5 Hydrology and Flooding

5.1 Introduction

5.1.1 This chapter provides an assessment of the likely significant effects on the water environment that may arise from the scheme. For the purposes of this chapter, the water environment is considered to comprise:

- surface watercourses (locally known as reens) within the study area;
- groundwater contained within aquifer units that underlie the study area; and
- other waterbodies or water dependent features that may potentially be affected including ditches and field grips[1] (set out in Section 5.7)

5.1.2 The chapter describes the baseline conditions of the existing water environment in the study area and the methodology used to assess potential impacts during the construction and operational phases of the scheme before presenting the results of those assessments and mitigation or monitoring deemed necessary.

5.1.3 The assessment considers the potential impacts on the following water environment features during construction and operation:

- Surface water: including surface water quality and hydromorphology;
- Groundwater: including groundwater quality and impacts on sensitive receptors such as groundwater Source Protection Zones (SPZ), Groundwater Dependent Terrestrial Ecosystems (GWDTE), existing abstraction wells, or spring lines that feed surface watercourses; and
- Flood risk.

5.1.4 Impacts on groundwater levels and impacts on surface or groundwater quality arising from disturbance to existing contamination will be assessed within Chapter 6 - Ground Conditions. Any associated impacts on ecology are considered within Chapter 7 - Biodiversity.

5.2 Review of proposed development

5.2.1 The proposed development would involve changes to the existing water environment and introduce development to the site that would have impacts on hydrology and flooding. The elements of the proposed development that have been considered within this chapter include construction practices, removal and reprovision of the reens, changes in ground levels to manage potential flood risk and the introduction of flood control structures and Sustainable Urban Drainage Systems. The proposed development has gone through a number of design

[1] For the purposes of assessment, field grips are defined as damp depressions in a land form

iterations to embed mitigation such that issues related to hydrology and flooding are resolved (Section 5.9).

5.2.2 For further details on the proposed development please refer to Chapter 3 – Proposed Development.

5.3 Legislation, policy context and guidance

National legislation

Environmental Protection Act 1990

5.3.1 The Environmental Protection Act 1990 makes provision to control pollution arising from industrial and other processes for waste management.

Land Drainage Act 1991 (as amended)

5.3.2 The Land Drainage Act 1991 requires that a watercourse be maintained by its owner. The Act provides functions to internal drainage boards and local authorities to manage watercourses and provide consenting powers for proposed works to watercourses associated with development.

Water Resources Act (England and Wales) 1991 (Amended 2009)

5.3.3 The Water Resources Act 1991 (WRA) (as amended) sets out the responsibilities of Natural Resources Wales (NRW) in relation to water pollution, resource management, flood defence, fisheries, and navigation.

Environment Act 1995

5.3.4 The Environment Act 1995 sets new standards for environmental management, such as requiring national strategies for air quality and waste. It also deals with the establishment of an Environment Agency (including NRW and the Scottish Environmental Protection Agency).

Water Resources (Abstraction and Impounding) Regulations SI 2006/641

5.3.5 The Water Resources (Abstractions and Impounding) Regulations SI 2006/641 contain provisions relating to the licensing of abstraction and impounding of water in England and Wales in the light of amendments made by the Water Act 2003 to the Water Resources Act 1991.

Flood Risk Regulations 2009

5.3.6 The Flood Risk Regulations 2009 transposes the EC Floods Directive (Directive 2008/60/EC) on the assessment and management of flood risk into domestic law in England and Wales and implements its provisions. The regulations designate a

Local Lead Flood Authority (LLFA) and imposes duties on NRW and LLFA to prepare a number of documents including:

- Preliminary Flood Risk Assessments;
- Flood hazard and flood risk maps; and
- Flood Risk Management Plans.

Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009

5.3.7 The Environmental Damage (Prevention and Remediation) (Wales) Regulations 2009 are based on the 'polluter pays principle and impose obligations on operators of economic activities requiring them to prevent, limit or remediate environmental damage. They apply to damage to protected species, natural habitats, sites of special scientific interest (SSSIs), water and land and implement Directive 2004/35/EC, on environmental liability.

The Groundwater (England and Wales) Regulations 2009

5.3.8 The Groundwater (England and Wales) Regulations 2009 regulations implement parts of the Water Framework Directive (WFD) that apply to groundwater (such as the Groundwater Directive). They supplement the Environmental Permitting Regulations 2010 and existing water pollution legislation.

Flood and Water Management Act 2010

5.3.9 The Flood and Water Management Act 2010 makes provision for water, including provision about the management of risks in connection with flooding and coastal erosion.

The Water Framework Directive (Standards and Classification) Directions England and Wales 2015

5.3.10 The WFD (Standard and Classifications) Directions England and Wales 2015 presents the updated environmental standards to be used in the second cycle of the Water Framework Directive (2000/60/EC) river basin management planning process in England and Wales. Environmental standards help assess risks to ecological quality of the water environment.

Well-being of Future Generations (Wales) Act 2015

5.3.11 The Well-being of Future Generations (Wales) Act 2015 strengthens existing governance arrangements for improving the social, economic, environmental and cultural well-being of Wales to ensure that present needs are met without compromising the ability of future generations to meet their own needs. The Act

ensures that when making decisions public bodies take into account the impact they could have on people living in Wales in the future.

The Groundwater (Water Framework Directive) (Wales) Direction 2016

5.3.12 The Groundwater (Water Framework Directive) (Wales) Direction 2016 sets out instructions to NRW on obligations to protect groundwater, including requirements to monitor and set thresholds for pollutants, add new pollutants to the monitoring list and change the information reported to the European Commission.

The Environmental Permitting Regulations 2016

5.3.13 The Environmental Permitting Regulations 2016 consolidate and replace the Environmental Permitting (England and Wales) Regulations SI 2010/675 in order to extend the requirement for an environmental permit to include flood risk activities in addition to polluting activities. NRW is identified as the regulator for Wales.

Environment (Wales) Act 2016

5.3.14 The Environment (Wales) Act 2016 puts in place the legislation needed to plan and manage Wales' natural resources in a more proactive, sustainable and joined-up way. The Act clarifies the law relating to shellfisheries, marine licencing, flood risk management and land drainage in Wales.

Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

5.3.15 The WFD was transposed into the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. WFD is delivered in England and Wales through a framework of River Basin Management Plans (RBMPs).

Schedule 3 of the Flood and Water Management Act 2010, Sustainable Drainage (Wales) Order

5.3.16 Schedule 3 of the Flood and Water Management Act 2010 (the 2010 Act) relates to provisions for SuDS. These include the establishment of a SuDS Approving Body (SAB) to be set up within the local authority alongside their LLFA duty. SAB approval is required before construction of drainage systems can commence on new and redeveloped sites. Provided appropriate statutory National SuDS

Standards are met, the SAB will be required to adopt and maintain the approved SuDS that serve more than one property.

National policy

The Wales Spatial Plan (2004)

5.3.17 The Wales Spatial Plan sets out the planning agenda for Wales. Its main principle is that development should be sustainable and protect water resources and manage flood risk.

Planning Policy Wales Edition 10 (December 2018)

5.3.18 Planning Policy Wales sets out the land use planning policies of the Welsh Government. It specifically outlines design approaches and techniques that improve water efficiency and minimise adverse impacts on water resources, surface water quality, the ecology of rivers and groundwater. It also ensures that new development is not exposed unnecessarily to flooding.

Technical Advice Note (TAN) 5: Nature Conservation and Planning (2009)

5.3.19 TAN are produced by Welsh Government and provide detailed planning advice on different subjects and should be read with conjunction with Planning Policy Wales document. TAN 5 gives advice as to the consideration of impacts on designated sites in relation to the water environment.

Technical Advice Note (TAN) 15: Development and Flood Risk (2004)

5.3.20 TAN 15 provides technical guidance which supplements the policy set out in PPW in relation to development and flooding. It advises on development and flood risk and provides a framework for the assessment of flooding.

Welsh Government: Taking Wales Forward 2016-2021

5.3.21 The policy document sets out the priorities of Welsh Government. It includes priorities relating to reductions in carbon emissions, delivering improvements to trunk roads and investment in flood defence / water management.

Regional policy

Severn River Basin District: River Basin Management Plan (RBMP) (2015)

5.3.22 The project is located within the Severn River Basin. The River Basin Management Plan provides a framework for protecting and enhancing the benefits provided by the water environment. It also informs decisions on land use planning. It contains four sets of information which are important for the management of land and water:

- Baseline classification of waterbodies;
- Statutory objectives for protected areas;

- Statutory objectives for water bodies; and
- Summary programme of measures to achieve statutory objectives.

Cardiff Flood Risk Management Plan (2015)

5.3.23 The Cardiff Flood Risk Management Plan (FRMP) covers sections of the Ely, Taff and Rhymney main river catchments. The proposed development does not fall within a Flood Risk Area identified by the FRMP. However, the northern part of the Site does exceed the Flood Risk Threshold[2]. There were no reported flooding incidents across Cardiff 2010-2015.

Local Policy

Cardiff Local Development Plan (2006-2026)

5.3.24 The Local Development Plan is used by Cardiff Council to guide and manage development, it provides the basis from which planning applications are determined.

5.3.25 The policies of relevance to this report include:

- Policy KP16: Green Infrastructure
- Policy EN4: River Corridors
- Policy EN10: Water sensitive design
- Policy EN11: Protection of Water Resources
- Policy EN14: Flood risk

Newport Local Development Plan (2011-2026)

5.3.26 The Local Development Plan provides land use policies and proposals to shape the future growth of Newport up until 2026.

