

THE QUAYS EV CHARGING

Surface Water Drainage Strategy

JULY 2022



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Report No	10052828-ARC-HDG-ZZ-RP-CE-00001
Date	JULY 2022

Version control

Version	Date	Author	Changes
P01	04/07/2022	D.Samuel	First Issue

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CONTENTS

1	INTRODUCTION	1
2	DESCRIPTION OF DEVELOPMENT	1
2.1	Existing Site	1
2.2	Current Use and Site Topography	1
2.3	Existing Site Geology.....	2
2.4	Local watercourse networks and drainage mechanisms.....	3
2.5	Existing Runoff Rates	4
2.6	Flood Risk.....	4
3	SUSTAINABLE DEVELOPMENT	5
4	GENERAL SURFACE WATER DRAINAGE DESIGN PROPOSALS	5
5	SUSTAINABLE DRAINAGE SYSTEMS STANDARDS FOR WALES.....	6
5.1	Compliance with Planning Policy Requirements	6
5.1.1	Compliance with Standard S1 – Surface Water Runoff Destination	6
5.1.2	Compliance with Standard S2 – Surface Water Runoff Hydraulic Control.....	8
5.1.3	Compliance with Standard S3 – Water Quality	10
5.1.4	Compliance with Standard S4 – Amenity	13
5.1.5	Compliance with Standard S5 – Biodiversity.....	14
5.1.6	Compliance with Standard S6 – Design of Drainage for Construction, Operation and Maintenance and Structural Integrity.....	14
6	CONCLUSION.....	16
APPENDIX A.....		18
Greenfield Runoff Calculations.....		18
APPENDIX B.....		19
Drainage calculations.....		19
1 in 2 year + 20% Critical Event Calculations		20
1 in 30 year + 30% Critical Event Calculations		21
1 in 100 year + 40% Critical Event Calculations		22
APPENDIX C.....		23
Drawings.....		23

APPENDIX D24

Study Limitations.....24

FIGURES

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

Figure 2: Existing Site Land Use (Site Boundary outlined in Red)..... 2

Figure 3: Local watercourses and drainage mechanisms 4

Figure 4: NRW Flood map for Planning (Rivers and Sea) 4

Figure 5: Development area to outfall at proposed infiltration basin 7

Figure 6: Development area to outfall to existing ditch 7

TABLES

Table 1: ICP SUDS Greenfield Runoff Rates 4

Table 2: Infiltration basin properties 6

1 Introduction

This report has been prepared by Arcadis Consulting (UK) Limited for Neath Port Talbot County Council in support of a Planning Application for EV charging bays. This Report outlines the Drainage Strategy for the site.

The mitigation and control is an arrangement to cater only for the EV charging bays related construction and associated operations.

2 Description of Development

2.1 Existing Site

The Quays EV charging site is located off Brunel Way within Neath Part Talbot. The area of investigation is located to the south of the Neath Part Talbot County Council building and is adjacent to previous parking areas. The site boundary consists of existing council and a small section of grassed area containing 2 bunds, the whole site is located on made ground. The wider area is a mix of brownfield, open spaces and built-up areas. The topography of the site is generally flat with the exceptions of bunds within the grassed area. The development is approximately 1km West of the M4, with access from Brunel Way to the East. The total site area (shown in Figure 1) is approximately 0.95 hectares (9500 m²), (which includes 2 sections of council parking, grassed area and a section of the larger council vehicle parking) centred around Nation Grid Reference (NGR) 273528 193262. The grassed area the proposed car parking is to be built on equates to approximately 0.1 hectares in size.

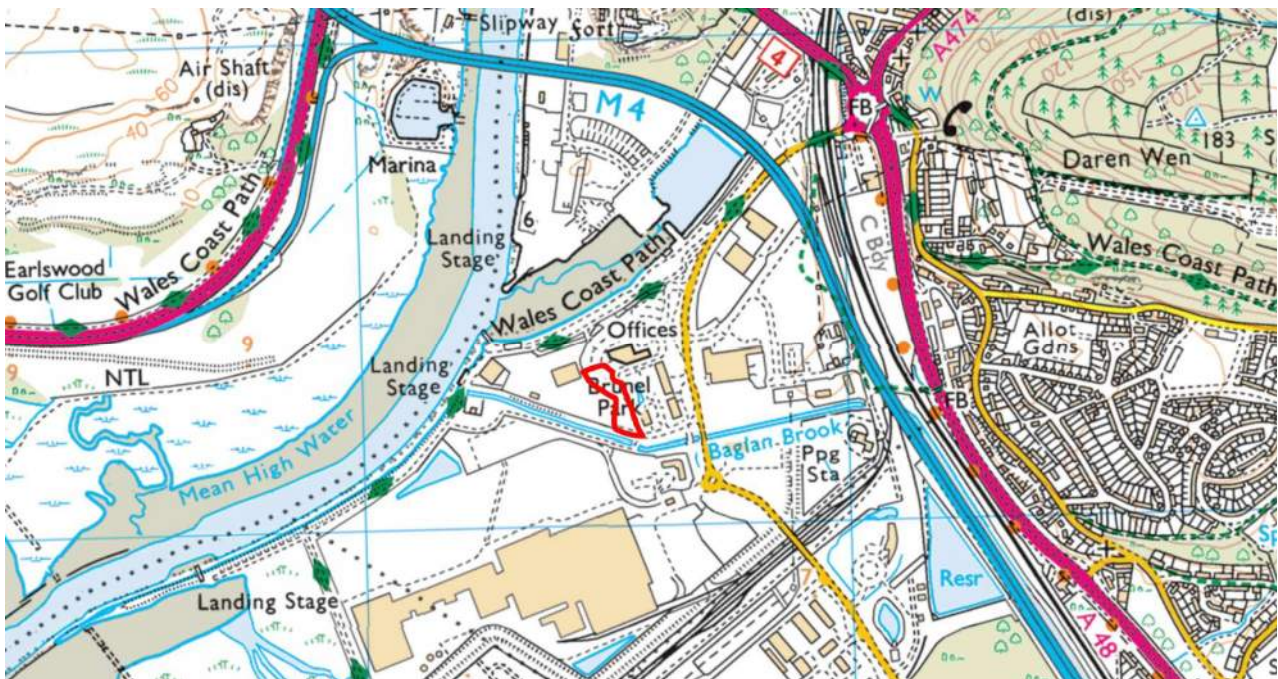


Figure 1 ; Site Location (Site Boundary outlined in Red)

2.2 Current Use and Site Topography

The site-specific topographical survey information shows that the elevations within the whole site development area varies between 99.5m and 100.85m ODN, as the site consists mainly of built roads/parking with tarmac surface the site doesn't have a general direction level direction.

The site is classed as a brownfield site and is currently used as car parking for the nearby council office building. A small drainage channel is located within the confines of the proposed site development, as indicated Figure 2 below, this is active drainage for the adjacent parking areas on site so will need to be retained following any nearby works.

Stockpiled material from adjacent works has been stored in bunds within the green space area as indicated in blue, section of these bunds will need to be removed prior to the commencement of construction for the proposed additional parking.

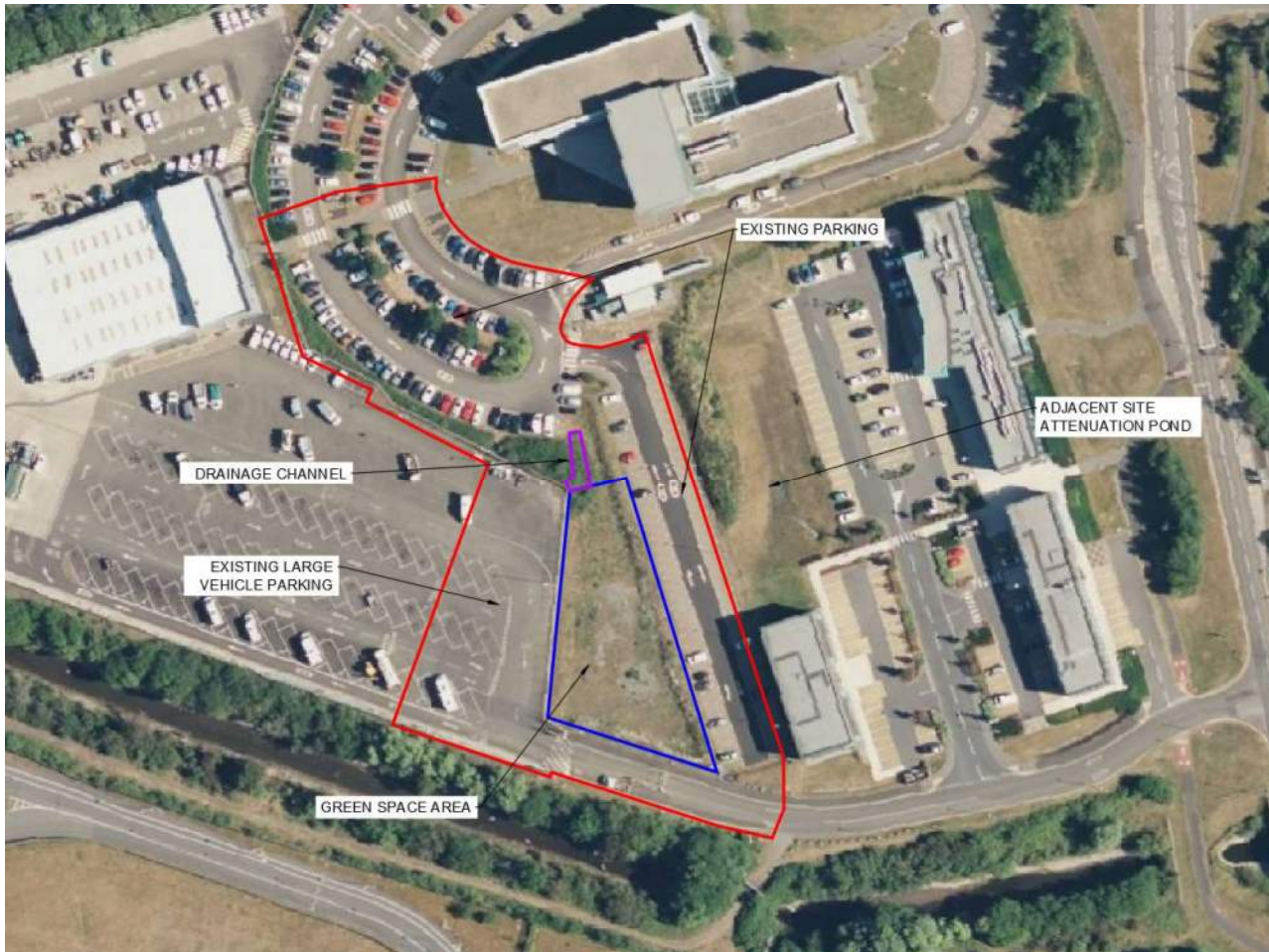
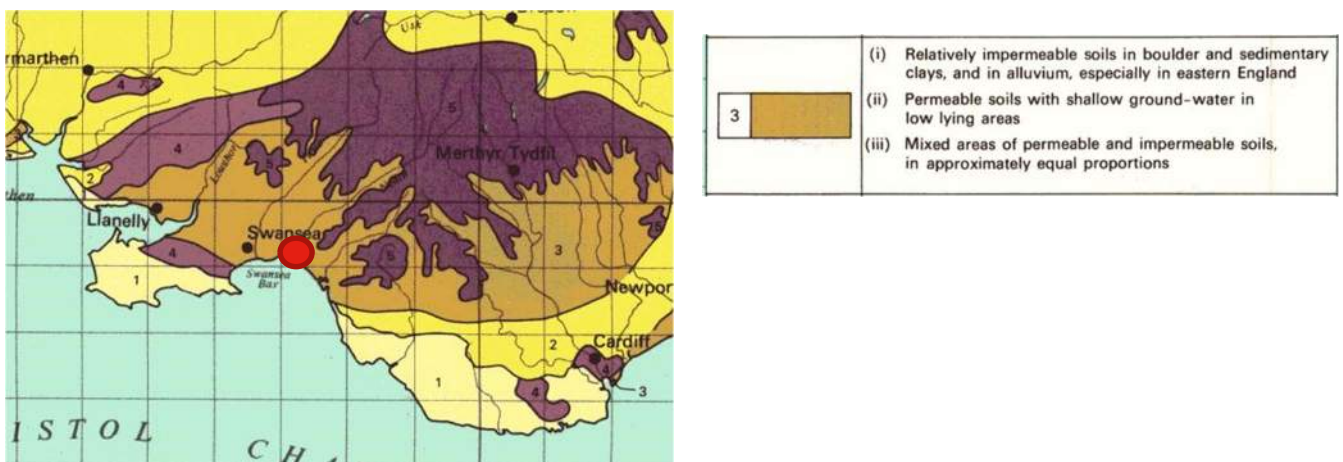


