

**Proposed Residential Development
Glan Gors
Wrexham**

Sustainable Drainage Solutions Investigation

6503/REPORT 001



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Main Author	N. Lewis
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Introduction

Bay Associates Consulting Limited have been appointed by Pennaf Housing Group to produce a drainage report, investigating sustainable means of disposing of surface water for the proposed development at Glan Gors, Wrexham and to determine the suitability of the technologies for the proposed development.

This report has been written in accordance with the Building Regulations Part H and Ciria documentation C609 'Sustainable Drainage Systems – Hydraulic, Structural and Water Quality Advice'

Project Description

Pennaf Housing in a joint venture with Wrexham County Council are to redevelop a former landfill site off Coed Aben, Wrexham with a grid reference of SJ 35183 49869. The site is located approximately 1.5km south east from Wrexham town centre.

The proposed development incorporates 23 residential units in the form of houses and flats with associated access roads and offsite parking. The proposed buildings are to be of traditional construction with pitched roofs. The scheme has received outline planning consent and full planning permission application has now been issued.

The development is to achieve a minimum of the 'Code for Sustainable Homes' level 4 this requires the design and implementation of sustainable means of draining the development.

Existing Site and Drainage

The existing site is elevated above Coed Aben and the surrounding boundaries by up to a metre; the site is relatively flat with a shallow fall towards Coed Aben. The total area of the site is approximately 7000m², 100% of which is soft landscaping.

See Appendix A for existing site survey.

Proposed Site and Drainage

As indicated above the site is to be redeveloped to accommodate 23 residential units with associated access roads and off street parking. The proposed layout reduces the area of soft landscaping from the existing and as such the proposed hardstanding areas generates an on flow of 99l/s (utilising a peak intensity of 50mm/hr. In order to discharge to the public sewer we propose to utilise SUDS technologies where possible to reduce both flow and volume off site to the surface water sewer that crosses the north western corner of the development.

See Appendix B for the proposed site layout

Ground Conditions

As indicated previously the site was formally used as a landfill and as such the ground conditions are poor, the site investigation revealed that the ground consisted of little topsoil overlaying a clay capping layer which encapsulates the refuse which is approximately 5 - 10m in depth.

Please see Appendix C for Terra Firma's trial pit logs

Drainage Solutions

Permeable Paving

Permeable paving system allows surface water runoff to infiltrate the permeable block surface into a sub base before allowing the surface water to infiltrate to the underlying sub grade. The sub base has a reservoir of approximately 30% of the total volume which is created by voids between the specified aggregate. The water leaving this drainage system is cleaned by filtration and naturally occurring microbes that live within the geotextile and sub base. The presence of the beneficial bacteria negates the need to provide oil interceptors due to the microbe's high consumption rate of hydrocarbons.

Permeable paving can also accommodate roof water which can be discharged into the sub base via a gravity fed drainage system. The water is dispersed within the sub grade via a distribution tank. To ensure all fines are caught the distribution tank is wrapped in a geotextile. All distribution tanks are to be located at a minimum of five meters away from buildings where possible to comply with building regulations 2002.

In addition to the above the permeable paving system can be used as a form of attenuation through replacing the permeable geotextile with an impermeable membrane with an outlet. This can be considered uneconomic as it offers little storage unless spread over large areas.

Conclusion

Due to the existing ground consisting of clays and more significantly landfill a permeable drainage system cannot be considered. Waters discharging to the ground will mobilise contaminants potentially polluting the nearby watercourses and ground waters.

Soakaways

A Soakaway is a drainage pit or trench that takes run off from a development and allow it to percolate into the ground. These devices have storage volume so that the run off may be allowed to empty from the device into the ground over a period of time, usually 24 hours to provide storage for runoff from any following storms.

Infiltration devices are most suited to areas where run off is relatively unpolluted and sediment loads are low i.e. roofs. They should be designed to take run off from relatively small catchment areas to reduce the risk of clogging. If larger areas are drained they should be split into smaller sub – catchments.

