

New workshop and office buildings at Tankertech Ltd,
Unit 11 Edwards Works, Llandarcy

DRAINAGE STATEMENT & CALCULATIONS

 H&M Davies Ltd Rhydywel Fach Crwbin Kidwelly	Project		Job no.1550	
	Tankertech Ltd, Llandarcy		Start page no./Revision	
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Drainage statement

Drainage Statement for Tankertech Ltd, Llandarcy.

Introduction

This statement outlines the proposal for the disposal of surface water runoff from two new steel framed buildings at Tankertech Ltd, Unit 11 Edwards Works, Llandarcy. The application site is an industrial site on brown field land on an established privately owned industrial estate. The site is not withing a Flood Risk Zone as indicated by the enclosed NRW Floor Risk map.

The site consists of high levels of made ground comprising ash and clinker material, crushed bricks and slag type materials with iron oxide deposits, likely to be from the sites historical past uses which included chemical works, copper works and gas works. Also, a pollution sheen was visible on water at the base of the test hole during the ground infiltration testing suggesting chemical / oil contamination in the surrounding soils. The composition of this contamination is unknown but considering the historical industrial activities at the site it can be assumed it is a legacy of the site's industrial past with the Groundsure Report highlighting this as a Moderate – High Contaminated land site.

Although the site does provide very high levels of infiltration making soakaways a valid option, the history of the site and potential for ground contaminants and migration of pollutants should be considered if adopting soakaways. The site does benefit from a storm water sewer, part of the original gas works site drainage which is in working order. The site drainage is privately owned and not subject to Welsh Water Adoption. This storm drain discharges to a tidal tributary of the river Neath at the south of the site. The outlet consists of a flap valve (Fig.3), which is below high tide level.

A previously demolished building on the site which formed part of the Gas Works complex measured approximately 31m x 15m giving an impermeable roof area of 465m². The roof storm water previously discharged into the existing storm drains on the site which were part of the original Gas Works site services. Based on rainfall levels in accordance with the Wallingford Procedure the maximum runoff from the original roof based on a 100 year event with a 30% increase for global warming would have amounted to 22.5l/sec. The new buildings comprise a 25m x 12m workshop building and a 9m x 9m office building with a combined impermeable roof area of 381m², which is less than the original building on the site. In comparison the maximum runoff from the new buildings amounts to 18.4l/sec, less than 22.5l/sec from the original building.

Current proposals

Adopting the hierarchical SUDS design process, intercepting for re use is being proposed to comply with the 5mm interception requirement. Re use on site for the full runoff volumes is not considered practical as the potential for harvested water use on site is very low when compared with the actual runoff volumes and installation costs involved. Water use on site connected with the business activities uses storage tanks and filtration systems, thereby re using water on a continuous basis, this system will be topped up from the harvesting tank as required. Apart from toilet facilities there is very little other demand for harvested water on site.

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Infiltration to ground was considered for the excess harvesting tank overflow as the next hierarchical level with a soakaway located 5m from the new workshop building. An infiltration test hole carried out on the site resulted in very high levels of infiltration (see separate Soil Infiltration Test report), but excavations highlighted the sites historical industrial past and the presence of high levels of made-up ground comprising ash and clinker material, crushed bricks and slag type materials with iron oxide deposits. The composition of this contamination is unknown but considering the historical industrial activities at the site it can be assumed it is a legacy of the sites industrial past which included chemical works, copper works and gas works, plus a likelihood of imported local blast furnace slag which may present heavy metal contamination and high pH contamination risks to groundwater. During infiltration testing a pollution sheen was visible on water at the base of the test hole suggesting chemical / oil contamination in the surrounding soils. The composition of this contamination is unknown but considering the historical industrial activities at the site it can be assumed it is a legacy of the site's industrial past or imported contaminants. Infiltration into contaminated ground could potentially result in pollutants being mobilised and leaching into ground water. Considering the extensive and expansive nature of the sites historical past it is assumed that the ground makeup is relatively uniform across the site and not just limited to the test hole area only.

The next level in the hierarch structure considers discharge to watercourse. This is being discounted as there is no open watercourse at or near the site. There is an abandoned canal 35m to the west of the site but this may be discounted as a discharge destination due to unfavourable levels and the condition of the canal. We could consult with NRW and the Canal & Rivers Trust, but I would imagine the unmaintained nature of this canal would only raise unsurmountable concerns and obstacles.