Figure 2: Existing Site Land Use (Site Boundary outlined in Red)

2.3 Existing Site Geology

The Wallingford WRAP map identifies the ground conditions as class 3.



Infiltration is likely to be a viable methodology for surface water discharge. However, this will need to be confirmed by site specific BRE 365 testing. For the purpose of the hydraulic modelling and calculations, it has been assumed the soil type is sand based with an infiltration coefficient of 1×10^{-5} m/s. This has been taken from Table 25.1 of CIRIA C753.

Soil type/texture	ISO 14688-1 description (after Blake, 2010)	Typical infiltration coefficients (m/s)
Good infiltration media - gravel - sand - loamy sand - sandy loam	Sandy GRAVEL Slightly silty slightly clayey SAND Silty slightly clayey SAND Silty clayey SAND	$3 \times 10^{-4} - 3 \times 10^{-2}$ $1 \times 10^{-5} - 5 \times 10^{-5}$ $1 \times 10^{-4} - 3 \times 10^{-5}$ $1 \times 10^{-7} - 1 \times 10^{-5}$
Poor infiltration media - loam - silt loam - chalk (structureless) - sandy clay loam	Very silty clayey SAND Very sandy clayey SILT N/A Very clayey silty SAND	$1 \times 10^{-7} - 5 \times 10^{-6}$ $1 \times 10^{-7} - 1 \times 10^{-5}$ $3 \times 10^{-8} - 3 \times 10^{-6}$ $3 \times 10^{-10} - 3 \times 10^{-7}$
Very poor infiltration media - silty clay loam - clay - till	– – Can be any texture of soil described above	$1 \times 10^{-8} - 1 \times 10^{-6}$ $< 3 \times 10^{-8}$ $3 \times 10^{-9} - 3 \times 10^{-6}$
Other rock* (note mass infiltration capacity will depend on the type of rock and the extent and nature of discontinuities and any infill)	N/A	$3 \times 10^{-9} - 3 \times 10^{-5}$

2.4 Local watercourse networks and drainage mechanisms

The River Neath is located approximately 350m to the west and Baglan brook is 50m to the south of the site. There are local drainage networks surrounding the site which have been identified on utility plans and primarily consist of pipes, gullies and inspection chambers. There is also an existing ditch adjacent to the site.

The existing site is currently drained through infiltration, and the land adjacent contains an infiltration basin, similar to that proposed in the design for The Quays site.

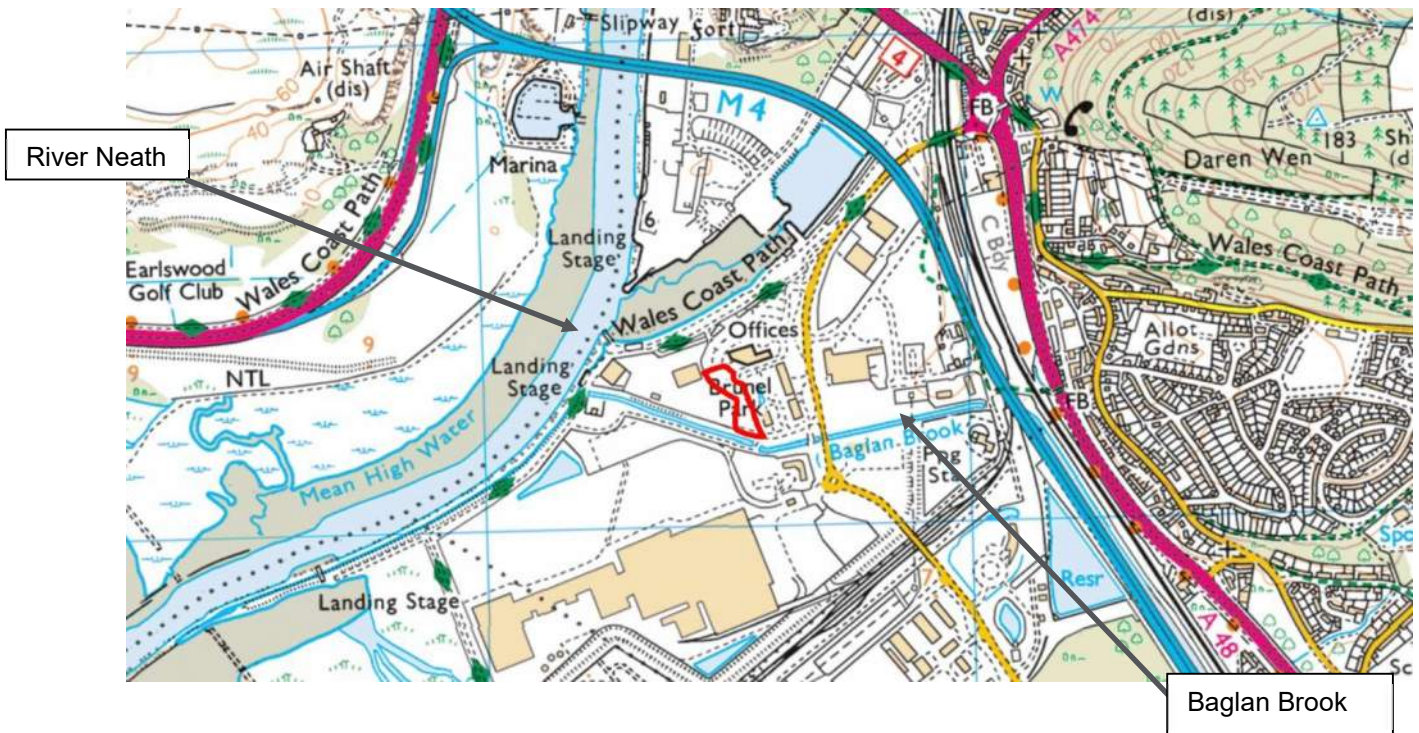


Figure 3: Local watercourses and drainage mechanisms

2.5 Existing Runoff Rates

Without appropriate control measures, the proposed development could increase the volume and rate of surface water runoff through the addition of impermeable surfaces such as pavements, footways and structures.

The greenfield runoff rates have been calculated using the ICP SuDS method (for a site with less than 50ha area) and the results are presented in **Error! Reference source not found.** The calculations are based on a 1 ha area and the results are presented in Appendix A for further information.

Description	Rate (l/s/ha)
QBar	5.7
Q1 Year	5
Q30 Years	10
Q100 Years	12.4

Table 1: ICP SuDS Greenfield Runoff Rates

The calculated allowable discharge rate for the site is 5.7l/s/ha

2.6 Flood Risk

The site is shown by the Natural Resource Wales online Flood Map for Planning (Rivers and Sea) to be located within Flood Zone 1, land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%). An extract of the Natural Resource Wales map is shown in **Error! Reference source not found.**, below.

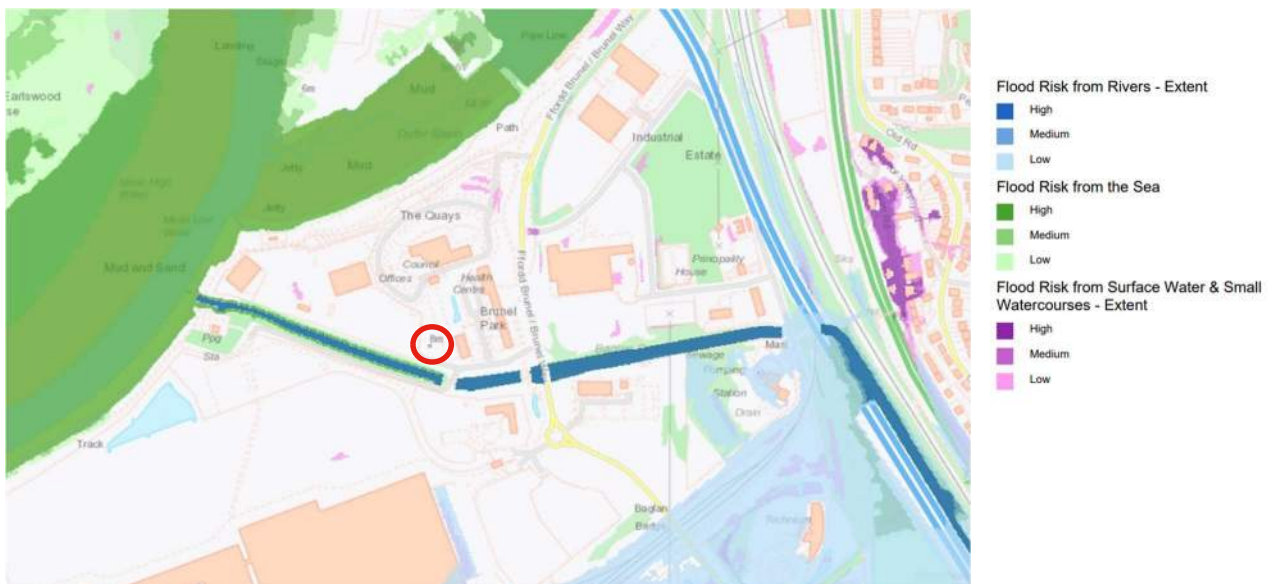


Figure 4: NRW Flood map for Planning (Rivers and Sea)

The site is therefore confirmed as not being at risk of flooding from fluvial sources. The nearest location where a higher risk of fluvial flooding is indicated on the mapping is approximately 35m south of the site, where Baglan Brook is located.