All soakaway systems should be preceded by some other form of treatment to remove sediment and treat pollutants to acceptable levels before entering the infiltration device i.e. a petrol interceptor or catch pit.

Part H of the Building Regulations requires consideration of infiltration before any other method of dealing with storm water runoff. Soil and groundwater conditions are crucial to the successful use. Many areas of the UK, clay soils or high ground water levels limit the use of infiltration devices.

Soakaways can be constructed in many formats from traditional stone filled trenches, perforated manhole chambers and cellular box systems. The stone filled trench is oversized in order to accommodate the volume of stone, this leaving void ratio of 33% for storage of runoff. Cellular box systems are increasingly popular as a void ratio of approximately 95% is available thus allowing the overall structure to be smaller. Circular soakaway systems or perforated manhole chambers are only suggested for individual domestic use as a circular structure does not allow for sufficient contact area with the surrounding ground in which to infiltrate to; thus increasing the size of the structure.

Conclusion

Due to the existing ground consisting of clays and more significantly landfill a permeable drainage system cannot be considered. Waters discharging to the ground will mobilise contaminants potentially polluting the nearby watercourses and ground waters.

Ponds and Swales

Swales are typically relatively broad yet shallow channels cut into the ground and are most commonly found at the edges of roads, or close by. Surface water is directed into the swale where it flows along to a suitable storage or outfall point, and may gradually soak into the ground beneath. Unlike normal drainage ditches that tend to contain running water most of the time, swales are intended to be dry for long periods, and so they are often smothered with vegetation that doesn't mind being inundated occasionally.

Ponds can be created as a feature within landscaped areas of the site which can provide temporary storage for storm water, reduce peak flows to receiving waters and facilitate in the filtration of pollutants through microbial decomposition and allow water infiltration directly to the ground. The base of the pond can be lined with an impermeable membrane which will maintain a specified depth of water which enables the pond to remain an ornamental feature as supposed to a ditch, any water levels higher than the membrane will either infiltrate to the ground should conditions allow or discharge through an overflow pipe to a watercourse or sewer.

Conclusion

Due to the existing ground consisting of clays and more significantly landfill a permeable drainage system cannot be considered. Waters discharging to the ground will mobilise contaminants potentially polluting the nearby watercourses and ground waters.

These systems can be used as on site storage whilst creating a feature pond. It would be common place to provide an overflow to allow additional waters to discharge to the onsite drainage system thus reducing the potential for onsite flooding. As this system carries out the same function as below ground storage we can further rule out this system and utilise a less obtrusive methods.

Discharge to Watercourse

A Watercourse will be controlled by the Environment Agency and/or the local authority and will determine a discharge rate from a proposed development. It is common practice for a pollution prevention device to be installed prior to discharge to a watercourse such as a petrol interceptor.

In order to protect the integrity of the watercourse the proposed discharge will be restricted to an agreed rate, usually 'greenfield' rate. This is achieved through the introduction of a flow control device and an attenuation tank.

Conclusion

The nearest watercourse/ open ditch is located approximately 130m south of the site boundary (as the crow flies) beyond Eden Drive and a number of houses. The stream depth is approximately 1.3m (from top of bank to stream bed) and runs in a westerly direction towards the River Clywedog which is lies 900m to the south.

Due to the nature of the area – an established residential estate, a direct route cannot be achieved and as such a route along Coed Aben, Anthony Eden Drive and finally Gernant will be necessary which is approximately 300m in length. Whilst considering pipe depth in the public highway and that the topography in the area is relatively flat it is evident that a gravity system cannot work as the pipe will be deeper than the stream itself and as such alternative means of disposing the SW are necessary.

As indicated above the DCWW surface water sewer which runs along the north western corner of the development runs beneath the houses on Anthony Eden Drive and as such is able to discharge to the unnamed stream. We have determined that a restricted flow to this sewer offers the only viable surface water solution.

