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SULLY TO COSMESTON ATR

Surface Water Drainage Strategy

MARCH 2022

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1 Introduction

This report has been prepared by Arcadis Consulting (UK) Limited for Vale of Glamorgan Council (VoG) in support of a new Active Travel Route between Sully and Cosmeston. This Report outlines the Drainage Strategy for the site.

2 Description of Development

2.1 Existing Site

The proposed Active Travel Route is located in the village of Sully, Vale of Glamorgan, encompassing the communities of Sully and Lavernock and is approximately 7 miles (11.3km south/ southwest of Cardiff City Centre).

The proposed route is distinguished between three sections of development area, the first two section utilising the existing footway/ cycleway along South Road and Lavernock Road before crossing over the road, near the Vineyards, onto the disused railway, section three. This is depicted in ***Figure 1***. The route utilises the disused railway, crossing two bridge structures over St Mary's Well Bay Road and Fort Road and heads north towards Cosmeston Drive housing estate. The route adjoins an existing shared footway cycleway at this location.

The site is bounded primarily by large open greenspace, with notable elevation difference along both the Lavernock Road and disused railway sections. Cosmeston Lakes is situated to the north of the Active Travel Route with the Bristol Channel south of the scheme.

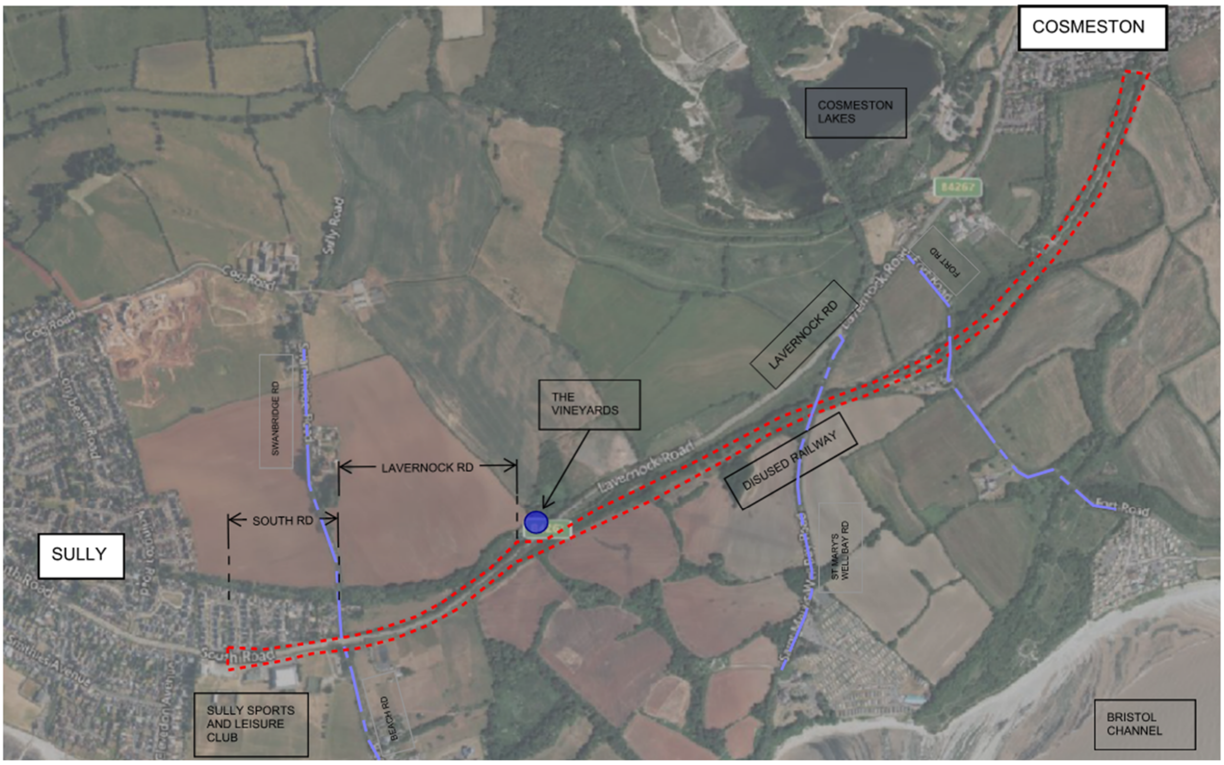


Figure 1: Site Location (Site Boundary outlined in Red)

2.2 Current Use and Site Topography

2.2.1 Topography – South Road and Lavernock Road

A topographical survey was undertaken in September of 2022 by Azimuth Land Surveys Ltd and is contained within ***Appendix A*** for reference.

The topography of the route within Lavernock indicates that the longitudinal falls are primarily in an east to west direction at an average gradient of 1 in 40, with a short section within South Road falling west to east at a typical grade of 1 in 120, coalescing at a low point within the road. The elevations within the highway, along its centreline show that the eastern side has a recorded elevation of 37.74m and the high point on the western side, within South Road being 21.2m. The low point, located near the entrance to the Sully Sports and Leisure Club, is noted at 20.26m.

The arrangement and subsequent site elevations are of a typical construction i.e., the road is crowned with the footways and verges draining towards the highway.

The open greenspace on the northern side of Lavernock Road is linked to the existing footway/ cycleway via graded earthworks, incorporating well-established trees and vegetation. During the topographical survey, access to the top and bottom of the earthworks was not possible due to the dense growth, and as such, LiDAR information was obtained to provide this additional detail outside of the topographical survey extents.

The combined information indicates that the grading from the highway to the fields starts off gradually at the beginning of Lavernock Road and increases to steep earthworks down to the existing fields with significant elevation differences, approximately 3 metres at its highest. As the route approaches The Vineyards dwelling, the earthworks switch from the highway being on an embankment to within a cutting, with the fields at a higher elevation. At its maximum, the elevation difference is approximately 3 metres. The steep gradients and large elevation differences have been confirmed visually via a site visit. ***Figure 2*** below highlights the elevation differences noted along the northern side of Lavernock Road.

Figure 2: Existing Site elevation differences along Lavernock Road

2.3 Existing Site Geology

The existing site geology and ground information is primarily pertinent to the development of the ATR along the existing disused railway. The geology along Lavernock Road is of less significance due to the built up nature along the length and its 'capping off' via existing paved areas and the use of positive drainage systems along the route.

The route along the disued railway consists of engineered upper layers used to form the historic railway line and will vary dependant on its location in relation to being a cutting or an embankment.

Usually, within a cutting, the railway alignment would be made up of 250mm to 300mm of rail ballast (30-50mm diameter stone typically) placed upon the material present at formation level, if suitable, or engineered fill if the formation for the ballast is deemed unsuitable.

Where the railway alignment is on an embankment, the embankment would typically be created using suitable general fill material to build up levels, generally consisting of stone of varying sizes and soils.

Along the proposed ATR, the disused railway line travels through both cutting and embankments. As such, site specific testing will be undertaken to ascertain the construction buildup along the route.

A review of the British Geological Survey (BGS) mapping indicates that the underlying bedrock in the area varies along the proposed Active Travel Route. ***Figure 3*** below shows the varying nature of the bedrock throughout the ATR and is summarised in the ***Table 1*** below. The BGS does not present information in relation to the overlying superficial deposits within the ATR area, however, as shown in ***Figure 4*** the surrounding areas to the north of the site consist of Alluvium, a composition of clay, silt sand and gravel. A small area of 'Head' superficial deposits is also indicated.

Bedrock Geology	Geology Description (from BGS)	Location
Mercia Mudstone Group	Clay and Mudstone	Along the Length of South Road and Lavernock Road upgrade works and partially within Disused Railway Route
Friars Point Limestone Formation	Limestone (dolomitised and dolomite)	Disused Railway Route
Blue Anchor Formation	Mudstone	Disused Railway Route
Penarth Group	Mudstone and Limestone, interbedded	Disused Railway Route
St Mary's Well Bay Member	Mudstone and Limestone, interbedded	Disused Railway Route
Lavernock Shales Member	Mudstone	Disused Railway Route

Table 1: Bedrock Geology encountered with the Active Travel Route Area

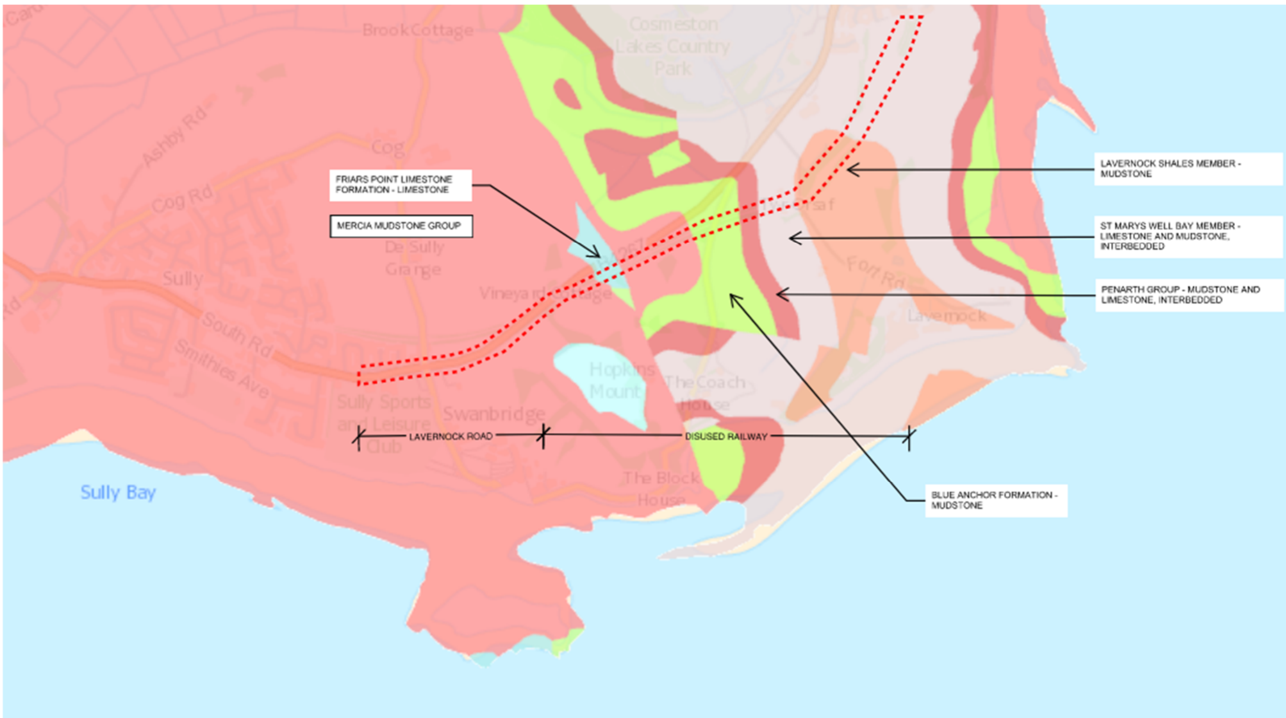


Figure 3: BGS Mapping of Bedrock Geology

The lack of superficial deposit information along the length of the route, and particularly along the disused railway, will be determined via site specific investigations during the progression of the design.

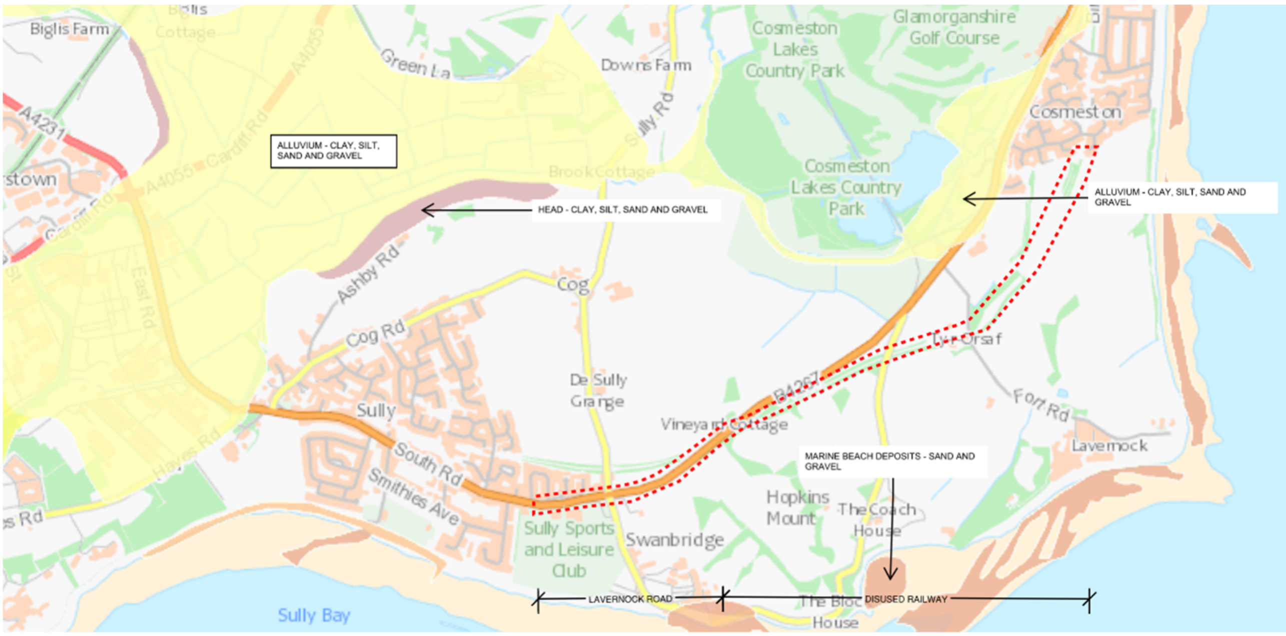


Figure 4: BGS Mapping of Surrounding Superficial Deposits

2.4 Local watercourse networks and drainage mechanisms

2.4.1 Existing Watercourses

The closest watercourse to the site is the Sully Brook, denoted as a main river, which is located to the north of the site and immediately south of Cosmeston Lakes. The brook is noted (within DataMapWales) to run in an east to west direction, starting on the eastern side of Cosmeston Lakes and continuing west towards Barry Docks.

The distance from the Sully Brook to the proposed ATR route varies along its length, with the furthest distance equating to approximately 1350m and the shortest distance of 375m. ***Figure 5*** below indicates distances along the route to this watercourse.

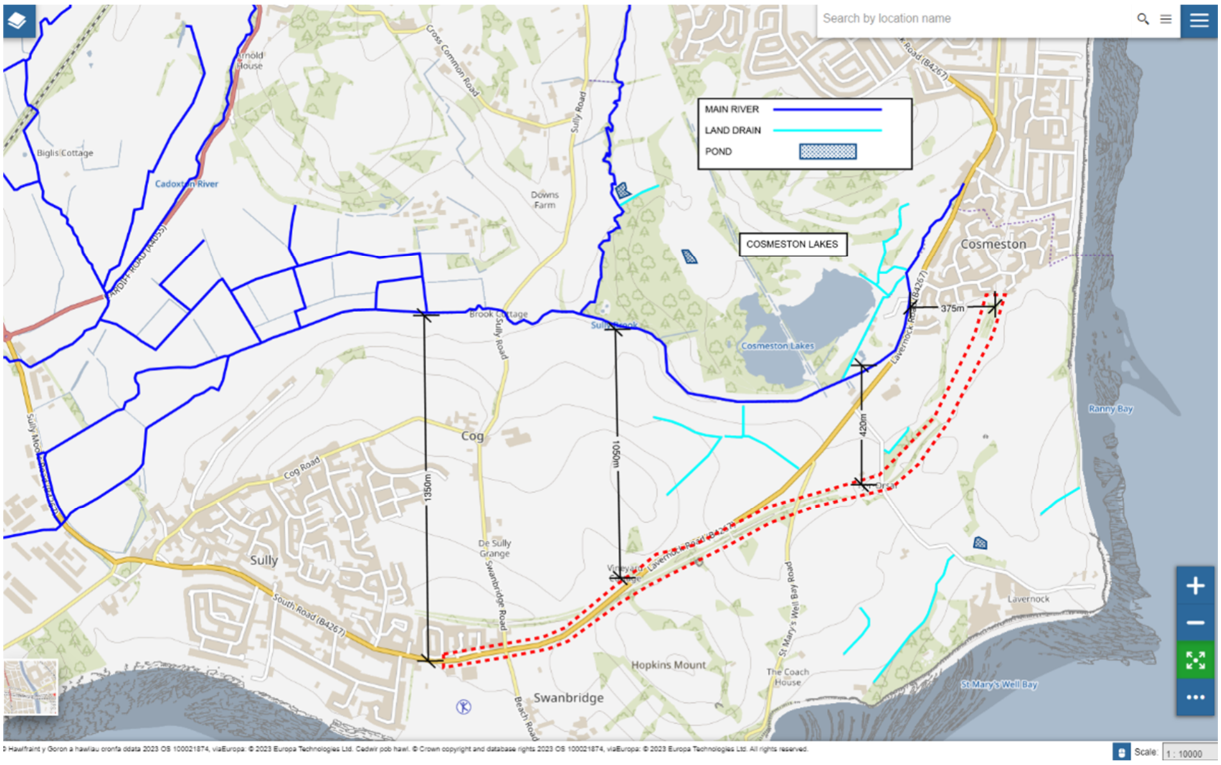


Figure 5: Local watercourses and drainage mechanisms (*https://datamap.gov.wales/maps/new?layer=inspire-nrw:NRW_MAIN_RIVERS#/)*

Local ditches and land drains are also noted within the surrounding fields as well as the inclusion of Cosmeston Lakes on the northern side of the site.

Within the topographical survey, a Ø1000mm pipe is shown next to the St Mary's Well Bay Road, located at the base of the railway embankment carrying what is assumed to be land drainage flows beneath the railway embankment into a drainage ditch which runs parallel to St Mary's Well Bay Road.

2.4.2 Existing Sewers – South Road and Lavernock Road

The topographical survey, contained within ***Appendix A*** and General Arrangement drawing contained within ***Appendix B***, indicates that South Road and Lavernock Road is drained by a positive drainage sewer system, which is indicated by the presence of gullies and manholes within the highway. Sewer asset records have been requested from the Vale of Glamorgan Highways team to provide further detail on the network, but the receipt of these is still awaited.

A Section 19 report produced by the Vale of Glamorgan Council (***Appendix C***) discusses drainage arrangements in the vicinity of the Sully sports and leisure centre. Section 4 and Figure 4-2 indicates the Lavernock Road drainage system may outfall into a highway network located along Beach Road, which ultimately outfalls into the Severn Estuary. The report notes that the networks discharge at an uncontrolled rate into the estuary, as indicated below in ***Figure 6***.

As discussed in ***Section 2.2*** the low point of the highway between South Road and Lavernock Road is located adjacent to the entrance of the Sully sports and leisure centre and therefore would indicate that Lavernock road would drain into the indicated highway drainage along beach Road.

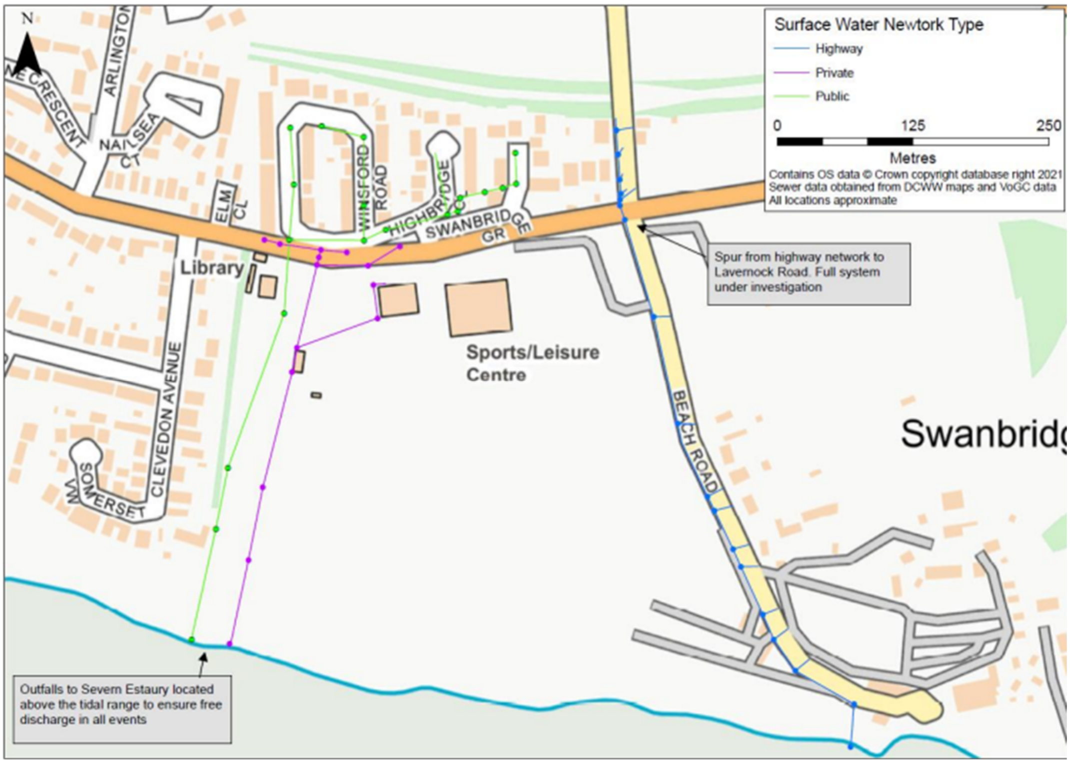


Figure 6: Extract of highway drainage located near the Sully Sports and Leisure Centre – Sully Section 19 Report

2.4.3 Existing Drainage – Disused Railway

Reference to the topographical survey (**Appendix A**), drawings (***Appendix B***) and ***Figure 7/ Figure 8*** are to be made for location and chainage references and location information.

The Disused Railway is formed initially, on the southern side, via two distinct sections of areas within cutting and on an embankment. Within the areas of cutting (noted to begin on the southern end of the disused railway, opposite 'The Vineyards' and heading east/ north-east before reaching a bridge at chainage 1260, (ref ***Figure 7***) formed to provide access between two farmland parcels) there are existing drainage ditch channels running parallel to it. Also, as is noted on the topographical survey (***Appendix A***) and within ***Figure 7***, a drainage inlet/outlet and a chamber have been observed at chainage 1160, although minimal in location and number. Of note is a cascade feature observed at the start of the route, chainage 885, seemingly directed from the adjacent fields into the drainage ditch. ***Image 1*** below shows the cascade as found during recent site visits and noted within the topographical survey.

Image 1: Cascade feature recorded during site visit

The details of the hard drainage features noted within this section of cutting and its integration within the overall drainage network is to be further confirmed. ***Figure 7*** below highlights the cutting and embankment arrangements and typical sections at the start of the disused railway.

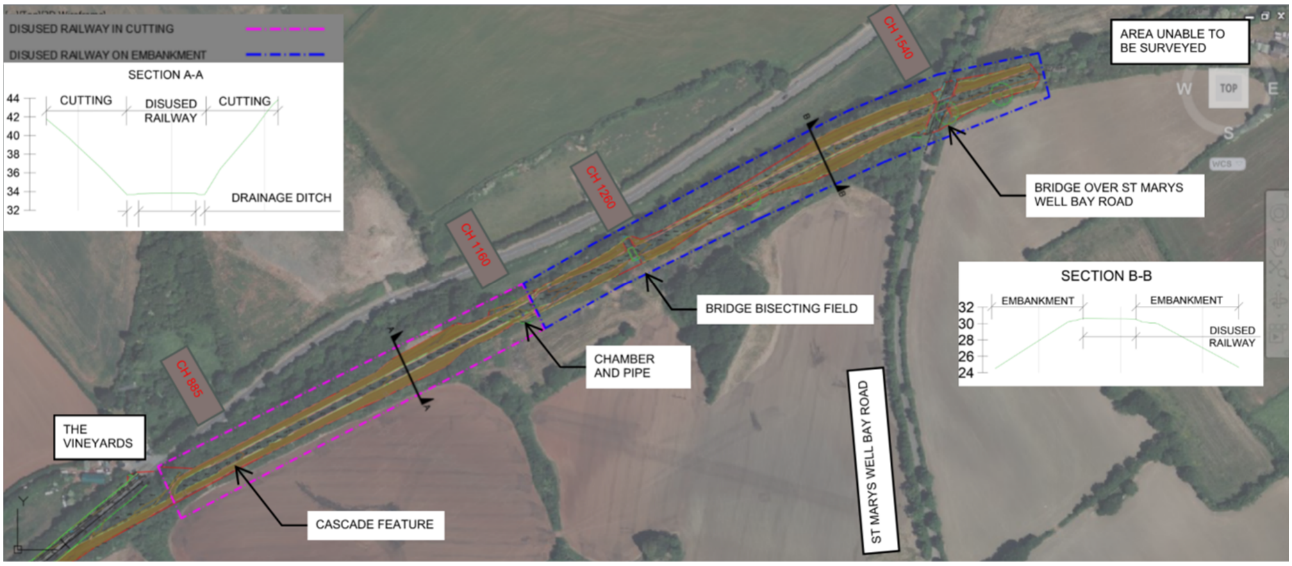


Figure 7: Southern Section of Disused Railway - Cutting and Embankment Location

The sections of embankment, as shown in ***Figure 7*** and ***Figure 8***, picked up within the topographical survey, indicates sporadic pipe locations along the route heading north. The information presented indicates location only, with no information on the line, level, or dimensions of the network. As noted in ***Figure 8***, the topographical survey indicates pipes as being present at a number of locations, specifically between chainage 1960 – 2080. On the most northern end of the route, just before the underpass, it is noted that a chamber and incoming Ø225mm and outgoing Ø300mm pipe is present at chainage 2360. No further information with regards to the direction of the network is currently available.

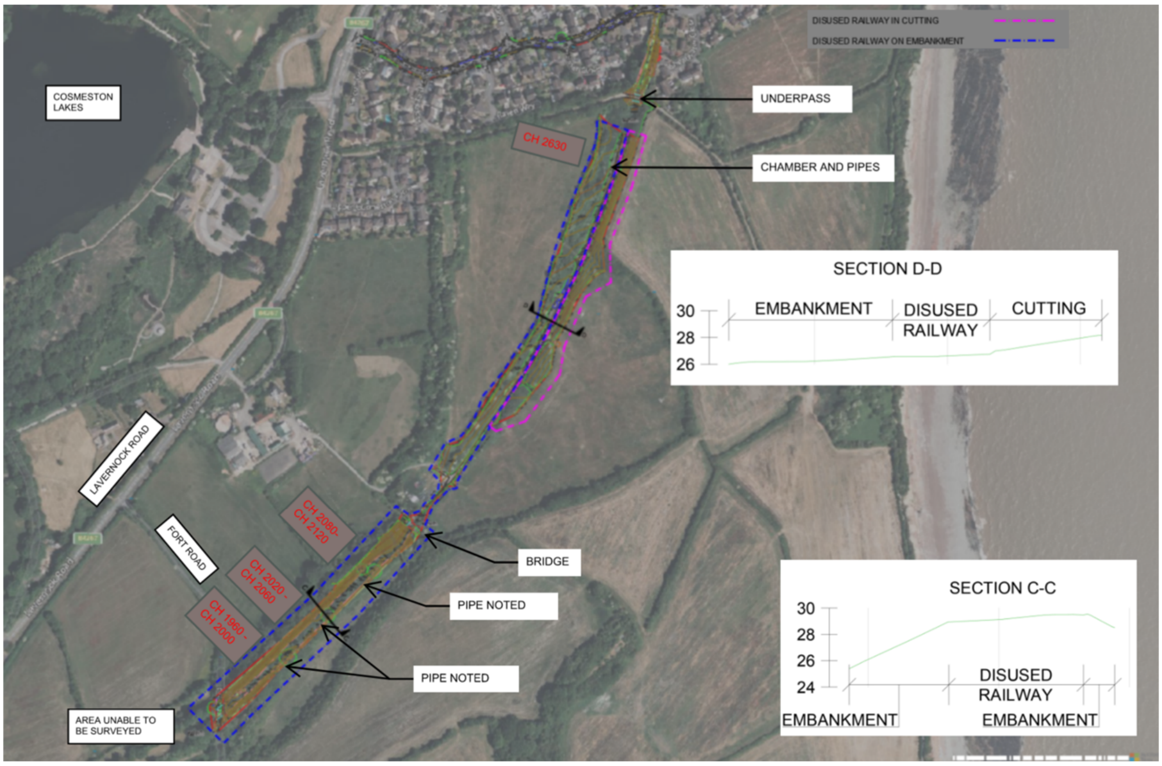


Figure 8: Central and Northern Section of disused Railway - Cutting and Embankment Locations

Detailed drainage information relating to the disused railway has been sought from the Vale of Glamorgan and Network Rail, but no information, as of yet, is available. On receipt of any further information, this report will be updated to reflect the detail provided.

2.5 Existing Catchment Areas

As noted in ***Section 2.2*** a topographical survey was undertaken within the boundaries of the site to inform the design of the Active Travel Route. This topographical survey (including lidar data where access was not available) has been used to determine the catchment areas for the highway drainage within South Road and Lavernock Road and the disused railway. These catchment areas are noted below in ***Table 2*** with drawings contained within ***Appendix B***. It is to be noted that OS mapping has been used in areas noted to be inaccessible within the topographical survey.

Catchment Area	Existing Catchment Area (m^2)	Existing Catchment Area (Ha)	Proposed Catchment Area (m^2)	Proposed Catchment Area (Ha)
South Road/ Lavernock Road	16285	1.63	16285	1.63
Disused Railway	25073	2.51	25073	2.51

Table 2: Comparison of existing and proposed catchment areas

As can be seen, there is no increase in catchment area required to construct the ATR along both South Road and Lavernock road, confirming that the construction remains within the existing developable site boundary. Additionally, there is no requirement to increase catchment areas within the disused railway.

Maintaining the existing catchment areas when developing the ATR scheme will ensure that no further impact from surface water runoff will be apparent within the site.

2.6 Flood Risk

The Development Advice Map, as shown in ***Figure 9*** from Natural Resources Wales (NRW) relating to fluvial or coastal/ tidal flooding, shows that the site is located within Flood Zone A and therefore at little to no risk of flooding from fluvial or coastal/ tidal flooding.

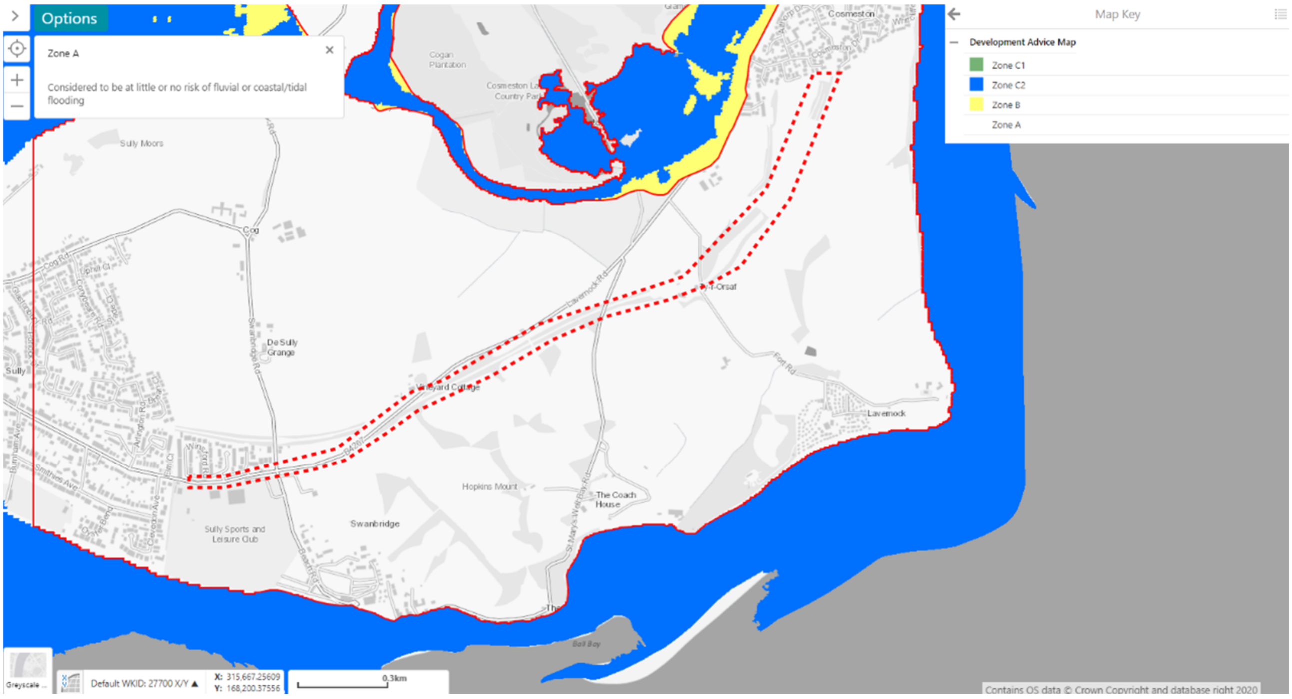


Figure 9: NRW Development Advice Map Flood Zones

The Flood Risk for Planning Map provided by NRW presents the flood risk from surface water and small watercourses and can be seen in ***Figure 10.*** The figure indicates that there are some noted areas of flooding within the site development area.

On the western side, within the Sully Sports and Leisure Centre area, a high flood risk category is noted. Details of the source of this high-risk flooding area are presented in the Section 19 Flood Investigation Report, commissioned, and produced by VoG (2021) in accordance with their duties as stipulated in the Flood and Water Management Act 2010. The report can be found within ***Appendix C***.

The report states that several factors influence the flooding in this area (as well as the residential area to the north) and include:

- Heavy rainfall causing localised surface water flooding.
- Surface water flooding taking three main flow paths to the area.
  - One flow path flowing south from the disused railway.
  - Two flow paths heading south from fields east of Swanbridge Road.

The combination of the heavy rainfall, leading to overland flow and runoff from the adjacent fields, caused the existing sewer system to become overwhelmed and not able to accommodate the flows adequately to mitigate against the flooding of the area.

The report also notes that although Sully has been prone to surface water flooding in the past, the area in question is not known to be regularly affected by flooding, with the majority of residents never knowing of flooding within the area during their residency.

Two further areas of flooding indicated in ***Figure 10*** are towards the central and far eastern sides of the route. The central area is shown as a low flood risk zone at the beginning of the route through the disused railway. This may be linked to the high-risk flooding zone within Lavernock Road. Additionally, the localised, high-risk zone shown at the eastern tie in appears to be linked with a wider area of flooding within the Cosmeston Lakes area. The VoG are due to issue a further Section 19 report for the central and eastern areas of flooding as shown below with a provisional date of delivery in May. When this report is made available, this strategy will be updated to reflect on the findings of the report.

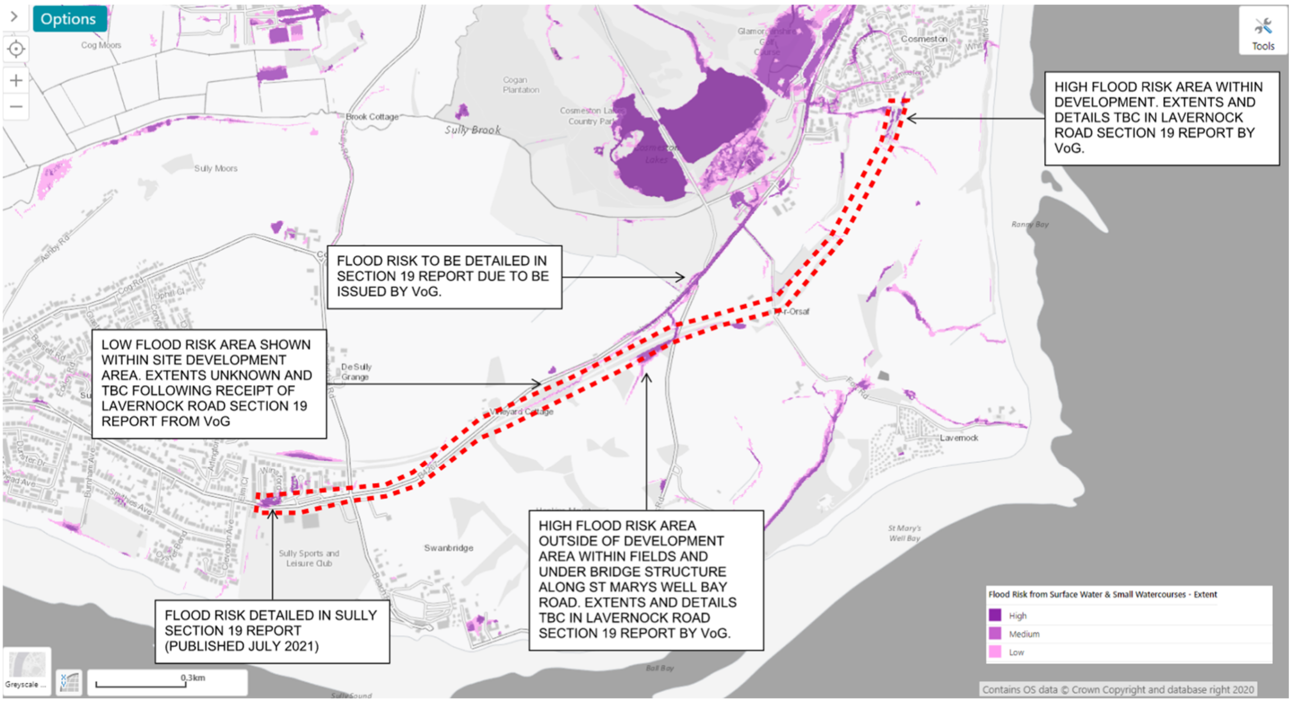


Figure 10: NRW Flood Risk for Planning - Flood Risk from Surface Water and Small Watercourses

Planning Policy Wales (PPW) (2002, and as revised 2021) sets out the planning policies relating to land use of the Welsh Government. A series of Technical Advice Notes (TANs) supplements the PPW, along with other regulatory letters and Welsh Government Circulars, and forms the overall national planning policy framework for Wales. The primary objective of the PPW is to ensure that the planning system contributes to sustainability and sustainable development and improving social, economic, environmental and cultural well-being in Wales.

Technical Advice Note 15 (TAN15) provides technical guidance in relation to development and flooding, advising on development and flood risk and provides a framework within risk arising from river and coastal flooding, as well as additional run off from developments in any location.

In accordance with TAN15 and the advice and guidance it contains, the site, being located wholly in Flood Zone A, no further justification tests are required and flood risk from rivers and coastal sources need not be considered further.

3 Sustainable Development

The principle of sustainable development is stated in the Well-being of Future Generations (Wales) Act, and this strategy has also been informed by the following document:

- Sustainable Development: Guidance to Risk Management Authorities. Section 27 – Sustainable Development. [November 2011 Published by The Welsh Government].

The supporting principles, and their relevance to sustainable drainage and flood risk management, are:

Low ecological footprint - all flood and coastal erosion risk management should not overuse but seek to work in harmony with natural resources and processes, promote resource efficiency, and minimise waste, so we are clear that flood and coastal erosion risk management will help us reduce Wales's ecological footprint.

Full costs and benefits – Whole system thinking, and whole life costing are key approaches that should be used. Taking account of risks - especially to the economic, social and environmental wellbeing of communities - and uncertainties associated with action and inaction, should also be part of the decision-making process;

Evidence base - An evidenced-based approach to decision-making should be used, but where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to promote sustainable approaches to flood and coastal erosion risk management;

Reflecting distinctiveness – Approaches to sustainable flood and coastal erosion risk management should reflect and respond to the particular needs and issues of communities, and the differing economic, social and environmental circumstances in different parts of Wales.

