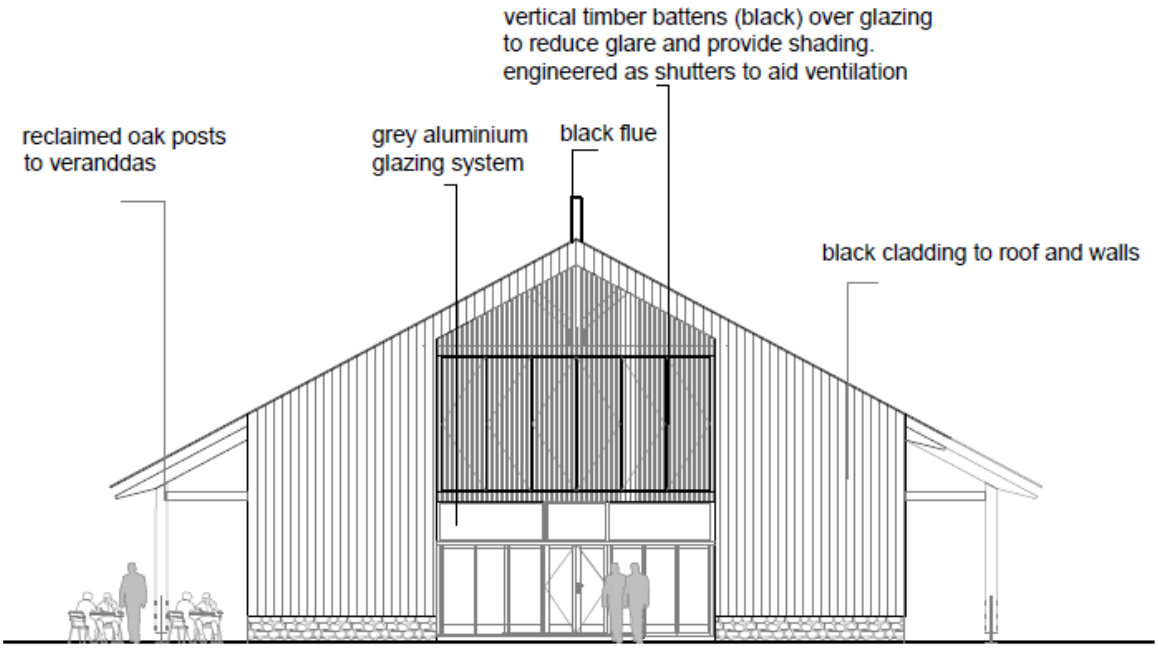
Francis Sant

Glwycaenewydd Environmental Permit For Eco Centre Foul Effluent Discharge
Support Information



May 2024
Final

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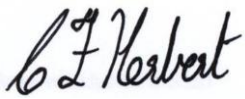
Signed ……  ……

Date ……..…May 2024……

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1 INTRODUCTION

It is proposed to develop an Eco Centre at Glwydcaenewydd Farm to provide a Well Being facility for existing residents. The centre will include a gym, consultation area, lecture room and a café. Toilets will also be provided in the centre, which will be in addition to those provided in the accommodation for the residents.

It is proposed that the foul sewer will be treated on site using a number of systems. Initially the foul sewer will be treated using a package plant. In addition, however, the effluent will be discharged through a filter, designed to remove nutrients as part of a research programme undertaken in conjunction with the University of South Wales. The effluent will then be discharged into a vertical wetland area, designed in accordance with the guidelines developed by the Constructed Wetland Association (CWA), before being discharged into a series of long horizontal wetland areas. These will be used as a nursery for reeds to supply others, including DCWW, who wish to develop their own wetland areas to remove excessive nutrients. The overflow from the wetland area will be discharged overland and allowed to be absorbed into the ground.

This document is produced to support the application for an environmental permit to allow the discharge of the foul effluent into the horizontal wetland.

2 THE DEVELOPMENT

Location

The proposed development (coordinates 289488 224530) is located on Glwydcaenewydd Farm, Crai some 15.5km south west of Brecon (see Figure 2.1 to 2.3 and Plate 2.1). The proposed building is located on the western side of the farm complex with the Afon Crai, a tributary of the Afon Usk, some 420m further to the west and below the proposed development.

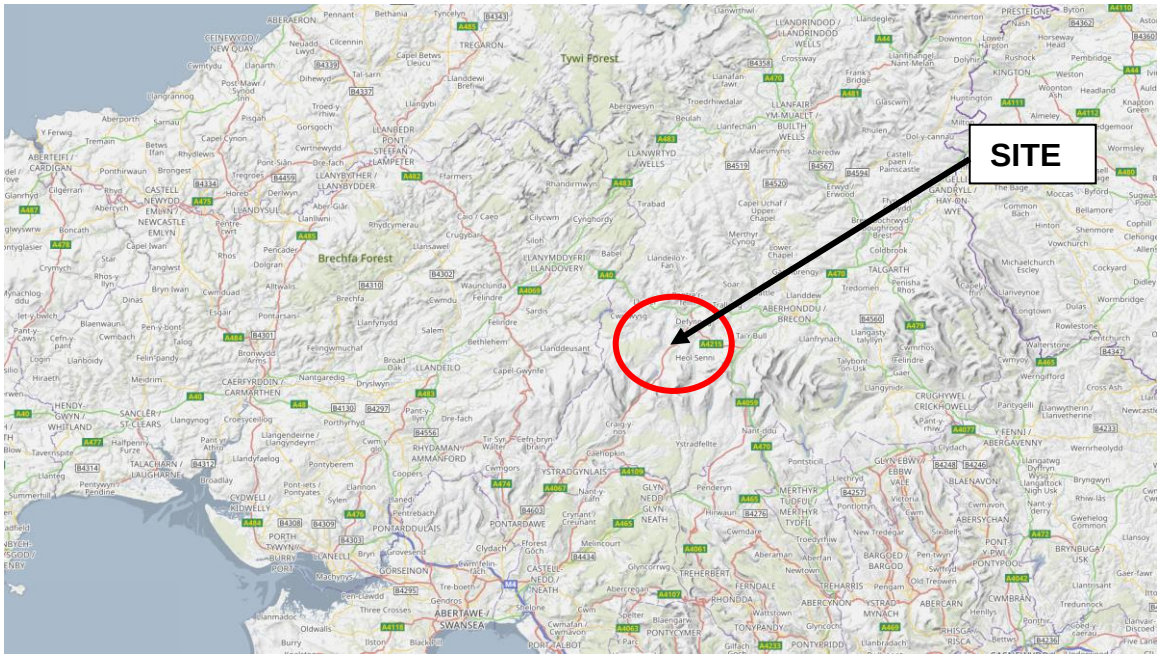


Figure 2.1 – Location Plan

Figure 2.2 – Plan of Area

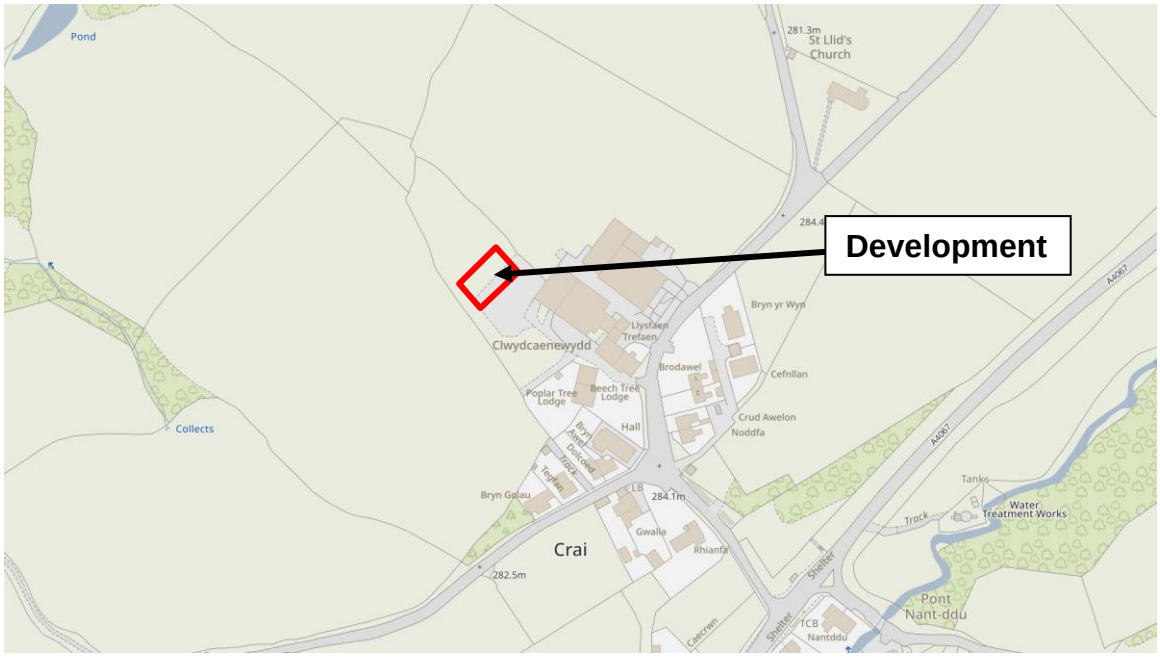


Figure 2.3 – Plan of Street

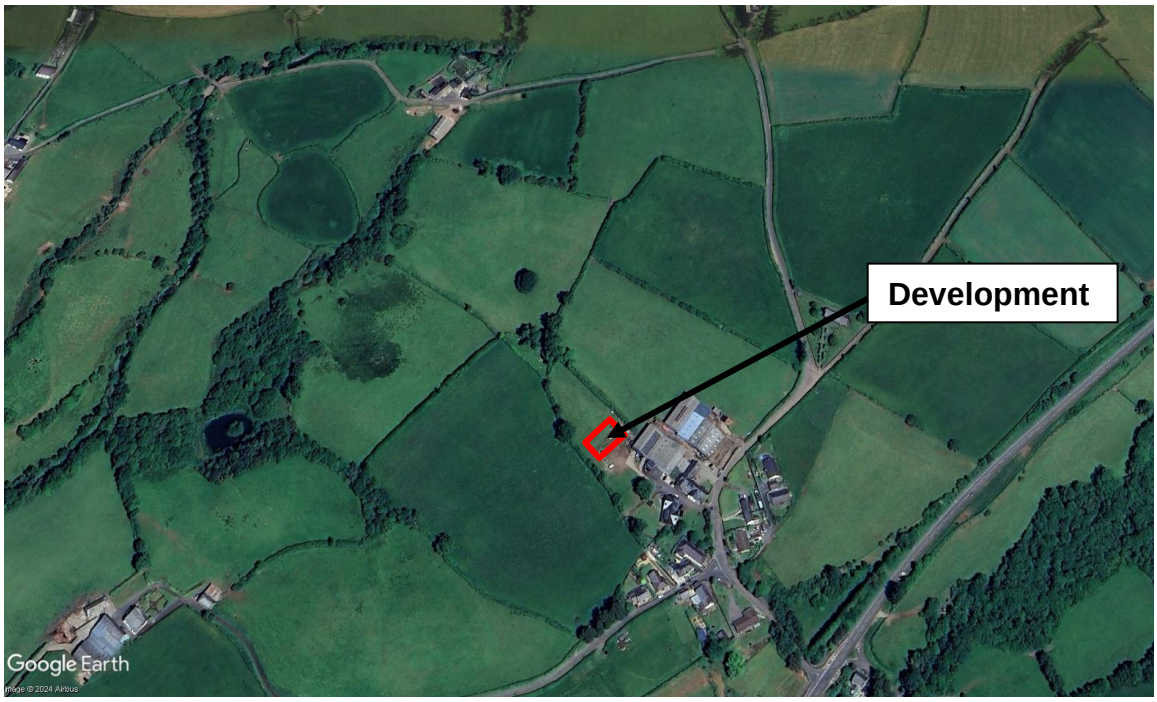


Plate 2.1 – Aerial Photograph of Site

Topography

A topographic survey shows the footprint of the proposed building will be set on land generally ranging between 275.0m AOD and 277.7m AOD with the field below the development falling to around 264.5m AOD (see Figure 2.4).

