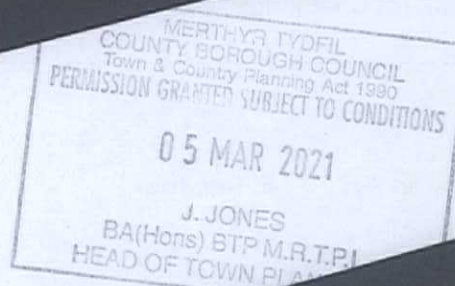


Drainage Strategy Report

Proposed Residential Development at:
The Former St Luke's Church
Heol Parc-y-Lan,
Gellideg,
Merthyr Tydfil.
CF48 1HB



Prepared for: Merthyr Valley Homes Ltd
Job No:10463



Vale Consultancy
CONSULTING CIVIL & STRUCTURAL ENGINEERS

Document Control

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Client	Merthyr Valley Homes Ltd
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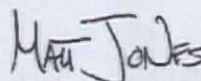
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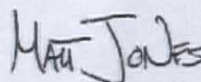
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1.0 Introduction

1.1 Purpose of the Assessment

Vale Consultancy have been appointed by Merthyr Valley Homes Ltd (*the client*) to develop the drainage strategy in support of a future SAB application and a pre-planning application for the demolition of an existing buildings and the construction of a residential development comprising of four detached blocks, with a new play area, car parking and landscaping on two sites north and south of Heol Parc-y-Lan. , at the former St Luke's Church site, Heol Parc-y-Lan, Gellideg, Merthyr Tydfil. CF48 1HB.

1.2 Limitations

This drainage appraisal report is prepared in support of a planning application and is for the exclusive benefit of the Client. It may not be assigned to or relied upon by third party without the agreement of Vale Consultancy in writing. Vale Consultancy retains all copyright and other intellectual property rights in the document and its contents unless transferred by written agreement between Vale Consultancy and the Client.

The findings and opinions expressed are based on the conditions encountered and/or the information reasonably available at the date of issue.

1.3 Scope of the Assessment

The scope of the assessment is as follows: -

Surface Water

- Obtain details of existing surface water sewers, ditch courses, watercourses, and any other water bodies within and adjacent to the site.
- Liaise with the Lead Local Flood Authority (Merthyr Tydfil CBC) regarding points and rates of discharge and drainage constraints.
- Calculate expected surface water discharge flows based on likely development proposals.
- Obtain copies of available borehole records and geological maps to consider the feasibility of utilisation of sustainable drainage systems (SuDS) for the development site.
- Develop a surface water drainage strategy for the site using the principles of Sustainable Drainage Systems. The surface water drainage strategy will be in accordance with the MTCBC requirements.
- The outline application will be in accordance with the requirements of Schedule 3 of the Flood and Water Management Act 2010.

Foul Water

- Obtain details of existing foul public water sewers from Dwr Cymru Welsh Water (DCWW).
- Assess existing foul water network and review current off-site discharge points.
- Calculate expected foul water discharge flows based on development proposals.
- Liaise with DCWW in relation to a Hydraulic Modelling Assessment to determine the impact of the development on the public sewer network.
- Develop a Foul Water Drainage Strategy for the site.

2.0 Development Site

2.1 Site Location and Description

The site is located at Heol Parc-y-Lan, Gellideg, Merthyr Tydfil. The site located within a predominately residential area and the northern site is occupied by St Luke's Church and playground with surrounding areas which are a mix of surface finishes of grass, tarmac and concrete. The site to the south is occupied by a single building and grassed public space with hard standing parking bays located in the front of the building.

The application site occupies a total area of approximately 0.28 hectares and is located at a National Grid Reference of SO 03140 07060. The site classification is "Brownfield"

The site location is indicated in **Figure 1**.

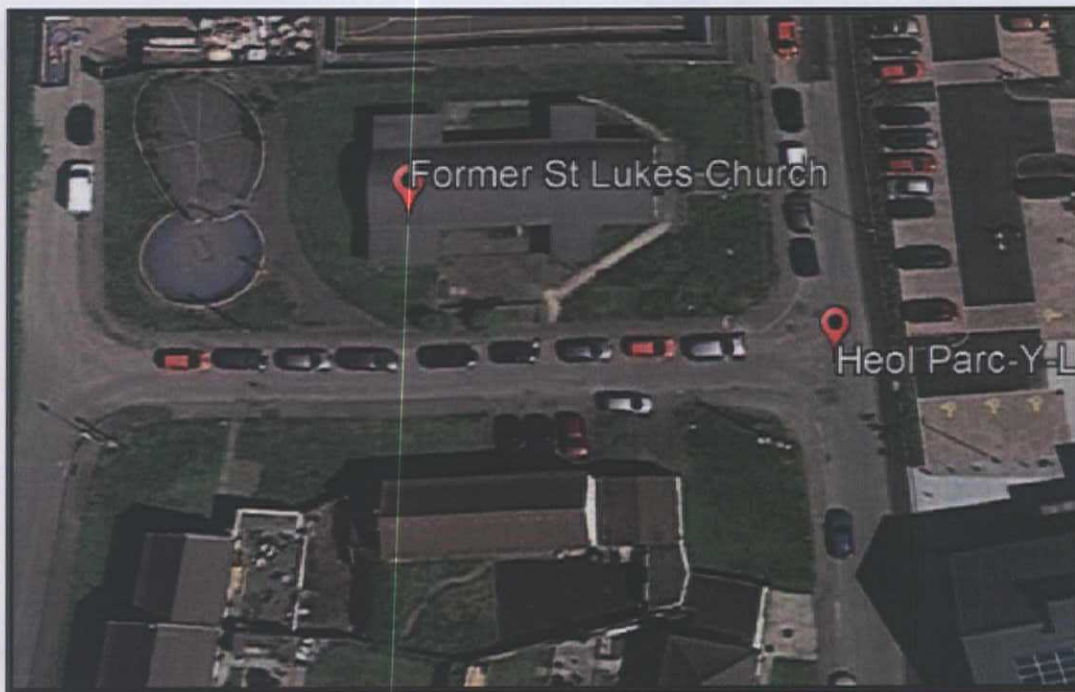


Figure 1 – Site Location

2.2 Site Proposals

The development proposals are to demolish the existing buildings on both sites and replace with 4 detached residential blocks (3 *No to the northern site and one to the site to the south*) for Merthyr Valley Homes Ltd.

3.0 Existing Site

3.1 Topography

The St Luke's development site is terraced and slopes from 242.5 m AOD to the west and the church lies above the levels of Lansbury Road 240.45 m AOD. The site to the south inclines to the west up to a levels averaging 243.5 m AOD with the existing building FFL at 241.17 m AOD and sloping down to Lansbury Road with levels averaging at 239.5 m AOD.

3.2 Geology

A review of geological information provided online by the British Geological Society (BGS) **Figure 3** indicates that the site is underlain by Brithdir Member-mudstone, siltstone and sandstone, with superficial deposits of Alluvium clay, silt, sand, and gravels.

Terra Firma (Wales) Ltd Consulting Geotechnical were commission by Merthyr Valley Housing Ltd to undertake a ground investigation of the site to assess the ground conditions in respect of the substructure solution and potential infiltration characteristics for soakaway drainage. The infiltration test results show that the shallow soils in the made ground has a degree of permeability such that there was insufficient outflow from the trial pit to calculate a soil infiltration rate in accordance with BRE 365(2016). The site indicates that infiltration would NOT be a suitable method to manage runoff from the proposed impermeable surface areas, by traditional point drainage soakaway at depth.

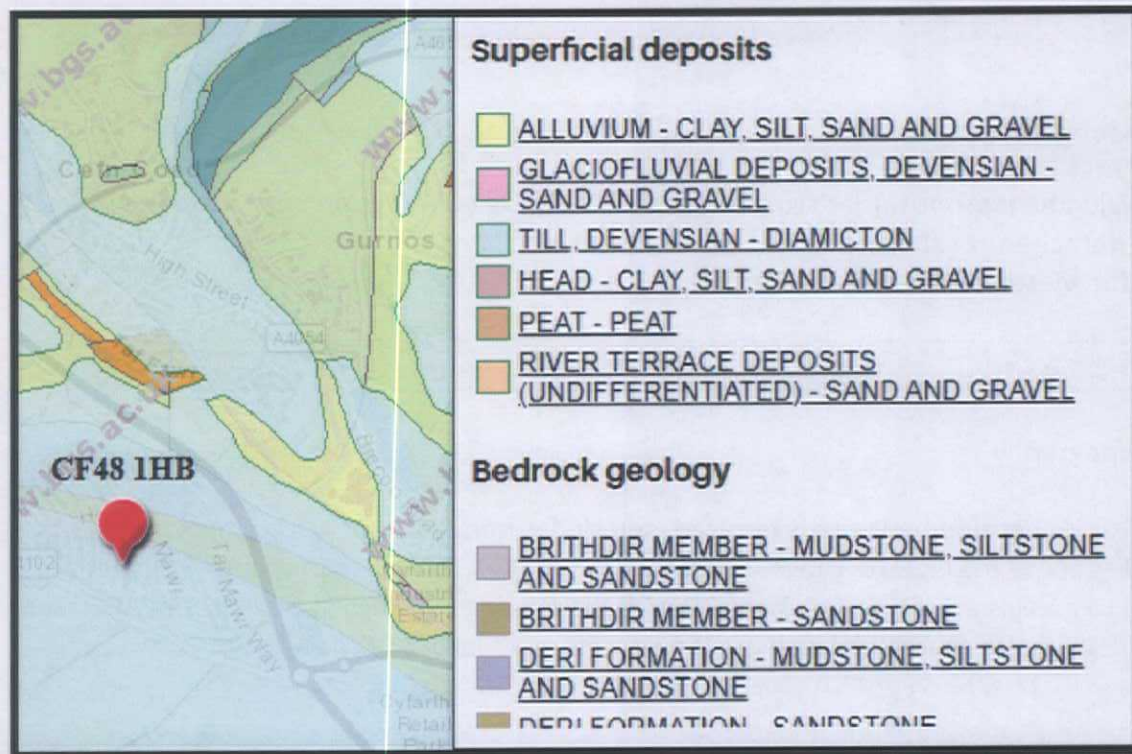


Figure 3: BGS Extract

3.3 Watercourses and Hydrology

Pluvial surface water run-off from the site currently discharges to a network of existing piped drainage for eventual offsite discharge to the surface water sewerage network.

3.4 Infiltration to Groundwater

As identified in Section 3.2, the underlying ground conditions are anticipated to be relatively permeable. The use of infiltration to groundwater is therefore considered to be a non-viable solution for surface water discharge to a traditional point drainage soakaway. In addition the base of any point location soakaway component at a 5 m distance, would need to be 1m above the maximum anticipated groundwater level (taking account of seasonal variations) then clearly with surveyed levels of the watercourse being 1 m below the site plateau level a 1 m separation distance to ensure a depth of unsaturated soils to help ensure the infiltration performance of the component with the cannot be achieved. The existing geological and hydrogeological feature/conditions for the BGS mapping (**Figure 3**) for the area indicates no variance in the sub-soil strata. The site indicates that shallow plane infiltration at or near the ground surface and spread over a wide area which can be provided with a permeable paving solutions would be a suitable method to manage runoff from the proposed impermeable surface areas for part of the catchment the area. Ref :Appendix E

3.5 Public Sewers and Existing Drainage

Asset records have been obtained from Dwr Cymru Welsh Water (DCWW) which indicates that there is a SW public sewer which is routed within the site demise of the southern site running parallel to Heol-y-Lan.