The next level considers discharge to surface water sewer. A private surface water sewer already exists on the site, part of the original gas works drainage system. The sites previous use as a gas works had an established drain network for storm water disposal with outfalls to a tidal tributary of the river Neath estuary. The previously demolished building discharged into these drains, and the current new building has been temporarily connected into these existing drains. These are currently in working order with no issues evident. As an informative the original building roof area was 465sqm, while the combine roof area of the new workshop and office building will be 381sqm, so discharge into these drains will be less than the original building discharge rates. It is proposed to retain the temporary connection to provide a discharge route to the tidal estuary in which case and referring to the SUDS Manual, the control of peak run-offs and runoff volumes is not necessary.

The requirement to provide interception for rainfall events of up to 5mm may be achieved by harvesting, infiltration or evaporation. It is proposed to introduce a 1500 litre gravity feed 'Rainwater Harvesting Ltd' F-Line below ground tank system fed by roof water to supply water to toilets in the new office block and workshop, and to provide top up water to the onsite closed loop tanker testing system. The tank will be installed adjacent to the new office building with a tank pump feeding a gravity header tank fitted at high level in the new office block and workshop. This gravity header tank will also incorporate mains water top up facility for continued use during periods of dry weather. The tank overflow will be connected to the existing on site storm drain system which discharges to the tidal estuary. Section 24.8, Box 24.3 (Simple approaches to interception), and Table 24.6 (Interception mechanisms) of the SUDS Manual states that Rainwater Harvesting Systems can be assumed to be compliant for zero runoff for the first 5mm rainfall for 80% of events during summer and 50% in winter.

The drain estuary outlet level when considering tide levels should be considered to establish the duration of time the flap valve is closed due to a high tide. Highest tide heights for the river Neath estuary are in the region of 9m to 9.9m with Chart Datums (CD) used for tidal elevations and Ordnance Survey (OS) datum used for topographical surveys. The CD tidal height can be converted to OS elevation by adding the negative CD value (-5m for Mumbles) to the OS value to obtain the

The time during which the storm drain will be tide locked will vary depending on actual tide levels. If we apply the Rule of Twelfths principle for tide height changes then at the sixth hour of a tide cycle, which is at the point of high tide then the tide rises & falls by $1/12^{\text{th}}$ of the tide range. Maximum tidal range at the river Neath estuary is approximately 9m, therefore $9\text{m} / 12 = 0.75\text{m}$ rise and fall one hour either side of low / high tide. During high spring tides the outfall will be tide locked for approximately 3 hours, while during average or normal high tide events the outfall will be tide locked for around 20 minutes.

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If infiltration to ground is being discounted on the grounds of soil-based contaminants and pollutants, then discharge to estuary will be adopted on the principle that clean uncontaminated storm water will be discharged to the river Neath tidal estuary via the existing storm drain network. However, the position of the storm drain outlet into the tidal tributary relative to tidal heights will create periods when the drain outlet will be submerged creating a possible tidal lock situation. These have been calculated as 3 hours for an exceptional spring tide event, or 20 minutes for normal high tide events. The chances of a 1 in 100 + 30% storm event occurring at these exact high tide event windows may well be rare, but such an event should not have a detrimental effect on the SUDS system.

The purpose of the outlet flap valve is to close and prevent sea water and debris entering the drainage network during high tidal events (Figs 3 & 4). During normal operation at lower tide levels water build up in the drain pipework will force the valve open allowing water to discharge into the tidal river. Referring to drawing No. SWA-Services-010 part view (Fig.5) this drawing gives a storm chamber invert height of 3.89m at the outfall, and an invert height of 6.44m at the final chamber on the application site (Fig.6) This gives a height difference of 2.55m between both chambers, while to surrounding ground level taken as cover level of 7.21m at the outfall cover level and is well above the high tide level of 5m (OS equivalent) and not subject to flooding from the sea as verified by the NRW Flood Risk Map (Fig.7). The reality of this situation is that while the outlet valve is forced closed by the tidal waters at high tide any buildup of water within the drainage network during storm events will build up against the valve until the water pressure in the pipe increases above the external water pressure forcing the valve open allowing water levels at both sides of the valve to obtain equilibrium, therefore water levels in the drain network should never rise above the high tide level present at the time, and should not create flooding issues at the applicant or neighbouring sites.



