ARUP

3.0 Civil Engineering

Civils Design – Site Overview

Site Description

The Elan Valley Visitor Centre is located downstream of Caban Coch Dam within the Elan Valley Estate. The surrounding topography includes the northern valley leading up to Cefn Llanfadog and the Afon Elan runs along the southwest boundary of the site.

The existing visitor centre is served by a foul pumping station located to the southwest of the building. A separate bike hub facility was built in 2022 some 50m east of the visitor centre but foul sewer connections were not permitted to the public sewer network. For more information refer to “Foul Water Drainage” section.

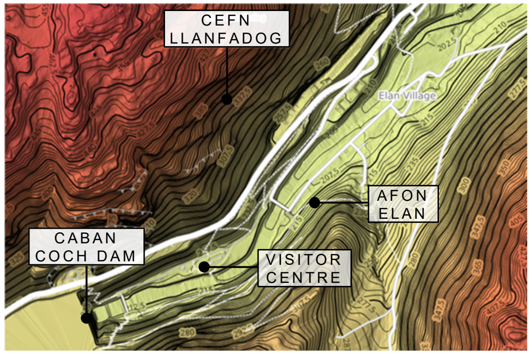


Figure 1: LiDAR showing surrounding topography

Fluvial and Tidal Flooding

Referencing Natural Resources Wales online Flood and Coastal Erosion Risk Maps[1] this site is outside of tidal influence from the sea with no hatching indicated within the vicinity of the site.

Based on LiDAR data, the Afon Elan is approximately 20m south of the visitor centre however is approximately 4.5m lower than the visitor centre level (approx. 214.50mAOD). Therefore, as captured in the Flood and Coastal Erosion Risk Map extract fluvial flood risk is contained to within the riverbank and fluvial flood risk is low.

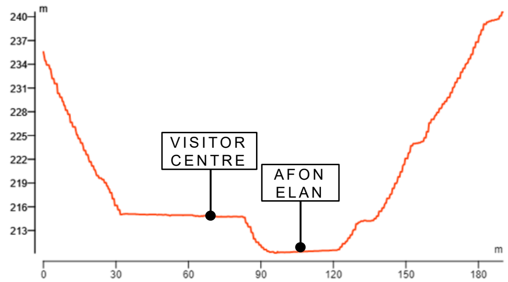


Figure 2: North-south cross-section through LiDAR showing elevation differential between visitor centre and Afon Elan

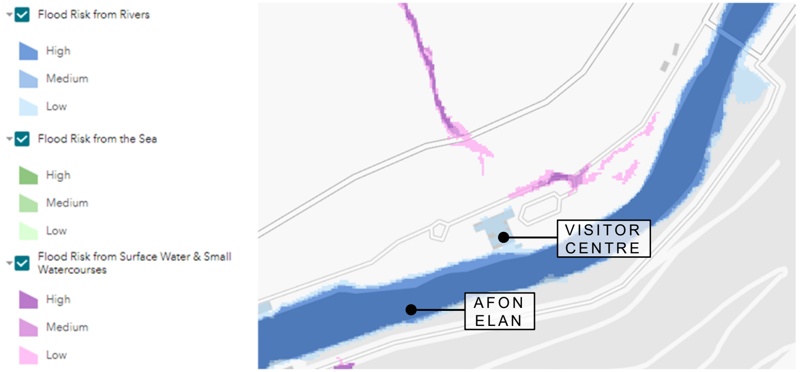


Figure 3: Natural Resources Wales Flood and Coastal Erosion Risk Maps showing site has low fluvial flood risk and low-medium surface water flood risk due to north valley contribution

Surface Water Flooding

As mentioned above, a portion of the north hillside from Cefn Llanfadog contributes to surface water off across the site. This is reflected in NRW’s Flood and Coastal Erosion Risk Maps[1] which identifies some small areas of low and medium flood risk from surface water. Reference of LiDAR data (using Scalgo Live software) and cross referenced against available topographic survey for the visitor centre indicates that these pink areas match with the existing location of a single gully that serves the Elan Valley Visitor Centre main car park.

To the west of the visitor centre, overland flow path carries runoff from the valley past the existing roundabout (adjacent to play area) and along the west building façade before flowing into the river. Additionally, the existing roundabout / coach parking area is prone to flooding in intense rainfall. To the east of the visitor centre valley runoff joins main car park flows before running northeast along the access track. Shortly after passing the overflow gravel park a low point in topography allows runoff to enter the river to the east.

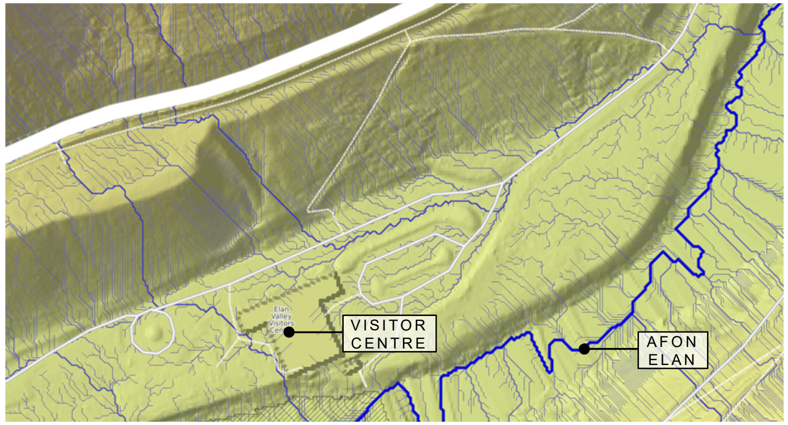


Figure 4: Overland flow paths represented using Scalgo Live. All surface water migrates towards Afon Elan. West of visitor centre water flows past west façade, east of visitor centre water follows main car park and access track before diverting east into Afan Elan

[1] Flood and Coastal Erosion Risk Maps (naturalresources.wales)

Surface Water Drainage: Overview

Existing Surface Water Drainage

A drainage survey of the visitor centre and bike hub showed that roof drainage currently infiltrates to the ground. There are two car park gullies in front of visitor centre entrance however these were not able to be found. However, comparing against topographic survey the car park falls to the east and so it is likely that these gullies do not exist. However, a single car park gully in the northwest of the car park (adjacent to the visitor notice board).

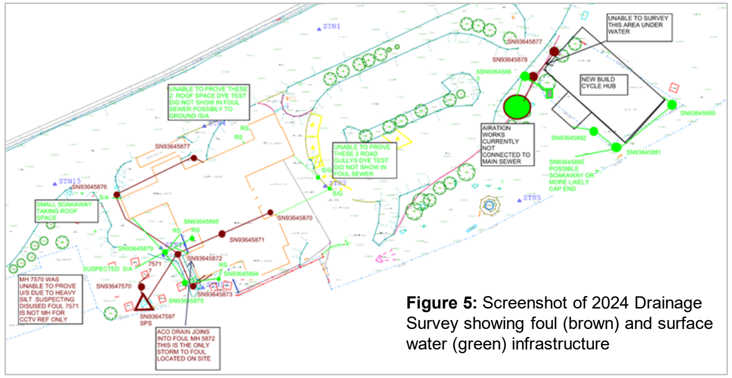


Figure 5: Screenshot of 2024 Drainage Survey showing foul (brown) and surface water (green) infrastructure

Proposed Drainage Masterplan

Due to the nature of this brownfield site, it is proposed that levels remain largely as existing. Some opportunities exist to slightly reprofile ground to the west of the visitor centre, encouraging water towards SuDS features through overland channels.