The existing buildings are served by a formal and separate foul and surface water drainage network which discharges to the offsite public sewerage system, and a recent drainage survey

by *Draintech* which was commissioned by MVH indicates the presence of a formal drainage system capable of supporting the development proposals : **Appendix C**

4.0 Legislation

4.1 Environment (Wales) Act (2016)

This Act provides the legislation needed to plan and manage Wales' natural resources in a more proactive and sustainable way. The key parts of the Act relating to flood and water management are:

- Part 1 – sustainable management of natural resources.
- Part 7 – flood and coastal erosion committee and land drainage (clarifies the law for other environmental regulatory regimes including flood risk management and land drainage).

4.2 Wales Spatial Plan (2008)

The Wales Spatial Plan (Ref. 8-13) is a framework for ensuring that the development of places and the delivery of services work together at a local, regional, and national level to improve the lives and prosperity of the citizens of Wales. It ensures the principles of sustainable development are fully embedded in future design with flood risk a recognised area of concern which needs to be addressed going forward.

The Planning Directorate has begun work on the National Development Framework (NDF) (Ref. 8-14) which will set out a 20-year land use framework for Wales and will replace the current Wales Spatial Plan. This document will set out where nationally important growth and infrastructure is needed and will provide direction for Strategic and Local Development Plans.

4.3 Planning Policy Wales (Edition 10, 2018)

Planning Policy Wales (PPW) (Ref. 8-15), which is supplemented by a series of Technical Advice Notes (TAN), sets out the land use planning policies for the Welsh Government. The PPW and TANs comprise national planning policy which should be considered in preparation of development plans. Meeting the Welsh Government's objective for sustainable development requires action through the planning system to move away from flood defense and towards a more positive avoidance of development in high risk areas. Local planning authorities should consult with other authorities and NRW to ensure that, as well as not being at risk itself, the development does not increase the risk of flooding elsewhere.

4.4 TAN 15: Development and Flood Risk (2004)

TAN 15 provides guidance which supplements the policy set out in Planning Policy Wales in relation to development and flooding. It provides advice on matters including the use of DAMs to determine flood risk issues, how to assess the flooding consequences of proposed development and action that can be taken through development plans and development control (management) procedures to mitigate flood risk when planning for new development. This document is discussed in more detail within the site-specific Flood Consequence Assessment that accompanies the proposed development

4.5 The Flood and Water Management Act (2010)

The Flood and Water Management Act takes forward some of the proposals from three previous strategy documents published by the UK Government - Future Water (2008), Making Space for Water(2008) and the UK Government's response to Sir Michael Pitt's Review of the summer 2007 floods.

In doing so, it gives the NRW a strategic overview role for flood risk and gives local authorities responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

Under Schedule 3 of the Flood and Water Management Act, Lead Local Flood Authorities (LLFAs) were to be required to establish SuDS Approval Bodies (SAB) which would have required Merthyr Tydfil CBC to approve and adopt SuDS for new developments. In December 2014, the Government announced that Schedule 3 would not be enacted, and SuDS would be dealt with by strengthening existing planning policy instead. This change, which took effect on April 6th, 2015, requires local planning authorities to ensure that SuDS are included on new developments.

On 7th January 2019, the Welsh Government enacted (Schedule 3 Sustainable Drainage) of the Flood and Water Management Act 2010. SUDs Approval Bodies (SABs) were set up to approve and adopt sustainable drainage systems. All planning applications submitted after 7th January 2019 must adhere to the requirements of this legislation.

4.6 Local Flood Risk Management Strategy

Under the Flood and Water Management Act, a duty has been placed on MTCBC to develop and maintain a Local Flood Risk Management Strategy (LFRMS). The strategy gives a clear vision on how flood risk will be managed in the authority's boundary and deals with only local flood risk which is defined in the act as being from:

- Surface water runoff
- Groundwater
- Ordinary watercourses (Main river flooding remains the responsibility of NRW)

4.7 Statutory Standards for Sustainable Drainage–2018

As a requirement of the Flood and Water Management Act, the Government must publish Statutory Standards and consult on them prior to publication. These standards address the design, construction, maintenance, and operation of drainage systems. The Statutory Standards for sustainable drainage consultation came into effect on 7th January 2019, requiring all new developments to included Sustainable Drainage Systems (SuDS) features that comply with the national standards. These covers:

The runoff destination – with the public sewer as the last resort for the receiving system

- The peak rate of runoff.
- The volume of runoff.
- The visibility, adaptability and biodiversity of SuDS feature.

- The water quality treatment.

4.8 BS 8533: Assessing and managing flood risk in development – Code of practice

The British Standard 8533 (BS8533) has been published by the British Standards Institution (BSI) in October 2011. This aims to provide further details, guidance and recommendations to the developers, planning authorities and flood risk managers in order to consider and identify the flood risk from all the potential sources of flooding and how to avoid, reduce and mitigate their likely impact in new or existing developments.

4.9 The SuDS Manual (2015) CIRIA C753

MTCBC are now the statutory consultee for major developments which have surface water implications. This new responsibility will require LLFAs to provide comments in relation to surface water drainage aspects of planning applications within 21 days.

The latest guidance on the use of SuDS is provided in 'The SuDS Manual' by CIRIA (ref: C753, London 2015). The SuDS Manual states that.

"The philosophy of sustainable drainage systems is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas.

The SuDS approach involves slowing down and reducing the quantity of surface water runoff from a developed area to manage downstream flood risk and reducing the risk of that runoff causing pollution. This is achieved by harvesting, infiltrating, slowing, storing, conveying, and treating runoff on site and, where possible, on the surface rather than underground. Water then becomes a much more visible and tangible part of the built environment, which can be enjoyed by everyone".

4.10 Sewers for Adoption 7th Edition

Sewers for Adoption is the standard in England and Wales for the design and construction of sewers to adoptable standards. It is a guide to assist developers in preparing their submission to a Sewerage Undertaker prior to entering an Adoption Agreement under Section 104 of the Water Industry Act 1991.

Dwr Cymru Welsh Water also publish supplementary guidance to Sewers for Adoption to define their specific requirements, where appropriate.

5.0 Sustainable Drainage Systems (SuDS) Compliance

5.1 SuDS Objectives

Surface water drainage systems developed in line with the ideals of sustainable development are collectively referred to as Sustainable Drainage System (SuDS). These systems are designed both to manage the environmental risks resulting from urban runoff and to contribute wherever possible to environmental enhancement. It is proposed that SuDS techniques are utilised wherever possible to manage surface water runoff from the development. The following paragraphs describe how SuDS could be incorporated into the development proposals.

SuDS objectives are to minimise the adverse effects from the development on the quantity and

quality of the runoff, and maximise amenity and biodiversity opportunities.” (CIRIA C753, 2015).

A strong design theme is essential if the maximum aesthetic benefits are to be gained from the SuDS approach. At a more local scale the SuDS should link with the individual plots’ structure, planting, public open space requirements and amenity areas, gaining multiple benefits from a limited area of land. Multi-user green corridors could provide a linking theme through the area.

Enough space must be allowed for the SuDS features to appear as natural features and not be constrained by the development into inadequate, unattractive areas. Working with nature can ensure that SuDS are in keeping with their setting, minimising management requirements and costs.

The following reference guides will be reviewed and utilised, as appropriate, during the SuDS features design procedure.

- Planning for SuDS – making it happen (CIRIA C687)
- Site handbook for the construction of SUDS (CIRIA C698, 2007)
- Designing for exceedance in urban drainage: Good practice (CIRIA C635, 2006)
- Flood Risks to People, Defra /Environment Agency 2006
- The GRO Green Roof Guide
- Health and Safety Principles for SuDS (CIRIA RP992/17)

5.2 The SuDS Management Train

The drainage design within the development, will comply with the four pillars of SUDS: Water Quality, Water Quantity, Amenity and Biodiversity.

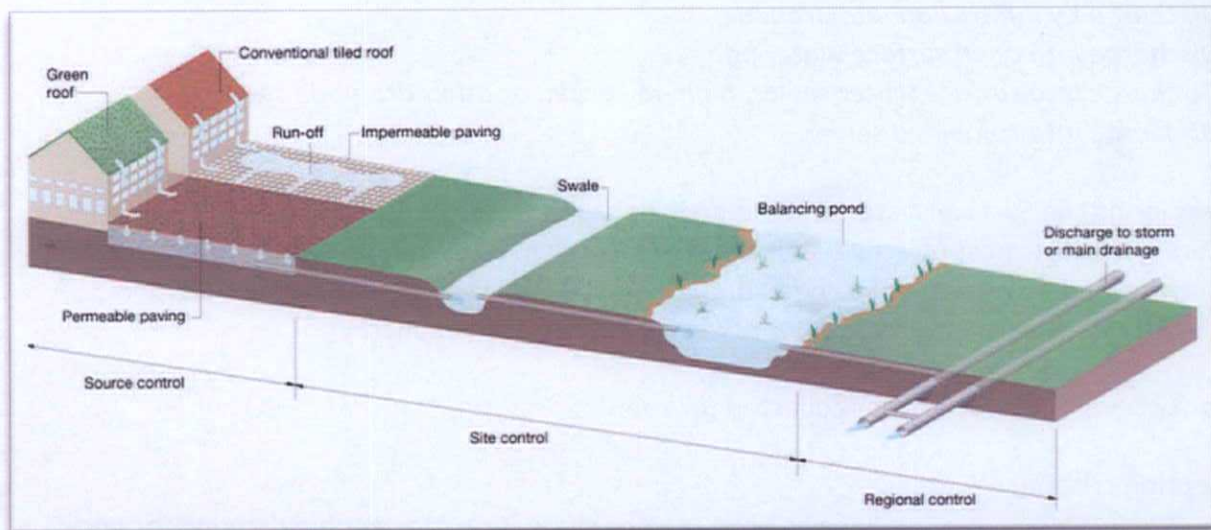
The ‘management train approach’ should be central to the surface water drainage strategy for the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of stormwater discharge from the site, and is as follows:

Prevention - the use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse/harvesting

Source Controls - control of runoff at source or as close to source as possible (e.g. soakaways, green roofs, pervious pavements)

Site Control - management of water in a local area and can include below ground storage/attenuation, detention basins, large infiltration devices

Regional Control - management of water from a site or various sites and can include wetlands and balancing ponds



SuDS Management Train: Fig 4

5.3 Building Regulation Hierarchy

In line with current best practice, priority consideration for means of surface water discharge should be given firstly to the use of infiltration. There are two factors determining whether infiltration can be utilised onsite.

