As required
Monitoring	Record areas of surface ponding/intake bypassing/surcharging (photos, inundated areas, depths) during extreme storm events and investigate the reasoning for this post-storm.	As required

Table 5-4 - Typical Pipe System Operation and Maintenance Requirements

5.4 Swales

The proposed drainage scheme will utilise a swale as a mechanism for collection, treatment and attenuation of surface water run-off. The anticipated maintenance and management for swales associated with the surface water drainage system is outlined in Table 5-5.

Maintenance Schedule	Required Action	Minimum Frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut grass – to retain grass height within specified design range	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets and outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, the half yearly
	Inspect inlet and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed area of poor vegetation growth, after plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeded	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 5-5 - Typical Swale Maintenance Requirements

6. Conclusion

Intrado has been appointed to develop a Flood Risk Assessment and Surface Water Drainage Strategy to manage surface water run-off resulting from the proposed planning application for the apartments at Cae Nant Terrace, Skewen.

The potential sources of flood risk at the site have been confirmed with the conclusion that the flood risk to the site was predominantly very low and warrant no further consideration or specific mitigation measures to be applied.

Technical information provided in this report on behalf of the Applicant seeks to demonstrate that a robust and sustainable drainage strategy has been prepared for the site, including residual events. It is proposed that the surface water run-off arising from the development discharges to the existing surface water sewer at the south of the site at an attenuated rate to current best practice and sustainable water management guidelines through the use of SuDS. A recommended maintenance plan has been outlined.

The surface water drainage strategy presented in this report demonstrates that adequate SuDS space provision is afforded within the development and that the proposed scheme is feasible and compliant to appropriate best practice and regulatory requirements and can be maintained in accordance with best practise. It is considered that the proposals ensure the safe management and maintenance of surface water run-off.

Appendix A

Calculator

RainCatcher's Rainwater Harvesting Systems Calculator

This calculator shows you the tank size you will require and the savings you can expect from your rainwater harvesting system.



Part 1: Annual Rainwater Yield

Roof area (m ²):	180
Roof type:	Pitched roof with tiles
Location:	Wales

Part 2 - Annual Water Demand

Number of occupants:	12
Type of building:	Domestic

Daily Water Consumption per person (Litres):

150 ▼

System implemented for:

WC:



Washing Machine:



Garden Use/External Irrigation :

**Part 3: Potential Saving**Water supply unit cost (£/m³):

1.36

Part 4 - Estimated payback period

Full system (Tank, Pump & Filter) price (£):

4023

Installation Cost (£)

2500

Avg. annual rainfall (mm):	1343.20
Annual Water Yield (L):	163198.80
Annual water demand (L):	295650.00
Annual non-potable water saving (%):	55.20
Annual Saving (£):	221.95
Minimum rainwater storage (L):	9791.93
Payback period (years):	29.39

This is a guide only based on the simplified approach seen in the QCF BPEC

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Appendix B

Report No

2004/R1

Date

February 2020

Project

CAE NANT TERRACE, SKEWEN – SITE INVESTIGATION REPORT

Client

Castell Group

**Spectrum Geo Services
Foxglove Cottage,
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Tondu,
BRIDGEND
CF32 0EH**

Report No:	Date:
2004/R1	February 2020

Project:
CAE NANT TERRACE, SKEWEN– SITE INVESTIGATION REPORT

Issue Number	Status	Description of Amendments
1	Draft	

Report prepared by:	
Signed 	February 2020

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Client			Castell Group
Current Site Status			The existing site is approximately rectangular, being an existing Snooker Club, with associated parking.
Development Proposals			The development proposals are understood to comprise residential housing.
Site Conditions	Location		The site is in Skewen, SA106UP.
	History	Site	The site has been classified as an agricultural field, then developed as a Hall and Snooker Club.
		Adjacent land	Residential properties built along the eastern and southern boundary. The northern side is bounded by a rail line.
	Geology	The geology of the area comprises Glacial Till overlying bedrock of Carboniferous Coal Measure..	
Mining	Coal Authority Report suggests no coals have been extracted above 110m		
Controlled Waters	Surface Water	No terrestrial waters.	
	Ground Waters	No records of controlled waters	
Flood Risk	1 in 30years		
Radon	The site is not considered to be in an area at risk from Radon		
Landfill	There are no landfills within the site area		

Cae Nant Terrace, Skewen
Phase 1 Summary Page 2 of 2

Principle contamination issues	The following contamination issues were identified during the Phase 1; No specific historic on site uses have been identified which would suggest contamination, however the site is in a predominantly industrial area.
Environmental Risk	- Significant and widespread contamination is considered unlikely, unless some processes as yet unidentified have occurred. - Initial consideration, in advance of site investigation is that: - The risk to end users is considered to be Low - The risk to construction/maintenance workers is considered Moderate. However, with appropriate PPE the risk is considered to be Low - The risk to the off site surface water and groundwater receptors is Low to Very Low - The risk to end users from marginally elevated soil gas is considered to be Low
Waste Management	Made ground has been identified
Geotechnical Constraints	Based on the available information, the following issues may be anticipated, and should be investigated by site investigation prior to development; - Near surface soft clay - Below ground services - Potential instability of excavations - Potential subsidence due to loose ground - Potential elevated background chemical values
Services	Below ground services may be anticipated on site including existing site drainage
Future Works	The following future works/surveys may be required; - Topographical survey - Trial Pitting Ground Investigation to prove the ground conditions and to collect samples for soil contamination testing and assessment. (undertaken as part of this report. - Additional intrusive investigation to determine the thickness of the soft clays, to include window sampling/boreholes and plate testing.

1.0 INTRODUCTION

1.1 Introduction

Spectrum Geo Services (SGS) were requested by Castell Group, to undertake a Site Investigation Study, of a site at Cae Nant Terrace, Skewen, Swansea,

This report includes a review of the available geological and historical information and trial pitting Ground Investigation operations.

1.2 Scope of Works

The objectives of this assessment are to report on:

- Envirocheck Historical Data
- Coal Authority Report
- Foundation options
- Drainage soakaway parameters
- Contamination levels.

1.3 Development Proposals

It is understood that the intention is to develop the site for the purposes of Residential Development.

1.4 Limitations

Subsoils are inherently variable and by their very nature are hidden from view such that no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may therefore be present beneath the site that were not apparent from the data available for review.

Unless specifically noted to the contrary, it should be assumed that this report has not been submitted to any regulatory authorities for approval. Redevelopment sites may have planning conditions attached in respect of contaminated land assessment. Where we are made aware of such conditions in advance of scoping the works, we can tailor the report to the regulatory authority requirements. Where we are not made aware of any such requirements there can be no certainty that our investigation will meet any or all of the regulatory authority requirements.

2.0 EXISTING SITE INFORMATION

2.1 Site Location

The development site is situated on Cae Nant Terrace, Skewen, Swansea, SA10 6UP. The site location plan is included in as Drawing 2004/01, **Appendix A.**

The existing site is roughly rectangular and has previously been developed, with former buildings and rough unmetalled areas.

2.2 Published Geology

Based on data available from the BGS webviewer, the following geological setting is anticipated;

- **Superficial deposits:**
- 1:50,000 scale superficial deposits description: Till, Devensian - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions (U).
- Setting: ice age conditions (U). These sedimentary deposits are glacial in origin. They are detrital, created by the action of ice and meltwater, they can form a wide range of deposits and geomorphologies associated with glacial and inter-glacial periods during the Quaternary.
- **Solid Geology:**
- 1:50,000 scale bedrock geology description: Hughes Member - Sandstone. Sedimentary Bedrock formed approximately 308 to 310 million years ago in the Carboniferous Period. Local environment previously dominated by rivers.
- Setting: rivers. These sedimentary rocks are fluvial in origin. They are detrital, ranging from coarse- to fine-grained and form beds and lenses of deposits reflecting the channels, floodplains and levees of a river or estuary (if in a coastal setting).

2.3 Hydrology

The site has no surface waters in proximity.

3.0 DESK STUDY

3.1 Introduction

To facilitate a Desk Study, Enviro Insight, Geo Insight and historical map information was procured, and is Appended.