Storm drain outlet

Figure 3 - Drain outlets

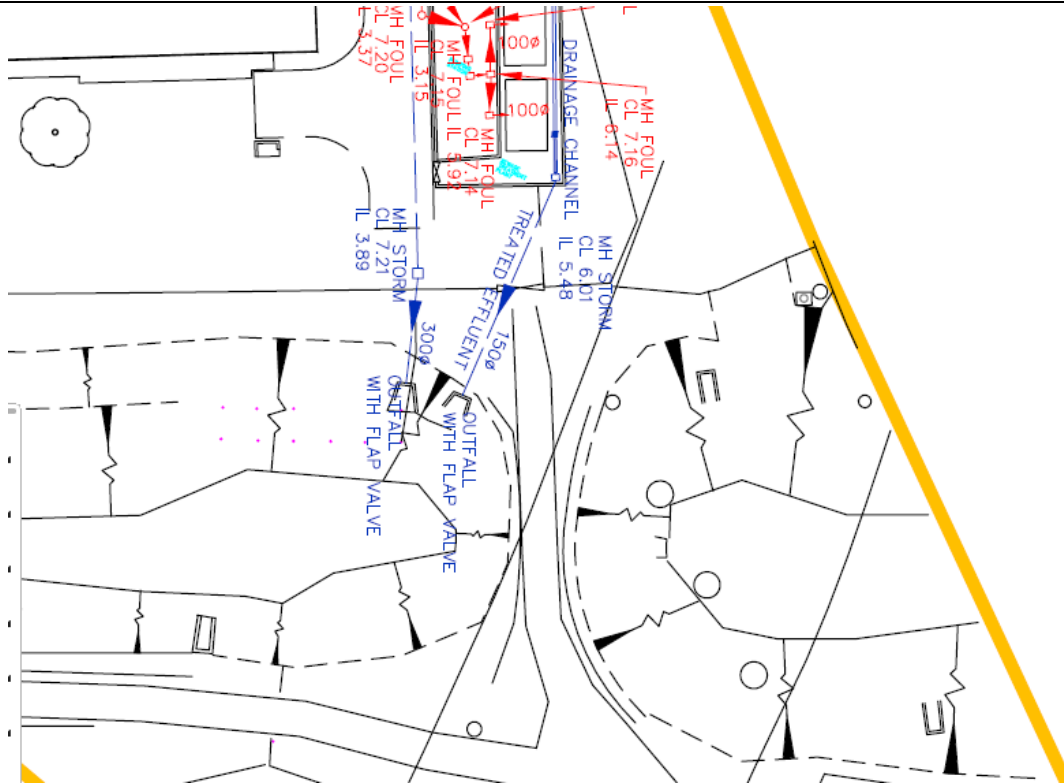


Figure 5 - Levels at outlet chamber

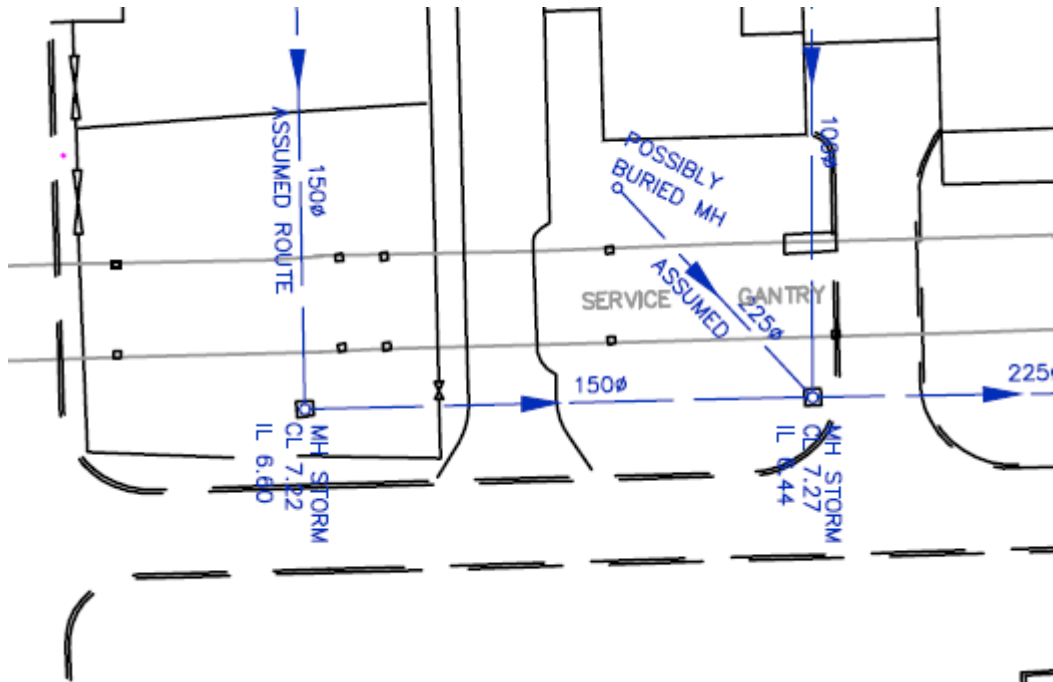


Figure 6 - Chamber levels at application site

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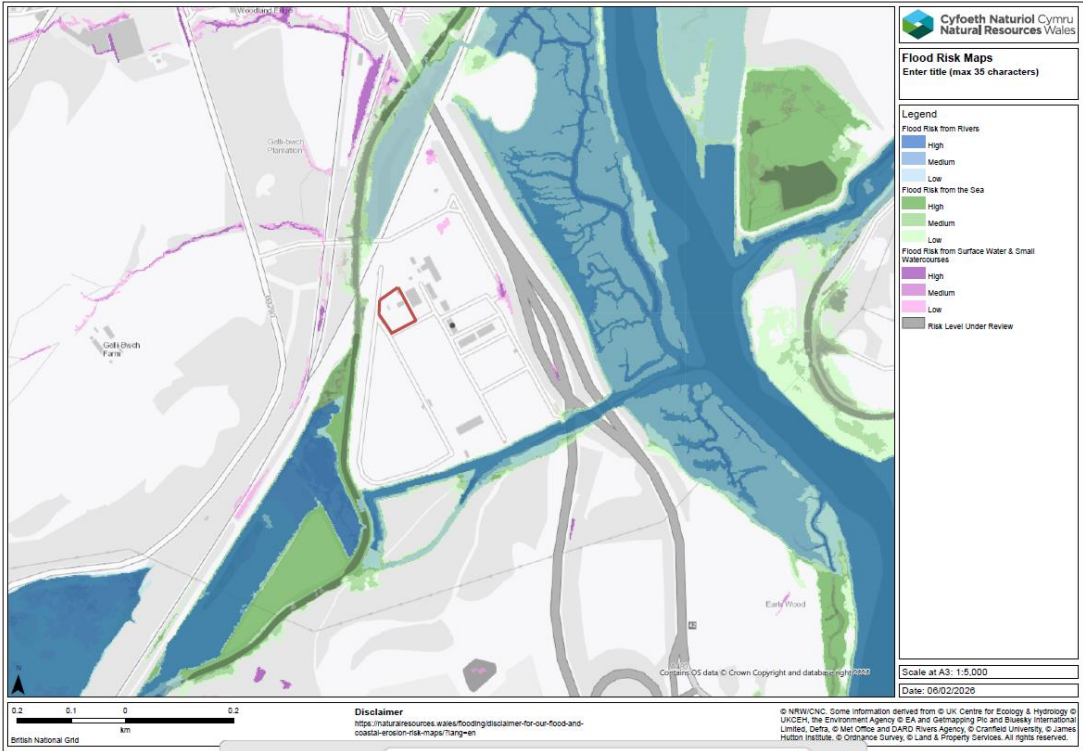


Figure 7 - NRW Flood risk map

Exceedance

The site being a level site is predominantly a gravel surface outside of buildings, and considering the very high infiltration rates for the ground any system failure will likely result in infiltration into the ground local to the failure point. It is not envisaged that there will be any exceedance flow off the site.