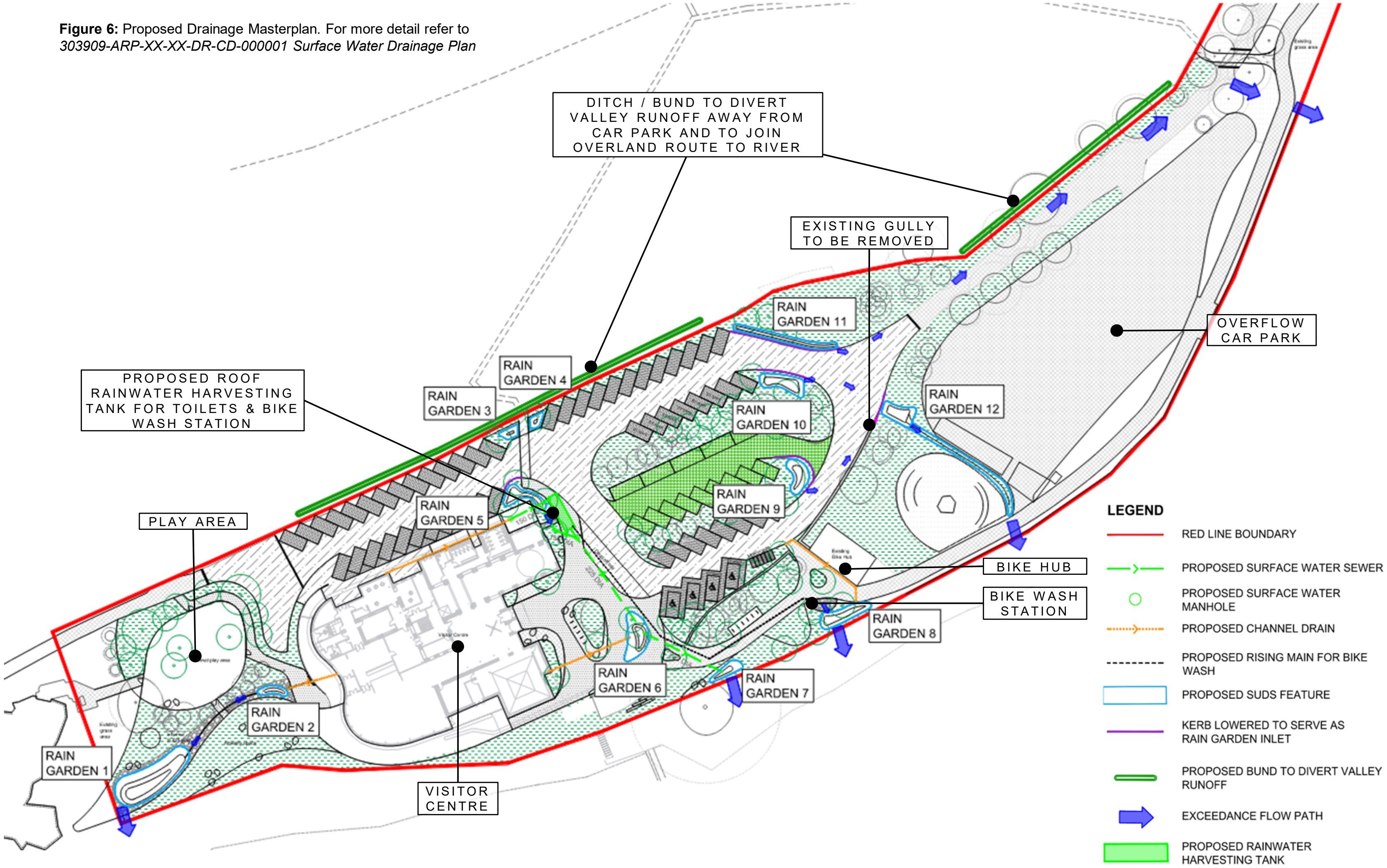
Proposed SuDS features have been strategically positioned outside of pedestrian desire lines to break up catchment areas and in existing low spots across the site. The existing topography naturally falls towards the Afon Elan and so exceedance routes have been considered so that SuDS act in series to improve treatment capacity and resilience.

Permeable paving is proposed for car park spaces (block paving and grasscrete) and the west pedestrian zones (resin bound gravel). Refer to Landscape Material Strategy for more information.

An existing bike wash station is located besides the bike hub which uses potable water. The designers identified an opportunity to harvest rainwater from the large visitor centre roof to be reused for bike washing and flushing of toilets.

To reduce surface water flood risk exacerbated by valley runoff, a ditch or bund is proposed along the northern edge to divert runoff away from the car park and to join to overland flow route to Afon Elan. If a bund is preferred this could be formed from site-won material.

Figure 6: Proposed Drainage Masterplan. For more detail refer to *303909-ARP-XX-XX-DR-CD-000001 Surface Water Drainage Plan*



Surface Water Drainage: S1 Surface Water Runoff Destination

Defining Catchment Areas

By overlaying the proposed masterplan over the existing topography, we have been able to define catchment areas. As mentioned, SuDS have been strategically located to break up the catchment areas into more manageable catchment areas.

Hierarchy Approach: Welsh Statutory SuDS Standards

Applying the hierarchy of water destination as laid out in the Welsh Statutory Standards this project is able to limit all runoff into the following Priority Levels:

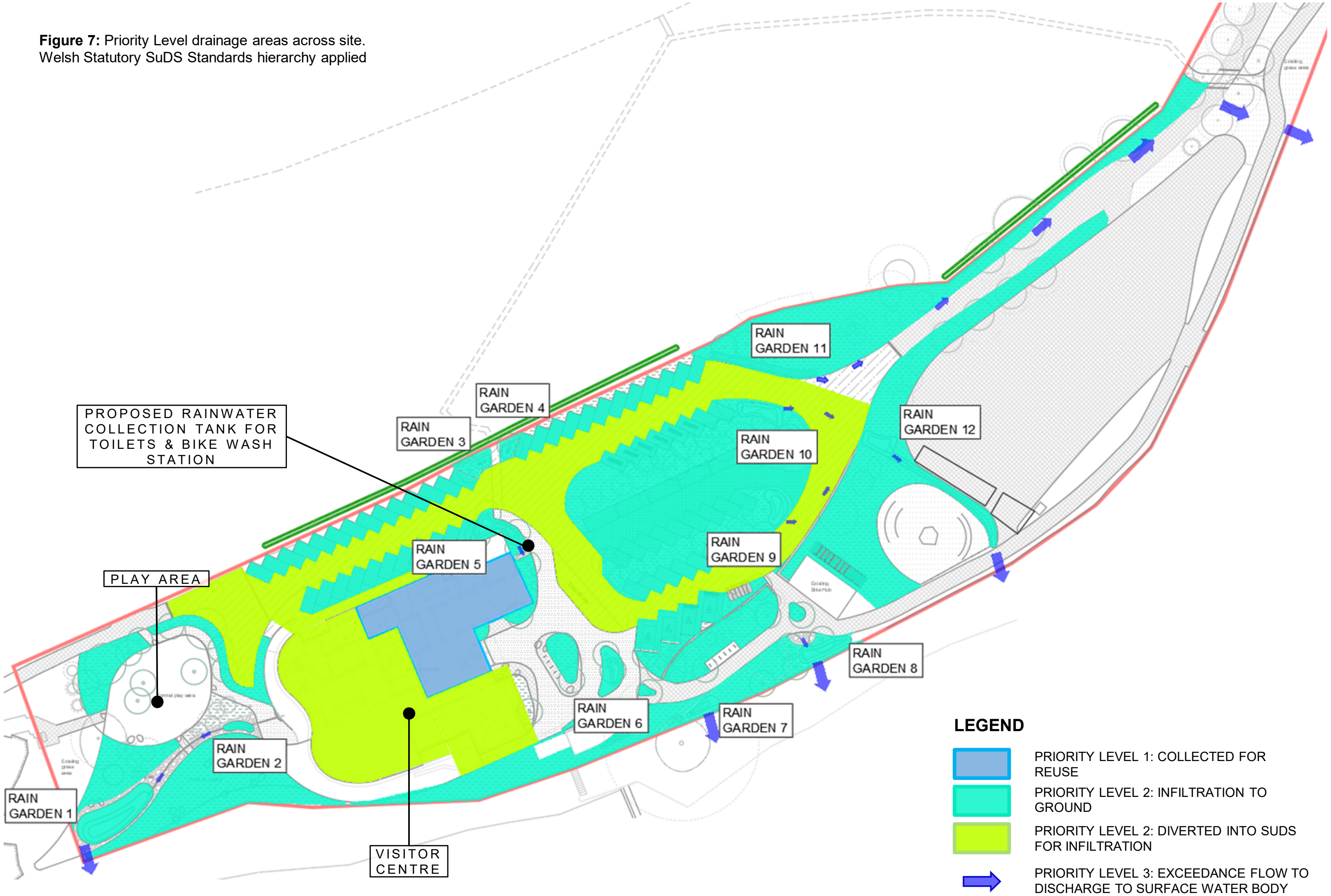
- Priority Level 1 (collected for reuse): northeast roof area to be used for toilet flushing and bike wash station
- Priority Level 2 (infiltrated to ground): permeable paving in car park, resin bound gravel for pedestrianised areas and all SuDS features to be unlined
- Priority Level 3 (discharged to a surface water body): all exceedance from SuDS to flow overland into Afon Elan

For more details refer to section "Surface Water Drainage: S2 Surface Water Runoff Hydraulic Control".

As indicated by blue arrows on Figure 7, the exceedance approach for the project includes:

- Keeping all flows at surface
- Assume infiltration as primary conveyance for SuDS
- Arrange SuDS in series where possible to apply "treatment train" approach
- Utilise existing topography for exceedance into river

Figure 7: Priority Level drainage areas across site. Welsh Statutory SuDS Standards hierarchy applied



Surface Water Drainage: S2 Surface Water Runoff Hydraulic Control and S3 Water Quality

Hydraulic Calculation Principles

Using FEH Catchment Descriptors for the site, this location has an average annual rainfall (SAAR) of 1579mm.

Given the stage of the project to RIBA Stage 2 Design, first principles hydraulic calculations have been undertaken. Using FEH rainfall data to derive critical rainfall depths for given return period, a range of intensities were assessed – the 1 in 2, 1 in 5, 1 in 10, 1 in 30 and 1 in 100-year events. Using an appropriate storm duration of 60-minutes to reflect a worst-case SuDS scenario (less intense rainfall over longer duration will allow SuDS to drain down) these volumes were uplifted to include 40% climate change allowance. This can be seen in Table 1.

The existing single gully in the northeast that serves entire main car park currently discharges untreated and unattenuated. Therefore, as part of these proposals we recommend removal of this gully as all runoff will eventually flow to Rain Garden 12 (the current low point) before overtopping into the adjacent ditch and flowing into the Afon Elan in exceedance events.

Table 1: Critical rainfall depths for 60-minute storm using FEH data

Event w/o CC	Rainfall depth (mm)	Design rainfall depth with +40% CC (mm)
Interception volume	-	5
1 in 2	11	15
1 in 5	17	24
1 in 10	21	30
1 in 30	28	40
1 in 100	36	50

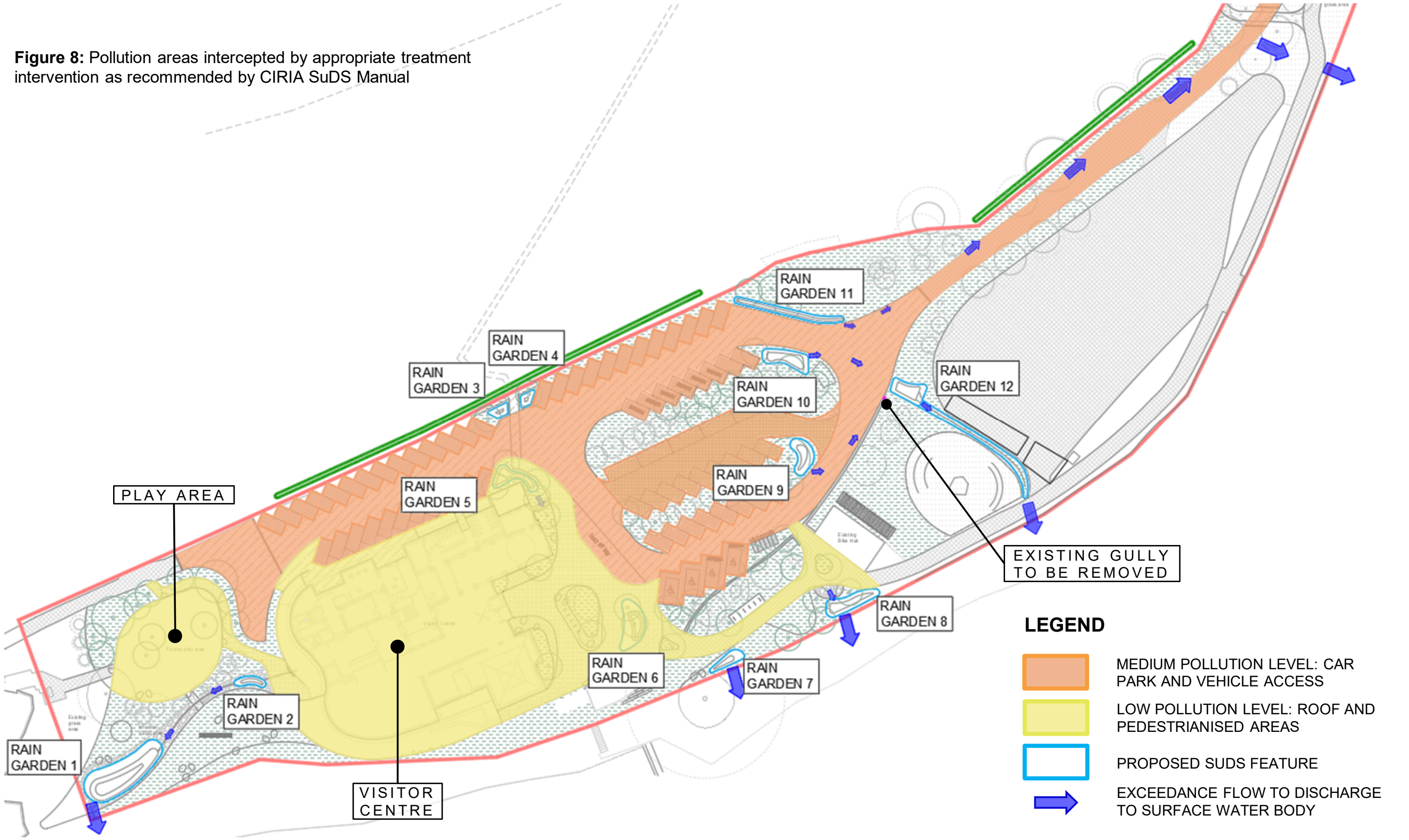
SuDS Design Principles – no pipe network & infiltration