The drainage design should also:

- Maximise the long-term economic, social and environmental wellbeing of people and communities in Wales, whilst living within environmental limits.
- Safeguard the continued provision of ecosystem services from our natural environment.
- Avoid the exposure of current and future generation to increasing risk.
- Improve the resilience of communities, the economy and the natural, historic, and social environment to current and future risk.

4 General Surface Water Drainage Design Proposals

The section of Active Travel Route along Lavernock Road is proposed to utilise the existing highway drainage infrastructure, comprised of a traditional gully and chamber sewer system, within the highway to deal with the runoff from the footway/ cycleway runoff.

The route within the disused railway is proposed to utilise a permeable paving system to manage the runoff from the development as well as maintaining the use of the existing drainage mechanisms utilised by the former railway.

Using the permeable paving option will mitigate against increasing any existing runoff from the development and ensuring that no increase to runoff will be apparent.

In addition, the site will be designed and constructed to remain within the confines of the existing catchment areas, ensuring that the development does not increase the catchment areas and thus create an increase in surface water runoff.

5 Sustainable Drainage Systems Standards for Wales

The Flood and Water Management Act 2010 (Schedule 3), which came into effect in Wales on 7 January 2019, requires new developments to include Sustainable Drainage Systems (SuDS) features that comply with national standards.

5.1 Compliance with Planning Policy Requirements

As set out in the Statutory standards for sustainable drainage systems sets out criteria which need to be considered.

The criteria are as follows:

- Standard S1 - Surface water runoff destination
- Standard S2 - Surface water runoff hydraulic control
- Standard S3 - Water Quality
- Standard S4 - Amenity
- Standard S5 - Biodiversity
- Standard S6 - Design of drainage for construction, operation and maintenance and structural integrity

5.1.1 Compliance with Standard S1 – Surface Water Runoff Destination

This Standard addresses the use of surface water by the development and where it should be discharged. The aim is to ensure that runoff is treated as a resource and managed in a way that minimises negative impact of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology. This will ensure that early consideration is given to the use of rainwater harvesting systems to both manage runoff and deliver a source of non-potable water for the site where practical. Where it is not, prioritisation should be given to infiltration. Discharges to sewerage systems must be limited where possible.

There are 5 Priority Levels to be considered, with Level 1 being the most preferable option.

The standard requires that the site comply with the highest of the following priority levels:

- Priority Level 1: Surface water runoff is collected for use.

The potential to collect, store and utilise the runoff is not feasible for this development. The lack of spatial availability to store and manage runoff limits the drainage mechanisms available.

Along Lavernock Road, and as discussed in ***Section 2.1***, the bounding topography is of steep graded earthworks down towards and up to existing fields on the left-hand side, with the Lavernock Road highway on the right.

Within the disused railway, the available development area is too narrow to provide suitable compliant storage features. Furthermore, providing storage structures below the proposed ATR is not deemed cost effective for the type of development that is being proposed. In addition to this, and due to the potentially ecological sensitivity of the area, minimal excavation and site clearance works are proposed to ensure the surrounding habitats and ecology is retained as far as is reasonably practicable.

Moreover, if the runoff were to be stored for use, there is no direct or planned source for which the water could be utilised.

- Priority Level 2: Surface water runoff is infiltrated to ground.

Testing to determine the infiltration rates along the disused railway has not been undertaken but in its current state, some level of infiltration will occur specifically within the areas of existing rail track ballast that remains throughout the route. The proposed route will utilise the existing infiltration rates and other existing drainage mechanisms to manage runoff from the site. The use of a permeable pavement will aid in this and ensure no increased runoff from the site, within the disused railway.

Presently within Lavernock Road, the method of discharge is via gravity surface water sewer system, and it is proposed to utilise this once the route is upgraded.

- Priority Level 3: Surface water runoff is discharged to a surface water body.

Direct discharge to a surface water body is not possible within the route. Along Lavernock Road there are no known land drainage or other surface water bodies within the vicinity of the area, however, the existing final outfall is assumed to be within the Severn Estuary in keeping with the arrangements in place for other private and public sewer networks in the area. This is as described in the Sully section 19 report, Section 4, ***Appendix C***.

The existing discharge from within the railway section is to be confirmed on receipt of any further drainage information received as discussed in ***Section 2.4.3***. It is assumed that drainage from the railway discharges at periodic intervals along tis length into local land drains or sewers and would incorporate infiltration where possible.

- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system.

Within Lavernock Road, the proposal is to utilise the existing gravity surface water sewers for drainage. It is to be noted, and as stated in Priority Level 3, that the eventual outfall for this existing system is to the Severn Estuary.

The existing discharge from within the railway section is to be confirmed on receipt of any further drainage information received as discussed in ***Section 2.4.3***. It is assumed that drainage from the railway discharges at periodic intervals along tis length into local land drains or sewers and would incorporate infiltration where possible.

- Priority Level 5: Surface water runoff is discharged to a combined sewer.

Not suitable as there are no combined sewers in the area.

5.1.2 Compliance with Standard S2 – Surface Water Runoff Hydraulic Control

This Standard addresses the use of surface water by the development and where it should be discharged. The aim is to ensure that runoff is treated as a resource and managed in a way that minimises negative impact of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology. This will ensure that early consideration is given to the use of rainwater harvesting systems to both manage runoff and deliver a source of non-potable water for the site where practical. Where it is not, prioritisation should be given to infiltration. Discharges to sewerage systems must be limited where possible.

The aim of Standard S2 is to manage the surface water runoff from and on a site to protect people on the site from flooding from the drainage system for events up to a suitable return period, to mitigate any increased flood risk to people and property downstream of the site as a result of the development, and to protect the receiving water body from morphological damage.

The allowable flow from a development site is to be informed by the regulatory requirements of the site.

A suitable model should be used to design the drainage system to a level of detail which effectively represents the conveyance and storage of the drainage system and is able to demonstrate its performance for all relevant hydrological conditions. An appropriate runoff model should be used which predicts the impervious and pervious area response appropriate for the rainfall event being used.

When rainfall takes place on greenfield sites there is, for the majority of rainfall events during the year, no discernible surface water runoff to receiving water bodies. The rainwater normally evapotranspires, or in winter it can result in river base flow replenishment and/or groundwater recharge. However, impermeable surfaces generate runoff from virtually all rainfall events, and this change in runoff characteristics can have a negative impact on the morphology and ecology of receiving water bodies. Interception aims to mimic greenfield runoff conditions.

By limiting discharges to sewers (and surface waters), replicating the greenfield runoff rate will reduce the impact on downstream capacity. If discharging to a combined sewer, this also reduces the impact on CSO spills and downstream wastewater treatment works.

- Runoff rate control
  - It is the aim to replicate greenfield runoff rates for extreme events helps ensure that the flood risk associated with the receiving watercourse/sewer is not increased by the development.
  - For previously developed sites, site runoff rates should be reduced to the greenfield rates wherever possible. Because the critical duration for the attenuation storage system for the proposed development will be much longer than the storm duration used for sizing pipework for the previously developed site, there is a risk that, by allowing previously developed runoff rates to occur (for a much longer duration) receiving watercourse damage and flood risk could be made considerably worse.

Thus, betterment of at least 30% should be considered as a minimum requirement (this will need to be established and agreed with the drainage approving body) and strong consideration should still be given to controlling volumes of runoff to greenfield equivalents.

- Runoff volume control
  - The volume of runoff from the site can be, in many scenarios, as damaging to downstream flood risk as peak flow rates. It is therefore necessary to ensure that volume of runoff discharged from the site during extreme events is also controlled.
  - Where possible, the volume of runoff from the site (or development) area should not exceed the volume of runoff from the equivalent area in its natural undeveloped or “greenfield” state (for the same rainfall event). Where flood risk from the receiving watercourse is particularly high, tighter local criteria for allowable volumes discharged from the site may need to be specified by the local regulator or drainage approving body and met by the drainage design.
  - The use of infiltration and rainwater harvesting are important mechanisms for delivering volume control: the greater the volume of runoff infiltrated or used on site, the lower the volume of runoff discharged. It is important to note for clay sites, greenfield runoff volumes will tend to be high because of the underlying impermeability, so the increase in volume for the developed site will be smaller than for the same site on more permeable soils. However, on more permeable soils, infiltration options should be available to assist in managing these larger volumes.
  - Ideally, the volumetric control of runoff should be demonstrated to meet greenfield runoff behaviour for all events and particularly those relevant for the mitigation of flood risk in the receiving watercourse. However, this would require the use of time series rainfall as part of a modelling exercise. Until this approach becomes standard industry practice, a simple method using the 1:100 year, 6 hour rainfall event is sufficient for design purposes, as it represents a suitable event for smaller watercourses that are most at risk from the effects of urban development. As designs for Interception will help control runoff volumes from smaller events, a single requirement for large events is considered a pragmatic solution.
  - The calculation of the difference in volume between the developed and greenfield scenario (defined as the Long-Term Storage Volume) is set out in the SuDS Manual.
  - Where controlling runoff to greenfield volumes is considered unachievable, then the runoff volume should be reduced as much as possible and any additional volume should be stored and released at a low rate which will not increase downstream flood risk (normally 2 l/s/ha is considered an appropriate rate) using either of the following approaches:
    1. The additional runoff volume (i.e. the difference between the predicted development runoff volume and the estimated greenfield runoff volume, often called Long-Term Storage) should be discharged from the site at a rate of 2 l/s/ha or less, while still allowing greenfield runoff peak flow rates to be applied for the greenfield runoff volume.
    2. All the runoff from the site for the 1:100 year event should be discharged at either a rate of 2 l/s/ha or the average annual peak flow rate (i.e. the mean annual flood, QBAR), whichever is the greater.

    Approach 2 provides a simpler approach but results in larger storage volumes being required than Approach 1.
  - Unless specific off-site arrangements have been agreed, all runoff generated on the site should be managed on the site using attenuation or temporary storage which discharges through defined points of exit from the site.
  - The design of the site drainage system should take account of the potential for runoff which might flow onto the site during an extreme event up to the 1:100 year event. Provision to route such flows around the site or to incorporate them into the site drainage should be made. There is no need to provide attenuation for such flows if they are incorporated into the site drainage system. Preventing water from coming onto the site should only be considered if it has no flooding implications for adjacent people or property.

- Flood protection for the site
  - Flood protection to a suitable level of service should be provided to people and property on (or adjacent to) the site. There are three principal criteria which would normally be applied to the drainage design:
    - Protection against surface flooding for roads and other access areas for the 1:30 year return period rainfall event. Lower levels of service may be used for certain locations depending on the impact on site users.
    - Protection against internal flooding of properties for the 1:100 year return period (or greater). Critical infrastructure and roads where access is essential may also be protected to the same level of service (or greater).
    - Freeboard against flooding of any structure should be appropriate to the uncertainty in providing the level of protection required and the consequence of the flooding occurring.
      - Extreme event exceedance management of surface water runoff
  - Extreme events exceeding the design event (usually the 1% - 1 in 100-year return period) could occur and may result in overland flows within the site, onto the site and from the site to adjacent areas. The duration of flooding, maximum depth, maximum velocity and the route of flood flows should be established and managed so as to mitigate the flood impact to people and property. The impact of exceedance flows from and on adjacent land should also be considered. The return period of this assessment will be related to the potential consequences associated with its impact.
  - Conveyance routes should be selected such that likely future changes on site will not prevent the safe routing of flood flows in the future.
      - Evaluation of impact of potential failure of a drainage system
  - The drainage proposal for a site should be evaluated for flood risks associated with potential system failure.
  - Where the probability and consequence of potential failure modes are considered unacceptable, then the drainage proposal should be modified, or the site layout changed, or the topography altered. Failure mechanisms to consider include:
    - Blockage of pipes,
    - Blockage of outlet structures,
    - Failure of pumps,
    - Risk of impediments across planned flood routing paths.

5.1.2.1 Site Specific Proposals

It is proposed that the widening of the existing shared footway/ cycleway along Lavernock Road uses the existing highway drainage system as its method of dealing with surface water runoff. As described in ***Section 2.5***, and the drawings contained within ***Appendix B,*** there will be no increase in catchment area of along South and Lavernock road, and as such, no increase in surface water runoff.

Within the disused railway section, the runoff within the area is dealt with currently. This will ensure that the runoff will not be increased and will future proof the route, preventing increased volumes of water affecting the surrounding areas. ***Section 2.5*** and the drawings contained within ***Appendix B*** confirm that there is no proposed increase in catchment area due to the ATR scheme.The typical sections below depict route will make use of a permeable pavement system to mimic the existing drainage mechanisms and not affecting how the proposals for the ATR along both South/ Lavernock road and the disused railway.

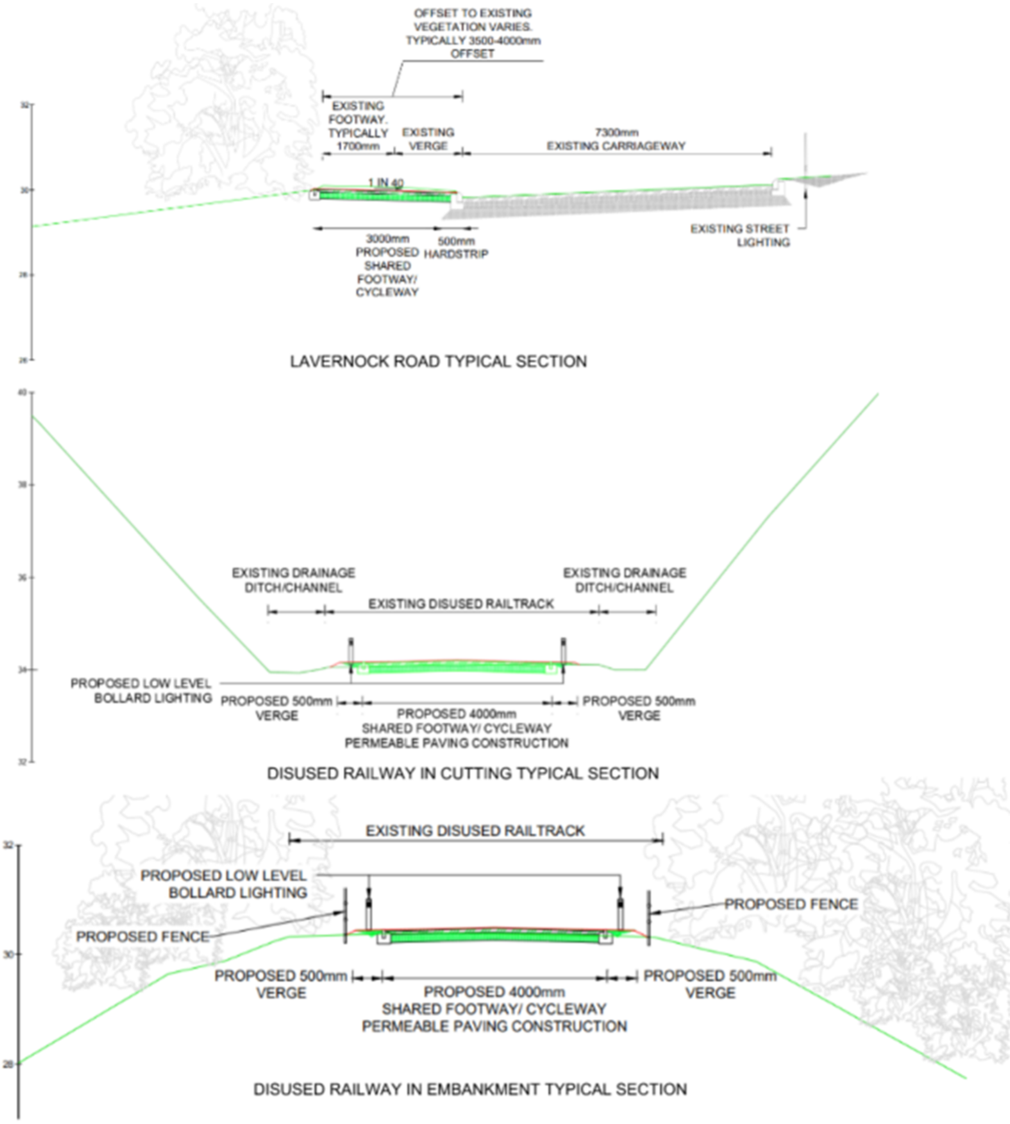


Figure 11: Typical sections along the proposed Active Travel Route

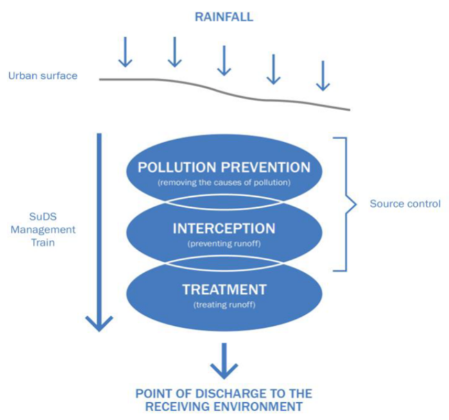
5.1.3 Compliance with Standard S3 – Water Quality

Standard S3 addresses the drainage design requirements to minimise the potential pollution risk posed by the surface water runoff to the receiving water body.

The effectiveness of components in improving water quality is strongly linked to the reduction in the volume of runoff. Well-designed SuDS, designing for water quality management, should maximise volume reduction when designing conveyance and attenuation measures, preferably using vegetated, surface-based systems.

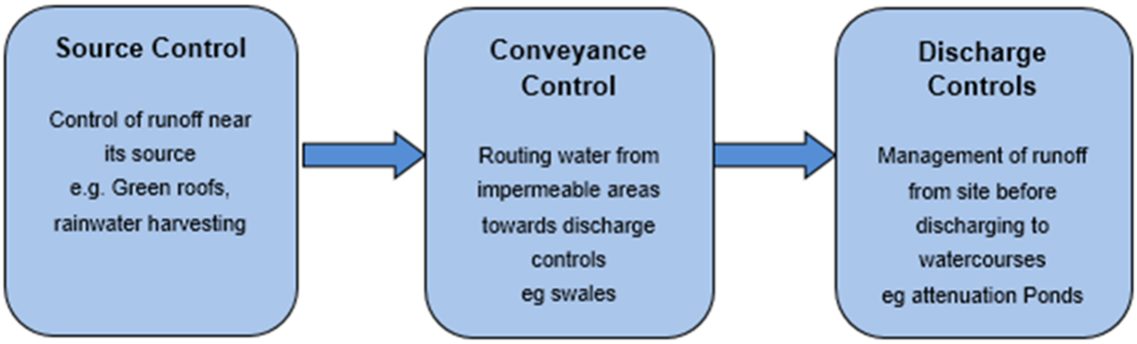
- SuDS design for pollution prevention
  - Where possible, surface water runoff should be managed using interception, sedimentation and treatment components close to its source. This will help to prevent sediment and other pollutants from being conveyed to, and building up in, downstream components and causing:
    - Increased risk of system blockage,
    - Increased maintenance requirements,
    - Lower amenity and biodiversity potential for downstream drainage components,
    - Increased risk of contaminant re-mobilisation and discharge.

The generic design process for pollution control for a particular site is set out in the below Figure. Pollution prevention strategies are detailed in the SuDS Manual. Interception, the primary defence against pollution, is detailed in Standard S2.



To comply with current best practice, the drainage system is to:

- Manage runoff at or close to its source.
- Manage runoff at the surface.
- Integrated with public open space areas and contribute towards meeting the objectives of the urban plan (not applicable for this development);
- Be cost-effective to operate and maintain.



The drainage system ensures that:

- Natural hydrological processes are protected through maintaining interception of an initial depth of rainfall and prioritising infiltration.
- Flood risk is managed through the control of runoff peak flow rates and volumes discharged from the site;
- Storm water runoff is treated to prevent detrimental impacts to the receiving outfall sewer because of urban contaminants.

5.1.3.1 Site Specific Proposals

The below review has been undertaken with regards to various SuDS techniques (as set out in CIRIA SuDS Manual 2015) and the opportunity to incorporate into the proposed drainage system.

SuDS Technique	Suitability for use within the development area
Rainwater Harvesting	Not proposed
Green Roofs	Not proposed
Infiltration Systems	Proposed to maintain existing infiltration rates within the disused railway section of the AT route, via the use of permeable paving
Proprietary Treatment Systems	Not required for the site
Filter Strips	Not proposed
Filter Drains	Not proposed.
Swales	Not proposed
Bioretention Systems	Not proposed
Trees and Vegetation Planting	Existing trees and vegetation along Lavernock Road are proposed to be maintained and not removed to accommodate the widening. Within the disused railway, some vegetation removal will be required to accommodate the construction of the ATR route, however, in collaboration with Ecologist and Environmental specialist, the amount of vegetation to be removed will be minimised as far as is reasonably practical and if possible, replacement planting will be undertaken to mitigate against any loss.
Pervious Pavements	Proposed for ATR within disused railway
Attenuation Storage Tanks	Not proposed
Detention Basins	Not proposed
Ponds and Wetlands	Not proposed

Table 3: Proposed SuDS Techniques for the ATR route in accordance with the Ciria SuDS Manual

The various treatment methodologies are classed as proprietary systems, in accordance with Table 14.1 of the CIRIA Guidance.

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TABLE 14.1 Proprietary systems classified on basis of main treatment process

Proprietary systems	Description	Treatment processes	Leisenring (2012) classification
Proprietary bioretention systems in concrete (or other material) structures	Filtration devices that use soils (or other filter media) and which support plants or bacterial biofilms	Filtration, adsorption, bioremediation	Biological filtration
Treatment channels	Channels that are designed to collect and treat water rather than convey it along the channel; can include proprietary filter media within the channel; can include weir and baffles at intervals to trap oils and floatables	Physical removal of sediment, oils and floatables; wetting and drying to promote degradation	Does not include test results for this type of system (note that there are examples in Europe that are certified by DiBT in Germany)
Hydrodynamic or vortex separators	Structures that use gravity and centrifugal force to separate out and collect medium-sized (63 to 250 μm) sediments and other litter or debris; smaller particles may be able to be removed by varying the flow rate into the system	Physical removal of sediment by gravity	Manufactured device – physical
Proprietary filtration systems	Devices that filter water by passing it through various filter media; they are constructed below ground in chambers and do not support vegetation	Filtration and adsorption	Filtration
Oil separators	Structures designed to separate gross amounts of oil and large size (> 250 μm) suspended solids from water; they do this by allowing light non-aqueous phase liquids (LNAPL) to float and large sediment particles to sink; many also have baffles, coalescers and oil skimmers to speed-up or enhance performance	Physical removal of floatables, physical removal of sediment by gravity	Oil/grit separators and baffle boxes
Multi-process	Systems that include multiple treatment processes in series	Various	Multi-process

Figure 12: Table 14.1 Proprietary systems - Ciria SuDS Manual

These proprietary systems are not proposed within the drainage system.

5.1.4 Compliance with Standard S4 – Amenity

Standard S4 addresses the design of SuDS components to ensure that, where possible, they enhance the provision of high quality, attractive public space which can help provide health and wellbeing benefits, they improve liveability for local communities, and they contribute to improving the climate resilience of new developments.

Standard S4 addresses the design of SuDS components to ensure that, where possible, they enhance the provision of high quality, attractive public space which can help provide health and wellbeing benefits, they improve liveability for local communities, and they contribute to improving the climate resilience of new developments.

A key aim for sustainable drainage is to provide an improved local environment which integrates the surface water drainage function with open space, providing amenity and recreation opportunities where possible.

This section shows how SuDS can add amenity value by contributing towards:

- making sites pleasant places to live or work.
- reducing hazards from climate change.
- creation of amenity space - contributing to green space accessibility standards; and
- promoting the well-being of site users.

Detailed guidance on these aspects is set out in the SuDS Manual.

5.1.4.1 Site Specific Proposals

The ATR route has been chosen for the purpose of reinvigorating the disused railway and making use of a space that, although partially used by the public for walking, a more safe, attractive and useable space for all.

It is proposed to maintain the existing trees and canopies along with the vegetation which will bound the ATR track, ensuring that all users, (pedestrian and cyclist) can enjoy the natural woodland like surroundings and the wildlife and ecology that comes with it. Further to this, providing a purposefully build, permeable route, will ensure that the area is well maintained to safeguard both the natural surroundings and the well-being of the public for future generations.

5.1.5 Compliance with Standard S5 – Biodiversity

Standard S5 addresses the design of SuDS to ensure, where possible, they create ecologically rich green and blue corridors in developments and enrich biodiversity value by linking networks of habitats and ecosystems together. Biodiversity should be considered at the early design stage of a development to ensure the potential benefits are maximised.

The aim of standard S5 is to ensure that, wherever possible, and having regard to the need to prioritise infiltration drainage and rainwater harvesting, the SuDS scheme makes the best use of a site to maximise benefits for biodiversity, as well as for amenity, water quantity and quality. Biodiversity benefits will usually be best achieved by drainage systems which are on the surface and visible with vegetated components, forming part of the local green infrastructure and local ecosystem structure. It is important to ensure that the SuDS design does not damage existing sensitive habitats. Amenity is addressed by Standard S4.

A key aim for sustainable drainage is to provide an improved local environment which integrates the surface water drainage function with open space providing habitat opportunities where possible. This Standard and Standard 4 (Amenity) provide guidance on how to ensure that SuDS can work for people and nature. SuDS can add biodiversity value by:

- Supporting and promoting natural local habitat and species,
- Contributing to the delivery of local biodiversity objectives,
- Contributing to habitat connectivity, delivering wider biodiversity benefits,
- Creating diverse, self-sustaining, resilient local ecosystems.

SuDS should be designed (where appropriate) to benefit priority habitats (defined as those most threatened and requiring conservation action) and help deliver strategic objectives set out in national and local biodiversity strategies, frameworks and action plans.

5.1.5.1 Site Specific Proposals

Providing a permeable surface within the ATR along the disused railway section will ensure that the current management of the water runoff is not affected, protecting the environment as it currently is and has adapted to. This will ensure the natural local habitats and species, vegetation and eco systems can maintain their own self-sustaining environment.

5.1.6 Compliance with Standard S6 – Design of Drainage for Construction, Operation and Maintenance and Structural Integrity

Standard S6 deals with designing robust surface water drainage systems so they can be easily and safely constructed, maintained and operated, taking account of the need to minimise negative impacts on the environment and natural resources.

- All elements of the surface water drainage system should be designed so that they can be constructed easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).
- All elements of the surface water drainage system should be designed to ensure maintenance and operation can be undertaken (by the relevant responsible body) easily, safely, cost-effectively, in a timely manner, and with the aim of minimising the use of scarce resources and embedded carbon (energy).
- The surface water drainage system should be designed to ensure structural integrity of all elements under anticipated loading conditions over the design life of the development site, taking into account the requirement for reasonable levels of maintenance.

5.1.6.1 Site Specific Proposals

It is proposed to utilise the existing gravity drainage within Lavernock Road, reducing the scale of construction works which could create unnecessary negative environmental impact through the use of additional materials and increased construction emissions.

The proposal within the disused railway is to make use of a permeable paving system, to allow the drainage of the area to mimic its current state. Using this form of construction would also allow for vastly reduced construction requirements by minimising the depth of dig, required to install the pavement. This option removes the need for hard drainage material installation, reduces construction works in terms of required excavation and pavement install and allows for a reduced construction programme.

In addition to this, where possible it is proposed to use a permeable paving that utilises recycled materials in its construction.

The operation and maintenance requirements would typically be in accordance with CIRIA C753 guidance, however, elements of this may vary dependant on the manufacturer's recommendations and requirements.

Site specific maintenance activities to be adhered to are as follows:

Pervious paving

Pervious pavements – Operation and maintenance requirements in accordance with CIRIA C753 – The SuDS Manual		
Maintenance Schedule	**Required Action**	**Frequency**
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent landscaped areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any adjacent soft landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting or cracking, or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging). Use rotating sweeper and jet wash on porous asphalt. Use brushing and suction sweeping on concrete block permeable

Pervious pavements – Operation and maintenance requirements in accordance with CIRIA C753 – The SuDS Manual		
		paving, with replacement of top 20mm of jointing material
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually
Refer to pavement manufacturer's requirements for additional detailed specification and frequencies for the required maintenance		
Pervious pavements will be maintained by the owner / occupier appointed management company		

Table 4: Operation and maintenance requirements in accordance with CIRIA C753 – The SuDS Manual

6 Conclusion

The report has set out the principles for a viable drainage strategy for the proposed Active Travel Route Scheme.

The key design principles are:

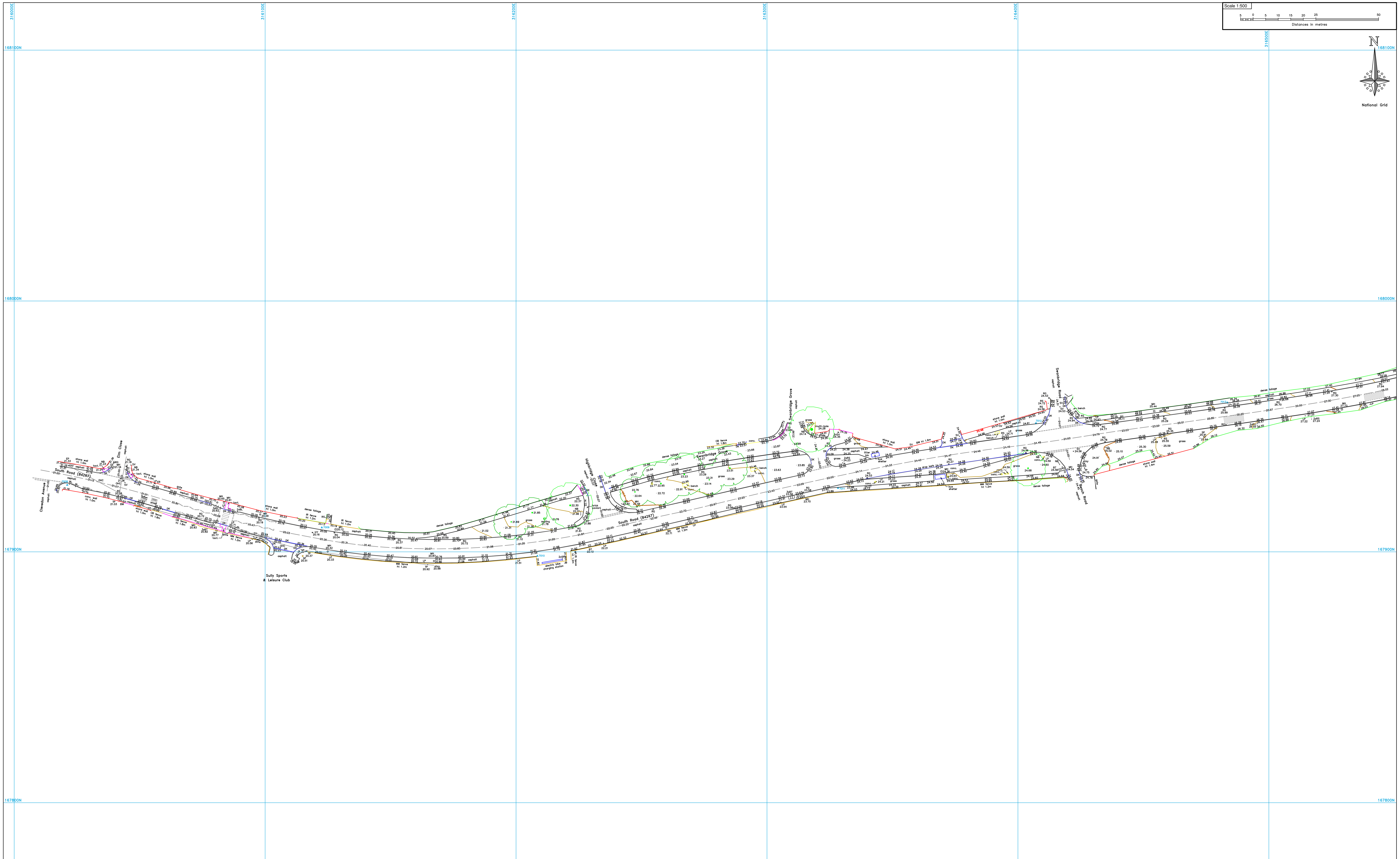
- Designing the Active Travel Route to be in keeping within the existing highway boundaries along South Road and Lavernock Road, ensuring that the drained areas remain as they currently stand and not increasing the runoff from within the development.
- Using sustainable drainage in the form of permeable paving to manage the runoff at source within the disused railway, ensuring that the current arrangements for runoff are maintained and not allowing for an increase in surface water runoff.

Through the use of a design sensitive the existing surroundings, the proposed development will ensure that no adverse effects from surface water runoff will be apparent do to maintaining and utilising the existing catchments within the area. Permeable paving will aid in managing surface water runoff at source and maintain the existing drainage mechanisms as are present within the exiting site.

Furthermore, ensuring that the design ensures that minimal disruption to the local tree and vegetation networks ensuring that the biodiversity and ecology of the area is maintained whilst providing an aesthetically pleasing route to promote more sustainable modes of travel within the local area.

Appendix A

Topographical Survey



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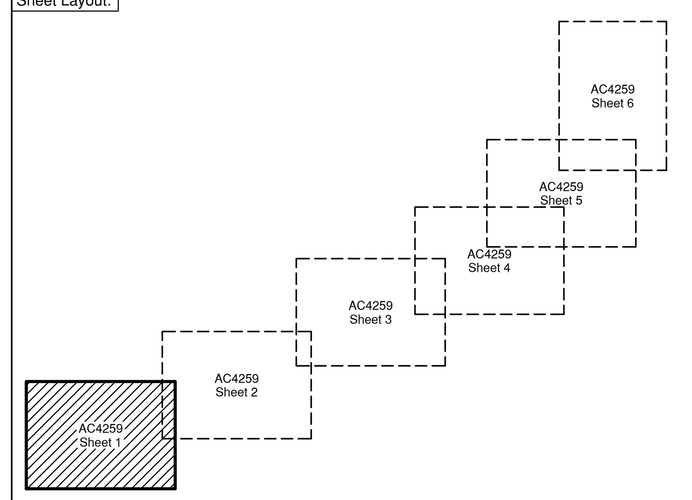

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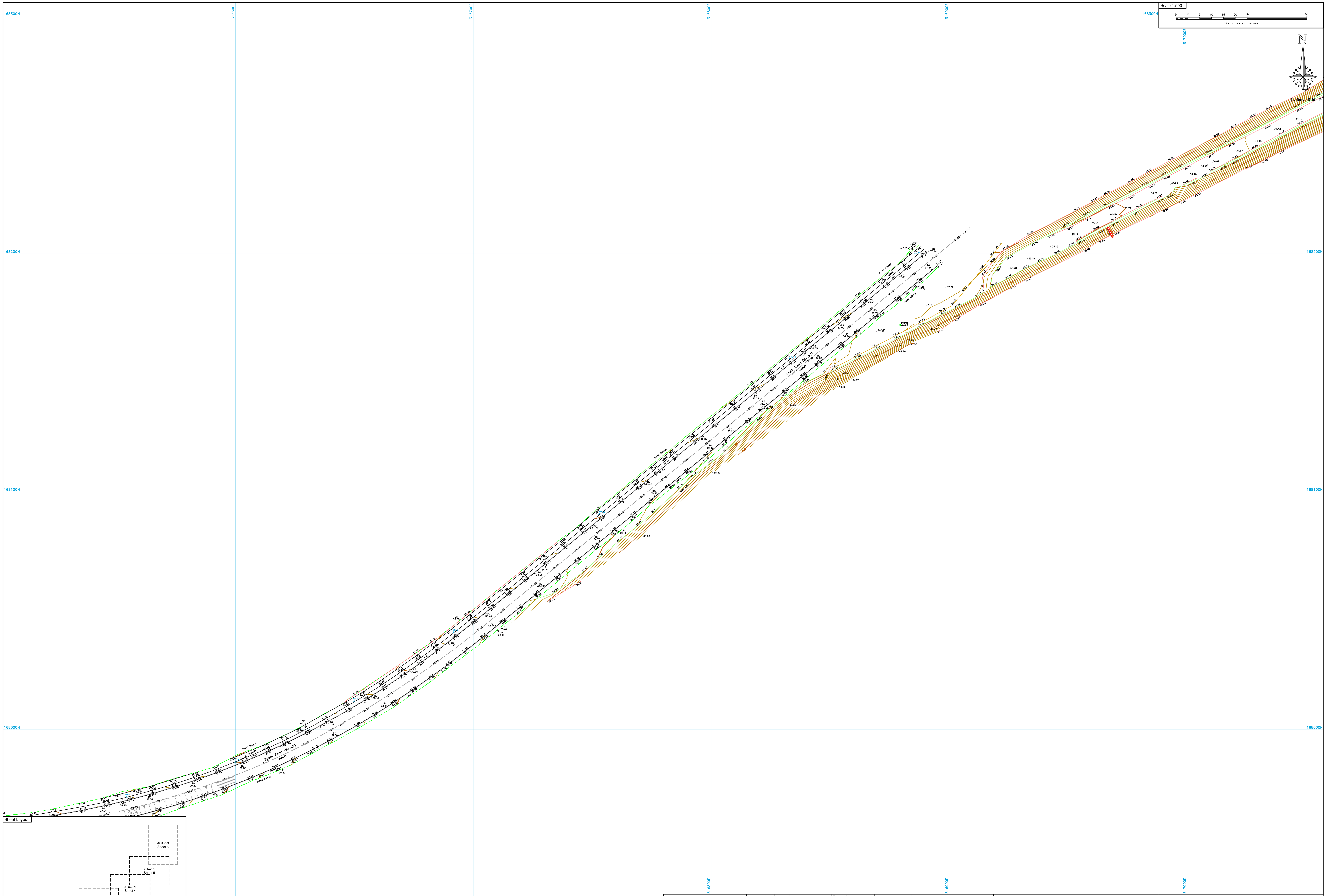
Sully to Comeston Active Travel Route.
Sully, Penarth, CF64 5UB.

Topographical Survey - sheet 1 of 6.