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Detail design

Original demolished Impermeable roof areas on plan = 456m²

New buildings Impermeable roof areas on plan = 381m²

DESIGN RAINFALL - ORIGINAL BUILDING

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.02

Design rainfall intensity

Location of catchment area; Swansea
Storm duration; D = 5 min
Return period; Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period; r = 0.280
5-year return period rainfall of 60 minutes duration; M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming; p_{climate} = 30 %
Factor Z1 (Wallingford procedure); Z1 = 0.33
Rainfall for 5min storm with 5 year return period; M5_5min_i = Z1 × M5_60min × (1 + p_{climate}) = 7.8 mm
Factor Z2 (Wallingford procedure); Z2 = 1.86
Rainfall for 5min storm with 100 year return period; M100_5min = Z2 × M5_5min_i = 14.5 mm
Design rainfall intensity; I_{max} = M100_5min / D = 173.8 mm/hr

Maximum surface water runoff

Catchment area; A_{catch} = 465 m²
Percentage of area that is impermeable; p = 100 %
Maximum surface water runoff; Q_{max} = A_{catch} × p × I_{max} = 22.5 l/s

DESIGN RAINFALL - NEW BUILDINGS

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.02

DESIGN RAINFALL

In accordance with the Wallingford Procedure

Tedds calculation version 2.0.02

Design rainfall intensity

Location of catchment area; Swansea
Storm duration; D = 5 min
Return period; Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period; r = 0.280
5-year return period rainfall of 60 minutes duration; M5_60min = 18.0 mm
Increase of rainfall intensity due to global warming; p_{climate} = 30 %
Factor Z1 (Wallingford procedure); Z1 = 0.33
Rainfall for 5min storm with 5 year return period; M5_5min_i = Z1 × M5_60min × (1 + p_{climate}) = 7.8 mm
Factor Z2 (Wallingford procedure); Z2 = 1.86
Rainfall for 5min storm with 100 year return period; M100_5min = Z2 × M5_5min_i = 14.5 mm
Design rainfall intensity; I_{max} = M100_5min / D = 173.8 mm/hr

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Maximum surface water runoff

Catchment area; $A_{catch} = 431 \text{ m}^2$
Percentage of area that is impermeable; $p = 100 \%$
Maximum surface water runoff; $Q_{max} = A_{catch} \times p \times I_{max} = 20.8 \text{ l/s}$

Calculations for infiltration to ground by soakaway if considered suitable for soil conditions on site. Soakaway construction based on use of plastic void crates with 95% void ratio. **Due to the potential for ground contaminants and pollutants infiltration to ground is not the preferred option.**

Soakaway design in accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.05

Design rainfall intensity

Location of catchment area; Swansea
Impermeable area drained to the system; $A = 384.0 \text{ m}^2$
Return period; Period = **100 yr**
Ratio 60 min to 2 day rainfall of 5 yr return period; $r = 0.360$
5-year return period rainfall of 60 minutes duration; $M5_{60min} = 19.0 \text{ mm}$
Increase of rainfall intensity due to global warming; $p_{climate} = 30 \%$

Soakaway / infiltration trench details

Soakaway type; Rectangular
Minimum depth of pit (below incoming invert); $d = 800 \text{ mm}$
Width of pit; $w = 2000 \text{ mm}$
Length of pit; $l = 7376 \text{ mm}$
Percentage free volume; $V_{free} = 95 \%$

Soil infiltration rate (BRE digest 365)