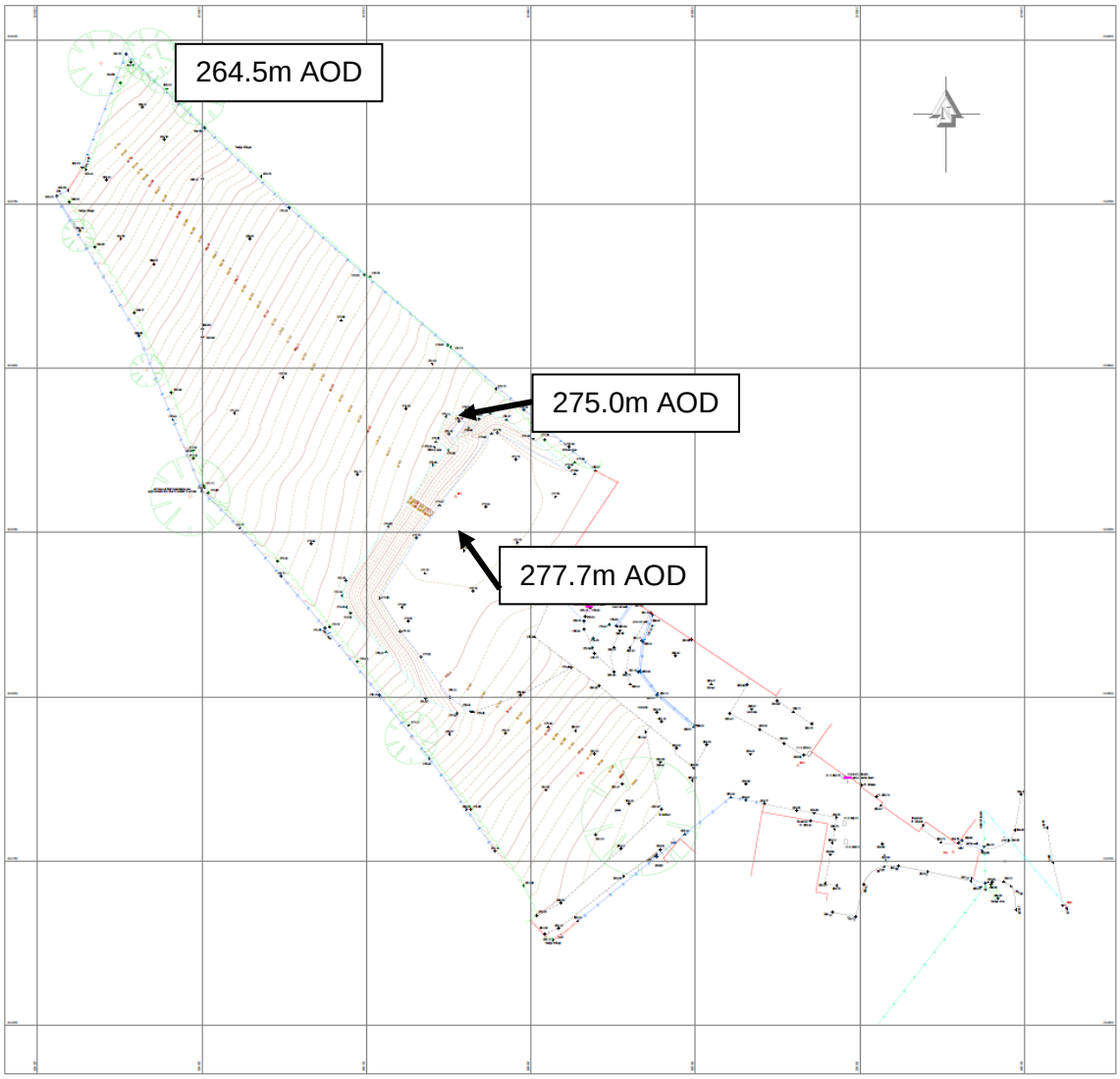


Figure 2.4 – Topographic Survey of the Site

Proposed Development

It is proposed to develop an Eco Centre as a facility for existing residential visitors (see Figure 2.5 to 2.10). The building will provide a location to hold well being courses and lectures and general recreation and will include a gym, consultation rooms a lecture room and a caffe.

The foul drain will drain to a Ecorock 5010 which has a treatment efficiency as indicated below (also see Appendix A).

- BOD 96% / 7mg/l
- COD 91% / 47mg/l
- SS 98% / 6mg/l
- N total 52% / 30mg/l
- P 30% / 7mg/l

The effluent from the package plant will then pass to a nutrient filter chamber subject to experimental work conducted by the university of South Wales. Subsequently the effluent will be pumped periodically to a vertical wetland area, designed in accordance with the guidelines provided by the Constructed Wetlands Association (see Appendix B).

After the tertiary treatment, and assuming the experimental filter treatment has no impact, the effluent is expected to have a treated value of

- BOD 94% / 0.5mg/l
- SS 96% / 0.24mg/l
- N total 92% / 2.5mg/l
- P 30% / 2.1mg/l

Should the wetland treatment area fail it would be possible to drain the effluent from the package plant to ground via a 135m2 drainage field.