The NPPF specifies that the suitability of all new development in relation to flood risk should be assessed by applying the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed. As the site is shown to be located in Flood Zone 1, where the risk of fluvial flooding is lowest, the site can be considered appropriate on flood risk grounds, and the development proposals therefore pass the Sequential Test. The remainder of this report provides an assessment of flood risk from other potential sources of flooding, i.e., pertaining to the development, in line with the requirements of the NPPF.

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' 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

It is proposed to provide the following drainage infrastructure as part of the new development proposals:

- A surface water system within the site boundary, which consists of ACO road drains, filter drains and an infiltration basin.

Infiltration is expected to be a suitable method of discharge for surface water runoff due to the existing site utilising the same methodology. A Geotechnical Investigation is being undertaken to determine the infiltration rate at the proposed infiltration basin area and will confirm the size of the elements within the system. For the purpose of hydraulic calculations an infiltration rate of 1×10^{-5} m/s for a sand based soil type has been taken from CIRIA C753.

	Depth	Storage Volume (m ³)	Infiltration Rate (m/s)
Infiltration Basin	0.5m	76	1×10^{-5}

Table 2: Infiltration basin properties

An ACO road drain is proposed at the junction to pick up surface water runoff. This will then outfall to an existing ditch to the east at a rate of 3.5l/s.

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
 - There is potential to collect and re use surface water, however it is not suitable for a car parking facility.
- Priority Level 2: Surface water runoff is infiltrated to ground

- The majority of development area is proposed to direct rainfall to the infiltration basin which will allow surface water runoff to infiltrate to ground.

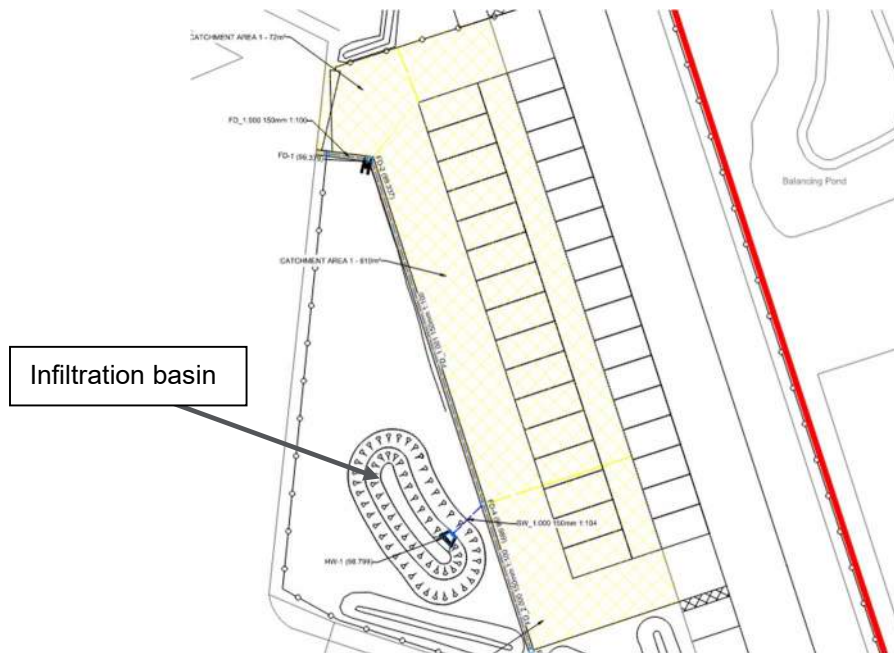


Figure 5: Development area to outfall at proposed infiltration basin

- Priority Level 3: Surface water runoff is discharged to a surface water body
 - Surface water run off from the proposed junction area is proposed to be collected by ACO Road Drains which will then discharge to an existing drainage ditch to the east.

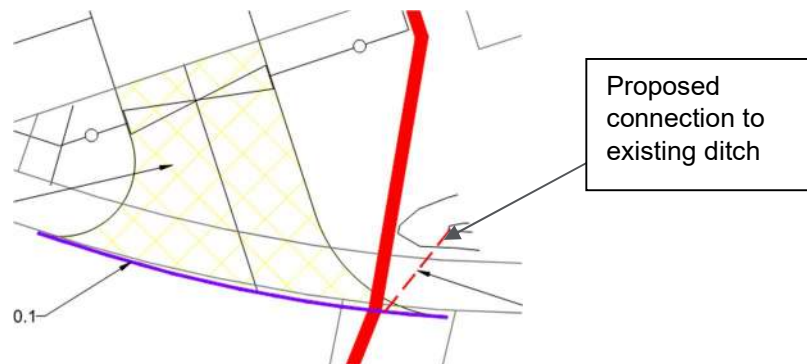


Figure 6: Development area to outfall to existing ditch

- Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system.
 - There is potential to discharge surface water runoff to a surface water sewer as drainage infrastructure has been identified on asset plans.
- 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 surface water in the car park is attenuated in a 0.5m deep infiltration basin which discharges water to the ground.

See Appendix C for proposed arrangements for the surface water drainage system.

The guidance requires that surface water drainage systems should cope with events that exceed the design capacity of the system. Any rainfall event with intensity more than that of the design capacity of the development surface water drainage network may result in temporary above ground flooding, potentially giving rise to overland flows. This excess water should be safely stored or conveyed from the site without adverse impacts to the development proposals, adjacent existing development or downstream.

The drainage system has been designed to operate for the 100 year + 40% event period without overland flows being generated.

5.1.3 Compliance with Standard S3 – Water Quality

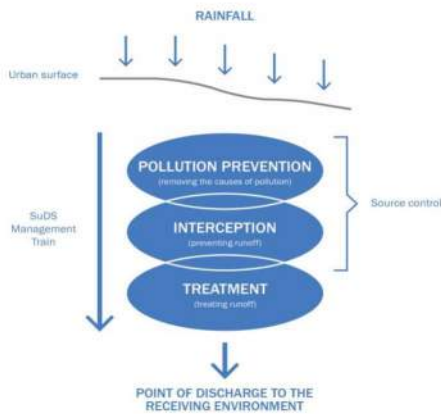
Standard S3 addresses the drainage design requirements to minimise the potential pollution risk posed by the surface water runoff to the receiving water body.

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.

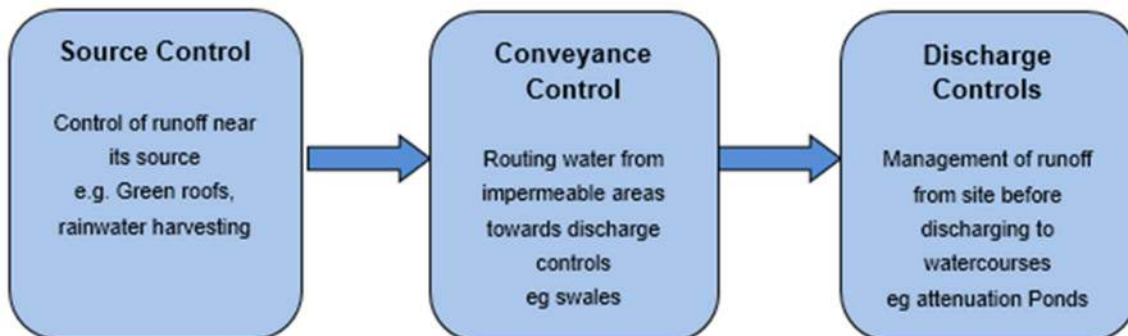
- SuDS design for pollution prevention
 - Where possible, surface water runoff should be managed using Interception, sedimentation and treatment components close to its source. This will help to prevent sediment and other pollutants from being conveyed to, and building up in, downstream components and 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.

• 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 for the drainage basin
Proprietary Treatment Systems	Not required for the site
Filter Strips	Not proposed
Filter Drains	Proposed to pick up surface water run off and the conveyance to the infiltration basin.
Swales	Not proposed
Bioretention Systems	Not proposed
Trees and Vegetation Planting	Planting of short flowering lawn and meadow is proposed.
Pervious Pavements	Not proposed for car park area. Surface water is proposed to be collected and conveyed to the infiltration basin via a filter drain system.
Attenuation Storage Tanks	Not required – An infiltration basin is proposed for any attenuation
Detention Basins	Not proposed
Ponds and Wetlands	An infiltration basin is proposed. Not suitable for additional wetland areas on the site.

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

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	

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 nature of the site as a car park limits amenity use. However, the capture, retention and attenuation of onward rainwater flows will reduce hazards from climate change. The system has been designed to operate for the 100 year + 40% event period.

The proposed introduction of an infiltration basin to accept flows from the site can be used as an appropriate amenity. It has been designed with 1:3 side slopes to help mitigate safety risks and also to provide for biodiversity and habitat creation. Fencing around the infiltration basin is not proposed as it may reduce the amenity benefits provided, will act as a barrier for easy maintenance and provide a trap where litter and dead vegetative material could collect.

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

The use of an infiltration basin can help support and promote the natural local habitat and maximise the biodiversity potential in the surround area.

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 an infiltration basin system. The site owner / operator will take responsibility for the maintenance and upkeep of all drainage features. The ecological value of the site is also enhanced through the additional planting proposed.

The operation and maintenance requirements would be in accordance with CIRIA C753 guidance.

6 Conclusion

This report has set out the principles for a viable drainage strategy for the disposal of surface water flows from the development.

The key design principles are:

- Use of sustainable drainage systems to manage and attenuate the increase in surface water runoff onsite, for up to and including the 1 in 100 year rainfall event (including a 40% allowance for climate change)

Through the use of a filter drain system and an infiltration basin, the proposed development will attenuate surface water flows and prevent flooding within the site and downstream. The ACO Road Drain proposed to drain the junction will freely discharge to an existing ditch adjacent to the site. The proposed strategy therefore achieves the aims and objectives of both local and national planning policies. However, the proposed solution is dependent on confirmation of suitable infiltration rates on site.

Appendix A

Greenfield Runoff Calculations

Arcadis SSC Europe B.V		Page 1
P.O. Box 161 AD Arnhem 6800 Netherlands		
Date 13-Jul-22 2:12 PM File GREENFIELD RATE.SRCX	Designed by D.Samuel Checked by M.Towler	
XP Solutions Source Control 2020.1.3		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	1.000	Urban	0.000
SAAR (mm)	1087	Region Number	Region 9

Results 1/s

QBAR Rural	5.7
QBAR Urban	5.7
Q1 year	5.0
Q1 year	5.0
Q30 years	10.0
Q100 years	12.4

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Appendix B

Drainage calculations

ACO HYDRAULIC DESIGN



+ SUMMARY REPORT - Page 1

Project Name: Quays EV Charging

Designer: Llewellyn Rees

Project Date: 20th April 2022

Location: ACO Head Office

Print Date: 20th April 2022

+ INPUTS

M5-60: 20mm/hr

Ratio R: 0.4

RUN / OPTION	LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows (l/s)	Discharge control (l/s)
1A	17.00	140.04	1.00	0.9	0	0	N/A	100.00	Free	None	0.00	None

+ OUTPUTS

M5-60: 20mm/hr

Ratio R: 0.4

RUN / OPTION	ACO PRODUCT	Part Number	METERAGE (m)	OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
1A	RoadDrain PD100F 10.1	32101	17.00	2.63	35.73**	0.57**	0.09**	4.32	3.64

*ACO would typically suggest flow velocities of 0.7m/s or greater in channels to be considered self-cleansing velocities. Flow velocities in the upper reaches of linear drainage systems are not likely to achieve self-cleansing velocities.

