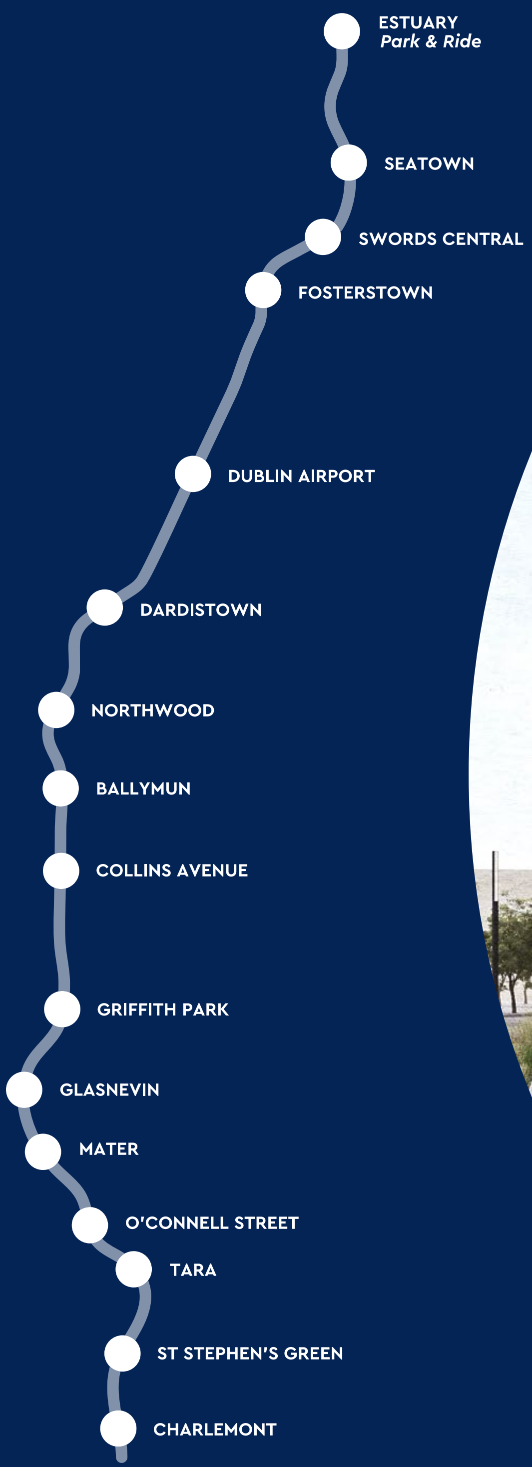

18 Hydrology

Contents

Table of Abbreviations

Acronym	Meaning
AEP	Annual Exceedance Probability
BOD	Biochemical Oxygen Demand
CEMP	Construction Environmental Management Plan
CFRAM	Catchment Flood Risk Assessment and Management
Ch.	Chainage
CIEEM	Chartered Institute of Ecology and Environmental Management
COD	Chemical Oxygen Demand
DANP	Dublin Airport North Portal
DASP	Dublin Airport South Portal
DCC	Dublin City Council
DCU	Dublin City University
EC	Electrical Conductivity
EIAR	Environmental Impact Assessment Report
EMT	Element Materials Technology
EMWR	Eastern Midlands Waste Region
EPA	Environmental Protection Agency
EU	European Union
FEM	Finite Element Method
FRA	Flood Risk Assessment
FRAM	Flood Risk Assessment Model
GDSDS	Greater Dublin Strategic Drainage Study
GSI	Geological Survey of Ireland
IFI	Inland Fisheries Ireland
IH	Institute of Hydrology
IW	Irish Water
LOD	Limits of Deviation
MCC	Meath County Council
MDL	Method Detection Limit
MOD	Metres (above) Ordnance datum
MPA	Marine Protected Areas
MRP	Molybdate Reactive Phosphorus
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority
OPW	Office of Public Works
OSi	Ordnance Survey Ireland
P&R	Park and Ride
PVC	Polyvinyl chloride
QMED	The mean annual maxima flood
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SPA	Special Protection Area

Acronym	Meaning
STMP	Scheme Traffic Management Plan
SuDS	Sustainable Drainage Systems
SWTV	Surface Water Threshold Value
TBM	Tunnel Boring Machine
TDS	Total Dissolved Solids
TII	Transport Infrastructure Ireland
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UKAS	United Kingdom Accreditation Service
WFD	Water Framework Directive

18. Hydrology

18.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) assesses the impact of the MetroLink Project (hereafter referred to as the proposed Project) on Hydrology during the Construction Phase and Operational Phase.

In accordance with the requirements of Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (i.e. the EIA Directive), it describes and assesses the likely direct and indirect significant effects of the proposed Project on Hydrology. This Chapter also provides a characterisation of the receiving hydrological environment within the proposed Project and within a wider study area in the vicinity of the proposed Project.

This Chapter should be read in conjunction with the following Chapters, and their Appendices, which present related impacts arising from the proposed Project and proposed mitigation measures to ameliorate the predicted impacts:

- Chapter 15 (Biodiversity);
- Chapter 19 (Hydrogeology); and
- Chapter 20 (Soils & Geology).

Limits of deviation have been set for the proposed Project and this is addressed in the Wider Effects Report annexed at Appendix A5.19

The assessment is based on a reasonable worst-case scenario with respect to potential impacts arising from the proposed Project, as described in Chapters 4 to 6 of this EIAR. The proposed Project description is based on the design prepared to inform the planning stage of the project and to allow for a robust assessment as part of the Environmental Impact Assessment (EIA) Process.

In the event where it is required to make assumptions as the basis of the assessment presented here, these assumptions are based on advice from competent project designers and are clearly outlined within the Chapter.

18.2 Outline Project Description

18.2.1 Overview of the proposed Project

A full description of the proposed Project is provided in the following chapters of this EIAR:

- Chapter 4 (Description of the proposed Project);
- Chapter 5 (MetroLink Construction Phase); and
- Chapter 6 (MetroLink Operations & Maintenance).

Table 18.1 presents an outline description of the key proposed Project elements which are appraised in this Chapter.

Diagram 18.1 presents an outline of the main elements of the proposed Construction Phase that are appraised in this Chapter and Diagram 18.2 presents an outline of the main elements of the Operational Phase of the proposed Project that are appraised in this Chapter.