Figure 2.5 – Plan of Proposed Development

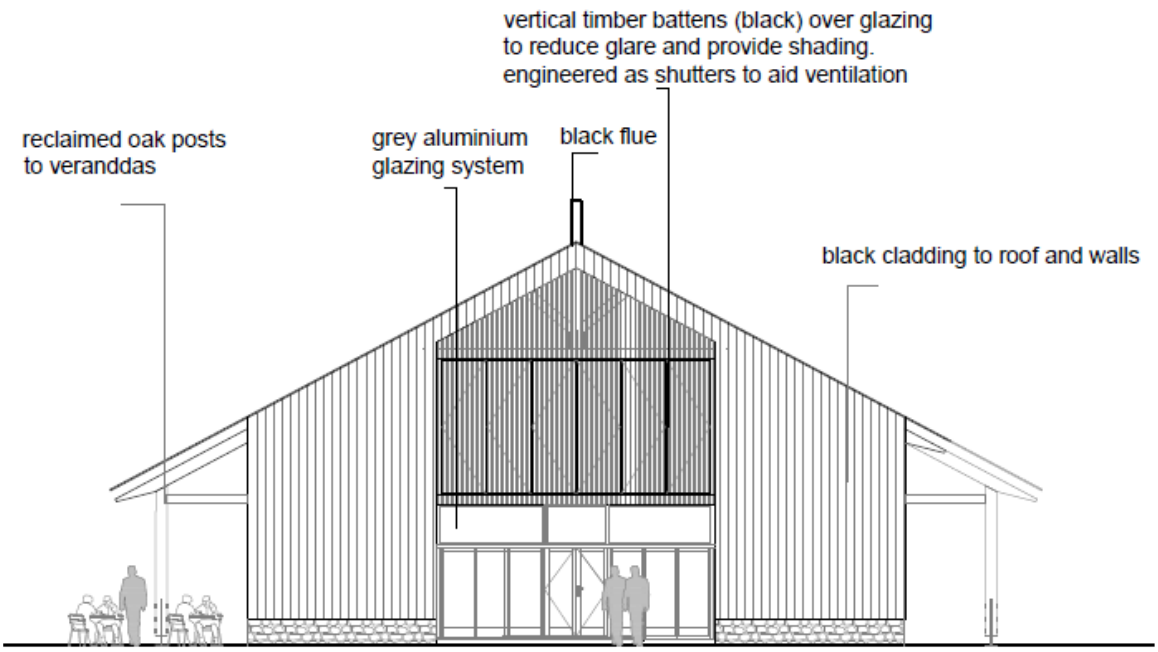


Figure 2.6 - Side Elevation of Proposed Development

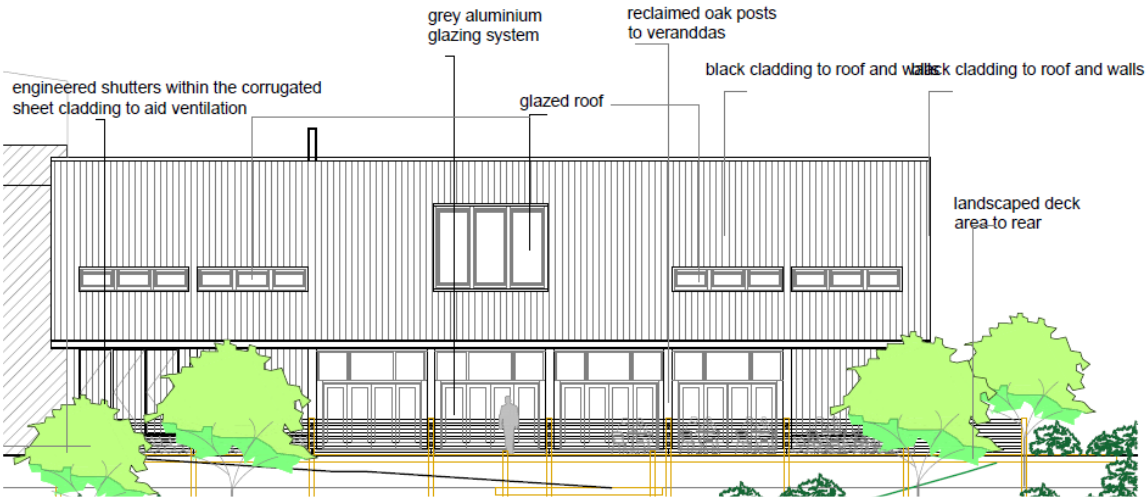


Figure 2.7 - Rear Elevation of Proposed Development

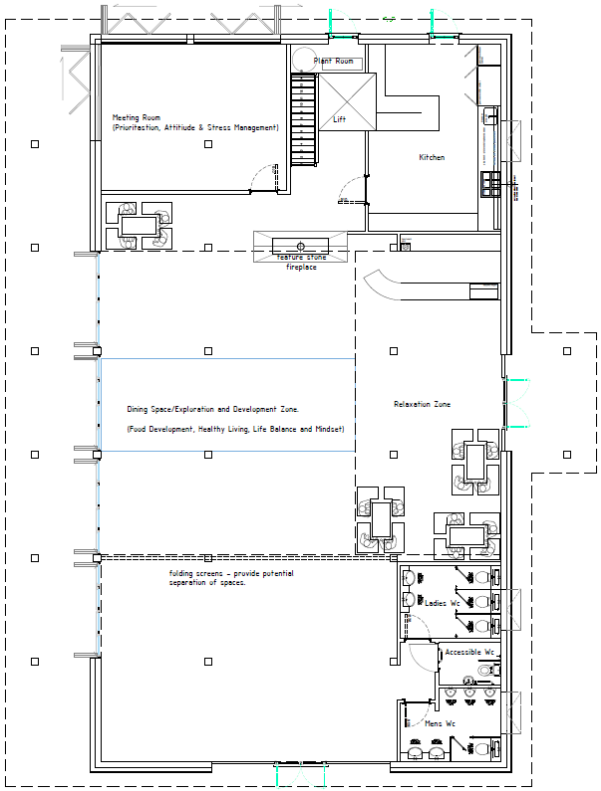


Figure 2.8 – Ground Floor Plan of Proposed Development

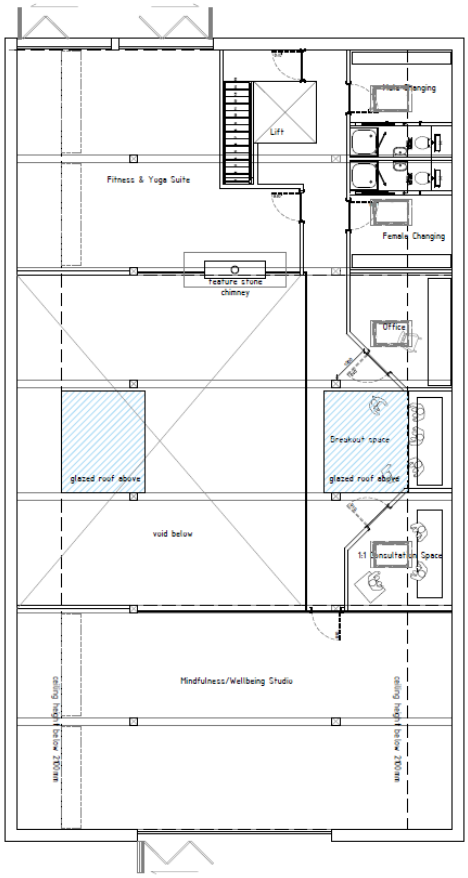


Figure 2.9 – First Floor Plan of Proposed Development

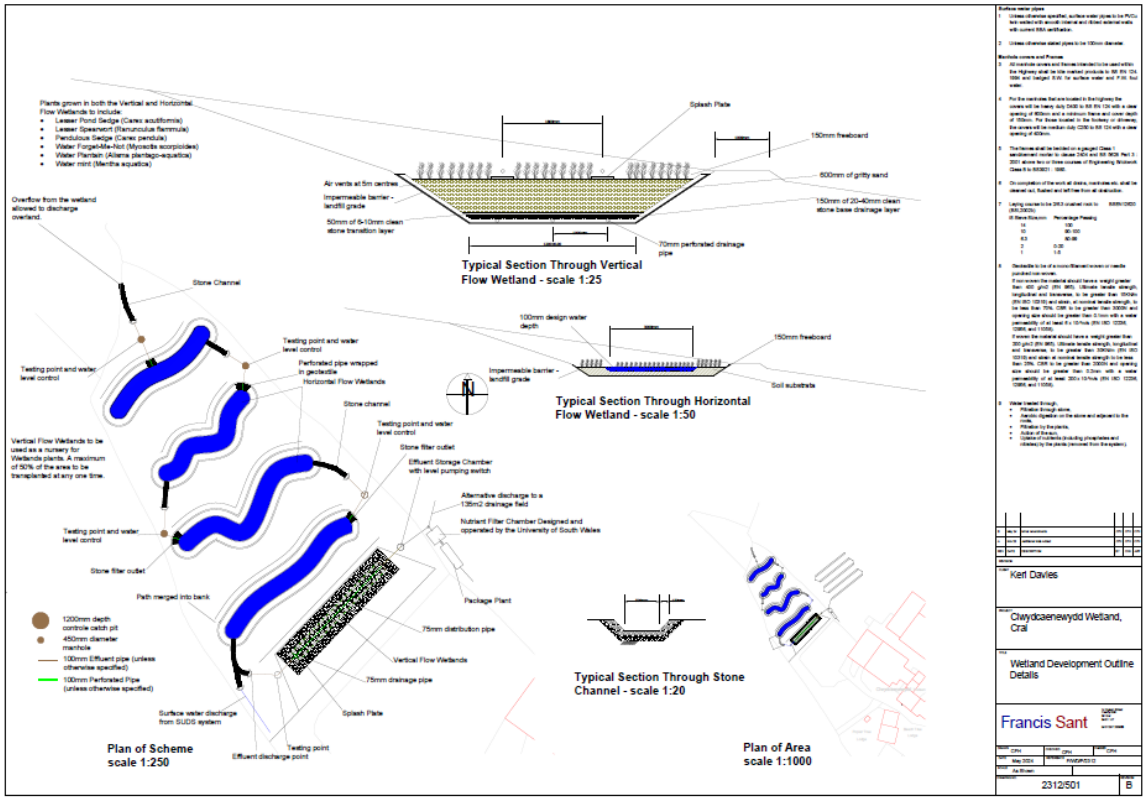


Figure 2.10 –Proposed Of The Foul Discharge From The Development

Loading

The loading for the package plant has been estimated using the British Water Code of Practice Flows and Loads – 4.

Non residential Conference Guest 36 x 60l =2160l
Staff 3 x 90l =270l
Part Time Staff = 45l
Total =2520l

We understand that a total of 35 people could stay at the resort, however, these would include lecturers. 36 assumed in the new calculations.
It is expected that at any one time there will be a maximum of 3 full time staff and two part time staff. At times a lecturer will be required to stay overnight on site, however, use one of the residential spaces. It is also noted that there is an existing staff rest rooms and facilities on site.

Geology

The upper part of the development area has no superficial geology while the lower part consists of Diamicton from Devensian Till overlying a bedrock of Argillaceous Rocks interbedded with Sandstone from the St Maughans Formation (see Figure 2.11 and 2.12).

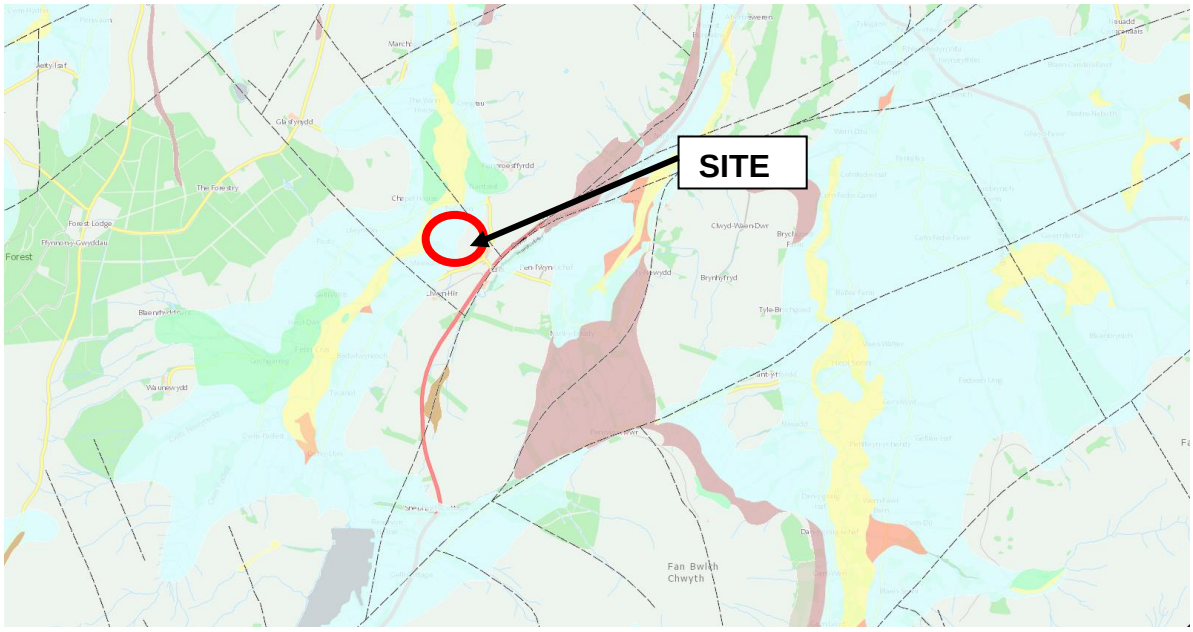


Figure 2.11 - Superficial Geology

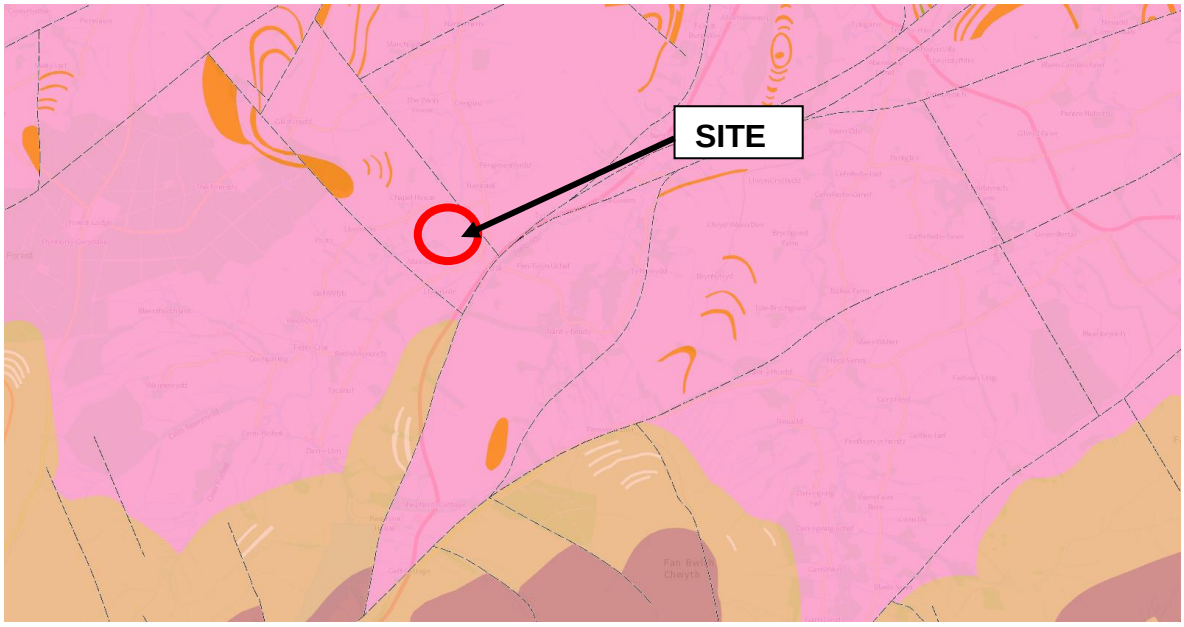


Figure 2.12 - Bedrock Geology

Percolation tests, undertaken in accordance with approved document H, shows that the soil has a Vp of 35.65 suggesting that a discharge to ground is acceptable (see Appendix C).

3 DESIGNATED SITES

Wales has 20 Special Protection Areas for vulnerable birds and 92 Special Areas of Conservation for other rare species and threatened natural habitats and protected by law. Together they are known as Natura 2000, and along with areas across Europe, they form an unparalleled network of international importance for nature conservation. Wales' Natura 2000 network covers more than 700,000 hectares (8.5% of Welsh land area and 35% of territorial waters). Most SACs on land or freshwater areas are underpinned by notification as Sites of Special Scientific Interest (SSSIs).

The nearby Afon Crai has been designated part of the Usk SAC and SSSI. The primary reasons that the site has been designated a SAC is due to the type of habitat presented as detailed in Annex II of the Habitats Directive and noted below:

There are no Annex I habitats that are a primary reason for selection of this site

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site:

Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

Annex II species that are a primary reason for selection of this site

Sea lamprey *Petromyzon marinus*

The Usk is a medium-sized catchment in south Wales, important for its population of sea lamprey *Petromyzon marinus*. Survey of juveniles and observation of spawning adults indicates that this species is mainly restricted to the lower reaches of the catchment. The site supports a range of Annex II fish species.

Brook lamprey *Lampetra planeri*

The Usk in south Wales supports a healthy population of brook lamprey *Lampetra planeri* and is considered to provide exceptionally good quality habitat likely to ensure the continued survival of the species in this part of the UK.

River lamprey *Lampetra fluviatilis*

The Usk in south Wales supports a healthy population of river lamprey *Lampetra fluviatilis* and is considered to provide exceptionally good quality habitat likely to ensure the continued survival of the species in this part of the UK. The river also supports important populations of 1096 Brook lamprey *Lampetra planeri*, for which it is also selected.

Twaite shad *Alosa fallax*

The River Usk is one of the largest rivers in south Wales, and twaite shad *Alosa fallax* has long been known to spawn there. The Usk is one of only four sites in the UK where a known breeding population of twaite shad occurs (the Rivers Wye and Tywi are other SAC sites). Water quality and quantity are considered favourable for this species. The main channel is largely unmodified and a variety of aquatic habitats are present, including good quality spawning gravels and deep pools used for cover by adults and fry. However, Trostrey and Rhadyr Weirs may be a barrier to shad migration under low flow conditions.

Atlantic salmon *Salmo salar*

The river Usk is a river famous for its salmon *Salmo salar*, with a high proportion (*c*. 30–40%) of multi sea winter fish recorded in the rod catch. In 1999 the Usk had highest estimated egg deposition of any British river south of Cumbria, and was one of the few rivers in England and Wales to exceed its spawning target for salmon. The Usk has a mixed catchment with a largely unmodified river channel, no significant obstructions to salmon migration, good quality spawning gravels and

a diversity of habitats providing excellent habitat for salmon parr. The most important tributaries for salmon spawning are included within the site boundary.

Bullhead *Cottus gobio*

The Usk represents bullhead *Cottus gobio* in the southern part of its range in Wales. It is considered to have exceptionally high-quality habitat with good water quality, abundant cover and a variety of aquatic habitats. Bullhead are widespread throughout the Usk system.

Otter *Lutra lutra*

The River Usk is an important site for otters *Lutra lutra* in Wales. They are believed to be using most parts of the main river, from Newport upstream, and in recent years signs of otters have increased. In 1991 an expansion upstream of known otter ranges was recorded on several tributaries, including the Honddu, Senni and Crai. The upper Usk may have acted as a 'refuge' during the decline of the 1950s, and had subsequently acted as a 'source' population for recolonisation of south-east Wales.

Annex II species present as a qualifying feature, but not a primary reason for site selection

Allis shad *Alosa alosa*

The citation for the SSSI is given below:

River Usk

The River Usk comprises a large, linear ecosystem which acts as an important wildlife corridor, an essential migration route and key breeding area for many nationally and internationally important species. The Usk is of special interest as a fine example of a river running over sandstones and for its associated plant and animal communities. Its character spans a wide range of types from an upland base-poor stream to a large lowland river with extensive tidal reaches. Its overall diversity is a product of its geology, soil types, adjacent land-use and hydrology.

The River Usk is one of the largest rivers in Wales. From its source to its confluence, the main channel is over 120 km long, and drains a catchment of 1358 km5. Rising at an altitude of 500 m on Mynydd Du on the Carmarthenshire/Powys border, the Usk flows eastwards below the northern scarp of the Brecon Beacons, turning south below Abergavenny and flows down through Monmouthshire to its confluence with the Severn Estuary below Newport.