5.3.27 The policies of relevance to this report include:

- Policy SP3: Flood Risk
- Policy SP4: Water Resources
- Policy GP1: Climate Change
- Policy GP5: Natural Environment
- Policy GP6: Quality of Design
- Policy GP7: Environmental Protection and Public Health
- Policy CE9: Coastal Zone

[2] The key flood risk indicators and their thresholds for a 1km square were set as follows:
- A minimum of 200 people,
- A minimum of 20 businesses, and
- 2 or more critical services.

NRW Advice on Water Quality Standards to be used for Impact Assessment of the M4 Relief Road on the Gwent Levels Ditch System[3]

5.3.28 These are a set of standards produced by NRW that were originally written as a briefing note for the proposed M4 relief road, however the standards are applicable for any works proposed to occur near to or on the Gwent Levels. Their purpose is to ensure the preservation of the Gwent Levels environment by advising on the water quality requirements within the ditch/reen system.

Relevant standards and guidance

5.3.29 The following assessment has been carried out following the Design Manual for Roads and Bridges (DMRB) Guidance LA 113 Road drainage and the water environment (formerly HD 45/09); hereby referred to as LA 113 (explanation provided in Section 5.4).

5.3.30 The Pollution Prevention Guidelines (PPGs) have now been revoked and in Wales are being replaced by the Guidance for Pollution Prevention (GPPs). These provide guidance on similar areas of practice. Where GPPs have yet to be issued, PPGs are still promoted as best practice in order to minimise pollution impacts during construction. The current GPP/PPG guidance that is currently enacted and relevant to the assessment includes:

- PPG 1 - Understanding your environmental responsibilities – good environmental practices;
- GPP 2 - Above ground oil storage tanks;
- PPG 3 - Use and design of oil separators in surface water drainage systems;
- GPP 4 - Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5 - Works and maintenance in or near water;
- PPG 6 - Working at construction and demolition sites;
- PPG 7 - Safe storage – The safe operation of refuelling facilities;
- GPP 8 - Safe storage and disposal of used oils;
- GPP13 - Vehicle washing and cleaning;
- PPG18 - Managing fire water and major spillages;
- GPP21 - Pollution incident response planning;
- GPP22 - Dealing with spills; and
- GPP26 - Safe storage – drums and intermediate bulk containers.

[3] Water Quality standards for Gwent Levels works: Briefing Note http://documents.newport.gov.uk/NorthgatePublicDocs/05241219.pdf

5.3.31 Due reference has been made to GOV.UK guidance for preventing pollution[4], working on or near water[5] and for managing water on land[6].

5.3.32 Construction Industry Research and Information Association (CIRIA)[7] guidance used for the assessment includes:

- Control of Water Pollution from Construction Sites – Guide to Good Practice (SP156);
- Control of Water Pollution from Construction Sites – Guidance for Consultants and Contractors (C532);
- Environmental good practice on site (C692); and
- Groundwater control: design and practice (second edition) (C750).

5.4 Scoping and consultation

Scoping

5.4.1 As detailed within the scoping report submitted at scoping stage, the assessment of impacts from construction and operation has been carried out in broad alignment with LA 113.

5.4.2 LA 113 provides the methodology and criteria for identifying likely impacts of a proposed road project on the water environment and predicting their magnitude and the significance of the resulting effects. There is no standard guidance for the methodology for a hydrology and flooding ES chapter and therefore in the absence of any sector guidance, DMRB is considered the most tried, tested and robust approach.

5.4.3 LA 113 is specifically designed for assessing the impacts of road or bridge construction on the water environment and therefore sections of it (e.g. Highways England Water Risk Assessment Tool (HEWRAT)) are not applicable to the proposed development. Despite this, the DMRB methodology is widely used for all types of construction schemes and benefits from being recognised by regulators.

[4] The Environment Agency, "Pollution prevention for businesses," 12 07 2016. [Online]. Available: https://www.gov.uk/guidance/pollution-prevention-for-businesses. [Accessed September 2019].
[5] The Environment Agency, "Check if you need permission to do work on a river, flood defence or sea defence," 2017. [Online]. Available: https://www.gov.uk/permission-work-on-river-flood-sea-defence. [Accessed September 2019].
[6] The Environment Agency, "Manage water on land: guidance for land managers," 19 02 2015. [Online]. Available: https://www.gov.uk/guidance/manage-water-on-land-guidance-for-land-managers. [Accessed September 2019].
[7] Construction Industry Research and Information Association (CIRIA), Free CIRIA Downloads Available: https://www.ciria.org/CIRIA/Resources/Free_CIRIA_publications/Resources/Free_CIRIA_publications.aspx?hkey=622b85b3-7d21-4e59-8093-459571496a0a [Accessed September 2019].

5.4.4 Cardiff City Council and NRW were consulted on the EIA scoping report.

5.4.5 During the scoping exercise, comments were provided by NRW as shown in Table 5.1. No other comments were received from statutory consultees including Cardiff Council.

Table 5.1: Response to scoping opinion

Comment received from	Scoping opinion clause	Response
NRW	Comprehensive water management proposals within reen network	The drainage strategy has been developed that seeks to maintain surface water and groundwater quality through a series of SuDS measures. Flood risk mitigation proposals have been developed to provide a standard level of protection for receptors. The unnamed reens that are lost to provide the development areas would be provided on at least a 1:1 basis in the southern area of the site.
NRW	Indirect loss/damage to the features of the SSSI from poor quality surface water run-off, due to the interconnected nature of the drainage system impacts at this location could affect a large area of the SSSI	A monitoring programme is in place and would identify any impacts on surface water quality. As mentioned above, attenuation features in the form of SuDS would be implemented to improve the quality of surface water run-off.

Consultation

5.4.6 Consultation with statutory consultees including SuDS Approval Body, NRW and Cardiff City Council has been undertaken with regards to the Drainage Strategy, flood mitigation and ecological mitigation proposals that are referenced in this chapter. The details of the consultations can be found in the Drainage Strategy in Appendix C1, the Flood Consequences Assessment appended to the Drainage Strategy and Chapter 7 – Biodiversity, respectively.

5.4.7 No further consultation has been undertaken.

5.5 Methodology

Study area

5.5.1 The study area has been selected based on a source – pathway – receptor approach as recommended by DMRB LA 113.

5.5.2 For direct effects on surface waters, the study area includes the geographical extent of the full scope of the works and all surface water features have been considered up to 500m away where features have hydrological connectivity to the scheme. The study area of 500m from the site has been based on professional judgement, particularly given that the watercourses connected to the scheme have

very low flow velocities, thereby limiting the potential dispersion of any pollutants. The study area is shown in Figure 5.1.

5.5.3 For groundwater, the study area includes an area extending up to 250m away from the boundary of the proposed development, in line with guidance for land contamination[8]. This distance is considered to be appropriate in order to establish the current baseline for the ground conditions at the site and includes all those sites that have plausible pollutant linkages. The study area is shown in Chapter 6 - Ground Conditions - Figure 6.1 The study area of 1km has been applied to identify sensitive controlled water receptors, for example source protection zones, water abstraction points or private water supplies.

5.5.4 The size of the study area has been selected based on professional judgement and is proportionate with the potential impacts posed by the scheme.

Overview

5.5.5 As set out in Section 5.4, this assessment has been carried out in accordance with DMRB guidance LA 113 Road drainage and the water environment.

5.5.6 This assessment also draws on other guidance including:

- Planning Inspectorate Advice Note 18 ('Water Framework Directive'). This guidance is specifically for Development Consent Order projects; however, it benefits from being recognised by regulators and details the relationship between WFD legislation and EIAs. The WFD Screening Assessment provided in Appendix C2 has been produced following this guidance.
- Planning Policy Statement 15 (Revised): Planning and Flood Risk.
- NRW Advice on Water Quality Standards to be used for Impact Assessment of the M4 Relief Road on the Gwent Levels Ditch System.

5.5.7 LA113 provides a standard methodology for the assessment of each topic area which has five key steps:

- Step 1 – Identification of water features within the study area. Water features are assessed against criteria defining quality and importance (or sensitivity). Table 5.2 sets out the attributes used to define the quality of water feature considered in defining the baseline. An assessment of the importance of each of these receptors is then undertaken using the criteria set out in
- Table **5.3**;
- Step 2 – Identification of potential impacts to the water features identified in Step 1, from construction and/or operation. Under the WFD, an impact is defined as causing a deterioration in the status of a water body or preventing a water body from reaching 'Good' status in the future;

[8] Guidance for the Safe Development of Housing on Land Affected by Contamination, RD66, EA, NHBC and CIEH, 2008

- Step 3 – Assessment of the potential magnitude of any construction or operation impacts on the receptor, based on the criteria in LA 113, summarised and defined in Table 5.4; and
- Step 4 – Assessment of overall significance receptors due to impacts, using the significance matrix provided in Table 5.5. This identifies the magnitude of impact on the top and receptor sensitivity on the side. The significance of impact is identified where the two meet within the matrix. This assessment considers a 'Very Large', 'Large' and 'Moderate' significance of effect as significant. Slight and neutral significance of effect is considered not significant.

