AECOM

St. Athan Northern Access Road

Drainage Strategy

Prepared for:
Welsh Government

Prepared by:
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1. INTRODUCTION

1.1 Purpose of the Report

AECOM has been appointed by the Welsh Government (WG) to design a new access road to serve the Aerospace Business Park in St. Athan. The new road, which is referred to as the Northern Access Road (NAR), will provide a link from the B4265 near Llantwit Major in the west to Eglwys Brewis Road in Picketston in the east.

This drainage strategy has been prepared to support the submission of a Planning Application for the NAR and summarises the proposals to manage surface water runoff from the highway. In addition, proposals for managing surface water runoff from the adjacent agricultural land and the interaction with the highway drainage systems are also described.

1.2 Scope of the Report

This strategy document will provide the following:

- Overview of existing site drainage;
- Calculation of the greenfield runoff rate from the site;
- Assessment of proposed impermeable areas and associated discharge rates from the proposed catchments;
- A detailed description of the proposals for managing surface water runoff throughout the site, including the use of Sustainable Drainage Systems (SuDS) which have been specifically designed to minimise the risk of bird strikes to aeroplanes from the adjacent RAF base; and
- Preliminary design information including General Arrangement drawings, modelling results and typical details.

1.3 Flood Consequences Assessment

The strategy for managing surface water has been developed in conjunction with the proposals developed for flood alleviation described in detail within the Flood Consequences Assessment Report (FCA).

The FCA conforms to the requirements of Technical Advice Note 15 (TAN 15) and outlines a number of flood mitigation measures incorporated within the scheme. Natural Resources Wales (NRW) and Vale of Glamorgan (VoG) have been consulted throughout the development of the FCA and have advised on the sensitivity of this area and the design/modelling criteria.

2. SITE LOCATION AND DESCRIPTION

2.1 Location

The proposed NAR is located to the northeast of the village of Boverton and south of Llanmaes, in the Vale of Glamorgan. It commences at the intersection with the B4265 and continues in an easterly direction through agricultural land towards the village of Picketston. At its eastern extent the proposed NAR will tie into the existing Eglwys Brewis Road (EBR) and a new signalised junction and roundabout will be constructed to provide access to the development.

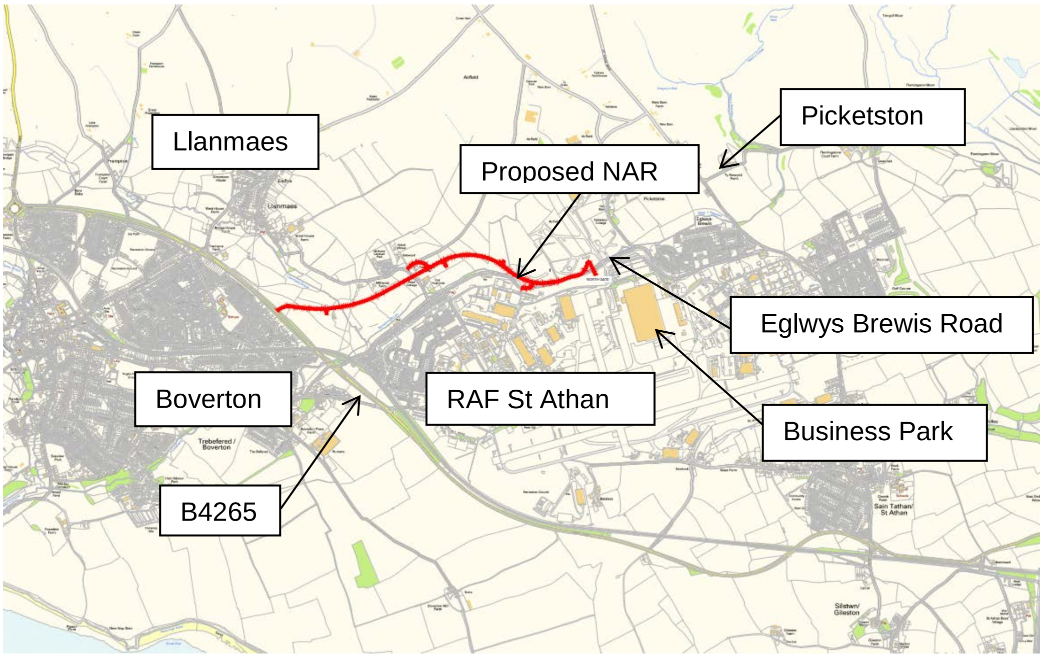


Figure 1 – Site Location

2.2 Watercourses

The route of the NAR traverses Llanmaes Brook which is classified as a main river by Natural Resources Wales (NRW); it flows north to south and is a tributary of Boverton Brook. The road also crosses Boverton Brook in the upper part of the catchment where it is classed by NRW as an Ordinary Watercourse (see Figure 2).

Field drain systems including culverts and ditches drain the agricultural land to Boverton Brook and the Nant y Stepsau located to the east of the site.

An existing flood defence structure, comprising an embankment and culvert is located on Llanmaes Brook just south of the proposed NAR boundary. The agricultural land to the north of this structure is currently utilised for flood storage.

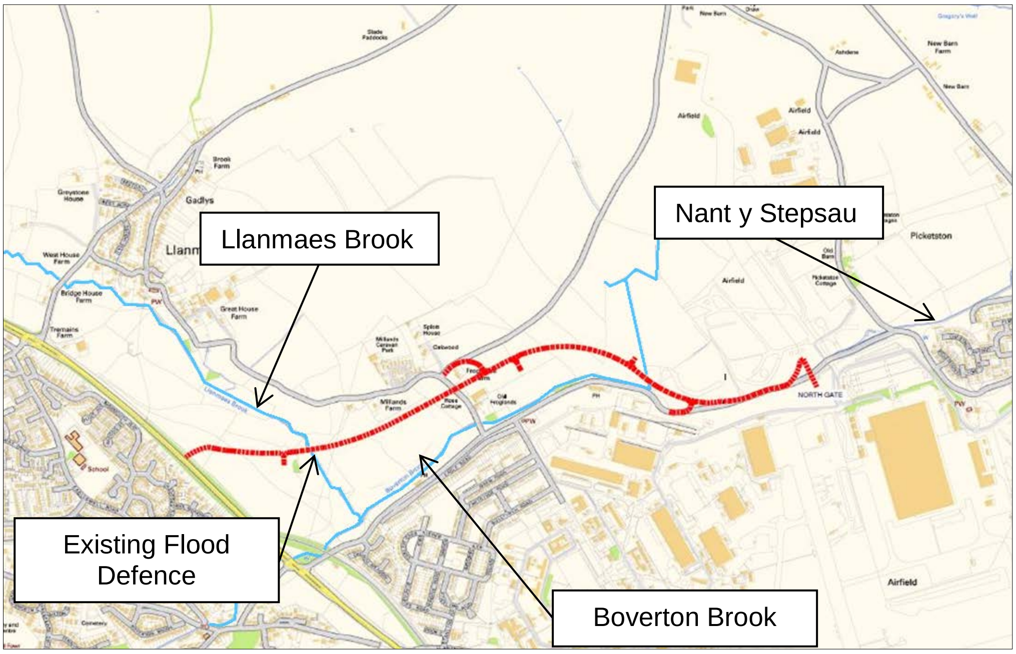


Figure 2 – Watercourses

2.3 Topography and Existing Catchments

Figure 3 shows the extents of the existing catchment areas draining towards Boverton Brook and the Nant Y Stepsau.