Table 18.1: Outline Description of the Principal Project Elements

Project Elements	Outline Description
Permanent Project Elements	
Tunnels	It is proposed to construct two geographically separate, single-bore tunnels, using a Tunnel Boring Machine (TBM). Each section of tunnel will have an 8.5m inside diameter and will contain both northbound and southbound rail lines within the same tunnel. These tunnels will be located as follows: ▪ The Airport Tunnel: running south from Dublin Airport North Portal (DANP) under Dublin Airport and surfacing south of the airport at Dublin Airport South Portal (DASP) and will be approximately 2.3km in length; and ▪ The City Tunnel: running for 9.4 km from Northwood Portal and terminating underground south of Charlemont Station.
Cut Sections	The northern section of the alignment is characterised by a shallow excavated alignment whereby the alignment runs below the existing ground level. Part of the cut sections are open at the top, with fences along the alignment for safety and security. While other sections are "cut and cover", whereby the alignment is covered.
Tunnel Portals	The openings at the end of the tunnel are referred to as portals. They are concrete and steel structures designed to provide the commencement or termination of a tunnelled section of route and provide a transition to adjacent lengths of the route which may be in retained structures or at the surface. There are three proposed portals, which are: ▪ DANP; ▪ DASP; and ▪ Northwood Portal. There will be no portal at the southern end of the proposed Project, as the southern termination and turnback would be underground.
Stations	There are three types of stations: surface stations, retained cut stations and underground stations: ▪ Estuary Station will be built at surface level, known as a 'surface station'; ▪ Seatown, Swords Central, Fosterstown Stations and the proposed Dardistown Station will be in retained cutting, known as 'retained cut stations'; and ▪ Dublin Airport Station and all 10 stations along the City Tunnel will be 'underground stations'.
Intervention Shaft	An intervention shaft will be required at Albert College Park to provide adequate emergency egress from the City Tunnel and to support tunnel ventilation. Following the European Standard for safety in railway tunnels TSI 1303/2014: Technical Specification for Interoperability relating to 'safety in railway tunnels' of the rail system of the European Union, it has been recommended that the maximum spacing between emergency exits is 1,000m. As the distance between Collins Avenue and Griffith Park is 1,494m, this intervention shaft is proposed to safely support evacuation/emergency service access in the event of an incident. This shaft will also function to provide ventilation to the tunnel. The shaft will require two 23m long connection tunnels extending from the shaft, connecting to the main tunnel. At other locations, emergency access will be incorporated into the stations and portals or intervention tunnels will be utilised at locations where there is no available space for a shaft to be constructed and located where required (see below).
Intervention Tunnels	In addition to the two main 'running' tunnels, there are three shorter, smaller diameter tunnels. These are the evacuation and ventilation tunnels (known as Intervention Tunnels): ▪ Airport Intervention Tunnels: parallel to the Airport Tunnel, there will also be two smaller diameter tunnels; on the west side, an evacuation tunnel running northwards from DASP for about 315m, and on the east side, a ventilation tunnel connected to the main tunnel and extending about 600m from DASP underneath Dublin Airport Lands. In the event of an incident in the main tunnel, the evacuation tunnel will enable passengers to walk out to a safe location outside the Dublin Airport Lands. ▪ Charlemont Intervention Tunnel: The City Tunnel will extend 360m south of Charlemont Station. A parallel evacuation and ventilation tunnel is required from the end of the City

Project Elements	Outline Description
	Tunnel back to Charlemont Station to support emergency evacuation of maintenance staff and ventilation for this section of tunnel.
Park and Ride Facility	The Park and Ride Facility next to Estuary Station will include provision for up to 3,000 parking spaces.
Broadmeadow and Ward Viaduct	A 260m long viaduct between Estuary and Seatown Stations, in order to cross the Broadmeadow and Ward Rivers and their floodplains.
Proposed Grid Connections	Grid connections will be provided via cable routes with the addition of new 110kV substations at DANP and Dardistown. (Approval for the proposed grid connections to be applied for separately but are assessed in the EIAR).
Dardistown Depot	A maintenance depot will be located at Dardistown. It will include: ▪ Vehicle stabling; ▪ Maintenance workshops and pits; ▪ Automatic vehicle wash facilities; ▪ A test track; ▪ Sanding system for rolling stock; ▪ The Operations Control Centre for the proposed Project; ▪ A substation; ▪ A mast; and ▪ Other staff facilities and a carpark.
Operations Control Centre	The main OCC will be located at Dardistown Depot and a back-up OCC will be provided at Estuary.
M50 Viaduct	A 100m long viaduct across the M50 to carry the metro between approximately the Dardistown Depot and Northwood Station.
Temporary Project Elements	
Construction Compounds	There will be 34 Construction Compounds including 20 main Construction Compounds, 14 Satellite Construction Compounds required during the Construction Phase of the proposed Project. The main Construction Compounds will be located at each of the proposed station locations, the portal locations and the Dardistown Depot Location (also covering the Dardistown Station) with satellite compounds located at other locations along the alignment. Outside of the Construction Compounds there will be works areas and sites associated with the construction of all elements of the proposed Project, including an easement strip along the surface sections.
Logistics Sites	The main logistics sites will be located at Estuary, near Pinnock Hill east of the R132 Swords Bypass and north of St Margaret's Road at the Northwood Compound. (These areas are included within the 14 Satellite Construction Compounds).
Tunnel Boring Machine Launch Site	There will be two main tunnel boring machine (TBM) launch sites. One will be located at DASP which will serve the TBM boring the Airport Tunnel and the second will be located at the Northwood Construction Compound which will serve the TBM boring the City Tunnel.

Enabling Works
- Pre-construction surveys and monitoring
- Site establishment and erection of temporary fencing
- Establishment of construction compounds, site office and security
- Site preparation
- Utility diversions
- Vegetation clearance
- Invasive species clearance
- Installation of monitoring systems
- Demolition
- Heritage surveys and preservation
- Establishment of temporary traffic measures

Main civil engineering works
- Excavation, earthworks and construction of structures including stations, tunnels, intervention shafts, cuttings, embankments, bridges and viaducts
- Construction of new roads and access routes
- Road realignments and modifications

Railway systems installation
- Installation of railway track, overhead line equipment, train controls and telecommunication systems
- Installation of mechanical, electrical and operating equipment
- Construction of power supply infrastructure and connection to the electricity transmission grid

Site finalisation works
- Removing construction compounds
- Land reinstatement, such as agricultural land and parks
- Planting, landscaping and erection of permanent fencing

Systems testing & commissioning
- Testing the railway systems
- Commissioning the railway
- Trial running

Diagram 18.1 Summary of Key Activities during the Construction Phase of the proposed Project

Operational Strategy
- Fully Automated Rolling Stock
- Designed for a maximum of 20,000 passengers per hour per direction
- Minimum possible headway at 100 seconds
- Train will accommodate 500 passengers
- Operational Hours from 05:30 until 0:30

Operational Systems
- Operational Control Centre at Dardistown
- 40 High Floor Vehicles
- Power Systems to supply power to vehicles and stations
- Communication Systems including Radio, WiFi, CCTV, Public Address and Voice Alarm (PAVA), public mobile network and Emergency Telephones
- Ventilation and Air Conditioning Systems
- Emergency Evacuation and Fire Fighting Systems

Maintenance Systems
- Vehicle Maintenance at Dardistown Depot
- Maintenance of Operational Corridor outside of Operation Hours (0:30 until 5:30)
- Maintenance of Power systems, Communication Systems and Ventilation and Air Conditioning Systems

Station Operation
- Access via Escalators, Stairs and Lifts
- Signage
- Ticket Machines
- Lighting
- Back of House
- CCTV and Security

Diagram 18.2 Summary of Key Activities during the Operation Phase of the proposed Project

18.2.2 Summary of Measures Included in the Project Design to Protect Water

This subsection describes the measures embedded in the design to manage drainage and pollution control during construction and operation of the proposed Project.