Client	Arcadis.						
Coord Grid	Plane Grid related to National Grid			Level Datum	OS Datum via Active GPS		
Scale	1:500@A0	Date	Sep 2022	Status	Final	Job No.	AC4259
Surveyed	N. Fowler	Drawn	L. Rajnohova	Checked	R. Williams	Dwg. No.	AC4259-01



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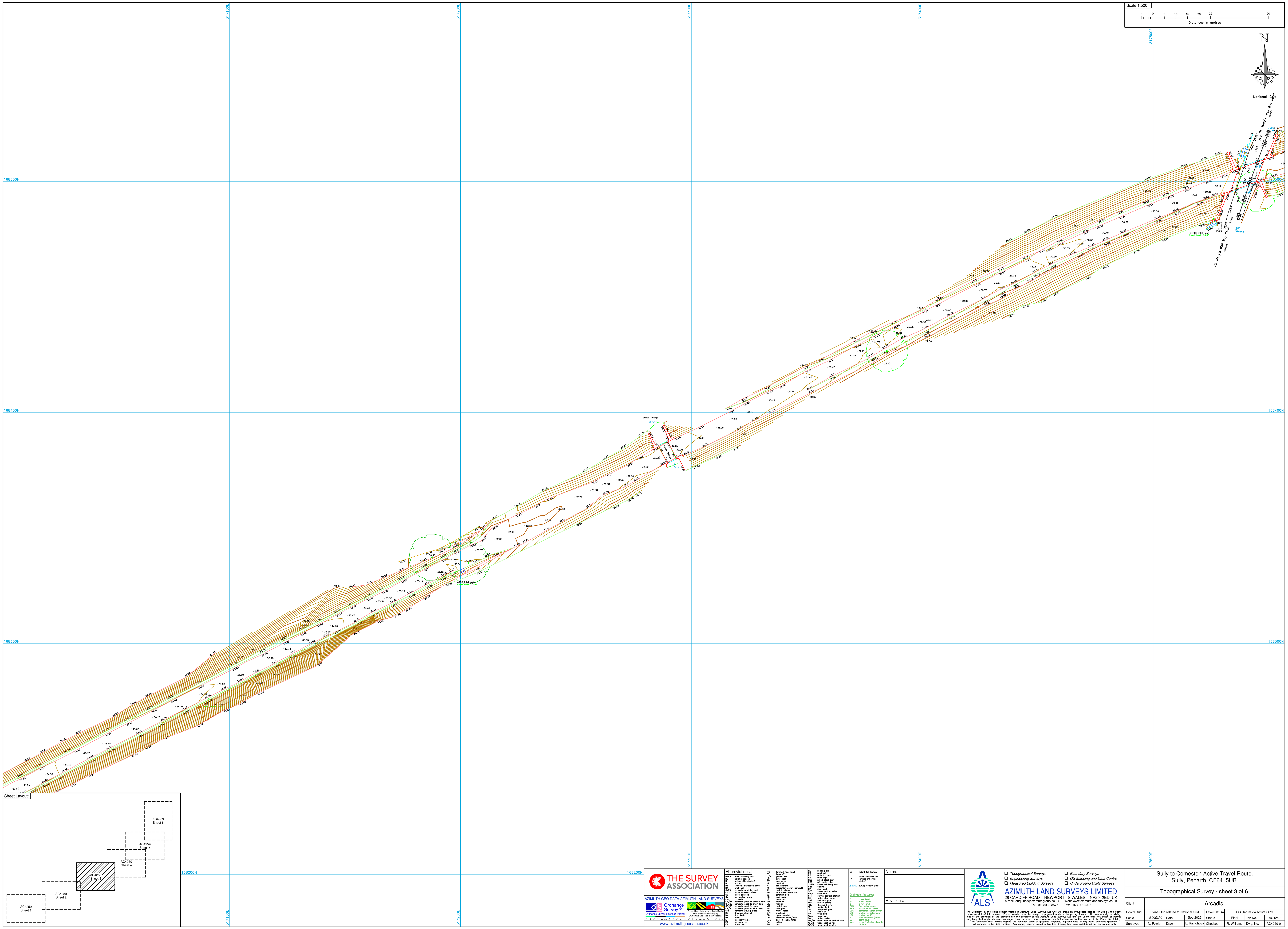

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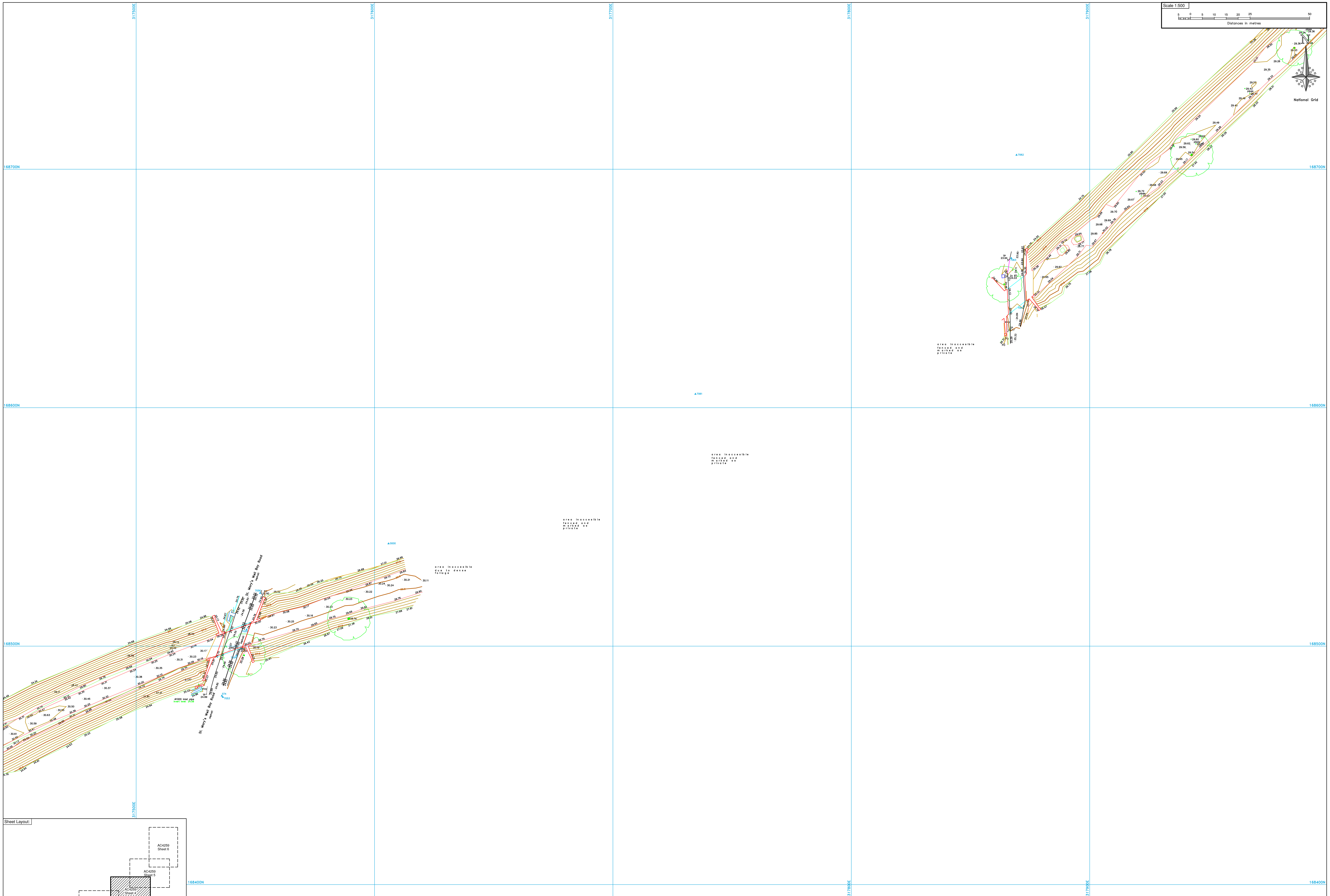

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Abbreviations:

B/RW	brick retaining wall
BB	Belisha beacon
BI	bollard (illuminated)
BL	bollard
BT	telecom inspection cover
BW	brick wall
C/RW	concrete retaining wall
CATV	cable television cover
CB	close boarded
CM	corrugated metal
conc.	concrete
CP/BW	concrete post & barbed wire
CP/CL	concrete post & chain link
CP/CP	concrete post & panel
CP/W	concrete post & wire mesh
CPS	concrete paving slabs
DC	drainage channel
DK	drop kerb
DR	drain
EP	electricity pole
ER	earthing rod
FB	flower bed
FFL	finished floor level
FS	flagstaff
G/W	gabion wall
GP	gate post
GV	gas valve
HR	handrail
HY	fire hydrant
IC	inspection cover (general)
IR	metal railings
Iwn	interwoven wood slat
JB	junction box
KO	kerb outlet
LP	lamp post
MH	manhole
MK	marker
MM	metal mesh
MP	mile post
NB	name board
O/H	overhead
OB	open boarded
OHC	overhead cable/wire
P/C	post & chain fence
PA	paling
PO	post
RE	rodding eye
RG	road gully
RP	reflector post
RS	road sign
RSJ	rolled steel joist
RWP	rain water pipe
S/RW	stone retaining wall
Sap.	sapling
SP	sign post
SPS	stone paving slabs
stay	stay wire
STN	survey control station
SV	water stop valve
SVP	soil vent pipe
tact.	tactile paving
THL	threshold level
TL	traffic light
TP	telephone pole
TV	cable tv
VP	vent pipe
Wlap	wood lap
WM	water meter
WP/BW	wood post & barbed wire
WP/R	wood post & rail
WP/W	wood post & wire
ht	height (of feature)
↑	arrow indicates up (unless otherwise stated)
▲9002	survey control point

Drainage features:

CL	cover level
ID	invert depth
IL	invert level
FWS	foul water sewer
SWS	storm water sewer
CWS	combined water sewer
UTD	unable to determine
UTL	unable to lift
ø	pipe diameter (mm)
SL	soffit level
←	arrow indicates direction of flow

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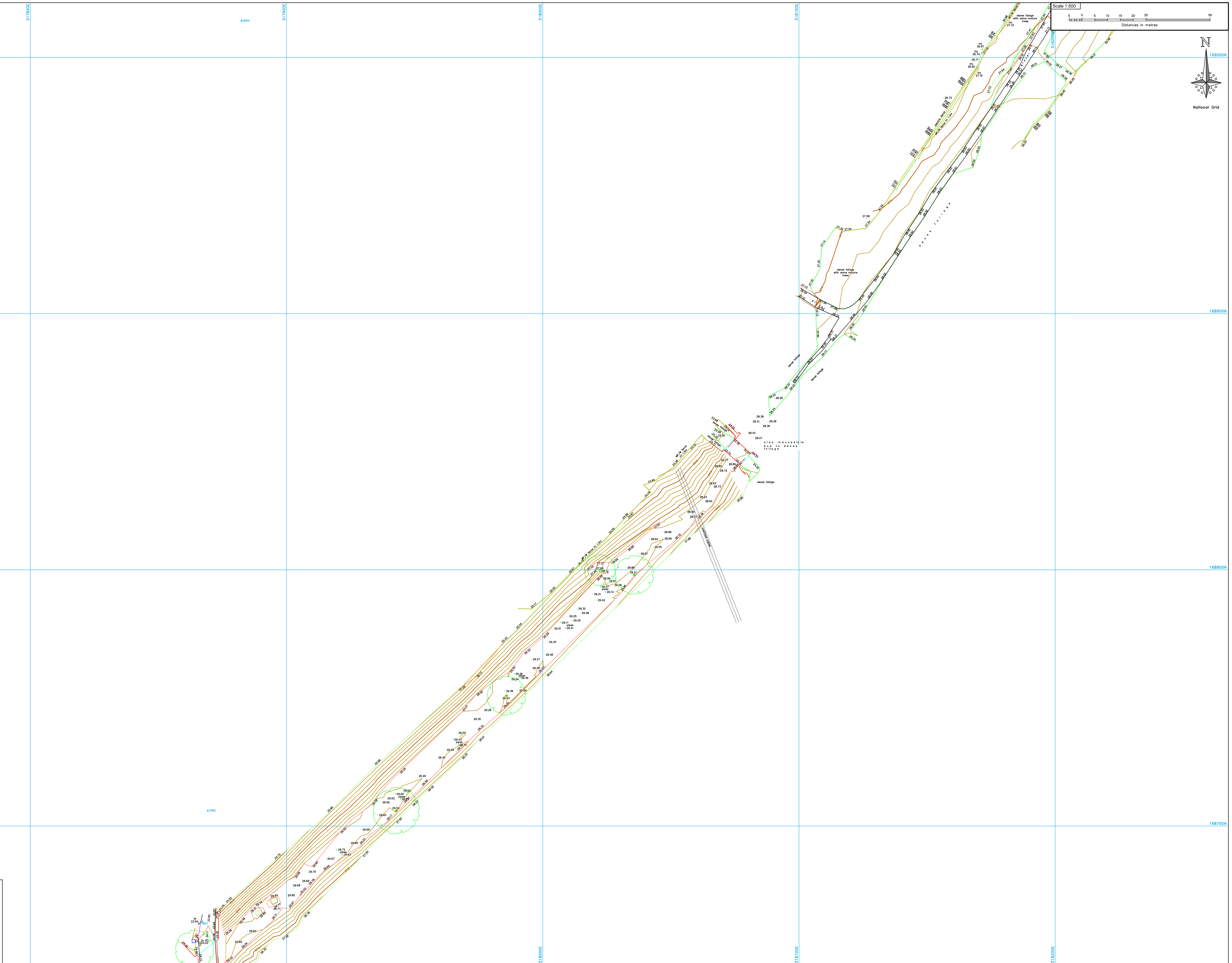

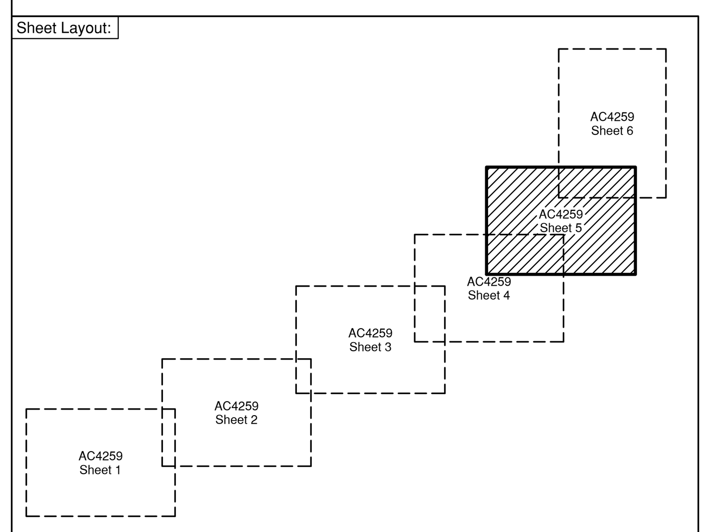

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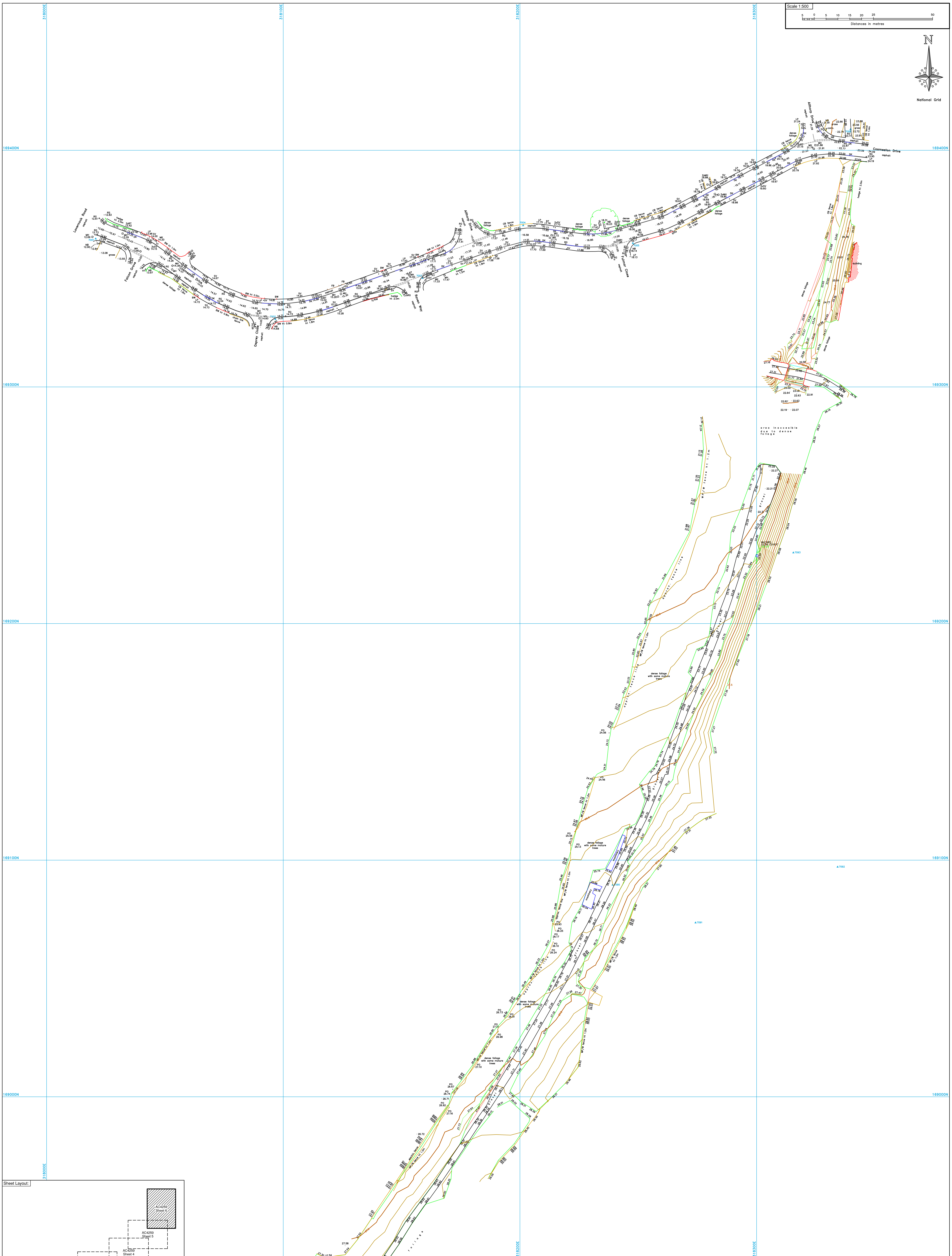

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Abbreviations:

B/RW	brick retaining wall	FFL	finished floor level	RE	rodding eye	ht	height (of feature)
BB	Belisha beacon	FS	flagstaff	RG	road gully	↑	arrow indicates up (unless otherwise stated)
BI	bollard (illuminated)	G/W	gabion wall	RP	reflector post	▲9002	survey control point
BL	bollard	GP	gate post	RS	road sign		
BT	telecom inspection cover	GV	gas valve	RSJ	rolled steel joist		
BW	brick wall	HR	handrail	RWP	rain water pipe		
C/RW	concrete retaining wall	HY	fire hydrant	S/RW	stone retaining wall		
CATV	cable television cover	IC	inspection cover (general)	Sap.	sapling		
CB	close boarded	IR	metal railings	SP	sign post		
CM	corrugated metal	Iwn	interwoven wood slat	SPS	stone paving slabs		
conc.	concrete	JB	junction box	stay	stay wire		
CP/BW	concrete post & barbed wire	KO	kerb outlet	STN	survey control station		
CP/CL	concrete post & chain link	LP	lamp post	SV	water stop valve		
CP/CP	concrete post & panel	MH	manhole	SVP	soil vent pipe		
CP/W	concrete post & wire mesh	MK	marker	tact.	tactile paving		
CPS	concrete paving slabs	MM	metal mesh	THL	threshold level		
DC	drainage channel	MP	mile post	TL	traffic light		
DK	drop kerb	NB	name board	TP	telephone pole		
DR	drain	O/H	overhead	TV	cable tv		
EP	electricity pole	OB	open boarded	VP	vent pipe		
ER	earthing rod	OHC	overhead cable/wire	Wlap	wood lap		
FB	flower bed	P/C	post & chain fence	WM	water meter		
		PA	paling	WP/BW	wood post & barbed wire		
		PO	post	WP/R	wood post & rail		
				WP/W	wood post & wire		

Drainage features:

CL	cover level
ID	invert depth
IL	invert level
FWS	foul water sewer
SWS	storm water sewer
CWS	combined water sewer
UTD	unable to determine
UTL	unable to lift
ø	pipe diameter (mm)
SL	soffit level
←	arrow indicates direction of flow

Notes:

Revisions:

ALS

- Topographical Surveys
- Engineering Surveys
- Measured Building Surveys
- Boundary Surveys
- OS Mapping and Data Centre
- Underground Utility Surveys

AZIMUTH LAND SURVEYS LIMITED
28 CARDIFF ROAD NEWPORT S.WALES NP20 2ED UK
e-mail: enquiries@azimuthgroup.co.uk Web: www.azimuthlandsurveys.co.uk
Tel: 01633 263575 Fax: 01633 213767

Sully to Comeston Active Travel Route.
Sully, Penarth, CF64 5UB.

Topographical Survey - sheet 6 of 6.

Client	Arcadis.						
Coord Grid	Plane Grid related to National Grid			Level Datum	OS Datum via Active GPS		
Scale	1:500@A0	Date	Sep 2022	Status	Final	Job No.	AC4259
Surveyed	N. Fowler	Drawn	L. Rajnohova	Checked	R. Williams	Dwg. No.	AC4259-01

Appendix B

Drawings

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-010-DR-C-00001 FOR SITE LOCATION PLAN
4. REFER TO DRAWINGS 10056562-ARC-AT-010-DR-C-00004-000006 FOR EXISTING SITE PLANS.
6. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
7. REFER TO DRAWINGS 10056562-ARC-AT-110-DR-C-00004-000013 FOR SHEET SETS AND FURTHER DETAIL INFORMATION.
8. REFER TO DRAWINGS 10056562-ARC-AT-130-DR-C-00001-00010 FOR PROPOSED STREET LIGHTING LAYOUTS.
9. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.

LEGEND

- PROPOSED PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- DRIVEWAY CROSSOVER
- PROPOSED RAISED CROSSING
- GRASSED AREA
- PROPOSED VERGE
- PROPOSED EARTHWORKS

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	GJ	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site
Sully to Cosmeston
Cardiff

Client
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
Barry - CF63 4RU
www.valeofglamorgan.gov.uk

ARCADIS

Registered office:
80 Fenchurch Street
London
EC3M 4BY

Coordinating office:
Arcadis Suite 4d,
4th Floor, Hodge House
144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:

ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
OVERVIEW

Designed: G.Jones	Signed: Digitally Signed	Date: 16/10/24
Produced: G.Jones	Signed: Digitally Signed	Date: 16/10/24
Checked: M.Pearson	Signed: Digitally Signed	Date: 18/10/24
Reviewed: S.Davies	Signed: Digitally Signed	Date: 18/10/24
Approved: M.Griffiths	Signed: Digitally Signed	Date: 18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:5000	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00003
Revision: P02

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SCALE 1:500 (A1)
SCALE 1:1000 (A3)

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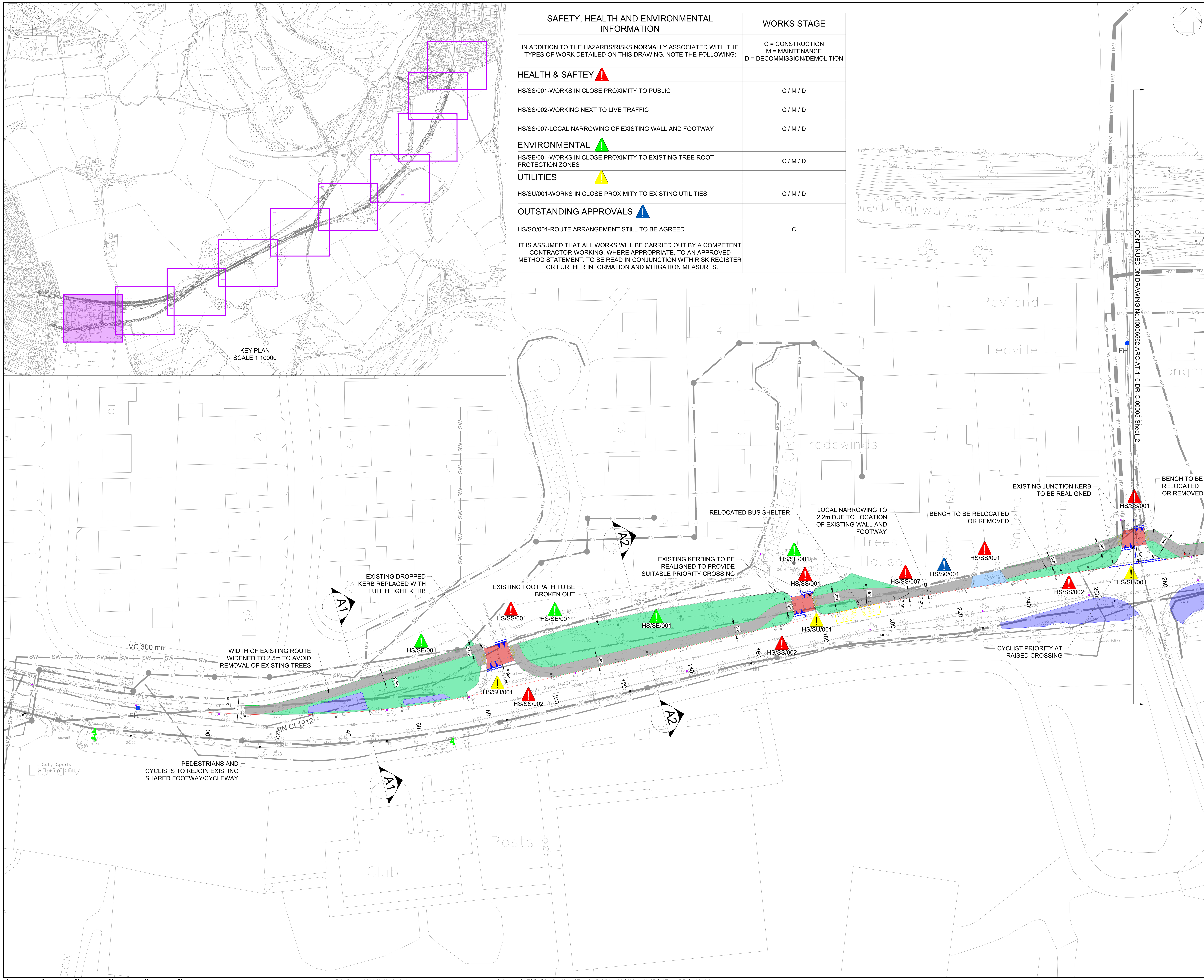

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/002-WORKING NEXT TO LIVE TRAFFIC	C / M / D
HS/SS/007-LOCAL NARROWING OF EXISTING WALL AND FOOTWAY	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
UTILITIES	
HS/SU/001-WORKS IN CLOSE PROXIMITY TO EXISTING UTILITIES	C / M / D
OUTSTANDING APPROVALS	
HS/SO/001-ROUTE ARRANGEMENT STILL TO BE AGREED	C
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW
4. REFER TO DRAWINGS 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- VEHICLE CROSSOVER
- PROPOSED RAISED CROSSING
- GRASSED AREA
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- PROPOSED RAIN GARDEN
- PROPOSED GULLY
- EXISTING GULLY
- PROPOSED STREET LIGHTING
- EXISTING STREET LIGHTING
- PROPOSED SIGN
- EXISTING SIGNS

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	GJ	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site	Client
Sully to Cosmeston Cardiff	Vale of Glamorgan Council Cyngor Bro Morgannwg Civic Offices, Holton Road Barry - CF63 4RU www.valeofglamorgan.gov.uk

ARCADIS

Registered office:	Coordinating office:
80 Fenchurch Street London EC3M 4BY	Arcadis Suite 4d, 4th Floor, Hodge House 144-166 St Mary St, Cardiff CF10 1DY Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT SHEET 1

Designed: G.Jones	Signed: Digitally Signed	Date: 16/10/24
Produced: G.Jones	Signed: Digitally Signed	Date: 16/10/24
Checked: M.Pearson	Signed: Digitally Signed	Date: 18/10/24
Reviewed: S.Davies	Signed: Digitally Signed	Date: 18/10/24
Approved: M.Griffiths	Signed: Digitally Signed	Date: 18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number:	Revision:
10056562 - ARC - AT - 110 - DR - C - 00004	P02

Print Date: 2024-10-18 16:44:32
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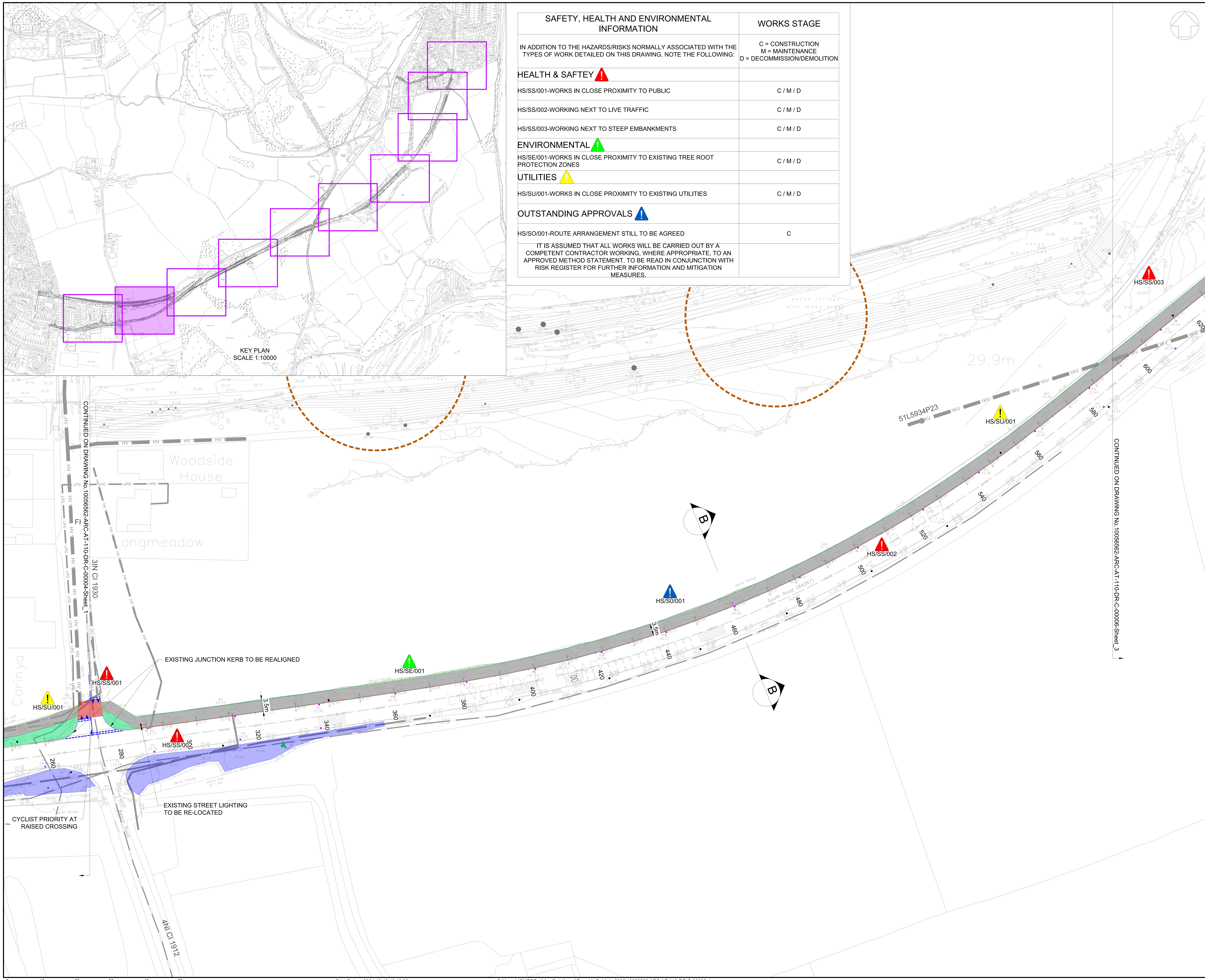

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/002-WORKING NEXT TO LIVE TRAFFIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
UTILITIES	
HS/SU/001-WORKS IN CLOSE PROXIMITY TO EXISTING UTILITIES	C / M / D
OUTSTANDING APPROVALS	
HS/SO/001-ROUTE ARRANGEMENT STILL TO BE AGREED	C
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. THIS DRAWING TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.
7. REFER TO REPORT 10056562-ARC-AT-300-RP-E-00002 FOR POTENTIAL BADGER PATH LOCATIONS.

LEGEND

- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED RAISED CROSSING
- GRASSED AREA
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- PROPOSED RAIN GARDEN
- PROPOSED GULLY
- EXISTING GULLY
- PROPOSED STREET LIGHTING
- EXISTING STREET LIGHTING
- PROPOSED SIGN
- EXISTING SIGNS
- POTENTIAL BADGER PATH LOCATION (SEE NOTE 7)

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

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Tel: 44 (0)29 2092 6700

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Drawing Title:

ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
SHEET 2

	Signed	Date
Designed: D.Doyle	Digitally Signed	10/10/24
Produced: D.Doyle	Digitally Signed	10/10/24
Checked: M.Pearson	Digitally Signed	18/10/24
Reviewed: S.Davies	Digitally Signed	18/10/24
Approved: M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C -00005
Revision: P02

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SCALE 1:500 (A1)
SCALE 1:1000 (A3)

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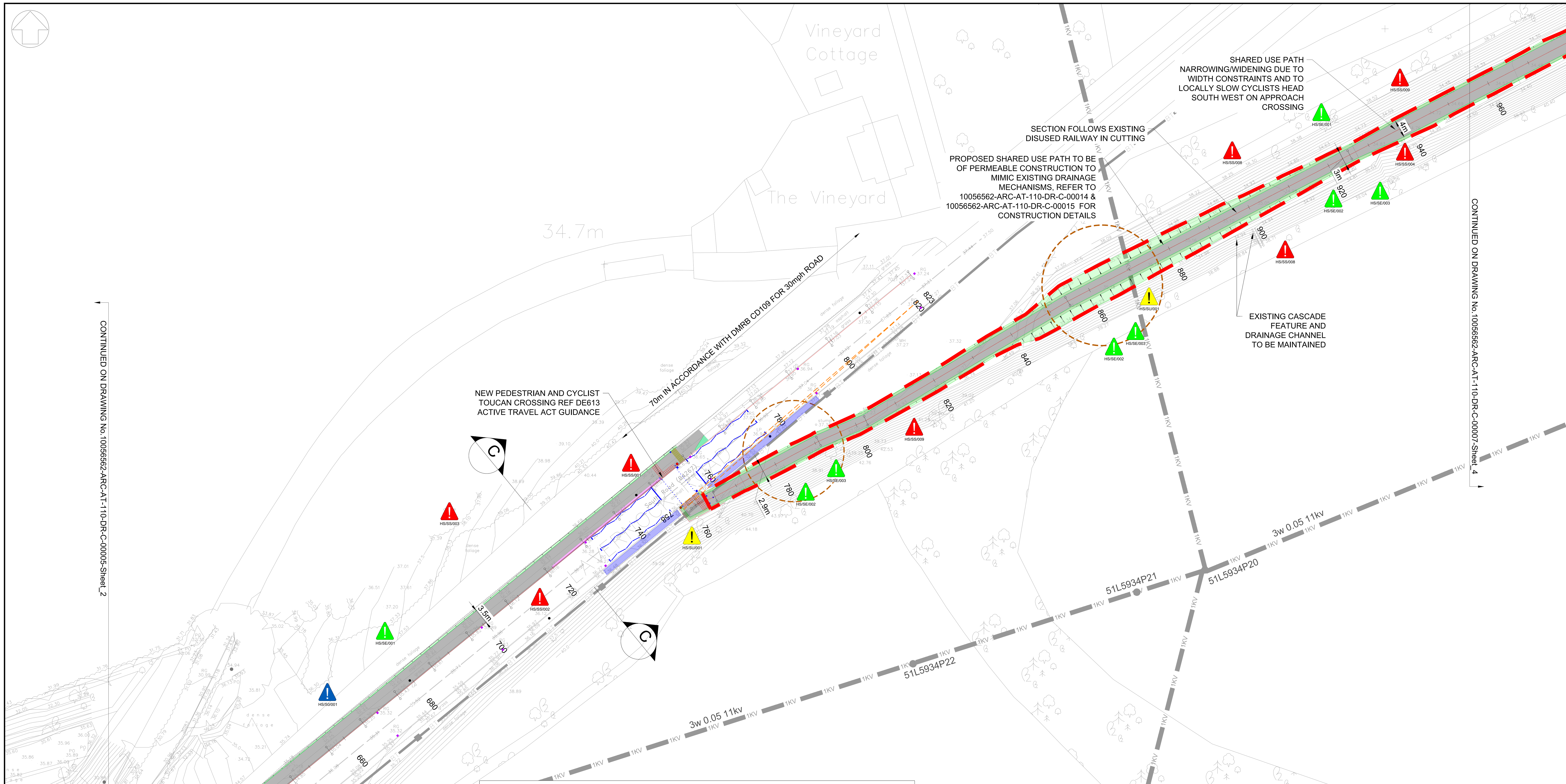
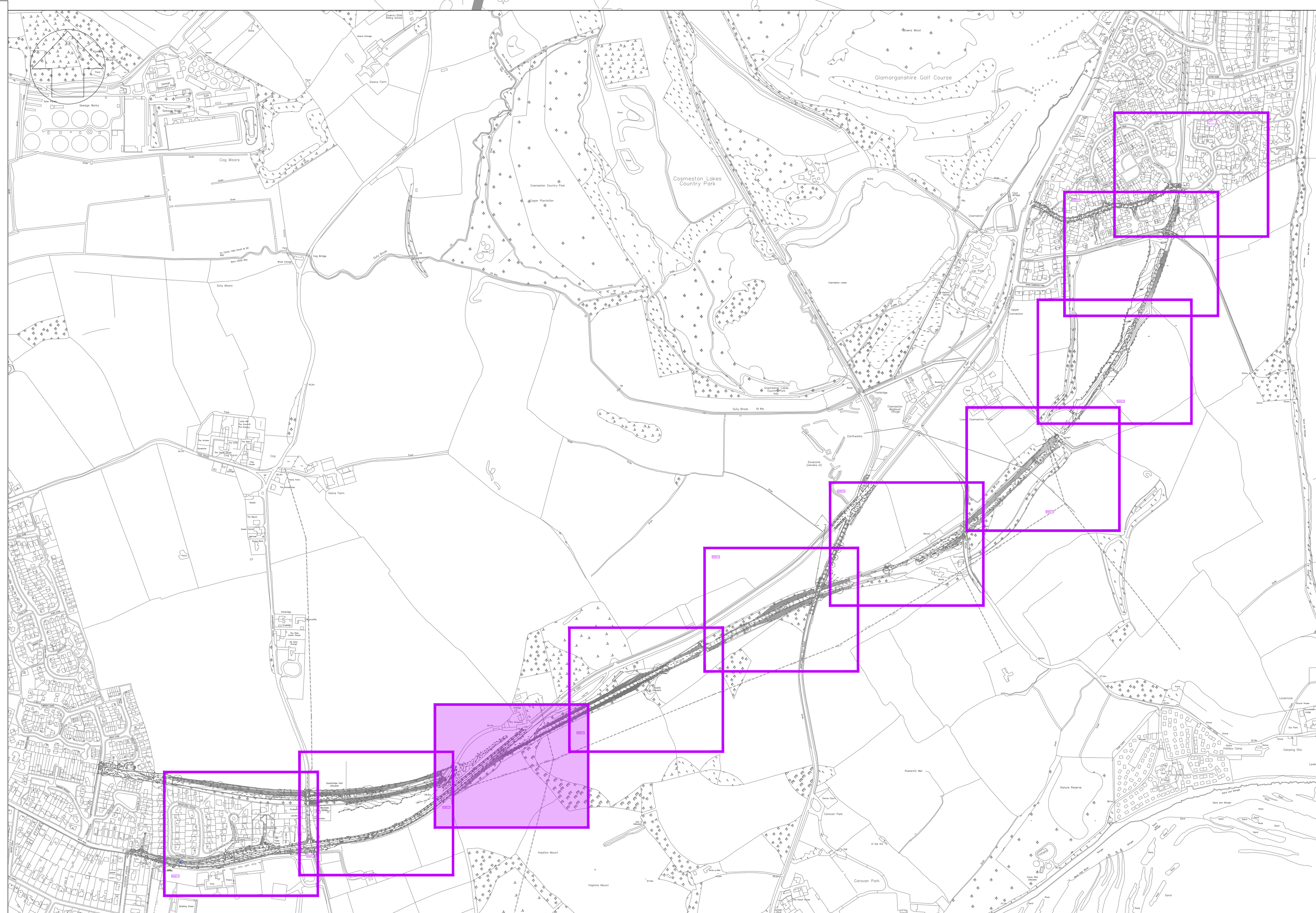


SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/002-WORKING NEXT TO LIVE TRAFFIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/008-WORKING NEXT TO STEEP SOIL CUTTINGS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
H/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
HS/SU/001-WORKS IN CLOSE PROXIMITY TO EXISTING UTILITIES	C / M / D
OUTSTANDING APPROVALS	
HS/SO/001-ROUTE ARRANGEMENT STILL TO BE AGREED	C
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	



KEY PLAN
SCALE 1:10000

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.
7. REFER TO REPORT 10056562-ARC-AT-300-RP-E-00002 FOR POTENTIAL BADGER PATH LOCATIONS.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- PROPOSED RAIN GARDEN
- PROPOSED GULLY
- EXISTING GULLY
- PROPOSED STREET LIGHTING
- EXISTING STREET LIGHTING
- PROPOSED STAGGERED REMOVABLE BOLLARDS
- PROPOSED SIGN
- VISIBILITY SPLAYS
- POTENTIAL BADGER PATH LOCATIONS (SEE NOTE 7)

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
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Coordinating office:
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144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

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Drawing Title:
ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT SHEET 3

Designed:	Signed	Date
D.Doyle	Digitally Signed	10/10/24
Produced: D.Doyle	Digitally Signed	10/10/24
Checked: M.Pearson	Digitally Signed	18/10/24
Reviewed: S.Davies	Digitally Signed	18/10/24
Approved: M.Griffiths	Digitally Signed	18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00006
Revision: P02

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SCALE 1:1000 (A3)

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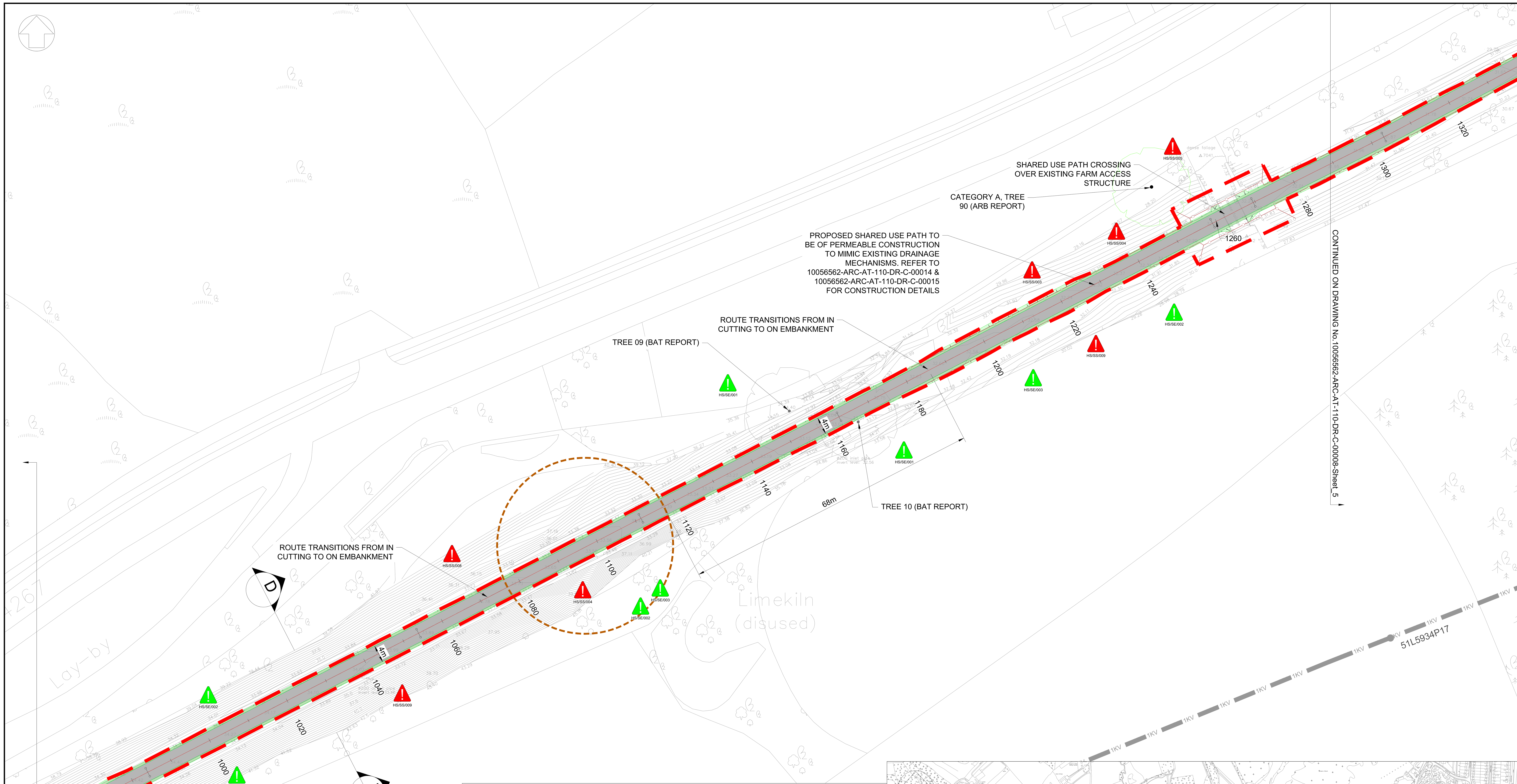
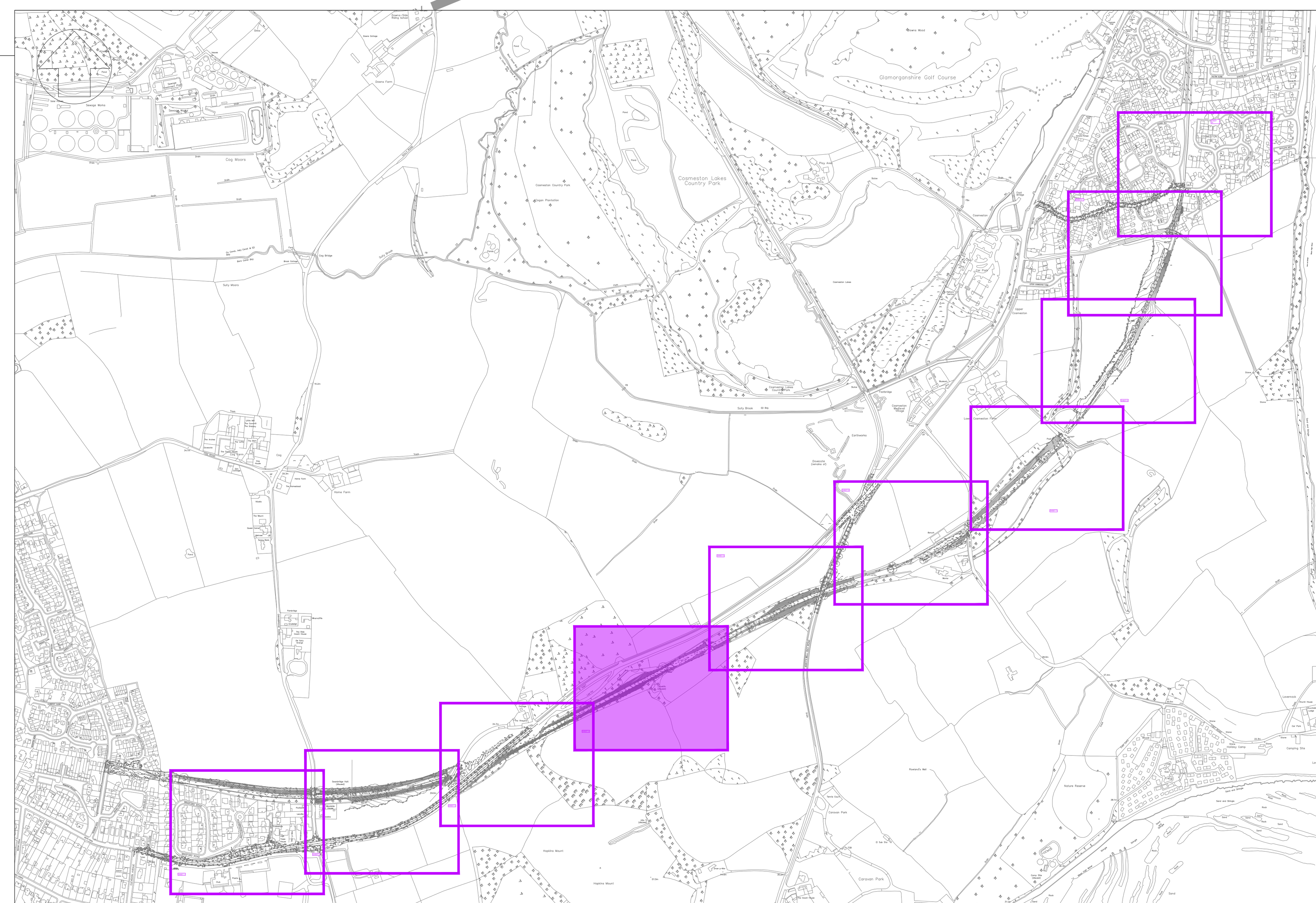


NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. REFER TO REPORT 10056562-ARC-AT-300-RP-E-00002 FOR POTENTIAL BADGER PATH LOCATIONS.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- POTENTIAL BADGER PATH LOCATIONS (SEE NOTE 6)

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/005-EXISTING BRIDGE	C / M / D
HS/SS/008-WORKING NEXT TO STEEP SOIL CUTTINGS	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	



KEY PLAN
SCALE 1:10000

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site
Sully to Cosmeston
Cardiff

Client
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
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EC3M 4BY

Coordinating office:
Arcadis Suite 4d,
4th Floor, Hodge House
144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
SHEET 4

	Signed	Date
Designed: D.Doyle	Digitally Signed	10/10/24
Produced: D.Doyle	Digitally Signed	10/10/24
Checked: M.Pearson	Digitally Signed	18/10/24
Reviewed: S.Davies	Digitally Signed	18/10/24
Approved: M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description: Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00007
Revision: P02

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SCALE 1:500 (A1)
SCALE 1:1000 (A3)

Print Date: 2024-10-18 16:50:59

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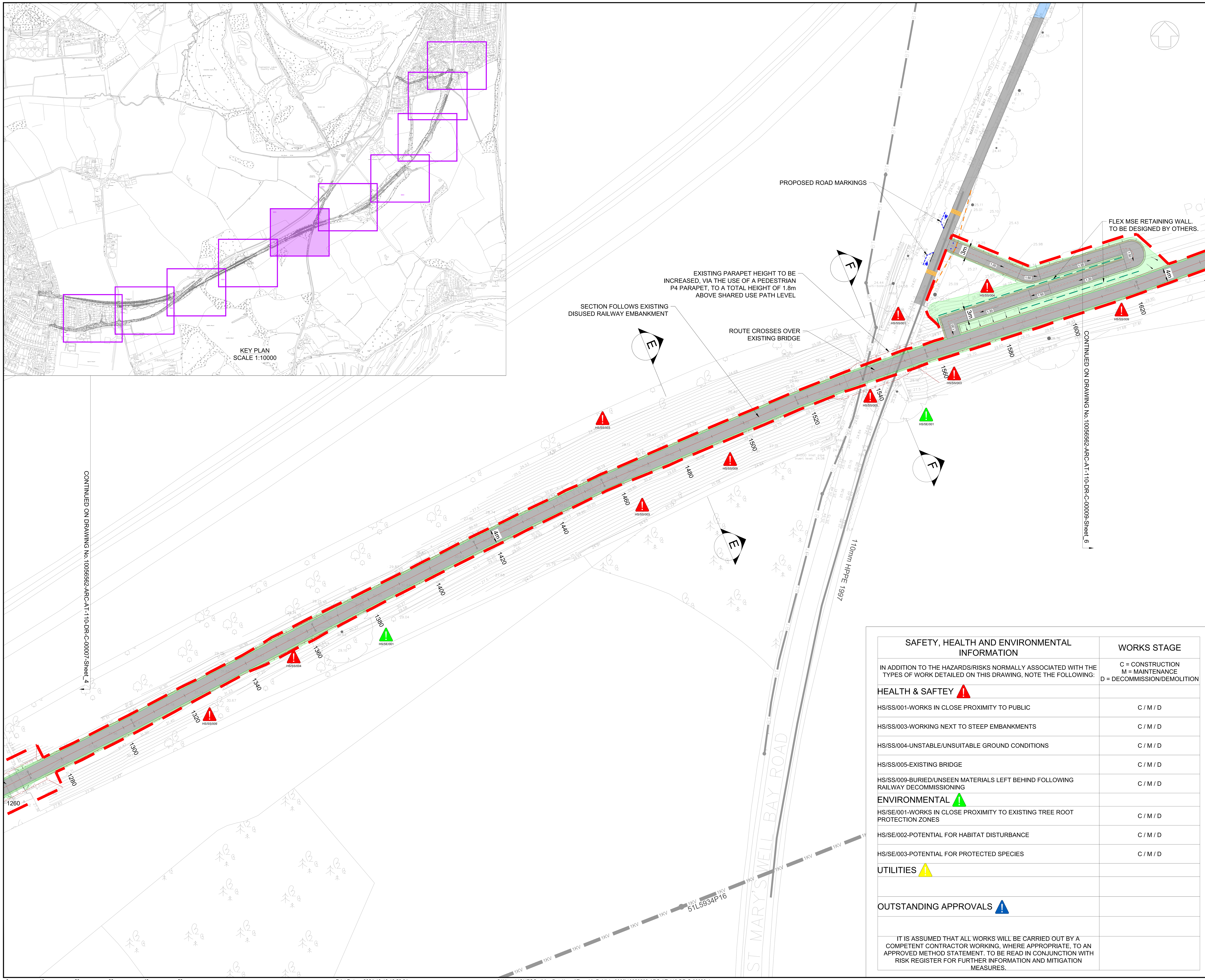

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/005-EXISTING BRIDGE	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- PROPOSED STAGGERED REMOVABLE BOLLARDS
- VISIBILITY SPLAYS

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site
Sully to Cosmeston
Cardiff

Client
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
Barry - CF63 4RU
www.valeofglamorgan.gov.uk

ARCADIS

Registered office:
80 Fenchurch Street
London
EC3M 4BY

Coordinating office:
Arcadis Suite 4d,
4th Floor, Hodge House
144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
SHEET 5

		Signed	Date
Designed:	D.Doyle	Digitally Signed	10/10/24
Produced:	D.Doyle	Digitally Signed	10/10/24
Checked:	M.Pearson	Digitally Signed	18/10/24
Reviewed:	S.Davies	Digitally Signed	18/10/24
Approved:	M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size:	Grid:	Datum:
A1	OS	ODN

Suitability Code:	Scale:	Project Number:
S3	1:500	10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00008
Revision: P02

0 10 20 30 40 50 METRES
SCALE 1:500 (A1)
SCALE 1:1000 (A3)

Print Date: 2024-10-18 16:53:01

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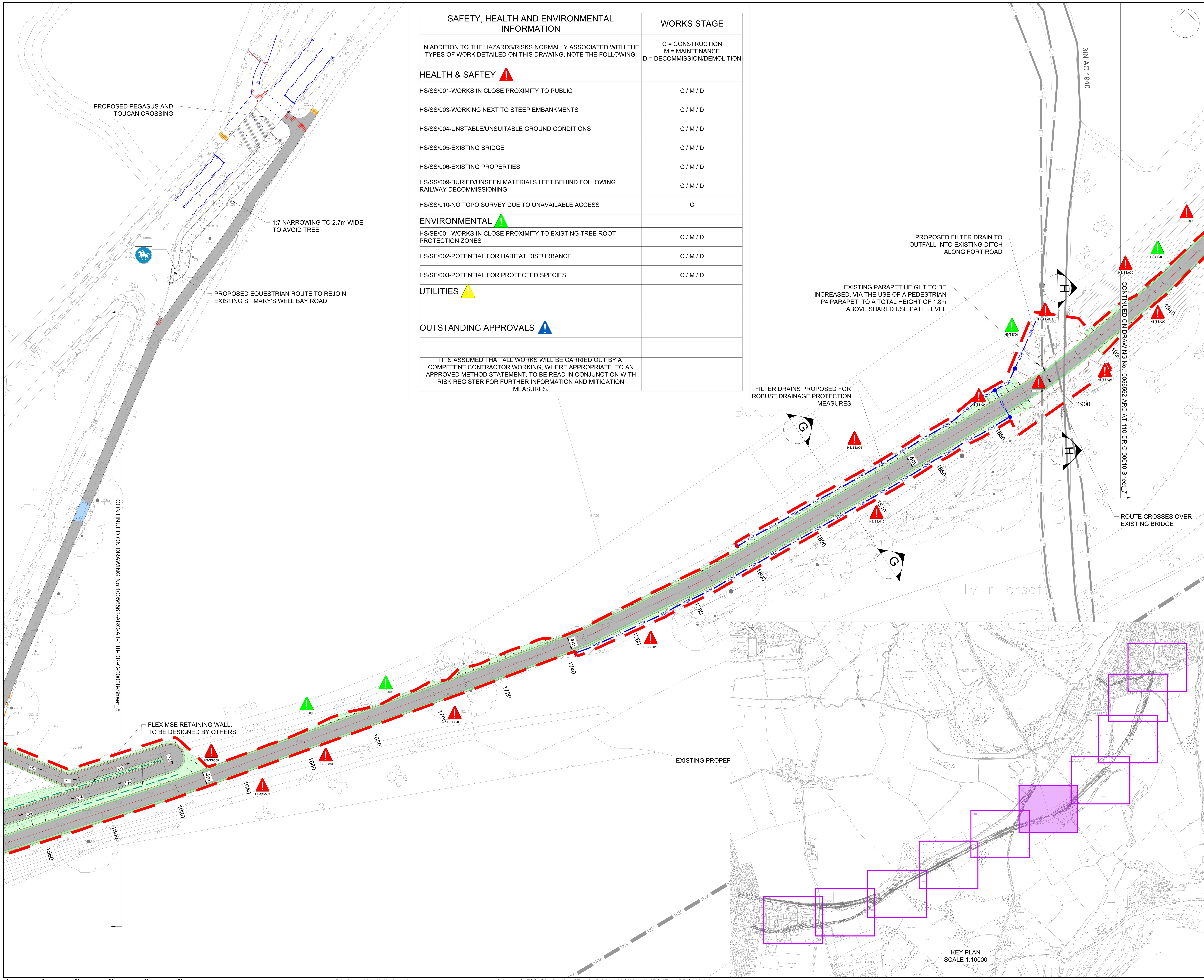
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/005-EXISTING BRIDGE	C / M / D
HS/SS/006-EXISTING PROPERTIES	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
HS/SS/010-NO TOPO SURVEY DUE TO UNAVAILABLE ACCESS	C
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	



NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- FDR — PROPOSED FILTER DRAIN
- CDR — PROPOSED CDR
- PROPOSED INSPECTION MANHOLE

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site: Sully to Cosmeston, Cardiff

Client: Vale of Glamorgan Council, Cyngor Bro Morgannwg, Civic Offices, Holton Road, Barry - CF63 4RU, www.valeofglamorgan.gov.uk

ARCADIS

Registered office: 80 Fenchurch Street, London EC3M 4BY
Coordinating office: Arcadis Suite 4d, 4th Floor, Hodge House, 144-166 St Mary St, Cardiff CF10 1DY, Tel: 44 (0)29 2092 6700
www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
SHEET 6

		Signed	Date
Designed:	D.Doyle	Digitally Signed	10/10/24
Produced:	D.Doyle	Digitally Signed	10/10/24
Checked:	M.Pearson	Digitally Signed	18/10/24
Reviewed:	S.Davies	Digitally Signed	18/10/24
Approved:	M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size:	Grid:	Datum:
A1	OS	ODN

Suitability Code:	Scale:	Project Number:
S3	1:500	10056562

Suitability Description: Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00009
Revision: P02

0 10 20 30 40 50 METRES
SCALE 1:500 (A1)
SCALE 1:1000 (A3)

Print Date: 2024-10-18 16:55:34

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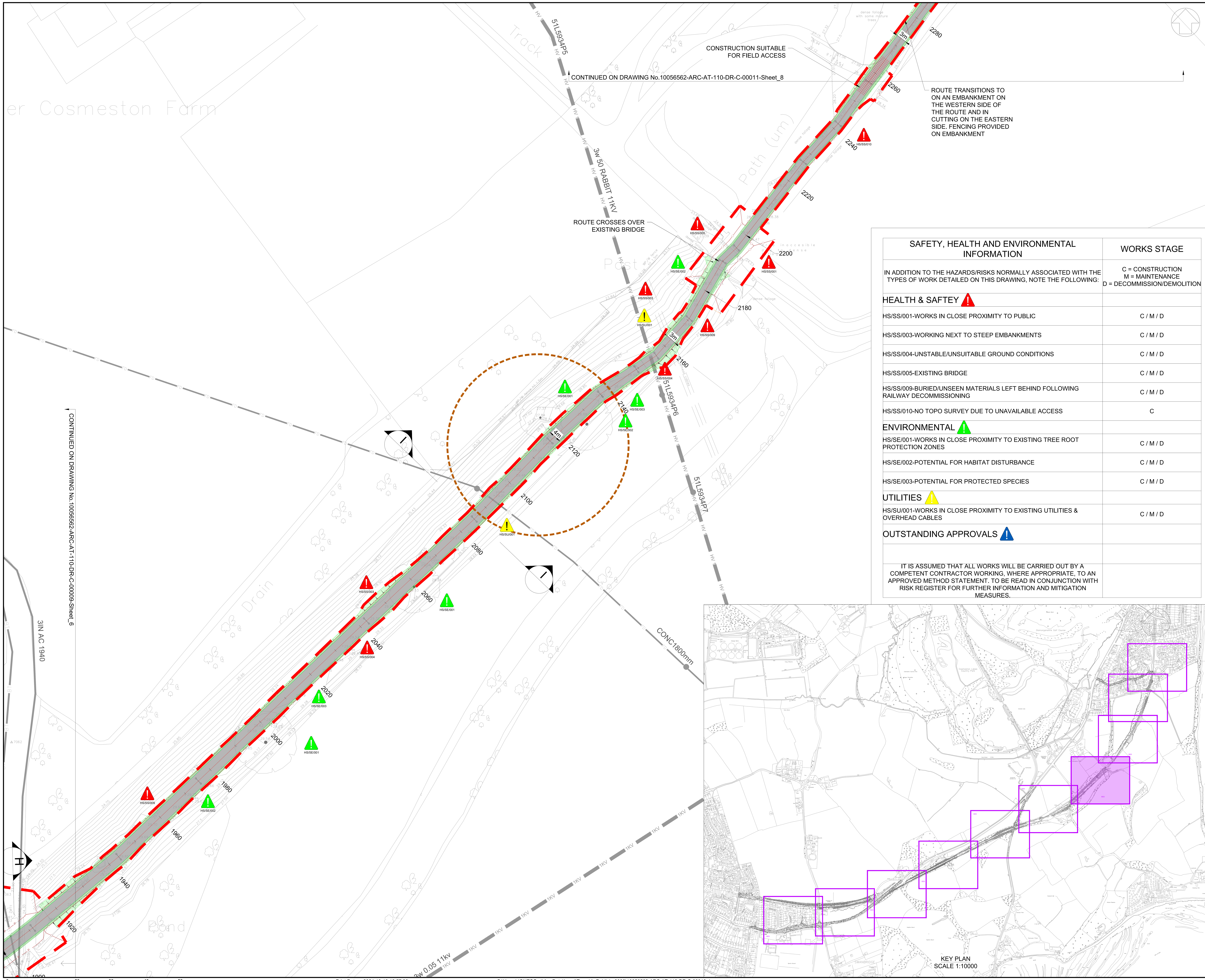


SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/005-EXISTING BRIDGE	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
HS/SS/010-NO TOPO SURVEY DUE TO UNAVAILABLE ACCESS	C
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
HS/SU/001-WORKS IN CLOSE PROXIMITY TO EXISTING UTILITIES & OVERHEAD CABLES	C / M / D
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.
7. REFER TO REPORT 10056562-ARC-AT-300-RP-E-00002 FOR POTENTIAL BADGER PATH LOCATIONS.

LEGEND

- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- POTENTIAL BADGER PATH LOCATIONS (SEE NOTE 7)

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	ISSUED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site	Client
Sully to Cosmeston Cardiff	Vale of Glamorgan Council Cyngor Bro Morgannwg Civic Offices, Holton Road Barry - CF63 4RU www.valeofglamorgan.gov.uk

ARCADIS

Registered office: 80 Fenchurch Street London EC3M 4BY

Coordinating office: Arcadis Suite 4d, 4th Floor, Hodge House 144-166 St Mary St, Cardiff CF10 1DY Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:

ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT SHEET 7

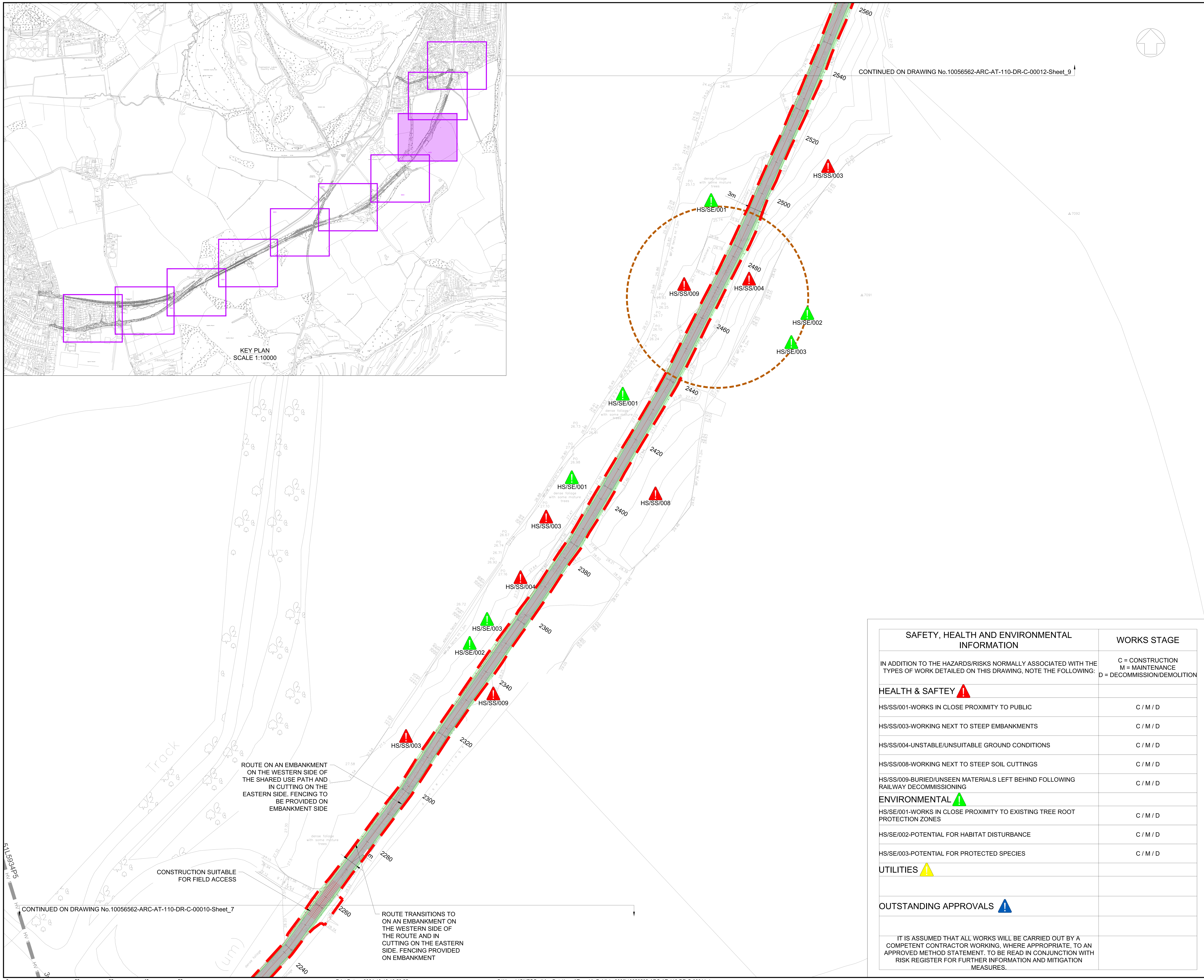
Designed: D.Doyle	Signed: Digitally Signed	Date: 10/10/24
Produced: D.Doyle	Signed: Digitally Signed	Date: 10/10/24
Checked: M.Pearson	Signed: Digitally Signed	Date: 18/10/24
Reviewed: S.Davies	Signed: Digitally Signed	Date: 18/10/24
Approved: M.Griffiths	Signed: Digitally Signed	Date: 18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00010

Revision: P02

Print Date: 2024-10-18 16:57:30   C:\Users\JONESG~1\AppData\Local\Temp\AcPublish_3032\10056562-ARC-AT-110-DR-C-00010.dwg



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/008-WORKING NEXT TO STEEP SOIL CUTTINGS	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.
7. REFER TO REPORT 10056562-ARC-AT-300-RP-E-00002 FOR POTENTIAL BADGER PATH LOCATIONS.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE
- POTENTIAL BADGER PATH LOCATIONS (SEE NOTE 7)

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site
Sully to Cosmeston
Cardiff

Client
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
Barry - CF63 4RU
www.valeofglamorgan.gov.uk

ARCADIS
Registered office:
80 Fenchurch Street
London
EC3M 4BY

Coordinating office:
Arcadis Suite 4d,
4th Floor, Hodge House
144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE
GENERAL ARRANGEMENT
SHEET 8

Designed:	Signed	Date
D.Doyle	Digitally Signed	10/10/24
Produced: D.Doyle	Digitally Signed	10/10/24
Checked: M.Pearson	Digitally Signed	18/10/24
Reviewed: S.Davies	Digitally Signed	18/10/24
Approved: M.Griffiths	Digitally Signed	18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00011
Revision: P02

0 10 20 30 40 50 METRES
SCALE 1:500 (A1)
SCALE 1:1000 (A3)

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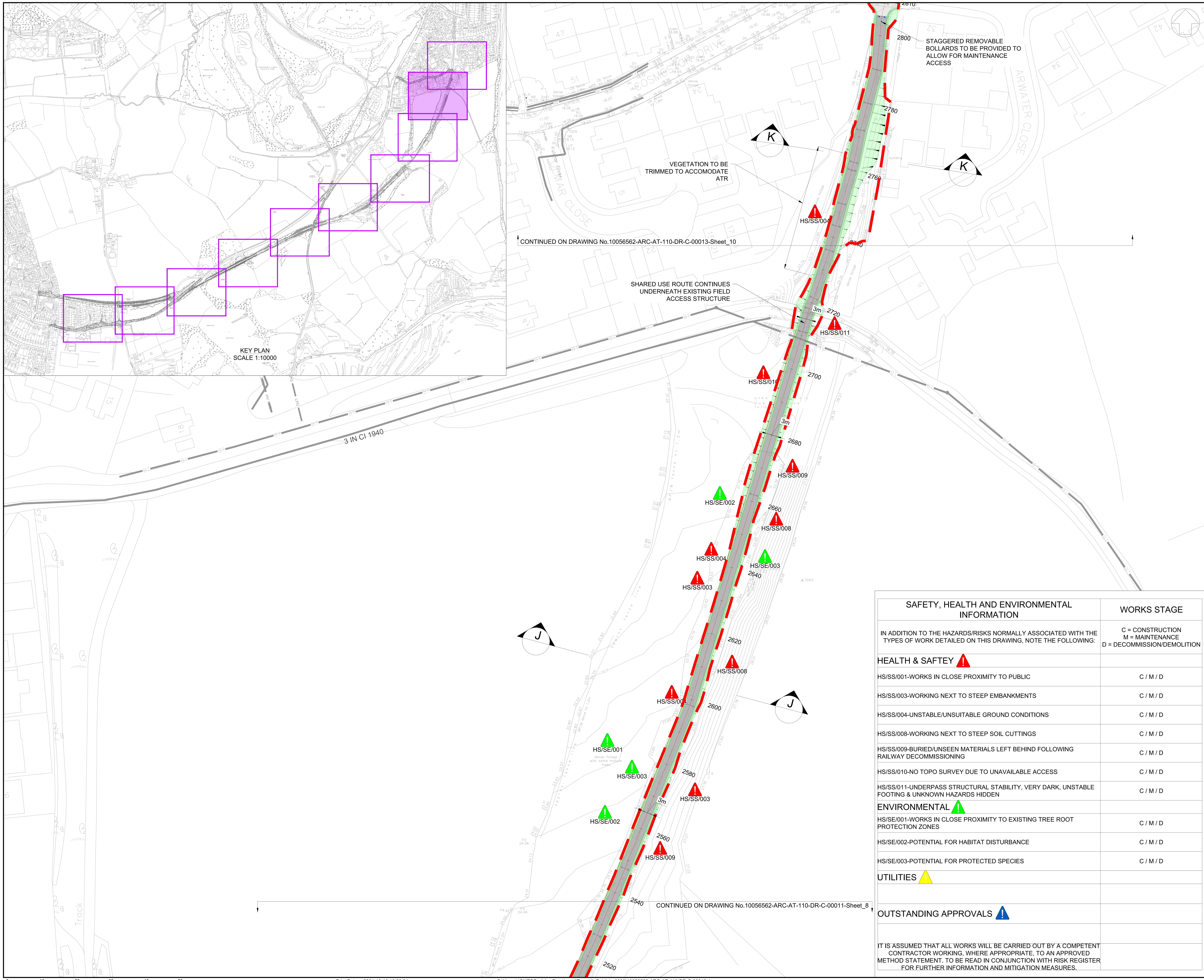

CONTINUED ON DRAWING No.10056562-ARC-AT-110-DR-C-00013-Sheet_10

CONTINUED ON DRAWING No.10056562-ARC-AT-110-DR-C-00011-Sheet_8

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/003-WORKING NEXT TO STEEP EMBANKMENTS	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/008-WORKING NEXT TO STEEP SOIL CUTTINGS	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
HS/SS/010-NO TOPO SURVEY DUE TO UNAVAILABLE ACCESS	C / M / D
HS/SS/011-UNDERPASS STRUCTURAL STABILITY, VERY DARK, UNSTABLE FOOTING & UNKNOWN HAZARDS HIDDEN	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.

LEGEND

- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- PROPOSED FENCE

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	DD	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site	Client
Sully to Cosmeston Cardiff	Vale of Glamorgan Council Cyngor Bro Morgannwg Civic Offices, Holton Road Barry - CF63 4RU www.valeofglamorgan.gov.uk

ARCADIS

Registered office:
80 Fenchurch Street
London
EC3M 4BY

Coordinating office:
Arcadis Suite 4d,
4th Floor, Hodge House
144-166 St Mary St,
Cardiff CF10 1DY
Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:
ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT SHEET 9

Designed: D.Doyle	Signed: Digitally Signed	Date: 10/10/24
Produced: D.Doyle	Signed: Digitally Signed	Date: 10/10/24
Checked: M.Pearson	Signed: Digitally Signed	Date: 18/10/24
Reviewed: S.Davies	Signed: Digitally Signed	Date: 18/10/24
Approved: M.Griffiths	Signed: Digitally Signed	Date: 18/10/24
Design Stage: Preliminary Design		
Original Size: A1	Grid: OS	Datum: ODN
Suitability Code: S3	Scale: 1:500	Project Number: 10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00012
Revision: P02

0 10 20 30 40 50
METRES
SCALE 1:500 (A1)
SCALE 1:1000 (A3)

Print Date: 2024-10-18 16:59:21

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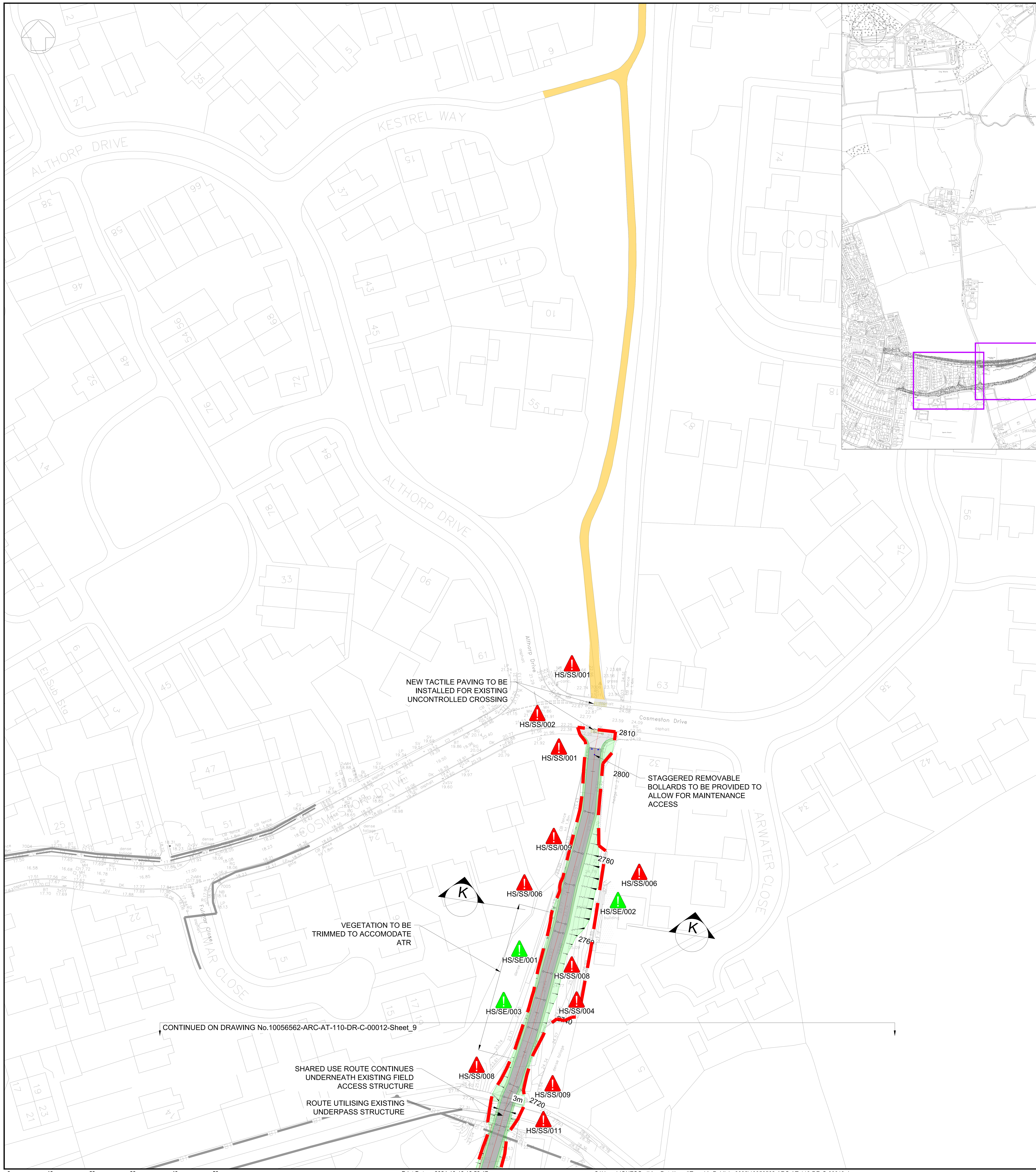

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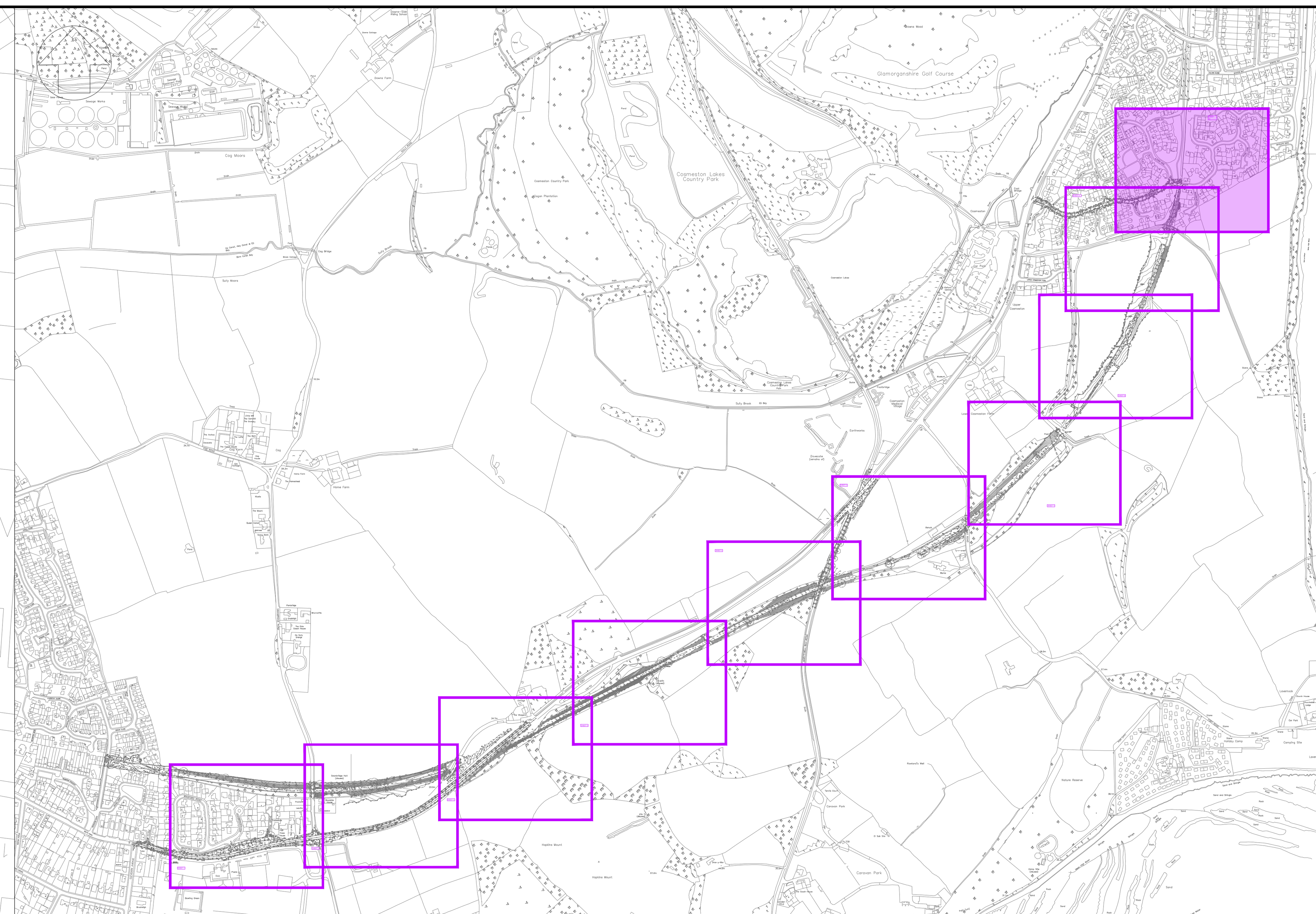

KEY PLAN
SCALE 1:10000

NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003 FOR GENERAL ARRANGEMENT OVERVIEW.
4. REFER TO DRAWING 10056562-ARC-AT-072-DR-C-00001 & 00003 FOR TYPICAL CROSS SECTIONS.
5. REFER TO DRAWING 10056562-ARC-AT-051-DR-C-00001 FOR EXISTING UTILITIES LAYOUT.
6. THE DESIGN IS BASED ON THE ASSUMPTION THAT THE POSTED SPEED LIMIT IS REDUCED FROM 40mph TO 30mph.

