



Dragon Packaging

47-48 Clywedog Road North

Wrexham Industrial Estate

Wrexham

LL13 9XN

Proposed Commercial Extension

SuDS Strategy

For: FI Real Estate

Integra Consulting

Suite 4

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Manchester

M15 4GB

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Environmental

Geotechnical

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1.0 INTRODUCTION

1.1 Background

This SuDS Strategy has been prepared to support a planning application at Dragon Packaging, 47-48 Clywedog Road North, Wrexham Industrial Estate, Wrexham LL13 9XN. It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the development site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

1.2 Standards

This SuDS Strategy complies with the principles of SuDS presented in the ‘Statutory Standards for Sustainable Drainage Systems – Designing, constructing, operating and maintaining surface water drainage systems’, however a Sustainable Drainage Approval Body (SAB) application is not currently sought in this instance. The six standards are as follows:

- S1 - Surface Water Runoff Destination
- S2 - Surface Water Runoff Hydraulic Control
- S3 - Water Quality
- S4 - Amenity
- S5 - Biodiversity
- S6 - Designing Drainage for Construction, Operation, Maintenance and Structural Integrity

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes geological information from the British Geological Survey (BGS) and the assessment will summarise and refer to this dataset in the text.

Wrexham Council is a statutory consultee for major planning applications in relation to surface water drainage, requiring that all planning applications are accompanied by a SuDS Strategy. The aim of the SuDS Strategy is to identify water management measures, including SuDS, to provide surface water runoff reduction and treatment. A SuDS approach has been adopted to the management of surface water runoff from the site .

1.3 What are SuDS?

A Sustainable Drainage System (SuDS) is designed to replicate, as closely as possible, the natural drainage from the site (before development) to ensure that the flood risk downstream of the site does not increase as a result of the land being developed. SuDS can also significantly improve the quality of water leaving the site and can enhance the amenity and biodiversity that a site has to offer.

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. The standards set out appropriate design criteria based on four main parameters:

1. Runoff Destination (in order of preference)

- a. Re-use;
- b. To ground;
- c. To surface water body;
- d. To road drain or surface water sewer;
- e. To combined sewer

2. Peak flow rate and volume (pre-and post-development)

3. Water Quality (based on potential hazards arising from development and sensitivity of the runoff destination)

4. Function (design; flood risk; operation and maintenance)

These parameters are then used to develop a drainage strategy based on the following six principles:

1. Manage surface runoff at source
2. Manage on the surface
3. Utilise public space and integrate into the drainage design
4. Effective operation and maintenance
5. Account for climate change and changes in impermeable area
6. Affordability

This report aims identify the most practicable runoff destination and drainage parameters for each site. A surface water drainage assessment is presented with reference to the hydrological and hydrogeological context of the development.

1.4 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Residential development is assumed to have a lifetime of 100 years while a lifetime of 75 years is assumed for non-residential developments. The recommended national precautionary climate change allowance for peak rainfall intensity is 30%.

1.5 SuDS Proposal

The SuDS Strategy at the development comprises:

- **Discharge to Surface Water Sewer:**
 - Attenuation in the form of underground crate storage from the new building roof areas together with the existing and proposed service yard and car parking areas then discharge to the Welsh Water adopted surface water sewerage system at a restricted discharge rate of 5.0l/s. The adopted surface water sewer then discharges to open watercourse circa 270m south east of the site.

- Given the constraints of the site, a sufficient SuDS treatment train is provided through the use of the Hydro International Up-Flo Filter Vault system with 8 No modules together with the 1.2m diameter twin walled HDPE chamber 'Downstream Defender' unit.

A 30% increase in rainfall intensity due to climate change during the lifetime of the development has been used within the calculations and a 10% increase in impermeable areas due to urban creep. The surface water runoff from the site will be restricted to greenfield runoff rates with a pragmatic minimum flow rate of 5.0 litres per second applied. The system will be maintained by the owner of the site and will not be adopted by the SAB.

1.6 Report Structure

This SuDS Strategy has the following report structure:

- Section 2 details the location & development description;
- Section 3 details surface water runoff destination;
- Section 4 outlines surface water runoff hydraulic control;
- Section 5 discusses water quality;
- Section 6 outlines amenity;
- Section 7 outlines biodiversity; and
- Section 8 discusses designing drainage for construction, operation, maintenance and structural integrity.

2.0 SITE LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The site is located at 47-48 Clywedog Road North, Wrexham Industrial Estate, Wrexham, LL13 9XN. The National Grid Reference (NGR) of the site is 337255, 349699 (refer to Appendix 1 for details).