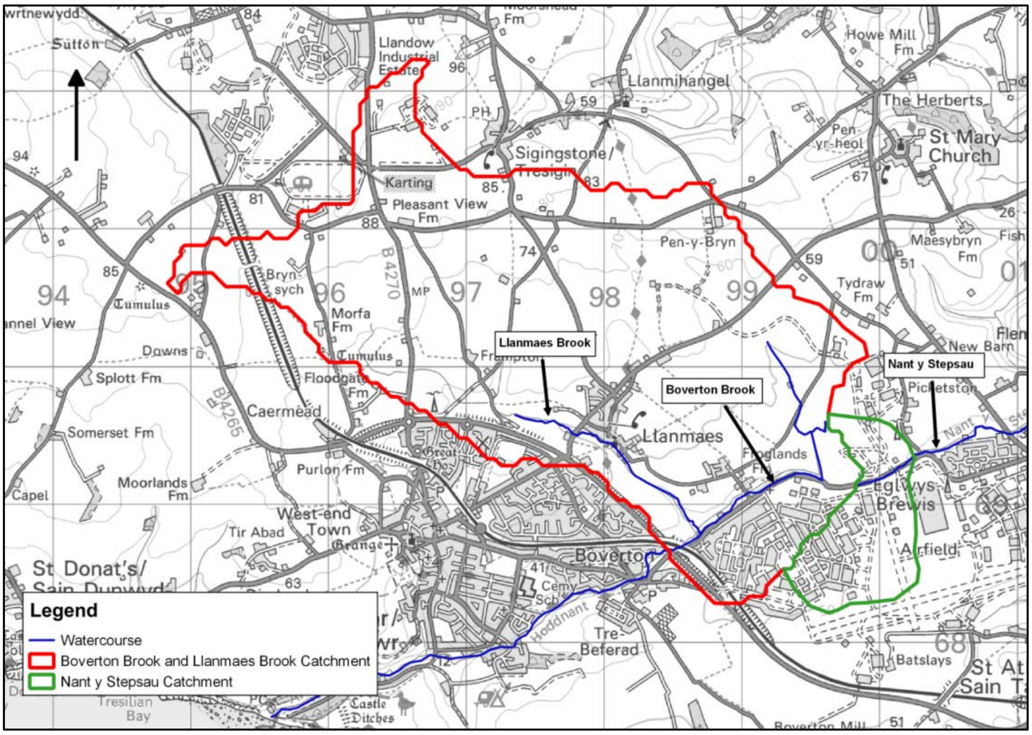


Figure 3 –Existing Catchments

2.3.1 *Area west of Llanmaes Brook*

The existing ground level at the eastern extent of the scheme is approximately 47.0m AOD. The ground falls in a south-easterly/southerly direction before interfacing with Llanmaes Brook which runs from north to south.

2.3.2 *Area east of Llanmaes Brook up to the intersection with Boverton Brook*

A small length of the existing ground at the western extent falls towards Llanmaes Brook. From this point the ground falls in a southerly direction to the interface with Boverton Brook.

2.3.3 *Area east of Boverton Brook*

The existing ground in this area falls generally from west to east. The EBR is located in a shallow valley with the surface water runoff from the highway and adjacent land intercepted by land drainage systems which outfall to the upper Nant y Stepsau.

2.4 Geology

The site is underlain by Porthkerry Member Limestone and Mudstone formation. Made Ground is also present across the proposed road alignment. The solid geology is overlain by firm dark brown clay with gravel and cobbles of limestone. Topsoil was generally comprised of firm to stiff clay and ranged in thickness from 0.1m to 0.25m.

Full details of the geotechnical investigation are contained within the Ground Investigation Report (Report Reference 60509148/St Athan/GIR).

2.5 Hydrology

Groundwater strikes were recorded within the weathered Porthkerry Member at 0.32m below ground level (bgl), 0.72m bgl and 0.8m bgl respectively. Groundwater strikes were also observed at shallow depths within the Made Ground at 0.5m bgl suggesting a perched water table within this unit.

The Groundwater Vulnerability Map of the area indicates that the Porthkerry Member (Blue Lias Formation) is classified by the Environment Agency (EA) as a Minor Aquifer.

A number of soil infiltration rate tests in accordance with BRE 365 were undertaken during the geotechnical investigation. Due to the slow infiltration rate it was not possible to calculate the design infiltration values and the ground conditions do not appear suitable for the use of soakaways.

3. FLOOD RISK

3.1 Background

The area in the immediate vicinity of the proposed development has experienced regular flooding events in recent years. In addition to the existing flood defence structure located on Llanmaes Brook, upstream of Boverton, VoG are developing proposals to provide further flood alleviation measures to the north of the proposed NAR independent of this scheme.

The information below summarises the conclusions of the FCA in regard to flood risk to the proposed development from various sources.

3.2 Fluvial

The NRW Flood Map shows the NAR crossing two areas classified as lying within Flood Zone 3. The watercourse crossing at Llanmaes and Boverton Brook are considered to be at a high risk of flooding. The area around Froglands Farm has also suffered from recent fluvial flooding (see Figure 4). Figure 5 highlights the risk of flooding in areas adjacent to the proposed NAR.

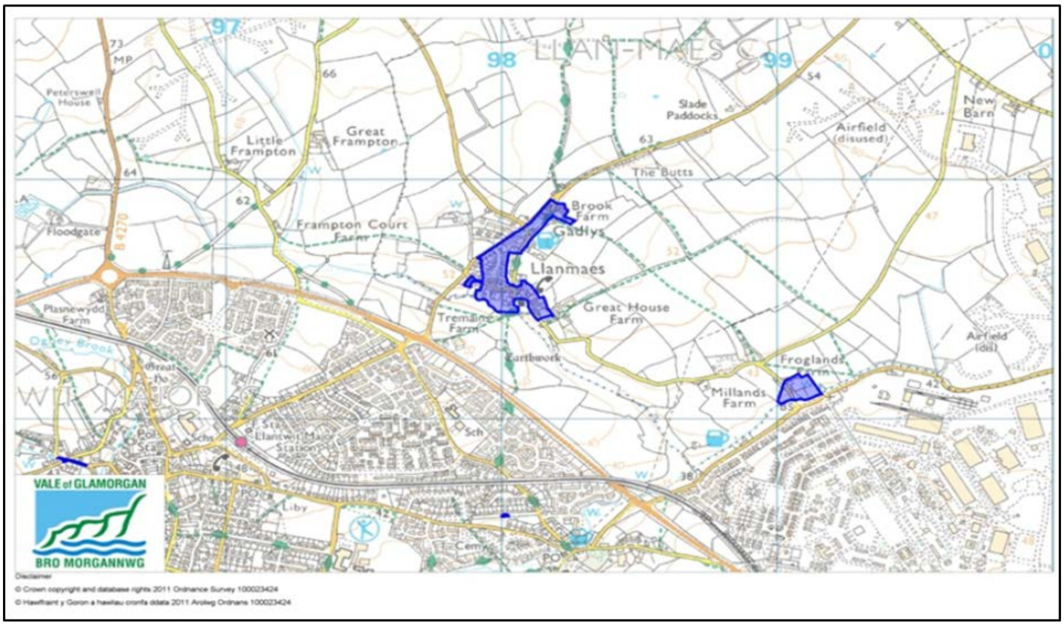


Figure 4 – Extent of Flooding 28th October 1998

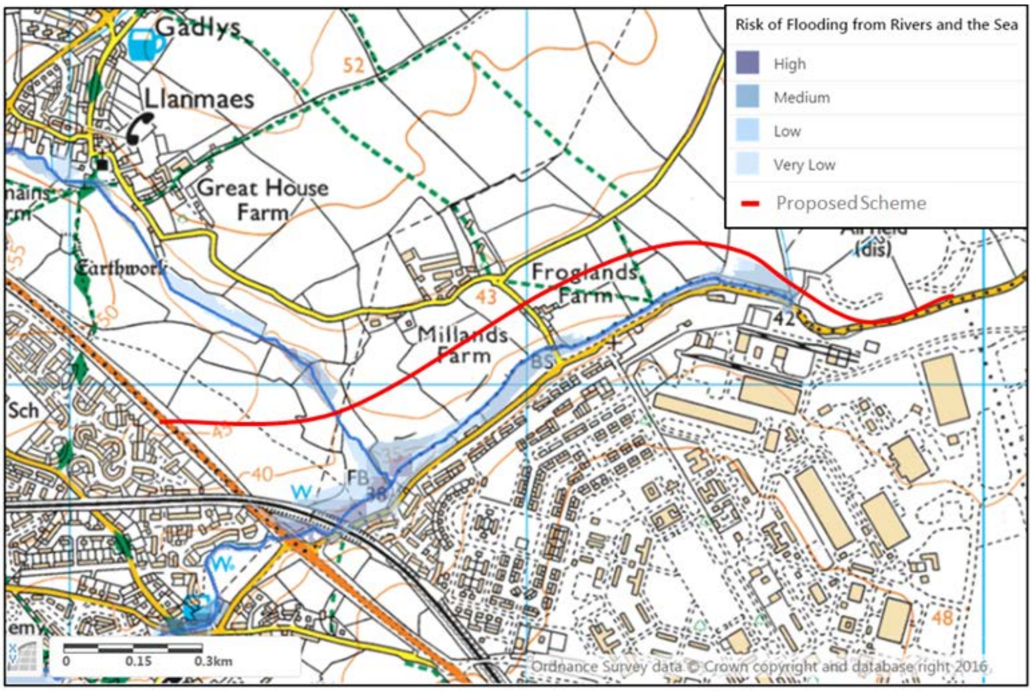


Figure 5 – NRW Risk of Flooding from Rivers and Sea Map

3.3 Overland Flow

As noted previously soil infiltration rates in this locality are low resulting in higher surface water runoff rates. The Pluvial hydraulic modelling undertaken to support the FCA highlights the locations at risk in the pre-development scenario.