**The flow in this channel varies between sub-critical and super-critical conditions so the depth / velocity calculation is not precise. However, your selected channel will have sufficient capacity to accommodate the defined flow.

Note that optimised solutions will only suggest non-turbulent, sub-critical flow regimes.

+ SUMMARY OF PARTS

ACO PRODUCT	Cumulative Product Meterage (m)	Part Number	CUMULATIVE OUTFLOW (l/s)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
RoadDrain PD100F 10.1	17.00	32101	2.63	4.32	3.64

Project Name: Quays EV Charging

Designer: Llewellyn Rees

Project Date: 20th April 2022

Location: ACO Head Office

Print Date: 20th April 2022

+ CUMULATIVE ATTENUATION REQUIREMENTS

Max permitted outflow (l/s): 2.63

+ CONTRIBUTING AREAS

RUN	CATCHMENT AREA (m2)
1A	140.04
Effective Catchment Area	140.04
Additional Contributing Area	0.00
TOTAL AREA	140.04

+ RAINFALL DATA

Duration	Intensity (mm/h)	Required Storage Volume (m3)
5 mins	52.08	0.00
10 mins	39.23	0.00
15 mins	31.65	0.00
30 mins	20.23	0.00
1 hour	12.40	0.00
2 hours	7.64	0.00
4 hours	4.64	0.00
6 hours	3.54	0.00
10 hours	2.47	0.00
24 hours	1.29	0.00
48 hours	0.77	0.00

+ NET STORAGE VOLUME REQUIRED

0.00 m3

+ GROSS ATTENUATION STORAGE REQUIREMENT

0.00 m3

+ EXAMPLE STORMBRIXX CONFIGURATIONS (StormBrixx SD)

DEPTH (NUMBER OF UNITS)	LENGTH (NUMBER OF UNITS)	WIDTH (NUMBER OF UNITS)	STORAGE VOLUME M3 (GROSS/NET)
½ (= 0.478m)	0 (= 0.00m)	0 (= 0.00m)	0.00 (0.00)
1 (= 0.914m)	0 (= 0.00m)	0 (= 0.00m)	0.00 (0.00)
1½ (= 1.392m)	0 (= 0.00m)	0 (= 0.00m)	0.00 (0.00)
2 (= 1.828m)	0 (= 0.00m)	0 (= 0.00m)	0.00 (0.00)

Please note that any changes to your design criteria are likely to affect the attenuation requirement.

Please contact ACO Design Services with the details of your tank selection, with salient details such as proposed Cover Level, Invert Level, Ground Water Level and soil conditions. We will quickly prepare a Structural Analysis to fully assess your requirements.

+ DISCLAIMER

This simplified estimate of storage determines the largest volume required using the rainfall intensities for a range of different rainfall durations, for the location and return period specified by the designer. The type of flow control device is not known, so the calculation assumes a constant rate of outfall from the storage volume for the whole duration of the storm. Please contact ACO Design Services for further advice and details of the ACO Q-Brake Vortex Flow Control and the ACO StormBrixx Cellular Storage tank.

ACO HYDRAULIC DESIGN



+ DETAILED RUN REPORT - Page 1

Project Name: Quays EV Charging

Designer: Llewellyn Rees

Project Date: 20th April 2022

Location: ACO Head Office

Print Date: 20th April 2022

Project Notes:

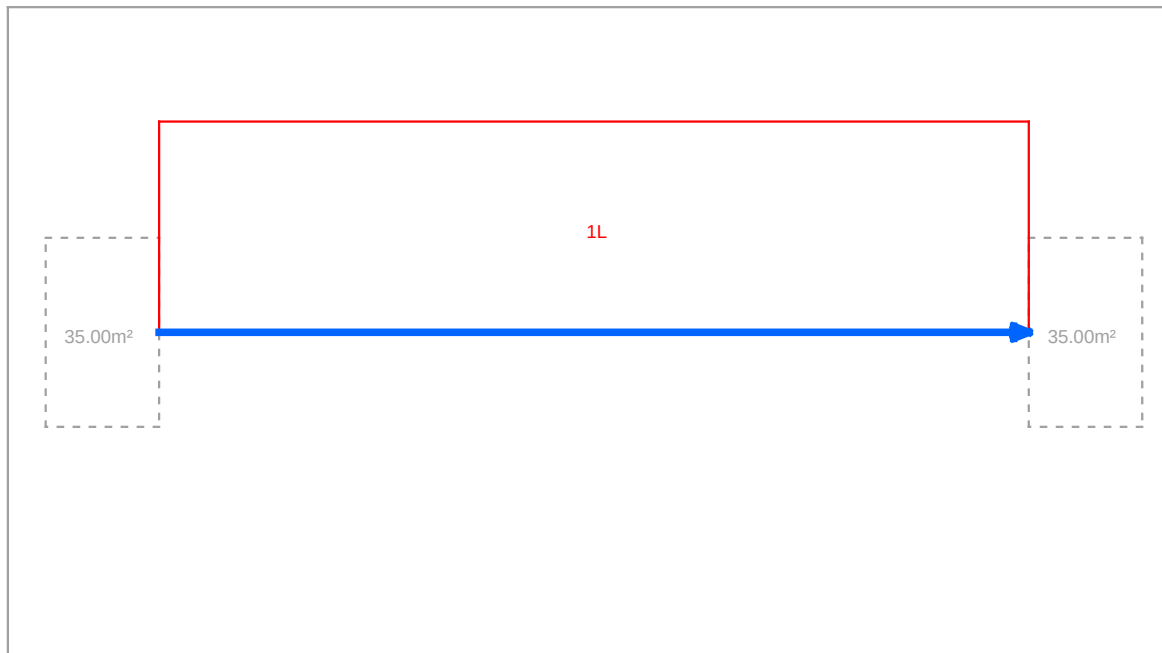
+ INPUT DATA:- Run 1: 'New Run', Option A 'New Option'

M5-60: 20mm/hr

Ratio R: 0.4

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
17.00	140.04	1.00	0.85	0	0.00	-	100.00	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	85.68
10 mins	66.24
15 mins	53.44
30 mins	33.61
1 hour	20.60
2 hours	12.30
4 hours	7.24
6 hours	5.36
10 hours	3.67
24 hours	1.89
48 hours	1.09



ACO HYDRAULIC DESIGN



+ DETAILED RUN REPORT - Page 2

Project Name: Quays EV Charging

Designer: Llewellyn Rees

Project Date: 20th April 2022

Location: ACO Head Office

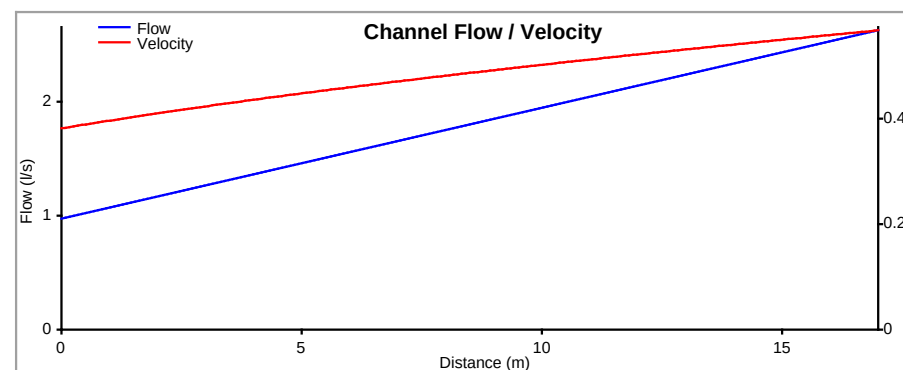
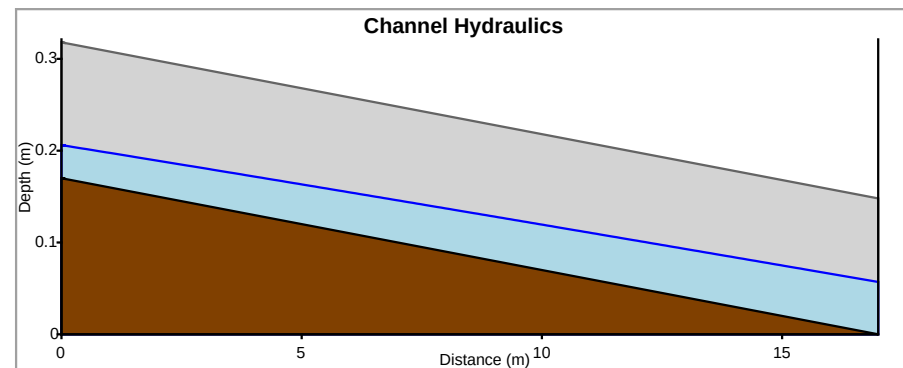
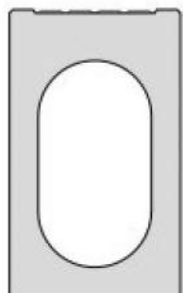
Print Date: 20th April 2022

+ OUTPUTS:- Run 1: 'New Run', Option A 'New Option'

OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
2.63	35.73**	0.57**	0.09**	4.32	3.64

RoadDrain

1	
System	PD100F 10.1
W - Width (mm)	100
H - Invert (mm)	225
Length (m)	17.00



**The flow in this channel varies between sub-critical and super-critical conditions so the depth / velocity calculation is not precise. However, your selected channel will have sufficient capacity to accommodate the defined flow.

Note that optimised solutions will only suggest non-turbulent, sub-critical flow regimes.