The first is the geological constraints determined by the underlying geology. Percolation field testing to BRE 365 will be undertaken across the site in all external areas post demolition. The number of tests will be specified to determine the infiltration characteristics of the made ground at shallow level. The high density of tests is required because the characteristics and composition of made ground can vary due to the nature of its unknown source and soil type.

The second is the physical constraints determined by land use and the proposed masterplan. Building regulations requires a minimum 5m standoff distance of point source soakaway from any structure, building or public highway. The drainage strategy does not propose the use of point source soakaways where infiltration can be concentrated to one specific location, sometimes resulting in localised sub-flows. Instead, shallow infiltration via permeable surfaces mimics the principle of natural infiltration of previous undeveloped parts of the site, i.e. covered by grass and gravels.

The elimination of point source soakaways removes the risk of the possibility of localised sub-flows and mimics the natural infiltration of a pre-developed site.

5.4 **S1**: Surface Water Runoff Destination

In compliance with the Welsh Government publication "*Statutory standards for sustainable drainage (SuDS) in Wales-designing, constructing, operating and maintaining surface water drainage systems*"

Surface water runoff destination have been considered in order of Priority Level.

The following receptors have been considered for surface water runoff in order of preference.

1. Water collected for re-use

2. *Discharge by infiltration into ground*
3. *Discharge into open surface water body*
4. *Discharge into surface water sewer, highway drain, or other drainage system*
5. *Discharge into combined sewer.*

By exploring the Surface Water destination in line with the SuDS Standards which are aimed at ensuring that the most effective drainage scheme is delivered with the most preferred levels of surface water destination has been determined by demonstrating that the exception criteria for each of the respective Priority Level 1-5 has been applied.

Priority Level 1: Surface water collected for use:

Exception criteria:

- *Rainwater harvesting has not been used as there is no foreseeable demand for non-potable water within the development proposals.*
- *There is no foreseeable need to harvest water at the site as DCWW has not identified any potential stresses on the mains water supply*
- *The use of rainwater harvesting is not a cost-effective /viable option for managing surface water runoff in comparison to the water supply benefit by installing/maintaining such a system and would only be realised when the tank is full.*

Move to next Priority Level

Priority Level 2: Discharge Surface Water to Ground.

Exception Criteria

- *Permeability: In-site site investigation to BRE3652 carried out by Terra Firma (Wales) in 4 no TPs indicates that the use of traditional soakaways as a means of surface water disposal by point drainage soakaways to be is non-viable as a means of managing surface water runoff from the impermeable areas. Water strike encountered at 1.6 m-2m depth in the TPs.*
- *The surface water design will be based on the non-viability of deep infiltration as a means of surface water disposal due to the potential risk of ground instability to the rear of the property however a shallow plane partial infiltration to the car parking area is proposed forming part of the proposed SuDs network with an eventual managed discharge to the offsite surface water sewer.*

Priority Level 3: Discharge to Surface water body

Exception Criteria

- *The nearest water body is the River Taff approximately 450m east of the site.*
- *The conveyancing route would involve crossing considerable infrastructure and a number of third party land ownerships on a trunk road and the rights of access would be difficult to resolve and overcome, and with the levels it would involve a pumping operation as a gravity system over the distance would be unachievable.*
- *A pump solution is not the appropriate solution to discharge surface water from the site.*
- *Given the urban nature of the site most surface water would be collected and conveyed by a formal drainage system.*

Move to next Priority Destination

Priority Level 4: Discharge to surface water or highway drain.

Exception Criteria.

- *The DCWW sewer records indicate that there is a public surface water sewer is available and routed in Heol-y-Lan. No highway drain is available*
- *It has been demonstrated that it is possible for surface water runoff to be discharged in accordance with Levels 1-4.*
- *The existing drainage from the former development discharged unrestricted surface water into the surface water sewer.*
- *The surface water runoff will be managed and reduced to mimic a greenfield rate for the 1 in 100 yr event + climate change at a rate of 2.0 l/sec/ha or QBAR whichever is the greater, with below ground stature incorporated into the new drainage system.*
- *Provision will be made for the removal of sediment and oils before connection into the sewer.*

It has been demonstrated with the appropriate justification that the most effective drainage scheme by exception can be delivered by the movement from Priority Level 1 through to Priority Level 4." Discharge surface water sewer at a regulated discharge rate.

The proposed drainage scheme will be designed to reflect the identified justification and exception criteria.

Discharge to a foul drainage will not be permitted.

5.5 SuDS Site Constraints

Not all SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required, so that the SuDS limitations can be determined. This assessment considers the following:

Land Use Characteristics: The proposed density and land use of the development will influence the SUDS selection.

Site Characteristics: Geological, groundwater and contamination characteristics could all affect the suitability of infiltration SUDS techniques.

Catchment Characteristics: The site is currently greenfield and the discharge rate from the redeveloped site will need to be limited.

Environmental and Amenity Performance: Factors including maintenance regime, cost, safety, and habitat creation need to be considered to influence the SUDS selection for the site.

5.6 SuDS Design Philosophy

The SuDS philosophy for the development site is adding value to engineering design through habitat enhancement, landscape design, provision of an amenity resource and promotion of source control techniques. Landscape and ecological issues, where appropriate, should be given equal priority to the engineering issues and at times may have higher priority in the sizing and detailing options.

The following design philosophy is proposed:

- *Surface Water Treatment using the 'Management Train' approach to remove*

and isolate contamination at source and site control facilities prior to conveyance from the site.

- *A minimum of two levels of treatment are provided.*
- *Integrate SuDS with landscape.*
- *Restrict development runoff peak flow rates to equivalent pre-development rates.*
- *Site control treatment using attenuation of storm runoff and providing conditions for settlement of suspended solids (detention).*
- *Use 'soft engineering' techniques to limit the visual impact of the facilities.*
- *Use of a piped conveyance for building surface water runoff to an below ground geocellular attenuation storage facility with a flow control and a raingardens/bioretention areas for a part of the building catchment area is the proposed SuDS solution .The SuDS components will provide some settling of pollutants with the potential for the detention basin to have a dual land use and an easily maintainable recreational facility.*
- *Aim to limit, where possible, the impermeable fraction of development.*
- *Provide overland flood routes for extreme events where possible.*
- *Landscape consultant to provide a planting schedule, with the use specified native plants.*

The drainage techniques proposed for this site include prevention, source controls and site controls. The following SuDS strategy is proposed for the development and the techniques are discussed in further detail in **Section 6**.

Section 7 of this document demonstrates the integration of sustainable drainage into the scheme, identifying the multiple benefits in accordance with the SuDS principals of Water Quantity, Water Quality, Amenity and Biodiversity.

Surface Water

First Level of Treatment – Source Control

The main objective of source control is the treatment and control of runoff as near to source as possible.

Prevention in the form of good housekeeping measures can help minimise the contaminants that may wash into the drainage system and extend the life of the system. Permeable surfaces utilising partial infiltration are prime examples of source control. However, partial infiltration will be a feasible method of drainage that permeable car parking areas and the rain garden on this site due to the geology and the absence of ground contaminants.

The system of water management will in part be a **partial infiltration storage system** for areas of the parking bays which will allow a proportion of the rainwater that exceeds the infiltration capacity of the upper mantle of sub-soils to be conveyed by a perforated pipe to the watercourse. Direct infiltration through the surface and into the underlying structural layer and infiltrating through the voids of the storage stone drainage blanket prior discharging into sub-soils with exceedance flow conveyed by perforated pipes within the stone reservoir to prevent a build-up of water above the subgrade and mitigate risk to soil stability with the ultimate discharge to the watercourse at a regulated flow rate.

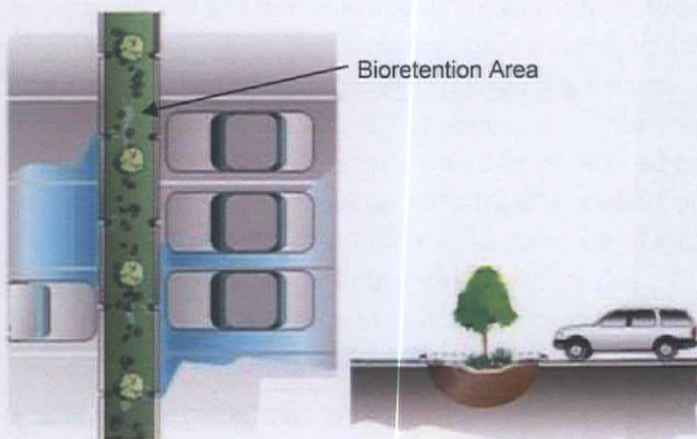
Other innovative source control solutions may be considered where possible as part of the overall approach to the Management Train, such as rainwater harvesting and bioretention. Water from roofs and hard standings can be piped directly to the rain garden/detention basin. Screens on downpipes and oil traps on gullies should be considered for filtering the roof debris and preventing oil entering the detention basin.

Green roofs can act as prevention and source control features and provide good water quality treatment. They reduce the volume and rate of runoff as water is encouraged to remain on the roof. They have the benefit of requiring no land take and assist with thermal insulation and sound absorption in the building. They are intended primarily to be viewed rather than used as external space, and if planned properly, can require minimal maintenance. **The inclusion of a green roof on the main building must be considered in the structural design due to the increased imposed loading from the retained water.**

Suggested Source Control Techniques for Specific Site Conditions

Source control techniques could include bioretention, permeable/porous surfaces and green roofs. These provide a means of slowing the runoff rate and treatment of the surface water by filtration, settlement, and bio-degradation.

Typical examples of source control systems to be included within the permanent works are briefly described below. The effectiveness of the various systems is inherently vulnerable to inadequate design. Hence particular care should be taken during detailed design.



5.7 Bioretention

Bioretention areas, also referred to as bioretention filters or rain gardens, are surface runoff controls that capture and treat stormwater runoff from frequent rainfall events. Excess runoff from extreme events is passed forward to other drainage facilities. The surface runoff is treated using soils and vegetation in shallow basins or landscaped areas to remove pollutants. The filtered runoff is then collected and returned to the conveyance system. Part of the runoff volume will be removed through evaporation and plant transpiration. Suitable flow routes or overflows are required to convey water more than the design volumes to appropriate receiving drainage systems safely.

Due to their nature, bioretention areas will be integrated into external areas within the site and are suited to fitting around parking bays without excessive land-take, as illustrated in the images above. They allow small areas of landscaping to be incorporated into what could otherwise be a hard-landscaped site.



5.8 Soakaways

Conventional soakaways are not a viable solution at the site as a method of surface water disposal. Ref: Appendix E

Extract from Terra Firma Site Investigation Report

7.7 Storm Drainage

Four soakaway tests were undertaken in accordance with BRE 365.

The locations of soakaways (SA1 – SA4) are shown on **Drawing 01** and their logs are presented within **Annex D**.

All four tests were performed in in-situ clay deposits.

The pits were monitored for a period of three hours. No infiltration was recorded. In SA3 the test water level rose marginally due to the influx of groundwater.

A soakaway drainage solution will not be viable for the new development.