18.2.2.1 Water Quality

- The vehicles are electrically operated so there is limited potential for contaminated run-off along the rail link as a result of minimal use of lubricants and chemicals for operational maintenance. There is also limited requirement for bulk chemical storage. Consequently, the potential for impact on water quality as a result of stormwater discharge is low during operation.
- In terms of construction, all water arising from the Construction Phase will ultimately be discharged to public foul sewer post treatment under formal consent by Irish Water. No surface water will be discharged to storm water drainage system or open watercourses during the Construction Phase. Therefore, water discharges from the construction areas will be released to sewers following effective treatment and attenuation and on the basis of a temporary permit/consent as issued by the relevant Local Authorities (including Irish Water). The contractor will be required to provide a Water Management Plan for disposal of construction run-off water for approval. Monitoring of the discharge will be in accordance with Local Authority discharge

requirements and any discharge water which exceeds approved discharge limits will be re-circulated at the site and treated or will be disposed offsite to an appropriate disposal facility.
- Where bulk chemicals will be stored, they will be bunded and located on impermeable hardstanding and under cover within designed maintenance compounds, mainly the Dardistown Depot.
- Oil and petrol interceptors will be included prior to outfalls from the Dardistown Depot, Park & Ride Facility (P&R) area and maintenance area. Additional interceptors will be installed along the drainage system prior to discharge points. Maintenance of the surface water drainage system and foul sewers as per normal urban developments will be undertaken to negate/limit any accidental discharges to ground. Petrol/oil interceptor(s) will be maintained and cleaned out in accordance with the manufacturer's instructions.
- All wastewater arising from the tunnels (including from the tunnels themselves, emergency access and ventilation shafts, portals, and foul water from station boxes) will ultimately be discharged to public foul sewer under formal consent by issued by the relevant Local Authorities (including Irish Water). No wastewater will be discharged to surface waters or the ground during operation.

18.2.2.2 Management of Storm Water Discharge Flows and Flood Risk Management

- All culverts are designed with inlet and outlet structures that include headwall, wingwalls and a buried concrete apron or amour stone to resist local scour of the stream bed at the inlet and outlet. Pipe culverts and box section inverts will all be buried beneath existing riverbed levels by depths of 150mm in respect to pipes and 300mm in respect of the box sections in fishery watercourses. All watercourses which are non-fishery waters will be culverted using a standard nominal 1,200mm or 900mm diameter concrete pipe or equivalent. Under Section 50 of the Arterial Drainage Acts 1945 and 'as amended by the Arterial Drainage (Amendment) Act 1995', culverting of streams by new, upgraded or extended culverts/bridges requires approval from the Office of Public Works (OPW). This allows the OPW to assess the potential impact of the particular proposal in relation to flooding. This minimum size of culvert proposed for the subject development meets OPW requirements with specific regard to hydraulic capacity, blockage potential and maintenance. Consideration of climate change is incorporated within the calculation of design measures. Railway Order (RO) applications will be prepared following approval of the Section 50.
- All culverts are designed to prevent permanent impact to the river morphology although a short-term local impact may occur during installation of these structures. The potential for permanent impact is prevented by ensuring the width of the river is not significantly exceeded or constricted by the culvert or crossing and that reasonable conveyance above and below the structure is minimised.
- In all fishery sensitive watercourses, the proposed culvert will be embedded into the channel to a depth of 300mm for box sections and a minimum of 150mm for pipe culverts (depending on hydraulic size requirements). Suitable local granular material will be placed to back fill the embedded culvert and sizing and design will be undertaken in consultation with Inland Fisheries Ireland (IFI). A method statement for such works will be prepared and submitted for approval by IFI prior to any commencement of construction works.
- All culverts are designed to allow for both aquatic species and mammal migration, as well as to maintain the existing riverbed as far as possible in accordance with 'Guidelines for the Crossing of Watercourses during the Construction or National Road Schemes' (NRA 2008).
- Construction of the viaduct over the Broadmeadow River and Ward River will comprise a 13-span concrete pad structure with twin concrete bridge deck beams taking one track each. Temporary construction 'bailey' bridges will be required to facilitate access for construction traffic which will also require works adjacent to these two rivers. The spanning of the rivers avoids the need for in-stream works at the construction stage which lessens the potential for constructional and operational (permanent piers) temporary construction and permanent operational impacts, including on the down-gradient Malahide Estuary Special Area of Conservation (SAC). To minimise the potential for accidental discharge to the rivers during construction, a minimum of a 5m set back 'buffer zone' will be maintained along each riverbank and monitored by a suitably qualified person during all related works in that area. As such there is no likely potential for an impact on water quality which could alter the water requirements to a degree that it could impact on the conservation objectives.

- To minimise any impact to receiving water flows during operation, the design incorporates effective attenuation to greenfield run-off rates for new hardstanding areas following the Institute of Hydrology Report Number 124 (IH 124) Methodology. The proposed attenuation storage volumes are sized to accommodate any potential increase in surface water run-off rates up to the 100-year return period storm event with an allowance for climate change effects. The alignment was divided into catchment areas based on the longitudinal slope of tracks, catchment size, local topography and nearby viable discharge points. Prior to discharge to the receiving watercourse, surface flow from each defined catchment is effectively attenuated to match the existing greenfield run-off rate (1% AEP (Annual Exceedance Probability), with climate change correction). This means that:

- attenuation storage is provided for areas where the track results in the creation of new impermeable surfaces in areas that are currently permeable (i.e. greenfield); and
- attenuation storage is not provided for areas where the track crosses areas which are currently impermeable.

The design calculations for the proposed attenuation are presented in Appendix A18.5 (Flood Risk Assessment).