Arcadis SSC Europe B.V		Page 1
P.O. Box 161 AD Arnhem 6800 Netherlands		
Date 13-Jul-22 2:08 PM File DRAINAGE CALCS.MDX	Designed by L.Rees Checked by M.Towler	
XP Solutions Network 2020.1.3		

STORM SEWER DESIGN by the Modified Rational Method

Pipe Sizes STANDARD Manhole Sizes STANDARD

Designed with Level Soffits

« - Indicates pipe capacity < flow

Network Results Table

Arcadis SSC Europe B.V		Page 2
P.O. Box 161 AD Arnhem 6800 Netherlands		
Date 13-Jul-22 2:08 PM File DRAINAGE CALCS.MDX	Designed by L.Rees Checked by M.Towler	
XP Solutions Network 2020.1.3		

Network 2020.1.3

Storage Structures for Storm

Filter Drain Manhole: S1, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00005	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00005	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	0.0
Invert Level (m)	99.379	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	4.2		

Filter Drain Manhole: S2, DS/PN: S1.001

Infiltration Coefficient Base (m/hr)	1.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	1.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	0.0
Invert Level (m)	99.337	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	34.8		

Filter Drain Manhole: S3, DS/PN: S2.000

Infiltration Coefficient Base (m/hr)	1.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	1.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Number of Pipes	1
Porosity	0.30	Slope (1:X)	0.0
Invert Level (m)	99.137	Cap Volume Depth (m)	0.000
Trench Width (m)	0.5	Cap Infiltration Depth (m)	0.000
Trench Length (m)	14.8		

Infiltration Basin Manhole: S6, DS/PN: S1.004

Invert Level (m)	98.640	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.03600	Porosity	0.10
Infiltration Coefficient Side (m/hr)	0.03600		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	14.7	0.500	58.6

1 in 5 year Critical Event Calculations

Arcadis SSC Europe B.V		Page 3
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5 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

```
Margin for Flood Risk Warning (mm) 200.0      DVD Status OFF
      Analysis Timestep      Fine Inertia Status OFF
      DTS Status      ON
```

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	5, 30, 100
Climate Change (%)	0, 0, 40

									Water
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Level
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	(m)
S1.000	S1	15 Winter	5	+0%	100/15 Summer				99.417
S1.001	S2	15 Winter	5	+0%	100/15 Summer				99.412
S2.000	S3	15 Winter	5	+0%	100/15 Winter				99.183
S1.002	S3	15 Winter	5	+0%	30/15 Summer				99.091
S1.003	S5	15 Winter	5	+0%					98.998
S1.004	S6	15 Winter	5	+0%	5/15 Winter				98.652
S3.000	S7	15 Winter	5	+0%					99.535

PN	US/MH Name	Surcharged		Flooded	Flow / Overflow (l/s)	Half	Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow		Time (mins)	Flow (l/s)			
S1.000	S1	-0.112	0.000	0.10				5 1.2		OK
S1.001	S2	-0.075	0.000	0.48				7 7.2		OK
S2.000	S3	-0.104	0.000	0.20				6 3.0		OK
S1.002	S3	-0.048	0.000	0.80				10.0		OK
S1.003	S5	-0.101	0.000	0.24				10.0		OK
S1.004	S6	0.012	0.000	1.02				5 9.5	SURCHARGED	

Arcadis SSC Europe B.V		Page 4
P.O. Box 161 AD Arnhem 6800 Netherlands		
Date 13-Jul-22 2:08 PM File DRAINAGE CALCS.MDX	Designed by L.Rees Checked by M.Towler	
XP Solutions		Network 2020.1.3

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Surcharged Flooded		Flow / Overflow		Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Cap.	(l/s)	Time (mins)	Flow (l/s)		
S3.000	S7	-0.115	0.000	0.12			1.3	OK	

1 in 30 year Critical Event Calculations

Arcadis SSC Europe B.V		Page 5
P.O. Box 161 AD Arnhem 6800 Netherlands		
Date 13-Jul-22 2:08 PM File DRAINAGE CALCS.MDX	Designed by L.Rees Checked by M.Towler	
XP Solutions Network 2020.1.3		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

```
Margin for Flood Risk Warning (mm) 200.0      DVD Status OFF
      Analysis Timestep    Fine Inertia Status OFF
      DTS Status          ON
```

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	5, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH		Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water
	Name	Storm							Level (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				99.464
S1.001	S2	15 Winter	30	+0%	100/15 Summer				99.460
S2.000	S3	15 Winter	30	+0%	100/15 Winter				99.198
S1.002	S3	15 Winter	30	+0%	30/15 Summer				99.175
S1.003	S5	15 Winter	30	+0%					99.017
S1.004	S6	15 Winter	30	+0%	5/15 Winter				98.713
S3.000	S7	15 Winter	30	+0%					99.543

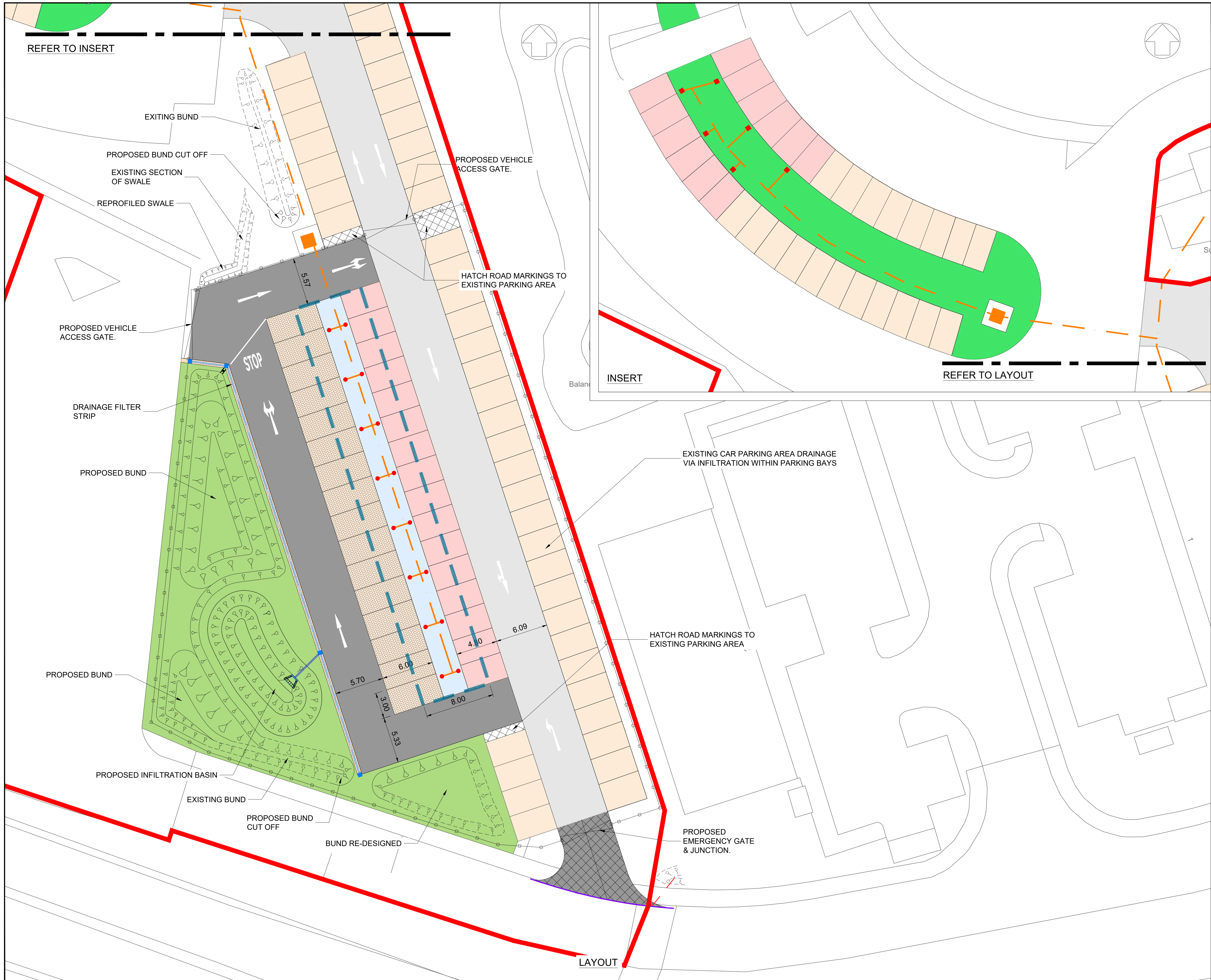
PN	Surcharged		Flooded		Half Drain		Pipe	Status	Level Exceeded
	US/MH Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)		
S1.000	S1	-0.065	0.000	0.15		3	1.9	OK	
S1.001	S2	-0.027	0.000	0.90		4	13.6	OK	
S2.000	S3	-0.089	0.000	0.31		5	4.5	OK	
S1.002	S3	-0.036	0.000	1.44			17.9	SURCHARGED	
S1.003	S5	-0.082	0.000	0.42			17.9	OK	
S1.004	S6	-0.073	0.000	1.88		5	17.7	SURCHARGED	

1 in 100 year + 40% Critical Event Calculations

Arcadis SSC Europe B.V										Page 7																																																																																																					
P.O. Box 161 AD Arnhem 6800 Netherlands																																																																																																															
Date 13-Jul-22 2:08 PM File DRAINAGE CALCS.MDX					Designed by L.Rees Checked by M.Towler																																																																																																										
XP Solutions					Network 2020.1.3																																																																																																										
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																																																																																																															
<u>Simulation Criteria</u>																																																																																																															
Areal Reduction Factor		1.000		Additional Flow - % of Total Flow		0.000																																																																																																									
Hot Start (mins)		0		MADD Factor * 10m³/ha Storage		2.000																																																																																																									
Hot Start Level (mm)		0		Inlet Coefficient		0.800																																																																																																									
Manhole Headloss Coeff (Global)		0.500		Flow per Person per Day (l/per/day)		0.000																																																																																																									
Foul Sewage per hectare (l/s)		0.000																																																																																																													
Number of Input Hydrographs		0		Number of Storage Structures		4																																																																																																									
Number of Online Controls		0		Number of Time/Area Diagrams		0																																																																																																									
Number of Offline Controls		0		Number of Real Time Controls		0																																																																																																									
<u>Synthetic Rainfall Details</u>																																																																																																															
Rainfall Model		FSR		Ratio R		0.300																																																																																																									
Region England and Wales Cv (Summer)		0.750																																																																																																													
M5-60 (mm)		18.200		Cv (Winter)		0.840																																																																																																									
Margin for Flood Risk Warning (mm)		200.0		DVD Status		OFF																																																																																																									
Analysis Timestep		Fine		Inertia Status		OFF																																																																																																									
DTS Status		ON																																																																																																													
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Climate Change (%)		0, 0, 40																																																																																																													
<table><tr><td></td><td>US/MH</td><td></td><td>Return</td><td>Climate</td><td>First (X)</td><td>First (Y)</td><td>First (Z)</td><td>Overflow</td><td>Water</td></tr><tr><td>PN</td><td>Name</td><td>Storm</td><td>Period</td><td>Change</td><td>Surcharge</td><td>Flood</td><td>Overflow</td><td>Act.</td><td>Level</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>(m)</td></tr><tr><td>S1.000</td><td>S1</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Summer</td><td></td><td></td><td></td><td>99.756</td></tr><tr><td>S1.001</td><td>S2</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Summer</td><td></td><td></td><td></td><td>99.751</td></tr><tr><td>S2.000</td><td>S3</td><td>15 Winter</td><td>100</td><td>+40%</td><td>100/15 Winter</td><td></td><td></td><td></td><td>99.294</td></tr><tr><td>S1.002</td><td>S3</td><td>15 Winter</td><td>100</td><td>+40%</td><td>30/15 Summer</td><td></td><td></td><td></td><td>99.254</td></tr><tr><td>S1.003</td><td>S5</td><td>15 Winter</td><td>100</td><td>+40%</td><td></td><td></td><td></td><td></td><td>99.032</td></tr><tr><td>S1.004</td><td>S6</td><td>15 Winter</td><td>100</td><td>+40%</td><td>5/15 Winter</td><td></td><td></td><td></td><td>98.788</td></tr><tr><td>S3.000</td><td>S7</td><td>15 Winter</td><td>100</td><td>+40%</td><td></td><td></td><td></td><td></td><td>99.559</td></tr></table>													US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water	PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.	Level										(m)	S1.000	S1	15 Winter	100	+40%	100/15 Summer				99.756	S1.001	S2	15 Winter	100	+40%	100/15 Summer				99.751	S2.000	S3	15 Winter	100	+40%	100/15 Winter				99.294	S1.002	S3	15 Winter	100	+40%	30/15 Summer				99.254	S1.003	S5	15 Winter	100	+40%					99.032	S1.004	S6	15 Winter	100	+40%	5/15 Winter				98.788	S3.000	S7	15 Winter	100	+40%					99.559
	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water																																																																																																						
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<table><tr><td></td><td>US/MH</td><td>Surcharged</td><td>Flooded</td><td></td><td>Half Drain</td><td>Pipe</td><td></td><td></td><td></td></tr><tr><td>PN</td><td>Name</td><td>Depth (m)</td><td>Volume (m³)</td><td>Flow / Cap.</td><td>Overflow (l/s)</td><td>Time (mins)</td><td>Flow (l/s)</td><td>Status</td><td>Level Exceeded</td></tr><tr><td>S1.000</td><td>S1</td><td>0.227</td><td>0.000</td><td>0.23</td><td></td><td>6</td><td>2.9</td><td>SURCHARGED</td><td></td></tr><tr><td>S1.001</td><td>S2</td><td>0.264</td><td>0.000</td><td>1.18</td><td></td><td>6</td><td>17.8</td><td>FLOOD RISK</td><td></td></tr><tr><td>S2.000</td><td>S3</td><td>0.007</td><td>0.000</td><td>0.52</td><td></td><td>5</td><td>7.6</td><td>SURCHARGED</td><td></td></tr><tr><td>S1.002</td><td>S3</td><td>0.115</td><td>0.000</td><td>2.01</td><td></td><td></td><td>25.0</td><td>SURCHARGED</td><td></td></tr><tr><td>S1.003</td><td>S5</td><td>-0.067</td><td>0.000</td><td>0.59</td><td></td><td></td><td>25.0</td><td>OK</td><td></td></tr><tr><td>S1.004</td><td>S6</td><td>0.148</td><td>0.000</td><td>2.62</td><td></td><td>6</td><td>24.6</td><td>SURCHARGED</td><td></td></tr></table>													US/MH	Surcharged	Flooded		Half Drain	Pipe				PN	Name	Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)	Status	Level Exceeded	S1.000	S1	0.227	0.000	0.23		6	2.9	SURCHARGED		S1.001	S2	0.264	0.000	1.18		6	17.8	FLOOD RISK		S2.000	S3	0.007	0.000	0.52		5	7.6	SURCHARGED		S1.002	S3	0.115	0.000	2.01			25.0	SURCHARGED		S1.003	S5	-0.067	0.000	0.59			25.0	OK		S1.004	S6	0.148	0.000	2.62		6	24.6	SURCHARGED																					
	US/MH	Surcharged	Flooded		Half Drain	Pipe																																																																																																									
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Appendix C