LEGEND
- PLANNING BOUNDARY
- PROPOSED SHARED FOOTWAY/CYCLEWAY
- PROPOSED VERGE
- PROPOSED EARTHWORKS
- EXISTING FOOTWAY/CYCLEWAY
- PROPOSED FENCE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	WORKS STAGE
IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:	C = CONSTRUCTION M = MAINTENANCE D = DECOMMISSION/DEMOLITION
HEALTH & SAFTEY	
HS/SS/001-WORKS IN CLOSE PROXIMITY TO PUBLIC	C / M / D
HS/SS/002-WORKING NEXT TO LIVE TRAFFIC	C / M / D
HS/SS/004-UNSTABLE/UNSUITABLE GROUND CONDITIONS	C / M / D
HS/SS/006-EXISTING PROPERTIES	C / M / D
HS/SS/008-WORKING NEXT TO STEEP SOIL CUTTINGS	C / M / D
HS/SS/009-BURIED/UNSEEN MATERIALS LEFT BEHIND FOLLOWING RAILWAY DECOMMISSIONING	C / M / D
HS/SS/011-UNDERPASS STRUCTURAL STABILITY, VERY DARK, UNSTABLE FOOTING & UNKNOWN HAZARDS HIDDEN	C / M / D
ENVIRONMENTAL	
HS/SE/001-WORKS IN CLOSE PROXIMITY TO EXISTING TREE ROOT PROTECTION ZONES	C / M / D
HS/SE/002-POTENTIAL FOR HABITAT DISTURBANCE	C / M / D
HS/SE/003-POTENTIAL FOR PROTECTED SPECIES	C / M / D
UTILITIES	
OUTSTANDING APPROVALS	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. TO BE READ IN CONJUNCTION WITH RISK REGISTER FOR FURTHER INFORMATION AND MITIGATION MEASURES.	

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MT	MG
P02	18/10/24	UPDATED FOR PLANNING	GJ	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site:
Sully to Cosmeston
Cardiff

Client:
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
Barry - CF63 4RU
www.valeofglamorgan.gov.uk

ARCADIS

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EC3M 4BY

Coordinating office:
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Drawing Title:

ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT SHEET 10

		Signed	Date
Designed:	G.Jones	Digitally Signed	14/10/24
Produced:	G.Jones	Digitally Signed	14/10/24
Checked:	M.Pearson	Digitally Signed	18/10/24
Reviewed:	S.Davies	Digitally Signed	18/10/24
Approved:	M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size:	Grid:	Datum:
A1	OS	ODN

Suitability Code:	Scale:	Project Number:
S3	1:500	10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 110 - DR - C - 00013
Revision: P02

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SCALE 1:1000 (A3)

Print Date: 2024-10-18 16:59:47

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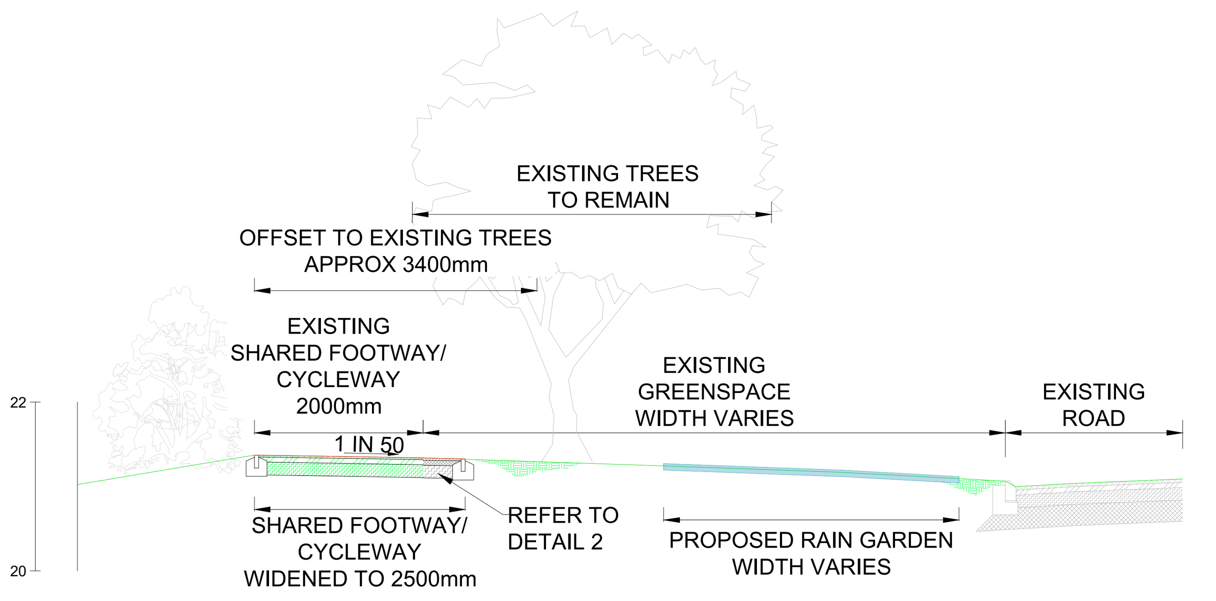

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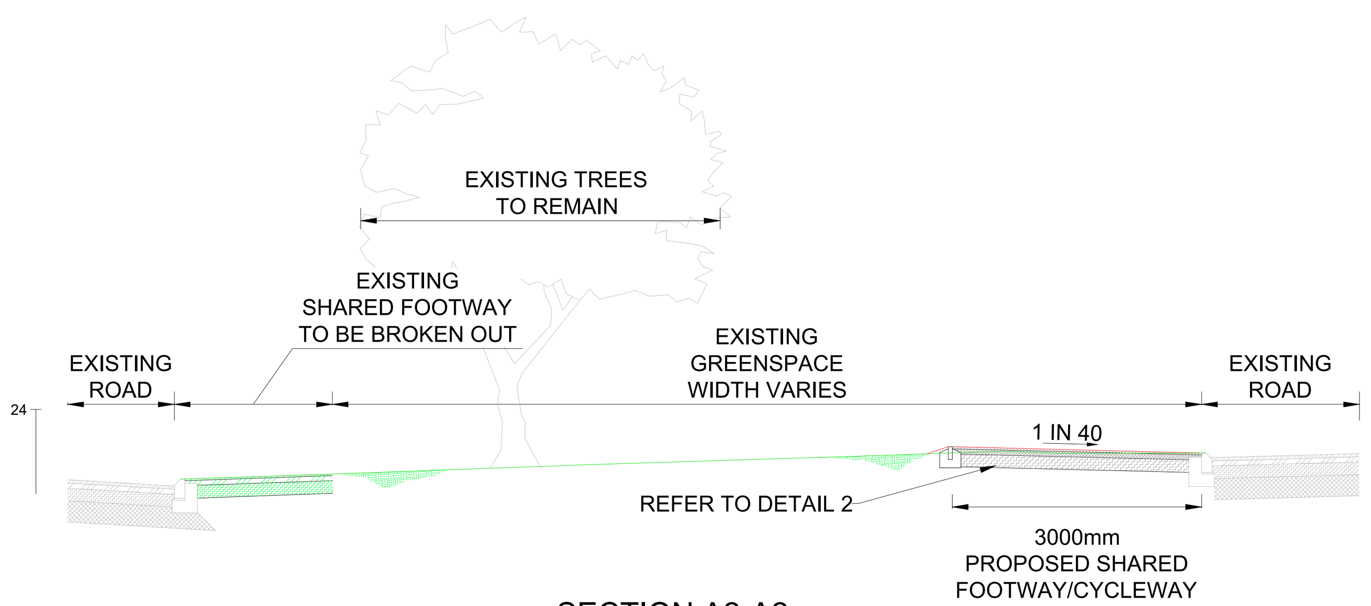

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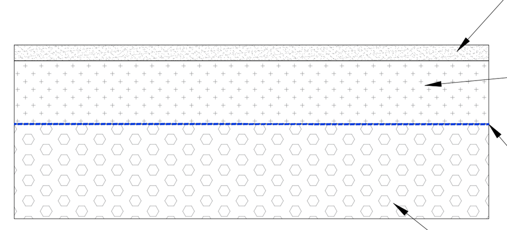


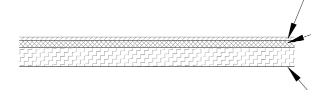
DETAIL 1: TRAILFLEX POROUS PAVING OVER DISUSED RAILWAY CONSTRUCTION DETAILS
1:20

SURFACE COURSE 50mm THICK:
TRAILFLEX™ POROUS PAVING COMPRISING RESIN BOUND AGGREGATES AND RECYCLED MATERIAL.

SUB-BASE COURSE MIN. 100mm THICK:
MINIMUM 100mm OF TYPE 3 GRANULAR SUB-BASE. ADDITIONAL BUILDUP TO 50mm BELOW PROPOSED SURFACE LEVELS WHERE REQUIRED FOR FINISHED SURFACE LEVELS. MATERIAL TO CONFORM TO BS EN 13285 AND SHW CLAUSE 801 AND 803. COURSE LAID AND COMPACTED TO SHW CLAUSE 802.

GEOTEXTILE:
PERMEABLE NON-WOVEN GEOTEXTILE AS PER TERRAM T1000 OR SIMILAR APPROVED BETWEEN TYPE 3 AND EXISTING RAILWAY BALLAST LAYERS.

EXISTING RAILWAY BALLAST:

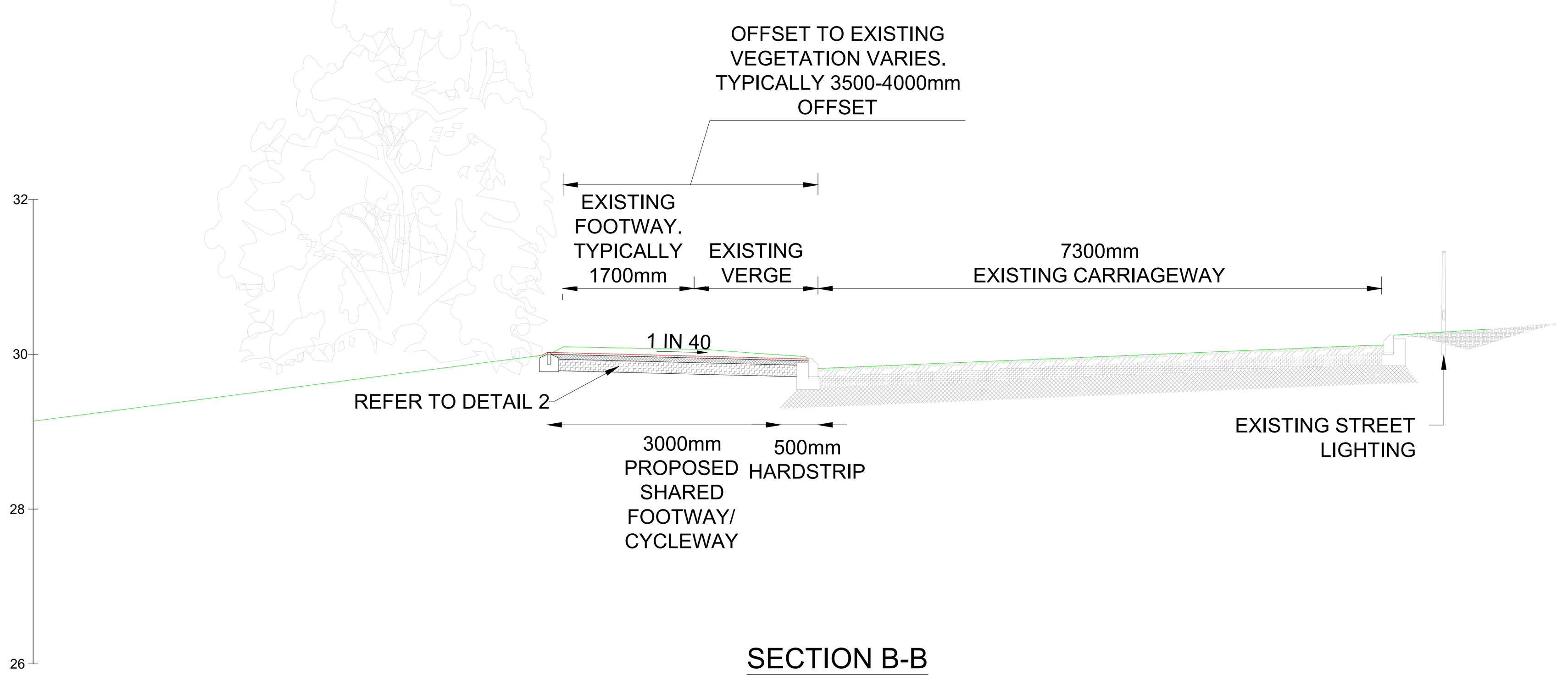


DETAIL 2: FLEXIBLE PAVING CONSTRUCTION
SCALE 1:50

SURFACE COURSE: 25mm THICKNESS OF 6mm DENSE ASPHALT CONCRETE SURFACE COURSE CONFORMING TO BS EN 13108-1 AND CLAUSE 909 OF THE SPECIFICATIONS FOR HIGHWAY WORKS, AMENDED NOVEMBER 2008.WITH A MINIMUM AGGREGATE PSV VALUE OF 65 AND A MAXIMUM AAV OF 14. (AC6 DENSE SURF 100/50 - PSV 65, AAV 14). NOTE LIMESTONE AGGREGATE WILL NOT BE PERMITTED IN ANY SURFACE COURSE.

BINDER COURSE: 60mm THICKNESS OF 20mm DENSE BASE AND BINDER COURSE ASPHALT CONCRETE (RECIPE MIXTURES) CONFORMING TO BS EN 13108-1 AND CLAUSE 906 OF THE SPECIFICATIONS FOR HIGHWAY WORKS, AMENDED NOVEMBER 2008 WITH A MINIMUM AGGREGATE PSV VALUE OF 65 AND A MAXIMUM AAV OF 14. (AC20 DENSE BIN 160/220 REC - PSV 65, AAV 14).

SUB BASE: 150mm THICKNESS OF TYPE 1 UNBOUND GRANULAR MATERIAL CONFORMING TO BS EN 13285 : 2003 AND CLAUSE 803 OF THE SPECIFICATIONS FOR HIGHWAY WORKS, AMENDED NOVEMBER 2007 AN TRANSPORTED, LAID, COMPACTED AND TRAFFICKED IN ACCORDANCE CLAUSE 802 OF THE SPECIFICATIONS FOR HIGHWAY WORKS, AMENDED NOVEMBER 2004.



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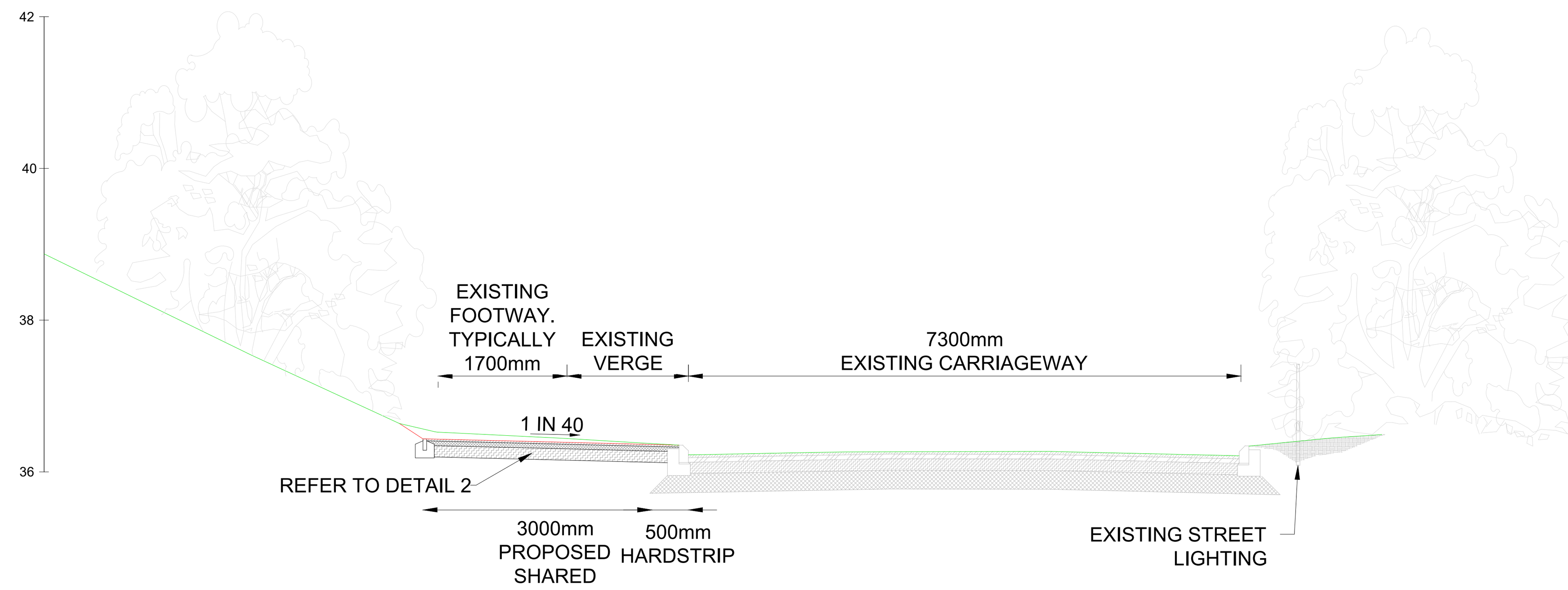

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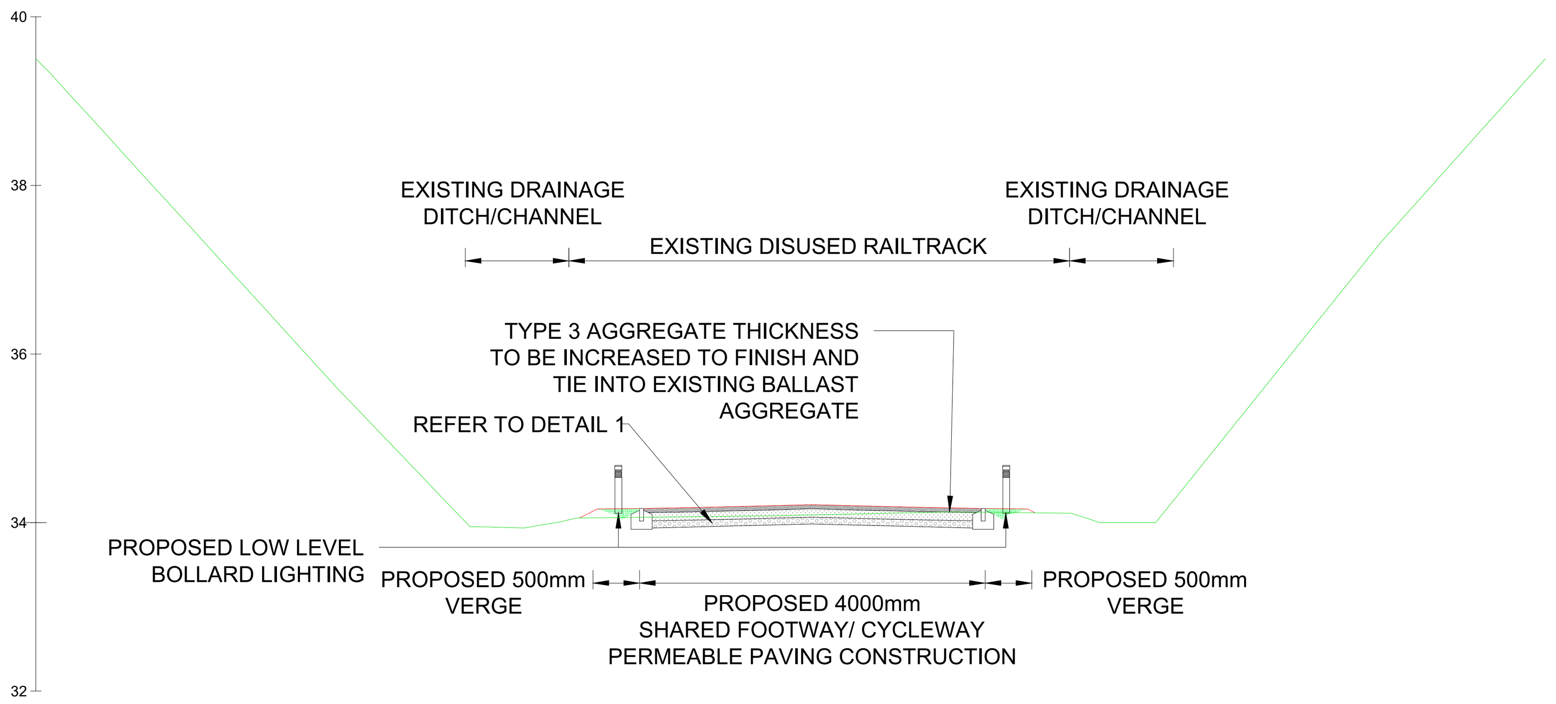

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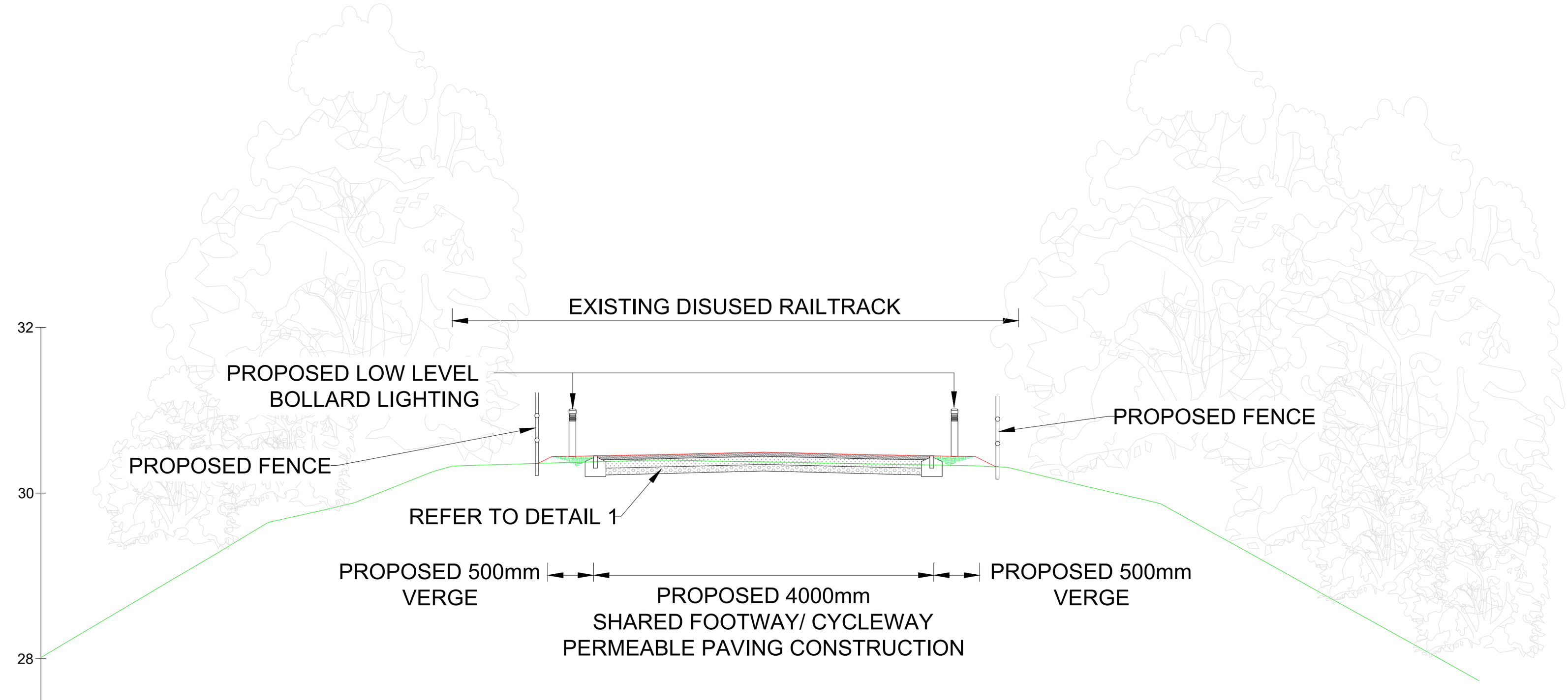

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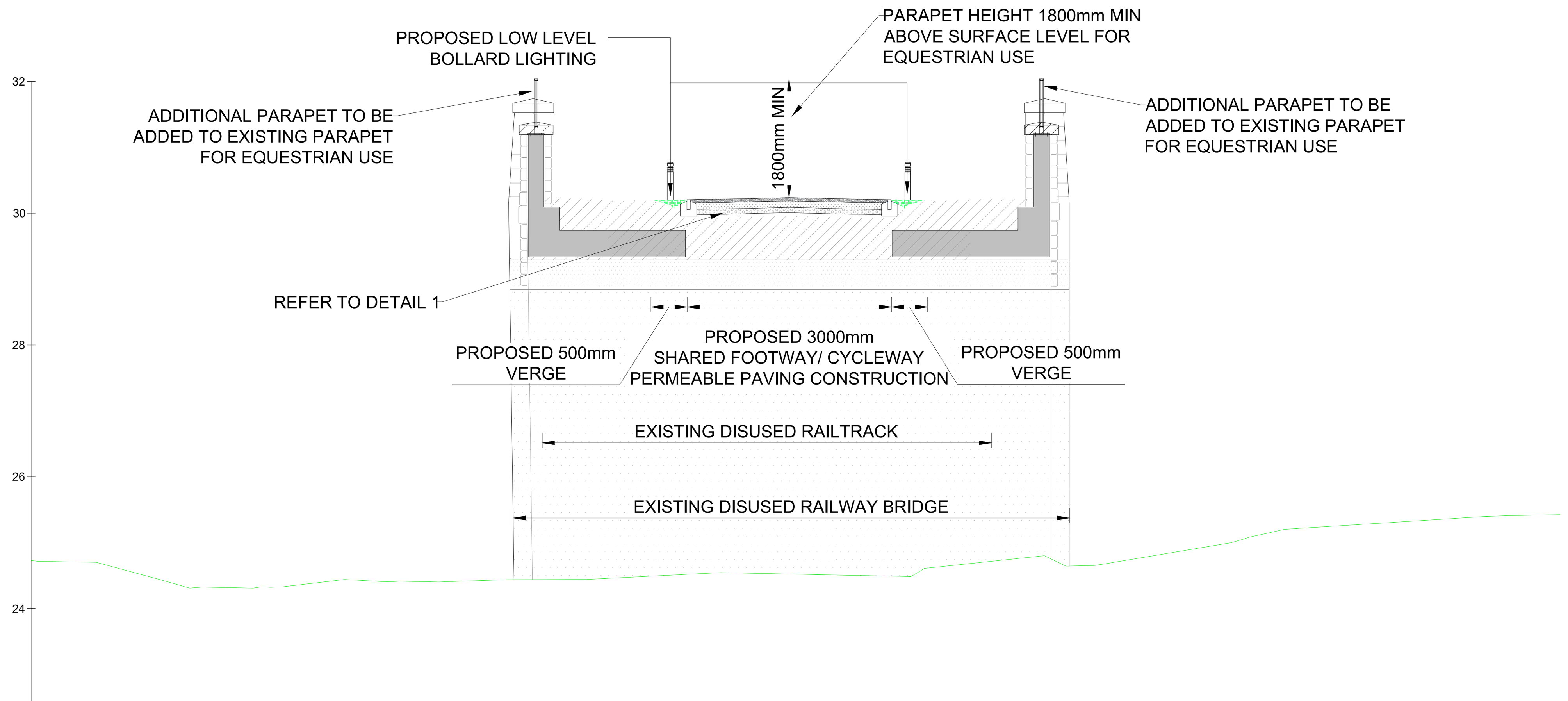

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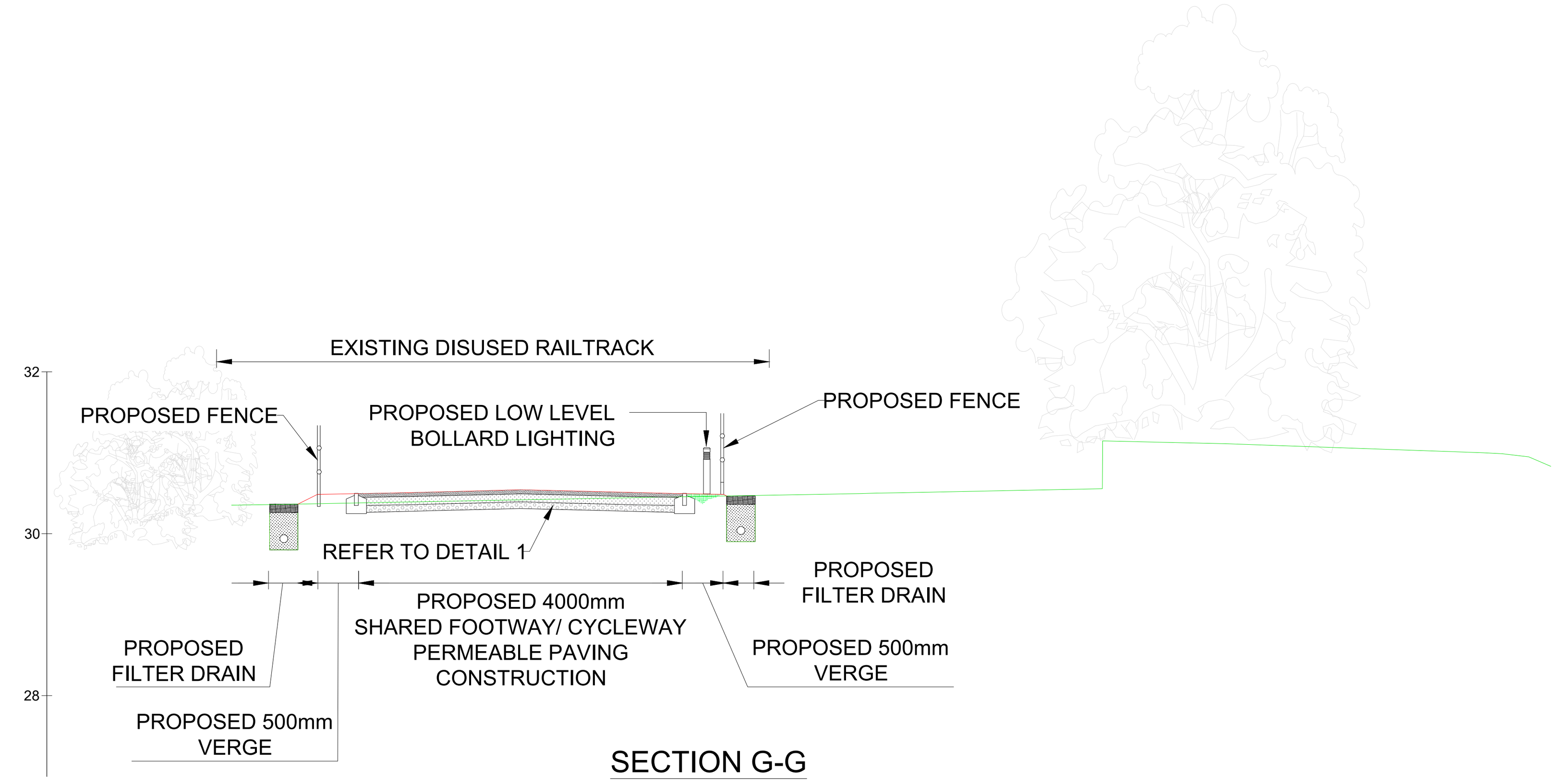

SECTION G-G

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NOTES:
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2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
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4. REFER TO DRAWING 10056562-ARC-XX-030-DR-C-00001 FOR ADDITIONAL PROPOSED PARAPET DETAIL.

