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Proposed Residential Development at Cae Gors, Tregarth, Bangor.
Sustainable Drainage Strategy

This design note sets out how the drainage strategy for the proposed residential development at Cae Gors, Tregarth, Bangor will address the six standards requiring evaluation as part of a SuDS Approving Body (SAB) Pre-application enquiry.

The six standards that need to be met are as follows:

- S1 – Management Hierarchy
- S2 – Surface water runoff hydraulic control
- S3 – Water Quality
- S4 – Amenity
- S5 – Biodiversity
- S6 – Designing drainage for construction, operation, maintenance and structural integrity.

<u>S1 – Management Hierarchy</u>

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

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

The proposed development is for 12 residential dwellings. Whilst the first priority is to collect rainwater for re-use, harvesting was considered and deemed not suitable. From a cost/benefit approach, individual single property systems are uneconomic and the area does not suffer from a water shortage. A shared communal system was also considered but deemed inappropriate with regard management and maintenance. The provision of rainwater butts will be promoted to provide some rainwater re-use for garden irrigation and rain gardens are proposed for the at source management of runoff from the roof areas.

The second priority is to consider infiltration of surface water runoff into the ground. The site generally falls from South to North, falling steeply over the initial third before plateauing out. Trial pits have been excavated across the and soakaway tests have been carried out in the lower areas. Ground investigations in the lower area encountered firm to stiff grey mottled orange slightly sandy very gravelly CLAY at 1.2m below ground level. This was overlaid by a thin layer of blackish Brown PEAT, brown silty sandy GRAVEL and brown silty gravelly sand with frequent cobbles and occasional brick (MADE GROUND). Groundwater was encountered in the excavations at depths between 0.4m and 1.1m below ground level. The trial pits in the elevated areas of the site encountered strong slightly weathered grey finely laminated mudstone (BEDROCK) 0.6m to 1.7m below ground level. This was overlaid by greyish brown very sandy slightly silty GRAVEL, orange brown silty very gravelly SAND and brown sandy gravelly silt (TOPSOIL). Soakaway testing following the general guidance of BRE Digest 365: Soakaway Design was attempted, however, an infiltration rate could not be determined as negligible infiltration

was observed over the monitoring period. Based on this it is considered that soakaways should not be relied upon as the primary means of managing surface water since a) infiltration rates were poor, and b) ground water levels were variable and high in places.

Whilst infiltration discharge may not be feasible for the complete management of the runoff from the development, the provision of unlined attenuation structures within the drainage system will enable initial/low intensity rainfall to infiltrate slowly through the base. This will help to manage the initial "first flush" runoff and reduce the volume of runoff leaving the site.

The third priority is to consider discharge to a surface water body. An un-named ordinary watercourse crosses the northern third of the development area. The watercourse is recorded on the Natural Resource Wales Long Term Flood Risk Maps and is a tributary to Afon Ogwen. The development proposals include for diverting the watercourse closer to the northern boundary of the site and will include provision to discharge surface water runoff from the site to it. The proposed choice of surface water runoff destination will therefore be to discharge into the watercourse.

Discharge to surface water sewers/highway drains or combined sewers has not been considered.

S2 – Surface water runoff hydraulic control

Discharge to the watercourse at Greenfield runoff rates is the proposed method of managing the flow off the site. In order to manage the discharge from the site, attenuation structures are proposed throughout the drainage network with an emphasis on managing water close to its source. These will include:

- Porous pavements (parking)
- Porous Pavements (private zones)
- Rain Gardens
- Cellular Attenuation.

Roof areas will drain via water butts into rain gardens. Flow will discharge onto the surface of the rain gardens to allow infiltration through the engineered surface soils. Excess flow will drain to sub surface filter material and will be discharge to the wider site drainage system. Above ground attenuation will be provided within the raingardens however overflow/weir surface gullies will also be provided to convey excess runoff to filter media below and the wider site drainage network using carrier drains.

Car parking areas throughout the development will be constructed using porous pavement methods providing initial attenuation at source, and trickle infiltration. The porous paved areas and raingardens will be linked with runoff from the plot rainwater drainage systems and the external public paved areas directed through the structures. Discharge from the rain garden/porous pavement structures will be controlled into the carrier drainage system close to source. Where private roads/zones are proposed, these will also be constructed using porous pavement methods which will provide additional attenuation to the drainage system. Subject to the engineering stability of the sub grade if wetted these will also allow trickle infiltration.