River Usk (Upper Usk) (source to Abergavenny)

The River Usk (Upper Usk) is a fine example of an upland river flowing in part over hard sandstones, creating steeply graded sections with rocks, cascades, boulders and cliff-bound banks. In other areas, on a broad flood plain, it cuts through extensive deposits of fluvio-glacial and alluvial material, creating a complex and active system of meanders, cut-off and back channels which contribute to the biological interest and diversity of the site.

The course of the Usk lies on the Powys/Carmarthenshire border west of Trecastle, within the Mynydd Du SSSI. It feeds the Usk Reservoir, below which this SSSI commences. The Usk is soon joined by the Afon Hydfer, an important headwaters tributary, which is also included within this site.

The Upper Usk then flows eastwards through a narrow valley towards Brecon, cutting deeply into the sandstone bedrock in many places along the way. Below Brecon the river flows across a wider alluvial floodplain as far as Buckland where it enters the steep-

sided Llangynidr gorge section. At Glanusk Park the Usk returns to an alluvial floodplain which extends as far as Abergavenny.

The Upper Usk is of special interest for three main river types: rivers on sandstone; mesotrophic rivers and oligo-mesotrophic rivers. The upper reaches in particular support communities characteristic of shaded upland rivers on rich geological strata and upland rivers with gravel and peat.

It is also of special interest for its mosses and lichens as well as for otter Lutra lutra and its fish populations.

There is a good range of breeding birds associated with riverine habitats, together with localised populations of the Atlantic stream crayfish Austropotamobius pallipes and the freshwater pearl mussel Margaritifera margaritifera, both of which are threatened in the UK. Several nationally rare and scarce species of flowering plant occur in the river and on its banks.

The SSSI incorporates adjacent areas of riparian habitat which directly support the special interest of the river. These include woodlands dominated by alder Alnus glutinosa and willows Salix spp., marshy grassland, stands of tall herb, swamp and fen vegetation. Shingle banks and gravel shoals below Brecon support a variety of species more normally considered to be arable weeds. Back channels contain marshes and pools supporting plant communities not found in the main channel. They also provide refuges for otters, waterfowl, invertebrates and small fish.

Geology and Topography

The catchment of the River Usk (Upper Usk) is predominantly upland in nature, the northern Brecon Beacons and southern part of the Eppynt being the most significant areas of high ground within it. The river is therefore upland in character, largely following a predetermined glacial valley and falling from 280 m at the base of the Usk reservoir to 100 m at Abergavenny over a distance of 69 km.

From its source on the Black Mountain, downstream, to Abergavenny, the river flows over sandstones and mudstones of the Old Red Sandstone Series. For the first kilometre or so sandstones are predominant over thinner mudstones in the Breconian Series. Before the Usk Reservoir, the river crosses the sandstone and mudstone sequence of the Dittonian and then descends onto the mudstone and thin sandstone sequence of the Pridoli Series. The river course remains within this sequence as far as Brecon, where it returns to the Dittonian. It then crosses into the Breconian again at Tal-y-bont, across which it then flows for the remainder of its course to Abergavenny.

Three zones of deformed rocks have been preferentially eroded by the river. From above Trecastle to Sennybridge the river follows along the line of the Carreg Cennen – Pontfaen Disturbance (an area of faulted and folded rocks). Around Brecon the river's course is effected by the Swansea Valley Disturbance, and from Llangynidr to Crickhowell the orientation of the river course is controlled by the Neath Disturbance.

Around its source on the Black Mountain the sandstones are masked by peat deposits but the upper stretches are characterised by rapids, coarse beds and stepped waterfalls over the sandstones. Below Trecastle, in places the river has become incised, creating steep valley sides while its bed is characterised by glides, rapids and waterfalls and, in places, has cut down to bedrock to form a deep channel between marginal rock shelves.

Near Brecon the valley broadens out and the river begins to meander across a flood plain developing gravel shoals and earth cliffs with localised areas of braided channels, backwaters and oxbows, which are reconnected to the main river during spate flows.

At Llangynidr the river has cut south through the Black Mountains scarp, exploiting a major fault line, to form a steep-sided gorge. The river channel in this gorge section is characterised by boulders, exposed rock platforms and deep channels and pools.

Between Llangatwg and Abergavenny the Usk Valley broadens out the river again starts to meander across a flood plain, creating gravel shoals, earth cliffs and backwaters and oxbows which significantly enhance the biological diversity of the site. Fluvio-glacial sand and gravels constrain the river's lateral movement to the immediate west of Abergavenny.

The Upper Usk has remained relatively free from human straightening, widening or deepening schemes. The section of the river at Pencelli, to the south of Brecon, is particularly complex and active, with rapidly eroding, steep river banks on the outer sides of the meanders contrasting with shallow slip-off slopes with shingle spits on the inner sides. Oxbows and backwaters are a feature of this area.

Flora

The headwaters of the Usk and Afon Hydfer have fairly acidic water, supporting characteristic upland aquatic species, including bulbous rush Juncus bulbosus, alternate water-milfoil Myriophyllum alterniflorum, floating sweet-grass Glyceria fluitans, and filamentous algae. Marginal plants include purple moor-grass Molinia caerulea, marsh marigold Caltha palustris, meadowsweet Filipendula ulmaria, lesser spearwort Ranunculus flammula, rushes Juncus spp. and a range of characteristic mosses and liverworts, such as Racomitrium aciculare, Hygrohypnum ochraceum, Rhynchostegium riparioides, Pellia epiphylla and Scapania undulata.

As the water becomes less acidic, the channel is largely shaded by alder and rusty willow Salix cineria spp. oleifolia. Here the banks support a flora more typical of shaded conditions, including lady fern Athyrium filix-femina, remote sedge Carex remota, the mosses Amblystegium fluviatile, Schistidium alpicola and Thamnobryum alopecurum and the liverworts Pellia epiphylla, Conocephalum conicum and Chiloscyphus polyanthos. Aquatic species are scarce here, but alternate water-milfoil and the red alga Hildenbrandia rivularis occur sparingly in the channel.

As the river becomes larger the channel is less shaded, although bankside trees are still prominent. Aquatic species become more frequent, including the mosses Fontinalis antipyretica and Cinclidotus fontinaloides, the liverwort Porella cordaeana, the lichens Dermatocarpon luridum and D. meiophyllizum and the algae Lemanea fluviatile, and Hildenbrandia rivularis. The nationally scarce mosses Fissidens rivularis and F. rufulus have been frequently reported on sandstone rocks rarely exposed above water level from these reaches. Characteristic marginal plants include reed canary-grass Phalaris arundinacea, hemlock water-dropwort Oenanthe crocata, bittersweet Solanum dulcamara, the mosses Homalia tricholmanoides, and Scleropodium cespitans and the liverworts Conocephalum conicum, Pellia endiviifolia and Lunularia cruciata.

The silt-encrusted tree bases support a notable community of specialised riparian mosses including Leskea polycarpa, Tortula latifolia, Orthotricum rivulare and the nationally scarce O. sprucei.

River banks are kept free of dense woody growth by regular flooding, and steep slopes or rock outcrops support a range of notable plants. Two nationally scarce hawkweeds, Hieracium stenstroemii and H. cinderella occur on rock outcrops around Llangynidr. Also in this area are found the nationally rare dandelions Taraxacum breconense and T. vechelii. The nationally scarce bramble Rubus iscanus, named after the R. Usk, is found at the confluence with the Afon Crawnon. Another nationally rare dandelion T. degelii occurs on rocks upstream around Fenni- fach.

Locally uncommon higher plant species of riverside rocks and banks include the globe flower Trollius europaeus and wild onion Allium vineale. A number of probably native black poplar trees Populus nigra ssp. betulifolia occur beside the Usk, with particularly large and well-grown examples being visible from the bridge at Crickhowell. Well-lit riverside rocks which are regularly flooded at Sennybridge, and in several places between Llanhamlach and Crickhowell, support the nationally endangered lichen Endocarpon adscendens.

Cliff woodland around Llangynidr is notable for its abundance of beech, here probably native, and at the north western edge of its British range. Other species of south eastern Britain which occur in abundance include the toothwort, Lathraea squamaria and early dog-violet Viola reichenbachiana. Small-leaved lime Tilia cordata is also frequent in this woodland and is there colonised by mistletoe Viscum album. Wild service-tree Sorbus torminalis is a rare associate.

Wide meandering of the river in the vicinity of Pencelli has produced a range of wildlife habitats, including old river channels and shingle banks exhibiting various stages of plant colonisation. The old channels contain both marsh and open water, supporting a number of characteristic plant communities, dominated variously by floating sweet-grass, amphibious bistort Persicaria amphibia, broad-leave pondweed Potamogeton natans and Canadian waterweed Flodeacanadensis. A wide variety of aquatic and emergent species are present in these areas including local rarities such as greater spearwort Ranunculus lingua, pink water-speedwell Veronica catenata, lesser marshwort Apium inundatum and wood club-rush Scirpus sylvaticus. Adjacent areas of seasonally flooded grassland are characterised by creeping bent Agrostis stolonifera and marsh foxtail Alopecurus geniculatus, which provide important feeding areas for migrating wildfowl and waders. At Pencelli, and elsewhere, there are extensive deposits of alluvial gravel.
Some are sparsely vegetated with species such as water-pepper Persicaria hydropiper, redshank P. maculosa and silverweed Potentilla anserina. More stable areas support communities dominated by common nettle Urtica dioica, creeping thistle Cirsium arvense, Indian balsam Impatiens glandulifera and other tall herbs such as mugwort Artemisia vulgaris and hemlock Conium maculatum. Thickets of willow Salix spp. scrub have developed locally along backwaters and on islands. At Pencelli these thickets are dominated by a particularly diverse range of willow species, including crack willow Salix fragilis, osier S. viminalis and the locally scarce almond willow S. triandra. The ground beneath is dominated by common nettle and other tall herbs, such as Indian balsam, bittersweet and cleavers Galium aparine.

Mammals
The upper Usk supports a strong population of otters. This species is threatened by habitat destruction, disturbance and pollution throughout its European range and is specially protected. Otters rely on woodland, scrub and tall bankside vegetation for cover. Breeding holts may often be found amongst the roots of large trees at the water's edge. The river and bankside trees support large populations of flying insects which provide an important food source for bats, including Daubenton's bat Myotis daubentonii and the rare lesser horseshoe bat Rhinolophus hipposideros. Below Brecon there is a

thriving population of water vole Arvicola terrestris, a species that has undergone a recent marked decline in the UK.

Invertebrates
The invertebrate fauna of the upper Usk has not been well studied but the river supports populations of the Atlantic stream crayfish and the freshwater pearl mussel, both declining species that are specially protected.

The hornet Vespa crabro is regularly recorded in Llangynidr Gorge, probably nesting in the dry, sheltered cliff woodland.

Breeding Birds
The upper Usk supports a wide range of breeding bird species that are associated with riparian habitats, including common sandpiper Actitis hypoleucos, grey wagtail Motacilla cinerea, dipper Cinclus cinclus, goosander Mergus merganser, and little grebe Tachybaptus ruficollis, and a number of species which are scarce in this part of mid-Wales, such as yellow wagtail Motacilla flava and little ringed-plover Charadrius dubius. Kingfisher Alcedo atthis and sand martin Riparia riparia nest in earth cliffs and banks produced by the actively eroding river throughout the whole length of the Usk, but particularly on the alluvial plains below Brecon.

Flooded fields in the vicinity of Pencelli attract a wide variety of birds in winter and on passage including wigeon Anas penelope, curlew Numenius arquata, lapwing Vanellus vanellus, jack snipe Lymocryptes minimum and green sandpiper Tringa ochropus.

Fish
A wide range of fish species occurs in the upper Usk. The upland sections contain native populations of brown trout Salmo trutta fario and provide important spawning areas for Atlantic salmon Salmo salar, sea trout Salmo trutta trutta and brook lamprey Lampetra planeri. Below Sennybridge, species such as chub Leuciscus cephalus can be found and minnow Phoxinus phoxinus, stone loach Noemacheilus barbatulus and bullhead Cottus gobio are abundant. A number of rare and scarce migratory species breed in the upper Usk, including sea lamprey Petromyzon marinus, which spawn between Abergavenny and Crickhowell and twaite shad Alosa fallax and allis shad A. alosa, which are believed to spawn in the vicinity of Abergavenny. River lamprey Lampetra fluviatilis spawns in the upper reaches, the larvae moving downstream to occupy silt banks in the middle reaches.