- Selected receiving watercourses for each defined catchment for the proposed Project were chosen with the intention of minimising the transfer of surface water flows across 'natural' sub-catchment boundaries to minimise potential for increasing flood risk or impact on water body status.
- All bridge structures, culverts, diversions have been designed to convey flows including consideration of climate change (see Section 18.6.1.2 and Section 18.6.1.3).
- The proposed Project crosses the Sluice River at Ch. 5+693 and one of its tributaries at Ch. 5+762. The CFRAM (Catchment Flood Risk Assessment and Management) mapping for the Sluice River shows that the watercourse has little natural floodplain. It is therefore proposed to cross these two watercourses with culverts that are compliant with TII and OPW [Section 50 of the Arterial Drainage Act 1945] requirements. Compliance of the design of these crossings will be ensured through appropriate consultation with the OPW and TII prior to construction works commencing.
- The drainage system for the proposed Project has been designed to incorporate Sustainable Urban Drainage System (SuDS) components and techniques (C753, CIRIA, 2015). The main track drainage consists of a box channel between the two tracks to carry the run-off to designated discharge points and to manage discharge at these points. Due to space constraints in the vicinity of two of the outfall locations, Geo-cellular systems have been used in lieu of conventional attenuation ponds. At the Dardistown Depot and P&R Facility, several other SuDS measures (attenuation tanks and/or ponds, wetlands and hydrobrake) have been incorporated into the long-term design.

18.2.2.3 Water Crossings – MetroLink Grid Connections

Existing road bridges over watercourses cannot always accommodate high voltage cables. In such cases it shall be necessary to pass underneath the watercourse. Crossings of smaller ditches and drains shall be carried out by open trench using damming and overhead pumping.

The crossing of streams and rivers shall be carried out by open trench method or trenchless methods. The open trench method crossing of streams and rivers can be carried out by 'damming and fluming' or 'damming and pumping' as discussed below.

The method adopted shall be implemented only with the approval of Inland Fisheries Ireland (IFI) prior to the commencement of the construction works. Where applicable, the construction shall take place outside the salmon spawning period from October to April, unless otherwise agreed with IFI.

Appropriate measures shall be put in place by the contractor to prevent ground damage on the access routes to watercourse crossings on both banks, particularly where the ground is soft or slopes steeply toward a crossing. This shall prevent solids reaching a watercourse from damaged access tracks.

There are three construction methodology options to crossing waterbodies:

- Open Trench (Damming and Fluming),
- Open Trench (Damming and Pumping); and
- Trenchless Installation.

The MetroLink/ESBN Construction Methodology of HV Cable Routes (Appendix A18.4) contains detailed project specific methodology and associated design measures on each methodology albeit open cut crossing or trenchless installation. The design measures of each methodology will ensure the protection of the watercourse and that there will be no adverse impacts to the receiving environment.

18.3 Methodology

18.3.1 Relevant Guidance

The hydrological baseline study and impact assessment have been carried out in accordance with the following key guidance and established best practice:

- Environmental Protection Agency (EPA) Advice notes on current practice in the preparation of Environmental Impact Statement (EPA, 2015) and Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2022).
- Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report (European Commission, 2017).
- Transport Infrastructure Ireland - Road Drainage and Water Environment (TII, 2015).
- Transport Infrastructure Ireland (previously National Road Authority) - Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII, 2009).
- Water Framework Directive (WFD) - Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. This relates to the improvement of water quality across Ireland including rivers and groundwater bodies.
- The Planning System and Flood Risk Management, Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW)).
- Guidelines on protection of fisheries during construction works in and adjacent to waters (Inland Fisheries Ireland, 2016)
- Guidelines for the Crossing of Watercourses during Construction of National Road Schemes, (TII, 2008).

Note: The Impact Assessment follows the EPA Guidelines for the EIAR process as outlined in Chapter 2 (Methodology in Preparation of the EIAR). Consideration of the TII/NRA impact significance and rating of significance has also been considered.

The quality, magnitude and duration of potential effects are defined in accordance with the criteria provided in the EPA *'Guidelines on the information to be contained in Environmental Impact Assessment Reports'* (2022) as outlined in Table 18.2.

Table 18.2 Description of Effects and Impacts for Hydrology Attributes as per EPA Guidelines (EPA, 2022)

Effect Characteristic	Term	Description
Quality of Effects	Positive	A change which improves the quality of the environment
	Neutral	A change which does not affect the quality of the environment
	Negative/Adverse	A change which reduces the quality of the environment
Describing the Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequences.
	Not significant	An effect which causes noticeable changes in the character of the environment but without noticeable consequences.

Effect Characteristic	Term	Description
	Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
	Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
	Significant Effects	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Very Significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
	Profound Effects	An effect which obliterates sensitive characteristics
Describing the Extent and Context of Effects	Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect.
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Describing the Duration and Frequency of Effects	Momentary Effects	Effects lasting from seconds to minutes
	Brief Effects	Effects lasting less than a day
	Temporary Effects	Effects lasting less than a year
	Short-term Effects	Effects lasting one to seven years.
	Medium-term Effects	Effects lasting seven to fifteen years
	Long-term Effects	Effects lasting fifteen to sixty years
	Permanent Effects	Effects lasting over sixty years
	Reversible Effects	Effects that can be undone, for example through remediation or restoration
	Frequency of Effects	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Probability of Effects	Likely Effects	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Type of Effects	Indirect Effects (a.k.a secondary or Off-site effects)	Effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative Effects	The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out
	\`Worst case' Effects	The effects arising from a project in the case where mitigation measures substantially fail
	Indeterminable Effects	When the full consequences of a change in the environment cannot be described.
	Irreversible Effects	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.

Effect Characteristic	Term	Description
	Synergistic Effects	Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of Sox and NOx to produce smog).

In line with the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (TII 2009) an assessment of the attribute importance has been undertaken in order to provide a basis for the assessment of impact provided. The attribute importance considers the potential as well as the existing use of the surface water features as a water resource (i.e. water supply, fisheries and other uses) as well as ecological habitat requirements. The TII criteria for rating the hydrological related attributes are presented in Table 18.3 below.

Table 18.3 Criteria for Rating Site Attributes - Estimation of Importance of Hydrology Attributes (TII, 2009)

Importance[1]	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status. Regionally important potable water source supplying >2,500 homes. Quality Class A (Biotic Index Q4, Q5). Flood plain protecting more than 50 residential or commercial properties from flooding. Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery. Locally important potable water source supplying >1,000 homes. Quality Class B (Biotic Index Q3-4). Flood plain protecting between 5 and 50 residential or commercial properties from flooding. Locally important amenity site for wide range of leisure activities.
Importance[2]	**Criteria**	**Typical Examples**
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery. Local potable water source supplying >50 homes. Quality Class C (Biotic Index Q3, Q2-3). Flood plain protecting between 1 and 5 residential or commercial properties from flooding.
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for a small range of leisure activities. Local potable water source supplying <50 homes. Quality Class D (Biotic Index Q2, Q1). Flood plain protecting 1 residential or commercial property from flooding. Amenity site used by small numbers of local people.