Subject to agreeing the technical aspects with the Highway Authority, runoff from the public access roads areas which will be offered for adoption will be allowed to flow onto the porous paved parking areas for collection. Storage and discharge from the porous paved areas will be controlled as described above.

The surface water drainage networks will convey flow through the development to the low areas of the site. Along with the source control of surface water runoff management and storage features, a cellular storage structure is also proposed under the public open space (POS) area upstream of the outfall from the site. This will provide additional storage to the drainage system whilst maintaining the amenity and biodiversity benefit of the POS area. It is proposed that the flow up to and including the peak 1 in 100 year event with a 30% allowance added for climate change will be stored within the attenuation structures throughout the site.

Various orifice and vortex flow control structures will be constructed throughout the drainage network and immediately upstream of the discharge from the site into the watercourse. Discharge will be controlled to existing Greenfield Runoff rates. The calculated rates using the HR Wallingford Greenfield runoff estimation tool are:

- Qbar - 1.3l/s
- 1 in 1 year - 1.2l/s
- 1 in 30 year - 2.4l/s
- 1 in 100 year - 2.9/s

It is proposed that runoff will be controlled to the Qbar discharge rate of 1.3l/s for all rainfall events with the required volume of attenuation provided.

S3 – Water Quality

Water treatment will be provided via the SuDS components included throughout the drainage network.

- The pollution hazard from roof areas is considered very low and discharge through the porous pavement open sub-base layer and rain gardens will provide sufficient pollution mitigation.
- The pollution hazard from individual driveway/residential car parking is considered low. Conveyance via the porous parking pavement and open sub base layer will provide sufficient pollution mitigation.
- The pollution hazard from low traffic roads, general access roads, is considered low. By conveying flow from these areas through porous pavements and the open stone sub-base layer, sufficient pollution mitigation will be provided. The use of traditional road gullies may also be required for highway adoption purposes, but it is acknowledged that these cannot be considered part of the SuDS water treatment train. However, if gullies are required run off from these areas will be directed through suitable SuDS features to ensure adequate pollution prevention treatment is provided.

Trapped gullies, trapped rainwater pipe hoppers and catchpit chambers will also be provided throughout the drainage network. These drainage features will be provided to intercept silt in the surface water runoff to reduce the risk of it entering the open stone attenuation structures.

It is therefore considered that adequate water quality treatment can be provided via SuDS components.

S4 – Amenity

In accordance with CIRIA SuDS Manual Table 5, tree planting and landscape/grass zones within the development will provide air quality improvements.

Green and Blue SuDS in the form of the rain gardens and the provision of public open space will help support flora and fauna for the benefit of the development community.

SuDS green and blue spaces will deliver health and wellbeing benefits by providing areas for recreation and relaxation.

S5 – Biodiversity

Green and Blue SuDS in the form of source control rain gardens and the provision of public open space will help support flora and fauna for the benefit of the development community. Careful design and construction of the proposed watercourse diversion will also provide biodiversity benefit. The works will be designed to replicate the existing channel using the existing materials and features. This will help to support and encourage existing and new flora, fauna and habitats.

Connection of the development drainage system onto watercourse and control of discharge to the existing Greenfield QBar rate, will help to maintain the watercourse avoiding damage to existing downstream habitats.

The choice of vegetated components within the landscape design will consider the biodiversity benefits with a view to supporting and promoting appropriate habitat and species.

S6 – Designing drainage for construction, operation, maintenance and structural integrity.

As far as is reasonably practicable the surface water drainage system will be designed with shallow SuDS components (rain gardens, permeable pavements, etc.) which can be constructed easily, safely, cost effectively and in a timely manner.

The drainage components will be designed with a view to them being easily maintained in accordance with the Operation, Management and Maintenance Strategy.

The structural integrity of the drainage components, particularly the permeable pavement elements of the system will be designed to withstand the anticipated loading conditions over the design life of the development, accounting for reasonable levels of maintenance.

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The SuDS will be offered for adoption by the SAB, and the limits of adoption will need to be defined. The SAB will be asked if it has any specific requirements for any SuDS elements it will be adopting.

Where appropriate, allowance will be made to the CBR values to account for leaky system / trickle infiltration. Consideration will also be given to ground bearing capacity for foundation design, and where necessary the extent of leaky system / trickle infiltration may be curtailed to avoid the risk of structural failure.

Conclusion

In accordance with the SuDS Approving Body Guidelines the six standards have been considered and appropriately addressed within the initial draft surface water drainage strategy.

The layout referenced 4761-CAU-XX-XX-DR-C-1600 indicates the conceptual SuDS layout.