Length of trial pit; $l_{trial} = 1200 \text{ mm}$
Width of trial pit; $b_{trial} = 1000 \text{ mm}$
Depth of trial pit (below invert); $d_{trial} = 1000 \text{ mm}$
Free volume (if fill used); $V_{trial} = 100 \%$
75% depth of pit; $d_{75} = (d_{trial} \times 0.75) = 750.00 \text{ mm}$
50% depth of pit; $d_{50} = (d_{trial} \times 0.50) = 500.00 \text{ mm}$
25% depth of pit; $d_{25} = (d_{trial} \times 0.25) = 250.00 \text{ mm}$
Test 1 - time to fall from 75% depth to 25% depth; $T1 = 10 \text{ min}$
Test 2 - time to fall from 75% depth to 25% depth; $T2 = 10 \text{ min}$
Test 3 - time to fall from 75% depth to 25% depth; $T3 = 10 \text{ min}$
Longest time to fall from 75% depth to 25% depth; $t_g = \max(T1, T2, T3) = 10 \text{ min}$
Storage volume from 75% to 25% depth; $V_{p75_25} = (l_{trial} \times b_{trial} \times (d_{75} - d_{25})) \times V_{trial} = 0.60 \text{ m}^3$
Internal surface area to 50% depth; $a_{p50} = ((l_{trial} \times b_{trial}) + (l_{trial} + b_{trial}) \times 2 \times d_{50}) = 3.40 \text{ m}^2$
Surface area of soakaway to 50% storage depth; $A_{s50} = 2 \times (l_{trial} + b_{trial}) \times d_{trial} / 2 = 2.200 \text{ m}^2$
Soil infiltration rate; $f = V_{p75_25} / (a_{p50} \times t_g) = 294. \times 10^{-6} \text{ m/s}$
Wetted area of pit 50% full; $a_{s50} = l \times d + w \times d = 7500409 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1); $I = M100 \times A$
Outflow (cl.3.3.2); $O = a_{s50} \times f \times D$
Storage (cl.3.3.3); $S = I - O$

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Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5;	0.36;	8.9;	1.88;	16.7;	6.43;	0.66;	5.77
10;	0.51;	12.6;	1.95;	24.6;	9.44;	1.32;	8.12
15;	0.62;	15.3;	1.99;	30.5;	11.72;	1.99;	9.73
30;	0.79;	19.5;	2.03;	39.5;	15.18;	3.97;	11.21
60;	1.00;	24.7;	2.01;	49.7;	19.08;	7.94;	11.13
120;	1.22;	30.1;	1.97;	59.3;	22.78;	15.88;	6.90
240;	1.48;	36.6;	1.92;	70.1;	26.92;	31.77;	0.00
360;	1.67;	41.2;	1.88;	77.5;	29.78;	47.65;	0.00
600;	1.90;	46.9;	1.83;	86.1;	33.06;	79.42;	0.00
1440;	2.42;	59.8;	1.74;	104.2;	40.02;	190.60;	0.00

Required storage volume;

$$S_{\text{req}} = 11.21 \text{ m}^3$$

Soakaway storage volume;

$$S_{\text{act}} = l \times d \times w \times V_{\text{free}} = 11.21 \text{ m}^3$$

PASS - Soakaway storage volume

Time for emptying soakaway to half volume;

$$t_{s50} = S_{\text{req}} \times 0.5 / (a_{s50} \times f); = 42\text{min } 21\text{s}$$

PASS - Soakaway discharge time less than or equal to 24 hours

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Drainage construction specification and maintenance plan

Construction stage

To prevent drain damage, soil compaction, soil erosion and site runoff as a result of heavy plant and soil movements the storm water drainage runs to be constructed during periods of dry weather only. Drainage runs to be excavated in accordance with the proposed site plan A100, and A101 sections with falls between 1:40/ 1:80, and invert depth minimum 500mm, and back filled with clean soil free from large stones. Buried drainage pipe to be 150mm PVC-U pipes with socket fittings, with concrete capping and chamber surrounds at high traffic areas where drain run depths are less than 900mm deep.

Drainage maintenance

Maintenance activities will entail the periodic inspection the roof gutter inlets to clear debris, the inspection of the Rainwater Harvesting system to check correct operation in line with manufacturer's instructions, and the periodic inspection of drain chambers to check for blockages and pollutant ingress. System to be checked for effective operation on a 3 monthly basis by visual inspection during periods of rainfall and checking the water is discharging into the drains and not backing up at the inlet gullies. Ensure ground around the SUDS infrastructure and over pipework is not subjected to heavy concentrated loading by plant and machinery. Drainage maintenance to be undertaken by the owner with any groundworks contractors undertaking future works on site informed of the position of underground drainage features.

References:

1550 Soil infiltration test to BRE365
Groundsure Report
1550 Drainage strategy
1550 CEMP
1550 SUDS Maintenance plan

Drawing Nos.
SWA-Services-001, 010 & 005. Site plans and survey data
01 Site Location Plan
02 Proposed Site Layout Plan
03 Proposed Steel Frame Office Building
A100 Location and site plans
A101 Optional soakaway details
A102 Area plan with height data