Table 5.2: Surface water features, their attributes and indicators of quality (adapted from LA 113: Table 3.69)

Feature	Attribute/ Service	Indicator of quality	Possible measure
Watercourse	Water Supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural); Chemical water quality.	Location and number of abstraction points Volume abstracted daily Physio-chemical quality elements of WFD ecological status Supporting hydrological regime element of WFD ecological status
	Dilution and removal of waste products	Presence of surface water discharges and effluent discharges.	Daily volume of discharge (treated/untreated)
	Recreation	Access to watercourse; Use of watercourse for recreation.	Length of watercourse used for recreation (fishing, water sports) and number of clubs
	Biodiversity	Biological water quality	WFD ecological status class; NRW routine fish and/or invertebrate monitoring data
		Fisheries quality	Fish Status Supporting hydromorphological element of WFD ecological status, includes geomorphology
	Value to economy	Value of use of watercourse	Length of watercourse used for recreation commercially Number of people employed Length of river bank developed Length of watercourse fished commercially
	Conveyance of flow	Presence of watercourses	Number and size of watercourses Number of watercourses artificially managed to control flow/levels
Floodplain	Conveyance of flood flows	Presence of floodplain; Flood flows.	Developed area within extent of floodplain affected; as determined from hydraulic modelling Flood risk Mean annual flood
Groundwater	Water supply/quality	Amount used for water supply (potable); Amount used for water supply (industrial/agricultural).	WFD groundwater quantitative and chemical status Catchment abstraction management Strategy (CAMS) status

			Location and number of abstraction points Volume abstracted daily and use (potable most important) Location and grade of SPZ
	Soakaway	Presence of soakaways or other discharges to the ground.	Location and number of discharge points Daily volume discharged
	Vulnerability	Groundwater vulnerability.	Classification of aquifer vulnerability
	Economic value	Extent of use for abstractions.	Number of people employed, cost of alternatives
	Conveyance of flow	Presence of groundwater supported watercourses; Potential for groundwater flooding; Groundwater interception by road structures or drainage.	Changes to groundwater recharge, levels or flows Number and size of watercourses
	Biodiversity	Presence of groundwater supported wetlands.	Changes to groundwater recharge, levels or flows Status or classification of wetland including GWDTE under WFD

Table 5.3: Criteria for estimating the importance of environmental attributes (adapted from DMRB LA 113: Table 3.70)

Importance	Criteria	Examples
Very High	Attribute has a high quality and rarity on regional or national scale	Surface water: Watercourse having a WFD classification shown in a RBMP and Q95 ≥ 1 .0 m3/s. Site protected/designated under EC or UK legislation (SAC, SPA, SSSI, Ramsar site, salmonid water)/Species protected by EC legislation Ecology and Nature Conservation. Groundwater: Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation Ecology and Nature Conservation. Groundwater locally supports Ground Water Dependent Terrestrial Ecosystem (GWDTE) and/or Source Protection Zone 1 (SPZ1). Flood risk: Essential infrastructure or highly vulnerable development[9]
High	Attribute has a high quality and rarity on local scale	Surface water: Watercourse having a WFD classification shown in a RBMP and Q95 <1.0m3/s. Species protected under EC or UK legislation Ecology and Nature Conservation. Groundwater: Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE SPZ2 Flood risk: More vulnerable development
Medium	Attribute has a medium quality and rarity on local scale	Surface water: Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m3/s. Groundwater: Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3 Flood risk: Less vulnerable development
Low	Attribute has a low quality and rarity on local scale	Surface water: Watercourses not having a WFD classification shown in a RBMP and Q95 ≤0.001m3/s. Groundwater: Unproductive strata

[9] Technical Guidance to the National Planning Policy Framework - https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf

Importance	Criteria	Examples
		Flood risk: Water compatible development

Table 5.4: Criteria for estimating the magnitude of an impact (adapted from LA 113: Table 3.71)

Magnitude	Criteria
Major Adverse	Results in loss of attribute and/or quality and integrity of the attribute.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute
Minor Adverse	Results in some measurable change in attributes, quality or vulnerability
Negligible	Results in effect on attribute but of insufficient magnitude to affect the use or integrity
Minor Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring
Moderate Beneficial	Results in moderate improvement of attribute quality
Major Beneficial	Results in major improvement of attribute quality
No Change	No loss or alteration of characteristics, features and elements; no observable impact in either direction.

Table 5.5: Significance matrix (adapted from DMRB LA 104: Table 3.8.1) as referenced in LA 113

Magnitude of impact (degree of change)						
Environmental value (sensitivity)		**No change**	**Negligible**	**Minor**	**Moderate**	**Major**
	Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

Methodology for establishing baseline conditions

Methodology for baseline conditions

5.5.8 The water environment baseline data for the study area has been obtained through desktop study, walkover study, groundwater monitoring and ground investigation reports (Chapter 6 - Ground Conditions – Appendix D1 – D5).

5.5.9 A site walkover was undertaken by a qualified geomorphologist on 26th March 2019. A visual inspection during a site visit is an appropriate method to inform this level of assessment.

5.5.10 Table 5.6 provides desk-based information sources which have been used to inform the baseline assessment.

Table 5.6 Sources of Information

Topic	Source
Designated Sites / WFD	Lle: Welsh Government Geo-Portal[10] Natural Resources Wales 'Water Watch Wales'[11] – WFD data
Flood Risk	Welsh Government – TAN15 Development Advice Maps Natural Resources Wales – Flood Maps, including historic extents The River Severn: Catchment Flood Management Plan;
Surface Waters	Ordnance Survey (OS) topographical maps[12]; Severn River Basin District River Basin Management Plan; Online historical maps[13]; DEFRA MAGIC Map – Designated Areas mapping A site walkover on 26th March 2019. Ordnance Survey mapping. Natural Resources Wales – LiDAR Natural Resources Wales (Gwent, Calidcot & Wentlooge IDD) – information on the management of the reen system including penning levels, maintenance schedules and survey data.
Groundwater	Natural Resources Wales –WFD designations, Source Protection Zone information. Abstraction licencing information. DEFRA MAGIC map – Aquifer maps British Geological index Onshore[14] Groundsure / Envirocheck Report (Chapter 6 - Ground Conditions – Appendix D1) Geological mapping[15];

[10] http://lle.gov.wales/home (last accessed 27/11/2019)
[11] http://waterwatchwales.naturalresourceswales.gov.uk/en/ (last accessed 17/07/2019)
[12] https://www.bing.com/maps
[13] https://www.old-maps.co.uk (Accessed July 2019)
[14] British Geoindex Onshore (Last Accessed 28/01/2020) - http://mapapps2.bgs.ac.uk/geoindex/home.html
[15] http://mapapps.bgs.ac.uk/geologyofbritain/home.html

	The British Geological Survey (BGS) borehole records database[16]. Cardiff Council – Registered Private Water Supplies Ordnance Survey mapping

5.5.11 The baseline describes the existing condition of surface water bodies within the study area. Criteria from LA 113 have been used to assess the attributes and indicators of quality associated with surface water bodies, this assessment has been used to define the baseline. The criteria are shown in Table 5.2 and have been adapted from LA 113: Table 3.69.

5.5.12 Criteria from LA 113 have been used to assess the importance (or sensitivity) of surface water features, this assessment has been used to define the baseline. The criteria are shown in Table 5.3 and have been adapted from LA 113: Table 3.70.

Assessment methodology

Methodology for construction impacts

5.5.13 The potential impacts of construction on surface water have assessed based on the planned construction methods and anticipated construction sequencing as outlined in Chapter 3 – Proposed Development. The potential impacts on water bodies during construction that will be considered in the assessment include:

- Surface water: including surface water quality and hydromorphology;
- Groundwater: including groundwater quality and impacts on sensitive receptors such as groundwater Source Protection Zones (SPZ), Groundwater Dependent Terrestrial Ecosystems (GWDTE), existing abstraction wells, or spring lines that feed surface watercourses; and
- Flood risk.

Methodology for operational impacts

Surface water

Surface water quality

5.5.14 A qualitative assessment using the risk-based source-pathway-receptor approach is suitable to assess the potential impacts of routine run off on surface water quality. Where an environmental risk is identified additional pollution mitigation measures are needed.

Hydromorphology

5.5.15 A qualitative assessment using the risk-based source-pathway-receptor approach is suitable to assess the possible impacts on the hydromorphology of water features. This will be undertaken based on a fluvial geomorphologist's understanding of the potential for impacts to the flow dynamics and sediment

[16] http://www.bgs.ac.uk/data/boreholescans/home.html

transport processes. Where relevant, the subsequent effects that this might have on the ecological potential of the water feature has also been assessed.

5.5.16 The assessment has been made using professional judgement and experience and is focussed on locations where the proposed works physically interacts with watercourses (for example proposed culverts or realignments) or where sediment loading from the proposed drainage system may occur.

Groundwater

5.5.17 A qualitative assessment of possible impacts on groundwater quality will be undertaken based on a geo-environmentalist's understanding of the potential for impacts on the quality of groundwater through new flow paths.

5.5.18 Impact of groundwater level change, identified within Chapter 6 – Ground Conditions, on sensitive receptors that are reliant on groundwater levels will be considered within this chapter, such as EA designated groundwater Source Protection Zones (SPZ), Groundwater Dependent Terrestrial Ecosystems (GWDTE)[17], existing abstraction wells, or spring lines that feed surface watercourses.

5.5.19 Potential impacts of the scheme on groundwater levels and groundwater quality through interaction with existing contamination is assessed within Chapter 6 - Ground Conditions.

Flood risk

5.5.20 A standalone Flood Consequences Assessment (FCA) has been undertaken for the scheme, the methodology used for assessment is in accordance with TAN15. This can be found in the FCA document appended the Drainage Strategy included in

[17] UK Technical Advisory Group (2004). Guidance on the identification and risk assessment of groundwater dependant terrestrial ecosystems (Working Draft Rev. 5) [Online]. Available at: https://www.wfduk.org/sites/default/files/Media/Characterisation%20of%20the%20water%20environment/Risk%20assessment%20of%20terrestrial%20ecosystems%20groundwater_Draft_210104.pdf (Accessed 11/02/2020).