3.4 Groundwater

It is likely that groundwater will be encountered during construction of the cutting and appropriate groundwater control measures may be required. In addition to the risk of groundwater flooding and ingress into the proposed carriageway foundation the impact of the construction proposals on hydrology and hydrogeology also require consideration.

3.5 Flood Alleviation Design

Design proposals for the flood defence structures at Llanmaes and Boverton have been described in detail within the FCA. The information contained within the document includes required culvert sizes, volume of storage, overflow weir arrangements and bund locations.

4. SURFACE WATER STRATEGY

4.1 Overview

The primary aim of this strategy is to ensure there will be no detrimental impact to the downstream watercourses and adjacent properties/land from the discharge of highway runoff. Due to the highly sensitive nature of the development with regards to flood risk, detailed consideration has been given to the management of overland surface flows in addition to the highway runoff from the carriageway.

The drainage systems are designed to manage the overland and highway runoff in a manner which will maintain the existing flow regime of the catchment, with discharges controlled to Greenfield Runoff Rate (GRR).

Independent highway and land drainage systems are proposed for the scheme in accordance with the guidance in Design Manual for Roads and Bridges (DMRB) HD 49/16 Highway Drainage Design Principal Requirements. Figure 6 shows the proposed highway catchments and their discharge points.

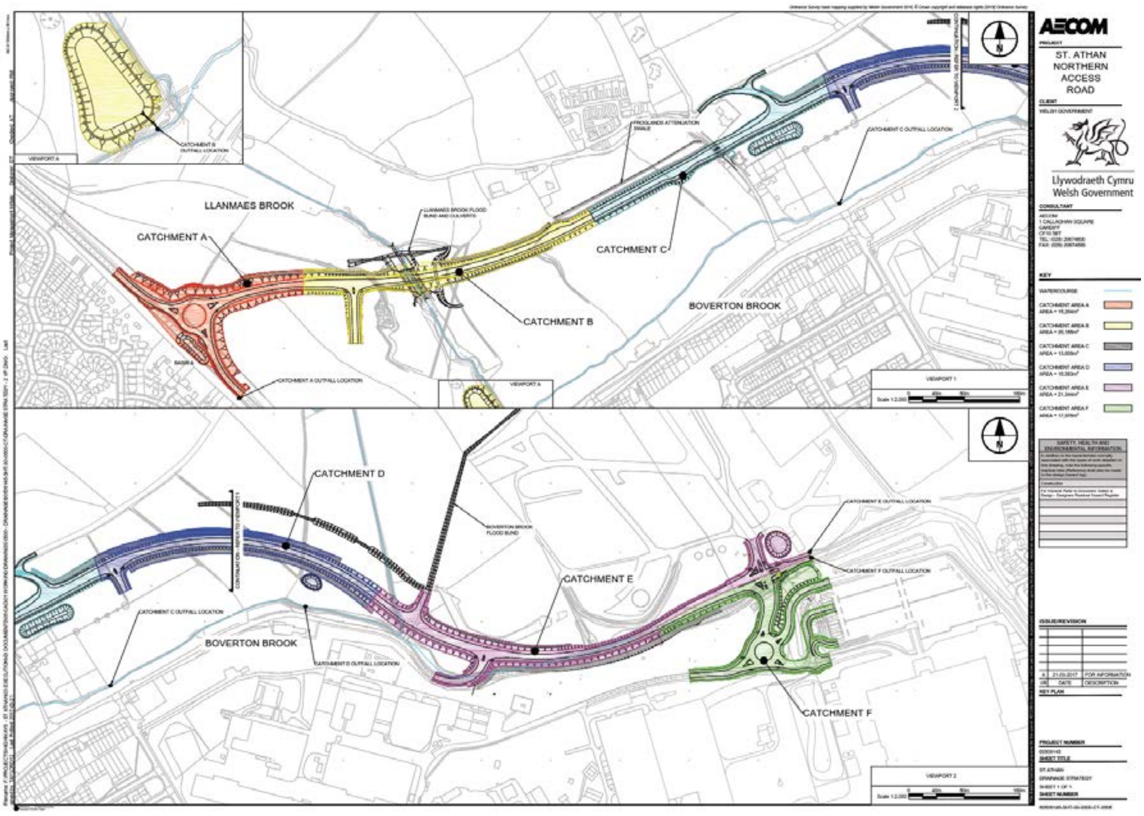


Figure 6 – Highway Catchments (Appendix: A Drawing 60509148-SHT-00-0000-CT-0506)

A high level description of the surface water management proposals for each catchment is contained in this section and includes the proposals for managing the overland flows from adjacent land.

Scheme wide proposals in relation to pollution control and the treatment of surface water runoff are contained in Section 5. Further outline design information including calculations and Typical Details are included in Section 6.

4.2 Catchment Sizes

Figure 6 identifies the catchment boundaries of the proposed highway drainage systems. The plan area of these highway catchments from earthwork boundary to earthwork boundary are shown in Table 1.

Table 1 – Highway Catchment Sizes

Catchment	Highway Area (ha)
A	1.520
B	2.017
C	1.361
D	1.656
E	2.134
F	1.797

4.3 Method of Discharge of Runoff

Due to the poor infiltration characteristics of the soils and underlying bedrock, infiltration has been discounted as an option to discharge surface water to ground. In addition the high groundwater table would limit the number of suitable locations.

The majority of the catchments will discharge to a fluvial surface water body excluding Catchment A which discharges at an attenuated rate to the existing highway surface water sewer located in the verge along the B4265.

4.4 Catchment A (Appendix A: Drawings 60509148-SHT-30-0000-CT-501 to 502)

4.4.1 *Overview*

This catchment includes areas of existing carriageway and greenfield. The proposed NAR falls in a westerly direction from the high point at approx. CH 250 to the outfall to the dry attenuation basin. The new roundabout and re-aligned B4265 falls in a southerly direction also outfalling in to the dry basin.

4.4.2 *Highway Drainage System*

Surface water runoff from the highway will be intercepted by kerb drains or gullies and discharge into a combined filter/carrier pipe network located in the verge. Gullies have been specified in locations where the highway longfall exceeds 1%.

The combined filter/carrier drains will also act as sub-surface drains to control groundwater ingress into the carriageway foundation and earthwork drainage to intercept the flows from the cutting face. Slope drains will be utilised in the cutting areas and convey the flows to the combined filter/carrier drains located in the verge.

The grassed dry basin will attenuate and treat the surface water runoff before discharging into the existing highway drainage system located in the western verge.

The existing highway system provides no attenuation. Through the efficient use of the available land formed by the new roundabout the basin for this network has been sized to allow a 50% reduction in runoff rate when compared with the existing situation. This will provide betterment and help to reduce the flood risk to the downstream highway sewer system.

4.4.3 *Land Drainage System*

A cut off ditch is required at the top of the cutting on the north side of the NAR to intercept overland flows. This will drain in an easterly direction towards Catchment B and discharge to the flood alleviation structure at Llanmaes Brook.

4.5 Catchment B (Appendix A: Drawings 60509148-SHT-30-0000-CT-502 to 503)

4.5.1 *Overview*

From the high point at approx. CH 250 to the next high point at approx. CH 680 the proposed highway falls towards Llanmaes Brook with the low point in the alignment located at CH 390. The existing land is all greenfield. The runoff will be conveyed to a wet forebay/dry basin attenuation system located at the southern edge of the land boundary.

4.5.2 *Highway Drainage System*

The carriageway is predominantly on embankment with combined kerb drainage units utilised to collect and convey the surface water runoff. In this location which is highly sensitive to flood risk the use of kerb drainage units will ensure surface flows above the 5yr return period enter the drainage system along the length of the catchment as there is no practical restriction to the volume of flow which can enter the system (Report SR581 “Hydraulic Capacity of Drainage Channels With Lateral Flows).

Using gullies in this location wouldn’t be suitable as the flow entering the system will be limited by the inlet capacity of the gully grating. Microdrainage simulations which include the CKD systems will be submitted to prove that flooding from the highway will be controlled in storm return periods up to and including the 1000 year event.