KEY
- PROPOSED SURFACE
- EXISTING SURFACE

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	10/03/23	FIRST ISSUE	GJ	CH	MG	MG
P02	18/10/24	UPDATED FOR PLANNING	GJ	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project:
Sully to Cosmeston ATR

Site
Sully to Cosmeston
Cardiff

Client
Vale of Glamorgan Council
Cyngor Bro Morgannwg
Civic Offices, Holton Road
Barry - CF63 4RU
www.valeofglamorgan.gov.uk

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Drawing Title:
TYPICAL CROSS SECTIONS
SHEET 1

		Signed	Date
Designed:	G.Jones	Digitally Signed	18/10/24
Produced:	G.Jones	Digitally Signed	18/10/24
Checked:	M.Pearson	Digitally Signed	18/10/24
Reviewed:	S.Davies	Digitally Signed	18/10/24
Approved:	M.Griffiths	Digitally Signed	18/10/24

Design Stage: Preliminary Design

Original Size:	Grid:	Datum:
A1	OS	ODN
Suitability Code:	**Scale:**	**Project Number:**
S3	AS SHOWN	10056562

Suitability Description:
Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 072 - DR - C -00001
Revision: P02

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Print Date: 2024-10-18 16:42:49

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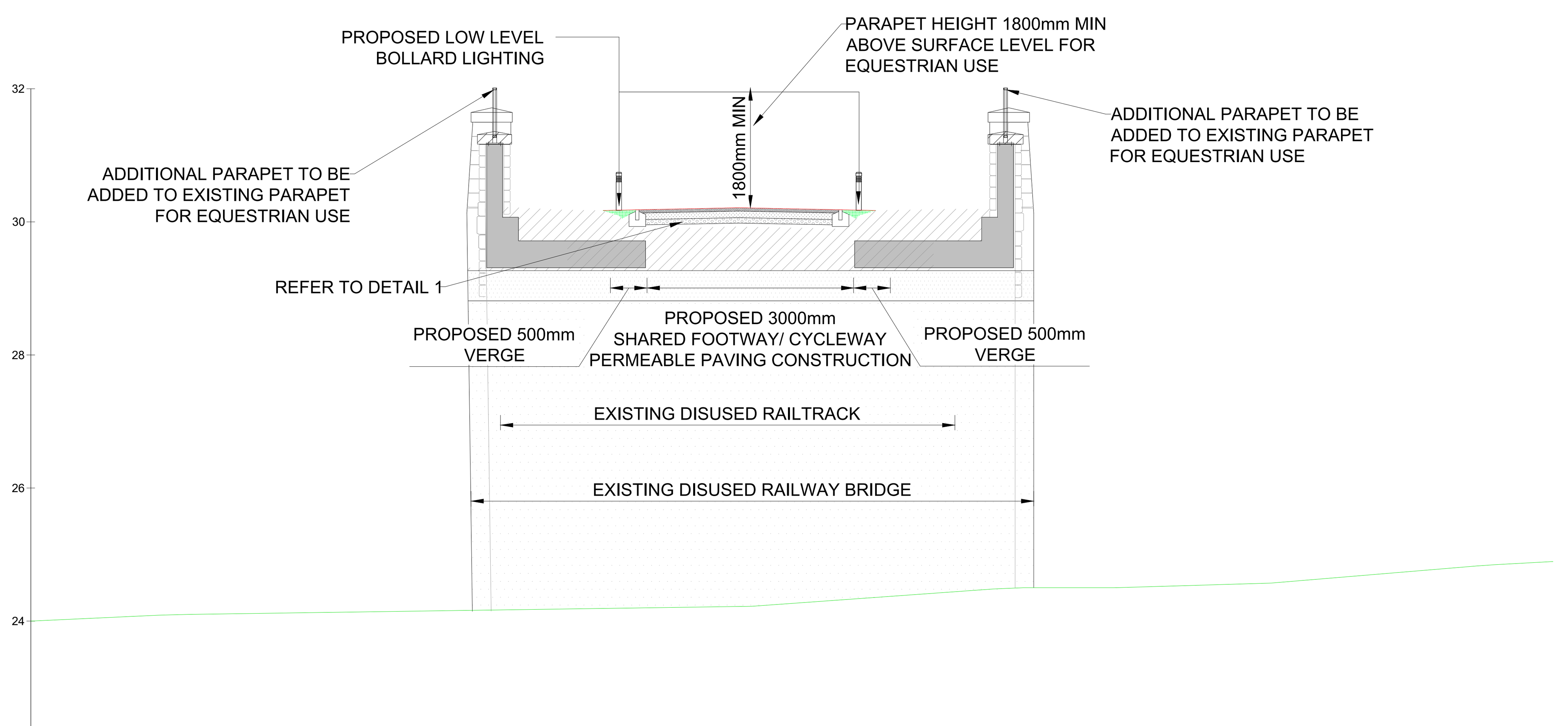
NOTES:
1. DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
2. ALL UNITS IN METRES UNLESS STATED OTHERWISE.
3. REFER TO DRAWING 10056562-ARC-AT-110-DR-C-00003-00013 ACTIVE TRAVEL ROUTE GENERAL ARRANGEMENT FOR SECTION LOCATION

KEY
PROPOSED SURFACE
EXISTING SURFACE



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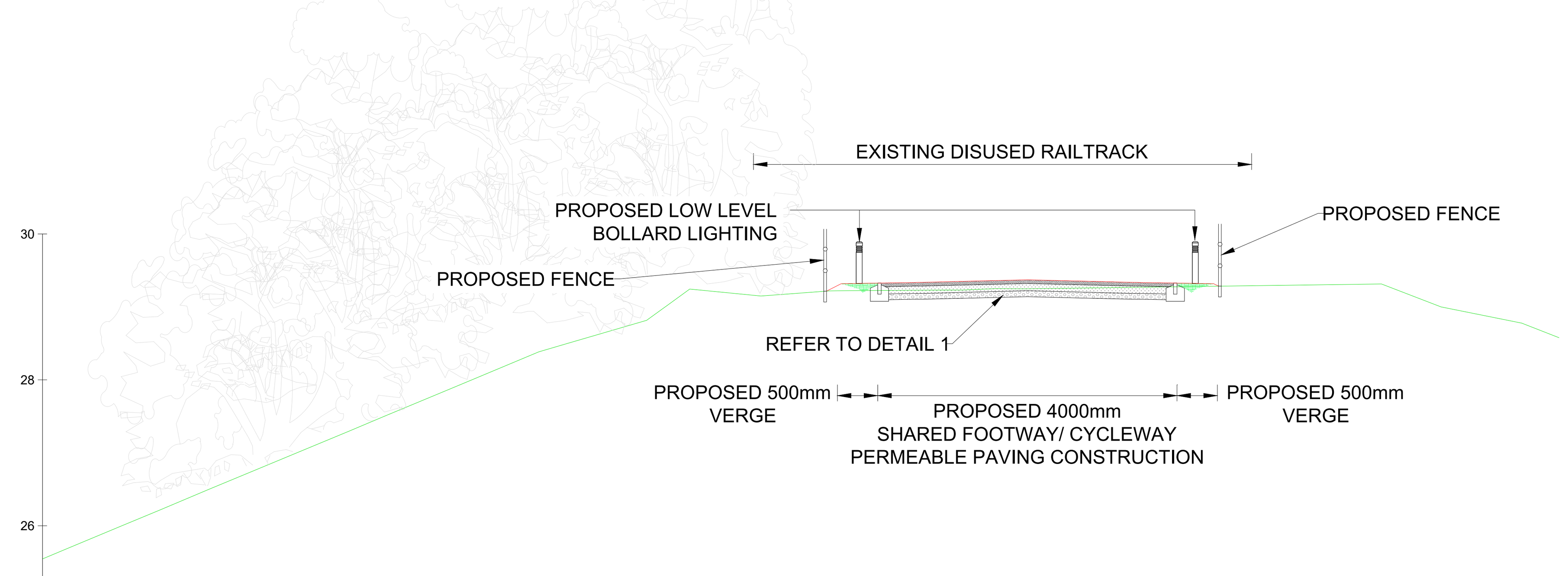

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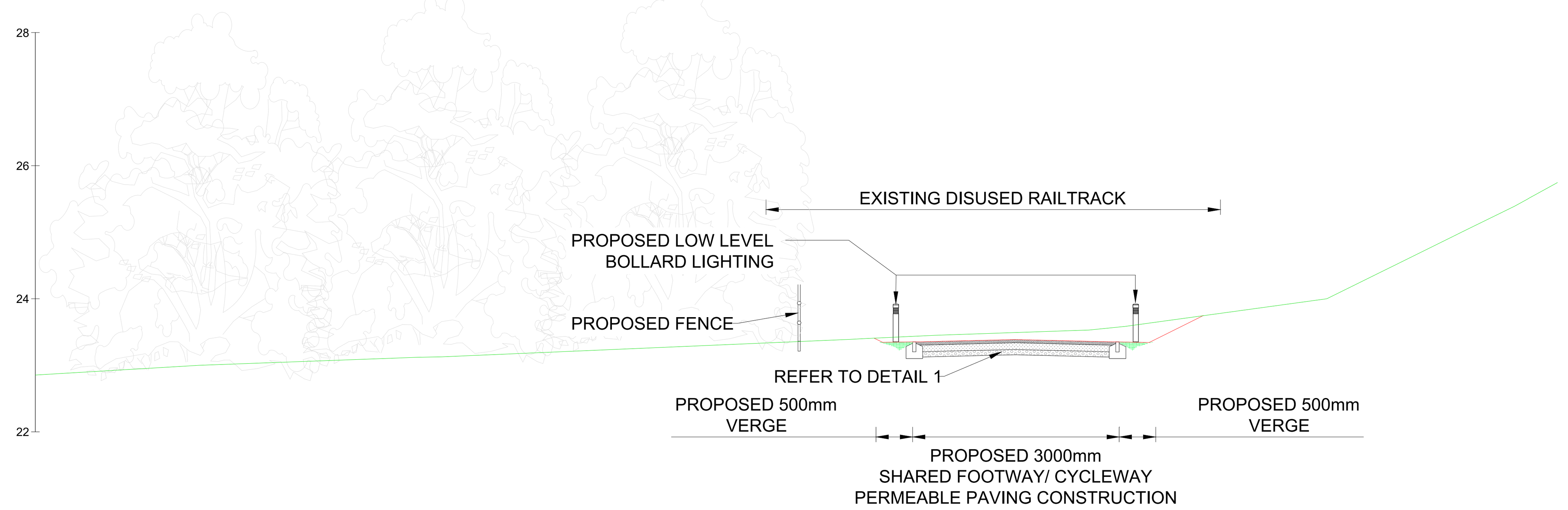
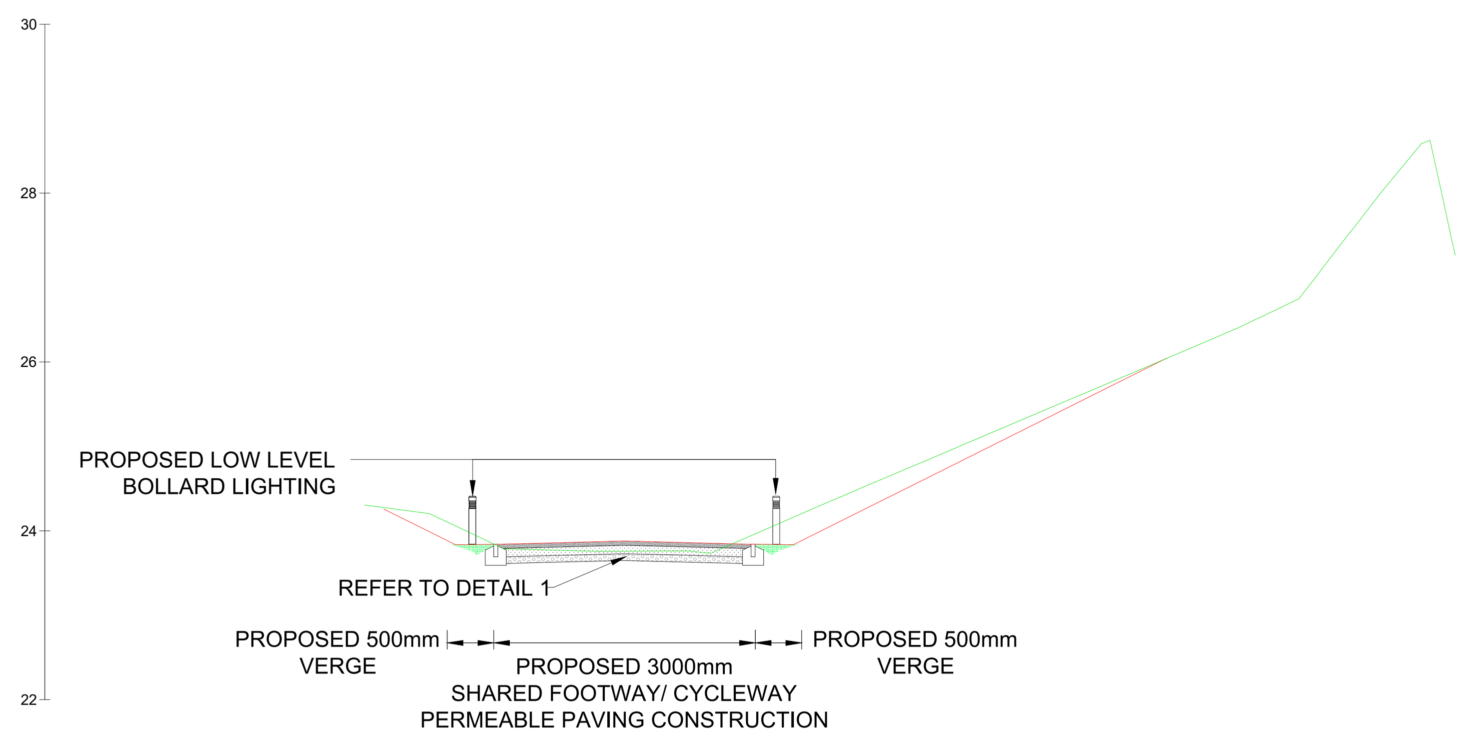


SECTION J-J



SECTION K-K

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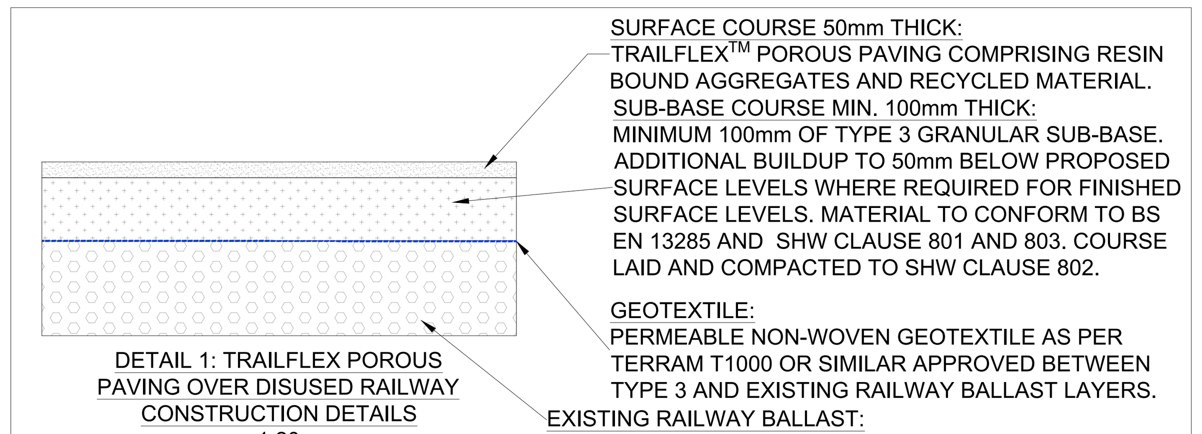

DETAIL 1: TRAILFLEX POROUS PAVING OVER DISUSED RAILWAY CONSTRUCTION DETAILS
1:20

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01	18/10/24	FIRST ISSUE	GJ	MP	SD	MG

VALE of GLAMORGAN
BRO MORGANNWG

Project: Sully to Cosmeston ATR

Site: Sully to Cosmeston, Cardiff

Client: Vale of Glamorgan Council, Cyngor Bro Morgannwg, Civic Offices, Holton Road, Barry - CF63 4RU, www.valeofglamorgan.gov.uk

ARCADIS

Registered office: 80 Fenchurch Street, London EC3M 4BY

Coordinating office: Arcadis Suite 4d, 4th Floor, Hodge House, 144-166 St Mary St, Cardiff CF10 1DY, Tel: 44 (0)29 2092 6700

www.arcadis.com

Drawing Title:

TYPICAL CROSS SECTIONS SHEET 2

		Signed	Date
Designed:	G.Jones	Digitally Signed	18/10/24
Produced:	G.Jones	Digitally Signed	18/10/24
Checked:	M.Pearson	Digitally Signed	18/10/24
Reviewed:	S.Davies	Digitally Signed	18/10/24
Approved:	M.Griffiths	Digitally Signed	18/10/24

Design Stage: Detailed Design

Original Size: A1 | Grid: OS | Datum: ODN

Suitability Code: S3 | Scale: AS SHOWN | Project Number: 10056562

Suitability Description: Suitable for Review and Comment

Drawing Number: 10056562 - ARC - AT - 072 - DR - C - 00003

Revision: P01

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Appendix C
Sully Section 19 Report

Section 19 Flood Investigation

23rd December 2020

Sully, Vale of Glamorgan

Final Report

July 2021

www.jbaconsulting.com

Revision History

Revision Ref/Date	Amendments	Issued to
21/06/2021	Draft Report v1.0	Vale of Glamorgan Council
14/07/2021	Draft Report v2.0	Vale of Glamorgan Council
15/07/2021	Draft Report v3.0	Vale of Glamorgan Council
15/07/2021	Final Report v4.0	Vale of Glamorgan Council

Contract

This report describes work commissioned by Michael Clogg on behalf of Vale of Glamorgan Council, by an email dated 10 May 2021. Toby Jones and Bethlyn Jones of JBA Consulting carried out this work.

Prepared by .... Toby Jones BSc MSc

Senior Analyst

Faye Tomalin BSc (Hons) MSc MCIWEM C.WEM

Chartered Senior Analyst

Reviewed by .... Bethlyn Jones BA MSc MCIWEM C.WEM

Principal Analyst

Purpose

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Executive summary

This report has been produced in-line with the duties placed upon The Vale of Glamorgan Council (VoCG) under Section 19 of the Flood and Water Management Act 2010. The Act states, "*On becoming aware of a flood in its area, a lead local flood authority (LLFA) must, to the extent that it considers it necessary or appropriate, investigate:*

a) which risk management authorities have relevant flood risk management functions and

b) *whether each of those risk management authorities has exercised or is proposing to exercise those functions in response to the flood*".

This Section 19 investigation provides a factual report of the storm event which occurred on 23rd December 2020 and the flooding that happened in the community of Sully as a result. The investigation focuses on the residential area located to the north of South Road, Sully and reviews evidence provided by responders and residents regarding the flood event. It has also been informed in part by Section 19 data analysis for Dinas Powys produced by JBA Consulting in March 2021.

The Section 19 data analysis report identifies that due to a series of storm events which occurred throughout the month of December 2020, the soils were already saturated prior to the rainfall on 23rd December.

The nearby Cog Moors rainfall gauge recorded an initial short and intense burst of rainfall between 09:00 and 10:00. However, the main burst of rainfall started at 12:45 and continued until 18:00, with 47.8mm of rainfall falling over this 5.25hr period, giving an average intensity of 9.1mm/hr. The maximum hourly intensity over the period was 14.4mm/hr between 14:00 and 15:00. The rainfall intensity was >10mm/hr between 13:15 and 15:30 and between 15:45 and 17:00. The storm is reported to have been equivalent to a 1 in 20 year rainfall event.

Following the flood event, VoGC issued flood incident forms to approximately 280 properties throughout the Sully area as well as conducting face to face interviews with residents by means of a door knocking exercise. Responses were received from 74 property owners/residents and it was identified that 18 properties were flooded internally and 26 externally as a result of the storm, as well as transport links being affected. The residential areas impacted were situated around Conybeare Road and Swanbridge Grove.

The source of the flooding originated from the heavy storm event which caused localised surface water flooding. The flood incident reports completed by residents within the vicinity of Swanbridge Grove identified three main flow paths; one flowing south through the disused railway embankment and two from the field east of Swanbridge Road. In addition, a further flow path was identified from the top of the adjoining field flowing down the footpath and into the Conybeare Road residential area.

The evidence gathered in this report demonstrates that the cause of the internal flooding at the residential area north of South Road, Sully was a result of heavy rainfall causing rapid runoff from the adjoining fields which overwhelmed the capacity of the surface water drainage network. The flooding of Conybeare Road occurred as a result of the heavy rainfall combined with blockage of a perched gully inlet which drains towards Brean Close.

Although there is CCTV evidence of debris build up through sections of the surface water drainage system, the event is thought to have exceeded the capacity of the drainage system and as such the impact of this build up is considered to be fairly low. However, it is noted that the capacity of the existing surface and highway drainage system is not fully understood and so the full impact of this reduced capacity cannot be accurately determined.

Key recommendations of this report include a need for the LLFA to model the capacity of the existing surface and highway drainage systems at both locations to improve understanding of flood risk and to assess viability of FRM schemes to manage surface water flood risk at both Conybeare Road and Swanbridge Grove. Consideration should also be given to benefits of Property Flood Resilience and an enhanced maintenance schedule for the South Road surface water drainage system and for the rear of Conybeare Road. Furthermore, ownership and maintenance responsibilities of the perched gully inlet in the south west corner of the adjoining field should also be confirmed by VoGC and DCWW.

Contents

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List of Tables

Abbreviations

AEP	Annual Exceedance Probability
DCWW	Dŵr Cymru Welsh Water
FWMA	Flood and Water Management Act 2010
JBA	Jeremy Benn Associates Ltd
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
LTA	Long Term Average
NRW	Natural Resources Wales
RMA	Risk Management Authority
SuDS	Sustainable Drainage System
S19	Section 19
TBR	Tipping bucket rain gauge
VoGC	The Vale of Glamorgan Council

Definitions

Annual Exceedance Probability: The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

Risk: In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.

Surface water flooding: Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing pluvial flooding.

1 Introduction

1.1 Background to investigation

As the Lead Local Flood Authority (LLFA) The Vale of Glamorgan Council (VoGC) has a duty to prepare and publish the results of investigations into significant flood incidents, as detailed within Section 19 (S19) of the Flood and Water Management Act 2010 (FWMA). The Act states, "On becoming aware of a flood in its area, a lead local flood authority (LLFA) must, to the extent that it considers it necessary or appropriate, investigate:

a) which risk management authorities have relevant flood risk management functions and

b) whether each of those risk management authorities has exercised or is proposing to exercise those functions in response to the flood".

This report has been prepared for the purpose of meeting the LLFA S19 requirements by providing a detailed, factual account of the flooding that occurred in December 2020 in the vicinity of Sully, Vale of Glamorgan, South Wales. It also investigates which Risk Management Authorities (RMAs) have flood risk management functions in respect of the flooding. During this event, internal flooding was reported at 18 properties, with 12 outbuildings also affected and 24 gardens flooded. Additionally, approximately 600m of the highway and footway within the Swanbridge Grove area was affected by flood water. This report will focus on investigating the causes of the internal flooding of properties to the north of South Road (B426), Sully as a result of the storm event (Figure 1-1).

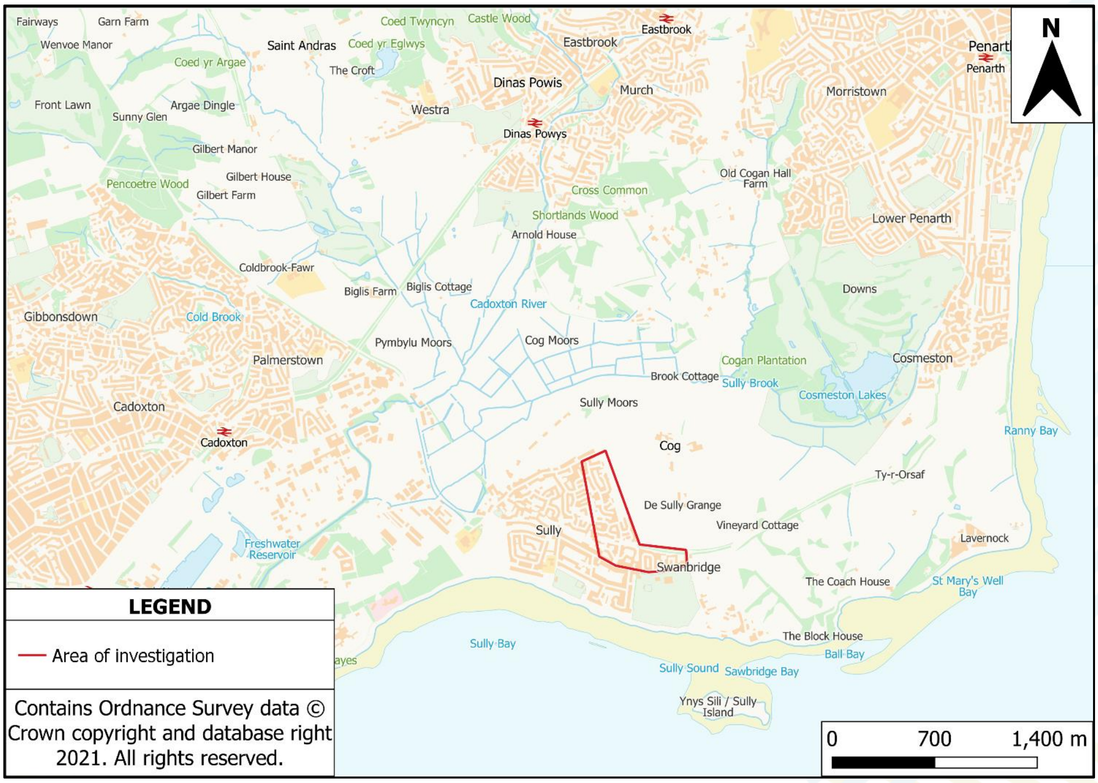


Figure 1-1 Site location

Previous to this report, a flood reconnaissance study, undertaken by JBA Consulting for Natural Resources Wales (NRW), documented widespread flooding in the area. Section 19 data analysis was also undertaken by JBA Consulting for The Vale of Glamorgan Council to collect and analyse hydrological data relating to the flood event and document the findings.

To provide an accurate account of the flood event, this S19 Report will:

- Identify events leading up to the flood;
- Investigate the number of properties flooded;
- Investigate which Risk Management Authorities (RMAs) have flood risk management functions in respect of the flooding;
- Investigate whether each RMA has exercised or is proposing to exercise those functions in response to the flood.

1.2 Site location

Sully is a large coastal village located in the Vale of Glamorgan, South Wales, approximately 18km south-west of Cardiff (Figure 1-1). The village comprises a large residential population. Key infrastructure includes the B4267, which intersects the village east to west connecting it to Barry (south-west), Penarth and Cardiff (north-east). This road is also known as Sully Moors Road as it enters Sully, then becoming South Road and finally Lavernock Road as it travels out towards the east of Sully past the junction with Swanbridge Road. The population in the 2011 census was 4,543 with a 2019 population estimate of 4,867.

The site location investigated in this report is the residential area north of South Road as identified in Figure 1-2. It forms an L-shape, bordered to the east by Swanbridge Road and then follows the boundary line of the field to the west of Swanbridge Road up to Cog Road in the north. The southern boundary of the field is characterised by a disused railway line and embankment.

This area of investigation is characterised by two sub-catchments. The residential streets affected by the flooding in the sub-catchment to the south, hereby referred to as the 'Swanbridge Grove residential area' are:

- Swanbridge Road
- South Road
- Swanbridge Grove
- Highbridge Close
- Winsford Road

The second residential area affected by the flooding in the sub-catchment to the west is Conybeare Road.

Figure 1-3 shows the topography of the site using Opensource LiDAR data. Ground levels are shown to be highest towards the north of the site, at approximately 44m AOD south of Cog Road. The ground level reduces to approximately 24m AOD towards the southern boundary of the site at South Road.

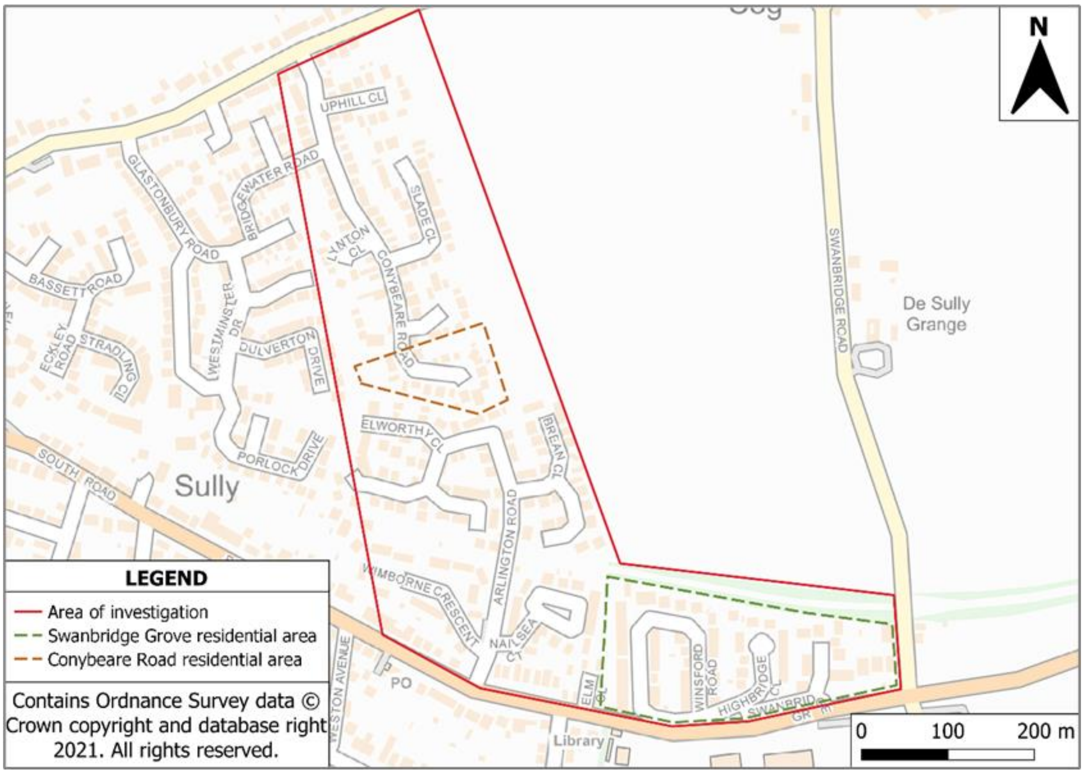


Figure 1-2 Areas of investigation

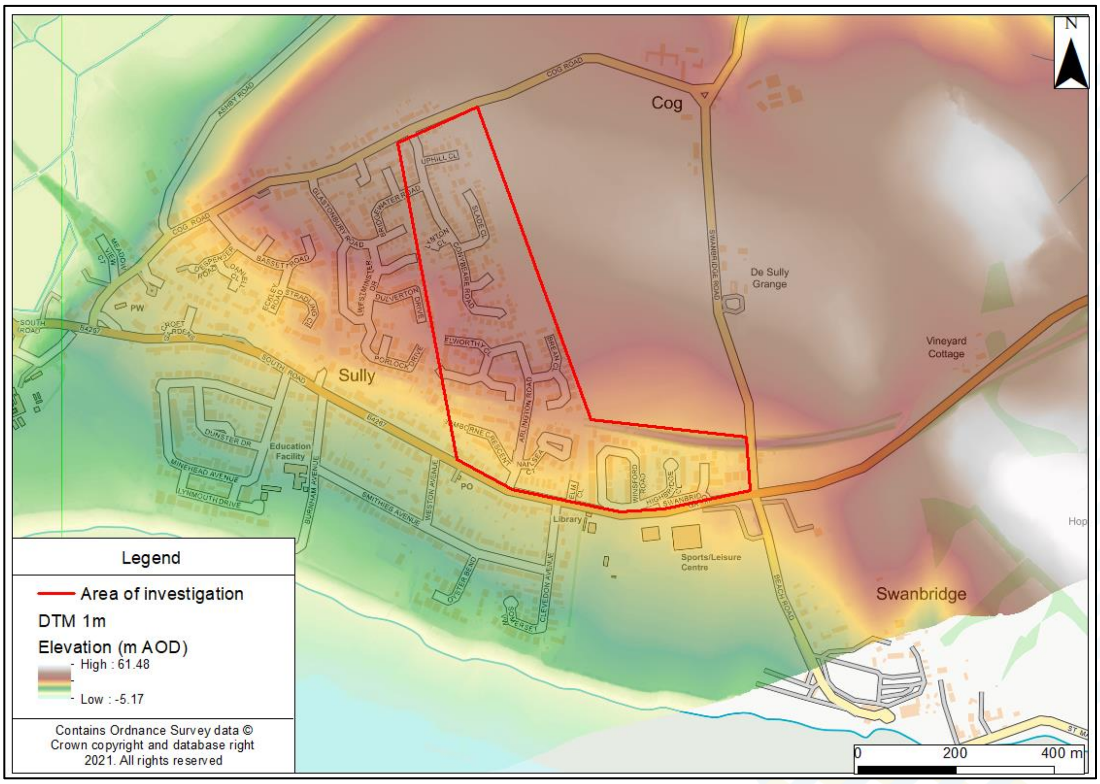


Figure 1-3 LiDAR

2 Roles and responsibilities

2.1 Duties under 'Flood and Water Management Act (2010): Section 19 - Local authorities: Investigations'

Under Section 19 of the Flood and Water Management Act 2010, the Lead Local Flood Authority, VoGC, have a duty to investigate and publish reports on flood events that occur within its area to the extent that it considers it necessary or appropriate.

(1) On becoming aware of a flood in its area, a lead local flood authority must, to the extent that it considers it necessary or appropriate, investigate -

(a) which risk management authorities have relevant flood risk management functions, and

(b) whether each of those risk management authorities has exercised, or is proposing to exercise, those functions in response to the flood.

(2) Where an authority carries out an investigation under subsection (1) it must-

(a) publish the results of its investigation, and

(b) notify any relevant risk management authorities.

2.2 Risk Management Authorities

2.2.1 Lead Local Flood Authority

The Vale of Glamorgan Council has been established as the Lead Local Flood Risk Authority (LLFA) for its administrative area under the Flood and Water Management Act 2010. It is responsible for managing the risk of flooding from ordinary watercourses, surface runoff and groundwater.

Additionally, the LLFA takes on role of the Sustainable Drainage Systems (SuDS) Adopting and Approving Body in which they are responsible for approving designs and adopting and maintaining finished SuDS.

As the LLFA, VoGC have statutory duties:

1. to prepare local flood risk management strategies;
2. to comply with the National Strategy for Flood and Coastal Erosion Risk Management;
3. to co-operate with other authorities, including sharing data;
4. to investigate all flooding within its area, insofar as a LLFA consider it necessary or appropriate;
5. to maintain a register of structures and features likely to affect flood risk;
6. to contribute to sustainable development; and
7. through consenting powers on ordinary watercourses.

2.2.2 Natural Resources Wales

Under the Flood and Water Management Act 2010 NRW has the following responsibilities:

1. Operational responsibilities for flooding from main rivers, the sea and coastal erosion.
2. Oversight responsibilities in relation to all flood and coastal erosion risk management in Wales.

Natural Resources Wales's role with regard to Flood Risk Management is primarily to reduce flood risk through the management and maintenance of drainage channels, ordinary watercourses, pumping stations and control structures. This includes constructing new flood risk management assets, maintaining levels and conducting planning assessments to consider the risks of flooding from main rivers, the sea and reservoirs, alongside an oversight role providing guidance to Local Authorities for planning and taking a strategic role for flooding from all sources.

Natural Resources Wales has a statutory duty to provide a flood warning service to communities at risk of flooding. This is provided through a direct flood warning service and is primarily for areas at risk of fluvial and coastal flooding.

2.2.3 Highways Authority

The Vale of Glamorgan Council undertake the role of the Highways Authority, being responsible for the maintenance of all adopted highways in the Vale and the associated infrastructure. This includes ensuring the highway has a drainage system that controls the surface water that enters onto the highway, providing and managing highway drainage and roadside ditches to ensure they are clear of obstructions. The above duties and responsibilities of the Highways Authority are not applicable to Trunk Roads, which are the responsibility of the Welsh Government.

2.2.4 Dŵr Cymru Welsh Water

As a Water Utility Company, the role of Dŵr Cymru Welsh Water as a risk management authority is to manage the risk of flooding to water supply and sewerage facilities and flood risk arising from their infrastructure. The main responsibilities of the Water Utility Company are to:

- Ensure their systems have the appropriate level of resilience to flooding, and maintain essential services during emergencies;
- maintain and manage their water supply and sewerage systems to manage the impact and reduce the risk of flooding and pollution to the environment;
- advise LLFAs on how their assets affect local flood risk and work with RMAs to coordinate management of flood risk management assets; and
- work with developers, landowners and LLFAs to understand and manage risks

2.3 Other Authorities

2.3.1 Network Rail

Network Rail has an operational responsibility as a riparian owner and is required to undertake regular maintenance of all assets that pose a risk to flooding.

2.3.2 Landowners and riparian owners

Riparian Landowners are legally responsible under common law for the maintenance of the land from the edge of the waterbed to the middle of the riverbed. The landowner is responsible for removal of obstructions caused within the boundaries of their land affecting the watercourse. This includes the maintenance of the bed, banks and any boundary features e.g. through routine clearance of debris and/or blockages. Due to the surface water source of the flooding Riparian Landowner responsibilities are not applicable to this flood event.

2.3.3 Residents

Residents and property owners are responsible for the protection of their own properties against flooding. Residents have the right to defend their property provided they do not increase the risk of flooding to other properties.

2.4 Permissive Powers

Risk Management Authorities have direct permissive powers under the Flood and Water Management Act 2010, as well as the Land Drainage Act 1991. For NRW and the LLFA this includes:

- Powers to request information.
- The ability to raise levies for local flood risk management works.
- Powers to designate certain structures or features that affect flood or coastal erosion risk.
- The expansion of powers to undertake works to include broader risk management actions.
- The ability to cause flooding or coastal erosion under certain conditions.

3 Stakeholder engagement

Following the flooding in December 2020, VoGC issued flood incident forms to approximately 280 properties throughout the Sully area as well as conducting face to face interviews with residents by means of a door knocking exercise. Responses were received from 74 property owners/residents regarding the impact of flooding. From this engagement, information was collated regarding:

- date of flooding;
- extent of flooding to private land and properties;
- depth of flooding on private land and in properties;
- perceived source/cause of flooding; and
- impacts and estimated cost of damages.

In addition, photographs and videos of the flooding were provided by residents that were used in investigations for this report.

4 Catchment characteristics

4.1 Drainage system

It should be noted that responsibility for different sections of drainage systems lies with individual RMA's, and that RMA's have different system capacity targets for their drainage networks. DCWW aim to maintain a 1 in 30 year (0.33% AEP) capacity, while the Highways Authority aims to maintain a 1 in 5 year (20% AEP) capacity. It should be noted that any DCWW surface water system is designed to take roof and yard drainage only, whilst the highway network is designed to take flows from the highway only. Most systems are not designed with the intention of receiving sheeting overland flows from greenfield areas.

4.1.1 Swanbridge Grove residential area

4.1.1.1 Surface water

The surface water network in the Swanbridge Grove residential area is primarily managed by the Highways Authority and DCWW with private sewers serving individual residential properties.

The DCWW surface water network, an extract of which is shown in Figure 4-1 with the full plan contained in Appendix A, runs from Highbridge Close, Swanbridge Grove and Winsford Road, down to South Road before tracking south by the public library, parallel to Clevedon Avenue, and discharging into the sea at an uncontrolled rate. The outfall is located at a higher elevation than the tidal range at this location and therefore the outfall discharges freely during all storm events.

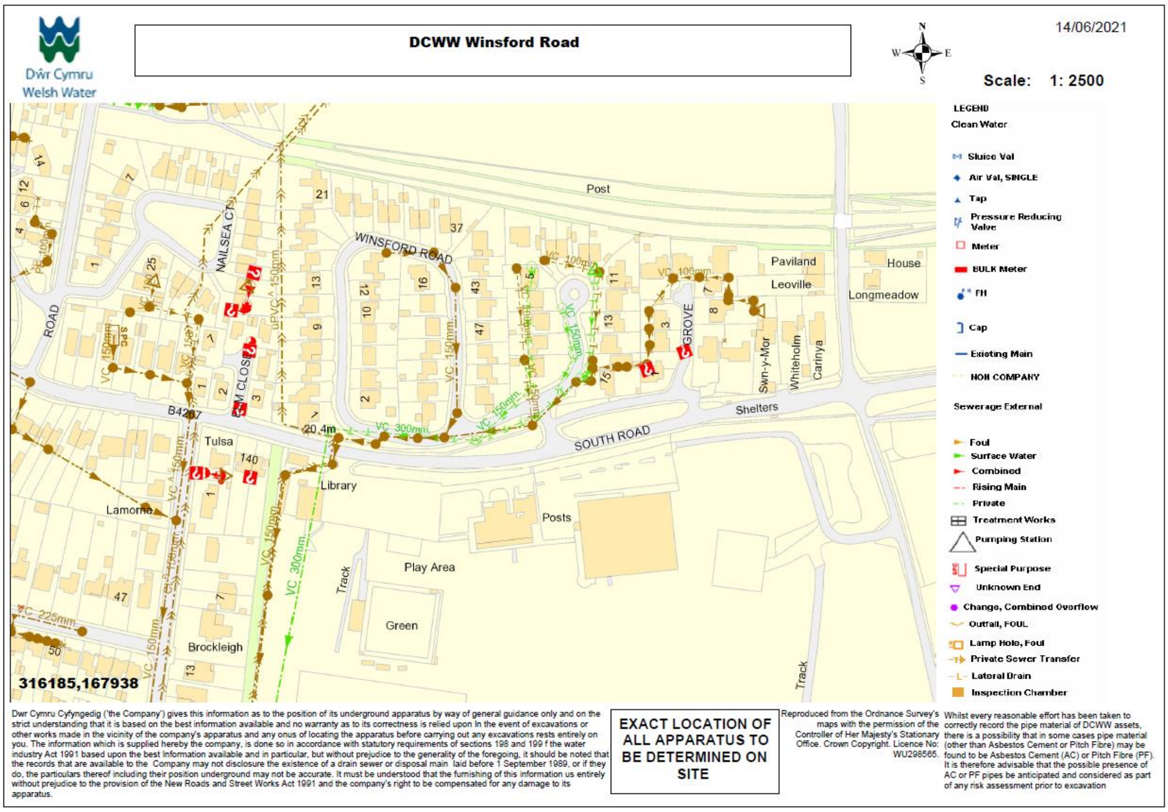


Figure 4-1 DCWW Public Sewerage Network

A private sewer runs from South Road in a southerly direction across Sully Sports Fields, to an outfall into the Severn Estuary, as shown in Figure 4-2.

The highway surface water network within Highbridge Close, Swanbridge Grove and Winsford Road is drained via the highway gullies which are reported to be cleansed annually. The water discharges to the public DCWW network detailed above.