Appendix C1. The results of the report will be used to assess the impact on the receptors specified in Section 5.7.

WFD compliance

5.5.21 A standalone WFD compliance assessment has been undertaken for the scheme, the methodology used for assessment can be found in the document included in Appendix C2.

5.6 Limitations and assumptions

Limitations

5.6.1 Surface water features are not listed on NRW 'Water Watch Wales', therefore the baseline condition described in the assessment was obtained from a site visit undertaken in 26 March 2019.

Assumptions

5.6.2 The LA 113 definitions, along with professional judgement have been used within assessment. Where any significant effects are determined, mitigations measures are proposed.

5.6.3 For the assessment of construction impacts, where construction methods and sequencing information are not available, standard construction practices are assumed.

5.6.4 Engagement and liaison with the SAB is on-going, a pre-SAB application will made and agreed prior to planning submission. Full SABS applications will be made and ratified post determination of the planning application. However, for the purposes of assessment, it is assumed that the storm drainage systems would be constructed, operated and maintained in accordance with the Drainage Strategy submitted at pre-SAB and included in Appendix C1.

5.7 Baseline environment

Surface water

5.7.1 The scheme sits within the Gwent Levels reen system, which is designated as a SSSI, largely due to the habitats that are reliant upon the water environment[18]. The Gwent Levels are an area of land that has been reclaimed from the Severn Estuary, beginning in the Roman era. The Levels contain artificial drainage channels, known as 'reens'. The primary function of the reens is to move water from the land surrounding the levels to the Severn Estuary. Without the system, the agricultural land, homes and businesses would flood. The reens also provide a

[18] DEFRA: MAGIC Map. SSSIs in Wales map.

second purpose of storage. The Gwent Level reen system has been divided into two types of reens for the purpose of assessment, primary and unnamed reens. Primary reens are defined as larger reens which are named, unnamed reens are smaller and have not been named.

5.7.2 Several reens and drainage ditches cross the site, including the primary reens Greenlane Reen, Ty-Ffynnon Reen, Railway Reen and Faendre Reen, which flows along the western edge of the site. Water levels in these reens remain at a constant summer and winter levels by a series of sluices across and beyond the scheme area.

5.7.3 The site is within the 'Broadway Reen – source to River Severn Estuary' catchment (GB109056073370) river WFD water body, which is designated as an artificial water body[19]. As of 2015, the water body had an overall status of moderate, as a result of the status of quality elements including ammonia, dissolved oxygen and phosphate. The reasons for not achieving good status have been attributed to activities including water level management, diffuse source runoff from agricultural land and intermittent sewage discharge[20].

5.7.4 As the water body is designated as artificial under the WFD, NRW have undertaken a mitigation measures assessment for the water body. This notes several measures that are required in order to reach good status. These primarily focus on the management of the water levels and vegetation in the reen system, with specific measures including managing invasive species, vegetation control, installing fish passes and re-opening culverts.

5.7.5 A review of Ordnance Survey (OS) mapping indicates there are approximately 80 watercourses and surface water features within 500m of the study area, many are part of the Gwent Levels reen system. The reen system comprises main reens which are named as well as smaller reens which are unnamed. Table **5.7** details the main named reens and due to the quantity and density, has grouped the smaller unnamed reens. The main named reens are shown in Figure 5.1.

5.7.6 All water courses within the site boundary are classified as Ordinary Watercourses and come under the jurisdiction of Cardiff Council as LLFA. The nearest main river is Tarwick Reen which flows south-eastwards from Hendre Lake towards the Severn Estuary. NRW are responsible for the regulation and maintenance of primary reens.

5.7.7 In line with DMRB guidance, the water features have been valued according to their importance (or sensitivity) as shown in Table 5.7 the criteria for the valuation is shown in Table 5.3. All surface water features have been valued as 'Very High' sensitivity due their location with the Gwent Levels SSSI.

[19] Natural Resources Wales: Water Watch Wales.
[20] Natural Resources Wales – WFD Cycle 2, Reasons for Not Achieving Good dataset.

Table 5.7: Summary of water features within proximity of the scheme

Watercourse No/Name	Location Relative to the Scheme	Scheme Elements	Sensitivity
Within the Redline Boundary			
Faendre Reen	Located in the north western region of the planning application redline boundary, east of Cypress Drive and Water Avens Close.	Retained as part of the proposed development. A minimum offset of 12.5m would be provided between the bank of the reen and the proposed development, as per local plan guidance. Two new access roads, primary and secondary, to be constructed over the reen. Reen crossing could take the form of box culvert or bridge. Access road corridor would include pedestrian provision. A temporary construction access would also be needed over the reen. A new 4.0m wide channel would be formed to provide a low flow channel to Ty-Ffynnon in extreme flood events. Existing culvert in north west area of the site to be extended.	Very High
Green Lane Branch	Located in the north eastern region of the planning application redline boundary. Immediately south of Cobol Road.	Retained as part of the development. A minimum offset of 12.5m from the reen bank as per local plan guidance. Two road junctions formed which would cross the reen. Likely to be formed by box culverts. A pedestrian bridge would be constructed over reen	Very High

Greenlane Reen	Located in the eastern region of the planning application redline boundary, west of Heol Las.	Retained as part of the development with but would be widened by 3.0m to provide additional storage and capacity. A minimum offset of 12.5m from the reen bank as per local plan guidance. A pedestrian bridge would be constructed over the reen. Alterations may be required to the existing field access north of the gas pressure reduction station to allow a temporary construction access. A new road junction formed with Heol Las, south of the railway would cross the reen. Likely to be formed by a bridge or box culvert. A temporary construction access would also be needed over the reen. A new 4m wide reen would provide connection between the flood compensation storage area and Greenlane Reen. A flow control device in the form of a sluice gate or penstock tilting weir, formed within the existing reen channel. This would be located south of the railway corridor within an earthwork embankment / structure.	Very High
Ty-Ffynnon Reen	Located in the central region of the planning application redline boundary, between Heol Las and Feandre Reen.	Retained as part of the development. A minimum offset of 12.5m from the reen bank as per local plan guidance. Two road crossings formed which would cross the reen. Likely to be formed by box culverts or bridges. A temporary construction access would also be needed over the reen. A pedestrian bridge would be constructed over reen. A new 4.0m wide channel would be formed to provide a low flow channel to Faendre Reen in extreme flood events.	Very High
Railway Reen	Located in the central region of the planning application redline boundary, north and south over railway line.	A road crossing formed which would cross the reen. Likely to be formed by box culverts or bridges. A temporary construction access would also be needed over the reen.	Very High

		Existing railway culvert to be extended south of the railway. A flow control device in the form of a sluice gate or penstock tilting weir formed within the existing reen channel or formed as part of the culvert extension works. This would be located north/south of the railway corridor within an earthwork embankment / structure.	
St Mellons Reen	Located along the southern boundary of the planning red line boundary, between Heol Las and Tarwick Reen.	Retained as part of the development.	Very High
Unnamed minor reens, ditches and field grips	Throughout planning red line boundary.	4.43km of unnamed reens, ditches and field ditches within the redline boundary would be removed and reprovided in the southern area of the site.	Very High
Within the assessment study area			
Faendre Ext	Located in the northern region of the planning application redline boundary, located north of Fortran Road.	No works proposed in proximity of the reen.	Very High
Faendre Winter Sewer	Located in the northern region of the planning application redline boundary, located south of Glenrise Close and Swanage Close.	No works proposed in proximity of the reen.	Very High
Little Green Lane Reen	Located approximately 0.2km east of the northern edge of the redline boundary.	No works proposed in proximity of the reen.	Very High
Wood Ditch Reen	Located approximately 0.5km east of eastern edge of redline boundary, the reen intersects St Mellons.	No works proposed in proximity of the reen.	Very High

Cross Reen	Located immediately east of eastern edge of redline boundary, approximately 300m south of the railway line.	No works proposed in proximity of the reen.	Very High
Blackwater Reen	Located approximately immediately east of the eastern edge of the redline boundary, approximately 0.04km north of the railway line.	No works proposed in proximity of the reen.	Very High
Tarwick Reen	Located approximately 0.8km west of western edge of the redline boundary, immediately south of Hendre Lake.	No works proposed in proximity of the reen.	Very High
Fen Eliffant Reen	Located approximately 0.2km west of the western edge of the redline boundary, 0.06km west of Hendre Lake.	No works proposed in proximity of the reen.	Very High
Pil- Du-Reen	Located approximately 0.2km west of the western extent of the redline boundary, immediately west of Hendre Lake.	No works proposed in proximity of the reen.	Very High

Groundwater

5.7.8 The site is underlain by the 'SE Valleys Southern Devonian Old Red Sandstone & Triassic Mercia Mudstone' (GB40902G201500) groundwater WFD body[18]. As of 2015, the groundwater body has an overall status of good.

5.7.9 In line with DMRB guidance, the groundwater body has been valued according to its importance (or sensitivity), the criteria for the valuation is shown in Table 5.3. The groundwater body has been valued as 'Medium' sensitivity due to the St

Maughan's Formation being classified as a secondary (A) aquifer and the Mercia Mudstone Group being classified as a secondary (B) aquifer.