The highway runoff will be conveyed via a carrier pipe system to a wet forebay/dry basin located to the south. The system is designed to attenuate the flows to GRR prior to discharging into Boverton Brook.

4.5.3 *Land Drainage System*

The toe of embankment drainage to the north of the NAR will comprise ditches draining to Llanmaes Brook which will intercept any overland flows. The ditch to the west will also convey intercepted overland flows from the top of the cutting in Catchment A. Earthwork drainage to the south is also provided by toe of embankment ditches and French drains where the runoff volumes are small. The drainage regime is maintained with the overland flows in this catchment ultimately discharging to Llanmaes Brook.

4.5.4 *Llanmaes Flood Alleviation Scheme*

Llanmaes Brook is the location of the existing flood defence system. This system will be replaced by a new system constructed north of the NAR. The proposals include a new earthwork bund and free flow culvert which will attenuate flows during rainfall events. Flood relief culverts are also provided to manage exceedance flows.

The proposed scheme will provide betterment over the existing structure as blockage scenarios of the culverts during high intensity rainfall events have been considered in the modelling.

Full details of the proposals including the pluvial and fluvial hydraulic modelling results are described in the FCA. Figure 7 below shows the design proposals.

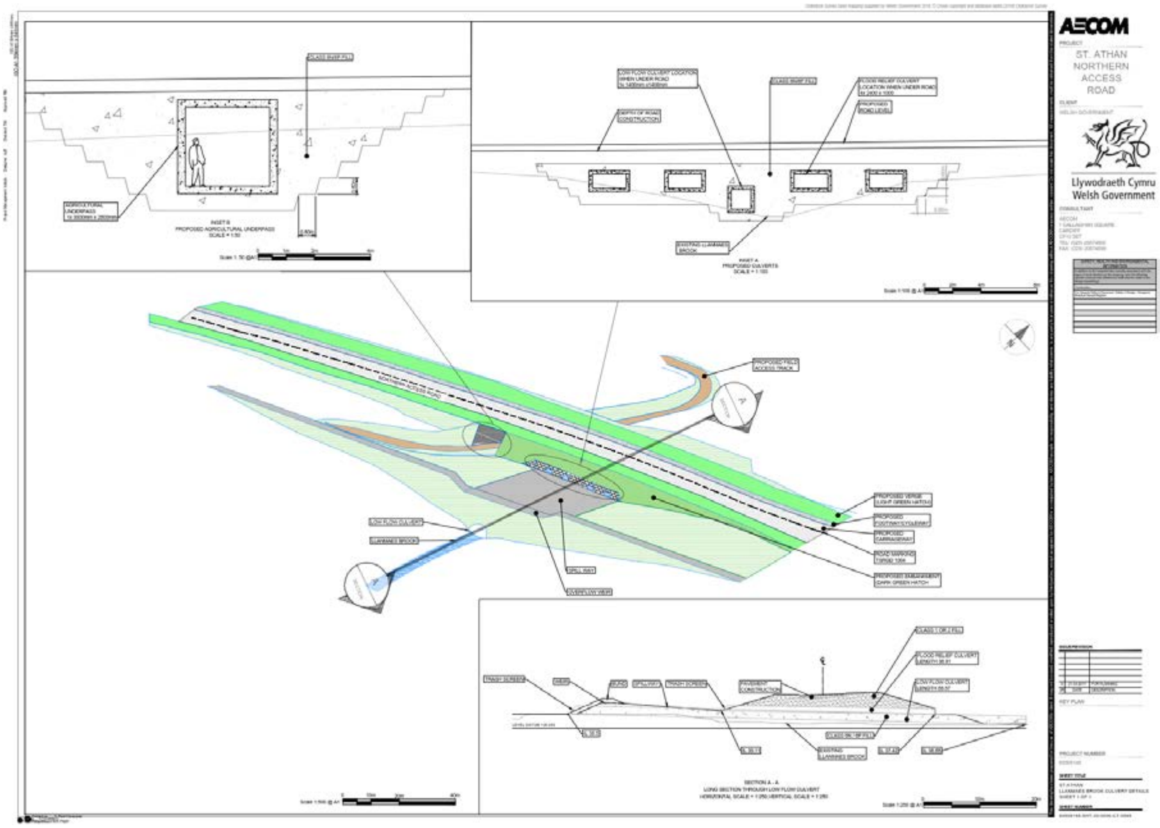


Figure 7 – Llanmaes Brook Flood Alleviation Proposals (Appendix A: Drawing 60509148-SHT-30-0000-CT-0595)

4.6 Catchment C (Appendix A: Drawings 60509148-SHT-30-0000-CT-502 to 503)

4.6.1 *Overview*

This catchment drains to a low point located adjacent to Froglands Farm (CH 900). The highway is on a small embankment for a majority of its length. The highway runoff will be attenuated in a wet forebay/dry basin before discharging to Boverton Brook.

4.6.2 *Highway Drainage System*

Kerb drains and gullies are used throughout to drain the carriageway surface and carrier drains convey the surface water to the basin. Subsurface drainage is provided by narrow fin drains.

The runoff is attenuated and treated in the wet forebay/dry basin before discharging at GRR into Boverton Brook.

4.6.3 *Land Drainage System*

Surface water flooding is a problem in this locality. The existing highway acts as a channel which conveys water along its length until it intersects Boverton Brook to the south. The pluvial flood modelling (FCA) indicates that the flow rate at the interface with the NAR is of the order of 180l/s in a 1 in 100 year return period storm event.

A wide swale/linear basin attenuation system will be constructed to the north of the NAR and west of Froglands to attenuate these overland flows. The existing highway area will be landscaped to ensure the flows are diverted to the SuDS storage feature. A ditch will also traverse the north edge of the highway south of Froglands Farm to intercept overland flows in this locality and convey them to the storage area.

The flows will discharge through a culvert beneath the NAR to Boverton Brook along the existing highway. In order to provide downstream betterment and flood relief the culvert will act as a throttle in high intensity rainfall events thus reducing flow rate. This arrangement has been included within the pluvial modelling and further details are contained in the FCA.

4.7 Catchment D (Appendix A: Drawings 60509148-SHT-30-0000-CT-504 to 505)

4.7.1 *Overview*

The carriageway falls to a low point at approximately CH 1400. The existing land is all greenfield and the NAR intersects Boverton Brook and a number of ditches which drain the agricultural fields. The proposed NAR is on embankment throughout this catchment. The runoff will be attenuated in a shallow pond/reed bed prior to discharge at GRR to Boverton Brook.

4.7.2 *Highway Drainage System*

The carriageway is drained via kerb drainage units which outfall directly into the swales located at the toe of the embankment on the south side of the NAR. The swales convey the runoff to the low point where a shallow pond/reed bed is proposed to provide treatment to the runoff prior to discharge to Boverton Brook.

In addition to conveying the runoff the swales will also provide attenuation storage for the higher return period rainfall events. The existing ground gently slopes in this area and the efficiency of the swales with regard to storage potential has reduced the required volume within the terminal storage feature.

The embankment on the south side of the highway also drains to the swale. Subsurface drainage of the carriageway will be provided by a fin drain system.

4.7.3 *Land Drainage System*

Along the north boundary of the highway embankment the runoff from the adjacent fields and ditches will be intercepted and conveyed towards Boverton Brook. The system will then discharge via the flood relief culverts which are part of the formal flood defence in this location.

4.7.4 *Boverton Brook Flood Alleviation Scheme*

Boverton Brook is crossed by the alignment of the proposed NAR. In addition to the fluvial flows there are considerable overland flows which fall towards the embankments. As per the proposals for Llanmaes Brook new earthwork embankments and culverts independent of the NAR will be constructed to manage the runoff during high intensity rainfall events.

Full details of the proposals including the pluvial and fluvial hydraulic modelling results are described in the FCA.

4.8 Catchment E (Appendix A: Drawings 60509148-SHT-30-0000-CT-505 to 507)

4.8.1 *Overview*

From the high point in the alignment at approximately CH 1550 the carriageway falls longitudinally in an easterly direction to the low point at the scheme limit and tie-in with the existing EBR. The runoff is conveyed to the wet forebay/dry basin and outfalls into the ditch which discharges into the upper Nant Y Stepsau.

4.8.2 *Highway Drainage System*

The carriageway is drained via kerb drainage units which discharge to a carrier pipe system located in the northern verge that conveys the runoff to the outfall into the basin. Subsurface drainage will be provided by a fin drains which connect to the carrier system. Filter drains have not been specified due to their impact on embankment slope stability.