3.2 Site History

Information about the historical development of the site and the adjacent land has been obtained from a review of the available Ordnance Survey maps. The historical land use is summarised in below:

On site historical Land use

- 1876: The site appeared to be fields, with an east west stream in the north east. A rail cutting is evident running west to east along the sites northern boundary.
- The 1889 map that a pair of small buildings had been constructed in the north of the site.
- By 1918 The Main Colliery is shown to the north west of the site, several hundred metres distant. Cae Nant Terrace has been built to the south east and a Picture Theatre to the southern boundary,
- By 1940 other buildings including a large "Hall" had been built at the site. More housing stock is evident around the area. The site remained similar until 1970, when the British Legion/Snooker Club was built.
- The site has remained similar until current date.

3.3 Former Land Use and Potential Contaminative Processes/Landfill

- a) The EnviroInsight report indicates not potential risks of such within a reasonable distance. Indeed, the closest areas of industrial process lie across the rail cutting to the north and thus there is little risk of impact to the site.

3.4 Coal Authority Report

The Coal Authority indicates that the shallowest recorded coal workings were at 110m depth at the site and that there are no known mine entries within 20m of the site. No Mine Gas has been recorded.

4.0 CONCEPTUAL MODEL

4.1 Rationale

The site characterisation attempts to identify potential previous and existing site sources of contamination. The Conceptual Model links the identified sources likely to cause significant possibility of significant harm via pathways to identified critical receptors. The Conceptual Model is therefore based on a number of identified source-pathway-receptor scenarios. For land to be classified as contaminated a significant pollutant linkage will need to be identified which will include each component of the Conceptual Model. The absence or removal of a source or interception of a pathway will 'break' the pollutant linkage.

The Conceptual Model is characterised by identification of the following:

- On-site sources, which may impact on-site receptors via plausible pathways.
- On-site sources, which may impact off-site receptors via plausible pathways.
- Off-site sources, which may impact on-site receptors via plausible pathways.

The change of land use will require assessment of the new site development layout within the context of introducing new exposure pathways. The planning regime will require assessment of the site to ensure the new development will not be classed as contaminated land under the definition provided by the Part 2A of the Environmental Protection Act 1990 as defined in the Environment Act 1995.

From the information available a Conceptual Model for the site has been produced. These include metals, asbestos and PAH.

5.0 PRELIMINARY CONCEPTUAL MODEL AND QUALITATIVE RISK ASSESSMENT

The principles of environmental risk assessment are presented in ***Appendix B***

Source Characterisation

All potential **on-site** and **off-site** sources of contamination identified by this desk study are detailed in Table 5.2.1 below. The table also details any potential sources which have been discounted.

Table 5.2.1: Identified Potential Sources of Contamination

Source		Distance (m)	Compass Direction	Identified by:	Comments
Former Rail Sidings/Cutting	Off-Site	50	N	Historical maps	Discounted due to distance and because the site is above of the source
Potential Fly tipping and demolition waste	On site	On Site	NA	Historical Maps	General suites of chemical testing

It is not possible to discount all of potential sources of contamination. Potential sources of contamination which cannot be discounted are carried forward to a preliminary qualitative risk assessment. The Contaminants of Concern (CoC) for the remaining potential sources of contamination are listed in Table 5.2. 2.

Table 5.2. 2: Contaminants of Concern

CONTAMINANTS OF CONCERN								
Source	Metals	Pesti cides	PAH	Soil Organic Matter	SO ₄ , SO ₃	pH	Asbestos	SVOCs / VOCs
ON-SITE								
Made Ground	X		X	X	X	X	X	

Pathway Characterisation

The potential pathways by which receptors might be exposed to contaminants (sources) at the site can vary depending on the proposed or current land use (e.g. residential properties, public open space, retail).

For humans, the three possible routes of exposure to contaminants are:

Inhalation of dusts or vapours

Ingestion of dusts or soil either by hand-to-mouth activity or by eating plants grown in contaminated soils

Dermal (skin) contact with contaminated soils and waters and transfer of contaminants through the skin into the body

Buildings and service conduits can also be affected by contaminants in the following ways:

Soil gas or vapour pooling in voids within or beneath structures

By direct contact of building fabric with contaminated soils

Service trenches acting as preferential migration pathways

Ingress of contaminants into conduits, contaminating drinking water supplies

Finally, for the local water environment the following pathways may be present:

Run-off from the site surface entering surface water courses near the site

Leaching of contaminants from the soil to on-site groundwater

Migration of contaminated on-site groundwater to off-site groundwater and/or surface water bodies

Receptor Characterisation

The receptors are the elements in the pollutant linkage that can potentially be harmed by the contaminants. These are as follows:

Humans: site workers and residential users

Buildings: building fabric and services; and

The local water environment (surface water and groundwater)

Pollutant Linkages

The significance of potential pollutant linkages at the site is now qualitatively assessed by considering the magnitude of the hazard and the possibility of the linkages occurring based on the observations made, in Table 4.2.3 below.

Preliminary Qualitative Risk Assessment

The preliminary conceptual model outlined above has been used to undertake an initial qualitative risk assessment for the site to determine the possibility of significant risks that may exist following development of the site. This is presented in Table 5.2.3. The qualitative risk assessment will

also investigate the risks to the wider environment as a result of contamination from on site sources. The principles of environmental risk assessment are presented in Appendix B.

Table 5.2.3: Preliminary Qualitative Environmental Risk Assessment for Identified sources of Contamination

Source	Potential contaminants	Potential Pathway(s)	Potential receptor(s)	Assessment	Potential Severity	Potential Probability	Risk Class	Investigation Required
Made Ground	Metals, PAHs, asbestos, SO ₄ , pH,	Ingestion, inhalation, dermal contact	Humans (residents & end users)	Dermal contact, inhalation and ingestion pathways will be broken in areas covered by hardstanding. However the risk of humans coming into contact with potential contaminants at the site will remain in areas of soft landscaping. Contaminants could compromise the integrity of any water supply pipe and subsequently lead to consumption of contaminated water supply.	High	Very Low	Low	Yes
			Humans (site workers)	Construction and maintenance workers could come into contact with contaminated made ground. Excessive exposure may occur during some manual activities including working in service trenches.	High	Low	Moderate	Yes
		Direct contact, aggressive ground conditions,	Building fabric and services	The presence of contamination in shallow soils may pose a risk to buried concrete structures. Direct contact with this contamination in both soil and superficial groundwater (if present) can result in damage to concrete fabric and services in a similar fashion to that described above for water supply pipe.	High	Low	Moderate	Yes
		Leaching, migration.	Surface water environment Groundwater environment – Superficial Groundwater	There is no surface water at the site. The majority of proposed development is to consist of tarmac and drained surfaces which will prevent surface water run-off from coming into contact with potentially contaminated made ground. Mobile contaminants that may be present on site, could migrate to surface water bodies by transportation via the bedrock aquifer, however the presence of hardcover to the site will reduce the infiltration of water through potentially contaminated soils therefore reducing the leaching potential. Given that superficial deposits are expected to be very limited beneath the site, it is unlikely that a superficial aquifer will be present.	High	Very Low	Low	No

6.0 SITE OPERATIONS

6.1 Site Works

The site was mostly obscured by the existing Snooker Hall. Thus, site works were limited to 2 No Trial Pits in the car park, which were undertaken on 04 February 2020 and comprised those Trial Pits, and a Soakaway test. Conditions during the fieldwork were predominantly sunny and dry. The positions are shown on Drawing SGS/2004/02.

The positions of the Ground Investigation holes were limited to those areas, which were not affected by underground utilities.

The work was undertaken in accordance with BS5930.

Samples were recovered of strata encountered, to allow laboratory testing to be undertaken.

Soakaway testing was undertaken in one of the trial pits.

7.0 LABORATORY TESTING

7.1 Introduction

On completion of site operations, selected soil and rock samples were scheduled for laboratory testing. The following laboratory testing was undertaken and is Appended.

- pH,
- Sulphate by aqueous extract
- Metals soil suite
- PAH
- Organic Matter
- Asbestos ID

The results are presented within Appendix D.

8.0 SITE CONDITIONS ENCOUNTERED

8.1 Ground Conditions

The ground conditions encountered are summarised below. Conditions can vary in areas which are between trial pits and thus have not been investigated.