On Swanbridge Road there is an open channel which collects highway run off, located north of the railway bridge. The channel discharges into the highway surface water network at the location of the railway bridge. The highway network at this location, shown in Figure 4-2, flows in a southerly direction along Swanbridge Road and Beach Road prior to discharging into the sea at an uncontrolled rate. The outfall is situated above the tidal range and the system would therefore discharge freely during all storm events. This highway system is designed to take flows from the highway only, and not to receive sheeting overland flows from the surrounding fields. Full bore pipe capacity of the 150mm dia clay pipe along Swanbridge Road to the junction of South Road is estimated at 19.4l/s.

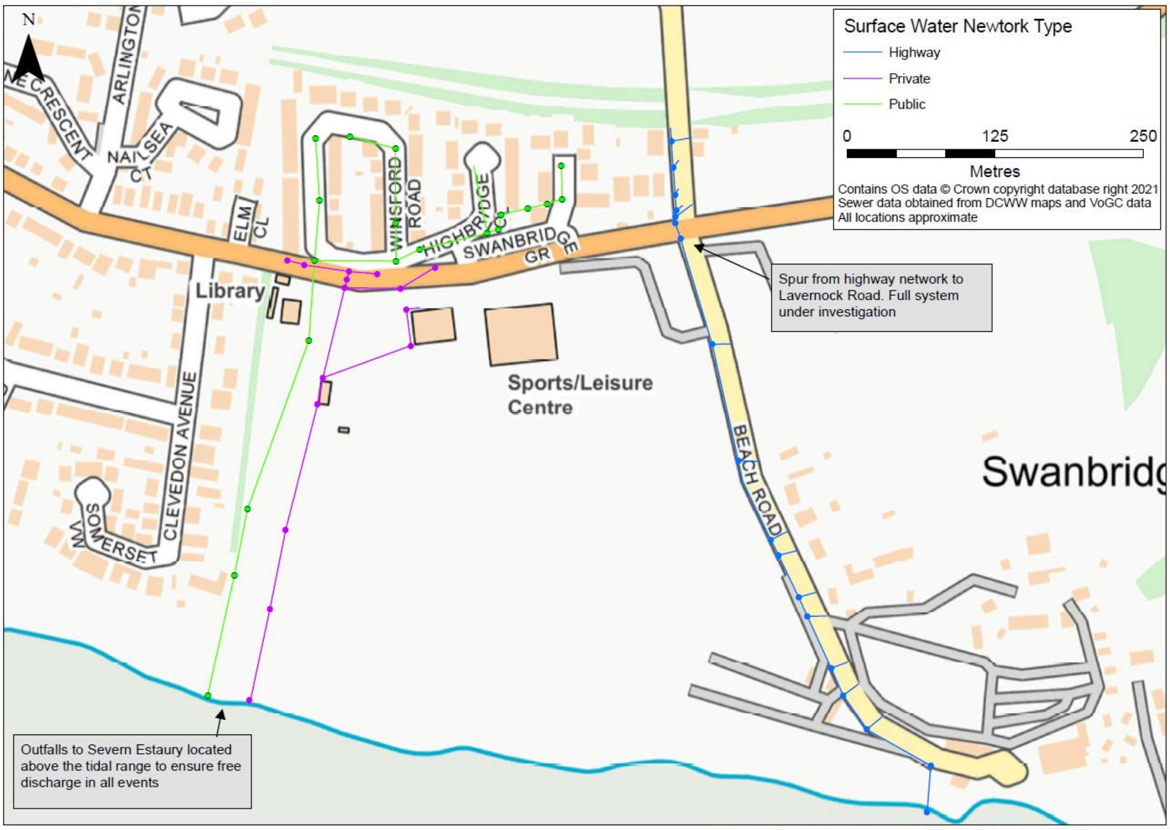


Figure 4-2 Swanbridge Grove Investigation Area Surface Water Network

4.1.1.2 Foul drainage

The foul system servicing Swanbridge Grove and Highbridge Close is still shown as under private sewer transfer on DCWW sewer maps, as shown in Figure 4-1 above. The system connects into the public foul sewer network servicing Winsford

Road, which then flows in a southerly direction under South Road towards the coast and the wider public foul network.

4.1.2 **Conybeare Road residential area**

4.1.2.1 Surface water

The highway network drainage system extends to the footpath running along the rear of Conybeare Road where this footpath forms part of the adopted highway. A series of four gullies and channel drain receive surface water flows from the footpath and enters the DCWW surface water sewer in the footpath between 71 and 76 Conybeare Road, as shown in Figure 4-3.

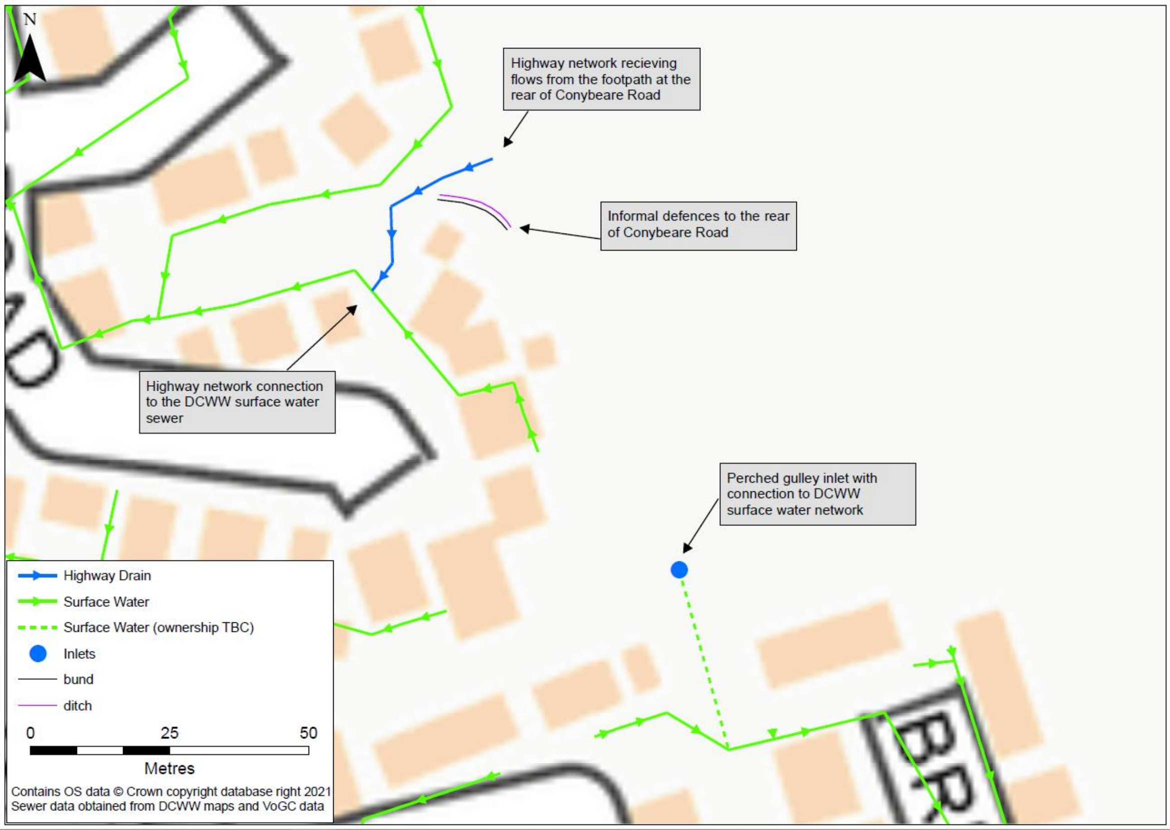


Figure 4-3 Conybeare Road Surface Water Network

The highway drainage system serves the public footpath and is not intended to cope with sheeting overland flows from the adjacent land. The public surface water sewer flows primarily to the rear of the residential properties prior to forming part of the wider Sully public system, as shown in Figure 4-4 and Appendix B.

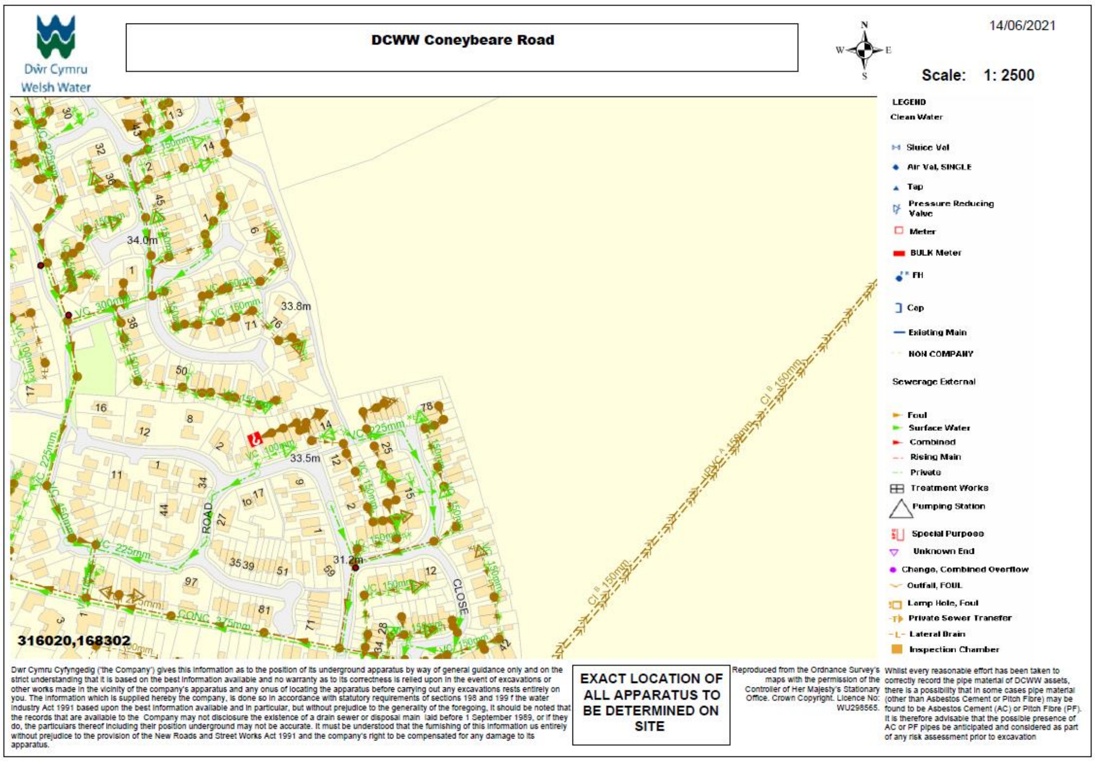


Figure 4-4 DCWW drainage lines Conybeare Road

A perched gully inlet that connects to a DCWW surface water sewer is located at the south-west corner of the Conybeare Road residential area. This asset is designed to allow surface water to pool around it and the sediment contained within to settle. As the level of water surrounding the gulley rises sufficiently to require draining, water free from sediment enters the inlet. Whilst the DCWW sewer maps do not show this inlet, design drawings from the original development in 1984 show this inlet as an original feature which joins to the DCWW surface water sewer to the north of Brean Close (Appendix C). An extract of this plan is shown in Figure 4-5 below, and the DCWW drainage network is shown in Figure 4-4 above. Due to the impact that a blockage of the inlet could have on the adjacent community, adhoc repairs have been undertaken by VoGC on a reactive basis. However, ownership and maintenance responsibilities for this asset remain unconfirmed.

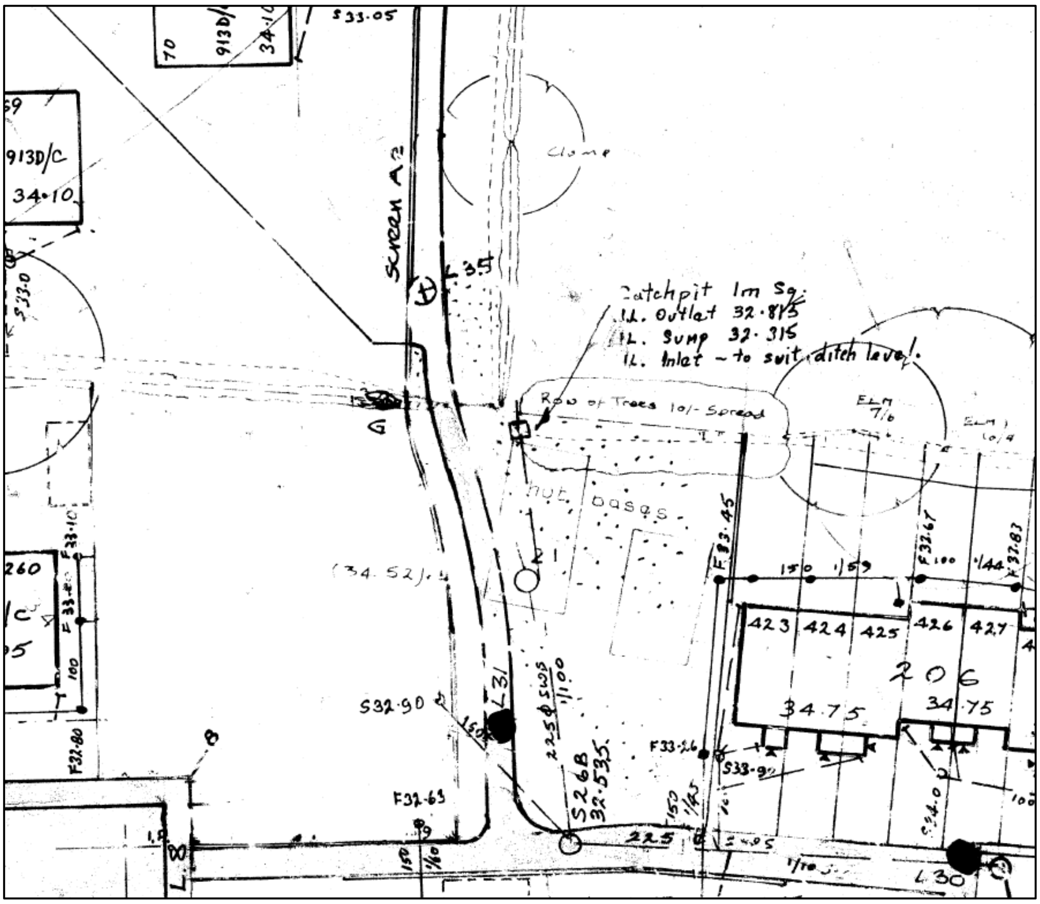


Figure 4-5 Original Sully development plans

The DCWW surface water systems serving Brean Close and Conybeare Road form separate systems which converge east and south of the two areas, respectively.

To the rear of Conybeare Road, is a small informal flood defence installed with the intention of managing surface water. This is comprised of a small bund and ditch to the rear of 76 Conybeare Road, as shown in Figure 4-3 above and Figure 4-6 below.

Figure 4-6 Informal defences to the rear of Conybeare Road (picture provided by VoGC)

4.1.2.2 Foul drainage

The foul system servicing Conybeare Road connects to the public foul sewer network, which serves the wider Sully area.

4.2 Catchment characteristics

High land to the north of the site and at the northern end of the adjoining field acts as a natural watershed for the Cadoxton catchment to the north and for the Sully Coastal catchment to the south. Within the Sully Coastal catchment, surface water runoff is considered the principal flooding mechanism where surface water flows in a southerly direction, across the site area, to the sea.

The Sully Coastal catchment is predominantly underlain by Triassic Rocks comprised of mudstone, siltstone, and sandstone. There are smaller areas of Carboniferous Dinantian Rocks (limestone with subordinate sandstone and argillaceous rocks), and Jurassic Lias Group (mudstone, siltstone, limestone, and sandstone). Superficial deposits of alluvium (clay, silt, and sand) are found along, and in the areas adjacent to, the nearby watercourse. Soils are predominantly loamy and clayey with impeded drainage, with freely draining soils in smaller areas to the north and south of the catchment. Sully is located in an area formed primarily of Sedimentary Bedrock with loamy freely draining soils.

4.2.1 Surface water runoff catchments

2m LiDAR and 0.5m contour lines were used to derive surface water catchments in and around the area of investigation, as shown in Figure 3-6. The key catchments of interest in this area are discussed in more detail below.

4.2.1.1 Catchment C

A slight ridge in the topography east of Conybeare Road creates a steep catchment (C) which channels surface water towards Kingsley Close and Conybeare Road.

The catchment is mainly comprised of agricultural land. However, at the top of the catchment, construction of a residential development site is underway for Taylor Wimpey plc (planning reference 2019/00111/RES). The development is comprised of 325 new homes, areas of public open space and highways infrastructure, with the use of SuDS techniques to manage surface water. At the time of the flood event, construction of the site was not complete. It should be noted that the majority of the Taylor Wimpey development site is located within Catchment A, which naturally drains towards the north east.

4.2.1.2 Catchments E to H

Swanbridge Road forms a boundary between catchments E and F where water is conveyed in a southerly direction towards the disused railway embankment. It is likely that surface water from catchment E pools against this embankment before percolating through the embankment to the properties in Winsford Road, Highbridge Close and Swanbridge Grove.

Within Catchment F water is conveyed in a southerly direction and escapes onto Swanbridge Road flowing in a southerly direction south of the railway bridge. The surface water then combines with water from Catchment G, which has been deflected by the disused railway embankment, flowing in a south-westerly direction towards Swanbridge Road, and subsequently pooling in areas of low ground around Winsford Road and Highbridge Close.

The area will also receive surface water flows from catchment H, further increasing the amount of surface water in this location.

It should be noted that Winsford Road and Highbridge Close have the lowest local ground levels, and this results in surface water from Catchments E, F, G and H pooling in this area. Ground levels of South Road are higher than those across Winsford Road and Highbridge Close, resulting in surface water entering Winsford Road ponding with no means of escape.

The UK SUDS tool has been used to calculate Greenfield runoff rates for each catchment using the FEH Statistical Method, with the results shown in Table 4-1 and the Greenfield runoff volumes shown in Table 4-2. A climate change allowance of 20% and 40% was used for these calculations in line with Welsh Government guidance[1]. The Greenfield runoff volumes were calculated for a 6 hour 100 year storm event from the FEH Web Service[2].

[1] Adapting to Climate Change. https://gov.wales/sites/default/files/publications/2019-06/adapting-to-climate-change-guidance-for-flood-and-coastal-erosion-risk-management-authorities-in-wales.pdf
[2] FEH Web Service. https://fehweb.ceh.ac.uk/

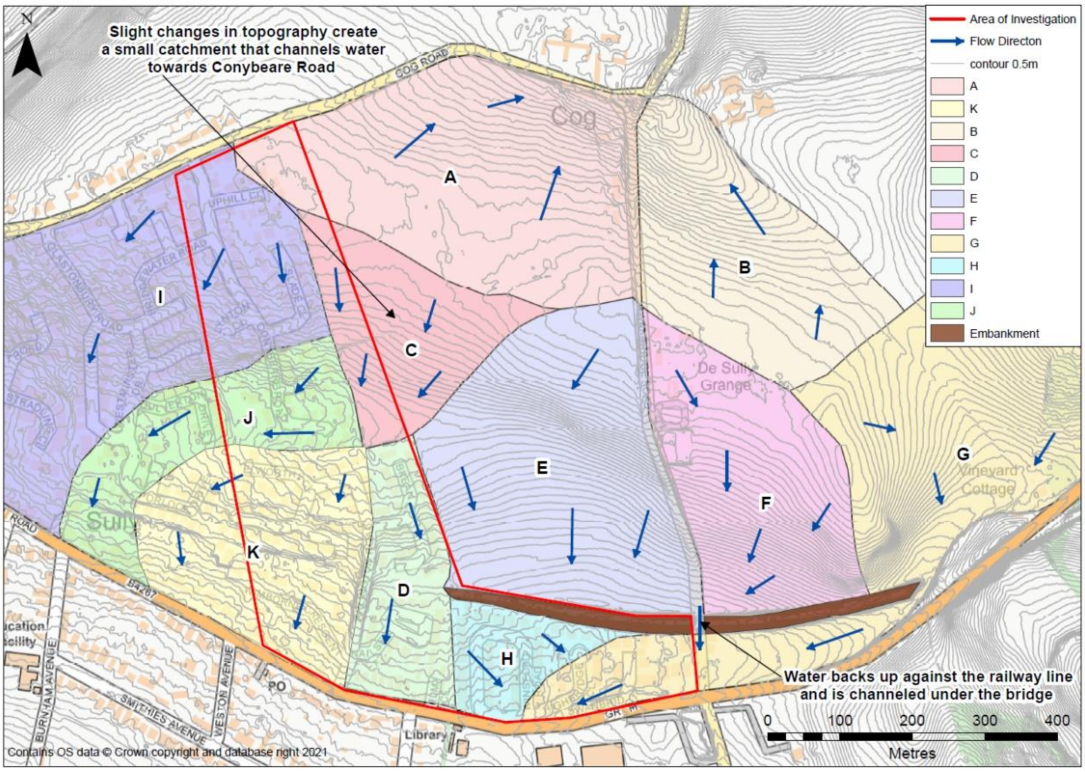


Figure 4-7 Surface water runoff catchments

Table 4-1 Greenfield Runoff Rates

			Greenfield Runoff Rates			
Catchment	**Catchment Area (Ha)**	**QBAR (l/s)**	**3.3% AEP (l/s)**	**1% AEP (l/s)**	**1% AEP with 20% climate change (l/s)**	**1% AEP with 40% climate change (l/s)**
A	13.2	30.4	54.1	66.2	79.4	92.7
B	8.3	19.1	34.0	41.6	49.9	58.2
C	5.2	12.0	21.3	26.1	31.3	36.5
D	4.0	9.2	16.4	20.1	24.1	28.1
E	12.9	29.7	52.8	64.7	77.6	90.6
F	8.7	20.0	35.6	43.6	52.3	61.0
G	16.5	38.0	67.6	82.8	99.4	115.9
H	2.3	5.3	9.4	11.5	13.8	16.1
I	21.1	48.6	86.4	105.8	127.0	148.1
J	5.4	12.4	22.1	27.1	32.5	37.9
K	7.8	18.0	31.9	39.1	46.9	54.7

Table 4-2 Greenfield Runoff Volumes

			Greenfield Runoff Volumes			
Catchment	**Catchment Area (Ha)**	**QBAR (m3)**	**3.3% AEP (m3)**	**1% AEP (m3)**	**1% AEP with 20% climate change (m3)**	**1% AEP with 40% climate change (m3)**
A	13.2	819	1629	2367	3011	3695
B	8.3	515	1024	1488	1893	2324
C	5.2	323	642	933	1186	1455
D	4.0	248	494	717	912	1119
E	12.9	800	1592	2313	2943	3611
F	8.7	540	1074	1560	1985	2436
G	16.5	1024	2036	2959	3764	4619
H	2.3	143	289	412	524	644
I	21.1	1310	2604	3783	4814	5906
J	5.4	335	666	968	1232	1512
K	7.8	484	963	1398	1779	2184

Due to the Greenfield and permeable nature of the catchments (siltstone and sandstone overlain by freely draining slightly acid but base-rich soils as defined by BGS and Soilscapes) surface water runoff from the site would be expected to be low. However, the topography around the area of interest, along with a clayey topsoil as a result of farming practices in the area, creates catchments that channel surface water to specific points and can lead to an increase in runoff. This combined with the number of catchments that lead to one area (e.g water from Catchments E to H all flows towards Winsford Road), causes high levels of surface water runoff that exacerbates flooding in the adjacent residential areas. This is especially true around Conybeare Road and Winsford Road.

5 Information gathering

5.1 Flood risk

5.1.1 Long-term flood risk information

The Natural Resources Wales (NRW) long-term flood risk map from Rivers and from the Sea shows the site is wholly located within Flood Zone 1 for both Rivers and Sea meaning flood risk is Very Low and has a less than 1 in 1,000 (<0.1% AEP) chance of river flooding in any year (Figure 5-1).

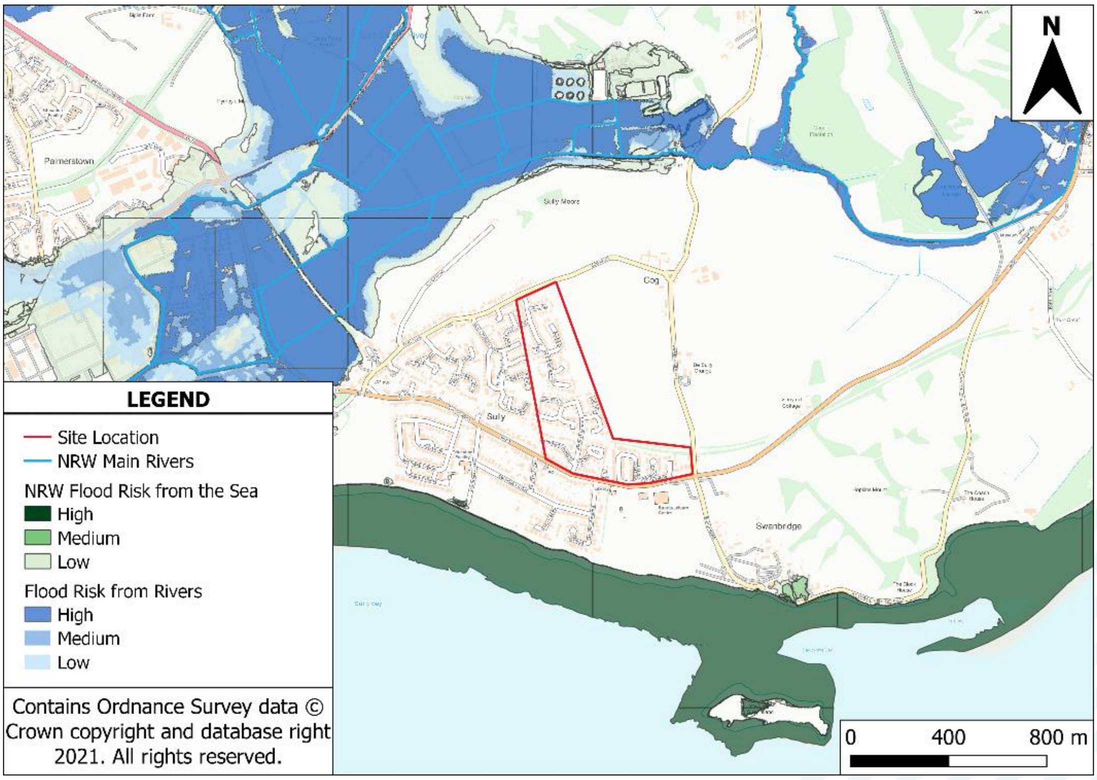


Figure 5-1 Risk of flooding from rivers and the sea

The NRW Flood Map for Surface Water shows the site has a mixed flood risk from surface water. Pooling of surface water on Winsford Road, Highbridge Close and off Conybeare Road to the east and west have resulted in these areas being at high risk of surface water flooding. A high risk of surface water flooding is defined as a greater than 1 in 30 chance of flooding in any year as a result of local rainfall (Figure 5-2).

Similarly, the southern boundary of the adjacent field is also at high risk from surface water flooding as surface water may accumulate along the disused railway embankment.

Additionally, small areas off Elworthy Road and Swanbridge Grove are at low risk, meaning these areas have between a 1 in 1000 (0.1%) and 1 in 100 (1%) chance of flooding in any year as a result of rainfall.

There are no groundwater level measurements available within the vicinity of the site.

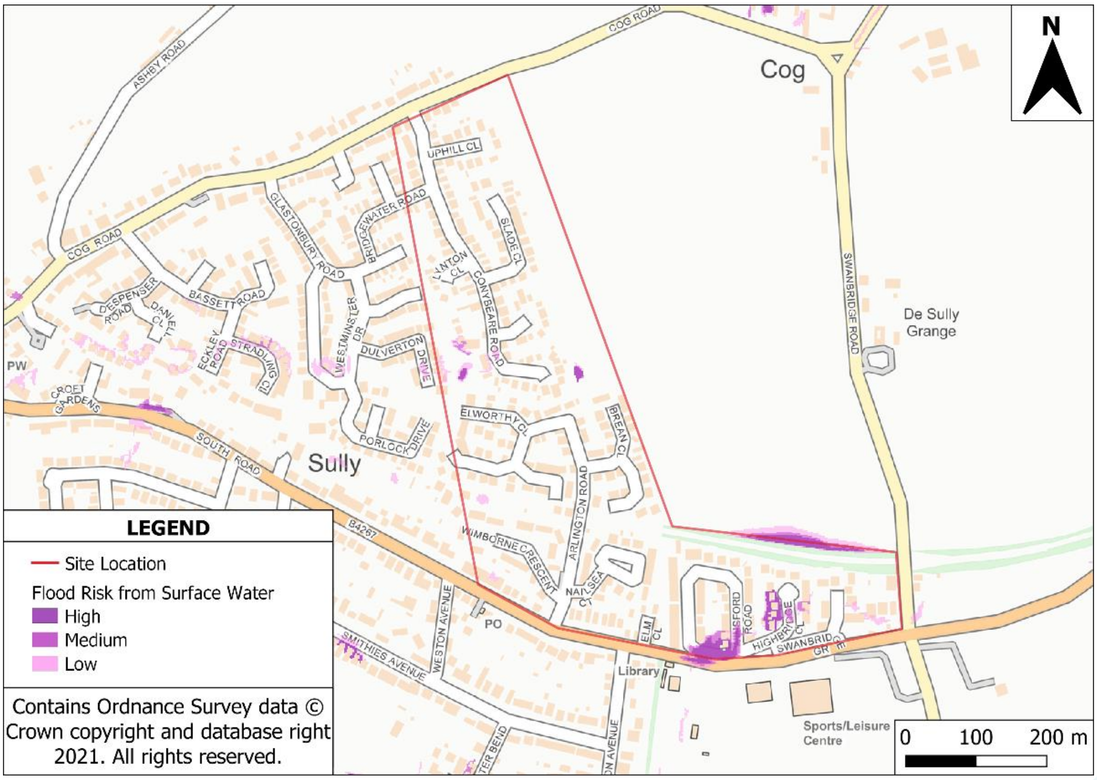


Figure 5-2 Risk of flooding from surface water

5.1.2 Flood history

Table 5.1 details the known flood history of the area of investigation in Sully, South Wales, based on records held by VoGC. Whilst Sully has proven to be prone to surface water flooding it should be noted that the whole area being investigated does not have a history of flooding and with the residents most affected having not experienced flooding during their occupancy.

Table 5-1 Flood history

Date	Source of flooding	Description of impacts
October 1998	Surface water	External flooding gardens, internal flooding to ground floors of 3-5 properties on Conybeare Road. External flooding of one property on Arlington Road.
October 2000	Surface water	External flooding gardens, internal flooding to ground floors of 5 properties on Conybeare Road. External flooding of one property on Arlington Road and flooding of highway.

22/12/2012	Surface water and highway drainage	Heavy rainfall water run off retained behind disused railway embankment percolating through and causing 1 garage to flood and serious external flooding of 7 properties abutting to the south.
31/02/2015	Unconfirmed; likely surface water flooding	Severe Highway Flooding on South Road, Sully and subsequent flooding from Highway to one property causing significant external flooding and internal flooding.
21/11/2016	Surface water	Conybeare Road, Sully. Surface water flooding due to sheeting overland flows from farmland to the rear. 1 property internally flooded and 4 externally flooded.

6 Hydrological analysis of the December 2020 event

6.1 Conditions at the time

The overall rainfall for January to December 2020 was above average across most of the UK, particularly across western regions. December featured a series of cyclonic systems, with successive spells of unsettled weather generating rainfall over saturated ground. Overall, December rainfall was substantially above average with 139% of the long-term average (LTA) for the UK and in a broad portion of Wales rainfall exceeded 150% of the LTA.

Soil moisture deficits (SMD) were near-zero across the whole of the UK, the wettest soils for late December at a national scale since 2012, meaning there was little capacity for the ground to retain additional water. Mean river flows over January to December 2020 were exceptionally high in Wales. As a result of these conditions surface water flooding causing significant disruption was a recurrent characteristic of the month.

6.2 Overview of Event

The flood event on 23rd December 2020 occurred in response to a short and intense storm event. A short sharp period of intense rainfall was observed between 09:00 and 10:00 at Cog Moors Sewage Treatment Works (STW) TBR rain gauge (the closest rain gauge to the site), recording 8.2mm in 1 hour. After a period of no rainfall for 1.5 hours and 1mm between 11.30 and 12.00 a longer period of persistent heavy rainfall between 12:45 and 18:00 occurred. During this 5.25hr period 47.8mm of rain fell with an average intensity of 9.1mm/hr. The maximum rainfall intensity occurred between 14:00 and 15:00 equalling >10mm/hr. Figure 6-1 below shows the rainfall hyetograph of the flood event at the Cog Moors STW TBR, as detailed in the Section 19 Data Analysis report undertaken by JBA Consulting.

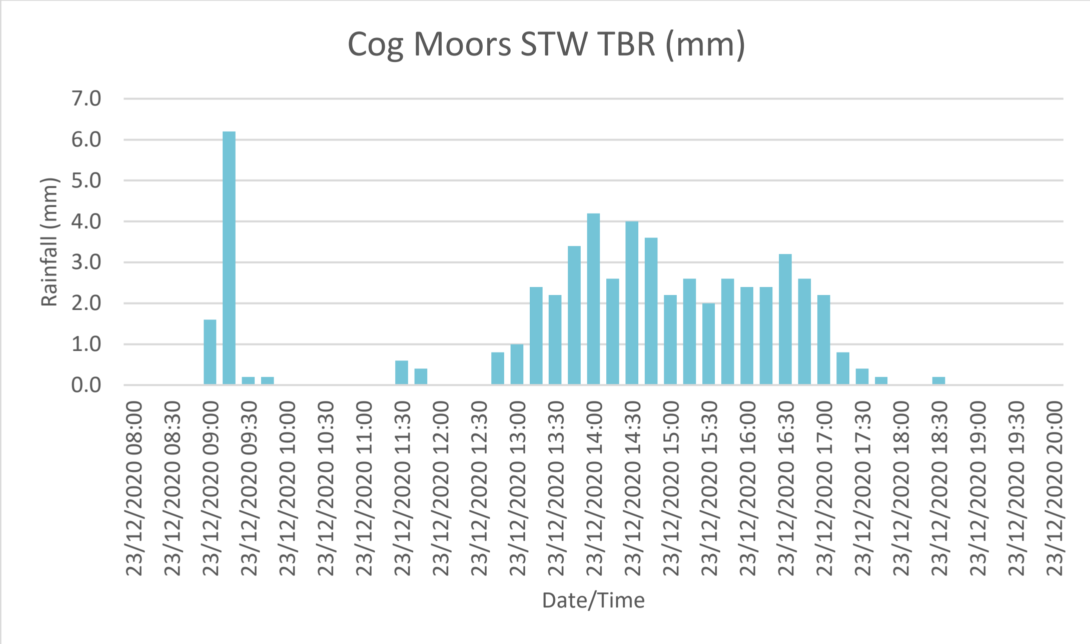


Figure 6-1 Rainfall hyetograph of December 2020 flood event

As described above, prior to the flood there had been a succession of storm events, which had left behind a highly saturated catchment. As a result of this there would have been little capacity for storage within the catchment. The tidal range at Sully was below the river level throughout the storm event, indicating that tides did not have an adverse impact on flood risk.

The outcome of this high volume of rainfall falling on a saturated catchment was rapid flows of surface water run-off across non-permeable urban surfaces and slopes. These flows pooled at lower elevations This also caused problems for the surface water sewer network, which was unable to cope with a large volume of water over this short timeframe.

The days following the event were comparatively dry in the area with short periods of light rainfall on the 24th and 26th December and no impacts resulting from the additional rainfall were reported.

6.3 Timeline of Event

A timeline of the incident response is given Table 6-1.

Table 6-1 Timeline of incident response

Date & time	Activity/event	Agency
23/12/2020 13:45	Received alarm from St Richard Gwyn Gauging Station on the Coldbrook.	VoGC
23/12/2020 15:50	Email received by FCERM Inbox regarding flooding at Millbrook Road, Dinas Powys.	VoGC
23/12/2020	Several reports of Flooding during the evening.	VoGC

	Reports of flooding included: • Highbridge Close, Sully • South Road, Sully • Swanbridge Grove, Sully • Swanbridge Road, Sully • St Marys Well Bay, Sully • Wynsford Road, Sully • Ashby Road, Sully • Sullymoors Road, Sully Emergency room opened.	
23/12/2020	Sully Moors Road closed by Police	Police
24/12/2020	Email received by planning enforcement regarding flows from adjoining field (Taylor Wimpey development site) onto Cog road and flooding of Conybeare Road Sully. Reported that farmer had been in field on 23/12/2021 clearing ditch and inlet. This appears to have been in reference to excavating the perched gully inlet.	VoGC
07/01/2021	Visited Taylor Wimpey site and Conybeare Road outlet structure, undertook inspection and reported to VoGC.	VoGC
17/01/2021	Email received regarding highway gully flooding at Brean Close during storm event. Contacted Welsh Water (DCWW) who reported no issues with system.	VoGC
19/01/2021	VoGC visited Taylor Wimpey site and Conybeare Road outlet structure. Undertook temporary repair, undertook inspection and reported to VoG. VoGC inspected manholes at Brean Close found blockage and arranged for cleansing.	VoGC
04/02/2021	VoGC inspected Taylor Wimpey development site and Conybeare Road outlet structure.	VoGC
05/03/2021	VoGC inspected Taylor Wimpey development site and Conybeare Road outlet structure.	VoGC

7 Source-pathway-receptor analysis

7.1 Source

7.1.1 River and sea

As established in Section 5, the site being investigated is at very low risk of flooding from rivers and the sea and are not considered a source of flooding for this flood event. There are no drainage systems that connect to the river. Highway gullies and public and private sewers discharge at an uncontrolled rate into the sea but the tidal range would not have affected the discharge rate. Additionally, locally impermeable rock formations will have impeded drainage and local soils were saturated.

7.1.2 Extreme rainfall

The primary source of the flood water is the extreme rainfall experienced across South Wales on 23rd December 2020 and in particular around Sully.

This investigation presents Cog Moors STW TBR gauge data due to it being the closest gauge to the site being investigated. Rainfall totals at other local rain gauges were also assessed for the 23rd December 2020 event (detailed in Table 7-1) that provide context for the storm event across South Wales. Note: Rain fell at slightly different times at the gauges, hence the period and duration vary for each.

The findings indicate that the Cog Moors STW TBR gauge recorded substantially larger rainfall totals than at the other gauges within the vicinity of the storm event (see Figure 7-1). NRW have indicated confidence in the Cog Moors STW TBR gauge due to the data being consistent between the primary and secondary gauges that operate independently and after quality checks undertaken on 31st December following the event. Rainfall radar data did not indicate a localised storm around Cog Moors STW TBR, so it is unclear why local rainfall totals differ so substantially from other rain gauges.

The Dinas Powys S19 Data Analysis Report provided an analysis to estimate the flood frequency. The inference of flood rarity from rainfall data is seldom accurate, as treating rainfall rarity as a measure of flood rarity neglects the complex scenarios leading to flood formation. Therefore, a flood frequency specific to the site investigated in this S19 report is not inferred. However, the rainfall frequency estimation suggested Cog Moors STW TBR indicates a frequency of about 5% AEP (20yr return period) and the other rain gauges suggest a frequency of about 70%-20% AEP (1.5yr-5.0yr return period) across the wider area.