4.8.3 *Land Drainage System*

Along the northern embankment of the NAR a land drainage system comprising ditches and filter pipes will intercept and convey the small volume of overland flow to the Nant Y Stepsau. This maintains the existing surface water flow regime in this location where the existing ground, ditches and culverts fall to this point. Filter drains will be used where there are limitations on available land take.

The swale along the south of the embankment will intercept the overland flows from the south. A small proportion of the proposed junction with the EBR at CH 1700 will also outfall into this swale. The swale will convey the flows to the culvert which passes beneath the access road to the development before discharging to the ditch on the south of the existing EBR at the scheme extent.

The new land drainage culvert will be designed to throttle the flows with flood storage provided adjacent to the access road as shown in the FCA. As per the arrangement on the north this proposed culvert replaces an existing 300mm diameter pipe, maintaining the existing land drainage paths.

The land drainage proposals have been included within the Pluvial modelling undertaken as part of the FCA. The modelling demonstrates betterment to the Nant Y Stepsau from the design proposals.

4.9 Catchment F (Appendix A: Drawings 60509148-SHT-30-0000-CT-505 to 507)

4.9.1 *Overview*

This catchment includes both existing greenfield and impermeable surfaces. A combination of kerb drains and gullies collect the runoff before discharging to a swale south of the EBR. The swale widens where land is available to store the attenuated flows, prior to discharging at GRR to the existing ditch at the eastern scheme extent.

4.9.2 *Highway Drainage System*

The surface water is collected by gullies and kerb drains which discharge to filter/carrier drains located in the verges. These outfall to a swale which attenuates the flow before discharging at GRR to the existing ditch on the south of EBR.

4.9.3 *Land Drainage System*

No land drainage system is required for this catchment.

5. FLOOD MITIGATION DESIGN STRATGEY

5.1 Flood Mitigation Design Strategy

5.1.1 *Overview*

The proposed site is predominantly “Greenfield” and therefore the discharge rate from the drainage networks will be restricted to the site greenfield runoff rate.

The design proposals will restrict the discharge rates to the watercourses to the GRR through the use of SuDS systems combined with vortex flow controls located upstream of the outfalls. The vortex flow control will be designed so that the catchments they serve discharge at the calculated rates of greenfield runoff for various return period storms, ensuring no detriment to the downstream watercourses.

5.1.2 *Greenfield Runoff Rate Calculation Method*

The GRR for the site is calculated to determine the level of acceptable rate of discharge to the receiving watercourse. They are used by the overseeing organisations (NRW and VoG) to set the site specific drainage constraints.

The Institute of Hydrology (IOH) Report 124, Flood Estimation from Small Catchments, has been used to determine the peak GRR for the site (SuDS for Roads). The calculations have been undertaken using the Microdrainage computer software package and the results can be seen in Appendix B.

Table 2 – Existing Greenfield Runoff Rate

Rainfall Return Period	Qbar	Q1	Q5	Q100
Discharge rates from a typical catchment size of 50ha (l/s/ha)	2.6	2.3	3.1	5.7

5.1.3 *Climate Change*

Following discussions with VoG it was agreed that a 30% climate change allowance will be included within the design. The 30% allowance aligns with the criteria used in the pluvial and fluvial modelling undertaken to support the FCA and is above the minimum value specified in the DMRB.

5.1.4 *Maximum allowable discharge rates*

The maximum allowable discharge rates from the outfalls from each catchment have been calculated based on the GRR for the plan area of the highway catchment from earthwork boundary to earthwork boundary.

Table 3 – Allowable maximum discharge rates (l/s)

Rainfall Return Period	Qbar	Q1	Q5	Q100 + 30%
Catchment A	3.9	3.4 (*43.4)	4.6 (*72.5)	11.1 (*118.2)
Catchment B	5.2	4.6(**11.9)	6.3(**16.375)	14.9 (**33.5)
Catchment C	3.5	3.1	4.2	10.1
Catchment D	4.3	3.8	5.1	12.3
Catchment E	5.5	4.9	6.6	15.8
Catchment F	4.7	4.1	5.6	13.3

*Existing highway catchment runoff rate

** Allowance for 3.57ha development

5.2 Water Quality, Treatment and Attenuation

5.2.1 *Overview*

“A broad range of potential pollutants are associated with routine runoff from operational roads. These are combustion products of hydrocarbons, fuel and fuel additives, catalytic converter materials, metal from friction and corrosion of vehicle parts, lubricants, and materials spread during gritting and de-icing. Particulate contaminants originating from vehicles and vehicle related activities include carbon, rubber, plastics, grit, rust and metal filings.” (DMRB HD 45/09)

In addition to providing attenuation, the SuDS systems will treat the contaminated highway runoff prior to discharge to the watercourses. The scheme utilises various SuDS features chosen for their suitability in each specific location. The scheme is bounded by the RAF St Athan which has influenced the options available.

Pre-treatment of the runoff will be provided by road gullies and kerb drainage outfalls with a sump. First and secondary treatment is provided by the filter drains, swales and attenuation features.

Oil separators are not deemed necessary on this scheme with pollution control provided by the SuDS features and Penstocks. Penstock will be fitted in the filter/carrier pipe system so that in the event of a pollution incident the hazardous materials can be retained within the highway. If lowered in time, prior to discharge of significant quantities, penstocks can potentially retain 100% of spilled material, which are then relatively easily removed by suction or other methods, depending on the material involved.

A minimum 300mm freeboard will be provided on all SuDS features to allow additional storage capacity in the event of blockage. It will also help to ensure flood volumes from the 1000 year storm event will be contained within the development.

5.2.2 *Wet Forebay / Dry Basin (Appendix C: Drawing 60509148-SHT-30-0000-CT-0523)*

Catchments B, C, D and E discharge via a two stage SuDS system that includes a sediment forebay and dry attenuation basin. The forebay (which will be planted with reeds) will consist of 300mm of permanent water and be sized to hold the first flush water generated from the catchment (DMRB HA 103/06 Design and construction of Vegetative treatment system para 5.3). The maximum depth of storage in the forebay will be 300mm.

The first flush volume contained within the forebay will drain through to the attenuation basin via a filter drain. The filter drain runs along the bund located between the forebay and the pond. The forebay will drain back to the permanent water level within 72 hours.

The dry basin shall have a maximum storage depth of between 1.0m to 1.5m and combined with the forebay, will retain the 1 in 100 year (+30% climate change) return period storm event. The waters retained within the attenuation basin and forebay above the weir level will be designed to ensure they fully discharge within 35 hours.

This SuDS solution has been specifically designed and utilised on the trunk road network elsewhere in the UK when the schemes have been in close proximity to Ministry of Defence airfields. With the scheme bounded by RAF St Athan there would be an increased risk of bird strikes to aeroplanes caused by wet ponds attracting loafing birds. The removal/masking of the permanent water and fast drain down times minimise the risk allowing the full benefits of a SuDS solution to be realised.

5.2.3 *Dry Pond*

A Dry Pond will be used to attenuate the flows discharging to the highway sewer from Catchment A. This system has been chosen due to the limited available land, close proximity to pedestrian routes and numerous inlets, which make providing a forebay impractical.

The system will still provide betterment over the existing arrangement in both treatment level and attenuation. The hydraulic modelling results indicate a potential reduction in runoff rate of up to 50% when compared to the existing situation is achievable in this catchment.

Although the pond lies adjacent to the highway and pedestrian routes the SuDS feature will pose little or no risk to safety. “There is a general misconception that site control ponds and wetlands are unsafe and pose a risk of drowning. At the time of writing there is no recorded evidence of such an incident” (*SuDS for Roads)*. The gentle side slopes and shallow maximum water depth in this feature will reduce the risk and the feature will pose less of a hazard then rural roadside highway ditches.

5.2.4 *Swale (Appendix C: Drawing 60509148-SHT-30-0000-CT-0526)*

Catchments C, D and E use Swales to convey, attenuate and treat the highway runoff prior to discharge. These roadside features will be permanently dry and grassed, with a maximum design storage depth of 0.6m in a 100 year return period event.

In Catchment C the swales discharge to a small pond which will consist of permeant water to a depth of 300mm and be fully covered with reeds. This pond will be similar to the forebay described above.

5.2.5 *Environmental Risk Assessment*

An assessment of the potential impacts of highway runoff from the scheme on the water environment will be undertaken using the Highways Agency Water Risk Assessment Tool (HAWRAT) during detailed design.