5.9 Pervious Pavements

To mitigate the impact of site urbanisation the surface water drainage system for the development will be designed based on the principles of **CIRIA SuDS Manual C753**, and to achieve a restricted and managed permissible discharge rate attenuation storage will be required

Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic that allow rainwater to infiltrate through the surface and into the underlying layers, where water is temporarily stored before infiltration to the ground, reuse or release to a drainage system. If the permeability of the soil is insufficient to allow infiltration, or if there are contamination or shallow groundwater issues, a lined system would be required with eventual connection onto the drainage system.

Pervious pavements can be made of porous material or constructed as a permeable surface as described below:

Porous pavements infiltrate water across their entire surface material, e.g. reinforced grass or gravel surfaces, porous concrete, and porous asphalt.

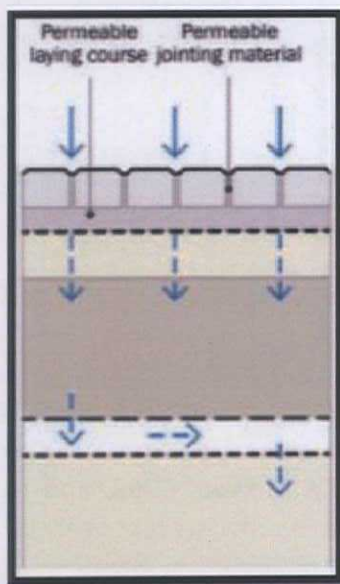
Permeable pavements are formed of material that is itself impervious. However, the materials are laid to allow surface water to infiltrate through the joints or voids between the blocks into the underlying pavement structure, intercepting surface water runoff and providing a pollutant

treatment medium prior to discharge to the downstream system. Treatment processes that occur within the surface structure, the subsurface matrix and the geotextile layers include filtration, adsorption, biodegradation, and sedimentation.

For this site, it is considered that permeable pavements, constructed using interlocking block paving over some of the surfacing, and would be the most appropriate method within the private parking areas. The use of different surfacing can help, for example, to distinguish between the parking areas and the roadways within the site.

In addition, a positive strategy is required to promote SUDS and raise awareness. The site owners should be made aware of the purpose and importance of SUDS drainage and the maintenance requirements if the system is to remain private.

The system of water management will be a **partial infiltration storage system** allowing a proportion of the rainwater that exceeds the infiltration capacity of the upper mantle of sub-soils to be conveyed by a perforated pipe to the surface water sewer. Direct infiltration through the surface and into the underlying structural layer and infiltrating through the voids of the storage stone drainage blanket prior discharging into sub-soils with exceedance flow conveyed by perforated pipes within the stone reservoir to prevent a build-up of water above the subgrade and mitigate risk to soil stability with the ultimate discharge to the offsite surface water sewer at a regulated flow rate.



Type B: Partial Infiltration System

The hydraulic benefits of a permeable system are that for small rainfall depths (5mm and below) there is no effective runoff from the permeable surface. The runoff during heavy rainfall periods is eliminated as the water can infiltrate through the surface of the system at a rate of 9000mm /m²/hour. Where the permeability efficiency of the surface is lost through siltation, assuming 90% (worst case), the permeability of the surface is still 900mm of water /hr/m² (900 litres /m²) which would represent 18 times greater than what is required to deal with 50mm /hr rainfall. The discharge of the water through the compacted sub-base has a void ratio of approximately 32% which allows the storm

water to be attenuated within the system and released by infiltration over a period, also 30% of the water entering the system will be lost through evaporation.

The system is an efficient means of managing surface water runoff close to its source—intercepting runoff, reducing volume and frequency of runoff, and providing a treatment medium.

Roof rainwater will be directed and discharged into the sub-grade void through a perforated pipe in “herringbone” configuration.

The quality of the discharge water and the removal of hydrocarbons is also improved.

The general hydraulic design will comply with the *CIRIA SuDS Manual 2015, Section 20* with a factor of safety of 10 applied to the permeable paving to allow for future reduction in performance. With a 10% allowance in the design for urban creep.

Typical Details of Permeable Paving





The use of pervious surfacing with partial infiltration within the site has been considered for the parking bays serving the development.

5.10 Green Roofs

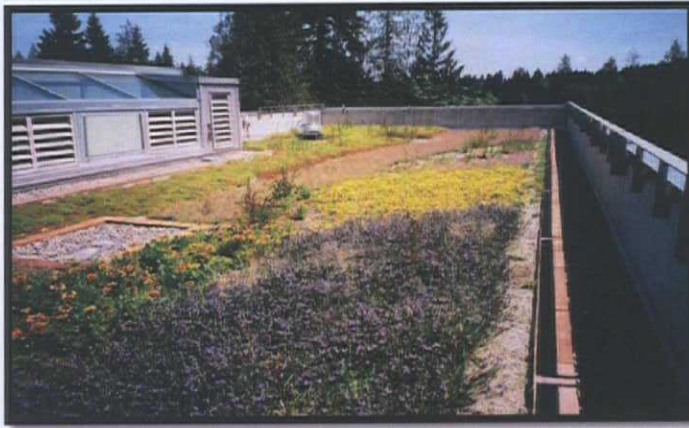
Where there is limited space on the site, the option of providing green roofs on some of the buildings may be considered to increase the biodiversity on the site and assist in reducing the volume of runoff and attenuating peak flows.

There are three main type of green roof, as follows:

- Extensive Green Roofs – the whole roof is covered in low growing, low maintenance plants, such as mosses, succulents, herbs, and grasses. The growing medium is 25-125mm thick and the roof is intended to be largely self-sustaining, with access required only for occasional maintenance. This type of green roof can be used on flat or sloping roofs and are lightweight and cost effective.
- Intensive Green Roofs (roof gardens) – these roofs are intended to be accessed and provide high amenity benefits. They can include planters, trees and even water features. The loads imposed by these green roofs are much greater than extensive green roofs and they require significant ongoing maintenance.
- Simple Intensive Green Roofs – as with the intensive green roofs, these can be assessed, but are generally vegetated with lawns or ground covering plants, which do require regular maintenance. The structural loading associated with these green roofs is lower, so they are less expensive than standard roof gardens.

Typical Details of Green Roofs





The introduction of a Green Roof system within the design proposals has been considered and discounted due to the cost and maintenance requirements as opposed to a conventional roof construction, based on the design consideration of accessibility requirements, the saturated weight and waterproofing of the system and the load-bearing capacity of the underlying roof deck and structure together with additional imposed loads and the need for the integration of rooftop equipment.

The use of a green roof has been considered and discounted for the main buildings due the structural implications and the imposed load on a demountable modular building.

A sedum roof is proposed for the outbuilding sheds.

5.11 Rainwater Harvesting

The use of a proprietary rainwater harvesting system has been considered for each of the respective development plots and disconnected due to the disadvantage of capital cost/installation and maintenance requirement that a specialist system would impose on the home owners and in addition following reasons also have an influence on the level of service that could be expected from the provision of a RWH system, as there is no foreseeable demand for non-potable water within the development proposals. There is no foreseeable need to harvest water at the site as DCWW has not identified any potential stresses on the mains water supply.

The use of rainwater harvesting is not a cost-effective /viable option for managing surface water runoff in comparison to the water supply benefit by installing/maintaining such a system and would only be realised when the tank is full.

Indicative costs estimate for a capture-store-pump-use based on a 2,000 (2m³) litre tank serving the development (Technical source University of Exeter/STW):

- *Onsite installation costs (Inc of exaction/backfill, pipework electrical supply etc) =£1,300.00*
- *RWH system with a 2m³ tank delivered to site =£2,500-£3,000.00*

Capital Costs circa =£4,000.00

Average water potable/domestic consumption/ day = 197m³/annum

DCWW Standard volumetric measured rate /m³=£1.36/m³

Typical water bill /annum=£1.36 x 197m³ =£268.00

House with RWH system would provide a 25% reduction on water demand:

£268.00x25 % =£200.00/annum

Therefore a 25% saving set against the capital investment cost would result in a 58-year break even recovery of costs.

The obligation to provide such a system is not a mandatory requirement in so far as reuse/recycling has been given due consideration.

5.12 Water Butts

Water butts can be provided by the simple water conservation /rainwater harvesting technique of an off the self-water butt which will collect the roof water runoff from the rear of the property (min size 0.5 m³),and when full the overflow arrangement will convey excess water away from the building in an erosion constructed half channel arrangement to the rain garden.

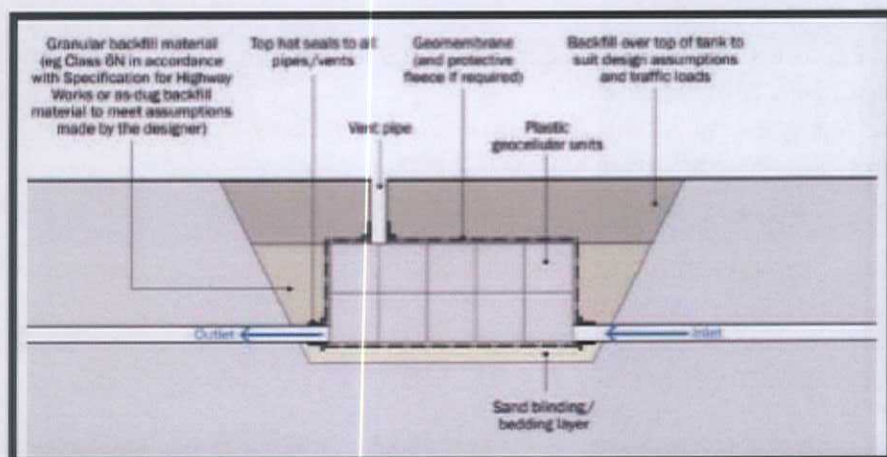
Water butts can be provided as a simple water conservation technique, and although they are not generally designed in terms of storm water management that can contribute to sustainable water management

5.13 Rain Gardens

The potential for surface water runoff capture and serve part the roof area of the building with a collection system , which would route the water of a rain garden, which in simple terms will be a 400-500 mm layer of compost/sand amended free draining soil which will have a simple inflow where the rainwater enters the planter and have a maximum depth of standing water of 150mm with a simple underdrain/overflow to direct the exceedance to a downstream carrier pipe component to the surface water drain. The sizing of the rain garden will be approximately 20% of the roof contributing catchment area. There will need to be a mechanism to ensure that the school carry out the necessary maintenance of the planter/rain garden in order that they continue to function as part of the SuDS drainage.

5.14 Geocellular Storage System

A below ground three-dimensional free flow geocellular modular plastic tanked storage system with a design volume capable of storing the volume of a 100 year +cc storm event, will be installed as an on-line facility to the northern site and offline to the southern sites building footprint. Water enter via inlet pipework and exits via an outlet pipe to the downstream flow control chamber. The system will be sealed with a proprietary impermeable liner with a vent to dissipate air pressure.



Typical Section Through a Geocellular Storage tank

Volume of attenuation tanks will be based on 1:100yr storm event + 40% cc
(Ref Drg Nos 10463-500,501, 503.)