Drawings



NOTES:

- DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
- ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
- ALL MANHOLE AND ACO COVERS AND FRAME WITHIN TRAFFICKED AREAS TO BE CLASS D400. FOR ELECTRICAL JUNCTION BOX REQUIREMENTS REFER TO MEP INFORMATION.

LEGEND:

- SITE BOUNDARY
- NEW ROAD CONSTRUCTION
- EXISTING ROAD CONSTRUCTION
- NEW PARKING CONSTRUCTION
- EXISTING PARKING CONSTRUCTION
- EXISTING PARKING CONSTRUCTION WITH PROPOSED EV MARKINGS
- LANDSCAPING AREA
- EXISTING VEGETATION
- PROPOSED FOOTWAY CONSTRUCTION
- PROPOSED EMERGENCY ACCESS ROAD CONSTRUCTION
- EV CHARGING POINTS
- ELECTRICITY ROUTE
- ELECTRICITY JUNCTION BOX
- FILTER DRAIN STRIP
- PROPOSED CANOPY

Rev	Date	Description	Prod.	Chk.	Rev.	App.
P01.1		FIRST ISSUE	---	---	---	---

Project:

Quays EV Charging

Site:

The Quays
Neath Port Talbot

Client:

Neath Port Talbot
County Council
The Quays, Brunel Way
SA11 2GG
NPT.GOV.UK

ARCADIS

Registered office:
80 Fenchurch
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EC3M 4BY

Coordinating office:
Arcadis Cymru House
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Fortran Road
Cardiff, CF3 0EY
Tel: 44 (0)29 2092 6700

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GENERAL ARRANGEMENT
LAYOUT

Designed: L. Rees	Signed:	Date: 11/04/22
Produced: ---	Signed:	Date: ---
Checked: ---	Signed:	Date: ---
Reviewed: ---	Signed:	Date: ---
Approved: ---	Signed:	Date: ---

Design Stage: Preliminary Design

Original Size: N/A	Grid: OS	Datum: ODN
Suitability Code: S0	Scale: 1:200	Project Number: 10052828
Suitability Description:		

Initial Status or WIP

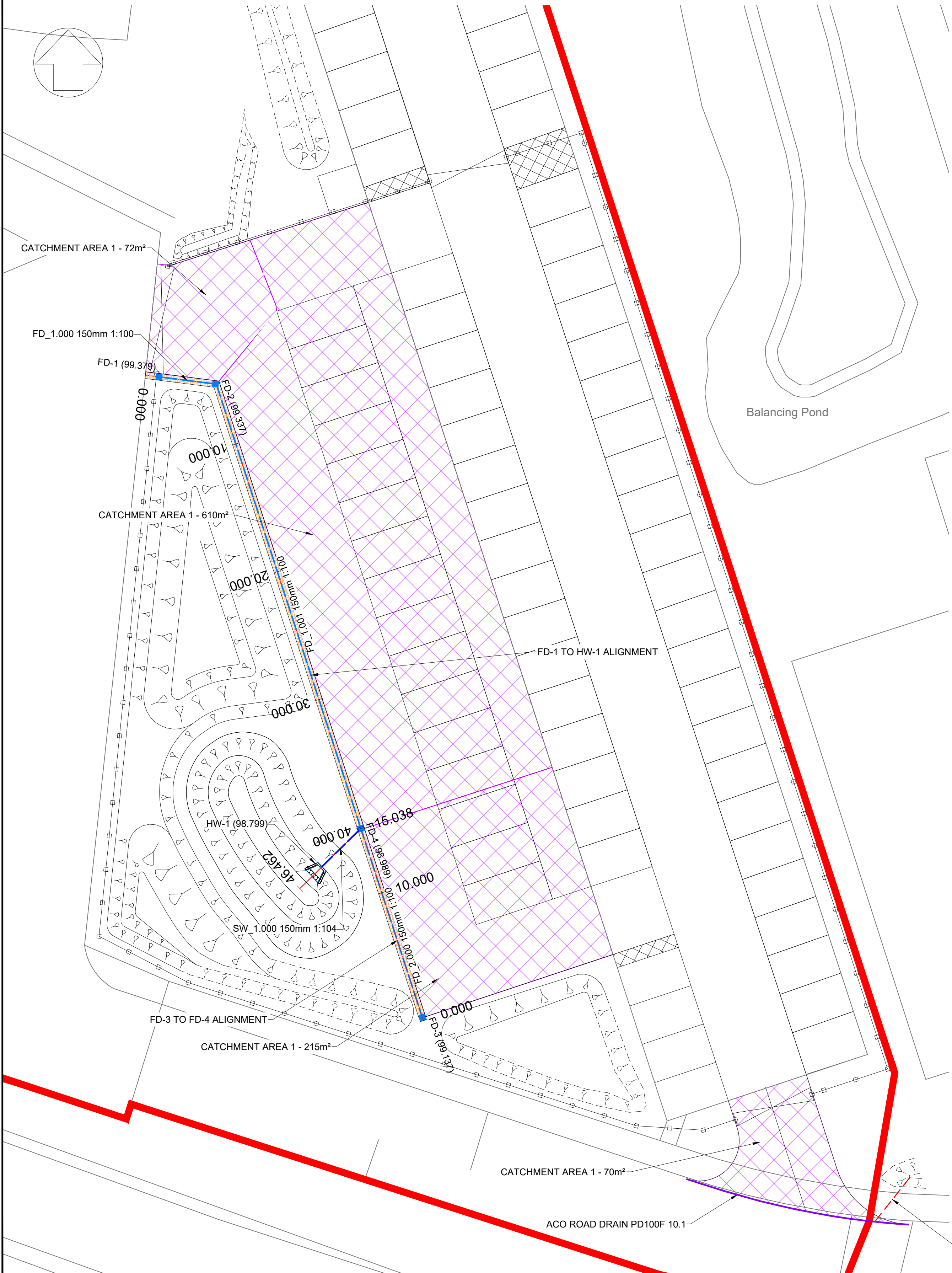
Drawing Number:
10052828 - ARC - CP -
070 - DR - C - 00001

Revision:
P01.1

Structure Table									
STRUCTURE REFERENCE	EASTING	NORTHING	COVER LEVEL	CHAMBER DIA (mm)	DEPTH TO LOWEST INVERT	INCOMING PIPES	OUTGOING PIPES	COVER GRADE (min)	STRUCTURE TYPE
FD-1	273521.851	193249.561	99.979	600	0.600		FD_1.000 - IL 99.379	D400	POLYPIPE CP60015150 CATCHPIT OR SIMILAR
FD-2	273526.049	193249.027	99.882	600	0.545	FD_1.000 - IL 99.337	FD_1.001 - IL 99.337	D400	POLYPIPE CP60015150 CATCHPIT OR SIMILAR
FD-3	273541.458	193201.867	99.826	600	0.689		FD_2.000 - IL 99.137	D400	POLYPIPE CP60015150 CATCHPIT OR SIMILAR
FD-4	273536.877	193215.954	99.631	600	0.643	FD_1.001 - IL 98.989 FD_2.000 - IL 98.989	SW_1.000 - IL 98.989	D400	POLYPIPE CP60015150 CATCHPIT OR SIMILAR
HW-1	273533.886	193213.008	99.304			SW_1.000 - IL 98.949			SFA6 A Precast Concrete Headwall

Pipe Table							
Pipe Name	Size (mm)	Material	Plan Length (m)	Slope	Start Invert Level	End Invert Level	Bedding Type
FD_1.000	150	PVC	4.233	1:99.99	99.379	99.337	SEE NOTE 5
FD_1.001	150	PVC	34.771	1:100.00	99.337	98.989	SEE NOTE 5
FD_2.000	150	PVC	14.813	1:100.00	99.137	98.989	SEE NOTE 5
SW_1.000	150	PVC	4.198	1:103.71	98.989	98.949	S

- NOTES:
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 - ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
 - ALL MANHOLES AND ACO COVERS AND FRAMES WITHIN TRAFFICKED AREAS TO BE CLASS D400.
 - FOR DRAINAGE DETAILS REFER TO DRAWING 10052828-ARC-CP-050-DR-C-00500.
 - FOR FILTER DRAIN CONSTRUCTION REFER TO DRAWING 10052828-ARC-CP-050-DR-C-00500.