5.3 Maintenance

Maintenance of any conventional pipe network or SuDS System will be required. For a conventional pipe network, access for maintenance and inspection will be provided with pipework laid to achieve self-cleansing velocities. Table 4 shows the maintenance activities for typical SuDS components.

Table 4 – SuDS Maintenance Activities (CIRIA SuDS Manual 2015)

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/ trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management[1]	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

■ will be required

□ may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

6. PRELIMINARY DESIGN

6.1 Overview

In order to determine the required land take and assist in the production of a detailed strategy to managing the overland surface water flows, it has been necessary to undertake a preliminary design. This section provides an overview of the drainage design undertaken to date and is supplemented with calculations, drawings and Typical Construction Details. The values quoted may be subject to change following detailed design.

6.2 Design Standards

The design has been undertaken in accordance with the standards and guidance outlined in the Design Manual for Roads and Bridges (DMRB). The following documents have been adhered to in the design;

- **HA 39/98 Edge of Pavement Details –** Principles on methods of interception of surface water.
- **HA 33/16 Surface and Sub-surface Drainage Systems for Highways –** Outlines the Return Period Storms for network design. The system will have no surcharging in a 1 in 1yr return period storm and no flooding of the pipe network in a 1 in 5yr return period storm. An additional allowance of 20% for climate change will be required for each storm.
- **HA 102/00 Spacing of Road Gullies -** provides design guidance for determining the length of road between gullies that can be drained by grating and kerb outlets
- **HA 103/06 Vegetative Treatment Systems for Highway Runoff -** guidance on how vegetated drainage systems may be used to convey, store and treat surface water.
- **HD 49/16 Highway Drainage Principal Requirements –** overarching requirements and guidance for highway drainage design
- **HD 45/09 Road Drainage and the Water Environment –** guidance on the assessment and management of the impacts of road projects on the water environment
- **The SuDS Manual, 2015 –** Best practice guidance on the planning, design, operation and maintenance of Sustainable Drainage System.
- **SuDS for Roads –** Specific SuDS guidance for road schemes

6.3 Rainfall Data and Design Return Period

Site specific Flood Estimation Handbook (FEH) rainfall data will be utilised for the hydraulic design of the drainage systems. Although normally used on larger catchments this methodology has been chosen to ensure consistency with the FCA hydraulic modelling, following agreement with VoG.

DMRB 4.2 HD 33/16 specifies the design criteria for the drainage networks, the drainage systems will ensure

- no surcharging of the pipe networks in a 1 in 1 year return period storm event
- no flooding of the pipe networks in a 5 year return period storm event

In addition the SuDS features will be designed in accordance with the criteria described in DMRB 4.2 HA Vegetative Treatment Systems for Highway Runoff. The design will ensure no flooding in a 1 in 100 year + 30% return period storm event. In addition the systems will be simulated for the 1 in 1000 year return period event to ensure no detriment to the downstream watercourse's or property.

6.4 Gully and Kerb Drain Design

Gully spacing design has been undertaken in accordance with DMRB HA 102/00. The maximum allowable flow width has been set at 0.75m. Example calculations can be found in Appendix D. As noted previously gullies have been specified where the carriageway longfall is greater than 1%.

Kerb Drain units and outfall locations have been determined using the manufactures guidance with respect to unit capacity at a specified gradient. The detailed design Microdrainage simulations will include the units as part of the networks to ensure the design criteria for the higher return period storms are achieved.

6.5 Pipe Network Design

The pipe network design has been undertaken in accordance with DMRB HD 33/16. All networks achieve the minimum design criteria as specified above for the 1 year and 5 year return periods.

Microdrainage simulations of all the networks including the attenuation features and hydrobrakes can be seen in Appendix E. The design assumptions, including the time of entry and pipe roughness are included within the simulation results and adhere to current best practice.

6.6 Attenuation Design

The attenuation features have been sized to ensure no flooding in the 1 in 100 year + 30% return period storm event. In addition a simulation of the 1000 year event has been undertaken to ascertain the potential impact and determine whether additional measures are required to ensure no downstream flooding from the site.

Full details of the simulation results are shown in Appendix D. The tables below summarise the findings.

6.6.1 *Summary of Results*

Table 5 – Attenuation Volumes (m3)

Catchment	100yr + 30%	1000yr	Comment
A	315	456	Very small flood volumes on carriageway in 100 year storm.
B	2591	3200	Very small flood volumes on

Catchment	100yr + 30%	1000yr	Comment
			carriageway in 100 year storm.
C	890	1240	Very small flood volumes on carriageway in 100 year storm
D	121	174	Small flood volume at entry to SuDS system in 1000 year storm. To be contained within site.
E	326	564	Flood volumes on carriageway in 100 year storm. To be contained within site.
F	245	300	Flooding from swale in 1000 year storm. To be contained within site.

Table 6 – Discharge rates

Rainfall Return Period	Q1	Q5	Q100 + 30%	Q1000
Catchment A	19.2	26.1	52.6	61.0
Catchment B	11.7	11.8	12.2	13.1
Catchment C	3.0	3.0	3.1	3.3
Catchment D	3.0	3.0	3.7	3.9
Catchment E	2.9	2.9	4.3	4.6
Catchment F	4.1	4.1	5.0	5.3

The results of the preliminary design simulations prove that the required runoff rate reduction is achievable. All of the flow rates are equal to or less than the maximum discharge rates calculated for the individual catchments, thus providing either no detriment or betterment to the receiving watercourse.

6.7 Typical Construction Details

In Appendix C there are a series of details intended for use throughout the scheme wide. They include manhole, filter pipe, penstock and the hydrobrake chamber.

7. CONCLUSION

The proposed Drainage Strategy will ensure no detriment to the watercourses or property/land from the discharge of highway surface water runoff. Simulations have demonstrated that the discharge rates from the attenuation features are at or below the GRR for the site.

SuDS features have been specified to convey, treat and attenuate the highway runoff. Various forms of SuDS have been chosen for their location specific suitability. The wet forebay/dry basin features will reduce the risk of bird strikes to aeroplanes by minimising visible standing water and provide treatment which would not be achieved with underground storage methods.

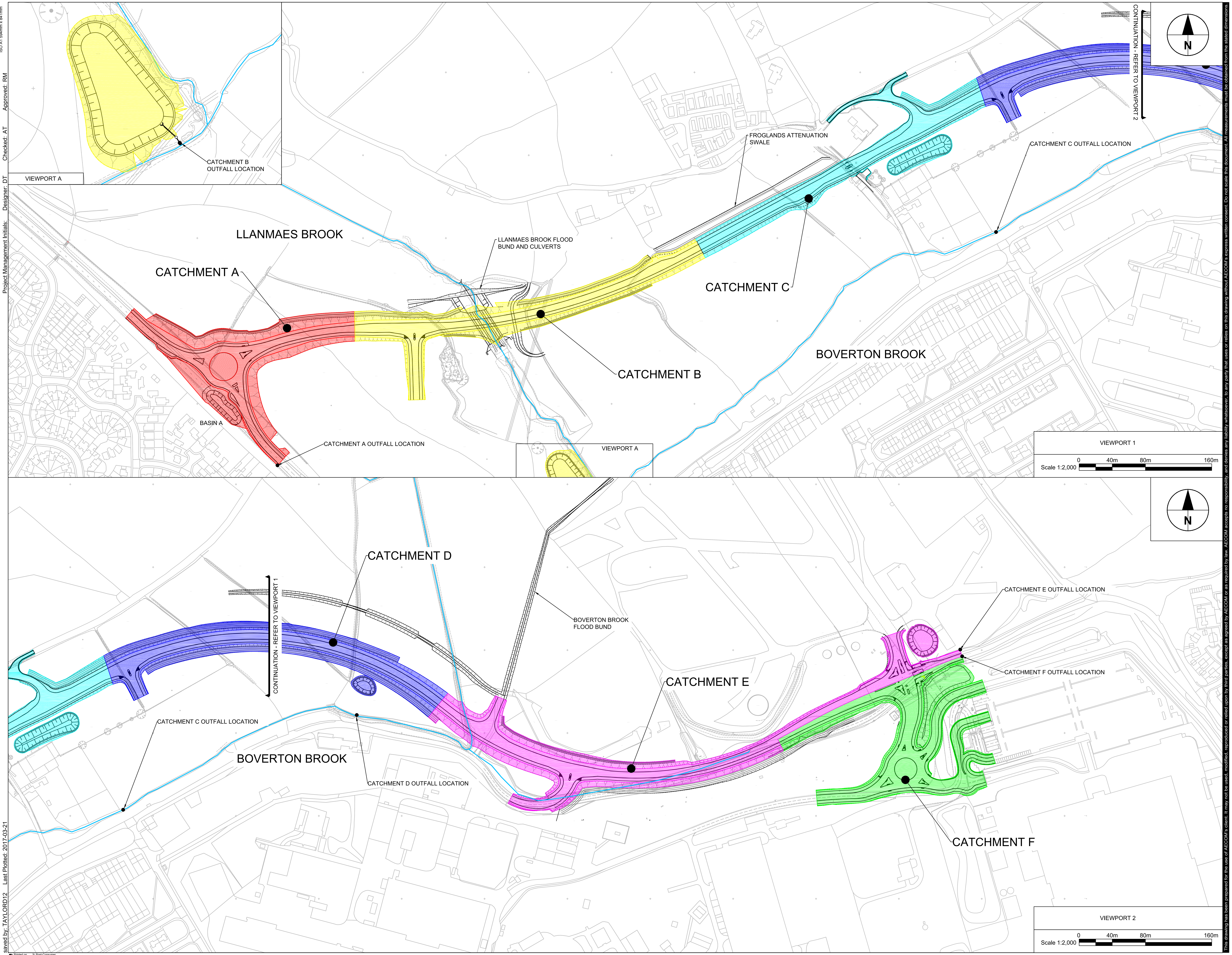
Land drainage systems have been provided independently of the highway systems. These systems convey the intercepted overland flows to the watercourses and where necessary attenuate the flows. Flood alleviation measures are proposed at Llanmaes Brook, Froglands Farm and Boverton Brook.