5.7.10 Other groundwater receptors including abstraction wells are listed and assigned a sensitivity in Table 5.8. The Welsh Government online portal[21] shows there are no SPZ within the study area. NRW data shows there are no potable water abstraction licenses within the study area[22]. OS mapping also shows there are no springs within the study area. Therefore, impacts on SPZ, potable water abstraction points and springs has been excluded from assessment.

5.7.11 There are two species of vegetation on site that can be GWDTE, the common reed (*Phragmites australis*) and the greater pond sedge (*Carex riparia*). However, the known ground conditions and locations of these species make it likely that these are dependent on surface water levels in the reen system than any groundwater. Therefore, impacts on GWDTE have been excluded from assessment.

Table 5.8: Groundwater receptors within the study area

Feature	Location relative to scheme	Sensitivity justification	Sensitivity assigned
Superficial deposits Tidal flat deposits – clay	Underlying entire site	Unproductive strata	Low
Secondary A aquifer	Underlying scheme, beneath Tidal flat deposits	Deep bedrock therefore groundwater not supporting surface water flows	Medium
Secondary B Aquifer	Adjacent, to the south of railway track, beneath Tidal flat deposits	Deep bedrock therefore groundwater not supporting surface water flows	Medium
Blacktown Water Well	600m north east of redline boundary	Non-potable use	Low
St Mellons Golf Club Water Well	680m north west of redline boundary	Non-potable use	Low
Bute Estate, St Mellons Water Well	700m north of redline boundary	Non-potable use	Low

[21] Lle: Source Protection zones (Last Accessed 28/01/2020)
[22] Natural Resource Wales: EPR Permits and Water Resource Licences. Available at: https://nrwregulatory.naturalresources.wales/Permits. Accessed 16/03/2020.

Flood risk

5.7.12 TAN15 DAM show that the proposed development site is within Zone C1[23], defined as 'areas within the NRW flood outline, equal to or greater than 0.1% risk of flooding, which are developed and served by significant infrastructure, including flood defences'.

5.7.13 The Rivers and Sea Flood mapping produced by NRW indicates that the whole proposed development site is within Flood Zone 3[24]. Areas that are either within the extent of flooding from rivers with a 1% (1 in 100) chance or greater of happening in any given year or the extent of flood from sea with a 0.5% (1 in 200) of happening in a given year. The flood map also identifies parts of the site that benefit from flood defences. Refer to FCA for further details.

5.7.14 The Surface Water Flood Mapping produced by NRW indicates there are areas of very low to low Surface Water Flood Risk within the site. Areas of low surface water flood risk follow the reen network. Low surface water flood risk is defined as an area which has between 1 in 1000-year and 1 in 100-year flood risk.

5.7.15 Potential flood risk receptors are shown in Table 5.9 and include the proposed development elements as well as surrounding agricultural land and residential properties.

Table 5.9 Flood risk receptors

Name	Sensitivity justification	Sensitivity assigned
Proposed employment buildings	Less vulnerable development	Medium
Proposed landscape areas	Water-compatible development	Low
Proposed car park areas	Less vulnerable development	Medium
Proposed railway station car parking and servicing areas	Less vulnerable development	Medium
Existing agricultural land	Less vulnerable development	Medium
Existing residential properties	More vulnerable development	High
Existing commercial properties	Less vulnerable development	Medium

[23] Planning Policy Wales: TAN15: Development and Flood Risk. Available at: https://maps.cyfoethnaturiolcymru.gov.uk/Html5Viewer/Index.html?configBase=https://maps.cyfoethnaturiolcymru.gov.uk/Geocortex/Essentials/REST/sites/Flood_Risk/viewers/Flood_Risk/virtualdirectory/Resources/Config/Default&layerTheme=2. Accessed 16/03/2020.
[24] Natural Resources Wales: Long term flood risk map. Available at: http://lle.gov.wales/map#m=-3.06481,51.51842,14&b=europa&l=138;. Accessed 16/03/2020.

WFD compliance

5.7.16 A detailed baseline of the existing status and objectives of WFD quality elements within the study area has been included in the WFD compliance assessment (Appendix C2). Figure 5.2 shows the WFD surface water bodies and Figure 5.3 shows the WFD ground water bodies.

5.8 Assumed construction practices

5.8.1 Due to the nature of an outline planning application, where a contractor has not been appointed, standard construction practices are assumed.

5.8.2 Measures to reduce construction impacts are considered standard practice and have been included in an Outline Construction Environmental Management Plan (CEMP) within this ES, (Appendix A2). It has been assumed that these measures would be carried out and have been incorporated into the impact assessment presented in this chapter. Measures beyond standard practice are typically considered to be mitigation and have been identified as such in the chapter.

5.8.3 In addition, during construction the contractors should adhere to industry standard practice working methods and mitigation measures set out in the Environment Agency's Pollution Prevention Guidelines (PPGs) (withdrawn but considered good practice) and Guidance for Pollution Prevention (GPPs). These plans, methods and measures would reduce the likelihood of impacts to the water environment.

5.8.4 The Outline CEMP, PPGs and GPPs include details of the management of water and sediment across both sites and provisions to minimise the likelihood of run-off, provide containment of spillage and capture or treat wastewaters where necessary. These mitigations are intended to prevent impacts upon surface water or groundwater quality.

5.9 Embedded mitigation

5.9.1 There are several measures built into the proposed development which seek to minimise the impact on the water environment once the development is operational. The measures will be secured through planning condition and include:

- Reprovision of 4.43km reens, ditches and field grips lost as a result of the development within the land to the south of the railway. only 2.72km were recorded as wet (the remaining were recorded as dry or field grips). These would be mitigated by reen reprovision of 3.72km of wet reens with a 3m wide base and 1 in 1 slopes on the banks, during construction. This is considered to be a net gain of wet reens, at a ratio of 1:1.38 (or 37% increase). These wet reens would be created to meet the conditions required to support

the aquatic invertebrate and macrophyte species that are features of the SSSI. The reprovision of reens to the south of the railway line to mitigate the loss of reens to the north of the railway line was agreed with NRW (see Chapter 7 – Biodiversity, Section 7.4);

- SuDS to control surface water run-off generated from the proposed development and enhance the water quality, biodiversity and amenity values of the development in line with the Statutory Standards for SuDS. Such SuDS features may include dry ponds, wet ponds, swales, bioretention systems, rain gardens, green roofs etc. This forms part of the Drainage Strategy, for further details see the Drainage Strategy in Appendix C1;
- Raising of existing ground level of proposed development areas to a minimum of 6.0m AOD to ensure that the site is flood free during a 0.5% tidal event and 1.0% fluvial event including allowances for climate change, whilst the depth of flooding cannot be more than 0.6m during 0.1% flood events. This is required predominately for the treatment, transmission and attenuation of surface water runoff generated by the Proposed Development but also forms part of the flood mitigation proposals. For further details see the FCA appended to the Drainage Strategy in Appendix C1;
- Widening of Green Lane reen between Cobol Road / Heol Las junction down to the field access from Heol Las located north of the gas pressure reduction station, located near the south eastern corner of the site by 3m. This forms part of the pluvial flood mitigation measures, for further details see the FCA appended to the Drainage Strategy in Appendix C1;
- Lowering approximately 3ha of land near the south west corner of the site to provide flood compensatory storage, south of the railway by 0.5m. A new 4m wide connecting reen would also be created to interconnect Greenlane Reen and the flood compensation area. This is to convey flows from Greenlane Reen into the flood compensatory storage area and to allow for flood waters to recede back into the reen network once the storm has past. This forms part of the flood mitigation proposals, for further details see the FCA appended to the Drainage Strategy in Appendix C1;
- Ground lowering of land either side of Ty-Ffynnon Reen where it forms a confluence with Feandre Reen to 4.93m AOD. A 4m wide low flow interconnecting channel with its base set at 4.6m AOD would also need to be formed between Ty Ffynnon and Faendre Reen for flood conveyance purposes during an extreme pluvial event. A sluice gate may also be needed within the formed channel to prevent water held by existing sluices to maintain penning levels along Faendre Reen. This forms part of the flood mitigation proposals, for further details see the FCA appended to the Drainage Strategy in Appendix C1; and
- Introduction of two sluice gates or penstock tilting weirs south of the railway, located along the existing Primary Reens, namely Railway and Green Lane reens. This would prevent tidal inundation from entering the site from the south during an extreme tidal event.

5.10 Assessment of effects

5.10.1 Construction projects have the potential to intersect a number of surface and groundwater features and create pollution sources or pathways that are not present under existing conditions.

5.10.2 Potential effects can occur as a result of construction or operation or a combination of construction and operation.

5.10.3 The assessment of effects from construction will focus on effects relating to the construction activities and methods and will not include assessment of effects of the proposed development scheme elements e.g. removal of existing reens, ditches and field grips. Construction effects are typically short-term and temporary.

5.10.4 The assessment of effects from operation will focus on effects relating to the proposed development scheme elements. These effects are typically permanent or long term.

Assessment of effects from construction

5.10.5 This section presents the assessment of potential effects to the water environment resulting from the construction of the proposed development. The significance of potential effects is based on a combination of the potential for pollution and the sensitivity of the receptor.

Surface water

Surface water quality

5.10.6 The most likely sources of surface water impacts are:

- Disturbance of silt/soil generating surface runoff with high sediment concentrations (mobilised suspended soils). This includes the proposed earthworks for land raising to create the development plateaux and land lowering to create the flood compensation area;
- Accidental spillage of fuels, oils and chemicals (e.g. concrete, plant fuels/oils, lubricants, hydraulic fluids and floating solids such as litter) resulting in pollution of watercourses and potential impact on fish; and
- Dewatering discharges from excavations containing high levels of suspended solids.