Stratum	Depth to base (m)	Remarks
Made Ground.	1.40 – 1.80	Comprising both cohesive and granular strata.
Very soft to soft CLAY	(2.40) – (2.80)	Glacial CLAY and alluvium.
PEAT	2.10	1.85m to 2.10m at TP02

Table 8.1. Generalised Strata

In general the site was mantled in Made Ground, which comprised of black and brown GRAVEL and CLAY of sandstone with various glass, wood, slate, ceramics and glass matter.

The natural deposits comprised relatively low strength and compressible Glacial Till of both GRAVEL and CLAY. The CLAY was noted as very soft to soft. PEAT was noted at TP02.

8.2 Groundwater Conditions

During the field operations, water was not noted as shown on the Engineering Logs, Appendix C.

It should be noted that groundwater levels vary due to changes in climatic and other conditions and may therefore at times vary from those recorded during these operations.

9.0 GEOTECHNICAL PARAMETERS

9.1 Introduction

This section presents geotechnical parameters, which will be taken forward into the foundation options appraisals, and assigns parameters to the strata encountered.

9.1.1 Made Ground

These deposits were found to extend to 1.80m depth at TP01.

The materials were loose and friable and extremely varied. Thus, it is not considered appropriate to assign them geotechnical parameters.

Plate Bearing testing should be undertaken to determine settlement parameters.

9.1.2 Clay

Very soft to soft CLAY was encountered within both trial pits.

Field descriptions suggest the following parameters:

Undrained Cohesive Strength (cu) = 20 to 40kN/m²

9.1.3 Peat

The peat was noted as fibrous.

It is not considered appropriate to assign geotechnical parameters in the absence of in-situ test results, which would only be obtained in borehole tests.

10.0 GEOTECHNICAL ASSESSMENT

10.1 Introduction

The following sections provide an assessment of the options relating to foundation options at site, making suggestions relating to potential options/assessment for bearing capacity and foundations and attack to buried concrete.

7.2 Foundation Options

The Made Ground will not prove suitable for founding on without treatment, due to lateral and vertical inhomogeneity. The Made Ground will also exhibit very low CBR values and thus would need to be treated for pavement design. It is recommended that intrusive boreholes/window samples and plate bearing testing is undertaken once the Snooker Hall is demolished.

The CLAY would provide an allowable bearing capacity as low as 25kN/m².

Excavations will degrade in wet conditions, and thus close support should be considered. The Made Ground will not stand open for any length of time.

All formations must be inspected by a professional Geotechnical Engineer to confirm that the materials will accommodate the allowable bearing capacity calculated, and so that soft spots are identified, and removed.

10.3 Attack to Buried Concrete

Laboratory testing during, noted a slightly acid to neutral pH value, and a maximum soluble sulphate value of 1600mg/kg, indicating Sulphate Class DS-2, in accordance with BRE Special Digest 1.

10.4 Groundwater

Groundwater was not noted. It is common to intercept perched water tables within glacial deposits, and thus suitable methods of dewatering should be made available at site.

It should be noted that groundwater levels vary due to changes in climatic and other conditions and may therefore at times vary from those recorded during these operations.

11.0 CONTAMINATION TESTING

Contamination testing was undertaken on two samples, as shown in the Appendices.

The results have been compared with current Environment Agency limits for Residential Uses, both with and without plant uptake.

Table 11.1 shows the exceedance, which were arsenic at TP01 and 02 (both with and without plants) and lead at TP02 (both with and without plants).

Thus, it is suggested that should soft landscaping be incorporated in the development, then a capping design will be required.

It may be also that the Local Authority may require further assessment of the elevated values in relation to a contamination Risk Assessment, both to on and off-site receptors.

Location	Units	Limit of Detection	TP01	TP02	TP04	CLEA/LQM/ GAC 6% SOM Resi Plant	CLEA/LQM/ GAC 6% SOM Resi No Plant
Depth to Top							
Depth to Bottom			0.50	0.30	1.50		
Date Sampled			30-Nov-19	30-Nov-19	30-Nov-19		
Sample Type			Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code			5A	4AE	5AE		
% Stones >10mm	% w/w	0.1	0.6	<0.1	21.2		
pH	pH	0.01	6.6	7.33	7.57		
Sulphate (acid soluble)	mg/kg	200	660	1600	<200		
Organic matter	% w/w	0.1	8.5	18.2	1.7		
Arsenic	mg/kg	1	56	51	6	32	35
Copper	mg/kg	1	84	231	13	2300	
Chromium	mg/kg	1	16	12	10	3000	
Lead	mg/kg	1	67	1520	30	450	450
Mercury	mg/kg	0.17	<0.17	<0.17	<0.17	11	14
Nickel	mg/kg	1	24	32	20	130	130

Asbestos in Soil (inc. matrix)					
Asbestos in soil			NAD	Chrysotile	NAD
			-	Loose Fibres	-
Asbestos ACM - Suitable for Water Absorption Test?			N/A	N/A	N/A

Red values indicate exceedance of guideline values.

PAH-16MS

Acenaphthene	mg/kg	0.01	<0.01	0.08	<0.01	1000
Acenaphthylene	mg/kg	0.01	<0.01	0.1	<0.01	850
Anthracene	mg/kg	0.02	<0.02	0.18	<0.02	9200
Benzo(a)anthracene	mg/kg	0.04	<0.04	1.12	<0.04	5.9
Benzo(a)pyrene	mg/kg	0.04	<0.04	0.8	<0.04	1
Benzo(b)fluoranthene	mg/kg	0.05	<0.05	1.22	<0.05	7
Benzo(ghi)perylene	mg/kg	0.05	<0.05	0.35	<0.05	47
Benzo(k)fluoranthene	mg/kg	0.07	<0.07	0.39	<0.07	10
Chrysene	mg/kg	0.06	<0.06	1.45	<0.06	9.3
Dibenzo(ah)anthracene	mg/kg	0.04	<0.04	0.11	<0.04	0.9
Fluoranthene	mg/kg	0.08	<0.08	2.88	<0.08	670
Fluorene	mg/kg	0.01	<0.01	0.14	<0.01	780
Indeno(123-cd)pyrene	mg/kg	0.03	<0.03	0.46	<0.03	4.2
Naphthalene	mg/kg	0.03	<0.03	0.13	<0.03	8.7
Phenanthrene	mg/kg	0.03	0.05	2.49	<0.03	380
Pyrene	mg/kg	0.07	<0.07	2.34	<0.07	1600
Total PAH-16MS	mg/kg	0.01	<0.08	14.2	<0.08	617000

Table 11.1: Contamination Results

12.0 IN-SITU TESTING

In-situ Soakaway Testing was undertaken. Calculation sheet is appended to this report.

An If value of $1.44 \times 10^{-4} \text{ms}^{-1}$ was recorded.

13 CONCLUSIONS

The Made Ground will not prove suitable as a foundation stratum, unless it is treated.

The underlying CLAY is considered to be of low quality, and thus not suitable for strips or pads.

Groundwater was not noted within these depths however, pumping from sumps may be necessary due to potential perched water tables.

Soakaway infiltration (If) values were considered reasonable to allow a design.

SGS consider that once the Snooker Club has been demolished, further ground investigation should be undertaken to determine the nature, depth and extent of the very soft and soft clays. This would likely be undertaken by window sampling or boreholes and in-situ plate tests.

Contamination testing has shown there to be elevated occurrence of both lead and arsenic. Depending upon the end development details, further assessment may be required to include a capping design, or risk assessment.

APPENDIX A

Phase 1 Data

Geo Insight	GS-5788441
Enviro Insight	GS-5788440
Small Scale Historical Maps	GS-5788439
Large Scale Historical Maps	GS-5788439

APPENDIX B

Principles of Environmental Risk Assessment

The Environmental Protection Act 1990, Part II A Contaminated Land (Section 57 of the Environment Act 1995), revised by Scottish Statutory Instrument No.658 (2005), and the Contaminated Land Regulations 1999 provide a basis on which to determine the risks and liabilities presented by a contaminated site. Contaminated Land is defined within Annex 3, Chapter A Part 1- Scope of Chapter and in all those Sections mentioned as:

“Any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that-

- (a) Significant harm is being caused or there is significant possibility of such harm being caused; or*
- (b) Significant pollution of the water environment is being caused or there is a significant possibility of such pollution being caused.”*

Section 57 of the Environment Act 1995 requires that any site identified as being “contaminated” by the Local Authority will be registered by them and remediation will be required to render the site fit for use.