Due to favourable topography towards the watercourse, the surface water strategy will maximise overland flow paths and groundwater infiltration. Where water needs to be conveyed below ground channel drains are proposed to keep water as close to the surface as possible. This enables all SuDS features to not require an underdrain in the base. By not having pipes in SuDS this will reduce the requirement for excavations for pipework and reduce the construction material buried in the ground including plastic pipes and concrete.

All SuDS features are proposed as unlined systems to improve groundwater recharge and plant resilience. This assumption is made due to the presence of other soakaways on site for the existing roof downpipes for the visitor centre and bike hub. Also due to proximity to the Afon Elan, all groundwater will eventually migrate to the watercourse.

Soakaway tests will be undertaken prior to construction to prove assumptions otherwise rain garden configuration will be altered to include a below ground pipe network. See "Simplified Typical SuDS Cross Section" for more information.

Figure 8: Pollution areas intercepted by appropriate treatment intervention as recommended by CIRIA SuDS Manual



Surface Water Drainage: S2 Surface Water Runoff Hydraulic Control and S3 Water Quality

Simplified Typical SuDS Cross Section

A simplified cross-section of a typical rain garden will be compromised of:
(1) Lowered kerbs to serve as inlet points to allow runoff to enter SuDS. (2) A low drop to top of soil maximum 100mm to allow for a free discharge of water and in exceedance events this space above soil can be additional storage. (3) 50-100mm stone mulch to retain soil moisture and reduce scour near inlets. (4) 500-800mm SuDS soil to be specified with high percolation rate to encourage quick drain down time. Side slopes of 45 degrees to support adjacent loaded surface. (5) 300mm crushed stone layer to provide attenuation and encourage positive drainage through base of SuDS.

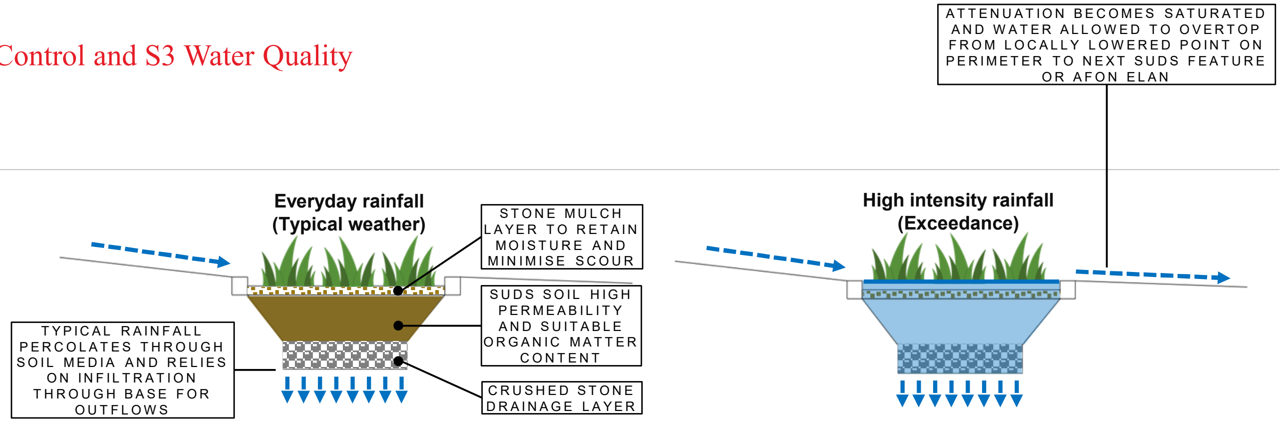


Figure 9: Simplified SuDS cross sections to demonstrate how SuDS will manage low and high intensity rainfall

Anticipated Pollution and Proposed Mitigation

Current land-use consists of vehicle access and parking, pedestrianised areas and roof area from the visitor centre. The CIRIA SuDS Manual Simple Index Approach has been followed to ensure that the required quality standards are met across the site. The most significantly contaminated flows will be from areas with vehicles, which is deemed to be a "Medium" pollution hazard level. This corresponds to pollution indices of 0.7 for total suspended solids (TSS), 0.6 for metals, and 0.7 for hydro-carbons provided by the SuDS Manual. Run-off from the pedestrianised areas and roof are categorised as a "low" pollution level.

All areas will be treated using vegetated bioretention systems i.e. rain gardens. The CIRIA SuDS Manual states that these have mitigation indices of 0.8 (TSS), 0.8 (metals), 0.8 (hydro-carbons). The highest concentration of pollutants and contaminants are found during the "first flush", i.e. during the first 5mm of rainfall. Therefore, all bioretention systems have been sized to contain this volume (interception volume) as a minimum to mitigate any potential detriment to river quality in the Afon Elan.

SuDS Treatment and Attenuation Potential

Using the defined catchment areas and by applying the different critical rainfall depths for different intensity storms (Table 1) we can anticipate the subsequent volume of rainfall that the receiving SuDS system will receive.