5.10.7 The risk of pollution impacts is heightened during periods when vegetation has been removed and exposed soil is present, such as during initial site preparation. Risks of surface water pollution impacts are also greater during works in close vicinity to surface watercourses. Without control measures, the risk of runoff from

exposed soil would remain until vegetation is established, which would take generally one growing season.

5.10.8 The magnitude of these impacts would be Major Adverse and short term. However, (as outlined in Section 5.8) if those measures as set out in the Outline CEMP are implemented particularly with respect to surface water management then the magnitude of impact would reduce to Negligible. All reens, ditches and field grips within the study area have the potential to receive run-off from the site. As the reens, ditches and field grips are considered to be of Very High sensitivity, the significance of effect on water quality of the reens, ditches and field grips is considered to be ***Slight Adverse***.

5.10.9 The effect of construction on surface water quality of the reens is not significant and is temporary in nature. Additional mitigation is not required.

Hydromorphology

5.10.10 The most likely sources of hydromorphological impacts relate to the direct physical modifications to surface water features including:

- Introduction and construction of culverts or bridges for the temporary construction traffic route crossings over Greenlane Reen, Ty Ffynnon Reen, Faendre Reen and unnamed reens;
- Construction of culverts or bridges for the proposed development access routes crossing over Feandre Reen, Green Lane Branch, Greenlane reen, Ty-Ffynnon and Railway Reen;
- Removal of 4.43km of existing unnamed reens, ditches and field grips shown in Figure 5.4 as part of land raising to create development plateaux;
- Widening Greenlane Reen between Cobol Road / Heol Las junction down to the field access from Heol Las located north of the gas pressure reduction station, located near the south eastern corner of the site;
- Lowering of ground for flood conveyance between Faendre Reen and Ty-Ffynnon Reen and the construction of low flow channel;
- New compensatory reens south of the railway; and
- Introduction of two sluice gates or penstock tilting weirs located along the existing Primary Reens, namely Railway and Greenlane reens.

5.10.11 The primary reens would be retained throughout the development, namely Greenlane Reen, Faendre Reen, Ty-Ffynnon, Railway Reen and Green Lane Branch with the exception of any culverts or bridges that would need to be introduced at reen crossing locations.

5.10.12 All proposed modifications would require in-channel working that have the potential to modify flow processes and sediment movement through bank failure, erosion, scouring and modification of geomorphological features. Changes to flow processes and sediment movement have potential for the washing of sediment into the reens. Clogging of the reens by silt would reduce in-stream habitat quality.

The effects of siltation could be long term, as the low flow velocities in the reens may be insufficient to remobilise the silt and flush it downstream.

5.10.13 Standard practice mitigation measures and working practices incorporated into the Outline CEMP will minimise risks to the hydromorphology of the reens in the study area.

5.10.14 When considering measures outlined in the Outline CEMP as inherent mitigation, the magnitude of hydromorphological impacts during construction is considered to be reduced. The magnitude of impact is therefore reduced from Major Adverse to Minor Adverse for each individual watercourse as construction activities are expected to cause a measurable change in attributes and quality but would not affect the integrity of the attribute, as specified in the criteria for estimating the magnitude of impact. Due to the quantity of watercourses affected, it is possible there would be a temporary measurable change in attribute quality.

5.10.15 As stated above, Greenlane Reen, Faendre Reen, Green Lane Branch Reen, Ty-Ffynnon, Railway Reen and the unnamed reens, ditches and field grips within the study area are likely to be impacted by construction activities at a minor adverse magnitude. As the reens, ditches and field grips are considered to be of Very High sensitivity, the significance of effect is ***Moderate Adverse***. The effect is temporary in nature.

5.10.16 The effect of construction on the hydromorphology of the reens is expected to result in significant impacts however there is no mitigation suitable or feasible to alleviate the impacts identified.

Groundwater

5.10.17 Sources of potential pollutants to groundwater quality include accidental spills (e.g. fuel from vehicle/plant), silt laden waters from excavation activities or from water contaminated during specific activities, such as concrete pouring/washing. Potential pathways for these pollutants include general earthworks, the excavation required for the connecting reen at location between Greenlane Reen and the flood storage area south of the railway which can directly infiltrate at source or in the case of spillages, infiltrate from the surface water features during periods of low flows. The receptor for these activities is the unproductive strata underlying the scheme area.

5.10.18 It is considered that standard practice mitigation measures and working practices included within the CEMP will significantly reduce potential impacts on groundwater quality within the underlying unproductive strata. Considering both of these factors, the potential magnitude of impact is Negligible. For the

unproductive strata and non-potable wells of Low sensitivity, the significance of effect is ***Slight Adverse***.

5.10.19 Installation of piling and band drains may create a pathway to underlying bedrock (classed as a secondary aquifer). These pathways are considered in more detail in Chapter 6 - Ground Conditions. In summary, the installation of band drains is required to increase the rate of ground consolidation. During this process the water released from the ground is likely to flow towards the ground surface and therefore downward migration is considered unlikely. Impacts from piling during construction is likely to be temporary and localised. Both activities are likely to result in Negligible magnitude of impact on groundwater quality. Considering the medium sensitivity of the groundwater contained within the secondary aquifer, the effect of these activities would be of ***Slight Adverse*** significance.

5.10.20 The effect of construction on groundwater quality within the study area is not considered to result in significant impacts and therefore additional mitigation is not required.

5.10.21 As identified in Section 5.7, there are no source protection zones, potable water abstraction points and springs within the study area and no GWDTE considered to be dependent on groundwater within the study area therefore these receptors have been excluded from assessment.

Flood risk

5.10.22 Activities such as removal of topsoil, raising of land and construction of areas of hard standing during construction are likely to cause an increased volume and rate of surface run-off across the site. This would potentially impact upon surface water flood risk to surrounding receptors.

5.10.23 The scheme involves the removal of 4.43km of existing reens, ditches and field grips and raising of land within a floodplain which has the potential to reduce the flood storage capacity of the site and hence increase the risk of flooding to and from the site. As part of the phasing of development, the introduction of new reens, flood compensatory storage area, flow control devices to the south of the site would be introduced in advance of the removal of existing reens, ditches and field grips and prior to raising of existing ground profile. Information on phasing can be found in Chapter 3 – Proposed Development.

5.10.24 Incorporating the phasing of development and working practices within the CEMP into the assessment, the potential magnitude of impact is anticipated to be Negligible. Therefore, for the existing residential receptors to the north and west of the site of high sensitivity, the significance of effect is ***Slight Adverse***. The

significance of effect on the existing agricultural land and commercial properties of medium sensitivity is ***Slight Adverse.***

5.10.25 The effect of construction on existing flood risk receptors is not considered to result in significant impacts and is temporary in nature therefore additional mitigation is not required.

Assessment of effects from operation

5.10.26 This section considers the potential effects on the water environment during the operation of the proposed development. Similar to the assessment for the construction phase, the significance of effects would depend on a combination of the potential for pollution as well as the sensitivity of the receptor.

Surface Water

Surface water quality

5.10.27 Potential operational impacts upon surface waters are the release of pollutants to the wider water environment from the surface water drainage and accidental spills.

5.10.28 The proposed development would include a variety of land uses, namely train station, commercial businesses, roads, car parks and public realm areas. Surface water runoff generated from roads and car parks, can become contaminated with hydrocarbons prior to discharge to the downstream receptors. Other pollutants such as suspended solids and metals could also be generated from the components proposed as part of the development.

5.10.29 The proposed surface water drainage system would comprise of SuDS features. Such features would include dry ponds, wet ponds, swales and bioretention systems and potentially such features as rain gardens and green roofs etc. when development plot details are better understood. The surface water runoff generated from each component would go through a treatment train / process which would consists of a sequence of different SuDS features. This would remove the pollutants that may be generated from each component to an acceptable level, in line with the 'Simple Index Approach' which is the recognised method of assessing water quality within the Welsh Governments Statutory Standards for SuDS.

5.10.30 For the purposes of the proposed road corridors, bioretention systems / swales would be located between the proposed carriageway and footway which would receive surface water runoff generated from the associated hardstanding. Surface water runoff would then be transmitted to another treatment process which would either consist of a dry pond, wet pond or swale prior to discharge into the reen network. The magnitude of impact on surface water quality from surface water run-off is considered to be Negligible, for the reens, ditches and field drains of Very High sensitivity the significance of effect is considered to be ***Slight Adverse***.

The effect is therefore not considered significant and additional mitigation is not required. For further details, see the Drainage Strategy and associated drawings.

5.10.31 Vehicles may be sources of accidental spills as a result of fuel leaks in car parks and development roads and present a source of potential pollutants to surface water quality. Spills could run-off into surface water features presenting a pollution pathway however it is considered that the introduction of the treatment train of SuDS features would reduce pollutant concentrations entering surface waters to an acceptable level. The magnitude of impact on surface water quality from accidental spills from vehicles is considered to be Negligible, for the reens, ditches and field drains of Very High sensitivity the significance of effect is considered to be ***Slight Adverse***. The effect is not considered significant and additional mitigation is not required.