2.2 Existing Development

The site currently consists of existing industrial buildings and an associated service yard / parking area.

2.3 Proposed Development

The proposals are for an extension on either side of the existing commercial units (refer to Appendix 3 for details). Further details with regard to the proposed development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

Topographically, the site slopes gently from north west to south east with ground levels ranging between 37.4 metres Above Ordnance Datum (mAOD) and circa 35.1mAOD (refer to Appendix 2 for details).

2.5 Catchment Hydrology / Drainage

Redwither Brook is located approximately 160m to the north of the site and the River Clywedog is located approximately 1.25km to the south of the site.

The site is located within an area of average rainfall. The 1961-1990 Standard Average Annual Rainfall (SAAR) for the site as recorded in the FEH Webservice is 692 mm per annum. The UK national average is 832mm per annum.

2.6 Ground Conditions

The British Geological Survey (BGS) Geological Map of the area indicates that the bedrock underlying the site consists of the Salop Formation - mudstone, sandstone and conglomerate. Sedimentary bedrock formed between 309.5 and 272.3 million years ago during the Carboniferous and Permian periods. The superficial deposits consist of Till, Devensian - diamicton. Sedimentary superficial deposit formed between 116 and 11.8 thousand years ago during the Quaternary period.

2.7 Contaminated Land

There is no evidence of historical industrial land use prior to 1938 following which the site formed part of a large munitions manufacturing factory. Following closure of the plant in the late 1940's, the site was re-developed for commercial uses. The above site history indicates that low levels of contamination may be present on site and a Phase 2 ground investigation is therefore recommended.

2.8 Ground Stability

Dissolution, sand liquefaction and landslides could be enhanced by SuDS infiltration and lead to unstable ground. Dissolution risk is low since the site does not appear to be directly underlain by chalk or other soluble rocks. Sand liquefaction risk is low since the site is not located on unconsolidated superficial sand deposits. Landslide risk is low since there are no records of landslides close to the site according to the BGS.

3.0 S1: SURFACE WATER DRAINAGE

3.1 Opportunities for Discharge of Surface Water

As part of the SuDS Standards the management of runoff from developments should be prioritised as to the choice of discharge destination. The priority hierarchy is listed below:

- 1) Collect for re-use;
- 2) Infiltrate to ground;
- 3) Discharge to a surface water body;
- 4) Discharge to a surface water sewer / highway drain; and
- 5) Discharge to a combined sewer.

It is necessary to identify the most appropriate method of controlling and discharging surface water. The design should seek to improve the local runoff profile by using systems that can either attenuate runoff and reduce peak flow rates or positively impact on the existing surface water runoff.

3.2 Collect for Re-use

The reuse of water from roofed areas to provide grey (non-potable) water for flushing WCs within buildings can reduce storm runoff without the need for treatment or oil separators since the risk of spillage or contamination is low.

Such a system would require one or more tanks at roof level and under optimum conditions these would be kept as near as full as possible to ensure a reliable water supply. For the purposes of a worst-case design scenario, it is assumed that the tanks would be full at the start of an extreme rainfall event and hence all storm rainfall would enter the surface water drainage system rather than grey water storage.

Whilst the first priority is to collect rainwater for re-use, rainwater harvesting was considered and deemed not suitable. From a cost/benefit approach, individual single property systems are considered to be unsuitable. The daily water requirement per person is minimal.

These types of units are typically used for storage/warehousing uses, together with some light production. There are no actual processes taking place and it is highly unlikely that there ever will be, as the unit are not designed for it and only have light electrical supplies. The proposed site layout in Appendix 1 show that there is no foreseeable non-potable water demand at the site.

In accordance with G1.4 of the SuDS standards, rainwater harvesting is not proposed for the site as:

1. There is no foreseeable need to harvest water at the site as the relevant water undertaker's water resources and drought management plans do not identify potential stresses on mains water supplies.
2. The use of rainwater harvesting is not a viable / cost-effective part of the solution for managing surface water runoff on the site, taking account of the potential water supply benefits of such a system.
3. The rainfall yield exceeds demand, rainwater harvesting is not feasible for storm water control under BS8515:2009+A1:2013 detailed design approach.

With regard to the second point above, the costs of rainwater harvesting systems (unit costs, installation costs, running costs and maintenance costs) outweigh the water saving costs. Furthermore, section G1.6 of the SuDS Standards states that; *'in most cases, rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Level 2 or lower priority runoff destination.'*

The use of large scale rainwater harvesting is not a viable / cost effective approach for the management of surface water runoff at the site taking into account the potential water supply benefits of such systems.