18.3.2 Sources of Information

The following data sources were reviewed as part of this baseline assessment for hydrology:

[1] *Note: The ecological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (formerly National Roads Authority, 2009) and advice on how to determine the importance of an ecological feature provided in CIEEM guidelines (CIEEM, 2018). Further information is provided on this assessment in Chapter 15 (Biodiversity).*

[2] *Note: The ecological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (formerly National Roads Authority, 2009) and advice on how to determine the importance of an ecological feature provided in CIEEM guidelines (CIEEM, 2018). Further information is provided on this assessment in Chapter 15 (Biodiversity).*

- Ordnance Survey Ireland (www.OSi.ie):
  - Discovery Series Mapping (1:50,000); Six Inch Raster Maps (1:10,560), Six Inch and 25inch OS Vector Mapping, Orthographic Aerial Mapping (GeoHive).
- EPA - online mapping resource (Envision and www.catchments.ie):
  - Teagasc Subsoil Classification Mapping, Water Quality Monitoring Database and Reports including EPA Hydrometric Data System/EPA Catchments, 'Water Quality in Ireland, 2013 to 2018 ': published in 2019.
- OPW: - online mapping resources:
  - Hydrometric data (www.floodinfo.ie/map/floodmaps/), OPW CFRAM Flood Risk Mapping, www.epa.ie/hydronet.
- National Planning Policy - Project Ireland 2040 - National Planning Framework (2018).
- Regional and Local Planning policy Dublin City Council/Fingal County Council:
  - Dublin City Development Plan (2016 – 2022), Dublin Airport Local Area Plan (January 2020), Fingal Development Plan 2017-2023.
- National Parks and Wildlife Service (NPWS):
  - Designated Areas Mapping (www.npws.ie).
- Other sources:
  - River Basin Management Plan 2018-2021 (including regional plans by Local Authority Waters Programme (Waters and Communities 2020)), Geological Survey of Ireland (GSI) on-line mapping, Greater Dublin Strategic Drainage Study (GDSDS), (National 'New Development' Plan and Dublin Drainage, 2005), as updated.
- Design Information (undertaken by Jacobs Engineering).
  - Chapter 4 (Project Description)
  - Chapter 5 (MetroLink Construction Phase)
  - Appendix A5.1 (Outline Construction Environmental Management Plan).
  - Chapter 6 (MetroLink Operations & Maintenance)
  - Flood Risk Assessment (attached as Appendix A18.5)

In advance of completing this assessment, a number of national, regional and local planning and policy documents were also reviewed to confirm the design complies with plans, policies or objectives relating specifically to surface water. A full report was prepared based on the planning of the proposed Project. The following documents have been reviewed in this context:

- Dublin City Development Plan (2016-2022)
- Fingal Development Plan (2017-2023)
- Draft Fingal Development Plan (2023-2029)
- Draft Dublin Airport Local Area Plan (2020 – 2026)

Mapping associated with this Chapter is provided in the Figures of this EIAR and comprises the following:

- Figure 18.1 Surface water drainage and EPA sub-catchment delineation
- Figure 18.2 Surface drainage and water quality sampling points
- Figure 18.3 River Flood Extents and Historical River Flood Events
- Figure 18.4 Coastal Flood Extents and Historical River Flood Events
- Figure 18.5 Surface Drainage Features & Proposed Discharge Points
- Figure 18.6 Historical Rivers – Dublin City & Environs
- Figure 18.7 Historical Rivers – Dublin (Santry to Royal Canal)
- Figure 18.8 Proposed Watercourse Diversion

- Figure 18.9 Proposed Drainage Catchment A1-Swords Western Distributor Road; A2 & Estuary Station Parking
- Figure 18.10 Proposed Drainage Catchment B & Existing Road
- Figure 18.11 Proposed Drainage Catchment C1
- Figure 18.12 Proposed Drainage Catchment C2-D1; Catchment D2
- Figure 18.13 Proposed Drainage Catchment E1 & Depot
- Figure 18.14 Proposed Drainage F.

18.3.3 Study Area and Baseline Data Collection

18.3.3.1 Study Area

The geographical scope defined for this assessment comprises all surface water bodies located within the area occupied by the proposed alignment as well as the lands within c. 500m buffer either side of the centre line of the proposed Project alignment. This distance is based on a conservative assessment for the likely zone for any interaction.

The proposed Project extends within the four geographical sections presented as follows:

- AZ1 Northern Section: Estuary Station to Dublin Airport North Portal;
- AZ2 Airport Section: Dublin Airport North Portal to South Portal;
- AZ3 Dardistown Section: Dublin Airport South Portal to Northwood; and
- AZ4 Northwood to Charlemont: City Section.

A full description of the proposed Project is presented in Chapter 4 (Description of the MetroLink Project).

18.3.3.2 Desktop Data Review

An extensive desktop review was undertaken by AWN Consulting Ltd. (AWN), on behalf of TII, in order to establish baseline conditions along the proposed alignment corridor with respect to hydrology. The following key aspects were considered when determining the importance of each attribute:

- Historical and existing modelled flood data;
- Water quality data (Q data) including [current] Water Body Status (EPA 2022);
- Use of attribute for fishery and/or leisure; and
- Ecological importance and water requirements, if any, for habitat protection.

18.3.3.3 Field Surveys and Analytical Testing

A number of field surveys and walkover assessments were carried out to assess the baseline hydrological environment in the context of the proposed Project. These were undertaken in July and August 2018, December 2018, and April and May 2019 and are described in Section 18.4.3 below. Chemical and biological sampling was undertaken to supplement the existing available long-term trends in water quality as collated by the EPA. These data refer to sampling events.

Project-specific biological surveys have been carried out by a number of ecologists (Jacobs, Scott Cawley and Triturus Environmental Services). All biological samples were taken with a standard kick sampling net (i.e. 250mm in width and with a 500µm mesh size) from riffle/glide habitat, utilising a three minute per sample approach. Macro-invertebrate samples (kick samples) were converted to EPA Q-value ratings as per Toner et al. (2005). Macro-invertebrate samples were collected by Triturus Environmental Services Ltd. at eight watercourses crossed by the proposed Project between the 28 and 29 September 2018. The locations of the aquatic surveys are presented in Chapter 15 (Biodiversity). The methodology for these surveys is provided in Section *15.2.5.2 Field Surveys* and the results are summarised in Section *15.3 Baseline Environment*. Surveys were completed at crossing points as shown below in Table 18.4. Locations where there is no sampling is explained in Chapter 15 (Biodiversity).