In conjunction with the proposals outlined in the FCA, the measures identified in this Drainage Strategy will ensure a holistic solution to surface water management at the site providing increased levels of flood resilience to the surrounding area.

8. REFERENCES

- Design Manual for Roads and Bridges. Volume 4, Section 2, HA 39/98 Edge of Pavement Details
- Design Manual for Roads and Bridges. Volume 4, Section 2 HD 33/16 Surface and Sub-surface Drainage Systems for Highways
- Design Manual for Roads and Bridges. Volume 4, Section 2 HA 102/00 Spacing of Road Gullies
- Design Manual for Roads and Bridges. Volume 4, Section 2 HA 103/06 Vegetative Treatment Systems for Highway Runoff
- Design Manual for Roads and Bridges. Volume 4, Section 2 HD 49/16 Highway Drainage Design Principal Requirements
- Design Manual for Roads and Bridges. Volume 4, Section 2 HD 45/09 Road Drainage and the Water Environment
- CIRIA Report C753, The SuDS Manual, 2015
- Pittner, C and Allerton, G (2009) SuDS for Roads, WSP Development and Transportation, WSP Group
- BRE (1991) Soakaway Design, BRE Digest 365, Building Research Establishment, Bracknell, UK
- Report SR581 – Hydraulic Capacity of Drainage Channels with Lateral Flows
- Planning Policy Wales (2004) Technical Advice Note 15: Development and Flood Risk, Publications Centre Wales;
- AECOM, 2017. St Athan Northern Access Road, Factual Ground Investigation Report

APPENDIX A - DRAWINGS



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KEY

WATERCOURSE	
CATCHMENT AREA A AREA = 15,204m²	
CATCHMENT AREA B AREA = 20,168m²	
CATCHMENT AREA C AREA = 13,609m²	
CATCHMENT AREA D AREA = 16,563m²	
CATCHMENT AREA E AREA = 21,344m²	
CATCHMENT AREA F AREA = 17,976m²	

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following specific residual risks (Reference shall also be made to the design hazard log).

Construction

For Hazards Refer to Document: Safety in Design - Designers Residual Hazard Register

ISSUE/REVISION

I/R	DATE	DESCRIPTION
A	21-03-2017	FOR INFORMATION

KEY PLAN

PROJECT NUMBER

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SHEET TITLE

ST.ATHAN
DRAINAGE STRATEGY
SHEET 1 OF 1

SHEET NUMBER

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Checked: AT
Designer: DT
Project Management Initials:

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NOTES

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4. LOCATION OF SITE COMPOUND TO BE AGREED WITH THE LOCAL HIGHWAY AUTHORITY PRIOR TO WORKS COMMENCING. ALL MOVEMENT OF PLANT SHOULD BE IN ACCORDANCE WITH RECOGNISED GOOD INDUSTRY PRACTICE. BANKSMEN SHOULD BE PROVIDED WHEN REQUIRED.
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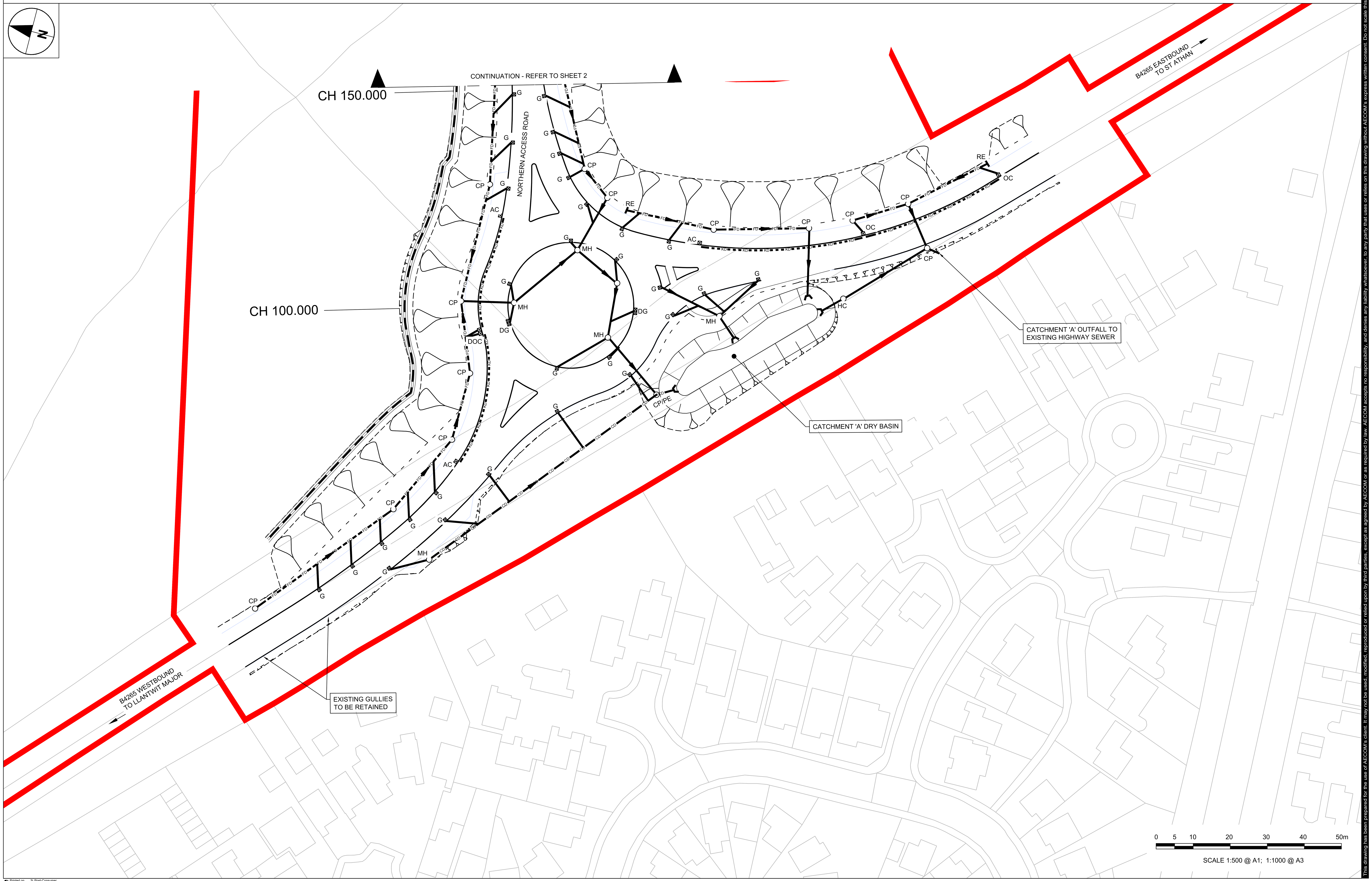
KEY

- SURFACE WATER CARRIER DRAIN
- FILTER DRAIN
- GULLY CONNECTION
- PROPOSED CULVERT
- COMBINED KERB DRAIN
- SWALE
- DITCH
- PLANNING APPLICATION BOUNDARY