3.3 Discharge to Ground

In determining the future surface runoff from the site, the potential of using infiltration has been considered. An overview of the general ground conditions may be used to gauge if there is potential for their application. As detailed previously, information from the British Geological Survey (BGS) Geological Map of the area indicates that the bedrock underlying the site consists of the Salop Formation - mudstone, sandstone and conglomerate with superficial deposits consist of Till, Devensian - diamicton. Furthermore, a review of adjacent BGS borehole data indicates circa 15m depth of boulder clay in a borehole located circa 15m from the development site.

Whilst the permeability and infiltration rate of the site would be confirmed by a site investigation into the hydrogeology prior to construction, the ground conditions suggest that surface water discharge to the ground would not be a viable option. Therefore, disposal of significant volumes of surface water runoff to infiltration devices is not considered likely to be appropriate.

3.4 Discharge to Surface Water Body

Should infiltration be found to be unsuitable, the next option is discharge to a water body. Redwither Brook is located in open channel circa 160m north of the site through multiple third party land ownerships and therefore discharge surface water runoff from the site into a watercourse is not considered to be a practicable option.

3.5 Discharge to Surface Water Sewer

Existing site surface water discharges freely to the adjacent Welsh Water surface water sewerage system located at the eastern corner of the site. It is therefore proposed to discharge post-development site surface water to the existing adopted surface water sewerage network in the same location.

In order to provide a significant level of betterment in relation to water quantity, it is proposed to provide attenuation in the form of underground crate storage from the new building roof areas together with the existing and proposed service yard and car parking areas then discharge to the Welsh Water adopted surface water sewerage system at greenfield run off rates using a pragmatic minimum restricted discharge rate of 5.0l/s. By doing this, pressure on existing infrastructure will be reduced and risk of flooding will not be increased. Therefore, it would be possible to discharge surface water runoff from the site into the adopted surface water sewerage system.

3.6 Discharge to a Combined Sewer

This option is not required.

4.0 S2: SURFACE WATER RUNOFF HYDRAULIC CONTROL

4.1 Surface Water Runoff Rates

An estimation of surface water runoff is required to permit effective site surface water management and prevent any increase in flood risk to off-site receptors. In accordance with The SuDS Manual, the greenfield runoff from the site has been calculated using the IH124 method (see Appendix 4). The 1 in 2 year greenfield runoff rate has been calculated to be 0.2 litres/second (l/s) for the proposed impermeable area of 0.45 hectares (ha).

The method used for calculating the runoff complies with the SuDS Standards and assumes that the excess runoff associated with the proposed development (plus an allowance for future climate change) will need to be managed by the proposed SuDS Strategy.

4.2 SuDS

Current guidance requires sustainable water management through the use of SuDS. SuDS measures should be used to control the surface water runoff from the proposed development site therefore, managing the flood risk to the site and surrounding areas from surface water runoff.

One of the aims of the SuDS Standards is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity. Systems incorporating these features are often termed SuDS and it is the requirement of the SuDS Standards that these are considered as the primary means of collection, control and disposal for storm water as close to source as possible. A hierarchy of techniques is identified:

1. **Prevention** – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).
2. **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting, permeable paving, soakaways and / or green roofs).
3. **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one / several large soakaways for the whole site, swales and / or infiltration trenches).
4. **Regional Control** – management of runoff from several sites, typically in a detention pond, basins, tanks and / or wetland.

It is generally accepted that the implementation of SuDS as opposed to conventional drainage systems, provides several benefits by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of open spaces and wildlife habitat; and

- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

The most appropriate attenuation system will need to satisfy three main characteristics, firstly, provide the required volume of storage, secondly, minimise the loss of developable land and thirdly, where possible provide local amenity.

The application of the SuDS Manual requires that the runoff from sites is not only restricted to meet the greenfield runoff characteristics but also that SuDS systems are utilised to improve the quality of the runoff prior to outfall to watercourses. The SuDS Manual and the SuDS Standards guidance applies a sustainability hierarchy to the various types of SuDS systems, this is summarised in Table 1.

Systems at the top of the hierarchy provide a combination of attenuation, treatment and ecology and are deemed the most sustainable options. There are always specific scenarios where systems are more suitable than others and at this stage it is not possible to guide the development towards a particular strategy. The usual approach is to consider the 'SuDS train' where each of the above options are considered in turn until a suitable solution is found.