FD-3 TO FD-4
SCALE: H 1:200,V 1:40
DATUM: 98.000

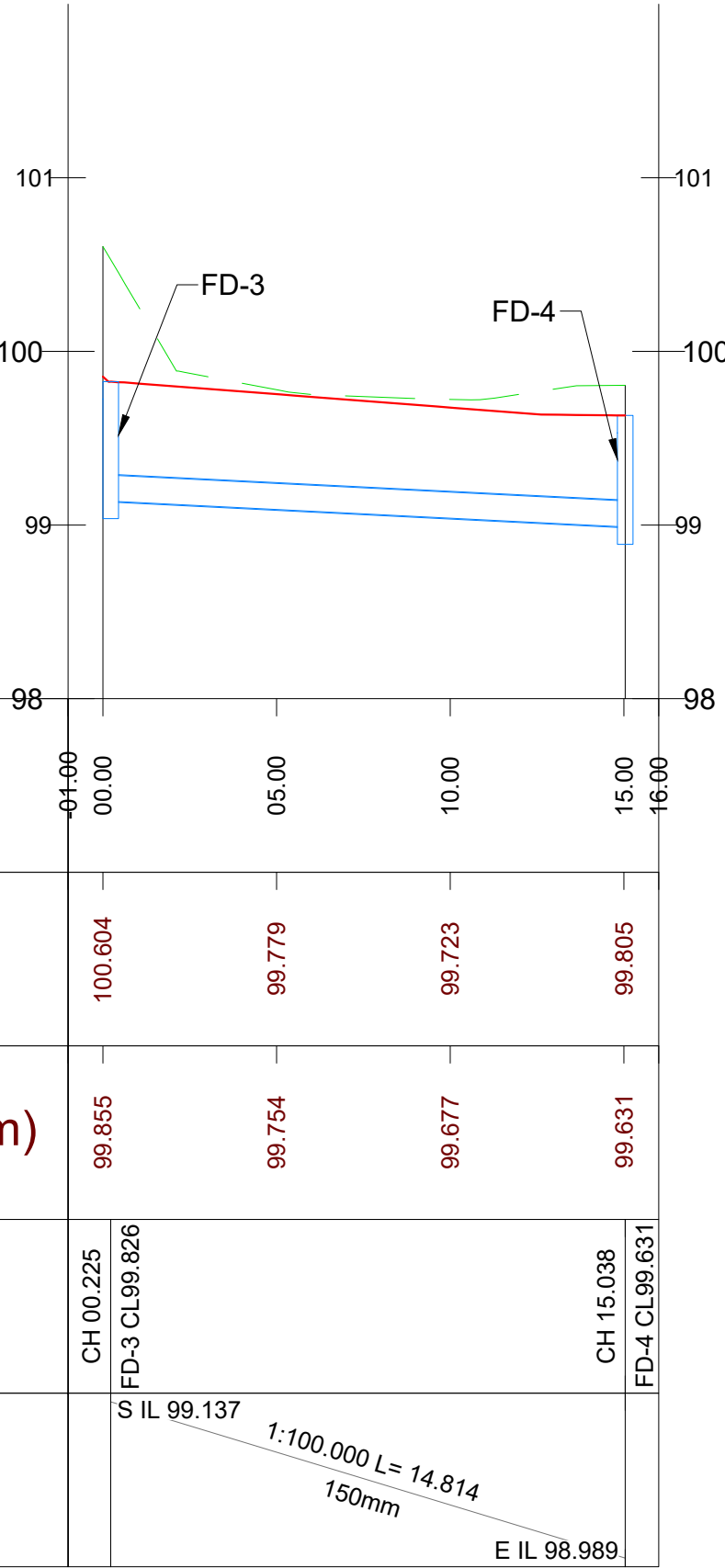
CHAINAGE (m)

EXISTING LEVELS (m)

PROPOSED LEVELS (m)

SW STRUCTURES

SW PIPES



- LEGEND:
- SITE BOUNDARY
 - PROPOSED FILTER DRAIN RUN
 - PROPOSED FILTER DRAIN MANHOLE
 - PROPOSED HEADWALL
 - PROPOSED SURFACE WATER DRAINAGE RUN
 - ACO CHANNEL
 - ACO CHANNEL CONNECTION
 - CATCHMENT AREAS

P01.1	FIRST ISSUE	---	---	---	---
Rev	Date	Description	Prod.	Chk.	Rev.

Project: Quays EV Charging

Site: The Quays Neath Port Talbot

Client: Neath Port Talbot County Council
The Quays, Brunel Way
SA11 2GG
NPT.GOV.UK

ARCADIS

Registered office: 80 Fenchurch Street, London EC3M 4BY

Coordinating office: Arcadis Cymru House, St Mellons Business Park, Fortran Road, Cardiff, CF3 0EY
Tel: 44 (0)29 2092 6700

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Drawing Title: SURFACE WATER DRAINAGE LAYOUT

Designed: L. Rees, 11/04/22

Produced: ---, ---

Checked: ---, ---

Reviewed: ---, ---

Approved: ---, ---

Design Stage: Preliminary Design

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

Suitability Code: S0, Scale: 1:200, Project Number: 10052828

Suitability Description: Initial Status or WIP

Drawing Number: 10052828 - ARC - CP - 050 - DR - C - 00001

Revision: P01.1

FD-1 TO HW-1
SCALE: H 1:200,V 1:40
DATUM: 98.000

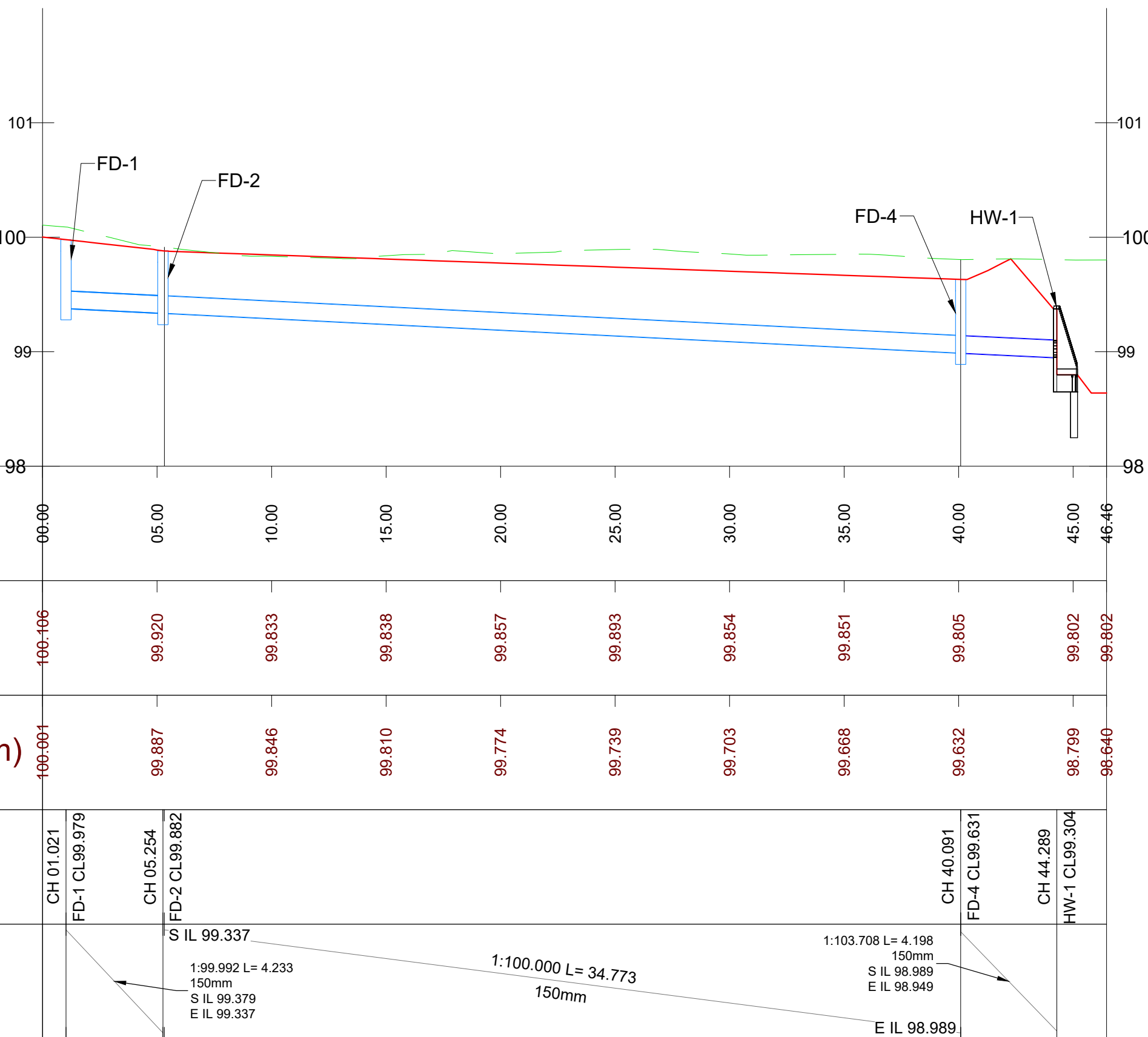
CHAINAGE (m)