MH	MANHOLE
CP	CATCHPIT
G	GULLY
DG	DOUBLE GULLY
AC	ACCESS CHAMBER
OC	OUTLET CHAMBER
DOC	DOUBLE OUTLET CHAMBER
PE	PENSTOCK
HC	HYDROBRAKE CHAMBER
RE	RODDING EYE
	HEADWALL



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ST.ATHAN
DRAINAGE GENERAL ARRANGEMENT
PRELIM DESIGN
SHEET 1 OF 7

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KEY

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FILTER DRAIN	CP – CATCHPIT	HEADWALL	
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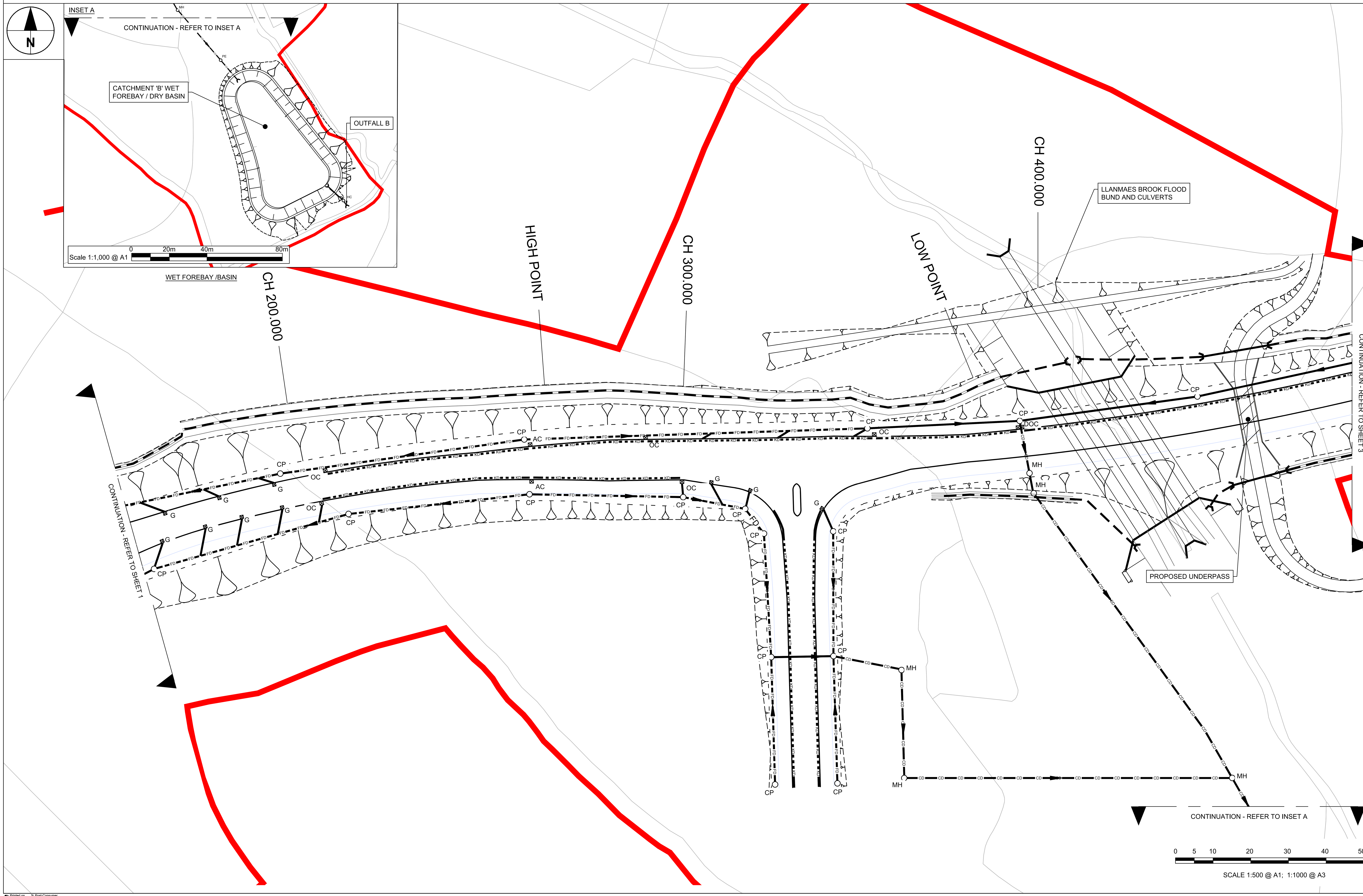

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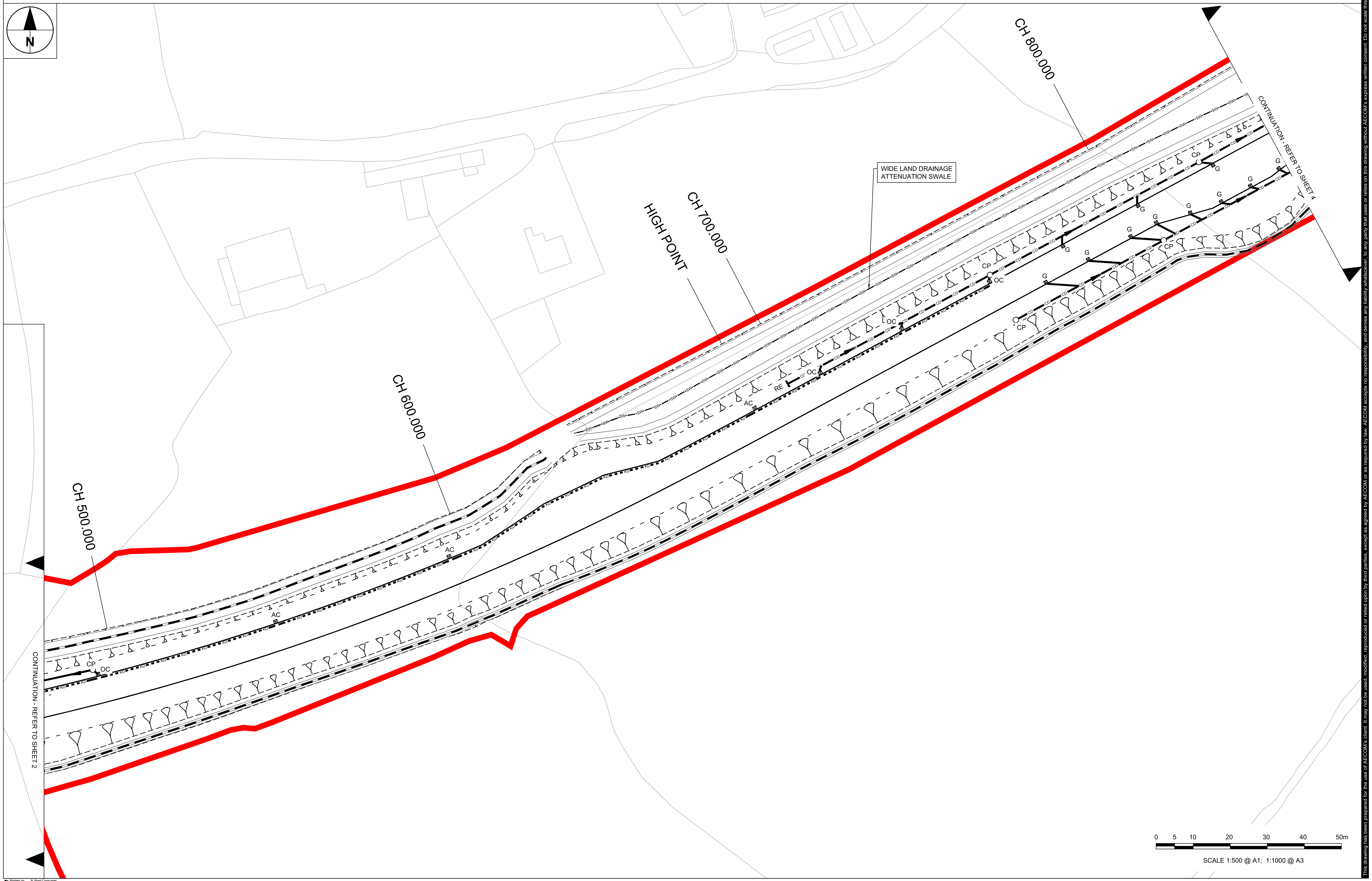

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