Table 1 - Sustainability Hierarchy

Most Sustainable	SuDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife	Proposed for Use on Site
	Rainwater Harvesting	✓	✓	✓	
	Green / Living Roofs	✓	✓	✓	
	Basins and Ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓	
	Filter Strips and Swales	✓	✓	✓	
	Infiltration Devices - Soakaways	✓	✓	✓	
	Permeable Surfaces and Filter Drains - Gravelled areas - Solid paving blocks - Permeable paving	✓	✓		
Least Sustainable	Tanked Systems - Over-sized pipes / tanks - Cellular storage	✓			✓

4.3 SuDS Strategy

The objective of this SuDS Design is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the site. The SuDS Design takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the site.
- No increase in flooding to people or property off-site as a result of the development.

- No surface water flooding of the site.
- A 30% increase in rainfall intensity due to climate change during the lifetime of the development.
- Maintain / improve surface water quality.
- Provide amenity and biodiversity benefits.

In line with adopting a 'management train' it is recommended that water is managed as close to source as possible. A hierarchical approach to surface water management has been adopted within this SuDS Design. This will reduce the size and cost of infrastructure further downstream and also shares the maintenance burden more equitably. A hierarchical approach to surface water management has been adopted within this SuDS Strategy.

The SuDS Strategy at the development comprises:

- **Discharge to Surface Water Sewer:**
 - Attenuation in the form of underground crate storage from the new building roof areas together with the existing and proposed service yard and car parking areas then discharge to the Welsh Water adopted surface water sewerage system at a restricted discharge rate of 5.0l/s. The adopted surface water sewer then discharges to open watercourse circa 270m south east of the site (refer to Appendix 6 for details).
 - Given the constraints of the site, a sufficient SuDS treatment train is provided through the use of the Hydro International Up-Flo Filter Vault system with 8 No modules together with the 1.2m diameter twin walled HDPE chamber 'Downstream Defender' unit.

The SuDS Strategy is shown in Appendix 7 and the Micro Drainage calculations for the proposed site drainage system are shown in Appendix 8.

These methods will reduce peak flows, the volume of runoff, and slow down flows and will provide a suitable SuDS solution for this site. The SuDS features for the site represents an enhancement from the current conditions as the current surface water runoff from the site is uncontrolled, untreated, unmanaged and unmitigated. The SuDS features will reduce the risk of flooding to the site and off-site locations.

In adopting these principles, it has been demonstrated that a scheme can be developed that does not increase the risk of flooding to adjacent properties and development further downstream.

4.4 Interception Storage

The underground crate storage and landscaped areas will provide interception storage as per Table G2.1 of the SuDS Standards.

4.5 Morphological Protection / Flood Risk Mitigation of Receiving Surface Water Bodies

The provision of suitable storage on site to mitigate the flood risk resulting from the development of the site will be a key factor in the evolution of the site development layout. One of the aims of the SuDS Standards is to provide not only flood risk mitigation but also to maximise additional gains such as improvements in runoff quality and provision of amenity and biodiversity.

It is therefore proposed that attenuation storage with a restricted outfall to the adjacent adopted surface water sewer system to the east of the site will be used – it is noted that the surface water sewer system outfalls into Redwither Brook to the east of the site. By restricting the runoff rate from the new building roofs, extended service yard / car parking areas and existing service yard areas to 5.0 litres per second, the receiving watercourse will be protected from erosion and the resulting morphological, ecological damage and increasing flood risk.

Runoff Rate Control

The 1 in 2 year greenfield runoff rate has been calculated to be 0.2l/s. Using a flow control device and practical minimum pipe sizes it is not practical to control the discharge rate to below 5.0 litres/second. Therefore, a value of 5.0 litres/second has been used as the limiting discharge rate before discharge to the adjacent adopted surface water sewerage system, for all events up to and including the 1 in 100 year (+30%) event.

Runoff Volume Control

The size of the attenuation storage has been calculated such that the development has the capacity to accommodate the 1 in 100 year rainfall event including a 30% increase in rainfall intensity that is predicted to occur as a result of climate change plus a further 10% allowance for urban creep. Consequently, all areas drained have been designed to accommodate the 1 in 100 year (+30% climate change) + 10% urban creep event.

Please refer to Appendix 8 for details of the volume of storage required for the proposed impermeable surfaces estimated using the Micro Drainage Software for the critical 1 in 100 year event with a 30% allowance for climate change (increase in peak rainfall) and 10% urban creep.

The Micro Drainage calculations demonstrate that the proposed surface water runoff volumes from the new building roofs and all existing/proposed external hard surfaced areas can be viably accommodated on site within the underground crate storage system during the 1 in 100 year with a 30% allowance for climate change and a 10% allowance for urban creep (see Appendix 5). This is based on a restricted discharge of 5.0l/s to the adopted surface water sewerage system.