Northern Site 3 no separate attenuation facilities

- 17m³
- 14m³
- 12m³

Southern site 1 No attenuation facility

- 10.6m³

Second Level of treatment – Site Control

Site control features such as detention basins and swales can be designed to attenuate storm runoff and provide conditions for settlement of suspended solids. The use of these types of attenuation within the development is proposed for some areas of the site where there is enough land available to provide these large feature

5.15 Swale

The use of swales has been considered and discounted due to the site constraints and land take.

6.0 S2: Surface Water Runoff Control and Drainage Strategy

The surface water from the development will be collected within the site and discharged using SuDS features to ground and the newly formed perimeter ditch. Where discharge to ditches is proposed, enhancement works may be necessary to ensure the appropriate capacity of the system can be achieved within the landscape proposals.

The objectives of sustainable drainage systems are threefold:

- To limit the peak run-off rate to that of the greenfield condition.
- To limit the volume of run-off to that of the greenfield condition.
- To maintain the quality of the surface water which is discharged to that of the greenfield condition.

The proposed drainage strategy is subject to liaison and approval with MTCBC SAB.

6.1 Peak Run-off Flow Rate

In accordance with best practice, the rate of run-off for the developed site should be no greater than for the undeveloped site. The estimated runoff rates and volumes from the proposed impermeable catchment areas have been calculated using the Modified Rational (Wallingford) Method. This method allows estimation of the amount of runoff likely to be generated from the development proposals from a range of storm returns. Rainfall depths for various storm return periods have been produced using the *Micro- Drainage Windes (Version 2015.1*. Depth – Frequency-Duration) modelling functions have been used to calculate rainfall intensities for a specific return period. The MRM uses the following equation to calculate peak runoff rate from a given area:

$$Q = 2.78 C_v C_R i A$$

Where:

CV = Volumetric Runoff Coefficient

Cr = 1.3 (Routing Coefficient)

I = Rainfall Intensity (mm/hr)

A = Area.

2.78 = Coefficient which accounts for the difference in units used for inputs and outputs of the equation.

The variable CV is a coefficient that describes the proportion of rainfall appearing on the surface water drainage system, CR is a routing coefficient added to the Rational Method to represent runoff characteristics of a particular site or area in a more accurate manner.

The Rational Method is recognised as oversimplifying the rainfall runoff process, but it is considered sufficiently accurate for runoff estimations for small catchment contributing areas. The main assumption being that the rainfall occurs at a uniform intensity for a duration equal to the time of concentration of the catchment and that the rainfall occurs over the entire catchment area, with the rainfall return period being the same as the runoff return period.

An assessment of the site has been completed through sub-division of the site to smaller development parcels linked to the likely phasing of the scheme.

The calculation has been completed for the anticipated impermeable development area based on an initial estimated impermeable development for the residential catchment areas with a 10% allowance for urban creep.

6.2 Three Annual Rainfall Probabilities (*merit specific consideration: 100%, 3.33% and 1%*)

The **100% annual probability** (once in one-year event) is the highest probability event to be specifically considered to ensure that the flows to the ordinary watercourse are tightly controlled for these frequent events

The **3.33% annual probability** (1 in 30-year event) is of importance because of the linkage with the level of service requirements of Sewers for Adoption that requires surface water sewers can convey this storm event within the drainage network without causing flooding to any part of the site.

The **1% annual probability** (1 in 100-year event) has been selected since it represents the boundary between high and medium risk of fluvial flooding defined in TAN 15 and recognises it is not practicable to fully limit flows for the most extreme storm events. Also, during storm events of this magnitude, the capacity of the surface water drainage system may be inadequate, however the floor levels of the proposed buildings will be flood free.

Flood flows up to 1% annual probability are contained within the site and will have little material impact in terms of nuisance and damage. Overland flood flows within the site have been assessed for the short high intensity rainfall events of between 15 mins and 1-hour duration.

6.3 Surface Water Drainage Strategy

As part of the new drainage strategy we are proposing the following:

- The system is designed not to flood any part of the site in a 1:100+cc year return period design storm.
- The development drainage system will be a non-infiltration system with a few SuDS components within the development demise.
- **During the detailed design process**, the proposed network will be simulated by the industry standard drainage design computer software, Micro Drainage - *WinDes*. *WinDes* applies the MRM, analysing each pipe on an individual basis for all storm durations between 15 and 1440 mins (1 day)

Assumptions:

- Design Criteria site with average ground slope less than 1%
- Global time of entry 5 mins
- Minimum velocity 0.75m/sec
- All roof areas and hardscaping to be 100% impermeably
- Hydraulic pipe roughness 0.6 Ks.

Part H of the Building Regulations and current best practice requires a sequential approach for the disposal of surface water and requires the first choice of surface water disposal to be discharge to infiltration systems where practicable.

The drainage strategy for the development will therefore seek to limit flow rates to those calculated above to minimise the impact on peak flows during storm events. As such, it will be necessary to provide attenuation within the site drainage systems to accommodate the increased run-off from the development.

An assessment of the site has been completed through sub-division of the site to smaller development parcels linked to the likely phasing of the scheme.

The calculation has been completed for the anticipated impermeable development area based on an initial estimated impermeable development for the residential catchment areas with a 10% allowance for urban creep.

Runoff Pre-development impermeable =0.045 ha x 0.014=6.15 l/sec
Northern site Area =0.027ha=3.75 l/sec
Southern site Area =0.017ha =2.4 l/sec

Runoff Post -development:
Northern Site :3.75l/sec x 70%=2.4 l/sec
Southern Site:2.4l/sec x 70%=1.7l/sec
The post development discharge from both sites represents a Betterment of 30% (In accordance with best practice and the Welsh Government Publication Titled:" Statutory standards for sustainable drainage (SUDs) in Wales -designing, constructing, operating and maintaining surface water drainage" systems: G2:23 and G2:24. Runoff rate for previously developed sites should replicate the predeveloped site (Greenfield) or <u>at least a 30% betterment</u> should be considered as an absolute minimum from the runoff rate from the previously developed site contributing catchment area).

6.4 Volumetric Run-off

Wherever possible, the volumes of run-off should also be assessed and maintained at existing equivalent rates where possible.

The volume comparison is generally made for a 1 in 100-year storm of 6 hours duration; this storm has been assessed as having the most severe effect on downstream watercourses. Given the increased impermeable area associated with the proposed development, this volume will increase for the same storm in the post-developed condition.

Given the topography of the site, it will not be possible to provide separate attenuation for long-term storage within the site boundary. Therefore, the drainage system will be designed to provide enough attenuation to limit flows to the equivalent of QBar for all storm return periods. The use of Sustainable Drainage Systems (SuDS) is, which could include features such as Bioorientation areas or permeable pavements to provide treatment and attenuation of peak flows to mimic the existing hydrological regime. The initial outline drainage strategy for the scheme subdivides the overall site into smaller catchment areas to suit the phasing plans which will be drained locally to features within each catchment area. In general, surface water in part will be collected via gravity systems with discharge to a detention basin and bioretention/rain garden area provided by a raised planter.

6.5 Initial Attenuation Sizing

The design intent will be to restrict flows from the individual catchments to the QBar flow rate for all storms up to the 1 in 100-year return period, plus 30% allowance for climate change to provide alleviation to existing off-site flooding. The underlying ground conditions are unlikely to allow for all run-off to be discharged via infiltration. As such, it is proposed to install liner to any of the basin area to allow water to dissipate naturally by evapotranspiration in addition to the regulated outflow.

Initial modelling of the site drainage has been undertaken within *Micro Drainage* to determine the runoff volumes required to achieve the discharge parameters. This has been based on controlling the flows from upstream catchment areas within the catchment boundary, with discharge being routed through SuDS drainage.

7.0 Site Specific SuDS Design Process

7.1 Site Description

Medium density residential development. The site will be developed with a surface water discharging via multiple SuDS components (rain gardens., sedum roofs, porous surfaces, dry detention basins with below ground geocellular storage). A strategic drainage system will collect runoff from the sites sub-catchments and local surfaces and convey by pipework to the detention basin/geocellular storage for both sites prior to discharging to the surface water sewer at a regulated flow rate. pipework to the surface water sewer.

SuDS Area =0.28 ha

7.2 Strategic Surface Water Management Objectives

Table 1: Strategic surface water management objectives.

Delivery Area	Strategic Objectives
Water resources	There are insufficient drivers for residential rainwater harvesting systems. The site is not in an area of water stress and there are no infiltration opportunities for much of the site.:
Flood risk	Rates and volumes of surface water discharge from the site to be controlled by a series of SuDs components less than the pre-development (brown field) values.
Water quality	The site will discharge surface water sewer into the below ground attenuation system, rain gardens, porous surface and the appropriate treatment measures of surface water will be required and implemented with the permanent works.
Amenity.	For providing appropriate amenity value in the SuDS design, opportunities include: Planting features to the to the site's rain gardens and soft landscaping areas.
Habitat and the biodiversity	The site-specific biodiversity has identified the need within development proposals and the planting opportunity within the site demise associated with the SuDS components.
Climate resilience	The development is in a low-key suburban environment. Urban cooling is not a factor. However, water resources, flood risk, habitat and biodiversity of the development proposal will all contribute to climate resistance.
Approval/adoption	MTCBC are the approving body for the surface water management system and will approve the scheme against the Welsh Government mandatory standards. The adoption of some of the system components is to be agreed in those areas of the development that are considered to the eligible for maintenance by the local authority. The site drainage within the development plot will be owned and maintained by the school or relevant management company and included within a property O & M manual.

7.3 Development characterisation outcomes

The proposed land use will form part of an existing building footprint with limited landscaping and given the limited opportunity and constraints of the development characteristics a bespoke site-specific surface water management system of integrated SuDS components.

Table 2: Site characterisation outcomes

Delivery Area	Strategic Objectives
Site topography	The areas of both sites are described in Section 3.1
Potential for infiltration	Field testing has been undertaken by Terra Firma (Wales) Ltd and the results of which identified that the site has low infiltration characteristics at depth and therefore plane infiltration shallow soakaways are a viable option

S.W. destination	Surface Water public sewer
Site flood risk	There is no known existing groundwater, coastal/fluvial or pluvial flood risk adjacent to the site: <i>Ref NRW DAMs</i>
Existing land use	Previously developed site- Brownfield classification.
Site infrastructure	The existing buildings have a separate foul and surface water connection to the offsite sewerage network
Existing Soils	The existing subsoil is suitable for partial shallow Infiltration SuDS components.
Biodiversity	The level of urbanisation with the site in a principally suburban zone has a low ecosystem/habitat.

7.3.1 Development SuDS Drainage Concept

As the site lies over soils suitable for partial infiltration. The drainage system for the development will need to manage the runoff from the catchment areas:

- Impermeable areas of the buildings.
- Impermeable area to the car parking and perimeter hardstanding.

The drainage scheme management train is described as follows:

- Impermeable area (roof and hardstanding) discharge into the rain gardens, porous surfaces and attenuation tank with a regulated flow control passing a permissible discharge forward at a rate of 2.4 l/sec for the northern site and 1.7 l/sec for the southern site.