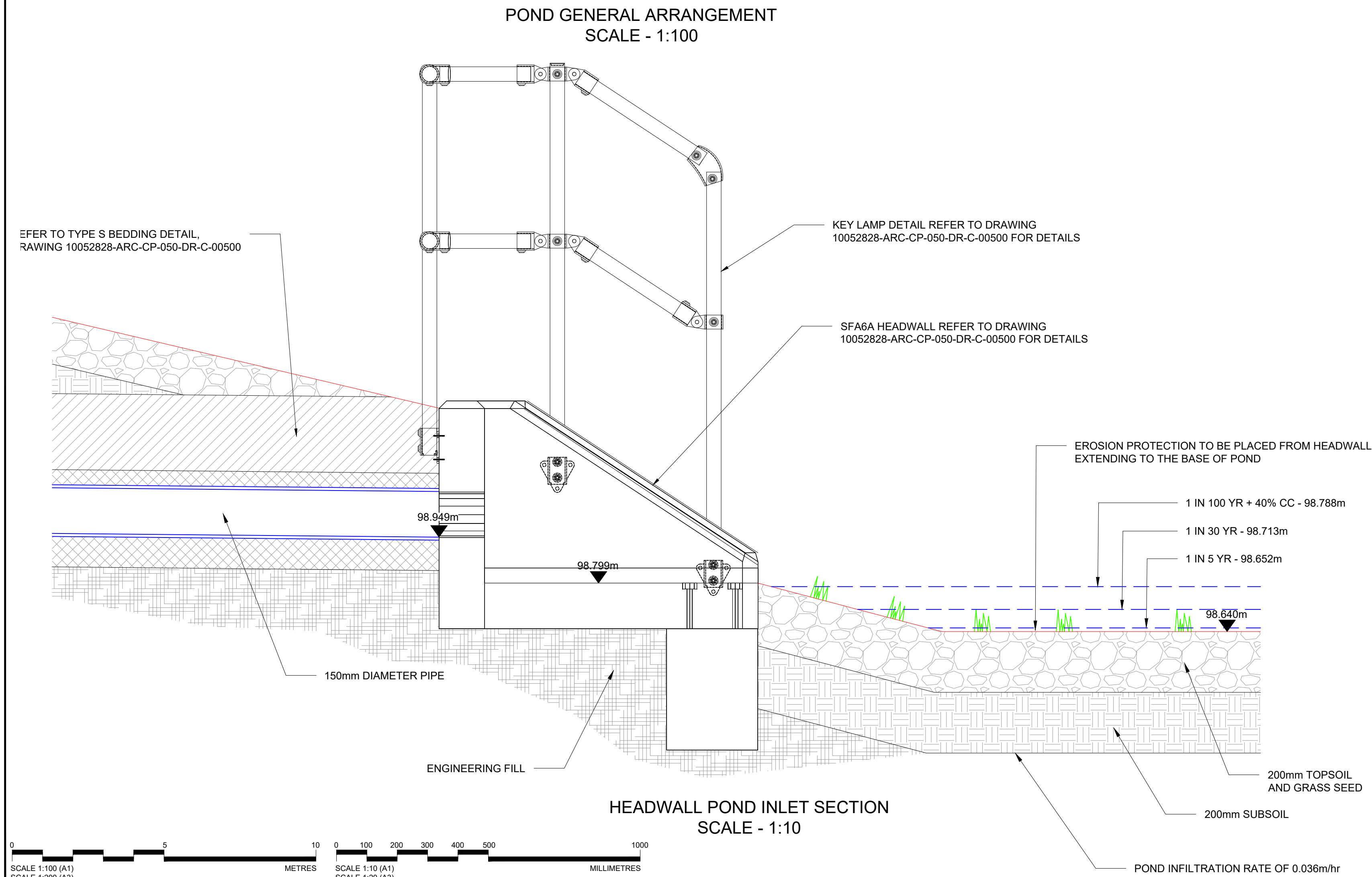
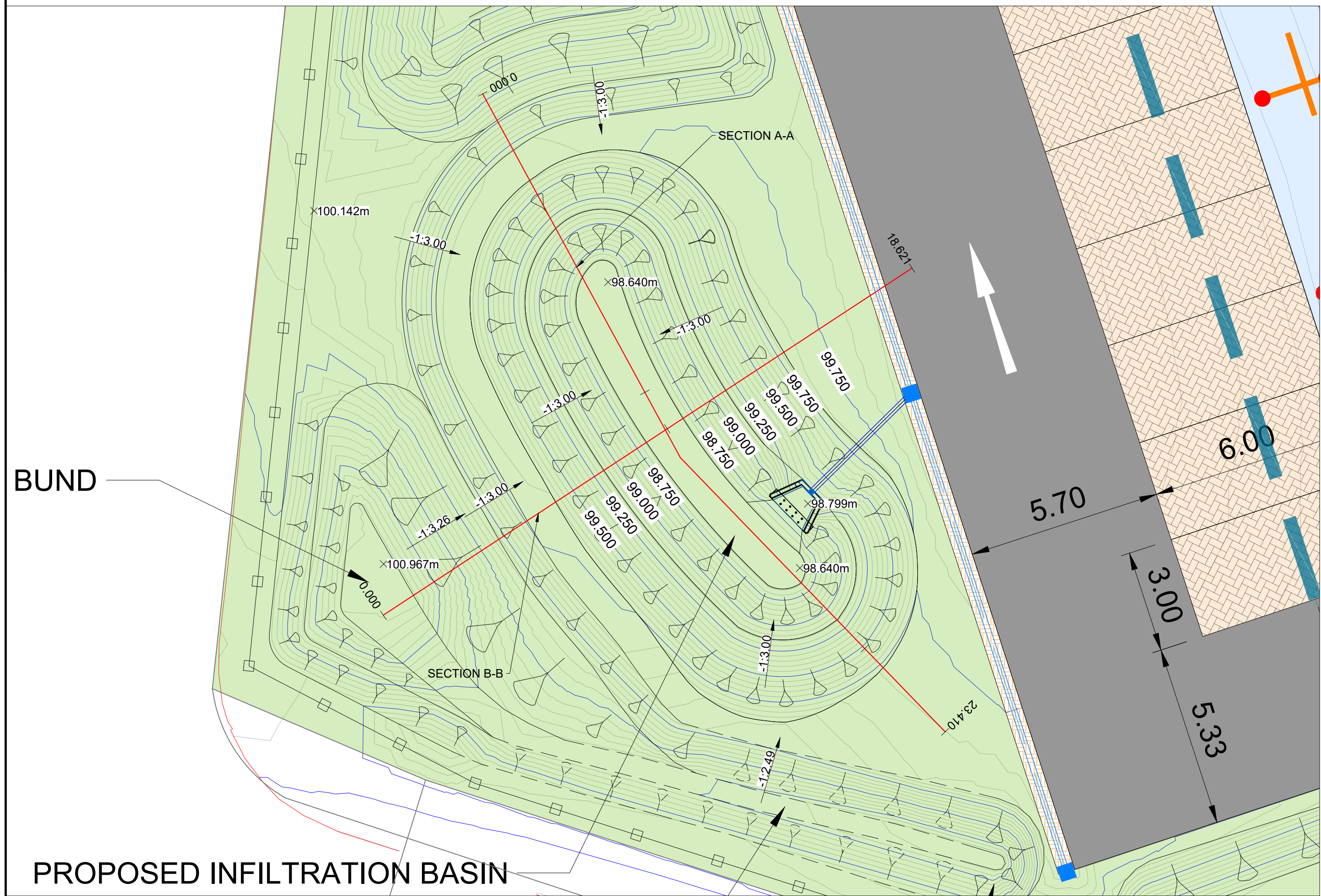
EXISTING LEVELS (m)

PROPOSED LEVELS (m)

SW STRUCTURES

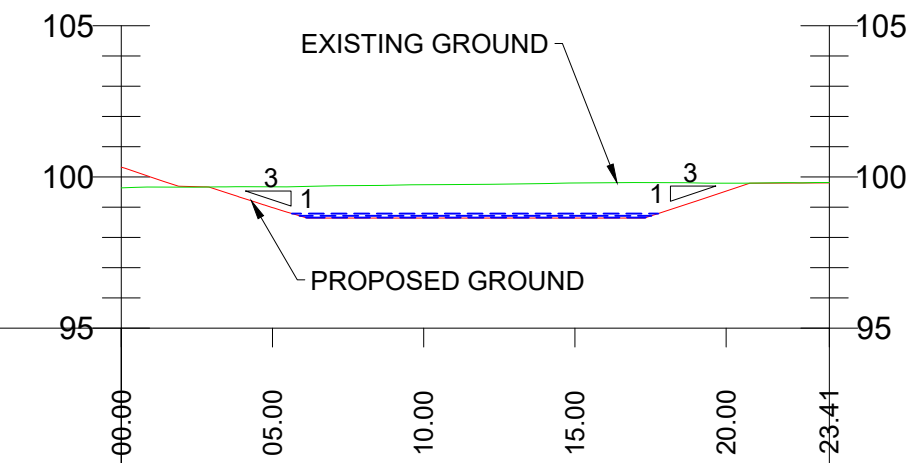
SW PIPES





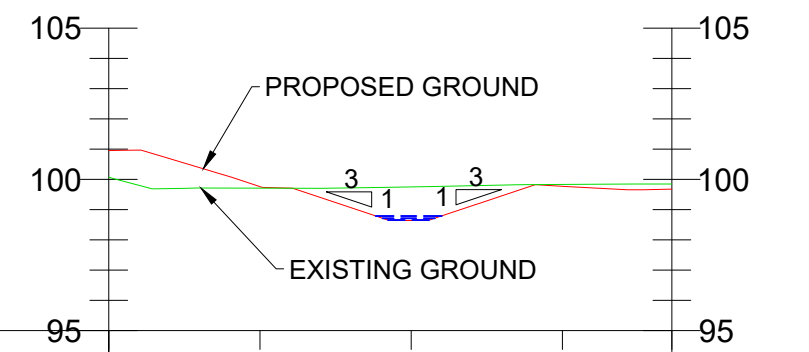
SECTION A-A
SCALE: H 1:200,V 1:200
DATUM: 95.000

CHAINAGE (m)	06.00	05.00	10.00	15.00	20.00	23.41
EXISTING LEVELS (m)	99.698	99.672	99.740	99.797	99.791	99.815
PROPOSED LEVELS (m)	100.321	98.985	98.640	98.640	98.531	98.801
LEVEL DIFFERENCE (m)	0.683	-0.687	-1.100	-1.157	-0.259	-0.014



SECTION B-B
SCALE: H 1:200,V 1:200
DATUM: 95.000

CHAINAGE (m)	00.00	05.00	10.00	15.00	18.62
EXISTING LEVELS (m)	100.671	99.708	99.748	99.828	99.843
PROPOSED LEVELS (m)	100.951	98.755	98.640	98.770	98.677
LEVEL DIFFERENCE (m)	0.881	0.047	-1.109	-0.058	-0.166



- NOTES:
- DO NOT SCALE FROM DRAWING, USE FIGURED DIMENSIONS ONLY.
 - ALL DIMENSIONS ARE IN METRES UNLESS STATED OTHERWISE.
 - REFER TO DRAWING 10052828-ARC-CP-050-DR-C-00001 FOR FULL SITE DRAINAGE INFORMATION.
 - REFER TO DRAWING 10052828-ARC-CP-050-DR-C-00500 FOR FURTHER DRAINAGE DETAILS.
 - FOR FULL POND LEVEL INFORMATION REFER TO DRAWING 10052828-ARC-CP-070-DR-C-00002

Rev	Date	Description	Prod.	Chk.	Rev.	App.
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Project: Quays EV Charging

Site	Client
The Quays Neath Port Talbot	Neath Port Talbot County Council The Quays, Brunel Way SA11 2GG NPT.GOV.UK

ARCADIS

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Tel: 44 (0)29 2092 6700

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POND GENERAL ARRANGEMENT
& DETAILS

Designed: L. Rees	Signed: Digitally Signed	Date: 14/07/22
Produced: ---	Signed: ---	Date: ---
Checked: ---	Signed: ---	Date: ---
Reviewed: ---	Signed: Digitally Signed	Date: ---
Approved: ---	Signed: Digitally Signed	Date: ---
Design Stage: Preliminary Design	Grid: OS	Datum: ODN
Original Size: A1	Scale: 1:200	Project Number: 10052828
Suitability Code: S0	Suitability Description:	

Initial Status	
Drawing Number: 10052828 - ARC - CP - 050 - DR - C - 00002	Revision: P01.1

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.

1. This report has been prepared by Arcadis (UK) Limited (Arcadis), with the reasonable skill, care, and diligence within the terms of the Appointment and with the resources and manpower agreed with the Client. Arcadis does not accept responsibility for any matters outside the agreed scope.
2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing. The contents of this report may not be used or relied upon by any person other than this party without the express written consent and authorisation of Arcadis.
3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.
4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis have no obligation to advise the Client or any other party of such changes or their repercussions.
5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.
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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