5.10.32 Trains are a potential source of accidental spills and present a source of potential pollutants to surface water quality. Spills released from trains would be managed in accordance with the Network Rail Standards and Environmental Management Plans. The track drainage system will be designed in accordance with Network Rail standards NR/L2/CIV/005. The railway station canopies, footbridge and platforms are a potential source of pollutants including salts and cleaning products used to maintain the station. These would be managed by the Station Environmental Management Plans and work practices. The Station drainage system will be designed in accordance with the Network Rail Standards, and the Statutory National Standards for Sustainable Urban Drainage Systems. The design of the station drainage is likely to be a closed drainage system with interceptors before discharging into the a range of sustainable drainage systems. Therefore, the track and platform drainage are considered sufficient to manage accidental spills and pollutants preventing surface water quality from being adversely affected. Upon detailed design, Cardiff Council would be consulted to determine whether further mitigation would be required. The magnitude of impact on surface water quality from accidental spills and pollutants is considered to be Negligible, for the reens, ditches and field drains of Very High sensitivity the significance of effect is considered to be ***Slight Adverse***. At present, a combination of electric and diesel trains operate on these lines however the current Transport for Wales fleet is being replaced by new tri-mode (diesel, electric, battery) trains which would further reduce the risk of accidental spills. The effect is not considered to be significant and additional mitigation is not required.

5.10.33 In developing the proposals for the development plots in detail, additional proprietary systems for water quality treatment may also be proposed in line with

PPG and BS EN 858 Parts 1 and 2 for added resilience on top of the SuDS features.

Hydromorphology

5.10.34 The activities that would have an impact on hydromorphology include:

- Introduction of culverts or bridges for the proposed development access routes crossing over Feandre Reen, Green Lane Branch, Greenlane, Ty-Ffynnon and Railway Reen;
- Removal of 4.43km of existing unnamed reens, ditches and field grips shown in Figure 5.4 to raise the exiting ground profile to proposed development plot and hardstanding levels;
- Widening of Greenlane reen between Cobol Road / Heol Las junction down to the field access from Heol Las located north of the gas pressure reduction station, located near the south eastern corner of the site;
- Lowering of ground for flood conveyance between Faendre Reen and Ty-Ffynnon Reen and the construction of low flow channel;
- Providing a flood compensatory storage area within the south east corner of the site and associated interconnecting reen; and
- Introduction of sluice gates or penstock tilting weirs along Railway Reen and Greenlane Reen.

5.10.35 Due to the number of activities expected to have varying impacts on the hydromorphology of receptors, the assessment of effects for each respective activity is shown below in Table 5.10.

5.10.36 As shown in Table 5.10, there are anticipated to be effects on the hydromorphology of reens as a result of the introduction of culverts, removal of existing reens, ditches and field grips, widening of reens, lowering of ground, introduction of the flood compensatory area and introduction of sluice gates, non-return valves and unidirectional culverts. The effects are expected to result in a change to or reduction in quality of the attribute however the effects are not expected to be significant and additional mitigation is not required.

Table 5.10: Assessment of Effects on Hydromorphology of Surface Water Features

Activity	Receptor	Environmental Sensitivity	Magnitude of Impact	Significance of Effect	Justification for Significance
Development traffic routes involving introduction of culverts	Feandre Reen, Green Lane Branch Reen, Ty-Fynnon Reen and an unnamed minor reens	Very High	Negligible	***Slight Adverse***	The footprint of the culverts is minimal compared to the length of the watercourse and does not affect the use of the watercourse.
Removal of 4.43km of existing unnamed reens, ditches and field grips	Unnamed reens	Very High	Negligible	***Slight Adverse***	The reens removed would be reprovided to the south of the site. The reens would be reprovided at a 1:1.37 ratio and on a 'like for like' basis. Due to the artificial nature of the reen system that is annually dredged and cleared by NRW, it is considered that the reprovided reens would quickly re-establish to their original form.
Widening of reen by 3m	Greenlane Reen	Very High	Negligible	***Slight Adverse***	Due to the artificial nature of the reen system that is annually dredged and cleared by NRW, it is considered that the reprovided reens would quickly re-establish to their original form. The new bank can be profiled to replicate existing conditions
Lowering of ground for flood conveyance	Area between Faendre Reen and Ty-Ffynnon Reen	Very High	Negligible	***Slight Adverse***	The banks of the reens would be lowered to accommodate the area of ground lowering for flood conveyance. It is not considered that this is would impact the flood storage use of Faendre Reen and Ty-Ffynnon Reen as the lowering of ground is for flood conveyance and would complement the purpose of the reens to provide flood storage capacity. The integrity of Faendre Reen and Ty-Ffynnon Reen is not considered to be affected as the reen system is an artificial system that is annually managed by NRW therefore the system has the ability to quickly re-establish to its artificial state.
Flood compensatory storage area and associated interconnecting reen	South east corner of site	Very High	Negligible	***Slight Adverse***	The banks of the reens would be lowered to accommodate the flood compensatory storage area and interconnecting reens. It is not considered that this is would impact the flood storage use of the reens within this area as the flood compensatory area would complement the purpose of

					the reens to provide flood storage capacity. The integrity of the reens within this area is not considered to be affected as the reen system is an artificial system that is annually managed by NRW therefore the system has the ability to quickly re-establish to its artificial state.
Introduction of sluice gates, non-return valves and unidirectional culverts	Railway Reen and Greenlane Reen	Very High	Negligible	***Slight Adverse***	The footprint of the sluice gates, non-return valves and unidirectional culverts would be minimal compared to the length of the watercourse and does not affect the use of the watercourse. The watercourse is a managed, artificial system that contains standing water with water levels penned and water direction controlled therefore it is not considered that the introduction of sluice gates, non-return valves and unidirection culverts would affect the use or integrity of the reens.

Groundwater

5.10.37 As stated within the operational surface water quality assessment, the magnitude of the surface water quality impacts of the scheme on the unproductive strata beneath the scheme would be Negligible. The unproductive strata has a Low sensitivity, the significance of effect on this receptor is therefore ***Neutral***. The effect is not considered to be significant and additional mitigation is not required.

5.10.38 Vehicles may be sources of accidental spillage as a result of fuel leaks in car parks and roads within the proposed development presenting a source of potential pollutants to groundwater quality. Potential pathways from vehicles accidental spills include direct infiltration at source or infiltration from surface water features during periods of low flow. The cohesive nature of ground underlying the scheme exhibits low permeability and hence inhibits downward migration. The direct infiltration pathway is therefore reduced. It is considered that the introduction of the aforementioned treatment train of SuDS features would remove pollutants that enter surface waters to an acceptable level. In addition, due to the materials of low permeability beneath the scheme, it is considered unlikely any pollutants would spread to the identified GWDTE's. Considering all of these factors, the potential magnitude of impact is Negligible. For the unproductive strata of Low sensitivity and the GWDTE of Low sensitivity, the significance of effect is ***Slight adverse***. The effect is therefore not considered to be significant and additional mitigation is not required.

5.10.39 Trains are a potential source of accidental spillages and present a source of potential pollutants to groundwater. The railway station canopies, footbridge and

platforms are a potential source of pollutants to groundwater including salts and cleaning products used to maintain the station. Potential pathways from train accidental spills and station pollutants include direct infiltration at source or infiltration from surface water features during periods of low flow. The cohesive nature of ground underlying the scheme exhibits low permeability and hence inhibits downward migration. The direct infiltration pathway is therefore reduced. Accidental spills would be collected and held in the track drainage, designed in accordance with Network Rail standards NR/L2/CIV/005 and intercepted by interceptors. Pollutants from the station would be managed by the Station Environmental Management Plans and work practices, and by interceptors in the platform drainage system. Therefore, the track and platform drainage systems are considered sufficient to manage accidental spills and pollutants and ensure that groundwater quality is not adversely affected. During detailed design, Cardiff Council will be consulted. Considering all of these factors, the potential magnitude of impact is Negligible. For the unproductive strata of Low sensitivity, the significance of effect is ***Slight adverse***. At present, a combination of electric and diesel trains operate on these lines however the current Transport for Wales fleet is being replaced by new tri-mode (diesel, electric, battery) trains which would further reduce the risk of accidental spills. The effect is not considered to be significant and additional mitigation is not required.

5.10.40 The area of ground lowering for the flood compensation area to the west of the site would be within the unproductive strata and would therefore not result in a significant impact on wider groundwater quality. The area is shown in the FCA appended to the Drainage Strategy in Appendix C1. With no pathway for effect, the magnitude of impact on the groundwater quality of the underlying secondary A aquifer is No change. The secondary A aquifer has a Medium sensitivity, the significance of impact is therefore ***Neutral.***

5.10.41 The effect of operation on the groundwater quality is not considered to be significant and therefore it is not considered that additional mitigation is required.

5.10.42 As identified in Section 5.7, there are no source protection zones, potable water abstraction points and springs within the study area and no GWDTE considered to be dependent on groundwater within the study area therefore these receptors have been excluded from assessment.

Flood risk

Surface water

5.10.43 The proposed development would consist of a train station, commercial buildings, roads, car parks and public realm areas, as detailed in Chapter 3 – Proposed Development. The potential operational impacts upon surface water is that these hard standings, formed as part of the development proposals, would cause an

increased volume and rate of surface water run-off across the site into the receiving reen network when compared to the existing situation.

5.10.44 As mentioned previously, the proposed surface water drainage system will comprise of SuDS features to attenuate surface water run-off. The attenuation features will either provide storage for the surface water runoff to be discharged at Greenfield Runoff Rate (GRR) or at the mean annual flood (Qbar) for all storm events up to and including the 1 in 100-year return period including an allowance of 40% for climate change. If the GRR is to be adopted then the difference in surface water runoff volume for the 1 in 100-year, six hour rainfall event between pre (greenfield) and post development will need to be discharged at 2 l/s/Ha whilst allowing the site to discharge at GRR.