The SuDS "Treatment Train" approach has been applied where possible – connecting systems in series for example Rain Garden 2 into Rain Garden 1, Rain Garden 5 into Rain Garden 6 (via overflow pipe) and Rain Gardens 9 and 10 into Rain Garden 12. In Table 2, where SuDS are arranged in series, these are treated as one system. However, Rain Garden 5 and 6 are considered individually due to length of pipework and similarly Rain Gardens 10-12 due to the exceedance route crossing the car park. Rain Garden 8 also serves to intercept and treat bike wash runoff prior to infiltration.

Attenuation volume has been derived by assuming 0.3m depth of water can be retained within the stone mulch, SuDS soil and drainage layer (Figure 9).

The results show that all SuDS features can treat and attenuate the 1 in 5yr +40% CC event as a minimum (interception volume i.e. first 5mm runoff would be absolute minimum to meet water quality requirements). These values are conservative as they do not account for a SuDS outflow rate due to infiltration although this can be applied when infiltration results are obtained.

Table 2: Hydraulic calculations for proposed SuDS features. Refer to Figure 8 for SuDS feature references. Refer to Table 1 for equivalent rainfall depths for different return periods

SuDS feature(s)	Catchment Location	Catchment area (m2)	SuDS footprint (m2)	Attenuation (m3)	Max attenuated event
Rain Gardens 1 & 2	West roof & northwest turning circle	939	92	53	1 in 100 +CC
Rain Garden 3	Local area – negligible	Negligible	7	2	1 in 100 +CC
Rain Garden 4	Local area – negligible	Negligible	6	2	1 in 100 +CC
Rain Garden 5	Side car park	212	19	6	1 in 5 +CC
Rain Garden 6 & 7	Southeast roof & east hardstanding	474	43	22	1 in 30 +CC
Rain Garden 8	Main car park west & bike wash runoff	440	26	8	1 in 5 +CC
Rain Garden 9	Main car park central*	249	20	6	1 in 5 +CC
Rain Garden 10	Main car park north	263	30	9	1 in 10 +CC
Rain Garden 11	Main car park north**	53	27	8	1 in 100 +CC
Rain Garden 12	Main car park northeast	318	54	13	1 in 30 +CC

** For Rain Garden 9 a 30% reduction is catchment area was applied due to surface being formed from grasscrete which has voids within the concrete.*

*** Rain Garden 11 also provides resilience to valley overland runoff due to the proposed bund that now diverts water away from the car park. This will slow down runoff before allowing water to rejoin the overland route to Afon Elan.*

Surface Water Drainage: S4 Amenity, S5 Biodiversity and S6 Constructability, Operation and Maintenance

S4 Amenity

The primary driver for this project is to attract visitors to the site. Working closely with the Landscape Architect for the project the visitor experience has been considered from entry onto the site.

One key asset that the team were keen to explore was how rainwater harvesting from the roof could be used for different purposes. The team were aware that a bike washing station is currently positioned in front of the Bike Hub, however currently potable water is supplied from the mains. Retaining this bike wash down facility for visitors will add to the overall experience but now rainwater harvested from the visitor centre can be used as the primary source. Through use of signage visitors can be encouraged to not use any chemical products and to not waste water, explaining how water has been collected and how it will be treated by nature-based solutions (Rain Garden 8).

The team were also very keen to integrate water into play elements. These principles have been applied to the west of the visitor centre from drawing roof water into discrete channels that connect to Rain Gardens 1 and 2. Refer to the Landscape Play Strategy for more information.

Figure 10: Photo of existing bike wash facility in front of bike hub

S5 Biodiversity

The Civils team engaged closely with the Landscape Architect to ensure the entire site benefitted from increased biodiversity. Planted SuDS features are only one aspect of the overall landscape strategy but will contribute to bringing significant benefit to nature. Rain Gardens 10 and 12 are proposed to include a lined section of rain garden to create small ponds to encourage wildlife to thrive. West of the visitor centre the picnic benches and play area currently are served by lawn grass. There are opportunities to significantly improve biodiversity and connection to nature in this vista, particularly by connecting the new panoramic windows from the café to the view of Caban Coch Dam. Refer to the Landscape Planting Strategy for more information.

In upcoming design stages drought tolerant plants should be specified as the SuDS features will remain dry most of the time until bursts of rain.

S6 Constructability, Operation and Maintenance

With the SuDS aspirations to exploit the existing topography and minimise use of pipework, construction is minimised and overall excavation depths reduced. This will reduce risk to operatives and reduce issues with unforeseen clashes such as buried utilities.

The existing single gully requires proactive maintenance to reduce flood risk, but a significant other consideration is that pollutants such as petrol from exhausts, microplastics from tyres and break pads and other harmful contaminants currently flow freely into Afon Elan. Removal of existing gully will enable the planted SuDS features to filter out pollutants in surface water runoff and capture it at source. In future stages, the maintenance schedule should consider appropriate removal and disposal of the top layer soil which will accumulate contaminants over time – some of which will not breakdown by plants or UV such as phosphorus.

The surface water conveyance principles are such that water is kept on the surface or as close to the surface as possible. This will enable any required maintenance or intervention (e.g. an oil spill) to be identified easily and will allow easy access above ground.

By arranging SuDS in series this will increase resilience of systems and should reduce the maintenance burden particularly for blockage due to silt or debris build-up.

Foul Water Drainage: Existing Foul Drainage and Wider Context

Existing Foul Drainage Overview

A 2024 drainage survey of the visitor centre showed that all wastewater flows to a sewage pumping station (SPS) in the picnic bench area west of the visitor centre. Sewage is collected in a wet well before being pumped through a 75mm rising main across Afon Elan and to Elan Village wastewater treatment works (WwTW).

As mentioned in "Site Description", wastewater flows from the bike hub constructed in 2022 were not permitted to connect into the public sewer network due to the risk of increased phosphorus (P) being released to the waterbody. Instead, a storage tank was built to intercept wastewater (bike hub toilets and runoff from bike wash station) which can be tankered off-site.

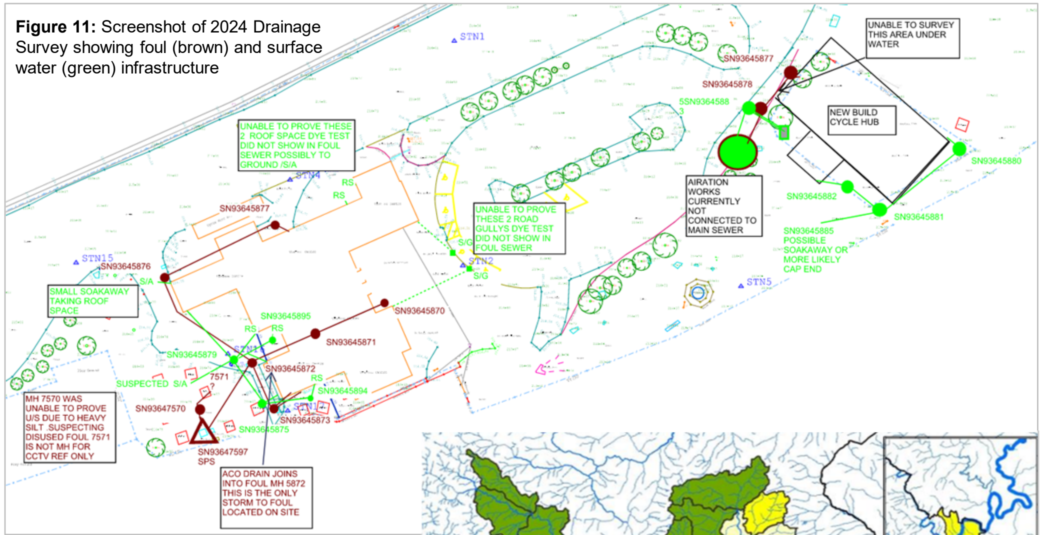


Figure 11: Screenshot of 2024 Drainage Survey showing foul (brown) and surface water (green) infrastructure

Elan Valley Visitors Centre SPS

Historical issues have been reported at the SPS which the project aims to address.