7.4 SuDS delivery design criteria for the site

7.4.1 Water quantity

- The use of rainwater harvesting is an unlikely driver
- Control peak runoff rates for the critical 1:100-year event (to meet the water quantity control standard) using appropriate sub-catchment and strategic system flow controls to include 40% climate change and 10% urban creep
- Control runoff volumes from the site for an appropriate 1:100-year event (to meet water quality standards)
- Control peak runoff rates for the site for 1:1-year return period event (to meet water quantity standard)
- Deliver interception of all hard surfaces on the site (to meet water quantity standards)
- Ensure the SuDS components drain sufficiently quickly so that the system is prepared to manage further rainfall
- Ensure that all surface water is retained within the SuDS components for events up to the critical 1:100-year event and contained within appropriate exceedance routes.

7.4.2 S3: Water quality

- Provide treatment of surface water runoff to meet the requirements of the water quality standards
- Ensure that the impact of periodic extended wet and dry periods (potentially more likely under climate change condition scenarios) but would not invalidate the treatment performance
- The use of drought tolerant grasses and shrubs in the rain garden/detention basin planting.

7.4.3 S4: Amenity

- Integrate the catchment area of the new building areas with the surface water management train
- Use water to support the vegetation
- Keep water on the surface where practicable
- The rain gardens, soft landscaped areas and proposed tree planting will provide amenity and biodiversity.

7.4.4 S5: Biodiversity

- Enhance planting areas with suitable and selected planting and a specialist selected species of tree.

Table 3: Selection of SuDS components

Water Quantity	Runoff collection standard downpipe to the raised planter. Interception: permeable paving and planter Storage: Detention basin (1:100+cc) Conveyance: pipework to SuDS components Exceedance: overland flow for events over and above the 100year +cc	Direct rainfall collection by detention basin and raised planter For small events less than 5mm would be lost through infiltration within the SuDS components through infiltration/evapotranspiration and runoff from these frequent small events for all surfaces will usually pass through the attenuation systems with limited mor no control. Storm events for 100 year + 40% attenuated in the detention basin, rain garden/porous surfacing and connecting pipes
Water Quality	Discharge to surface water sewer Ground water protection measures	Priority Level 5 Low hazard indices with slit traps prior to discharge into attenuation tank.
Amenity	Green space to the building with the	

	formation of rain gardens/dry detention basins.	
Biodiversity	Planting within the rain gardens/dry detention basin and tree planting will provide biodiversity	

7.4.5 Design Approach

The existing predeveloped site has a 0.28 ha area of which 80% is undeveloped, and the standard is set for 1:1 year and 1:100 year +40%+10% urban creep.

As the candidate site is smaller than 50ha the approach and method used to calculate the pre-developed peak runoff rate (GFR) from the site is: **The ICP SuDS function in the *Micro Drainage software***. This uses the IH Report 124 method for site up to 50ha, adjusted pro-rata by area for specific site (0.1ha) as recommended in Code of Practice for Sustainable Drainage Systems.

The hydrological characteristics for the Merthyr Region are: **Ref Appendix A**

SAAR (mm)	1200
SOIL factor	0.320
Hydrometric Area	9

7.6 7 Interception Design

The proposed rain garden is normally dry and will deliver interception because there is usually no runoff from them for most small rainfall events. Although there is no infiltration capacity apart from the natural imported or re-engineered soils which will have a water storage capacity and evapotranspiration assuming the rainfall is evenly distributed through the year, the effective monthly runoff contribution for 1 m² of paved area:

$$30\text{-days} \times (1200\text{mm}/365 \text{ days}) \times 50\% \text{ runoff} = 49 \text{ mm}$$

Based on the evaporative capacity of 1 m² of vegetative surface for the peak summer months approximates to:

$$30 \text{ days} \times 3\text{mm} / \text{day} = 90 \text{ mm of effective rainfall}$$

Therefore, the effective area for which interception can be delivered by 1 m² of vegetation in a peak summer month is:

$$90/49 = 1.83 \text{ m}^2$$

8.0 Pollution Control /Water Treatment

The design of the drainage system will need to consider treatment of the surface water run-off to allow for removal of pollution from the flow prior to discharge from the site. The selection of separate stages of treatment will be necessary to ensure enough removal of pollutants based

on the designation of the area being drained.

The drainage of part of the roof area of the building will be provided by inflow into the ran garden/planter. This will provide initial interception of silts and hydrocarbons, however the longer-term effectiveness of this is dependent on a maintenance regime being effectively managed.

Initial capture of the run-off from impermeable areas is likely to be completed using bioretention within highway buildouts where acceptable.

The proposed surface water drainage system will improve the water quality from the development proposals, entering the public sewer. This will be done by using a treatment chain where each subsequent system within the proposed drainage network is treated to improve water quality.

Infiltration drainage methods are unsuitable for this development and therefore treatment of surface water prior to entering the SuDS components has been considered and that the use of the gullies and silt traps will provide a degree of treatment.

The surface water treatment stage will depend on the potential hazards on the site and the sensitivity of the receiving surface water drain to possible pollution.

SuDS Component Management Train Approach

Do the SuDS /Treatment Practices achieve the following water quality treatment processes

SuDS/Treatment Practices	Pollution Prevention /Interception	Primary Treatment Process	Secondary Treatment Process	Tertiary Treatment Process
Permeable pavement/surface	Yes	Yes		
Infiltration systems	Yes	Yes	Yes	Yes
Green Roof	Yes	Yes		
Rainwater Harvesting System	Yes			
Filter Strips	Yes	Yes		
Swale	Yes	Yes	Yes	
Bioretention Surface	Yes	Yes	Yes	
Detention Basin	Yes	Yes	Yes	
Pond			Yes	
Wetland			Yes	Yes
Attenuation Storage	Yes			

Water Quality Standard

Land Use	Pollution Hazard Level	Water Quality Treatment for Discharges for
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		Development (CIRIAC753: Table 26.2)
Residential Roofs	Very Low	TSS=0.2. Metals=0.2. Hydrocarbons 0.05
Hard standing Areas surrounding the building	Low	TSS=0.3. Metals=0.2. Hydrocarbons=0.005

SuDS Mitigation Indices for discharge to Groundwater (CIRIA C753 Table 26.4)

Characteristics of the material overlying the proposed partial infiltration surface through which the runoff percolates	TSS	Metals	Hydrocarbons
<i>Constructed permeable paving (where a suitable filtration layer is included to provide treatment, including geotextile at the base separating the 4/20 granular stone reservoir from the subgrade) underlain by soil with good contaminant attenuation of at least 300mm deep</i>	0.5	0.5	0.6
<i>Bioretention (Raingarden) underlain by soil with good contaminant attenuation of at least 400 mm in depth</i>	0.8	0.8	0.8

SuDS components for the management train for the development site exceeds the pollution hazard index.

The various SuDS components within the drainage system will capture the pollutants for removal and treatment i.e. Rain garden, catch pits /gullies.

9.0 Exceedance Flow

In line with the design criteria of dealing with exceedance flows the proposed building will not flood for storm events with a return period greater than 100 years plus climate change.

In accordance with best practice (CIRIA C635 Designing for Exceedance), flood waters from storm events that exceed the design storm of 100years +cc will be channelled toward highway curtilage adjacent to the site boundary. The proposed network modelling results based on the Simulation Criteria for a 100-year storm return period for a range of storm durations with the network at pipe full capacity, will indicate the points of storm water escape from the proposed drainage network.

The exceedance overland surface conveyance of the flood pathways (default pathways) is directed by design to effectively convey exceedance flow away from the buildings to areas in the development low spots where temporary storage can be incorporated.

The potential points of exceedance escape would be from the interaction between the major and minor drainage system which is as follows:

- Flooding from manholes and other connections to the minor drainage system due to blockage or other defects.
- Excess surface water runoff that cannot enter the system due to the limited capacity
- Flooding caused by the high levels of surface water in the onsite/offsite sewer preventing the site from draining

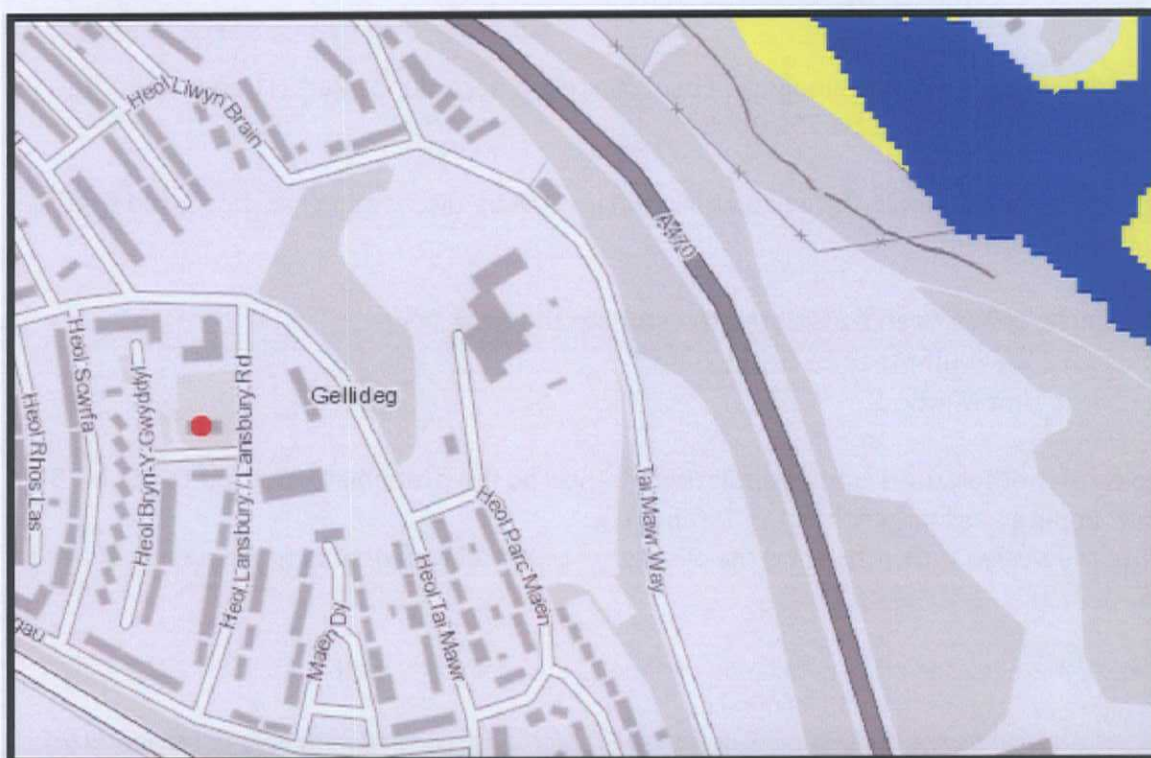
Potential points of escape within the drainage layout: the S5 and the flow control manhole demarcation manhole.

10.0 Status of Ownership of Drainage System

The drainage system serving the development new build will remain in private ownership and therefore maintenance of the system will be the responsibility of the school or assigned to a private managed company, with a legally binding maintenance agreement with step in rights for the LA to manage SuDS components and cross charge should there be a failure to adequately maintain the system. Which will consist of inspection/maintenance of the soakaways, rain garden with litter picking/debris removal.