5.10.45 A hydrological assessment has been produced which summarises the GRR and mean annual flood flow for the proposed development. The note can be found within the Drainage Strategy in Appendix C1. The attenuation features are proposed to take various SuDS forms, such as dry ponds, wet ponds and swales. Other SuDS features have also been incorporated within the development to meet the interception requirements. Such features include bioretention systems, swales, filter drains and strips. These have been located strategically across the development and integrated with the landscaping and public realm designs.

5.10.46 Access routes into the site would cross reens requiring culverts or bridges to be installed at 12 locations Feandre Reen, Green Lane Branch Reen, Ty-Fynnon Reen and an unnamed minor reens. These would be designed as to allow the same volume and rate of water to flow as the existing reen network in accordance to CIRIA Guide C786.

5.10.47 Based on the information included in the drainage strategy for the site including the introduction of the measures listed, the magnitude of impacts upon all existing and proposed receptors is considered to be Negligible. Existing receptors include existing residential properties with a High sensitivity and existing agricultural land and commercial properties with a Medium sensitivity. The significance of effect on all existing receptors is ***Slight Adverse***. Proposed receptors include proposed employment buildings, proposed landscape areas, proposed car park areas and proposed railway station and associated car park and servicing area. The sensitivity of proposed receptors ranges between Medium and Low however the significance of effect on all proposed receptors is ***Slight Adverse***. The effect on existing and proposed receptors is not considered to be significant and additional mitigation is not required.

Fluvial, Tidal and Pluvial

5.10.48 The development lies within a floodplain. A Flood Consequence Assessment (FCA) has been undertaken to determine if the development is justifiable in line

with the requirements of TAN15. The FCA can be found appended to the Drainage Strategy in Appendix C1.

5.10.49 Baseline tidal flood modelling has been carried out to check the extent of flooding during 1 in 200 and 1 in 1000 year tidal flood events, taking into account 75 years of climate change. The modelling demonstrates that for the 75 year climate change scenario, the 0.1% event flood the site is predicted to flood in the south and north eastern areas of the site. In the northern area of the site flood depths do not generally exceed 0.1m; with only localised areas around the reens predicted to flood to a maximum flood depth of 0.3m. In the southern area of the site, deeper flooding occurs in the south western corner, due to the lower topography of the area. Flood water surrounding the reens reaches a maximum depth of 0.5m, with most depths not exceeding 0.4m. Refer to Figure 5-2 and 5-3 within the FCA.

5.10.50 Consideration has also been given to the risk of flooding from pluvial sources. During high rainfall events, water held and transmitted in the reen system may overtop and spill onto the site. As such, baseline pluvial modelling has also been completed for the 1 in 100 year pluvial event including an allowance of 25% for climate change and the 1 in 100 year pluvial event. The modelling demonstrates some shallow flooding in places, refer to Figure 6-1 and 6-2 within the FCA.

5.10.51 To enable development to proceed in accordance with the requirements of TAN15, the FCA advises on flood mitigation measures to protect the site, these are detailed in Section 5.9.

5.10.52 The proposals are shown in the drawings contained within the Drainage Strategy in Appendix C1.

5.10.53 The method of control and responsibility of management of any control devices such as sluice gates are subject to discussions with NRW and Network Rail. The assessment has assumed that any control structures would be operated in a similar manner to the existing structures on and surrounding the site.

5.10.54 Based on the information included in the FCA for the site including the introduction of the measures listed, the magnitude of impacts upon all existing and proposed receptors is considered to be Negligible. Existing receptors include existing residential properties and commercial buildings with a High sensitivity and existing agricultural land with a medium sensitivity. The significance of effect on all existing receptors is ***Slight Adverse***. Proposed receptors include proposed employment buildings, proposed landscape areas, proposed car park areas and proposed railway station and associated car park and servicing area. The

sensitivity of proposed receptors ranges between High and Low however the significance of effect on all proposed receptors is ***Slight Adverse***.

5.10.55 The effect of operation on fluvial, tidal and pluvial flooding is not considered to be significant and therefore additional mitigation is not required.

5.11 Mitigation and enhancement

5.11.1 This section details the mitigation and enhancement measures that have been identified as being required.

Mitigation of effects from construction

5.11.2 The assessment of effects from construction activities identified Slight Adverse impacts on surface water quality, groundwater quality (including unproductive strata, non-potable wells and secondary aquifers) and flood risk (including surface water, fluvial, tidal and pluvial). The CEMP will include measures to mitigate impacts on surface water quality, groundwater quality and flood risk where available and practicable. The effects are not considered to be significant and therefore no additional mitigation is required.

5.11.3 The assessment has identified a Moderate Adverse impact on hydromorphology as a result of construction activities which would require in channel working. New reens will be introduced before the existing reens are removed as per the phasing plan which will be secured through planning condition. There is not considered to be a mitigation solution available to reduce the impact on hydromorphology as in-channel working in the reens, ditches and field grips is a fundamental and unavoidable part of the scheme to enable creation of development areas.

Mitigation of effects from operation

5.11.4 The assessment of effects resulting from the operation of the proposed development identified Neutral effects on groundwater quality of the secondary A aquifer. Slight Adverse effects were identified on surface water quality, hydromorphology, groundwater quality (including unproductive strata and GWDTE) and surface water flood risk. The effects are not considered to be significant and therefore no additional mitigation is required.

5.11.5 Reen monitoring and management will form part of the Habitat Management Plan (HMP) for the proposed development and will ensure that reen habitats remain optimal for target species and fulfil criteria for which the SSSI is designated. Monitoring and management activities will be agreed with NRW and are expected to be undertaken annually during Year 2, 3, 5, 10 & 15 (subject to agreement with NRW). Further details on the reen monitoring and management can be found in

Chapter 7 – Biodiversity. The Habitat Management Plan will be secured through planning permission.

Enhancement

5.11.6 A total of 4.43km of reens, ditches and field grips would be lost from the Gwent Levels – Rumney and Peterstone SSSI, of which only 2.72km were recorded as wet (the remaining were recorded as dry or field grips). These would be mitigated by reen reprovision of 3.72km of wet reens with a 3m wide base and 1 in 1 slopes on the banks, during construction. This is considered to be an enhancement through a net gain of wet reens, at a ratio of 1:1.38 (or 37% increase). These wet reens would be created to meet the conditions required to support the aquatic invertebrate and macrophyte species that are features of the SSSI. The new reens would be secured through planning condition.

5.12 Residual effects

5.12.1 The residual effects are the effects of the development, positive and negative, on the receptors after taking account of mitigation and enhancement measures.

5.12.2 There has been no additional mitigation described therefore the effects remain as specified in the assessment above.

5.12.3 The enhancement of additional reen provision has been factored in as part of the assessment therefore the effects remain as specified.

Residual effects from construction

5.12.4 There has been no additional mitigation or enhancement described therefore the effects remain as specified in the assessment above.

Residual effects from operation

5.12.5 There has been no additional mitigation described therefore the effects remain as specified in the assessment above.

5.12.6 The enhancement of additional reen provision has been factored in as part of the assessment therefore the effects remain as specified.

5.13 Assessment summary matrix

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)
Effects from construction on surface water quality							
Disturbance of silt/soil	Reens, ditches and field grips	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Accidental spillage	Reens, ditches and field grips	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Dewatering discharges	Reens, ditches and field grips	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Effects from construction on hydromorphology							
In channel working	Reens, ditches and field grips	Very High	Minor Adverse	Moderate Adverse	N/A	Minor Adverse	Moderate Adverse
Effects from construction on groundwater							
Accidental spills	Unproductive strata and non-potable wells	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Silt laden/contaminated waters from construction activities	Unproductive strata and non-potable wells	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Installation of piling and band drains	Secondary A aquifer	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Effect from construction on flood risk							
Removal of topsoil and creation of development plateaux and hardstanding	Existing residential receptors	High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse

Removal of topsoil and creation of development plateaux and hardstanding	Existing agricultural land	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Removal of topsoil and creation of development plateaux and hardstanding	Existing commercial properties	High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Effect from operation on surface water quality							
Surface water run-off	Reens, ditches and field drains	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Vehicle accidental spills	Reens, ditches and field drains	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Train accidental spills	Reens, ditches and field drains	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Effect from operation on hydromorphology							
Development traffic routes involving introduction of culverts	Feandre Reen, Green Lane Branch Reen, Ty-Fynnon Reen and an unnamed minor reens	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Removal of 4.43km of existing unnamed reens, ditches and field grips	Unnamed reens	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Widening of reen by 3m	Greenlane Reen	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Lowering of ground for flood conveyance	Area between Faendre Reen and Ty-Ffynnon Reen	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Flood compensatory storage area and associated interconnecting reen	South east corner of site	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Introduction of sluice gates, non-return valves and unidirectional culverts	Railway Reen and Greenlane Reen	Very High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Effects from operation on groundwater							
Surface water quality	Unproductive strata	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse

Accidental spills from vehicles	Unproductive strata and GWDTE	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Accidental spills from trains	Unproductive strata	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Ground lowering for flood compensation area	Secondary A aquifer	Medium	No change	Neutral	N/A	No change	Neutral
Effects from operation on flood risk							
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Existing agricultural land	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Existing residential properties	High	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Existing commercial properties	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Proposed employment buildings	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Proposed landscape areas	Low	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Proposed car park areas	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse
Surface water, fluvial, pluvial and tidal flooding through creation of development plateaux	Proposed railway station car parking and servicing areas	Medium	Negligible	Slight Adverse	N/A	Negligible	Slight Adverse