The presence of contamination is not the sole factor for deciding whether a site is contaminated. Relevant parties should identify site-specific risks and provide objective, cost-effective methods to manage the contamination in a manner that satisfies the proposed end-use.

A risk-based approach, which takes both technical and non-technical aspects into consideration when making decisions on contamination resulting from past, present or future human activities, is advocated. The assessment of environmental risks generally relies on the identification of three principal elements forming a ‘pollutant linkage’:

- SOURCE:** the contaminant
- PATHWAY:** the route through which the contaminant can migrate, and
- RECEPTOR:** any human, animal, plant, water environment or property that may be adversely affected (harmed) by the contaminant

In the absence of any one of these elements, on any given site, there is no risk. Where all three elements are present, risk assessment is required to determine the significance of the harm that is being or may be caused. As outlined above, the terms of the Contaminated Land regime specify that remediation need only be implemented where a site is causing, or there is a significant possibility that it will cause, significant harm, or significant pollution to the water environment.

Development of contaminated land is usually addressed through the application of planning and development legislation and guidance (i.e. Planning Advice Note 33). The suitable for use approach is seen as the most appropriate to deal with contaminated land, taking account of environmental, social and economic objectives. The assessment is made in the context of the proposed land use (i.e. residential, retail, open-space and tourist developments).

APPENDIX C

Trial Pit Logs

TP01 to TP02

APPENDIX D

Laboratory Testing

Drawings

Site Location

Exploratory Hole Locations

APPENDIX E

In-Situ Testing

Soakaway

SA1

APPENDIX F

Photographic Plates

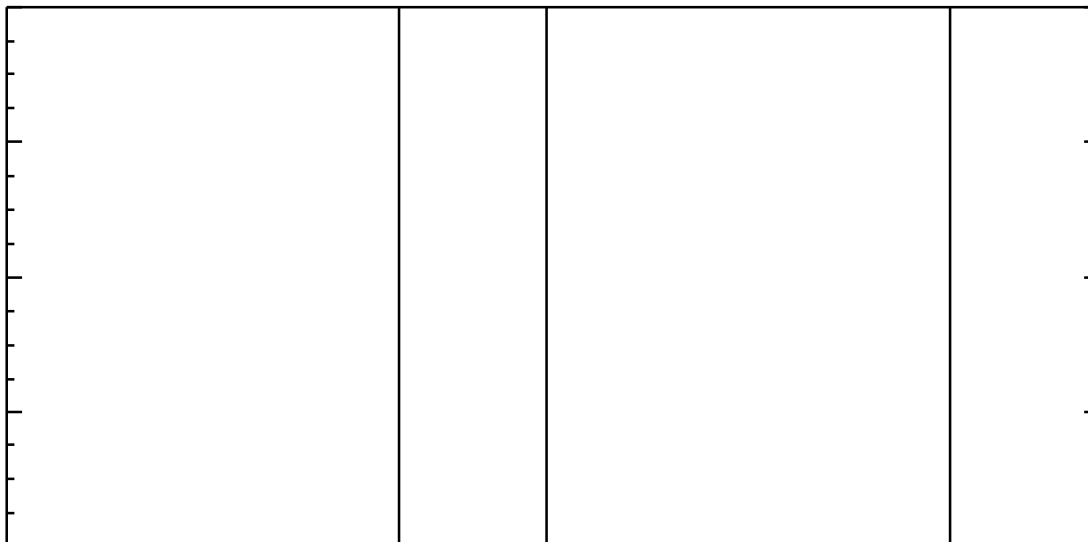
APPENDIX G

Drawings

Site Location Plan	SGS/2004/01
Exploratory Hole Location Plan	SGS/2004/02

Project	Skewen Snooker Club	Project No	2004
Described by	PL	Trial Pit No	TP01
Date	04/02/2020	Sheet No	1 of 1

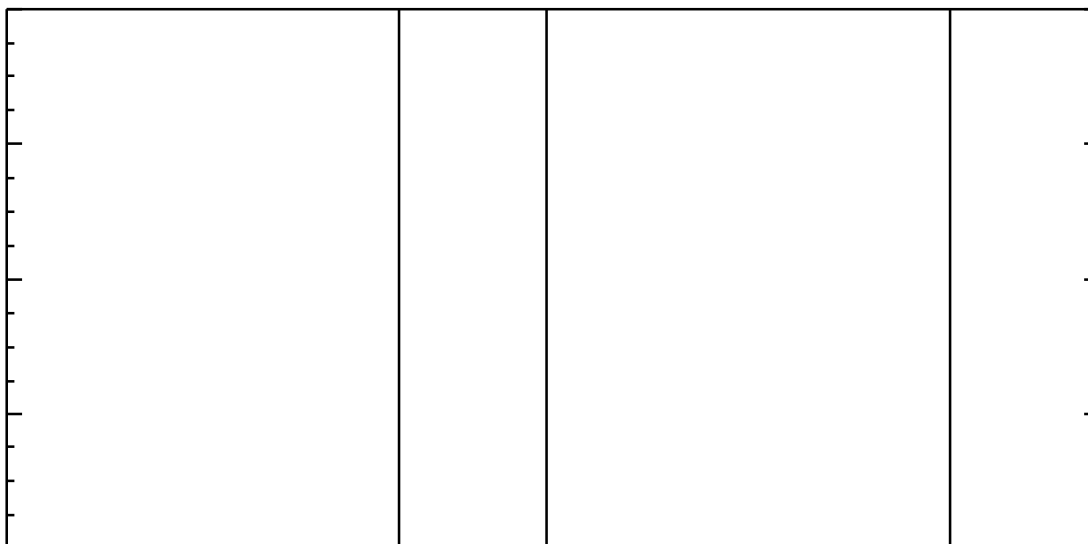
Face Sketch (Indicate stratum boundaries, codes and Face(s) sketched, use additional sheets as required)

[illegible]

Groundwater Observations Inflow at made ground/Till interface	Strike of Face A		deg	
	Length of Face A	1.90	m	
	Width of Face B	0.90	m	
Remarks				
Method/plant	5 ton tracked digger		Soakaway test carried out at 1.50mbgl	
Stability	Stable			
Shoring	None			
Weather	Dry			
Sample Type:				
U Undisturbed, P Piston, D Disturbed, B Bulk, W Water			Logger's Signature PL	
ES Environmental Soil Sample				
EW Environmental Water Sample				

Project	Skewen Snooker Club	Project No	2004
Described by	PL	Trial Pit No	TP02
Date	04/02/2020	Sheet No	1 of 1

Face Sketch (Indicate stratum boundaries, codes and Face(s) sketched, use additional sheets as required)



Samples and Tests			Strata		
Depth, m	Type & No	Results	Depth, m	Code	Description
0.50	B		GL - 1.20	1.00	MADE GROUND: Multicoloured silty SAND AND GRAVEL with low to medium cobble content of sandstone, brick and concrete. Gravel is angular to subangular fine to coarse of brick, sandstone, concrete and mudstone. Sand is fine to medium. Many fragments of glass, pottery, wood and metal.
1.30	B				
2.00	B				
			1.20 - 1.40	2.00	MADE GROUND: Brown slightly gravelly sandy CLAY with low cobble content of subangular sandstone and brick. Gravel is angular to subangular fine to coarse of sandstone and brick.
			1.40 - 1.85	3.00	Soft dark grey and black slightly gravelly sandy organic CLAY. Gravel is subrounded fine to coarse of sandstone. Possible GLACIAL TILL.
			1.85 - 2.10	4.00	Brown fibrous PEAT with some roots and rootlets
			2.10 - 2.40	5.00	Soft light grey slightly gravelly sandy CLAY. Gravel is subrounded to rounded fine to medium sandstone. Possible ALLUVIUM.