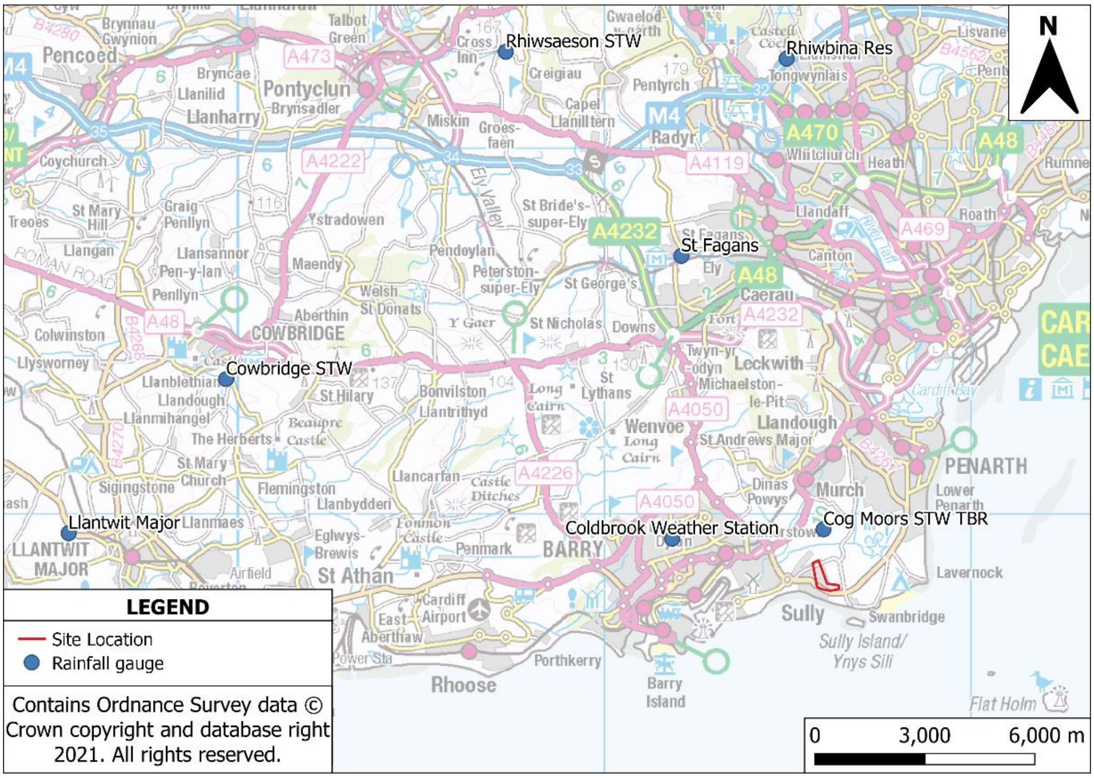


Figure 7-1 Rainfall gauge locations

Table 7-1 Rainfall gauge data

Rain gauge	Distance from site location (km)	Rainfall (mm) on 23/12/2020	Coordinates (XY)
Cog Moor STW TBR	0.86	47.8 in 5.25 hrs	315986,169586
		57.2 in 9.75 hrs	
Cold Brook Weather Station	3.89	29.0 in 5.25 hrs	311853,169334
		37 in 9.75 hrs	
St Fagans TBR	9.13	30.8 in 5.25 hrs	312103,177055
		43.6 in 9.75 hrs	
Rhiwbina Reservoir TBR	13.80	27.6 in 6.00 hrs	314976,182442
		44.4 in 9.75 hrs	
Rhiwsaeson STW TBR	16.34	28.2 in 7.00 hrs	307308,182629
		37.4 in 10.00 hrs	
Cowbridge TBR	16.84	28.8 in 6.75 hrs	299675,173689
		35.2 in 9.25 hrs	
Llantwit Major TBR	20.35	32.6 in 8.50 hrs	295375,169481

7.1.3 Groundwater

There are no groundwater level measurements available within the vicinity of the site. As groundwater levels rise in response to precipitation, groundwater could contribute to an increased level of surface water overland flow and a faster flow of water to river channels. However, flooding as a direct result of groundwater rising was not reported and the rapid onset and short duration of the flood event does not characterise groundwater flooding. Therefore, groundwater is not considered to be a direct source of flooding for this flood event.

7.2 Pathway

7.2.1 Swanbridge Grove residential area

For the residential area south of the adjoining field, surface water accumulated from two areas and travelled in 3 identified flow paths (see Figure 7-2):

1. The first flow path identified was in Catchment E (Figure 4-7) that received water from the fields west of Swanbridge Road and north of the housing estate which pooled at the disused railway embankment before percolating through and flowing into the estate to the south.
2. The second flow path identified originated from Catchment F where water collected from the field east of Swanbridge Road and flowed into the open channel on Swanbridge Road. The open channel eventually overtopped, and surface water continued along Swanbridge Road and into the properties to the west (Figure 7-2). Flood water then flowed in between the gardens of properties on Highbridge Grove where it eventually settled at the lowest ground levels within Swanbridge Grove and Winsford Road.
3. The third flow path recorded water flowing from the bottom field adjacent to Lavernock Road (Catchment G). The water is believed to have flowed along the disused old Lavernock Road route that runs adjacent to the disused railway embankment to the east of Swanbridge Road before tracking south and merging into the southerly section of Swanbridge Grove. Flows also occurred along South Road, where it then also flowed into the cul-de-sac of Swanbridge Grove and Highbridge Close.

Some flows moving west from Swanbridge Grove between properties toward Highbridge Close were reported to have been diverted by residents into a disused pool. Flows were reported to have caused a torrent of water to rush toward properties into Swanbridge Grove.

A further pathway reported by residents was through the drainage network being overwhelmed. It was reported by residents that drains and manholes outside of properties were overflowing.

7.2.2 Conybeare Road residential area

Regarding the flooding to the properties on Conybeare Road, the main flow pathway is reported to have been from the top of the field to the east (Catchment C), tracking west toward Conybeare Road.

It is reported that surface water pools in an area of local low ground level in the south-western corner of the field, north of Brean Close, at the location of the perched gulley inlet. As water levels increase, this area of ponding increases in a northerly direction adjacent to the footpath to the rear of Conybeare Road, prior to flowing onto the footpath. Once surface water reaches the footpath, water is able to flow into the residential area of Conybeare Road through the gardens of properties and via the public footpath.

It was also reported by residents that drains and manholes by the field adjoining the residential areas were overflowing during the flood event. However, the exact locations of these assets are not clear from the reports.

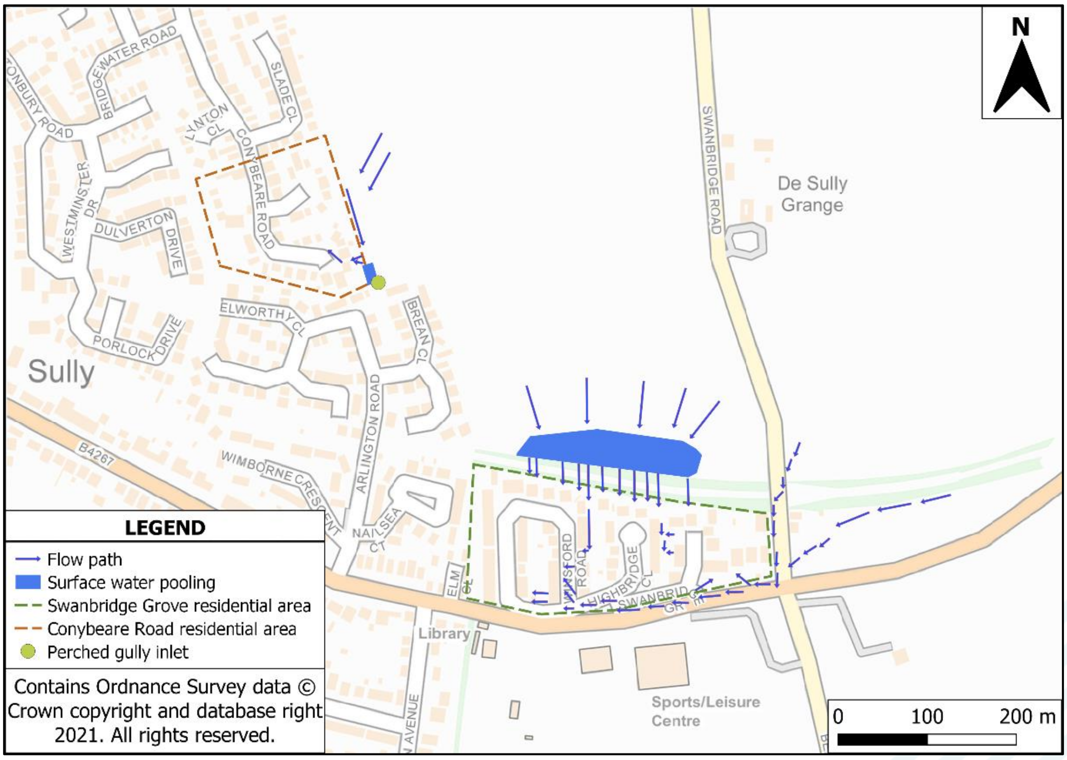


Figure 7-2 Flood water pathways

7.3 Receptor

7.3.1 People

The emotional impact of experiencing flooding and how it can have a harmful impact on mental health is well documented. Multiple reports from residents included concerns about the potential of flooding again and the unrest and anxiety this causes them. Residents also reported loss of personal possessions.

One resident reported they were unblocking a Council drain when the wave of flood water came down the public footpath, knocking them off their feet. The resident was injured and taken to hospital.

7.3.2 Property

The residential areas affected were:

- Swanbridge Road
- South Road
- Swanbridge Grove

- Highbridge Close
- Winsford Road
- Conybeare Road

The 74 returns from the 280 Flood Incident Forms issued by VoGC identified 18 properties that were flooded internally, 7 outbuildings and 19 gardens flooded. Flood water was brown with dirt and was reported to leave behind debris and 'slime' on walls, floors and possessions.

The volume of floodwater within the property varies due to the sloping ground level. The maximum approximate internal flood water depth reported was 1.2m (4ft) on Conybeare Road where 3 properties flooded and upward of 0.9m (3ft) on Winsford Road and 0.6m (2ft) on Swanbridge Grove. In total 15 properties flooded between Swanbridge Road and Winsford Road. Figures 6-4 to 6-6 provide a small representation of the extent of flooding that occurred and the impact it had on the residents.

Residents reported that they undertook measures to prevent property flooding including diverting flows and use of sandbags but did not report having had any temporary or permanent property level flood resilience measures installed prior to the storm event.

Reports of costs of damage to home and possessions from flooding per property varied considerably. Numerous properties reported estimated costs of £100 to £1,000 for properties experiencing internal and external flooding. Exceptional cases that experienced high level of internal flooding reported estimated costs of £10,000 to £50,000 in damages.

Figure 7-3 Image of external property flooding within the Conybeare Road investigation area (image received from resident completed flood report)

Figure 7-4 Image of internal property flooding within the Conybeare Road investigation area (image received from resident completed flood report)

Figure 7-5 Image of external property flood mark within the Swanbridge Grove investigation area (image received from resident completed flood report)

7.3.3 **Infrastructure**

Road access was prevented into Sully due to flooding of Sully Moors Road causing widespread traffic and some motorists being unable to access their destinations. One elderly resident who attempted to drive home reported being unable to return to their property for a number of hours.

Evidence collected by the VoGC identified a number of areas of highway and footway which were impacted by the flooding. Figure 7-6 below (Appendix D) shows the location of significant water build up within the Swanbridge Grove study area as reported by VoGC following their investigations.

Surface water run-off is reported to have filtered through the disused railway embankment, down Highbridge Close and through the rear gardens of properties situated between Highbridge Close and Winsford Road. It then collected in the low points of Winsford Road and the junction of Highbridge Close and South Road. One resident of Winsford Road reported that the road was impassable for a time due to the depth of water that was ponding in this area. At Swanbridge Grove, water filled the highway from the surrounding area, flowed south and collected in the low point at the entrance to Swanbridge Grove. Additionally, flows from Swanbridge Road were prevented from flowing onto South Road due to the high point on the carriageway, and instead flowed west along the footway and towards the low point at the entrance to Swanbridge Grove.

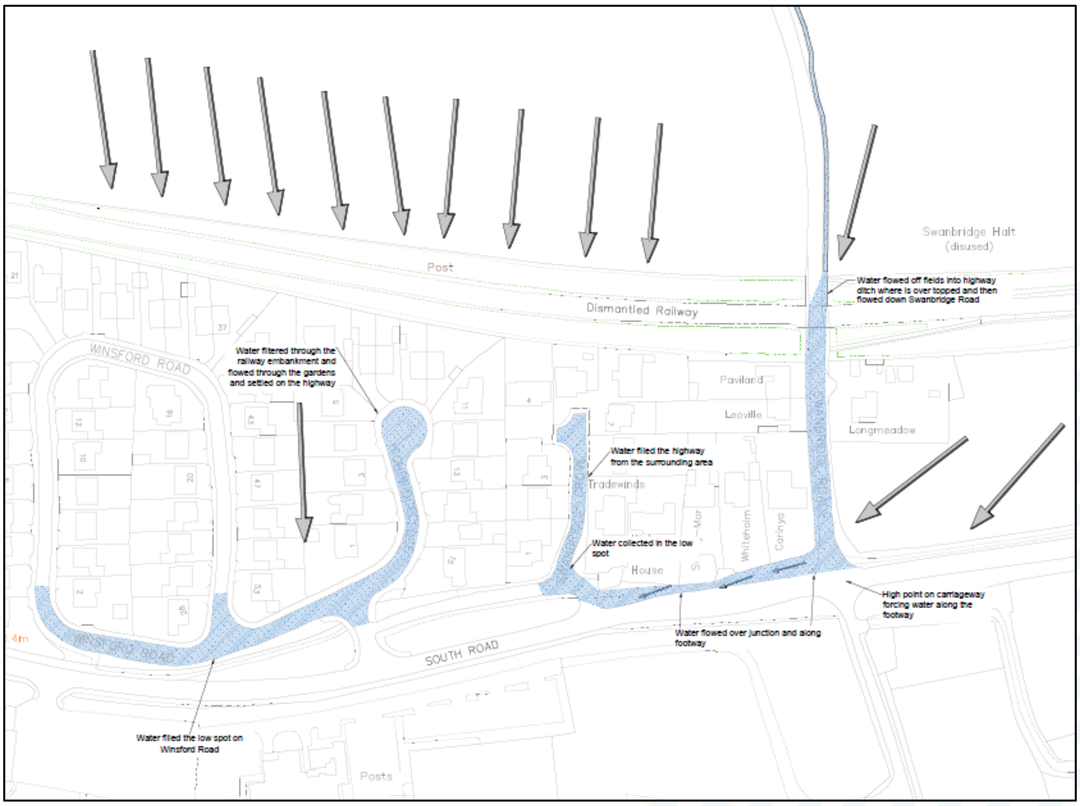


Figure 7-6 - Highway and footway flooding

7.3.4 Services

Flood water was observed around the Sully Sports and Social club and library on South Road, possibly limiting access to these services. The bus service travels along South Road and stopping at The Surgery Bus Stop (CF64 5TL) on South Road would also have been interrupted by the impacts of the flooding on the local roads.

8 Causal factors

8.1 Wider catchment conditions

8.1.1 Catchment C

After the storm event on 23 December 2020, VoGC attended the Taylor Wimpey development site. As identified in Section 4.2.1.1, the majority of the development site is located within Catchment A, with a small section of developed land to the south west of the site located in Catchment C.

During this visit some gullies were noted to be covered in a silty material and to be holding water, but the roads and drainage installed at the time were connected to the main drainage feature in the north eastern corner of the site, which is where the majority of land under development within Catchment A naturally drains (towards the Sully Brook, away from the area of interest at Conybeare and Swanbridge Road). The drainage feature was still under construction at the time, but the drainage pipes from the site were discharging adjacent to the feature. This has since been completed, allowing the runoff from the site to be stored and drain down at an attenuated rate.

An isolated section of drainage in the south west corner of the development which sits in Catchment C, was not connected to the main drainage system at the time of the VoGC visit. This area is bunded to prevent runoff flowing from the Taylor Wimpey site into the field to the south. There was no evidence during the visit that this bund had been overtopped. A short length of newt fencing was installed in the south west corner of the site, from an area of undisturbed ground with a long sward of grass. No evidence was seen of any significant flow from this area.

At the time of the VoGC visit following the December 2020 flooding, the field to the south of the Taylor Wimpey development site, east of Conybeare Road, was planted with what appeared to be winter wheat and so had almost no ground cover, leaving 100% bare earth. These conditions likely contributed to overland surface flows.

Additionally, the ground around the perched gully inlet in the south west corner of the field had been filled in, which will have reduced the storage capacity of surface water runoff in this location. This was later modified by VoGC to reinstate the gully cover and frame.

8.1.2 Catchments E to H

As described above, in Sections 5.1 and 5.2, throughout Catchments E to H soils were highly saturated with little capacity for storage throughout the catchments. The outcome of this high volume of rainfall falling on a saturated catchment was rapid flows of surface water run-off across non-permeable urban surfaces and slopes. These flows pooled at lower elevations This also caused problems for the surface water sewer network, which was unable to cope with a large volume of water over this short timeframe.

8.2 Surface water network

8.2.1 Swanbridge Grove residential area

8.2.1.1 Highway Network

As the Highways Authority, VoGC investigate reports of blocked drains from residents and regularly cleanse the highways surface water drainage network. The current cleansing rotas result in a 15 -18 month average rotation, although this cycle was disrupted by the 23rd December 2020 event.

The Highways Authority have stated that the highway gullies within the Swanbridge Grove residential area were cleansed on the following dates:

- 4th – 10th June 2019
- 2nd – 5th October 2018

The highway gullies along South Road were cleansed on 24th September 2020.

Following the flood event, a CCTV survey investigating the condition of the surface water network was completed by the VoGC for Swanbridge Road on 15th March 2021 and for Winsford Road, Highbridge Close and Swanbridge Grove on 28th April 2021. Additionally, the Highway Authority cleansed the highway network of the Swanbridge Grove residential area between 11th-18th March 2021. VoGC completed clearance of the Swanbridge Road highway network north of South Road on 8th July 2021.

The investigation of the highway network along Swanbridge Road and Beach Road network identified damage just north of the South Road junction and a high level of silt build-up just south of the junction. Low to moderate levels of silt and debris were also reported between the disused railway embankment and the South Road junction.

As detailed in Section 4.1.1.1, the highway network along Swanbridge Road, between the disused railway embankment and the South Road junction, is designed to receive highway flows only and has a full bore capacity of 19.4 l/s. Given the location of the system within Swanbridge Road, the highway network is prone to receiving sheeting overland flow from Catchments F and G. Greenfield runoff rates for Catchments F and G during a 1 in 20 year rainfall event are not known, however rates for the 1 in 2 year rainfall event are 20.0 l/s and 38 l/s respectively. During the 1 in 30 year rainfall event, runoff rates are 35.6 l/s and 67.6 l/s, respectively. Greenfield runoff rates during the flood event greatly exceeded the full bore pipe capacity of the system. It is therefore considered that although this highway system was significantly blocked and damaged at the time of the event, resulting in a reduction in its capacity, the impact of this is considered negligible due to the excessive volume of surface water of more than double the capacity of the Swanbridge Road drainage system during the event.

8.2.1.2 DCWW Network

Investigation of the DCWW surface water network on 28th April 2021 identified low levels of debris build-up on Winsford Road. On Highbridge Close low levels of debris build-up and a number of partial blockages were identified just before connecting with the drains from Swanbridge Grove. The section of drainage on South Road running parallel to Winsford had a number of blockages within the system. Investigation of the surface water system on Swanbridge Grove identified a low level build-up of silt, debris and roots.

8.2.2 Conybeare Road residential area

No CCTV surveys were completed for the Conybeare Road surface water network. However, numerous residents reported flood water surcharging from manholes and drains being overwhelmed. It is not known whether these manholes and drains relate to the highway or public surface water or foul system. However, VOGC and DCWW have confirmed that there were no reports of foul sewer flooding in this area.

The Highways Authority have stated that the highway gullies within the investigation area were cleansed on the following dates:

- 23rd November 2020
- 4th - 10th June 2019
- 2nd - 5th October 2018

Following the flood event, the Highway Authority cleansed the highway network of the Conybeare Road residential area between 11th-18th March 2021 with an inspection of the system undertaken by VoGC on 6th July 2021. During this inspection, the connection of the highway network to the DCWW network was clear with no sign of blockage.

The highway network gully at the rear of Conybeare Road is not intended to cope with sheeting overland flows from the adjacent land and the system was likely overwhelmed and could not drain at a fast-enough rate.

The risk of flooding to residents was likely heightened due to reported blockage of one or more surface drainage channels at the rear of Conybeare Road. Whilst it is unclear which assets these reports are referring to, it is possible they relate to the ditch and bund informal defence to the rear of Conybeare road, or the highway network that is in close proximity to the residential properties.

Feedback from residents following the event identified a blockage of the perched gully inlet located in the south west corner of the field adjacent to Conybeare Road.

It was reported that VoGC had not addressed reports from residents regarding the blockage at the time of the flooding. The most recent report of blockages received by VoGC prior to 23rd December 2020 relating to this feature were received on 14th November 2019 and 14th February 2020. The perched inlet was inspected by a VoGC LLFA officer on 12th June 2020 and found to be unobstructed. The perched inlet was also inspected and cleared by VoGC contractors in November 2020, in conjunction with cleansing of the highway drainage serving the adjacent footpath, whilst the status of the land drainage connection into a public surface water sewer was being addressed with DCWW. There are also reports that the farmer who owns the adjacent field cleared the perched gulley inlet on 23rd December 2020.

This perched gully inlet flows to the DCWW network to the south of Brean Close that is separate to the highway drainage serving the footpath area to the rear of Conybeare Road. However, blockage of this inlet would result in an increase in surface water volume flowing towards the highway network to the rear of

Conybeare Road due to the reduced capacity of the inlet and volume of surface water able to enter into the DCWW network.

It is unclear who owns the perched gulley inlet and is therefore responsible for its maintenance. Despite this Ad Hoc repairs and cleansings have been undertaken by VoGC on a reactive basis due to the impacts blockage of this inlet have on the adjacent community.

Following the flood event, VoGC cleared the blockage to the inlet on 19th January 2021.

9 Conclusion and recommendations

9.1 Conclusions

This report has detailed the investigation into the flooding of the residential area north of South Road, Sully in the Sully Coastal Catchment on 23rd December 2020. This investigation has reviewed evidence provided by responders and residents and has been informed by a Section 19 data analysis for Dinas Powys produced by JBA Consulting.

Within the area of investigation, the impacts from the storm event primarily occurred in two areas: the residential area north of South Road from Swanbridge Grove to Winsford Road; and Conybeare Road.

The evidence gathered in this report demonstrates that for both areas the cause of flooding was due to heavy rainfall resulting in rapid surface water flows in the adjoining fields that entered the residential areas. This was likely exacerbated by poorly functioning surface water drainage.

In the Swanbridge Grove residential area, three surface water flow paths into the residential area were identified. Firstly, from the field to the north pooling behind and then percolating through the disused railway embankment. Second, from the field east of Swanbridge Road via the highway ditch, and third from the field east of Swanbridge Road via the old Lavernock Road route. These flows resulted in internal flooding and widespread external flooding of residential properties and transport links being affected. This flooding was likely exacerbated by the highway drainage system being overwhelmed that led to increased flows from around the corner of Swanbridge Road toward South Road.

Flooding at Conybeare Road occurred from surface water flows from the adjoining field flowing down the footpath and entering the residential area. This resulted in internal flooding and widespread external flooding of residential properties. The was likely exacerbated by the highway drainage system being overwhelmed at the rear of Conybeare Road and the perched gully inlet in the south-west of the field being blocked.

The below actions are recommended in response to these findings.

9.2 Recommendations

Risk Management Authority/Stakeholder	Recommended actions
LLFA (VoGC)	Assess viability of Flood Risk Management Schemes to manage surface water flood risk for the Swanbridge Grove residential area.
LLFA (VoGC)	Assess viability of Flood Risk Management Schemes to manage surface water flood risk for Conybeare Road.
LLFA (VoGC) and DCWW	Confirm ownership and maintenance responsibilities of perched gully inlet at the south-west corner of adjoining field draining towards Brean Close.
Highways Authority (VoGC)	Model capacity of existing highway surface water network and consider improvements to Swanbridge Road Highway Drainage; investigate options for upgrading highway culverts and drains where required.
Highways Authority (VoGC)	Model capacity of existing highway surface water network and consider enhancing maintenance schedule for the South Road surface water drainage system and for the rear of Conybeare Road.
Highways Authority (VoGC)	Prioritise cleansing of the Swanbridge Road surface water drainage system due to the flood risk posed by surface water run-off from Swanbridge Road.
DCWW	Model capacity of existing public surface water drainage capacity and consider enhancing maintenance schedule for Winsford Road, Highbridge Close and Conybeare Road.
VoGC / Property Owners	Consider flood risk to own properties; to install property flood resilience (PFR) where necessary in liaison with the appropriate RMA's.

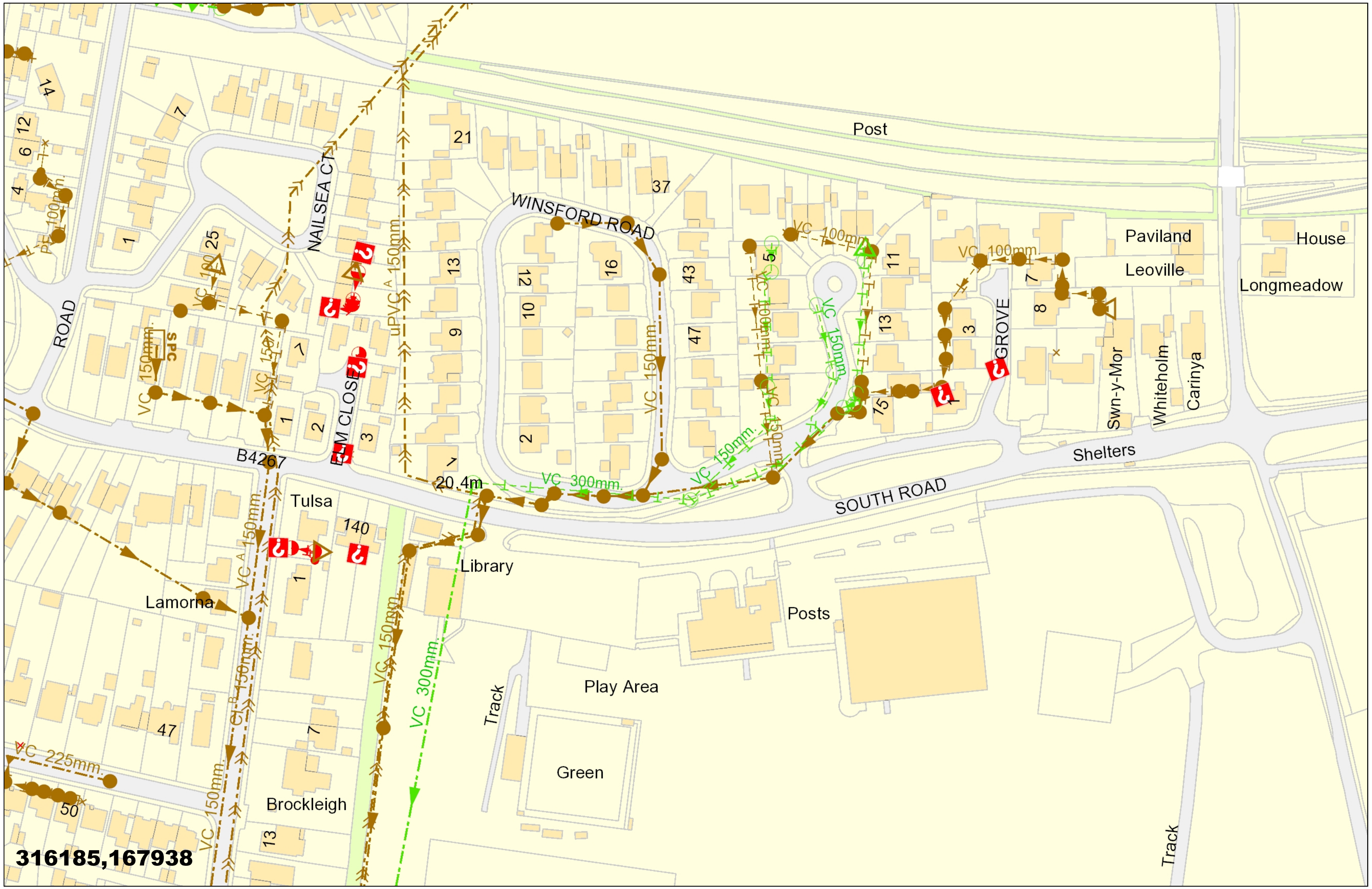
APPENDIX A – Swanbridge Grove Investigation Area DCWW Sewer Maps

Dŵr Cymru
Welsh Water

DCWW Winsford Road

14/06/2021

Scale: 1: 2500



LEGEND

Clean Water

- Sluice Val
- Air Val, SINGLE
- Tap
- Pressure Reducing Valve
- Meter
- BULK Meter
- FH
- Cap
- Existing Main
- NON COMPANY

Sewerage External

- Foul
- Surface Water
- Combined
- Rising Main
- Private
- Treatment Works
- Pumping Station
- Special Purpose
- Unknown End
- Change, Combined Overflow
- Outfall, FOUL
- Lamp Hole, Foul
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

Dwr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon In the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby the company, is done so in accordance with statutory requirements of sections 198 and 199 f the water industry Act 1991 based upon the best Information available and in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclosure the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information us entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

EXACT LOCATION OF ALL APPARATUS TO BE DETERMINED ON SITE

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be Asbestos Cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

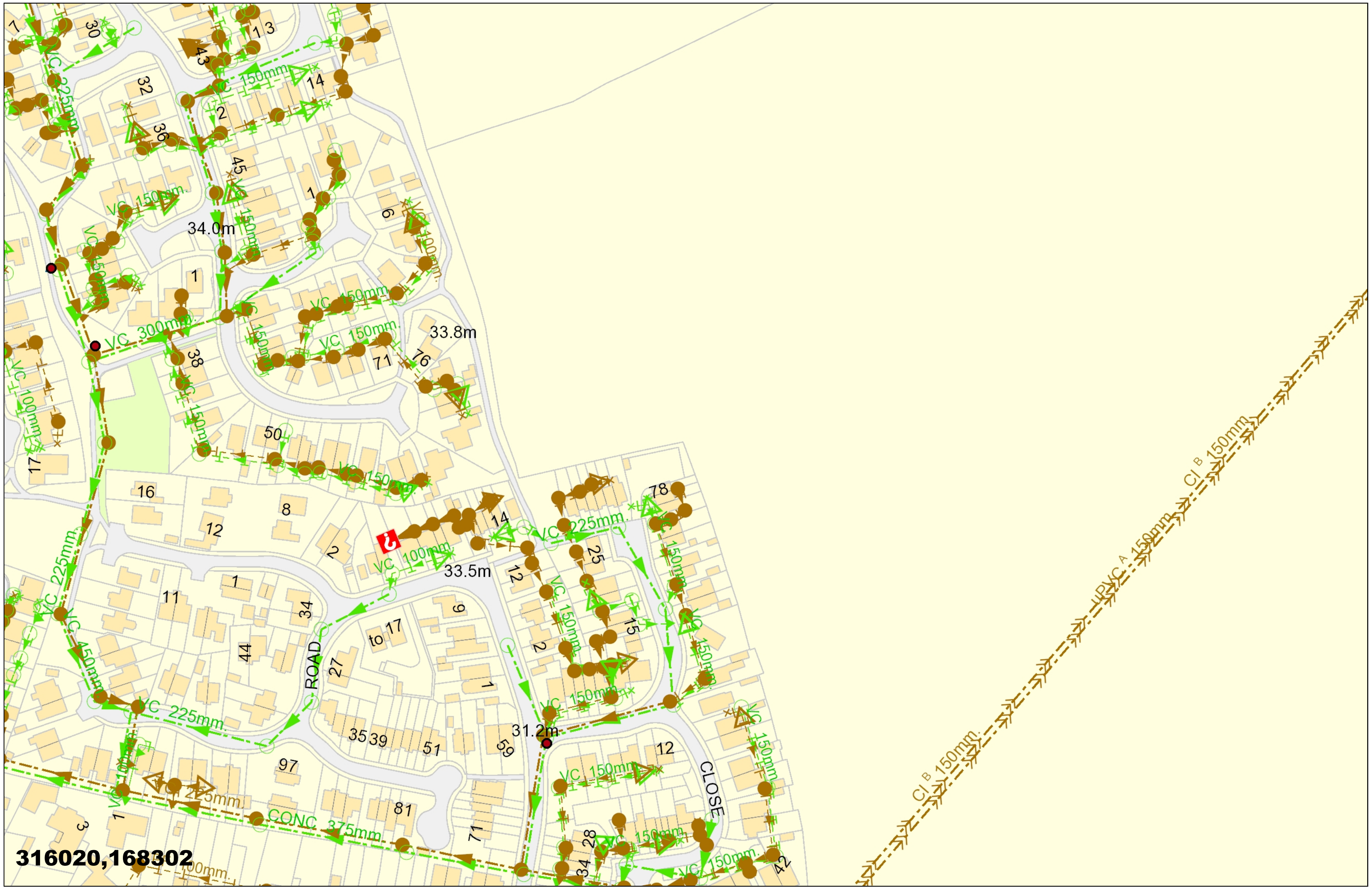
APPENDIX B – Conybeare Road Investigation Area DCWW Sewer Maps

Dŵr Cymru
Welsh Water

DCWW Coneybeare Road

14/06/2021

Scale: 1: 2500



LEGEND

Clean Water

- Sluice Val
- Air Val, SINGLE
- Tap
- Pressure Reducing Valve
- Meter
- BULK Meter
- FH
- Cap
- Existing Main
- NON COMPANY

Sewerage External

- Foul
- Surface Water
- Combined
- Rising Main
- Private
- Treatment Works
- Pumping Station
- Special Purpose
- Unknown End
- Change, Combined Overflow
- Outfall, FOUL
- Lamp Hole, Foul
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

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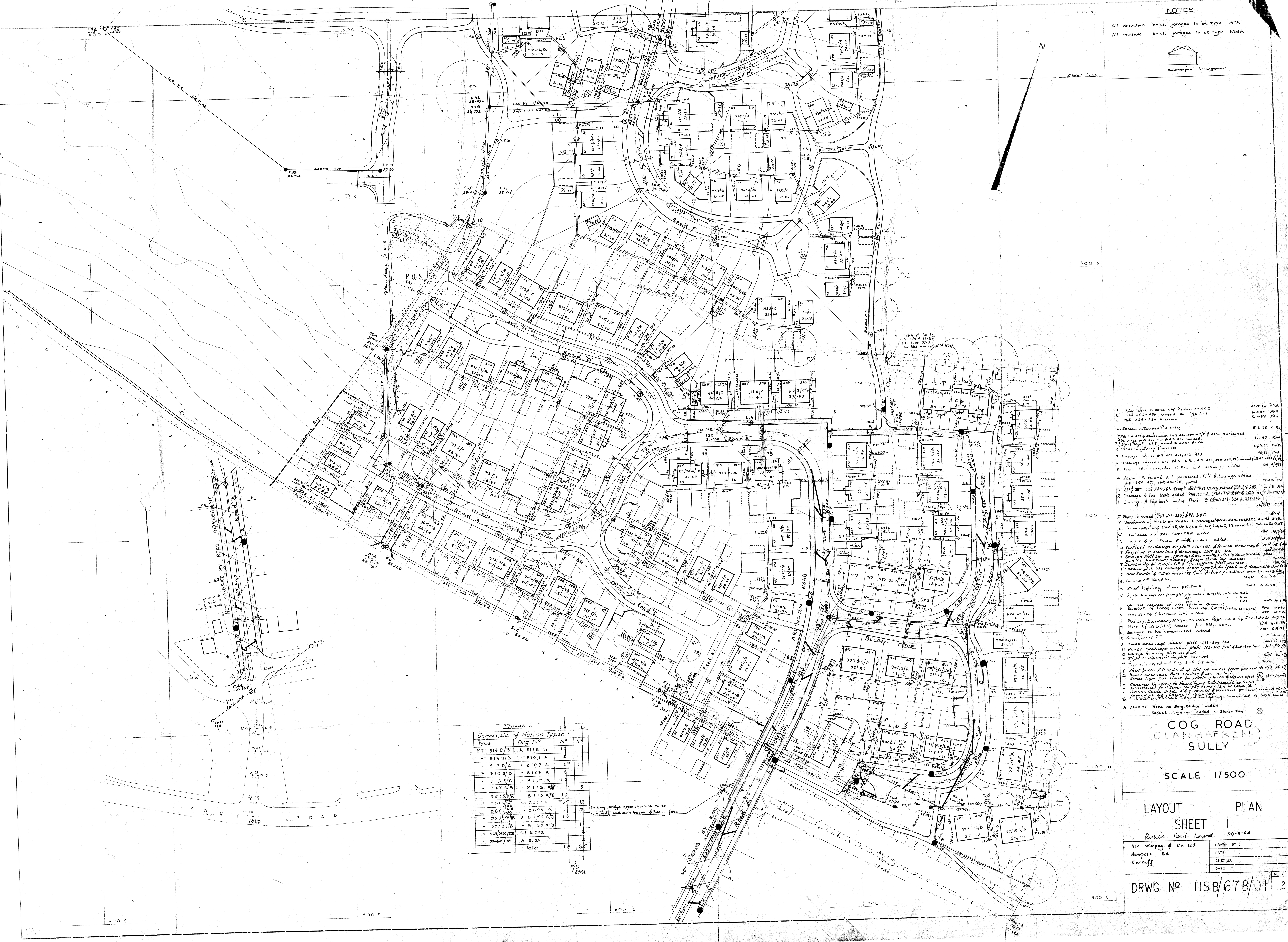
APPENDIX C – Brean Close Development Plans


NOTES
All detached brick garages to be type M7A
All multiple brick garages to be type MBA
Downpipes Arrangement
COG ROAD
GLANHAFREN
SULLY
SCALE 1/500
LAYOUT PLAN
SHEET 1
Revised Road Layout 30.8.84
Geo. Wimpey & Co. Ltd.
Newport Rd.
Cardiff
DRAWN BY:
DATE:
CHECKED:
DATE:
DRWG No 11SB/678/01
ARLINGTON ROAD
BREAN CLOSE
SOUTH ROAD
OLD RAILWAY
NOT COVERED BY ROAD AGREEMENT
P.O.S.
Road 'A'
Road 'D'
Road 'E'
Road 'F'
Road 'H'
Schedule of House Types

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Appendix D

Study Limitations

This appendix should be read before reliance is placed on any of the information, opinions, advice, recommendations, or conclusions contained in this report.

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6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties. Arcadis has taken reasonable steps to ensure that the information sources used for this investigation provided accurate information and has therefore assumed this to be the case.
7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.
8. This report refers, within the limitations stated, to the condition of the site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the site since the time of the investigation.
9. The content of this report represents the professional opinion of experienced Engineers. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.
10. Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.
11. Unless otherwise stated, samples from the site (soil, groundwater, building fabric or other samples) have not been obtained.
12. Arcadis has relied upon the accuracy of documents, oral information and other material and information provided by the Client and others, and Arcadis assumes no liability for the accuracy of such data, although in the event of apparent conflicts in information, Arcadis would highlight this and seek to resolve.

Unless otherwise stated, the scope of works has not included an environmental compliance review, health and safety compliance review, hazardous building materials assessment, Interviews or contacting Local Authority, requests for information to the petroleum officer, sampling or analyses of soil, ground water, surface water, air or hazardous building materials or a chain of title review

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