Rain Water Harvesting

Rain water harvesting is the capture and re use of rainfall. It is an alternative to public mains water in non-potable applications such as WC's, irrigation systems, laundries, vehicle washing, sprinkler systems and other uses where the water is not ingested.

Water is collected from roof areas and stored in a tank above or below ground. There are several systems in use; examples are 'Non Pressured Systems' where rainwater is gravity fed via a header tank to its point of use. The header tank is located at high level such as loft space, this enable the entire building to be serviced via gravity. Rain water butts which are located at the base of rain water pipes where gravity allows water to discharge when needed however these are not associated with the provision of drainage for internal use i.e. WC's

Conclusion

In order to reduce the volume of water entering the public surface water sewer we have considered the above options and propose to provide 750L rain water butts to each plot which can be used for garden irrigation and car washing

Green Roofs

Roofs are one of the most significant contributors to rainfall runoff in drainage systems. Green roofs can be used to reduce the volume and rate of runoff so that other SUDS techniques in the proposed scheme can be significantly reduced.

A green roof is a multi-layered system that covers the top of a building with vegetation, below the surface, green roofs can include various soil or substrate, drainage, waterproofing and insulation layers.

There are two types of green roof:

Extensive – the extensive covers the whole roof area with low growing, low maintenance plants. They are accessible only for maintenance. Extensive green roofs typically comprise a 25 – 125mm thick soil layer in which a variety of hardy, drought tolerant, low plants are grown.

Intensive – These are landscaped environments for recreation that included planters or trees and are usually publically accessible. There may also include after features and storage for rainwater for irrigation, Intensive roofs generally impose far greater loads on the roof structure and require significant on-going maintenance.

Green roofs can be used on a variety of sites. They can be used on most roofs but are ideal for flat or gently sloping roofs.

The process involved in the operation of a green roof is:

- Retention of rainwater in substrate and drainage layers
- Uptake of water and release by plants as vapour (transpiration)
- Uptake of water and biochemical incorporation by plants (photosynthesis)
- Evaporation from substrate due to wind and sun

Once the field capacity of the soil layer is reached, the water drains through to the drainage layer below at a rate that is roughly equal to the saturated hydraulic conductivity of soil or growth medium. The hydraulic performance is specific to the growth medium and plants used, as these will soak up most of the rainfall and then release it. Temperature, wind speed, substrate depth and growing season are the factors that will affect water removal from the system and total volume of runoff released to the drainage system.

Conclusion

The site is located in an established residential area as such the architect has worked with the planners to design a building which is complimentary to the local vernacular and a suitable palette of materials which tie in with the area. On this basis flat roofs are not permitted and as such rules out the effective use of green roofs.

Drainage Option Conclusion

Based upon this report we can conclude that we have examined and considered the available technologies that will reduce the burden upon the public sewer. The majority of surface water drainage techniques are dependent upon site constraints such as infiltration rates and proximity to a watercourse.

The underlying ground conditions do not allow for the use of infiltration technologies as indicated above the ground consists of landfill thus any surface water infiltration will potentially mobilise the known contaminants

The technologies that do not rely upon infiltration capabilities consist of rain water harvesting and green roofs. In order to reduce the burden upon the public sewers we propose to utilise the rain water harvesting technology in the form of rain water butts.

The proposed site generates will generate considerable discharge flows, however this can be mitigated through on site attenuation and flow control device.

Proposed Surface Water Drainage

The roof waters will be collected in a number of rain water pipes located around the building and will discharge to 750L rain water butts. In the event the water butts are filled the surface water will overflow into a cellular attenuation tank beneath the soft landscaping. The driveway and access road areas will drain directly to the onsite attenuation via a traditional gully and pipe system.

The drainage system will incorporate a cellular attenuation tank and flow restricting device which will restrict the flow of site surface water into the public surface water sewer to 5l/s

See Appendix D for proposed drainage