Groundwater Observations

Inflow at made ground/till interface

Strike of Face A

Length of Face A

Width of Face B

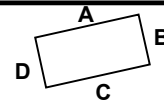
deg

1.90

0.90

m

m



Remarks

Soakaway test carried out at 1.50mbgl

Fast flowing stream about 10m from trial pit

Method/plant 5 ton tracked digger

Stability Stable

Shoring None

Weather Dry

Sample Type:

U Undisturbed, P Piston, D Disturbed, B Bulk, W Water
ES Environmental Soil Sample
EW Environmental Water Sample

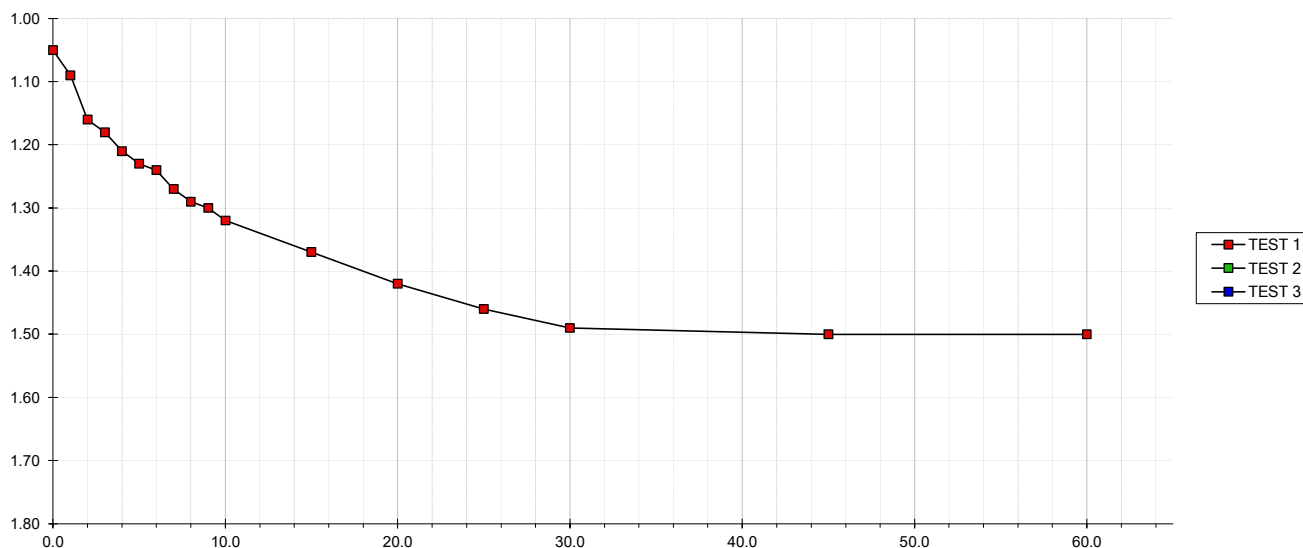
Logger's Signature

PL

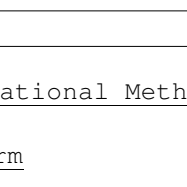
SOIL INFILTRATION RATE TEST See B.R.E. Digest 365, 1991, Soakaway Design.	Site..... Skewen Snooker Club Job Number..... 2004 Date of Test..... 04/02/2020	Trial Pit Number..... SA1 Length..... 1.90 m Width..... 0.90 m Depth..... 1.50 m Groundwater Level..... Dry
---	--	--

Remarks -	TEST 1		TEST 2		TEST 3	
Pit dry at start.	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)	Time(min)	Depth to Water (m)
	0.0	1.05	0.0		0.0	
	1.0	1.09	1.0		1.0	
	2.0	1.16	2.0		2.0	
	3.0	1.18	3.0		3.0	
	4.0	1.21	4.0		4.0	
	5.0	1.23	5.0		5.0	
	6.0	1.24	6.0		6.0	
	7.0	1.27	7.0		7.0	
	8.0	1.29	8.0		8.0	
	9	1.30	9		9	
	10	1.32	10		10	
	15	1.37	15		15	
	20	1.42	20		20	
	25	1.46	25		25	
	30	1.49	30		30	
	45	1.50	45		45	
	60	1.50	60		60	
Effective Storage Depth	m	0.45				
75% Effective Storage Depth	m	0.34				
(i.e. depth below GL)	m	1.16				
25% Effective Storage Depth	m	0.11				
(i.e. depth below GL)	m	1.39				
Effective Storage Depth 75%-25%	m	0.23				
Time to fall to 75% effective depth	mins	2.00				
Time to fall to 25% effective depth	mins	17.00				
V (75%-25%)	m3	0.38				
a (50%)	m2	2.97				
t (75%-25%)	mins	15.00				
SOIL INFILTRATION RATE	m/s	1.44E-04				

DESIGN SOIL INFILTRATION RATE, f	1.44E-04	m/s
---	-----------------	------------



Appendix C

INTRADO		Page 1
Castle House 63-69 Cardiff Road CF15 7RD		
Date 20/04/2020 11:21 File BLOCK A DRAINAGE.MDX		
Designed by Clare Checked by		
XP Solutions		Network 2018.1.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location GB 273650 197300 SS 73650 97300	
C (1km)	-0.025
D1 (1km)	0.455
D2 (1km)	0.388
D3 (1km)	0.405
E (1km)	0.283
F (1km)	2.474
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	17.000	0.085	200.0	0.008	5.00	0.0	0.600		o	100	Pipe/Conduit	
1.001	15.500	0.078	198.7	0.002	0.00	0.0	0.600		o	100	Pipe/Conduit	
2.000	21.000	0.163	128.8	0.008	5.00	0.0	0.600		o	100	Pipe/Conduit	
1.002	5.000	0.033	151.5	0.000	0.00	0.0		0.045	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.52	37.500	0.008	0.0	0.0	0.0	0.54	4.2	1.1
1.001	50.00	6.00	37.415	0.010	0.0	0.0	0.0	0.54	4.3	1.4
2.000	50.00	5.52	37.500	0.008	0.0	0.0	0.0	0.68	5.3	1.1
1.002	50.00	6.41	37.287	0.018	0.0	0.0	0.0	0.20	3.6	2.4

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INTRADO										Page 2		
Castle House 63-69 Cardiff Road CF15 7RD												
Date 20/04/2020 11:21 File BLOCK A DRAINAGE.MDX					Designed by Clare Checked by							
XP Solutions					Network 2018.1.1							

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	5.000	0.820	6.1	0.000	0.00	0.0		0.045	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	50.00	6.50	37.254	0.018	0.0	0.0	0.0	1.01	17.8	2.4

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		38.000	36.434	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 273650 197300 SS 73650 97300
Data Type	Catchment
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	30

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Online Controls for Storm Pump Manhole: 5, DS/PN: 1.003, Volume (m³): 0.9 Invert Level (m) 37.254		
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Micro Drainage

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

for Storm

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coefficient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH

FEH Rainfall Version 2013

Site Location GB 273650 197300 SS 73650 97300

Data Type Catchment

Cv (Summer) 1.000

Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep Fine

Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 30

US/MH

PN

Name

Storm

Return Period

Climate Change

First (X) Surge

First (Y) Flood

First (Z) Overflow

Overflow Act.

Water Level (m)

1.000

1

15 Summer

2

+0%

100/15 Summer

37.542

1.001

2

15 Summer

2

+0%

30/15 Summer

37.461

2.000

3

15 Summer

2

+0%

37.536

1.002

4

15 Summer

2

+0%

30/15 Summer

37.397

1.003

5

60 Summer

2

+0%

30/60 Summer

37.173

Surcharged Flooded

US/MH

PN

Name

Depth (m)

Volume (m³)

Flow / Cap.

Overflow (l/s)

Pipe Flow (l/s)

Status

Level Exceeded

1.000

1

-0.058

0.000

0.36

1.5

OK

1.001

2

-0.054

0.000

0.43

1.7

OK

2.000

3

-0.064

0.000

0.28

1.5

OK*

1.002

4

-0.040

0.000

0.89

3.1

OK

1.003

5

-0.231

0.000

0.00

0.0

OK

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Micro
Drainage

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

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coefficient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH

FEH Rainfall Version 2013

Site Location GB 273650 197300 SS 73650 97300

Data Type Catchment

Cv (Summer) 1.000

Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep Fine

Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 30

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level
1.000	1 15	Summer	30	+0%	100/15	Summer			37.562
1.001	2 30	Summer	30	+0%	30/15	Summer			37.520
2.000	3 15	Summer	30	+0%					37.553
1.002	4 15	Summer	30	+0%	30/15	Summer			37.477
1.003	5 60	Summer	30	+0%	30/60	Summer			37.414

Surcharged Flooded

US/MH

Depth

Volume

Flow / Overflow

Pipe

Flow

Level

PN

Name

(m)

(m³)

Cap.