4 Application Details

Application for an environmental permit: Part B6.5 Discharging treated domestic sewage effluent of up to 15 cubic metres a day into ground or up to 20 cubic metres a day onto surface water

About you

Please give details of the individual, or where relevant for groups or organisations of individuals, the main representative.

Title: Mr
First name: Keri
Last name: Davies

Who will be named on the permit?
An individual

Your address

For companies this must be the address on record at Companies House.

Address
Glwyd caenewydd
Crai
Powys

Postcode	LD3 8YP
Telephone mobile	07867508611
Telephone office	01874638973
Email address	keri@nfuconnect.net

Agent or others acting on behalf of the applicant

If you want us to contact an agent or another person not named above, their details must be provided below. This can be someone acting as a consultant or an 'agent' for you.

Title	Mr
First name	Ceirion
Last name	Herbert
Address	Francis Sant Ltd, 14 Queen Street, Caerfyrddin, Sir Gar
Postcode	SA31 1JT
Telephone mobile	
Telephone office	01267233833
Email address	cherbert@francissant.com

About this application

Have you spoken to us already about this application?
If you have had discussions with us before your application, give us the case reference or details.
Robert Harding Informal and Free Advice Service
Gareth Foulks NRW PAN019395 see e-mail below:

Good afternoon Gail,
In response to your email dated 26/09/2023 I have the following comments:

Application for an environmental permit document

• Any new application to discharge domestic sewage will need to be made using the online application process which can be found at: Natural Resources Wales / Apply for a permit to discharge domestic sewage. When doing so, please reference your previous application PAN019395.

• The Eco Centre proposal is to include a Bistro Café and Gym as well as the Conference room. The calculation for maximum volume of effluent to be discharged includes Non residential Conference Guests but does not account for additional volumes from the gym and café.
• In calculating the maximum volume of effluent to be discharged a figure of 30 Non residential Conference Guests has been used. Is there a potential for this number to rise to 36 if additional beds in the Oak Barn and Poplar Tree lets are utilised?
• Additional staff required onsite to facilitate the running of the Eco Centre and it's facilities must be factored into the calculation for maximum volume of effluent to be discharged.
• The type of sewage treatment plant proposed is an Ecorock – 5010, designed for a daily hydraulic loading of 4.5 m³ per day. This system meets EN12566 – Part 3 standards and is quoted to produce an effluent quality of BOD = 4 mg/l, Ammonia 3 mg/l and Suspended Solids 3 mg/l. I was unable to find the expected Total Phosphorus concentration in the final effluent, this will need to be provided.
• The document states that the treated effluent is to be discharged onto agricultural land via a Wetland Area. The planning application talks of percolation tests for discharge to ground via a drainage field. Please confirm how the effluent is to be discharged.
• The document states "Please treat the information in my application as confidential". Is this correct? Crai Valley Habitat Regulation Assessment Justification – Suggested revision
• Please confirm the Eco Centre will only be for visitor's resident on site.
• This document states "Private sewage treatment systems discharging domestic wastewater to ground built to the relevant British Standard (BS 6297:2007+A1:2008) where the drainage field is located more than 40m from any surface water feature such as a river, stream, ditch or drain, and also,to ensure that there is no significant in combination effect, the discharge to ground should be at least 200m from any other discharge to ground. The density of discharges to ground should also not be greater than 1 for every 4ha (or 25 per km2).

There are no discharges to the ground within 200 metres of the proposed soakaway." Please confirm if the treated effluent is to be discharged to a drainage field.

Crai Wetland Outline
• What calculations have been done showing the impact on groundwater from the unlined Horizontal Flow Wetlands?
• Surface water from the SUDS system is shown entering the horizontal flow wetlands, is this correct?
• Where does the discharge from the final horizontal flow wetland go once it exits the stone channel?
• What is the intention of the Vertical Flow Wetland
• What is the intention of the Horizontal Flow Wetlands

This is not an exhaustive list of comments and further information may be required to Duly Make the application. Once Duly Made, an assessment process (including consultation with internal and external consultees) would determine if a permit can be issued.
I'm no longer supporting the Water Quality Permitting Team so I suggest any future correspondence is directed to: waterquality.permitting@naturalresourceswales.gov.uk to ensure it reaches the correct people. I hope this information is of help.
Kind regards.
Gareth.

About your discharge
Where is your septic tank / sewage treatment plant located

Address Glwydcaenewydd. Crai
Postcode LD3 8YP

Please provide the 12 character national grid reference of the location of your septic tank / sewage treatment plant. This consists of two letters followed by 10 numbers (for example AB 12345 67890).
To find out the 12 character grid reference, you can search on the UK grid reference finder website

SN8949824550

What type of premises does your sewage treatment facility serve?
For example, the number of houses or a description such as a pub, café, restaurant, office and so on.

Eco cenre for residents at Glwydcaenewydd whose rooms have existing and separate sewer systems.

When did your discharge start?
When did your discharge start? (New or existing)

On or after 1 April 2010 (new discharges)

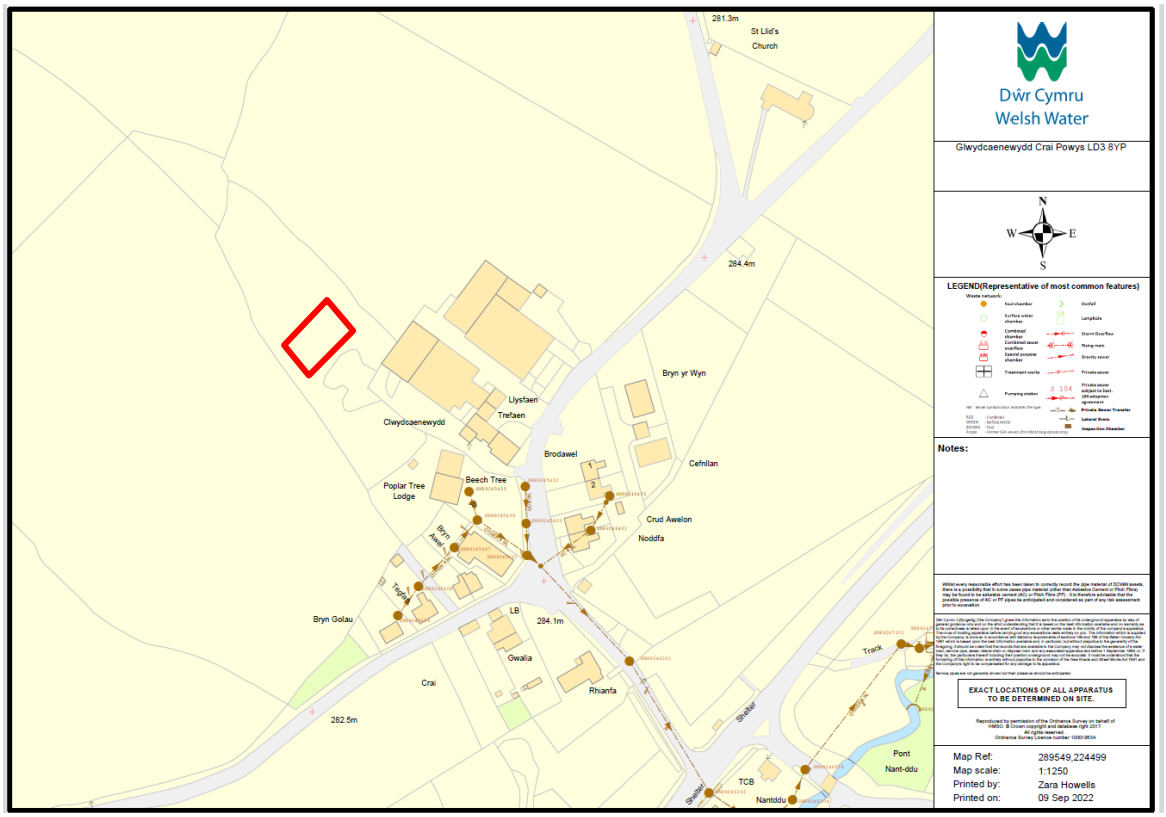
Could your discharge be made to the foul sewer?
Is your discharge

From another type of premises (for example a pub, cafe, restaurant, campsite or office?

How far away is the nearest foul sewer from the boundary of the premises (in metres)?
You will need to check this with your sewerage undertaker (usually your local water company) and you may also need to check if it is possible to connect to a private foul sewer. Measure the shortest distance between the boundary of premises served by the private sewage treatment system and the nearest foul sewer and/or private sewer.

102m

The measurement is taken from the proposed development and the nearest foul manhole. As the farm is over 30acers a measurement from the plot is not relevant in this instance.



Discharges from all other premises, for example a pub, cafe, restaurant or office
Divide the volume of the discharge (in cubic metres) by 0.75 and then multiply this figure by 30 metres

	Volume of the discharge (in cubic metres)	Divided by 0.75	Multiplied by 30 (in metres)
Discharges from all other premises	2.52	3.36	101

Is this distance you've calculated greater than the distance to the nearest foul sewer you've provided above?

No

Provide evidence why you cannot connect to the foul sewer
You must also send us evidence that you have: Approached the sewerage undertaker or owner(s) of the private sewer to reach an agreement for a connection to the foul sewer If the sewerage undertaker refuses connection to the public sewer, provided evidence that you have requested that they adopt the proposed treatment system If the sewerage undertaker refuses both of the above, you must appeal the refusal with Ofwat and provided evidence of the outcome of that appeal

- Glwydcaenewydd_Crai_EP_application_support_information.doc

You must explain why you cannot connect to the foul sewer:

There are a number of reasons why connection into the main sewer is not practical in this instance including:
- distance not proportional to the flow;
- the foul would need to be pumped;
- lack of capacity at the treatment plant;
- a number of scientific experiments are proposed to treat and strip nutrients from the effluent (in conjunction with the University of South Wales;
- nutrients required for growing reeds commercially to sell to DCWW for developing wetlands.
- the proposed system will remove the discharge from an existing septic tank and allow it to flow into the package plant treatment works with improved effluent quality.

What is the maximum volume of effluent you will discharge in a day (in cubic metres)?
Tell us the maximum volume of effluent you will discharge in a day (in cubic metres)?

2.52

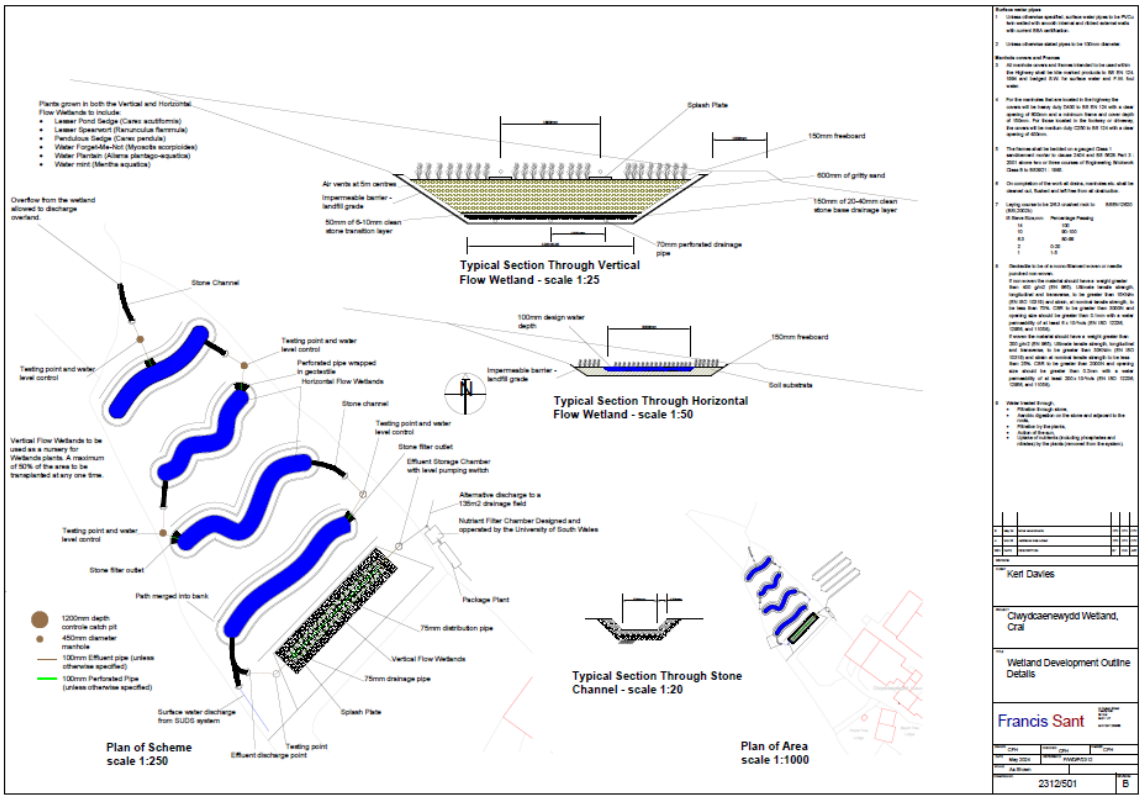
If your discharge comes from a single domestic property, use the table below to work this out. Number of bedrooms in your house Daily volume (m3 per day) 1 to 3 1 4 to 6 1.5 7 to 8 2
If you are discharging sewage from premises other than a single domestic property (for example, from a group of houses, a guest house or a very large house), the volume should be worked out using the Code of Practice: 'Flows and Loads 4 – Sizing Criteria, Treatment Capacity for Small Wastewater Treatment Systems which is published by British Water. (opens in new window)
Show how you calculated the figure given in the box below or upload below:

From Flows and Loads – 4
Non residential Conference Guest 36 x 60l =2160l
Staff 3 x 90l =270l
Part Time Staff = 45l
Total =2520l

We understand that a total of 35 people could stay at the resort, however, these would include lecturers. 36 assumed in the new calculations.
It is expected that at any one time there will be a maximum of 3 full time staff and two part time staff. At times a lecturer will be required to stay overnight on site, however, use one of the residential spaces. It is also noted that there is an existing staff rest rooms and facilities on site.