- The SPS only has one pump and so in the event of a pump failure wastewater cannot be passed forward resulting in immediate closure of the visitor centre. This also risks sending sewage to overflow to the river. An additional pump would increase the resilience of the SPS.
- The SPS wet well is undersized, meaning small increases in activity trigger the telemetry alarm. In this scenario the visitor centre must shut-down kitchen operations and close toilets whilst emergency procedures are implemented. A larger wet well would increase the resilience of the SPS during peak activity.
- The fats and grease produced from the kitchen builds up in the wet well and on the monitoring system, falsely triggering the alarm. The addition of a grease separator at source will avoid this issue.

Flow data at the SPS for the past year (Aug 2023-Aug 2024) indicate that that the maximum instantaneous pumped flow from the visitor centre was 4.44 l/s, the average daily flow to the WwTW was 4.8 m^3/d, and the peak daily flow was 20.3 m^3/d.

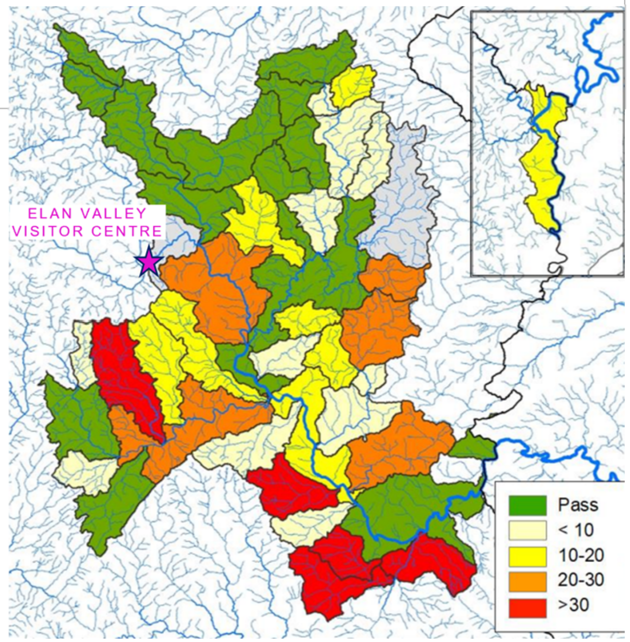


Figure 12: (right) map of phosphorus compliance for Welsh sections of the Wye SAC (NRW)

Elan Village WwTW

The Elan Village WwTW uses a small Oxigest unit provided by SATEC in 1970 with a descriptive permit (AW1001401). Table 3 shows the original design parameters.

Max flow per hour	Max flow per day	BOD Loading	Clarifier Loading
5 m^3	23.6 m^3	8.1 kg/BOD/day	4 m^3/hr

Table 3: Elan Village WwTW original design parameters

Nutrient Neutrality

The Elan Village WwTW discharges to the Afon Elan which is a tributary of the River Wye. Due to failing water quality targets the River Wye is designated as a Special Areas of Conservation (SAC) catchment, which has widespread failures in Phosphorus targets (See Figure 12). Under Habitats Regulations, Planning Authorities will need to complete a Habitats Regulations Assessment (HRA) to evaluate the impact of the proposed development in the SAC including nutrient impacts of proposed developments on water quality.

The Afon Elan could not be assessed against its phosphorus target due to lack of monitoring data. However, as it is upstream of failing sections of the River Wye it is likely that nutrient neutrality must be demonstrated to ensure no further deterioration of water quality. This means measures should be put in place so that there is **"no net increase in phosphorus loading for the duration of the authorisation".** [2]

[2] Natural Resources Wales / Principles of nutrient neutrality in relation to development or water discharge permit proposals

Foul Water Drainage: Strategy Overview

Increase in Domestic Flows

The expansion of the Elan Valley Visitor Centre is part of the greater Mid-Wales Growth Deal which aims to increase visitor numbers to Mid-Wales sites of interest. As the numbers of visitors increases, so will the wastewater generated by the site putting additional pressure on the sewer network. Therefore, the proposed Civils design scope includes:

1. Demonstrate no net-increase of Phosphorus to the SAC catchment
2. Effectively drain all foul flows to the Elan Village WwTW
3. Treat all foul flows to the WwTW permitted standards

The expected increase in visitor numbers by 2030 were estimated as in the table below:

Current Annual Visitors	2030 Annual Visitors	Peak Daily Visitors
180,000	202,500	1,800

These should be taken as high-level best estimates as visitor numbers to the Centre have historically been volatile year on year. After 2030, in the AMP9 investment period, the Elan Village WwTW is programmed to be upgraded under Welsh Water's programme of works.

Foul Drainage Masterplan

The existing Elan Valley Visitor Centre SPS will be relocated to facilitate the extension of the visitor centre western boundary. Due to major internal modifications an entirely new new foul network is proposed. The proposed foul sewers (Figure 13) will drain north of the main building and connect to a new foul sewer in the road. The new SPS now located within the overflow car park will address historical issues and intercept the existing rising main to Elan Village WwTW (more details in the "Proposed Elan Valley Visitor Centre SPS" section).

However, before wastewater flows reach the SPS they will undergo P-stripping (phosphorus removal) through a Package Treatment Plant (PTP) in the overflow car park. We have engaged a PTP supplier for an initial sizing design (more details in the "Additional Phosphorus Loading" section). To protect the PTP and ensure the WwTW never operates above design capacity, peak wastewater loads during high-tourist season will be attenuated through 2No. balancing tanks.

Finally, as a P-removal PTP will be built, the temporary solution that had been put in place for the bike hub can be decommissioned. New foul sewers will take the bike hub wastewater to the main foul network.