Table 18.4 Surface Water Crossing Points

Watercourses Crossed by the proposed Project (from north to south)	Electro-fishing Undertaken (8 watercourses)	Biological (Q-sampling) Undertaken (8 watercourses)	White-clawed Crayfish Surveys Undertaken (10 watercourses)	Habitat Suitability – Salmonid and Lamprey Species (11 watercourses)
Staffordstown Stream[3]	Yes	Yes	Yes – Sweep netting	Yes
Broadmeadow River	Yes	Yes	Yes – Trapping	Yes
Ward River	Yes	Yes	Yes – Trapping	Yes
Sluice River	Yes	Yes	Yes – Sweep netting	Yes
Cuckoo Stream	Yes	Yes	Yes – Sweep netting	Yes
Mayne River	Yes	Yes	Yes – Sweep netting	Yes
Santry River	Yes	Yes	Yes – Sweep netting	Yes
Tolka River	Yes	Yes	Yes – Trapping	Yes
Royal Canal	No	No	Yes – Trapping	Yes
River Liffey	No	No	No	Yes
Grand Canal	No	No	Yes – Trapping	Yes

Water quality sampling (field parameters and physio-chemical sampling) was undertaken at planned discharge points for both the construction and operational phases of the proposed Project and identified water features (i.e. rivers, streams, estuary and transitional waters) generally crossing the proposed route. Baseline sampling (which effectively provides a short-term comparative assessment) was undertaken to supplement long-term EPA trend data and to provide local data on the existing quality of surface watercourses which may be used as planned discharge locations for the construction and operational phases of the proposed Project.

Table 18.5 below presents the surface water quality sampling points used for baseline monitoring undertaken for the proposed Project between 2018-2019. Sampling points were chosen to include for all potential outfall points both during construction and operation. As such the sample points cover both the overground and underground areas of the proposed Project. The baseline water quality programme involved three sampling events, as follows:

- Sampling event Round 1: July and August 2018 (refer to Appendix A18.1);
- Sampling event Round 2: December 2018 (refer to Appendix A18.2); and
- Sampling event Round 3: April and May 2019 (refer to Appendix A18.3).

Table 18.5 Surface Water Quality Monitoring Points (2018-2019 Baseline Programme)

Ref.	Station/Main Construction Compound Name	Features selected for monitoring in vicinity of station indicated	Ref. Sampling location ID (Up-gradient)	Ref. Sampling location ID (Down-gradient)
AZ1	Park & Ride Facility (P&R)	Staffordstown Stream[4], Broadmeadow River, Lissenhall Great Stream	Staffordstown Stream SW35, Lissenhall Great Stream SW37	Staffordstown Stream SW36
	Seatown	Ward River, Broadmeadow River, Malahide Estuary, Seapoint Stream,	Ward River SW27, Un-named stream SW29A Seapoint Stream SW30, Malahide Estuary SW31,	Ward River SW28 Malahide Estuary SW32, Broadmeadow River SW34

[3] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*
[4] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

Ref.	Station/Main Construction Compound Name	Features selected for monitoring in vicinity of station indicated	Ref. Sampling location ID (Up-gradient)	Ref. Sampling location ID (Down-gradient)
		Greenfields Stream, Un-named stream	Broadmeadow River SW33	
	Swords Central	Gaybrook River, Swords Glebe, Ward River, Greenfields Stream	Ward River SW27, (Greenfields Stream SW29)	Ward River SW28
	Fosterstown	Gaybrook River, Swords Glebe, Sluice River, Un-named stream	Sluice River SW20A Un-named stream SW20B/20C, Gaybrook River SW22, Swords Glebe SW25	Gaybrook River SW23, Un-named stream SW24, Swords Glebe SW26, Sluice River SW20
AZ2	Dublin Airport	Cuckoo Stream, Sluice River, Marshallstown Stream, Un-named stream	Sluice River SW19, Un-named stream SW20B, Marshallstown Stream SW21	Sluice River SW20, Sluice River SW20A, Un-named stream SW20C
AZ3	Dardistown	Mayne River, Cuckoo Stream, Un-named stream	Mayne River SW15, Un-named stream SW15A, Cuckoo Stream SW17	Un-named stream SW15B, Mayne River SW16, Cuckoo Stream SW18
	Northwood	Santry River, Ballymun Stream, Northwood Drainage	Northwood Drainage SW14	Santry River SW14A
AZ4	Ballymun Village	Santry River, Ballymun Stream	Santry River SW10, Ballymun Stream SW12	Santry River SW11, Ballymun Stream SW13
	Collins Avenue Junction (DCU)	Bachelors Stream	N/A (Bachelors Stream SW07)	N/A (Bachelors Stream SW08)
	Griffith Park West	Tolka River, Bachelors Stream, Claremont Stream	Bachelors Stream SW07, Claremont Stream SW09	Tolka River SW06, (Bachelors Stream SW08)
	Glasnevin (Whitworth)	Tolka River, Royal Canal	Tolka River SW05, Royal Canal SW38	Tolka River SW06, Royal Canal SW39
	Mater	River Liffey	N/A (River Liffey SW03)	N/A (River Liffey SW04)
	O'Connell Street	River Liffey	N/A (River Liffey SW03)	N/A (River Liffey SW04)
	Tara Street	River Liffey	River Liffey SW03	River Liffey SW04
	St Stephen's Green	River Liffey	N/A (River Liffey SW03)	N/A (River Liffey SW04)
	Charlemont	River Dodder	River Dodder SW01	River Dodder SW02, Swan River SW40

Figure 18.1 presents an outline of the proposed Project alignment included in this baseline assessment, extending from Estuary Station to the north to Charlemont Station in the south. Figure 18.2 presents the location of the surface water monitoring points referenced in Table 18.4 above.

Water quality sampling followed good practice guidelines as *EN ISO 5667-2 Water Quality - Sampling Part 1: Guidance on design of sampling programmes and sampling techniques; Part 3: Guidance on preservation and handling of water samples; Part 6: Guidance on sampling of rivers and streams; Part 10:*

Guidance on sampling of waste waters; and *BS 6068-6.14 (BS ISO 5667-14:2014) Water Quality, Section 6.14: Guidance on quality assurance and quality control of environmental water sampling and handling.*

All samples collected by AWN were shipped under Chain of Custody quality control sheet to the UKAS Accredited laboratory Exova [now Element Materials Technology (EMT) Ltd.] for chemical analysis.