What type of sewage treatment system will you be using to treat your effluent?
All sewage effluent must be treated before it can be discharged into the environment and new systems must conform to the relevant standards For new systems the supplier or manufacturer should be able to provide details For existing systems please provide any information you do have on the system If you tick 'other' please give us more details about the system in the box provided or on a separate sheet and upload it. Tick one box to show what sewage treatment plant you will be using to treat your effluent.

The sewage will initially be treated using a package treatment plant that meets BS 12566 before passing through a filter chamber and subsequently onto a vertical wetland



Your sample point

You must provide a sample point where a sample of your discharge can be safely taken before it has mixed with any other discharges.

This sample point is used to assess compliance with any water quality emission limits on your permit.

You must ensure that it allows a representative sample of the discharge to be obtained. You must ensure that your discharge passes through the sampling point at all times.

Please give the 12 character national grid reference for the sample point. This consists of two letters followed by 10 numbers (for example AB 12345 67890). To find out the 12 character grid reference, you can search on the UK grid reference finder website.

There will be a number of testing points However the main testing point will be located below the vertical wetland:
SN8946724530

Your discharge point

Tell us where effluent is discharged into the environment.

For discharges into surface water (i.e. rivers, streams, lakes, ponds etc) this is the location where the discharge is made from the outlet pipe to the surface water. On some occasions discharges are made via surface water sewers owned by someone else before they discharge into a receiving water. Where this is the case the outlet will be the point where the surface water sewer meets the river, stream, ditch or canal.

For discharge into or onto land this is the location where the effluent from the treatment system enters the infiltration system.

Please give the 12 character national grid reference for the discharge point. This consists of two letters followed by 10 numbers (for example AB 12345 67890).

To find out the 12 character grid reference, you can search on the UK grid reference finder website.

SN8946224528

Where will your treated effluent discharge to?
Sewage effluents are usually discharged to one location in one receiving environment.

If you are proposing to discharge multiple effluents, you must complete a separate application form for each effluent and submit the form, along with the correct application fee, for assessment.

Where will your treated effluent discharge to?

Onto land (eg via reed bed or grass plot)

Discharges onto land
Select from the type of area where the effluent is disposed of

Other (please specify): Lined wetland ponds and subsequently overland

What is the surface area (in square metres) of the land used for your disposal?

675m2 horizontal wetland nursery, and 24,000m2 of pasture

Is any part of your infiltration system within 50 metres of a well, spring or borehole?

No

Is the well spring or borehole you have identified used to supply water?

No

Is any part of your infiltration system within 10 metres of a watercourse?

No

Your site plan
Please upload your plan here

File: Crai Wetland Outline_A1_RevB.pdf Download

Your management system
Your permit requires you (as the operator) to ensure that you manage and operate your activities in accordance with a written management system. This management systems identifies and reduces the risk of pollution.

You can find guidance on management systems and what to include in one on our website (opens in new window).

I confirm that I have read the guidance and that my management system will meet NRW requirements

When will you want to discharge?
What date do you want the permit for this effluent to start?
You cannot discharge your effluent prior to this start date on your permit. This is the date that your annual subsistence charges will start, even if you have not started to discharge.

01/10/2024

Will the discharge take place all year?
For seasonal discharges which only occur for part of the year, tells us when the discharge will take place.

Yes

How do you want to pay?
Who can we talk to you about your billing or invoice?

Same as application contact

How do you want to pay for your application fee?

Electronic transfer (e.g. BACS)

Paying by electronic transfer
Please provide your reference for the payment.

BACS reference: EPRDAVI0590000
Amount paid: **£**3376

There is uncertainty on the value payable or whether a permit is required due to the volume being discharged and that the proposals relace an existing discharge from a septic tank. The value given indicates the value already paid.

How we collect your personal data
We will process the information provided by you in line with the Data Protection legislation.
For more information on how we manage, store and use your data, see our Privacy Notice (opens in new tab)

I have read and understood this information

Freedom of Information
Under the Freedom of Information Act 2000, anybody may request information from a public authority. The Act grants two statutory rights: to be told if the public authority holds that information; and if so, to have that information communicated to you.
Find out how to request information under the Freedom of Information Act.

I have read and understood this information

Confidentiality and National Security
We will normally put all the information in your application on a public register of environmental information. However, we may not include certain information in the public register if this is in the interests of national security, or because the information is confidential. Confidential information is information that is commercially or industrially confidential in relation to any person and is unlikely to be applicable for small scale sewage discharges.

You can ask for information in the public register to be made confidential or withheld in the interests of national security by answering the question below and provide information on the next page giving your reasons. If we agree with your request, we will tell you and not include the information in the public register. If we do not agree with your request, we will let you know how to appeal against our decision, or you can withdraw your application.

Do you believe that for reasons of confidentiality or national security your details should not be included on the public register?

No

Declaration
A relevant person should make the declaration. You must be a relevant person or have the authority of a relevant person to sign this application on their behalf. An agent acting on behalf of an applicant is NOT a relevant person.

Each individual (or individual trustee) who is applying for their name to appear on the permit must complete this declaration. You can send a separate document with the relevant information if there are not enough spaces to sign below.

Relevant people means each applicant, and in the case of a company, a director, manager, company secretary or any similar officer or employee listed on current appointments in Companies House. In the case of a Limited Liability Partnership (LLP), it includes any partner. If the permit holder is an organisation of individuals, each individual (or individual trustee) must complete the declaration.

To simplify and speed up the application process, we recommend that the declaration is filled in by an officer of a company or one of the partners in a Limited Liability Partnership (LLP).

If you wish a manager, employee or consultant etc. to sign the declaration on behalf of a relevant person, we will need written confirmation from a relevant person; that is, an officer of the company, a partner in the LLP or the individual, confirming that the person has the authority to fill in the declaration.

If you are joint permit holders, you should each fill in your own declaration. We have provided extra spaces for this below. Please upload a separate sheet with your application if you need more room for signatories.

Where the operator is the subject of any insolvency procedure, the declaration must be filled in by the official receiver/appointed insolvency practitioner.

I have included written confirmation from a relevant person to confirm I can sign on their behalf

Upload written confirmation here
File: Confirmation.pdf

If you knowingly or recklessly make a statement which is false or misleading to help you get an environmental permit (for yourself or another person), you are committing an offence under the Environmental Permitting (England and Wales) Regulations 2016.

I declare that the information in this application is true to the best of my knowledge and belief. I understand that this application may be refused or approval withdrawn if I give false or incomplete information.

I understand that if I knowingly or recklessly make a false or misleading statement: I may be prosecuted; and if convicted, I may have to pay a fine and/or go to prison.

By signing below, you are confirming that you understand and agree with the declaration above.

Title Mr
First name Keri
Last name Davies
On behalf of (if applicable) Keri Davies
Date (DD/MM/YYYY) 17/05/2024

Submit your application
Enter the email address you'd like a copy of your application sent to:

cherbert@francissant.com

5 CONCLUSION

Conclusion

The development of the Eco Centre will provide a required facility for the existing residential guests staying at Glwydcaenewydd Farm. Due to the:

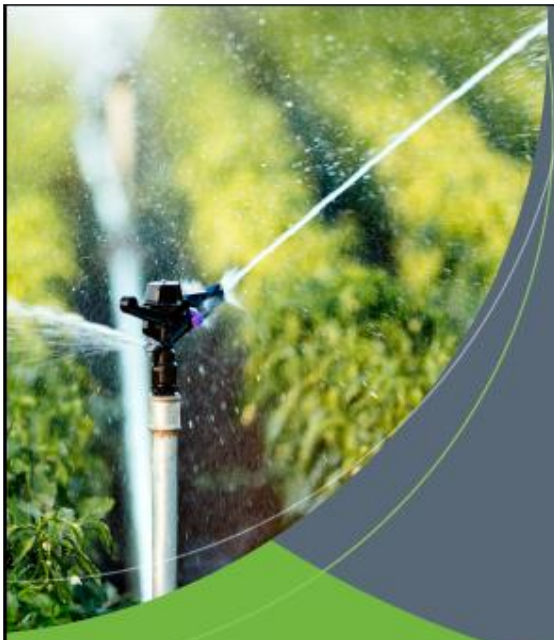
- difficulty of connecting into the main sewer,
- the lack of capacity in the main sewer,
- the intention to undertake experimental work to strip nutrients from effluent
- and the desire to use the nutrients for commercial purposes

it is intended to treat the sewage discharge from the proposed Eco Centre on site.

Initially the foul water will be treated using a ECOROCK 5010 system before the effluent is discharged into an experimental filter chamber (designed and operated by the University of South Wales) and subsequently discharged into a vertical wetland. The treated effluent will then be discharged into a horizontal wetland system. The volume of effluent is unlikely to be sufficient to support the horizontal wetlands and, therefore, the water will be supplemented by surface water from the roof.

It is uncertain whether an Environmental Permit is required for the effluent discharge or whether registration would be sufficient, considering the volume of effluent. Precautionary an Environmental Permit has been applied for. This document provides supplementary information in support of the application including details of the receptors potentially at risk from the discharge of nutrients from the treated effluent. Considering the proposed treatment it is our belief that that the system will be nutrient neutral.

Appendix A – Proposed Package Plant



THE FUTURE OF WASTEWATER TREATMENT

BIOROCK is home to an internationally-acclaimed team of wastewater specialists who share the goal of providing innovative, sustainable, and eco-friendly water treatment systems.

Our level of expertise and attention-to-detail guarantees only the best, most reliable products, providing the market with the ultimate non-electrical wastewater treatment technologies.

ADVANTAGES AND BENEFITS OF THE ECOROCK-5010 & THE MULTIROCK SOLUTIONS

	ECOROCK-5010 & MULTIROCK	Electrical Plants	Organic Media Plants
High Media Lifespan	✓	✗	✗
Low Operational Costs	✓	✗	✗
Minimal Annual Maintenance	✓	✗	✗
Effortless Installation	✓	✗	✗
Non Electric	✓	✓	✗
Long Septic Tank Pump-Out Intervals	✓	✓	✗
Odourless	✓	✓	✗
Silent	✓	✓	✗
Long Absence Periods	✓	✓	✗

THE ECOROCK-5010 SOLUTION

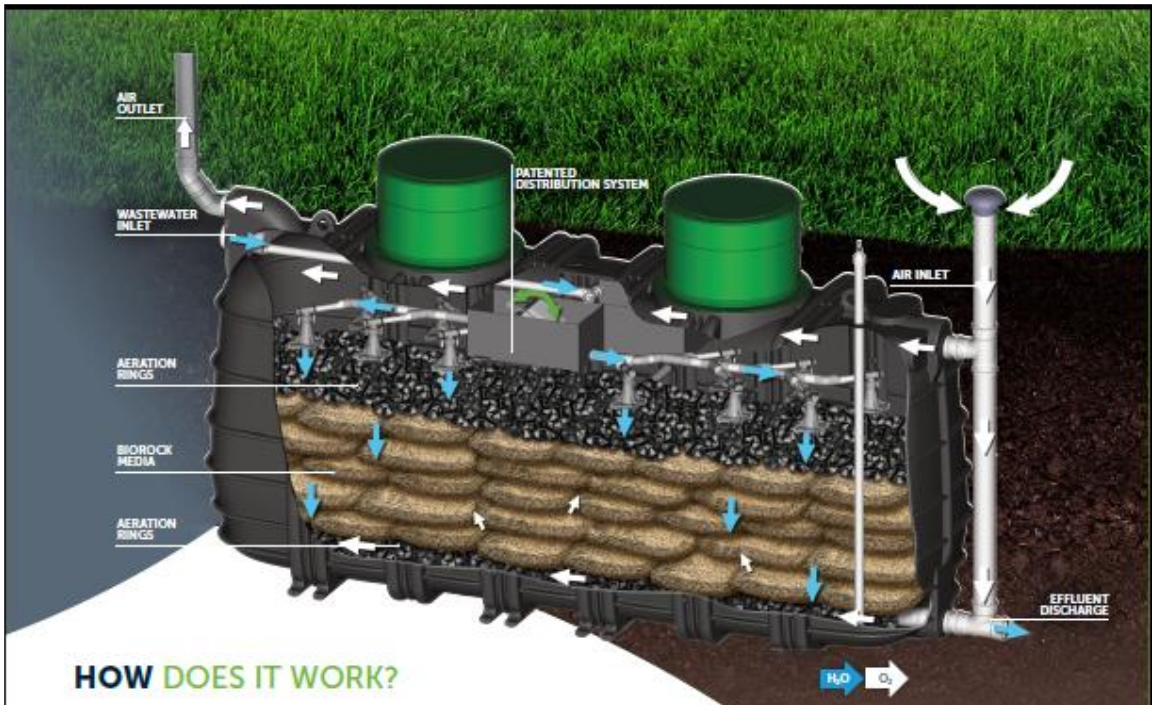
Our **ECOROCK-5010** unit is the perfect solution for wastewater treatment with a capacity **up to 30 persons**.