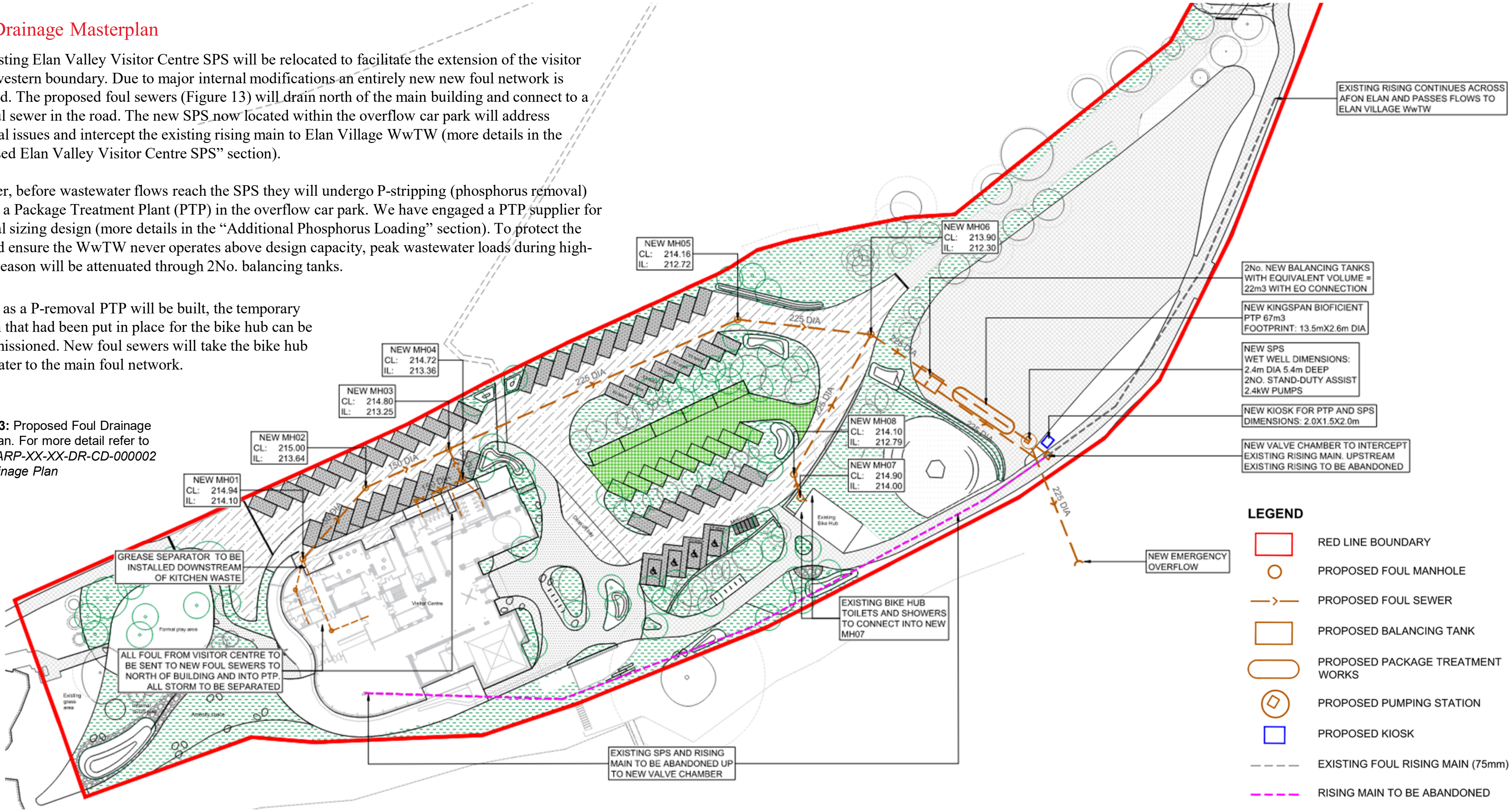


Figure 13: Proposed Foul Drainage Masterplan. For more detail refer to *303909-ARP-XX-XX-DR-CD-000002 Foul Drainage Plan*

Proposed Approach to Address Phosphates

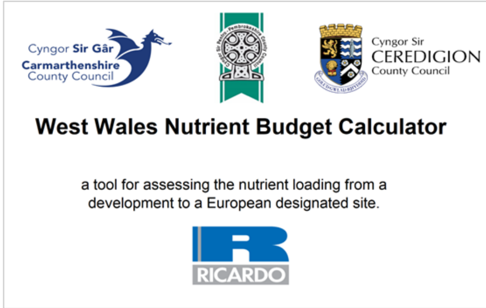


Figure 14: Latest Nutrient Calculator used for this project

Additional Phosphorus Loading

Preliminary calculations have been carried out using the West Wales Nutrient Calculator (Figure 14) to estimate as per best practice. Inputs to the calculator are as follows:

Input	Value	Source
Net increase in visits per year	22,500	2030 growth horizon
Average water usage per visit	10 l	Assuming a 2hr dwell time and water usage of 120 litres per person per day
Wastewater Effluent P concentration	5 mg TP/l	SAGIS Modelling Value as little sampling data available at WwTW

As minimal land use change is planned and surface water run-off is managed through SuDS features compliant with the Welsh Statutory Standard S3 relating to water quality, it is assumed there will be no additional P loading from surface water. It is expected there will be betterment as the existing site is solely served by a single gully that drains untreated and unattenuated to the watercourse.

Therefore, the total P load to mitigate for is due to the additional wastewater generated only and with the 20% buffer applied required is equal to **1.37 kg TP/year**

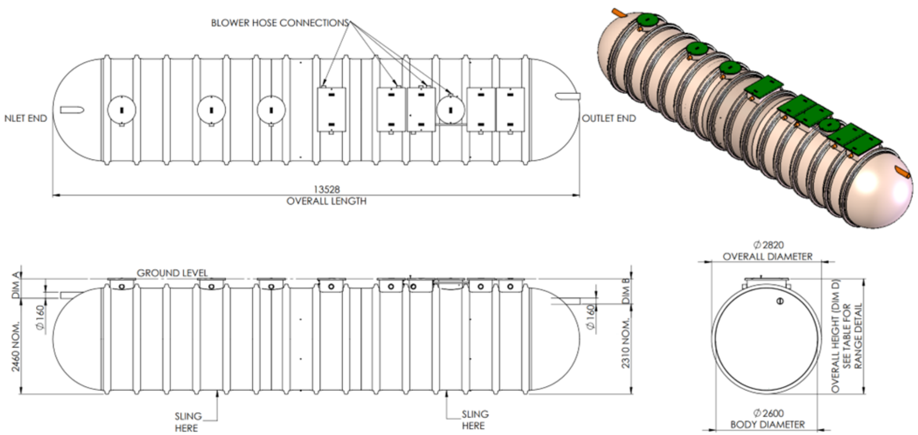


Figure 15: Kingspan Klargester Bioficient 67 +P Package Treatment Plant

Phosphorus Mitigation Strategy

To mitigate the additional P loading, several options were discussed but due to funding constraints the most feasible solution was to introduce a P-removal treatment stage on site. This had previously been considered for the bike-hub in 2021 but was deemed disproportionately expensive for that development. An updated quote for a PTP with P-removal capabilities was requested from Kingspan Klargester to treat all wastewater flows for the visitor centre before pumping to the WwTW.