(l/s)

(l/s)

Status

Exceeded

1.000

1

-0.038

0.000

0.70

2.8

OK

1.001

2

0.005

0.000

0.74

3.0

SURCHARGED

2.000

3

-0.047

0.000

0.53

2.8

OK*

1.002

4

0.040

0.000

1.54

5.4

SURCHARGED

1.003

5

0.010

0.000

0.00

0.0

SURCHARGED

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 273650 197300 SS 73650 97300
Data Type Catchment
Cv (Summer) 1.000
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

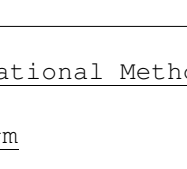
Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 30

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level
1.000	1 30	Summer	100	+30%	100/15	Summer			37.695
1.001	2 60	Summer	100	+30%	30/15	Summer			37.651
2.000	3 15	Winter	100	+30%					37.600
1.002	4 60	Summer	100	+30%	30/15	Summer			37.643
1.003	5 60	Summer	100	+30%	30/60	Summer			37.635

	US/MH	Depth	Volume	Flow /	Overflow	Pipe		Level
PN	Name	(m)	(m³)	Cap.	(l/s)	Flow (l/s)	Status	Exceeded
1.000	1	0.095	0.000	0.89		3.6	SURCHARGED	
1.001	2	0.136	0.000	0.88		3.6	SURCHARGED	
2.000	3	0.000	0.000	0.71		3.8	SURCHARGED*	
1.002	4	0.206	0.000	1.86		6.6	SURCHARGED	
1.003	5	0.231	0.000	0.00		0.0	SURCHARGED	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	1999
Site Location GB 273650 197300 SS 73650 97300	
C (1km)	-0.025
D1 (1km)	0.455
D2 (1km)	0.388
D3 (1km)	0.405
E (1km)	0.283
F (1km)	2.474
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	6.460	0.032	200.0	0.002	5.00	0.0	0.600		o	100	Pipe/Conduit	
1.001	14.500	0.073	200.0	0.004	0.00	0.0	0.600		o	100	Pipe/Conduit	
2.000	28.600	0.114	250.0	0.011	5.00	0.0		0.045	3 \=/	300	1:3 Swale	
1.002	5.000	0.033	151.5	0.062	0.00	0.0		0.045	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	50.00	5.20	38.250	0.002	0.0	0.0	0.0	0.54	4.2	0.3
1.001	50.00	5.65	38.218	0.006	0.0	0.0	0.0	0.54	4.2	0.8
2.000	49.60	6.69	38.250	0.011	0.0	0.0	0.0	0.28	31.8	1.5
1.002	48.33	7.00	38.020	0.079	0.0	0.0	0.0	0.27	10.5	10.3

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	5.000	0.820	6.1	0.000	0.00	0.0		0.045	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 Flow (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.003	48.09	7.07	37.987	0.079	0.0	0.0	0.0	1.32	52.5	10.3

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		38.700	37.168	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 273650 197300 SS 73650 97300
Data Type	Catchment
Summer Storms	No
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	30

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

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coefficient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 0

Number of Time/Area Diagrams 0

Number of Offline Controls 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model

FEH

FEH Rainfall Version

2013

Site Location GB 273650 197300 SS 73650 97300

Data Type

Catchment

Cv (Summer)

1.000

Cv (Winter)

1.000

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep

Fine Inertia Status OFF

DTS Status

ON

Profile(s)

Summer and Winter

Duration(s) (mins)

15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years)

2, 30, 100

Climate Change (%)

0, 0, 30

									Water
PN	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	1	15 Summer	2	+0%					38.271
1.001	2	15 Summer	2	+0%					38.251
2.000	3	15 Summer	2	+0%					38.287
1.002	4	120 Summer	2	+0%	100/30 Summer				38.121
1.003	5	120 Summer	2	+0%				0	38.030

Surcharged Flooded							Pipe	
PN	US/MH	Depth	Volume	Flow /	Overflow	Flow	Level	
	Name	(m)	(m³)	Cap.	(l/s)	(l/s)	Status	Exceeded
1.000	1	-0.079	0.000	0.10		0.4	OK	
1.001	2	-0.067	0.000	0.24		1.0	OK	
2.000	3	-0.313	0.000	0.01		2.1	OK	
1.002	4	-0.124	0.000	0.41		4.2	OK	
1.003	5	-0.183	0.000	0.08	0.0	4.1	OK	

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Micro
Drainage

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

Simulation Criteria

Areal Reduction Factor 1.000

Additional Flow - % of Total Flow 0.000

Hot Start (mins) 0

MADD Factor * 10m³/ha Storage 2.000

Hot Start Level (mm) 0

Inlet Coefficient 0.800

Manhole Headloss Coeff (Global) 0.500

Flow per Person per Day (l/per/day) 0.000

Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 0

Number of Time/Area Diagrams 0

Number of Offline Controls 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH

FEH Rainfall Version 2013

Site Location GB 273650 197300 SS 73650 97300

Data Type Catchment

Cv (Summer) 1.000

Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0

DVD Status OFF

Analysis Timestep Fine

Inertia Status OFF

DTS Status ON

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 2, 30, 100

Climate Change (%) 0, 0, 30

US/MH

PN

Name

Storm

Return Period

Climate Change

First (X) Surge

First (Y) Flood

First (Z) Overflow

Overflow Act.

Water Level (m)

1.000

1 15 Summer

30

+0%

38.283

1.001

2 15 Summer

30

+0%

38.272

2.000

3 15 Summer

30

+0%

38.302

1.002

4 60 Summer

30

+0%

100/30 Summer

38.185

1.003

5 60 Summer

30

+0%

0

38.040

Surcharged Flooded

Pipe

US/MH

PN

Name

Depth (m)

Volume (m³)

Flow / Cap.

Overflow (l/s)

Pipe Flow (l/s)

Status

Level Exceeded

1.000

1

-0.067

0.000

0.19

0.7

OK

1.001

2

-0.046

0.000

0.55

2.2

OK

2.000

3

-0.298

0.000

0.02

3.9

FLOOD RISK*

1.002

4

-0.060

0.000

0.89

9.1

OK

1.003

5

-0.172

0.000

0.13

0.0

6.4

OK

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

Simulation Criteria

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

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

Synthetic Rainfall Details

Rainfall Model FEH
FEH Rainfall Version 2013
Site Location GB 273650 197300 SS 73650 97300
Data Type Catchment
Cv (Summer) 1.000
Cv (Winter) 1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 2, 30, 100
Climate Change (%) 0, 0, 30

Water

PN	US/MH	Storm	Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
	Name		Period	Change	Surcharge	Flood	Overflow	Act.	(m)
1.000	1 15	Summer	100	+30%					38.299
1.001	2 15	Summer	100	+30%					38.292
2.000	3 15	Summer	100	+30%					38.318
1.002	4 60	Summer	100	+30%	100/30	Summer			38.270
1.003	5 60	Summer	100	+30%				0	38.047

Surcharged Flooded				Pipe			
PN	US/MH	Depth	Volume	Flow /	Overflow	Level	
	Name	(m)	(m³)	Cap.	(l/s)	Exceeded	
1.000	1	-0.051	0.000	0.31	1.2	OK	
1.001	2	-0.026	0.000	0.87	3.5	OK	
2.000	3	-0.282	0.000	0.03	6.3	FLOOD RISK*	
1.002	4	0.024	0.000	1.43	14.7	FLOOD RISK	
1.003	5	-0.165	0.000	0.16	0.0	8.2	OK