11.0 Flooding

The NRW Development Advice Map for the site indicate that Heol -y -Lan is in an area of little to no flood risk.



Extract from NRW Development Advice Maps (DAMs)

12.0 Foul Water Drainage Strategy

12.1 Foul Drainage Principles

"When drawing up sewerage proposals for any development, the first presumption must always be to provide a system of foul drainage discharging into a public sewer. This should be done in consultation with the Sewerage Undertaker of the area."

If, by taking into account the cost and/or practicability, it can be shown to the satisfaction of the local planning authority that connection to a public sewer is not feasible, a package sewage treatment plant incorporating a combination of treatment processes should be considered.

Only if it can be clearly demonstrated by the developer that the sewerage and sewage disposal methods are not feasible, considering cost and/or practicability, should a system incorporating septic tank(s) be considered and proposed if appropriate." (DETR Circular 03/99).

12.2 Public Sewers

The sewer records obtained from Dwr Cymru Welsh Water (DCWW) indicate there is a SWsewer within the southern site boundary. A copy of the sewer records is included within the **Appendix B**

There are existing DCWW sewerage assets serving the site with adequate capacity to support the development proposals.

12.3 Existing Site Dry Weather Flow Discharge Rate

There is an existing foul water discharge to the public sewer network from the site.

12.4 Proposed Site Dry Weather Flow Discharge Rate

The new foul water system drainage will be designed in accordance Part H1 and H2 of the Building Regulations and BS EN 752:2008.

In the proposed scheme, no surface water drainage will be discharging into proposed foul water drainage system.

Two approaches have been considered to estimate the peak flow.

- A fixed 6 DWF multiple to BS EN 752-4 or
- Discharge Unit Method.

The choice of method used is the population method as the probability method to BSEN 752-4 will result in pipe sizes larger than DN 150mm e.g.

*Calculate the design flow rate using the Discharge Unit Method, assuming frequency of use is **kdu 0.5**.*

The choice of method used is the population method as the probability method to BSEN 752-4 will result in pipe sizes larger than DN 150mm e.g.

*Calculate the design flow rate using the Discharge Unit Method, assuming frequency of use is **kdu 0.5**.*

- Discharge Unit for Appliances /a one bed apartment= (1 no wc=1.9, 1no whb=0.3, sink=1.3, , shower 0.6.) =4 units x 16 no apartments = 67 DU

$Q = 0.5 \text{ kdu} \sqrt{67} = 4.0 \text{ l/sec}$ therefore use water consumption/capita

The hydraulic design of the domestic water component generated by the development proposal has been based on the current code of practice produced by the British Water flows and loads-sizing criteria, treatment capacity for sewage treatment systems, which is based on the relationship between water usage and wastewater production. Adequate cover and protection will be provided to the proposed foul water drainage system.

The residential units with a peak flow multiple for sewage treatment plant of 6 DWF (Dry Weather Flow) and 10% infiltration based on 4000 litres per dwelling per day (based on 3 persons/dwelling 200 litres per head per day): 0.046 litres/second: Sewers for Adoption 7TH Edition B5.1

Dwr Cymru Welsh Water wastewater profile assessment use the design figure per capita return to sewer flow of 180l/hd/day design standard.:0.042 l/sec**

Therefore, applying the same maxim to the proposed development

12.5 Design Flow Rates from Proposed Development (Ref: Appendix C)

Category of Building: Residential House

Wastewater Flows based

Total Number of apartments

16 No 1 bed apartments plots @ 0.042/sec =0.67 l/sec.

Total daily flow = 57,888. litres per day

Therefore, the total daily foul water flow emanating from the building based on 90% of cold-water demand is: 57,888 l/day x 0.90 =52,099l/day (0.042 l/sec) **This figure is a design peak flow rate and not an average water usage and represents the peak flow rate from a number of appliances.

52,099 l/day total flow / 1000 = 52 cubic metres per day effluent discharge to public sewerage system

Design note:

Peak flow rate may also be determined by the application of a diurnal wastewater flow pattern resulting in a variable peak factor so that attenuation and diversification effects tend to reduce peak flow, and so the ratio of peak to average flow generally decreases from top to bottom of the new drainage network.

After site clearance, a new gravity drainage system serving the development proposals will be constructed. The design options for the proposed foul water layout serving the development expectations are as follows:

13.0 Conclusions & Recommendations

13.1 Surface Water

Details of the existing sewer network, ditch courses, watercourses and any other water bodies have been obtained.

A detailed surface water drainage scheme has been developed. Surface water discharge flows have been calculated based on the development proposals.

Discharge flows from the development will be limited to 1.7 l/sec + 2.6 l/sec = Total 4.3 l/sec for all storms due to limited opportunities within the site to provide long term storage.

The scheme includes a SuDS management train approach including porous surfacing, partial infiltration, raingardens, sedum roofs to outbuildings, tree planting and bioretention basins with geocellular storage.

A surface water drainage scheme has been developed in accordance with these principles and is indicated on drawing 10463-501-502-503.

Foul Water

Details of the existing public sewer network have been obtained from Dwr Cymru Welsh Water.

The expected foul water discharge flows have been determined based on the development proposals.

Recommendations

This document should be reviewed and updated as the design develops.

A detailed Ground Investigation has been carried out to inform geological, hydrological, and ground conditions on the site.

Surface water discharge from the site should be limited to the permissible discharge rate of 4.3 l/sec for all design storms pro-rata from both sites.

The development of SuDS capture, and conveyance of flows should be developed in conjunction with the SAB in accordance with Schedule 3 of the Flood and Water Management Act.

The layout of the proposed development and the design of the new on-site surface water drainage system should allow for the excess runoff from an exceptionally intense local rainstorm to be confined for the duration of the storm within the site.

The detailed design of the on-site surface water drainage system should consider the possible effects of climate change on storm runoff over the next one hundred years.

14.0 S6: Surface Water Drainage Operation and Maintenance Strategy

Conventional surface water drainage features such as gullies, channels, and manholes should be inspected as an absolute minimum annually, and where practicable after intense storm events, with silt removal.

Maintenance Guidelines Raised Planter /Rain Garden

Operation and maintenance requirements for bioretention systems		
Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

Maintenance Guidelines for Permeable Paving

Operation and maintenance requirements for pervious pavements		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	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
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	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 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	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, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Maintenance Guidance for Attenuation Tanks

Operation and maintenance requirements for attenuation storage tanks		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

15.0 Summary of SuDS

S1 -Surface Water Destination

The proposed SuDS features to the proposed building will discharge to a combination of partial infiltration through permeable paving, attenuation storage tank and rain garden and ultimately to a surface water drain: Priority Level 2 and 5.

S2 -Surface Water Runoff Hydraulic Control

Part 1 of this standard (interception) will be adequately dealt with by the proposed SuDS scheme as detention basin and rain gardens, are all interception mechanisms with assumed compliance.

S3 -Treatment

Given the low pollution hazard levels of the proposed development and the introduction of the SuDS components the water treatment is satisfied.

S4- Amenity

The standard S4 is considered enough given the nature of the site.

S5 -Biodiversity

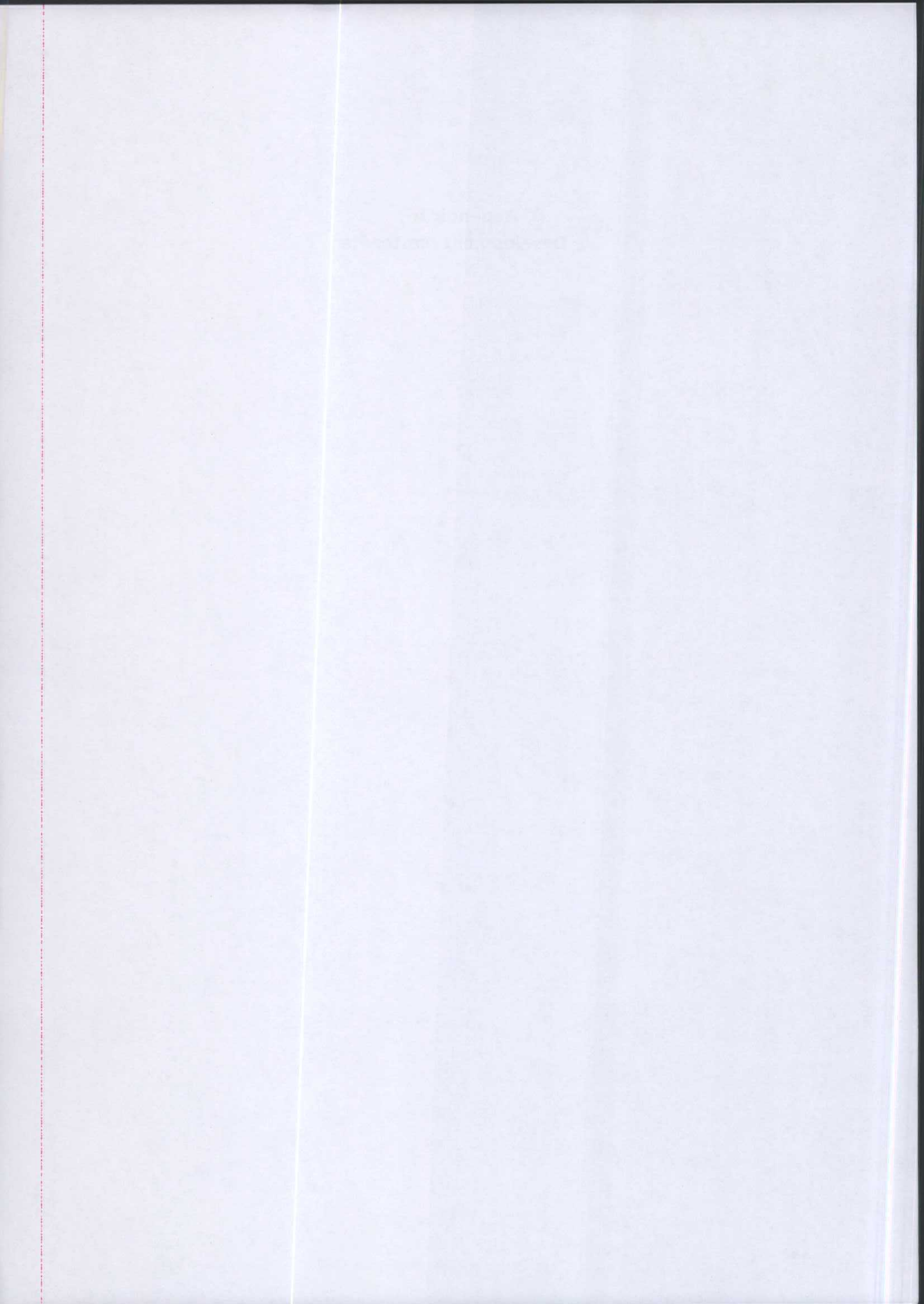
The standard S5 is considered enough given the nature of the site

S6 -Design for Construction, operation, and maintenance.