After engaging with the supplier, given anticipated loads and wider context the most suitable product was the Bioficient 67 +P Unit with chemical dosing (Figure 15). This unit will be configured upstream of the relocated SPS and within the overflow carpark boundary. Due to effluent ultimately reaching Elan Village WwTW the unit has been sized to achieve its stated Phosphorus performance only. Partial treatment of BOD, SS, and ammonia will still occur but not to effluent standards.

Key technical information for the unit is provided in the table below:

Max flow	Peak flow rate for ½hr in any 2hr period	Retention time	Effluent Phosphate concentration
50 m³/day	6.25 m³/hour	28 hours	2 mg/l

In the proposed foul sewer arrangement all sewage is diverted into the PTP. Therefore, the anticipated P loading compared to existing flows produced by the Visitor Centre reduces from 9 kg TP/yr to 3.6 kg TP/yr, providing **5.4 kg TP/yr betterment**.

Other Considerations

As ferric dosing is applied in this system, DCWW will have to request a variation of permit to include iron monitoring. Typical iron permits are 4mg / l which should be achieved following normal PTP operation.

Maintenance and operational costs have not been estimated at this stage. The dosing chemical must be supplied by others and is not included as part of initial quotes. Sludge will be produced on site and so a disposal program will need to be put in place. It is possible that dosing at the Visitor Centre would only be required as a temporary measure until upgrades at Elan Village WwTW are introduced in AMP9 which will include its own P-removal process.

Foul Water Drainage: Providing Resilience and Sufficient Capacity

Proposed Elan Valley Visitor Centre SPS

At this stage the Welsh Water Standard Details have been referenced for typical small submersible wastewater pumping stations (Figure 16).

Some assumptions made to propose a feasible design:

- Wet well dimensions: 2.4m diameter, 5.4m deep to provide 1-hour emergency storage volume at peak design flow
- 2No. 2.4kW pumps
- Valve chamber to be constructed on alignment of existing rising main
- Same instantaneous flow passed forward rate as previous SPS to not increase pressures on the WwTW
- Kiosk footprint of 2.0x1.5x2.0m to house combined electrical instrumentation for PTP and SPS
- Electrical power supply to be provided same source as visitor centre

A variation of consent will have to be requested to Natural Resources Wales to relocate the coordinates for the SPS emergency overflow discharge location into Afon Elan.

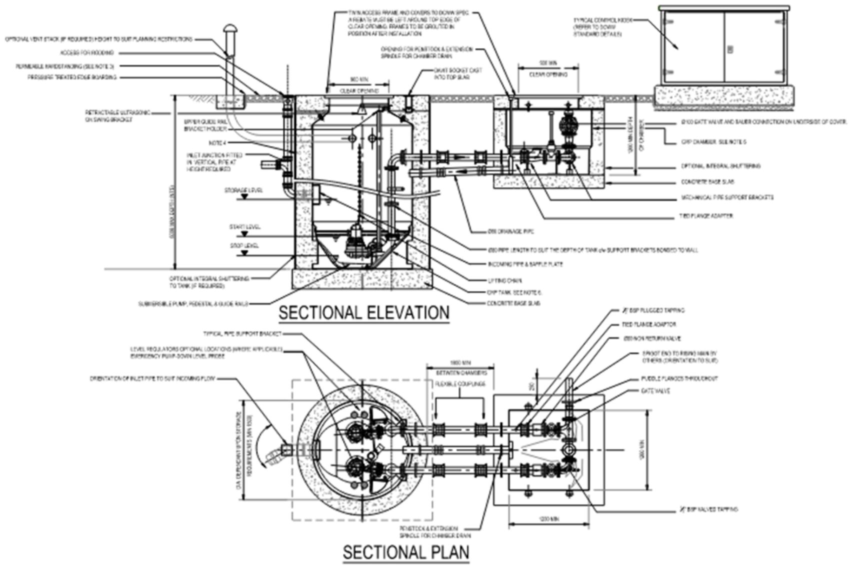


Figure 16: DCWW standard detail for small submersible wastewater pumping station

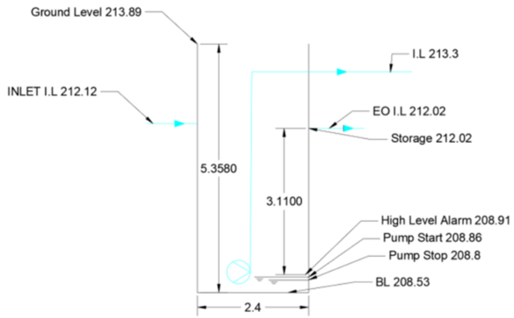


Figure 17: Indicative cross section and assumed levels to size proposed SPS

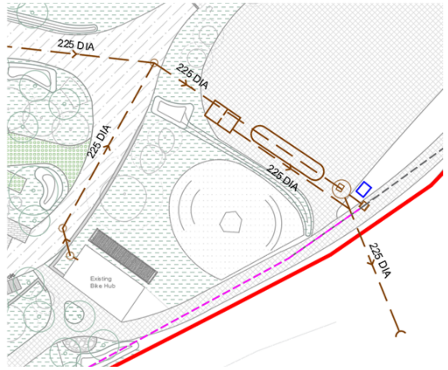


Figure 18: Extract of foul network arrangement

Proposed Balancing Tank

Due to the small size and lack of data available at Elan Village WwTW, there is potential that the works could be operating above its maximum daily design capacity during current and future peak fluctuations of visitors. To avoid this risk, a balancing tank is proposed on site, upstream the PTP and SPS. This would serve as a buffer to attenuate peak daily loads that could occur on weekends over several days so that the WwTW never operates above design capacity.

Given the stage of the project to RIBA Stage 2 Design, first principles hydraulic calculations have been undertaken based on maximum flow capacity in a given day versus maximum flow generated in a day. As per data provided by DCWW, the works design capacity is 23.6 m^3 per day but 10.3 m^3 of this is already utilised by the permanent indigenous population of the small catchment. This gives a max allowance for the visitor centre of 13.3 m^3.

We have estimated maximum daily flows generated by the visitor centre using the following approach which is the same approach used by Kingspan Klargester to size their PTP.

Q = No. of visitors x 10 litres (for toilet use) + no. meals prepared x 15 litres
= 1800 x 10 + 400 x 15 = 24000 l/day = 24 m^3/day

Designing to store the difference in loads for two days retention which would permit to manage two days in a row of 1800 visitors in a day, the balancing tank volume is:

V = (24 – 13.3.) x 2 = 21.4 m^3

Practically to store flow for two days would risk sewage turning septic and settling. This needs review at the next stage but at this stage is assumed to be formed of two smaller tanks that fill and empty quicker. There is also opportunity to reduce or remove the need for the balancing tank if the PTP itself is found to provide sufficient volume and retention time to attenuate peak loads. This will need verification at the next design stage.