This innovative technology provides a consistent high-quality effluent, meeting all of the strictest standards. Powered by nature, our effective biological purification technique doesn't require any electricity and has no moving parts, making maintenance and operational costs particularly low.

THE MULTIROCK SOLUTION

MULTIROCK is a wastewater treatment solution designed to facilitate high-capacity sewage disposal for communities with **30+ persons.**

Built with our ECOROCK-5010 treatment units installed in parallel, **MULTIROCK** is a modular system which offers you the best purification results while being easy to install.



HOW DOES IT WORK?

Step 1: Primary Tank

The primary tank clarifies the sewage water by fats, oils, greases and organic solids. The sewage then passes through an effluent filter, before discharging into the ECOROCK-5010 Unit(s).

Step 2: Multi-Way Splitter (for MULTIROCK Solution)

Our **multi-way splitter** ensures that the pre-treated wastewater is continually and consistently distributed across the ECOROCK-5010 Units.

Step 3: BIOREACTOR Process

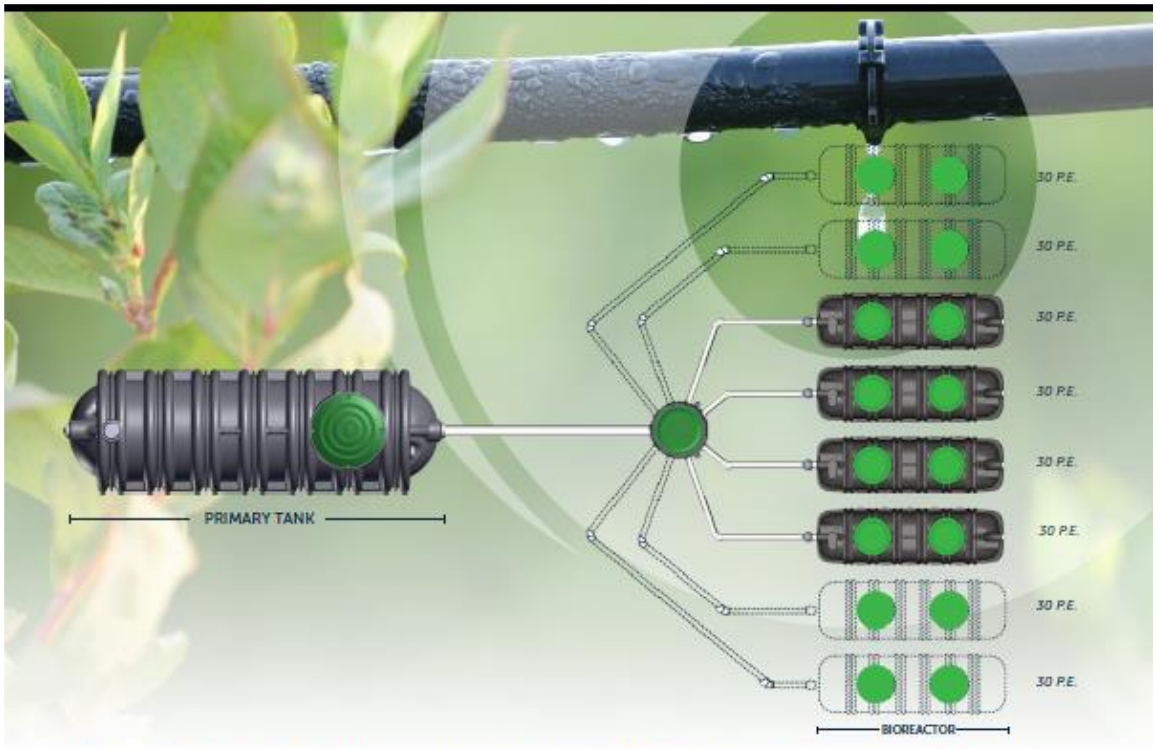
The aerobic purification (secondary treatment) and the filtration (tertiary treatment) processes take place in the ECOROCK-5010 unit(s).
To naturally treat the wastewater, our systems use our unique BIOROCK Media, an exclusive and very efficient carrier material for bacteria.

Step 4: Discharge

Depending on the ground type, effluent will be discharged by gravity, or by a pump.

THE UNIQUE BIOROCK MEDIA

Our **exclusive media** is degradation-resistant, stable and sustainable - keeping the purification system working effectively over the long-term. You will exclusively find it in BIOROCK systems.



When the ECOROCK units are installed in parallel they can accommodate up to 240 P.E.

ECOROCK-5010 SPECIFICATIONS

VOLUME	5000 l		
WEIGHT (EMPTY)	567 kg		
DIMENSIONS (IN MM)	Length	Width	Height
	3800	1150	2280

Do you need a smaller non-electric power plant? We have a solution for any project, no matter the size!

Find more information in our brochures for wastewater treatment plants with capacities from 4 to 30 people.

SAVE MONEY WITH MULTIROCK

One of the main benefits of having an **MULTIROCK treatment solution** is that it's a sustainable and economical investment. Our system requires minimal maintenance, does not need electricity, and has a long lifespan.

You will constantly save on electricity, maintenance, and tap water costs as you can reuse the purified water for irrigation.

BIOROCK
engineered for tomorrow

MULTIROCK-EN-05-2022

Call us today for a **FREE** project consultation
or visit
www.biorock.com

ISO 9001

BIOROCK units are approved and tested by many international Standards.

25 YEAR WARRANTY
25 Year warranty on tanks
10 Year warranty on media
*subject to conditions

BIOROCK
engineered for tomorrow

Declaration of Performance

1. **Unique identification code of the product type:**
Small, packaged sewage water treatment plants ECOROCK-1500-8, ECOROCK-2000, ECOROCK-3000 and ECOROCK-5010

2. **Type and serial number**
Ali units have a specific serial number and an identification code on its identification plate as an identification of the construction product as required pursuant to Article 11(4).

3. **Intended use of the construction product:**
Treatment of sewage water from domestic dwellings for discharge to water course or soak awa y.

4. **Name, registered trade name and contact address:**
BIOROCK S.à.r.l., 4-5, Z.A.E. Le Triangle Vert L-5691 in Luxemburg.

5. **Report on Treatment efficiency:**
EN12566-3:2005 + A2:2009 Anne x B; Report on the treatment efficiency test of small wastewater treatment systems up to 50 PT. Test report - No. CERIB 008015- March 2017

6. **Declared performances**

Essential characteristics	*Performance*	*Harmonized standard*
Nominal organic daily load (kg of BODs/ day)	0.48 / 0.60 / 0.90 / 1.80	EN12566-3 + A2 (2013)
Nominal dailyflow (m^3/day)	1.20 / 1.50 / 2.25 / 4.50	EN12566-3 + A2 (2013)
Material	HDPE	EN12566-3 + A2 (2013)
Water tightness	Passed	EN12566-3 + A2 (2013)
Durability	Passed	EN12566-3 + A2 (2013)
Structural behavior	Passed	EN12566-3 + A2 (2013)
Treatment efficiency (Nominal sequences)	BOD: 96 % / 7 mg/l COD: 91 % / 47 mg/l S.S.: 98 % / 6 mg/l Ntotai*[1]: 52 % / 30 mg/l P: 30 % / 7 mg/l	EN12566-3 + A2 (2013)
Electrical Consumption	0.0 kWh/day	EN12566-3 + A2 (2013)

[1] *Water temperature > 12 °C*

The performance of the product identified above is in conformity with the set of declared performance(s). This declaration of performance is i sued, in accordance with Regulation (EU) No 305/2011, un der the sole responsibility of the manufactur identified above .

Signed for and on behalf of the manufacturer by:

Ellange, 21th of September 2021

Gerrit SMIT

BIOROCK S.à.r.l.
4-5 ZAE Le Triangle Vert, L-5691 ELLANGE, Luxembourg | Luxemburg | +35 226 176 6 33 | info@biorock.com | www.biorock.com
Bank: ING in Luxemburg | IBAN: LU98 0141 6449 3700 0000 | BIC: CLLLULL VAT Number: LU 23786557 | Trade Register Number: B151.659

Appendix B – CWA Guidelines for Constructing Wetlands To Treat Domestic Septic Tank Effluent

CONSTRUCTED WETLAND ASSOCIATION

GUIDELINES

Constructed Wetlands to Treat Domestic Septic Tank Effluent




Contents

Operational principles 3
Design 4
Construction 8
Operation and maintenance 9
Annex A 10

ACKNOWLEDGEMENTS

The CWA would like to thank all the contributors to the development of these guidelines, those present at the CWA workshop in Stoke on Trent on 18th Feb 2015, and participants in subsequent development work. In particular:

Dr Chris Weedon (Watercourse Systems Ltd);
Geoff Sweaney (Wetland Engineering);
Dr Rick Hudson (Cress Water Solutions Ltd);
Stewart Moir (Moir Environmental Ltd);
Clodagh Murphy and Patrick Hawes (ARM Ltd);
Dr Matt Simpson (WWT Consulting Ltd);
Catherine McIlwraith (Eden Rivers Trust);
Tristan Josh (Eco~tech Systems Ltd);
Also thanks to the Wildfowl and Wetlands Trust, and to Bridget Williams of the Environment Agency for her support and encouragement.

Front cover photos (clockwise left to right) courtesy of: Moir Environmental, Watercourse Systems, WWT Consulting, Cress Water Solutions

Operational principles

There are several ways one might approach nitrification of domestic wastewater using wetland treatment systems. This standard has been developed for one particular approach, a pulse-loaded "vertical flow constructed wetland". Systems of this type are also commonly referred to as "compact vertical flow reedbeds" in scientific literature.

- These guidelines have been developed to be applicable to the legislative and regulatory framework of the UK.
- The design is intended to treat up to five cubic metres per day of domestic wastewater and to discharge to surface water.
- The wastewater should be settled in an effective septic tank suitable for the loads and type of effluent it receives.
- The effluent from the septic tank is to be fed in batches on to the top surface of a wetland treatment system with adequate rest periods between batches.
- Each batch should be distributed as evenly as possible over the top surface of the wetland.
- The treatment medium in the wetland needs to provide just the right amount of resistance to flow. It should be sufficiently free draining that it completely empties between batches, however must provide some resistance to prevent instantaneous drainage of water applied at the surface.
- The wetland should be free-draining at the bottom.
- If designed appropriately and sized correctly, the discharge from the wetland should not exceed 10:10:5 for BOD: suspended solids: ammonia.

In order to achieve these operational principles, the wetland should be designed and constructed as set out below. The guidance takes the format of a specification (green background), followed by an explanation of the reason for this requirement and/or how this relates to the operational principles (blue background) where appropriate, we have followed this explanation with an example of how this may be achieved in practice (grey background).

Specification
Purpose of specification
Reliable example

Design

The top surface of the treatment area should be at least 3m² per person equivalent (PE). The minimum total area is 15m² regardless of the population served, and the minimum width or length of the top surface is 2m*. The aspect ratio of the top surface is not important.

To ensure sufficiently low area loading rate for effective treatment, and to ensure "edge effects" are not significant.