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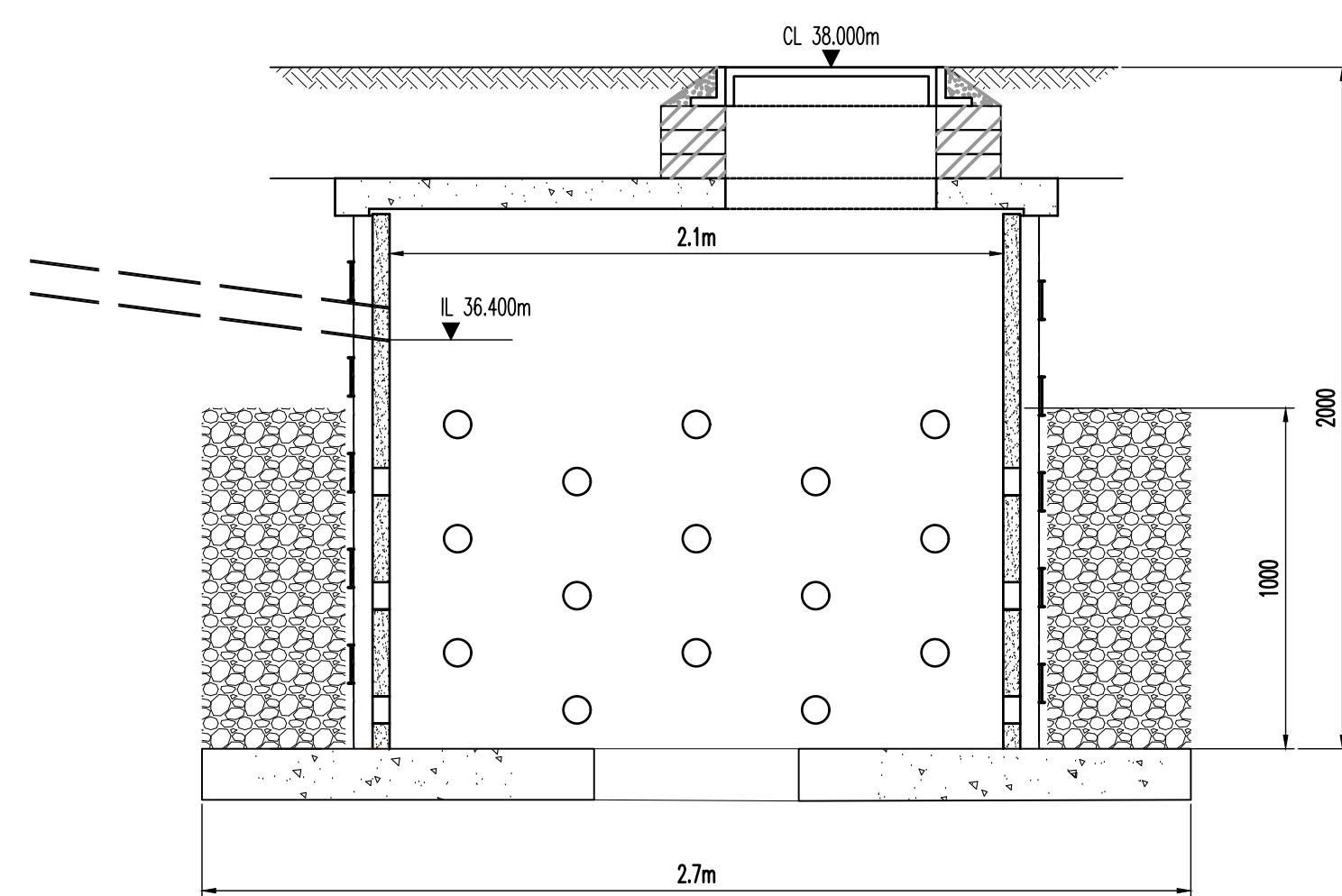
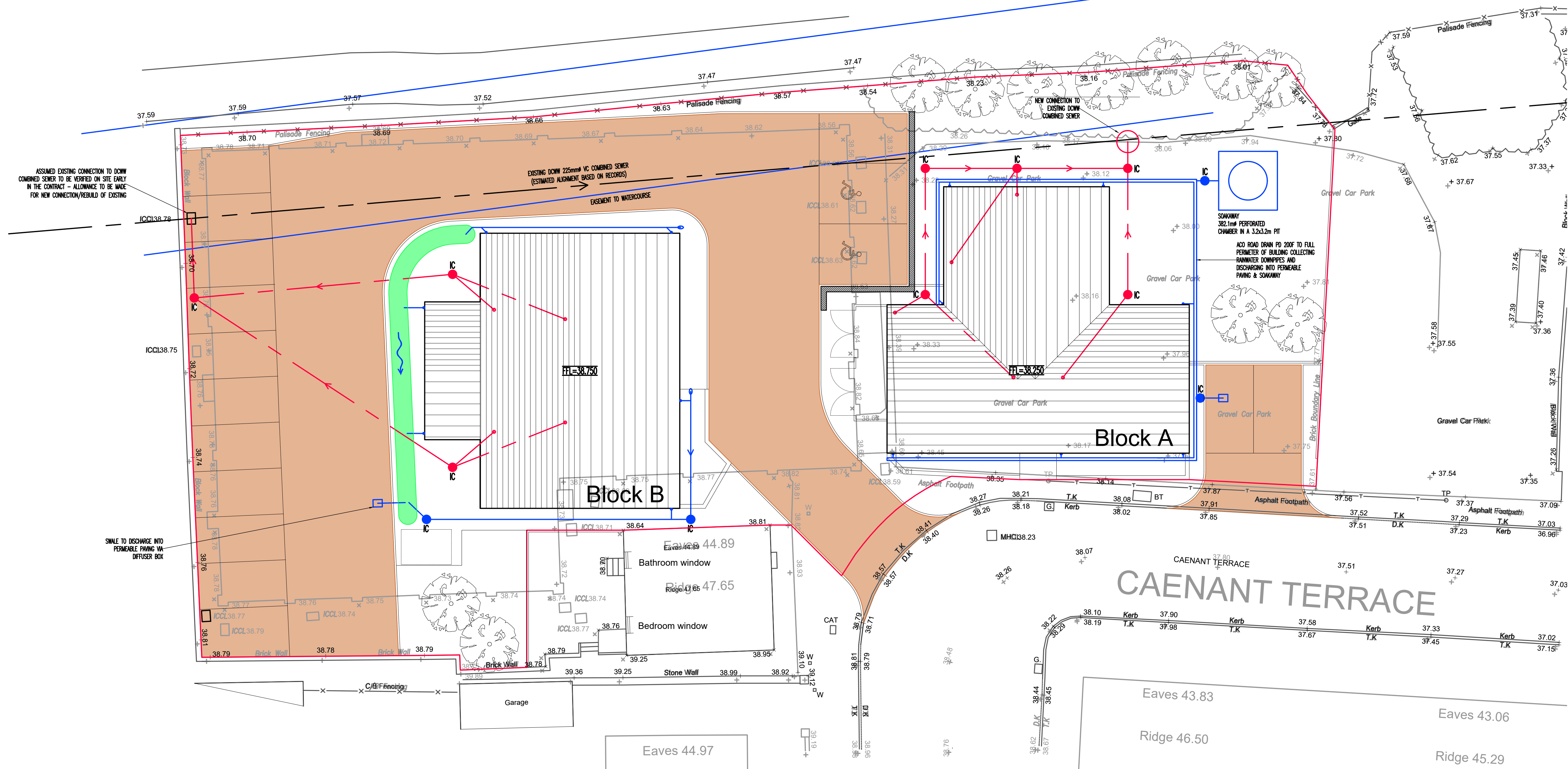
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GENERAL