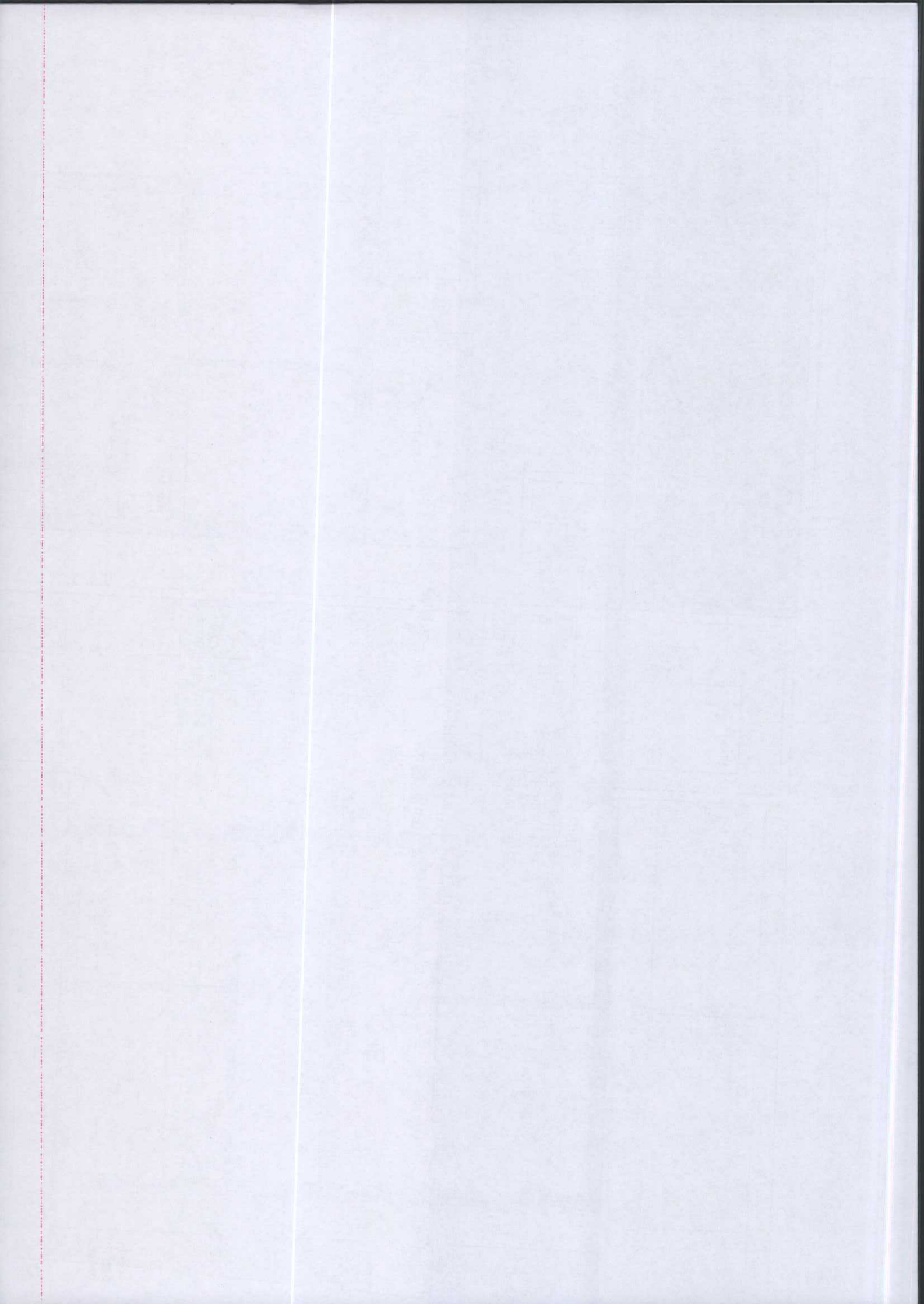
The maintenance for the rain garden/planters and Detention basin is included.

Appendix A

Development Master Plan

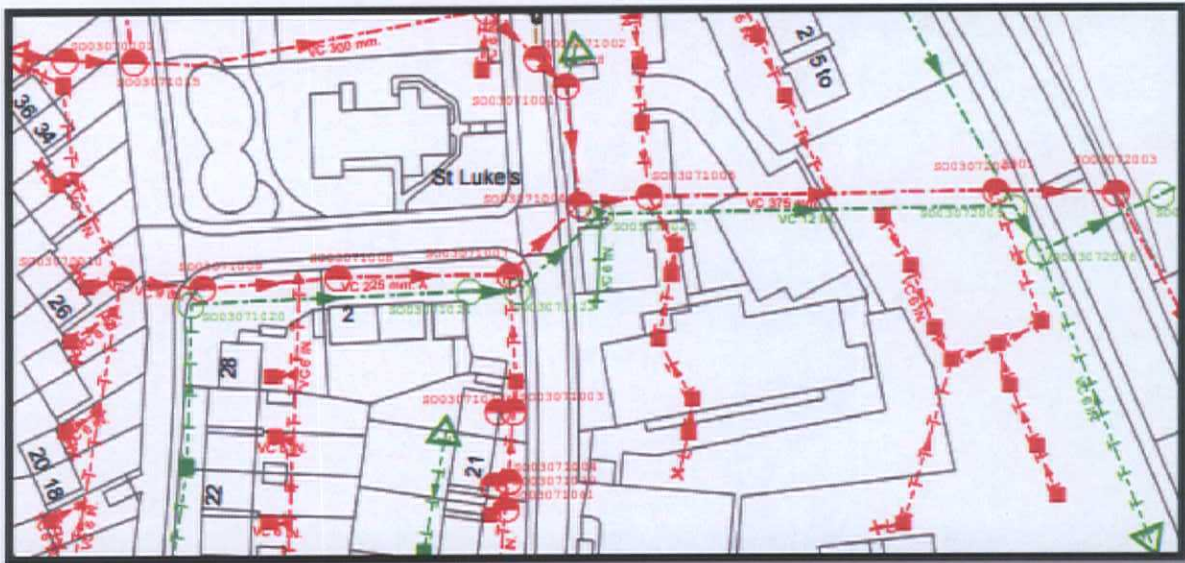


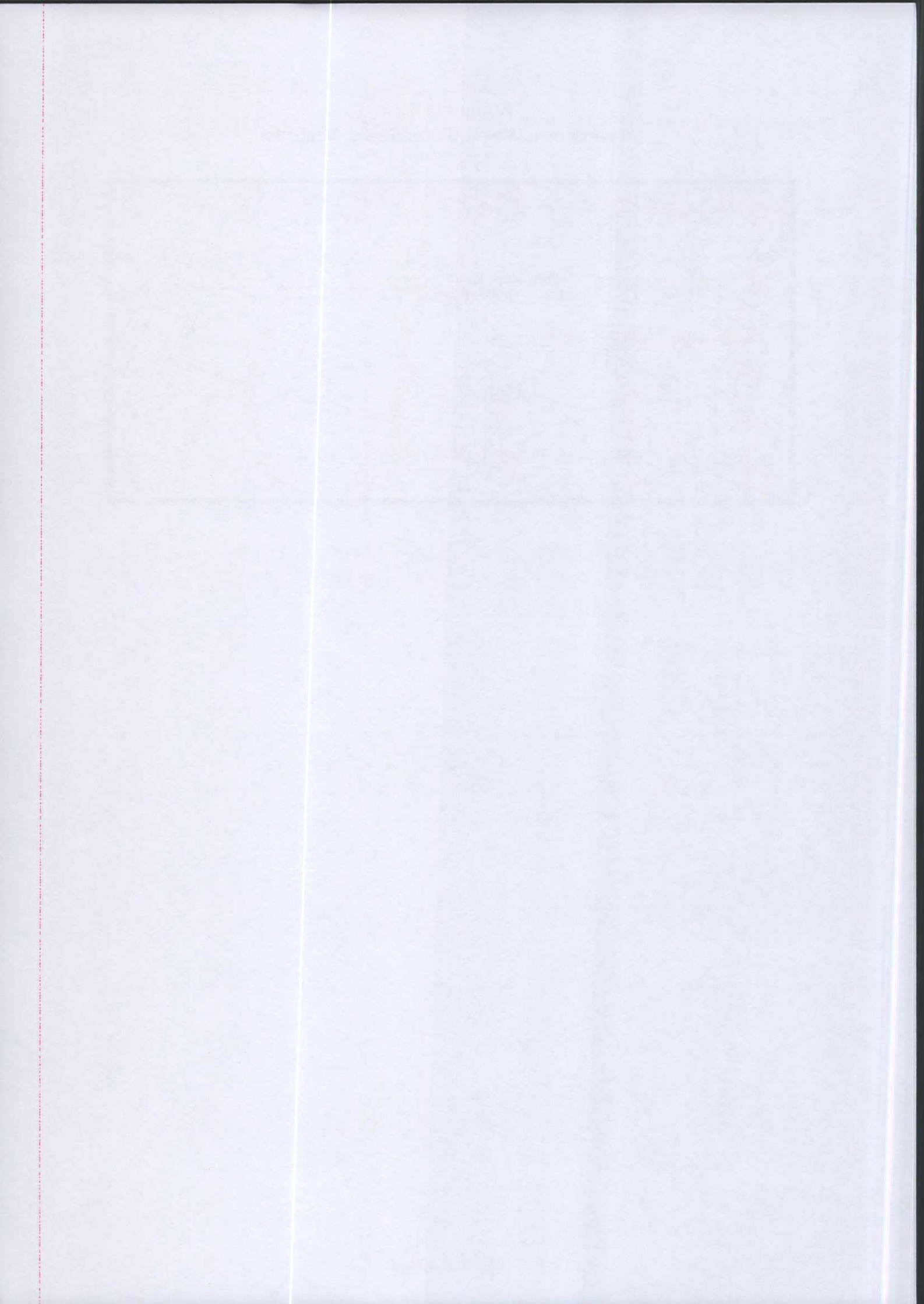




Appendix B

Dwr Cymru Welsh Water Sewer Records







Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby by the company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based upon the best information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

**EXACT LOCATION OF
ALL APPARATUS TO
BE DETERMINED ON
SITE**

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Appendix D
Drainage Strategy Drawing
(Drg No:10463-501-04)



Scale: 1:750

- LEGEND**
- Clean Water
 - Sluice Val
 - Air Val, SINGLE
 - Tap
 - Pressure Reducing Valve
 - Meter
 - BULK Meter
 - 1" FH
 - Cap
 - Existing Main
 - NON COMPANY
 - Sewerage External
 - Foul
 - Surface Water
 - Combined
 - Rising Main
 - Private
 - Treatment Works
 - Pumping Station
 - Special Purpose
 - Unknown End
 - Change, Combined Overflow
 - Outfall, FOUL
 - Lamp Hole, Foul
 - Private Sewer Transfer
 - Lateral Drain
 - Inspection Chamber



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EXACT LOCATION OF ALL APPARATUS TO BE DETERMINED ON SITE

Reproduced from the Ordnance Survey's maps with the permission of the Controller of Her Majesty's Stationary Office. Crown Copyright. Licence No: WU298565. Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation.

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Appendix C
Existing Drainage Mapping
(Draintech Site Survey: September 2020)