During each sampling round, field parameters such as pH, dissolved oxygen, conductivity, temperature and total dissolved solids (TDS) were collected *in situ*. Furthermore, visual assessments were carried out to estimate the flow of the waterbody, embankment conditions and the status of the waterbody in terms of the presence of litter and possible fly tipping in the area. The field parameter results are available in Appendix A18.1 to A18.3 for each surface water monitoring round and monitoring point along with the tabulated laboratory test results. All tables indicate the geographical split applied to the project i.e. AZ1-AZ4. Exceedances of available surface water threshold values, where available, are also presented. These exceedances are based on the water quality results being compared to the *S.I. No. 272 of 2009* [and amendments thereof including *Surface Water Amendment Regulations S.I. No. 386 of 2015]. S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019*. Reference is also made to the laboratory LOD/method detection limit (MDL). Results are detailed in Appendix A18.1 to A18.3 of this EIAR.

The analytical suite for the baseline surface water monitoring undertaken between 2018-2019 included the following physico-chemical parameters:

- Anions and cations (including chloride, sulphate, sodium, calcium, potassium, magnesium, fluoride, ammonia, orthophosphate (as MRP), and alkalinity);
- Metals and other compounds (including aluminium, antimony, arsenic, barium, beryllium, boron, cadmium, cobalt, iron, manganese, molybdenum, nickel, chromium, copper, mercury, lead, selenium, phosphorous, thallium, vanadium and zinc);
- Physico-chemical parameters including total suspended solids (TSS), biochemical oxygen demand (BOD); chemical oxygen demand (COD) and Kjeldahl Nitrogen; and,
- Hydrocarbon compounds including benzene, toluene, ethylbenzene and xylene (BTEX) (aliphatics/aromatics), and mineral oil fraction (aliphatics).

In order to determine any evidence of historical contamination and update baseline understanding, laboratory test results were compared with *S.I. No. 272 of 2009* [and amendments thereof including *Surface Water Amendment Regulations S.I. No. 386 of 2015]. S.I. No. 77/2019 - European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2019*. Both 'inland surface water' and 'other surface water' categories are presented in Appendix A18.1 to A18.3 of this Chapter.

The main surface watercourses crossing the proposed alignment are also presented in Figure 18.2 together with defined surface water quality sampling points along these particular features and which were visited as part of the baseline monitoring programme completed to date for the project[5].

18.3.3.4 Flood Impact Assessment

A baseline assessment of flooding was undertaken is included as Appendix A18.5 Flood Risk Assessment.

18.3.4 Consultation

The baseline and impact assessment for Hydrology have included the review of all responses received in respect of stakeholder submissions and concerns about water. The compiled feedback from both statutory and non-statutory bodies as well as from engagement with other private individuals with regard to surface water, has been considered in the overall project design and reviewed as part of this assessment.

[5] *(Note: Some locations were not sampled on occasion due to lack of access, observed dry culvert outfalls, or dry watercourses, for example during the April/May 2019 sampling round. These sampling locations can be referred to in field monitoring sheets provided in Appendix 18.1 to 18.3).*

Key concerns from stakeholders with regard to flooding included the following (on the basis of geographical area split reference):

- AZ1 - Localised flooding potential on lands near the proposed P&R Facility site north of the Estuary Station and the need for effective water management;
- AZ2 - The need to be cognisant of planned drainage proposals in the context of the drainage network for Dublin Airport;
- AZ4 - Effects from inclement rainfall on the tributary of the [below ground] River Wad near Ballymun Road;
- AZ4 - Effects of a tributary of the [below ground] River Wad and localised flooding potential near Glasnevin;
- AZ4 - Localised surface flooding potential near the proposed Griffith Park Station;
- AZ4 - Potential impacts on existing combined sewer network in the area of Griffith Park from tunnelling and excavations; and
- AZ4 - Localised surface flooding potential near the proposed Tara Station.

The project approach to consultation and summary of issues raised during the consultation process for the proposed Project is discussed in more detail in EIAR Chapter 8 (Consultation) and Appendix A8.18.

Inland Fisheries Ireland (IFI) was consulted about habitat presence within the waterbodies that are crossed by or close to the proposed Project. IFI provided data on the rivers and the presence of any fishery habitats within the waterbodies, which was used to characterise the baseline assessment and attribute importance rating of each watercourse.

Irish Water recommended a number of aspects to be considered in the scope of the EIAR. Including impacts to water services and Irish Water physical assets; upgrades required; discharge to an Irish Water collection network; any potential impact on stormwater discharges to combined sewer networks and measures to mitigate; impacts on receiving waters (used for abstraction for public supply); any connections required; mitigation for said aspects. These have been tackled in the following chapter as well as others in the EIAR.

With regards to water protection measures, the IFI has recommended that the *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016) is consulted for any proposed works undertaken near any of the relevant rivers and streams and that the "*maintenance of habitat integrity (both in-stream and riparian) is essential in safeguarding the ecological value of this important urban natural resource*". They have also recommended that "*A comprehensive and integrated approach for achieving estuary and river protection during construction and operation should be implemented through environmental construction management planning*".

A biodiversity and hydrology combined meeting was held on 31 August 2020 with IFI and included the attendance of DCC Biodiversity Officer. DCC made the following comments/observation relevant to the preparation of this Chapter of the EIAR:

- Requirement for IFI to see detailed documentation on the design of culverts.
- Requirement to translocate fish from impacted river channel prior to any temporary diversion works occurring and that this activity must be undertaken by licensed contractors authorised under Section 14 of the Fisheries (Consolidation) Act, 1959.
- Implementation of Sustainable Drainage Systems (SuDS) to reduce amounts of surface water being discharged into watercourses as well as the use of hydrocarbon petrol interceptors.
- Requirement for protective measures during construction especially in the context of management of silt.

These observations and comments have been taken on board and implemented throughout the EIAR.

Iarnród Éireann recommend with regard to hydrology, the integrity of the Royal Canal, adjacent Iarnród Éireann's railway corridor at Glasnevin, should be analysed and the risk of flooding/catastrophic inundation should be assessed.

Waterways Ireland highlighted that any activity either during construction or post construction that resulted in the release of any form of polluting or deleterious matter into the canal, such as fuels, oils, concrete or excess waste, litter, or construction waste, is to be fully avoided and prevented.

Refer to Chapter 8 (Consultation) of this EIAR for further information.

18.4 Baseline Environment

18.4.1 Introduction

The following section describes the hydrological environment in relation to the proposed Project. The description is based on the detailed design and engineering documents for the project (depth of tunnel bore, station boxes and works areas with corresponding discharge points). Key elements of the project in relation to hydrology are summarised in Table 18.1 above. Also refer to Chapter 5 (MetroLink Construction Phase) and Chapter 6 (MetroLink Operations & Maintenance) of this EIAR as well as the Alignment Book; Structures Book; Utilities Book; Property Book of the RO.