The additional site building areas and the existing / proposed external hardstanding areas are to discharge from the site at a rate of 5.0 litres per second – given that surface water from the existing service yard slab currently discharges freely to the adjacent adopted surface water sewerage system (refer to Appendix 5 for existing drainage survey), it is evident that the surface water runoff from the developed site will be less than existing.

The remainder of the site that is not formally drained i.e. landscaped areas, will be permeable (grass). The majority of rainwater falling on these areas will soak into the ground. Surface water runoff would be directed to the drainage system through guttering and lateral drains located around the perimeter of the buildings and through contouring of the hardstanding areas.

4.6 Designing for Local Drainage System Failure/Exceedance

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event or potential failure of the drainage system through the blockage of pipes, blockage of outlet structures and risk of impediments across flood routing paths.

The SuDS Design applies a safe and sustainable approach to discharging rainfall runoff from the site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section is therefore associated with the way the residual risk is managed.

As part of the SuDS Strategy it must be demonstrated that the flooding of property would not occur in the event of design exceedance or local drainage system failure. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. It is also very unlikely that a catastrophic failure would occur.

The SuDS features have been designed to accommodate the 1 in 100 year event plus climate change (+30%) together with a further 10% allowance for urban creep. It should also be noted that additional storage is provided within the manholes and lateral drains which will provide betterment over and above the 1 in 100 year (+30%) event. Flow resulting from a rainfall event in excess of the 1 in 100 year (+30%) event plus 10% urban creep (exceedance event) will be managed to minimise the risks to people and property. There will not be an extensive sewerage network on the proposed development site and therefore any potential exceedance flooding would be from the sewers and lateral drains connecting the buildings to the underground storage areas. It is very unlikely that a catastrophic failure would occur.

The site slopes gently from north west to south east; the proposed units will be located above the attenuation storage crates and lateral drains so that any flows will not enter the proposed units ensuring any exceedance flooding would not affect the units. Boundary planting will also retard and allow infiltration of any surface water runoff. It is not considered that there is an increased risk to the properties on the site or located on third party land adjacent to the site.

Consequently, the impact of an exceedance event or local drainage system is not considered to represent any significant flood hazard. The above noted design measures manage and mitigate the flood risk from surface water runoff to the proposed properties from surface water runoff generated by the site development and to offsite locations as well the risk from surface water runoff generated offsite

5.0 S3: WATER QUALITY

5.1 SuDS and Water Quality

According to the SuDS Standards (see Table 2), the proposed development is a combination of low (roof water) to medium hazard (runoff from car parking and roads).

Table 2 - Level of Hazard

Hazard	Source of Hazard
Low	Roof drainage
Medium	Residential, amenity, commercial, industrial uses including car parking spaces and roads
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards)

The proposed development has a 'low to medium' pollution hazard level (see Table 3), as per Table 26.2 of the SuDS Manual.

Table 3 - Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.70	0.60	0.70

* Indices values range from 0-1.

To deliver adequate treatment, the SuDS features should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type). Water treatment will be provided via the SuDS components included through the drainage network.

In line with the requirements stipulated in Table 26.2 and Table 26.3 of the SuDS Manual, it is proposed to utilise 2 No proprietary water treatment systems at the site in the form of the Hydro International Up-Flo Filter Vault system with 8 No modules together with the Hydro International 1.2m diameter twin walled HDPE chamber 'Downstream Defender' (refer to Appendix 9 for details). It is also noted that a petrol interceptor is provided directly upstream of the underground crate attenuation.

It is proposed that the 'Up-Flo Filter' unit is located immediately downstream of the surface water attenuation crate storage. The filter unit itself has sufficient capacity to accommodate the design flows directly downstream of the attenuation crate storage and hydrobrake system.

The 'Downstream Defender' unit will be located immediately downstream of the 'Up-Flo Filter' unit and will also have sufficient capacity to accommodate the design flows directly downstream of the attenuation crate storage and hydro brake system.