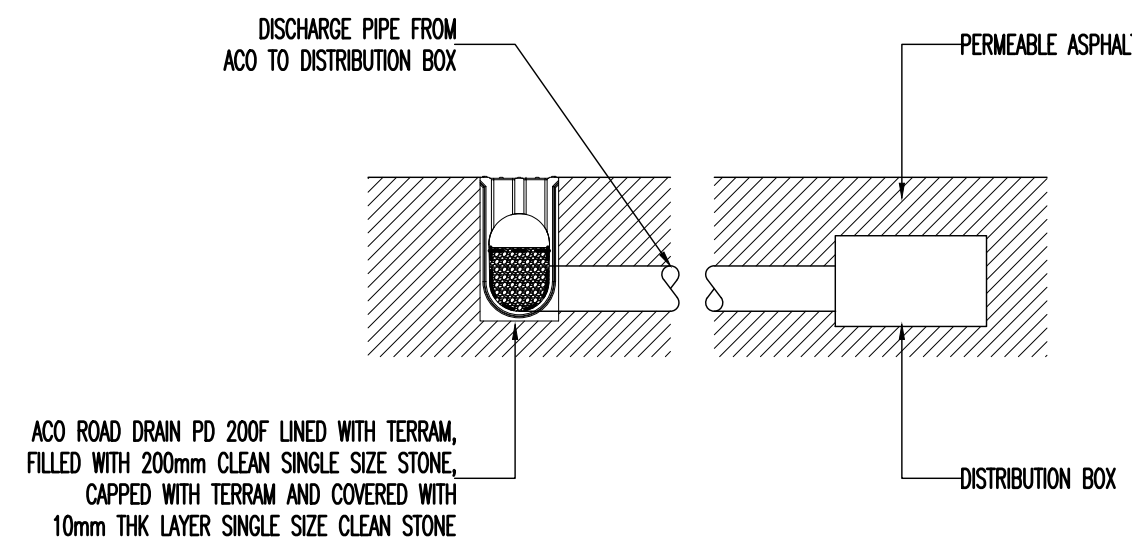
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KEY:

- NEW STORM WATER DRAINAGE
- NEW FOUL WATER DRAINAGE
- EXISTING FOUL WATER DRAINAGE
- PERMEABLE PAVING AREAS
- BIO RETENTION & SWALE AREAS
- ~ DIRECTION OF FLOW



SOAKAWAY TYPICAL DETAIL
N.T.S.



SCHEMATIC DETAIL OF ACO DISCHARGING TO PERMEABLE PAVING

P1	FIRST ISSUE	BP	APR 2020
REV.	DESCRIPTION	BY	DATE

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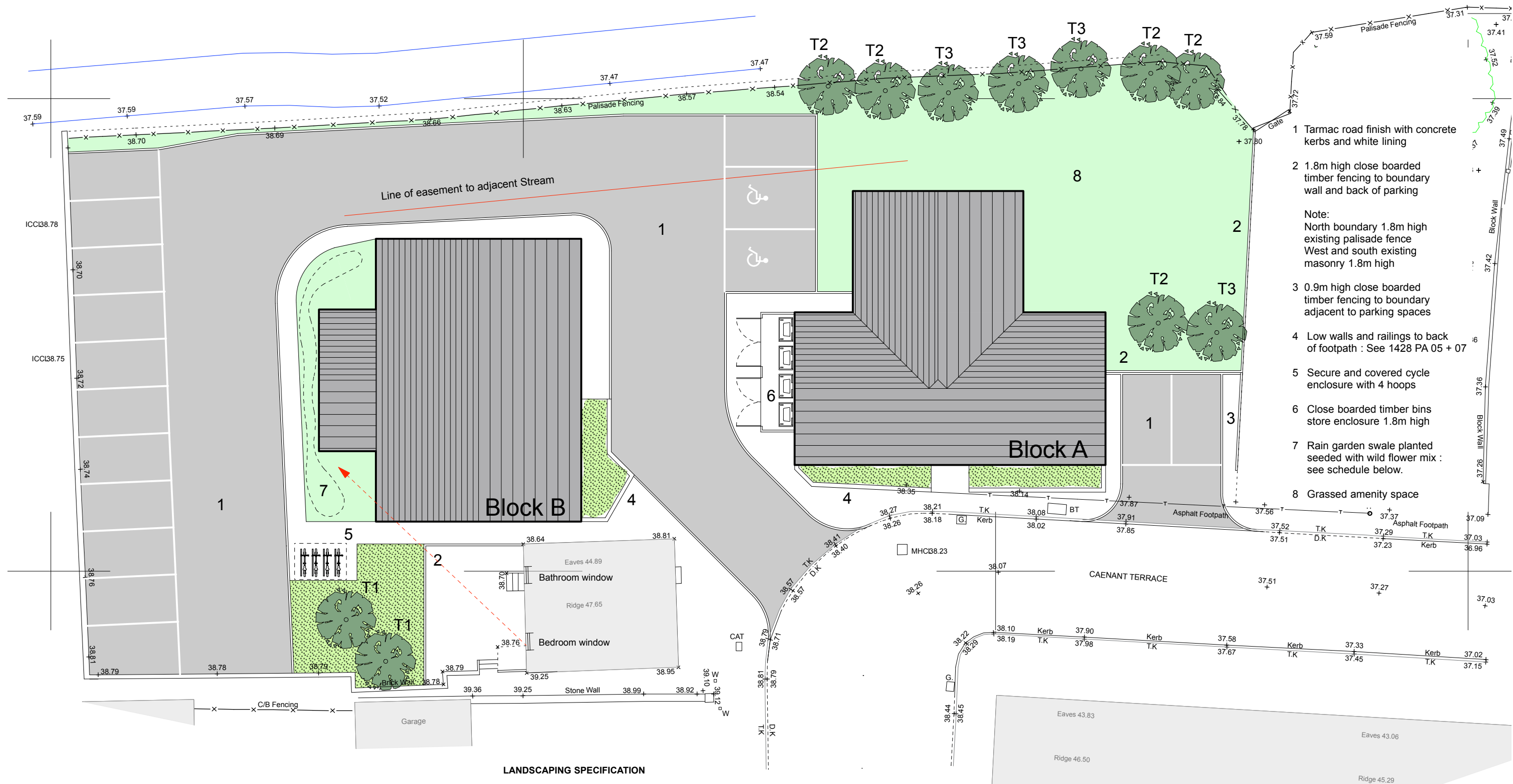
drawing title
PROPOSED DRAINAGE

drawn	BP	chkd	CLC	scale	1:125@A1	date	JAN 2019
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Preliminary	☒	Job No.	IR20018	Drawing No.	SK101	Rev.	P1
Tender	☐						
Construction	☐						

PRELIMINARY

Appendix D



1 Tarmac road finish with concrete kerbs and white lining

2 1.8m high close boarded timber fencing to boundary wall and back of parking

Note:
North boundary 1.8m high existing palisade fence
West and south existing masonry 1.8m high

3 0.9m high close boarded timber fencing to boundary adjacent to parking spaces

4 Low walls and railings to back of footpath : See 1428 PA 05 + 07

5 Secure and covered cycle enclosure with 4 hoops

6 Close boarded timber bins store enclosure 1.8m high

7 Rain garden swale planted seeded with wild flower mix : see schedule below.

8 Grassed amenity space

LANDSCAPING SPECIFICATION

Plants for Bio Retention Areas

Plants for the base of vegetated swales and bio retention areas to include grasses and sedge meadow plants which create a dense fibrous root system with many root channels. This will hold the soil together and increase infiltration while preventing erosion.

The sloping sides of the swales and bio retention area to be seeded with amenity grass mix to match the adjacent areas.

Grass Seed mix for Bio Retention Areas

Botanical Name	Common Name
Andropogon gerardii	Big Bluestem
Calamagrostis canadensis	Bluejoint Grass
Carex lurida	Bottlebrush Sedge
Carex stricta	Common Tussock Sedge
Carex vulpinoidea	Brown Fox Sedge
Elymus virginicus	Virginia Wild Rye
Juncus canadensis	Canadian Rush
Panicum virgatum	Switch Grass
Scirpus cyperinus	Wool Grass
Spartina pectinata	Prairie Cord Grass

Wild Flower Seed mix for Bio Retention Areas

Botanical Name	Common Name
Stachys officinalis	Betony
Lotus corniculatus	Bird's-foot Trefoil
Centaurea nigra	Black Knapweed
Primula veris	Cowslip
Ranunculus acris	Meadow Buttercup
Leucanthemum vulgare	Oxeye Daisy
Silene silaus	Pepper Saxifrage
Lychnis flos-cuculi	Ragged Robin
Plantago lanceolata	Ribwort Plantain
Prunella vulgaris	Selfheal
Rhinanthus minor	Yellow Rattle

Trees planted within bio retention areas

Botanical Name	Common Name
T1	Sambucus nigra
T2	Betula Pendula
T3	Cretaceous Monogyna
	Silver Birch
	Hawthorn

Kennedy James Griffiths
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Proposed Apartments Caenant Terrace, Skewen

Title: 11 02 2020

Proposed Site Plans

Status: Scale @ A3
1:200

Job Number: Revision: Drawn by: DJ

1428-PA-02

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