NB the British Water Code of Practice for Flows and Loads #4 (current at the time of writing these guidelines) requires that domestic properties be designed for a minimum of 5 people (PE) i.e. 15m².

The total bed area should be undivided, or else divided into two equal beds to facilitate maintenance. If two beds are used, these should be loaded simultaneously (except when undergoing maintenance).

To ensure correct sewage loading rate to wetland surface.

The wetland sides and base should be lined with a suitably protected waterproof membrane, or constructed in inert ground of Vp** > 100 s/mm.

To ensure treated effluent is directed to outlet. The Environment Agency allow septic tank effluent to infiltrate into soakaway between 15-100 s/mm, therefore infiltration at smaller rates where Vp >100 s/mm is acceptable.

If a waterproof liner is needed, a puncture-resistant synthetic membrane would be suitable, protected with geotextile membrane above and below according to the manufacturer's recommendation.

The wetland should be drained from the base using one or more "Base Drainage Pipes" connecting to a single pipe discharge of at least 70mm minimum bore.

To ensure the treatment layer is free draining.

A single, rigid base pipe 70mm in diameter is adequate for bed width <3m. For larger bed widths, parallel base pipes with 2m or less between centres would provide adequate drainage.

* NB the sizing (and this standard generally) relate to wetlands treating small volumes of effluent from septic tanks. Smaller unit areas may be appropriate for other scenarios, e.g. tertiary treatment (receiving effluent that has already been treated in a package treatment plant).

** The measurement Vp is a value relating to the infiltration rate of the soil, defined in relation to a test described in the UK Building Regulations 2010 approved Document H2.

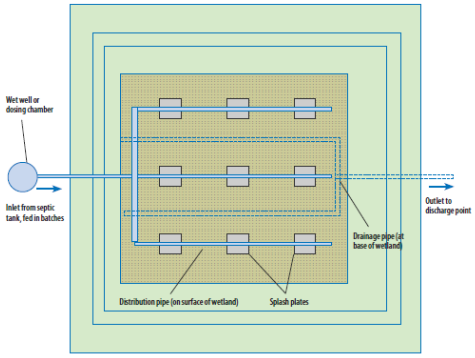


Figure 2. *Typical plan view of a vertical flow constructed wetland prior to planting*

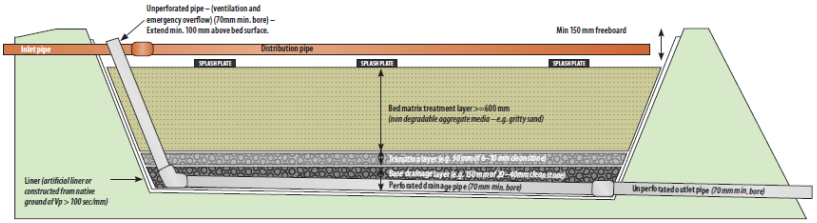


Figure 1. *Typical longitudinal section through a vertical flow constructed wetland prior to planting*

Photograph courtesy of Cress Water Solutions

The base of the wetland should be ventilated by means of "Ventilation Pipes". These should be made from perforated pipe set within the drainage layer, which is connected to non- perforated pipe that extends above the surface of the wetland. These may be dual purpose pipes (drainage and ventilation) or may be dedicated ventilation pipes.

To create an aerobic environment within the treatment layer.

One way to achieve this ventilation is to fit each base drainage pipe with at least one non-perforated riser, the end of which is positioned around 100mm above the wetland surface.

The Base Drainage Pipes should be completely covered with the "Drainage Layer" of the wetland. This must be a physically stable, chemically inert, free-draining gravel with a level surface.

To ensure rapid, efficient drainage.

One option for an effective base drainage layer compatible with 100mm base drainage pipe would be 20-40mm clean river terrace gravel, of nominally 150mm depth.

The Drainage Layer of the wetland should be covered with the "Transition Layer". This should be a physically stable, chemically inert gravel of smaller particle size than the Drainage Layer, and with a level surface. The particle size needs to be sufficiently small to prevent the sand of the Treatment Layer descending into the pore space of the drainage layer.

To prevent the small particles within the Treatment Layer medium being washed down into the Drainage Layer, while ensuring free passage of air through all the layers of the wetland.

Typically this may be 6-10mm clean river terrace gravel of 50mm depth.

The Treatment Layer of the wetland should be placed on top of the Transition Layer. This will comprise chemically inert, non-degradable aggregate material of appropriate percolation rate. The percolation rate should be such that the material will return a time of 30-60 seconds when subjected to the test defined in appendix A.

To ensure sufficient treatment time, avoiding surface ponding.

The Treatment Layer would typically be a gritty sand with a very low fines content.

The Treatment Layer should be at least 600mm in depth at the time it is placed, and of consistent density over entire bed.

To prevent short-circuiting and ensure effective treatment.

The surface of the Treatment Layer should be level to within +/- 10mm and regular.

To ensure maximum effluent spread during surface-flushing.

Typically, this may be achieved with a hand-raked surface.

The wetland basin should be shaped to provide sufficient freeboard (at least 150mm) above the surface of the Treatment Layer.

To ensure wastewater is retained in the treatment system.

Effluent should be introduced on to the surface of the Treatment Layer in intermittent batches, 5-12 litre/m² of bed surface, at sufficient flow rate to cover > 60% surface, in a manner that avoids sand-pitting (ponding). The interval between consecutive applications of effluent should be sufficient to allow the wetland surface to drain completely.

To ensure appropriate loading rate over treatment matrix, allowing effective effluent treatment and ensuring wetland plant development.

A sinking-pipe dosing device is suitable for achieving batch dosing at the appropriate rate where natural fall allows gravity feed. Pump-fed distribution is a suitable alternative. Splash plates would typically be used to avoid pitting of the wetland surface.

If pipework is used to achieve the effluent distribution on to the surface of the treatment layer, the pipe arrangement needs to be self-draining.

To maximise self cleansing and prevent ice accumulation in freezing temperatures.

This may be achieved by locating the distribution holes on the underside of the distribution pipes.

Photograph courtesy of WWT Consulting

Photograph courtesy of WWT Consulting

The wetland plant species should be selected to provide an even distribution of stems over the surface of the wetland. They should be planted as seedlings into the surface of the Treatment Layer, at a density of at least 4 plants per m².

To ensure rapid and robust plant growth.

Common Reed (*Phragmites australis*) is commonly used.

If earth bunds surround the wetland bed, these must be formed into a shape that is stable, clean and designed to prevent runoff from the surrounding land from reaching the Treatment Layer. Such bunds should be finished in materials resistant to erosion from rainfall.

To ensure longevity of the treatment system and protect the treatment layer from clogging.

Prepared turf is a suitable for a soft finish and paving slabs may be suitable for a hard finish.

Construction

Photograph courtesy of Moir Environmental

The perimeter of the wetland should be shaped to prevent rainwater runoff from the surrounding land from flowing on to the wetland surface. Where the wetland is formed by creating new banks, the material forming the banks should be compacted to a civil engineering standard appropriate to ensure that the banks have sufficient strength for the loads it will receive, and that the finished levels account for an appropriate amount of settlement of the newly formed banks. External slopes in soft landscaping should generally not exceed 1 in 3, and should be stabilised against erosion with turf or other erosion protection.

To ensure newly formed slopes are stable.

If a waterproof liner is needed, the base and sides of the excavation that will contain the wetland should be prepared to be free from any protruding stones or other materials that could damage the liner. The liner should be placed with adequate protection from puncturing from above or below, ensuring a watertight seal around any joins or pipe insertions in accordance with the manufacturer's recommendations.

To ensure the liner remains watertight.

If a waterproof liner is needed, this needs to be of a robust and durable material, recommended by a reputable supplier for its intended use. If in-situ testing of the liner integrity is required, this test should be completed with the Drainage Layer and Transition Layer (free draining gravel) in place, however the treatment layer (e.g. gritty sand) **must not** be in place, as prolonged submersion of the treatment layer may adversely affect its performance. Water tightness may be tested by filling the wetland basin with water, and monitoring the water level therein over a 24 hour period.

To confirm the liner remains watertight after placement of the gravel.

HDPE, LDPE, Butyl rubber and synthetic clay liners have all been used successfully as liners for wetlands.

The bed media should be placed carefully in position without mechanical compaction. Plant and machinery should not track on the treatment layer. Care should be taken that media when placed is of even density taking care to prevent voids and loose areas which may settle unevenly. Reasonable pedestrian access for tasks such as planting, maintenance and preparation of the bed surface is acceptable.

To ensure the bed media, particularly the treatment medium retains a consistent and appropriate permeability to water.

The bed media can normally be placed using a mechanical excavator accessing the ground surrounding the wetland only, without tracking on the treatment area. A long reach excavator can be used for larger wetland cells if necessary. Media can be levelled using pedestrian access to the treatment area, and raking by hand. Light compaction by systematic and even "treading" on the surface by pedestrians can be beneficial to avoid uneven settlement.

Sequence of activities in wetland construction. Photo courtesy of Moir Environmental

Operation and maintenance

Photograph courtesy of Watercourse Systems

Upstream system features (e.g. septic tank, flushing chamber/pump chamber) need to be maintained in good working order. The septic tank should be emptied at least once every 12 months, or according to the manufacturer's recommendation, whichever is the more frequent.

To prevent excessive solids carry-over to treatment layer surface.

Cut grass and other vegetation on bunds and bed edges to retain the defined shape of the wetland cell.

To ensure the wetland cell is continuously defined and free from unwanted invasive plants.

Scythe or strim the grass and remove cuttings.

Photograph courtesy of Cress Water Solutions

Remove all weeds from the surface of the Treatment Layer, retaining a regular sand surface.

To select for wetland species, so ensuring surface permeability and ease of maintenance.

Hand-pull weeds.

Keep the surface of the Treatment Layer free from excessive build-up of organic debris (e.g. decaying leaves and other plant matter).

To ensure a free draining surface and preserve the hydraulic performance of Treatment Layer.

If the wetland is planted with Phragmites, reed stems should be cut to a height of 25-100mm at least every two years (ideally annually). This should be done in December, January or February for a UK growing cycle, and any substantial build-up of leaves should be removed annually. To protect the biodiversity value of the wetland, this cut can be carried out by rotation, cutting half the wetland each year.

Photograph courtesy of WWT Consulting

Annex A

Constructed Wetland Association Test for permeability of sand treatment layer for Vertical Flow Wetlands

The test outlined below will ensure that the sand media for the treatment layer of the wetland has the correct permeability to be used for a vertical flow wetland of this design. It is based upon the similar "Grant Test" test described in Annex 4 of BRE publication 420. There are some important differences adopted in the CWA approved test owing to an improved understanding of the performance of wetland systems that has been gained since the publication of BRE 420 in 2001.

TEST PROCEDURE

1. Stand a 350mm length of 110mm OD uPVC pipe on a bed of free-draining gravel (e.g. 50mm depth of 10mm gravel);
2. Place test material into the pipe, levelling the material's surface to a depth of 200mm after firmly tapping the outside of the pipe;
3. Add 500ml clean water to the surface of the sand;
4. Record the time taken for the water to descend, until just disappearing below the sand surface;
5. At the moment the water disappears, add 500ml clean water to the sand surface;
6. Record the time taken for the water to descend, until just disappearing below the sand surface;
7. Repeat 3–6 until the time remains relatively constant (about 8–10 iterations);
8. This constant time should be in the range 30–60 seconds for the sand to be suitable for a vertical flow wetland Treatment Layer.

Appendix C – Document H Percolation Tests

In respect of premises at Glwydcaenewydd, Crai, Brecon, Powys
Description of ground strata;
Freely draining slightly acid loamy soils

The overall depth of the test holes dug were: (state in metres/millimetres)

TEST HOLE 1	TEST HOLE 2
600mm	600mm

I confirm that the water table did not rise to within 1 metre of the invert of the proposed land Irrigation scheme.
The weather conditions on the day were: Dry
The results of the percolation tests were:

TEST HOLE 1				TEST HOLE 2			
	Time in seconds		Vp		Time in seconds		Vp
Test 1	5400	/150	36	Test 1	4800	/150	32
Test 2	5600	/150	37.3	Test 2	5200	/150	34.6
Test 3	5700	/150	38	Test 3	5400	/150	36
Trial Hole 1	Average	Vp	37.1	Trial Hole 2	Average	Vp	34.2

Average Vp of Test Holes 1 & 2	35.65

Calculating	The	Drainage	Field	Area			
P	X	Vp	X	0.25	=	A	
	X	35.65	X	0.25	=		M2
Calculating	**The**	**Linear**	**Drainage**	**Field**	**Length**		
A	/	TW	=	L			
	/	0.600	=		m		

Signed:
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