The simple index approach in line with the requirements of The SuDS Manual has been followed in order to verify that the SuDS treatment train provided by the combination of the 'Up-Flo Filter' and the 'Downstream Defender' provides a suitable level of water treatment at the subject site:

Determination of SuDS pollution mitigation indices

Up-Flo Filter:

In terms of the relevant SuDS mitigation indices, the attached data sheet information (refer to Appendix 9) shows that the Up-Flo Filter delivers high removal of a variety of pollutants including:

Sediment or Total Suspended Solids (TSS):

SuDS Pollution Mitigation Index = 0.8

Sediment Bound Heavy Metals and Nutrients:

SuDS Pollution Mitigation Index = 0.69

Liquid Hydrocarbons:

SuDS Pollution Mitigation Index = 0.4

Downstream Defender:

In terms of the relevant SuDS mitigation indices, the attached data sheet information (refer to Appendix 9) shows that the Downstream Defender delivers high removal of a variety of pollutants including:

Sediment or Total Suspended Solids (TSS):

SuDS Pollution Mitigation Index = 0.5

Sediment Bound Heavy Metals and Nutrients:

SuDS Pollution Mitigation Index = 0.4

Liquid Hydrocarbons:

SuDS Pollution Mitigation Index = 0.8

Utilising the Simple Index Approach in line with Chapter 26 of CIRIA C753 The SuDS Manual, the aggregated Surface Water Mitigation Index is as set out below:

Sediment or Total Suspended Solids (TSS):

$$\text{SuDS Pollution Mitigation Index} = 0.8 + (0.5 \times 0.5) = 1.05$$

Sediment Bound Heavy Metals and Nutrients:

$$\text{SuDS Pollution Mitigation Index} = 0.69 + (0.5 \times 0.4) = 0.89$$

Liquid Hydrocarbons:

$$\text{SuDS Pollution Mitigation Index} = 0.4 + (0.5 \times 0.8) = 0.8$$

In combination, the above SuDS Mitigation Indices for the Up-Flo Filter and the Downstream Defender demonstrate that this proposed SuDS treatment system exceeds the relevant pollution hazard indices in relation to the proposed land use for both total suspended solids and heavy metals.

Accordingly, the proposed use of the Hydro International Up-Flo Filter Vault system with 8 No modules together with the 1.2m diameter twin walled HDPE chamber 'Downstream Defender' is deemed to provide a sufficient SuDS treatment train without the need for any further measures to be employed on the site.

6.0 S4: AMENITY

6.1 Amenity Benefits

In accordance with the SuDS Manual, tree planting and landscape / grass zones within the development will provide air quality improvements. The tree planting and landscaped / grassed zones will help support flora and fauna for the benefit of the development community.

In accordance with the SuDS Manual, the SuDS features will provide an indirect amenity value by supporting the resilience of the development and the adjacent landscape to changes in climate and will deliver health and wellbeing benefits by providing areas for recreation and relaxation.

7.0 S5: BIODIVERSITY

7.1 Biodiversity Benefits

Planting will use a variety of native species of local provenance to ensure opportunities for biodiversity and sustaining habitat within the development. The majority of trees are to be retained. Carrying out grass cuts and removing from site will also improve biodiversity of landscaped areas.

7.2 Scrub and Trees

Scrub and trees will provide important terrestrial habitat cover and act as a windbreak. Trees and scrub will attract a greater variety of insects and birds to the site and will provide terrestrial habitat for amphibians. Species should be native and of local provenance.

7.3 Features

The surrounding land will include features beneficial to wildlife. This will include log / deadwood piles, embankments and hibernacula. Hibernacula generally comprise mounds of timber or other material covered by turf to provide damp, sheltered habitat. If available, inert discarded bricks or rubble from the site can be used. This will create habitat for reptile basking.

Arisings from trees or bushes that have been cut down could be used to create log / deadwood piles, which are beneficial to a range of species, particularly insects. Using recovered material is always preferential to importing material to the site for the construction of such features, as this increases the risk of spreading invasive non-native species and diseases.

8.0 S6: DESIGNING DRAINAGE FOR CONSTRUCTION, OPERATION, MAINTENANCE AND STRUCTURAL INTEGRITY

8.1 Maintenance Responsibility

The system will be maintained by the owner of the site. An Operation and Maintenance Manual will be developed, the Operation and Maintenance Manual shall be passed on to subsequent future owners covered by the document. The maintenance will be the responsibility of the property owner as the SuDS features will serve a single private site.

8.2 Phasing

The surface water drainage scheme will be installed and fully operational before occupation of the site occurs.

8.3 Construction Phase Surface Water Impacts

The proposed development has the potential to introduce contaminants from the associated machinery, infrastructure, transportation, importation of construction materials and maintenance and storage of plant equipment as discussed below:

Excavated Ground and Exposed Ground

Recently disturbed and vegetation free ground allows for relatively low velocity runoff to erode the surface. This leads to increased runoff and sedimentation of receiving waters, thereby increasing flood risk / potential impacts on water quality.

Stockpiles

Rainfall could lead to erosion of material should a stockpile be uncovered. This could lead to siltation of drainage or receiving watercourses and therefore an increase in flood risk / potential impact on water quality.

Oils and Hydrocarbons

The use of oils and hydrocarbons on construction sites provide a risk of leakages and spillages, leading to pollution incidents. This could affect the water quality in drainage / receiving watercourses and aquifers.

8.4 Construction Phase Surface Water Management Plan

The following section provides detail on site drainage during the Construction Phase, this will reduce the potential for vehicle movement on wet ground, which can increase the potential for compaction. In summary, the withdrawn Pollution Prevention Guidance¹ (PPG) and Government guidance² states

¹ Pollution Prevention Guidelines PPG1: Understanding Your Environmental Responsibilities (July 2013).

Pollution Prevention Guidelines PPG6: Working at construction and demolition sites (March 2012).

Pollution Prevention Guidelines PPG7: The safe operation of refuelling facilities (July 2011).

Pollution Prevention Guidelines PPG8: Safe storage and disposal of used oils (February 2004).

Pollution Prevention Guidelines PPG13: Vehicle washing and cleaning (July 2007).

Pollution Prevention Guidelines PPG21: Incident Response Planning (March 2009).

Pollution Prevention Guidelines PPG22: Dealing with spills (April 2011).

² <https://www.gov.uk/guidance/storing-oil-at-a-home-or-business>, May 2015.

<https://www.gov.uk/guidance/manage-waste-on-land-guidance-for-land-managers>, May 2014.

Guidance for Pollution Prevention GPP2: Above ground oil storage tanks (January 2018).

that the following methods of surface water management should be put in place during the construction phase to ensure pollution, sediment and erosion control.

Excavated Ground and Exposed Ground

To limit the volume of runoff reaching the exposed ground, runoff diversion or interception devices / bunds can be placed upstream of exposed ground. To help control sediment in runoff from leaving the site or entering drainage, silt fences, bunds, hay bales or ditches can be placed downstream of exposed ground to intercept runoff.

Stockpiles

Soil stockpiles will be located away from any site drainage systems and measures to intercept runoff will be incorporated, such as a silt fence or small perimeter bunds around the base of the stockpiles. Concrete should also be stored to prevent release into drains.

Oils and Hydrocarbons

Simple measures can be taken to prevent oil and hydrocarbons becoming pollutants, such as:

- Maintenance of machinery and plant.
- Drip trays.
- Regular checking of machinery and plant for oil leaks.
- Correct storage facilities.
- Check for signs of wear and tear on tanks.
- Care with specific procedures when refuelling.
- Designated areas for refuelling.
- Emergency spill kit located near refuelling area.
- Regular emptying of bunds.

Ground Compaction

In order to minimise ground compaction, the following measures will be implemented:

- A temporary hardcore surface will be placed as the construction site access road (to be removed at the end of the Construction Phase).
- Vehicle movements on bare soil will be minimised.
- Vehicle movements on wet ground will be minimised.

The pollution, sediment and erosion control mitigation measures as detailed above will ensure that the effects on receptors during the construction phase are negligible.

Guidance for Pollution Prevention GPP5: Works and maintenance in or near water (January 2017).

Guidance for Pollution Prevention GPP8: Safe storage and disposal of used oils (July 2017).

Guidance for Pollution Prevention GPP13: Vehicle washing and cleaning (April 2017).

Guidance for Pollution Prevention GPP21: Incident Response Planning (July 2017).

Guidance for Pollution Prevention GPP22: Dealing with spills (October 2018).

Guidance for Pollution Prevention GPP23: Safe storage - drums and intermediate bulk containers (February 2019).

8.5 Operation / Maintenance and Structural Integrity

The SuDS have been designed for easy maintenance to comprise:

- Regular day to day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS features.
- Occasional tasks – checking the SuDS feature and removing any silt that builds up in the SuDS features.
- Remedial Work – repairing damage where necessary.

As far as is reasonably practicable the surface water drainage system has been designed so that the SuDS features can be constructed easily, safely, cost effectively and in a timely manner. The surface water drainage scheme will be regularly maintained. The key maintenance requirements are regular inspection of silt traps, manholes, pipework and pre-treatment devices, with removal of sediment and debris as required.

The structural integrity of the drainage components will be designed to withstand the anticipated loading conditions over the design life of the development, accounting for reasonable levels of maintenance. The maintenance will be the responsibility of the property owner as the SuDS features will serve a single property.

The management and maintenance of the above noted SuDS measures to serve the proposed development will be undertaken by a maintenance management company to be appointed for the project. The appointment of the maintenance management company is to be confirmed at the completion of the build phase. All parts of the drainage network are to be accessible and are to be constructed from materials that are suitable and robust for the lifetime of the development.

The maintenance activities required for the drainage network are as follows:

8.5.1 Cellular Storage Structure

The maintenance for the cellular storage structure is as follows:

Operation	Frequency
Inspect and identify any areas that are not operating correctly and if required take remedial actions	Monthly for three months then six monthly intervals
Debris caused from catchment surface (where it may cause risk to performance)	Monthly
Where rainfall infiltration into cellular storage from above, check surface or filter for blockage or silt, algae or other matter by jetting	As required but at least twice a year
Remove sediment from upstream surface water network by jetting	Annually or as required
Repair / check all inlets, outlets, overflows and vents	As required
Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after severe storms

8.5.2 Flow Control

The maintenance for the flow control is as follows:

Operation	Frequency
Inspect and identify any areas that are not operating correctly, if required take remedial actions	Monthly for three months then at six monthly intervals
Debris removal from catchment surface (where it may cause risk to performance)	Monthly
Check control chamber for blockage or silt, algae or other matter by jetting	As required, but at least four times a year
Remove sediment from upstream drainage network and sediment from within manhole by jetting	As required, but at least twice a year
Repair / check all inlets and control mechanics	As required
Inspect / check all inlets and control mechanics to ensure that they are operating as designed	Twice a year as a minimum and after severe storm events

8.5.3 Flow Control Chamber Design Criteria

In addition to the above maintenance methods, the flow control chamber will be designed so it works effectively throughout the lifespan of the development and will have precautionary features to ensure maintenance work can be carried out promptly and efficiently to ensure no control failure which may otherwise subsequently lead to flooding.

Details of the flow control chamber are as follows:

- High Water Level Alarm: Alarm installed and directed to site maintenance team
- Spares: Control spares to be kept on site for efficient maintenance

8.5.4 Up-Flo-Filter

The maintenance for the Hydro International Up-Flo Filter is as follows (refer to Appendix 9 for Operation and Maintenance manual details):

Operation	Frequency
Inspection	Regularly during first year of installation to determine the site-specific rate of pollutant accumulation. After the initial year then every six months.
Oil and floatables removal	Twice a year or as needed or following a spill in the drainage area.
Sediment removal	Every six to twelve months and also following a spill in the drainage area.
Media Pack Replacement	Once per year or as needed in the event of continuous base conditions.
Drain Down Filter Replacement	Once per year with Media Pack replacement or as needed in the event of continuous base conditions.

8.5.5 Downstream Defender

The maintenance for the Hydro International Downstream Defender is as follows – it is noted that, for most cleanouts, it is not necessary to remove the entire volume of liquid in the vessel as only removing the first few centimetres of oils/floatables and the sediment storage volume is required (refer to Appendix 9 for Operation and Maintenance manual details):

Operation	Frequency
Inspection	Regularly during first year of installation to determine the site-specific rate of pollutant accumulation. After the initial year then every six months.
Oil and floatables removal	Annually along with sediment removal or following a spill in the drainage area
Sediment removal	Annually or as needed. Also following a spill in the drainage area.

8.5.6 Flood Routes

A visual monthly inspection of flood routes should be made in order to check that routes are not blocked by new fences, walls, soil or other rubbish with removal undertaken as necessary.

8.5.7 Spillage – Emergency Action

Most spillages on development sites are of compounds that do not pose a serious risk to the environment as they enter the drainage system in a slow and controlled manner with time available for natural breakdown in a treatment system. Therefore, small spillages of oil, milk or other known organic substances should be removed where possible using soak mats as recommend by the Environment Agency with residual spillage allowed to bio-remediate in the drainage system.

In the event of a serious spillage, either by volume or of unknown or toxic compounds, then the spillage should be isolated using soil, turf or fabric and outlet pipes from chambers downstream of the spillage blocked with bungs. Bungs for blocking pipes may be made by wrapping soil or turf in a plastic sheet or close woven fabric. The Environment Agency should be contacted immediately.

Contact Natural Resources Wales immediately. Tel: 0300 065 3000.

8.5.8 Linked and Further Maintenance

The maintenance of the drainage network and SuDS features is to be linked with the landscape maintenance plan for the proposed development.

8.5.9 Maintenance Activities

A log of all maintenance activities is to be kept and made available to the Local Planning Authority (LPA) and / or the Lead Local Flood Authority (LLFA) on request.