Section 18.4 of the baseline description is subdivided by geographical areas. The geographical split for describing the baseline environment for the proposed Project is outlined in Table 18.6 below.

Table 18.6 Proposed Geographical Split for Baseline and Assessment

Reference	Geographical Split	Description
AZ1	Northern Section	Section of the proposed Project from Estuary to north of the DANP. Includes the proposed P&R at Estuary.
AZ2	Airport Section	Section of the proposed Project from the DANP, the tunnel underneath Dublin Airport, Dublin Airport Station and DASP.
AZ3	Dardistown to Northwood	Section of the proposed Project from south of DASP until the Northwood Portal. This section includes the proposed Depot site at Dardistown, the M50 crossover and the proposed Construction Compound at Northwood.
AZ4	Northwood to Charlemont	This section includes the underground tunnel between Northwood and Charlemont. All stations along this section are included.

18.4.2 Overview of Regional Hydrology

The proposed Project falls within the Irish River Basin District (formerly ERBD) as defined under the EU Water Framework Directive (WFD) (2000/60EC). The route predominantly lies within the Liffey and Dublin Bay Catchment (WFD Catchment Identification: 09 within reference areas AZ1-AZ4, with the northern portion of the route also crossing within the Nanny-Devlin Catchment (WFD Catchment Identification: 08), reference area AZ1, north of Swords, Chapter 6 (MetroLink Operations & Maintenance) Dublin (EPA, 2020). The two principal water regions are further categorised in sub-catchments as indicated in Table 18.7 below.

Table 18.7 Hydrological Sub-catchments within the Study Area

Geographical Reference	Sub-catchment (SC) Name	Sub-catchment ID	WFD Catchment	Extent Within Study Area	Downstream Discharge
AZ1	Ballough Stream_SC	08_06	Nanny-Devlin (WFD Id: 08)	Area to the northwest of Malahide Estuary and northern extreme of the route	Malahide Estuary
	Broadmeadow_SC_010	08_03		Generally, the area to the west of Swords (River Valley,	Broadmeadow Estuary /Malahide Estuary

Geographical Reference	Sub-catchment (SC) Name	Sub-catchment ID	WFD Catchment	Extent Within Study Area	Downstream Discharge
				Brackenstown /Rathbeale)	
AZ1, AZ2, AZ3	Mayne_SC_010	09_17	Liffey and Dublin Bay (WFD Id: 09)	Santry to Estuary (North of Swords Business Park	Dublin Bay with discharge also shown to Baldoyle Estuary, North Bull Island and Tolka Estuary (to the east) and Malahide Estuary (to the north).
AZ4	Tolka_SC_020	09_04		River Liffey to Santry	Tolka Estuary to Dublin Bay
	Dodder_SC_010	09_16		South of Ranelagh to the River Liffey	Liffey Estuary Lower and Dublin Bay

The proposed alignment extends 18.8km and crosses several watercourses from Estuary in the north (near the N1 interchange) to the suburb of Ranelagh in the south of Dublin City Centre. All rivers, streams and drainage features along the route eventually outfall directly or indirectly to the Irish Sea via coastal and transitional waters, at either Malahide Estuary/Baldoyle Estuary to the north of the River Liffey, or at Dublin Bay to the south of the River Liffey.

Transitional waters are located at Malahide Estuary (from the Malahide Viaduct in the east to Lissenhall Great west of the M1, approximately 300m at the Broadmeadow River), Mayne Estuary at Baldoyle, North Bull Island, Tolka Estuary (extending from Dublin Bay to near Drumcondra to the west, or approximately 1.4km up the Tolka River) and the Liffey Estuary Lower (extending approximately 9km west towards Islandbridge).

The EPA (2022) generally carries out water quality assessments of rivers as part of a nationwide monitoring programme. Data are collected from physico-chemical and biological surveys, sampling both river water and the benthic substrate (sediment) in contact with the water. The EPA has a number of quantitative and qualitative monitoring stations along specific watercourses in the vicinity of the proposed route; these are summarised below in Table 18.8 and Table 18.9, respectively.

Table 18.8 EPA Hydrometric Gauge Stations within the Study Area

Geographical Reference	River Name	Waterbody Id.	Station Name	Station Number	Active Y/N	Authority
AZ1	Broadmeadow River	Broadmeadow_040	Broadmeadow	08008	Y	OPW
	Ward River	Ward_030	Owen's Bridge	08004	N	FCC
	Ward River	Ward_040	Balheary	08009	N	FCC
AZ2	Sluice River	Sluice_010	Kinsaley Hall	09105	N	FCC
AZ3	Mayne River	Mayne_010	Hole in the Wall	09106	N	FCC
	Santry River	Santry_010	Cadburys	09102	Y	DCC
AZ4	Bachelors Stream/Tolka	Tolka_050	Finglas Weir	09104	N	DCC

Geographical Reference	River Name	Waterbody Id.	Station Name	Station Number	Active Y/N	Authority
	Tolka	Tolka_060	Botanic Gardens	09037	Y	DCC
	Liffey	Liffey Estuary Lower (Transitional Body)	Dublin North Wall	09064	Y	Dublin Port
	Liffey	Liffey Estuary Upper (Transitional Body)	O'More Bridge	09066	Y	Marine Institute
	Dodder	Dodder_050	Waldron's Bridge	09010	Y	DCC
	Dodder	Dodder_050	Ballsbridge	09060	N	Marine Institute

Table 18.9 EPA Water Quality Stations within the Study Area

Geographical Reference	River Name	EPA Code	Waterbody Id.	Station Name
AZ1	Broadmeadow	1008	Broadmeadow Water (Transitional Body)	Broadmeadow Water - WFD Reporting Station
	Broadmeadow	08B02	Broadmeadow_040	Bridge near Waterworks
	Broadmeadow	-	Broadmeadow_040	Bridge West of Lissen Hall
	Ward	08W01	Ward_040	Bridge downstream Scotchstone Bridge
AZ3	Mayne	09M03	Mayne_010	'Hole-in-the-Wall' Road Bridge
	Santry	09S01	Santry_010	Clonshaugh Road Bridge
AZ4	Bachelors Stream	09B14	Tolka_050	Tolka River at Violet Hill Drive, Finglas
	Tolka	09T01	Tolka_060	Footbridge Griffith Park
	Liffey	-	Liffey Estuary Upper (Transitional Body)	Liffey Estuary Upper - WFD Reporting Station
	Liffey	-	Liffey Estuary Lower (Transitional Body)	Liffey Estuary Lower - WFD Reporting Station
	Poddle	09P03	Poddle_010	The Priory, Kimmage Road
	Dodder	09D01	Dodder_050	Footbridge, Beaver Row

Note: EPA (2021) active quality stations at the rivers that cross the proposed Project alignment.

Figure 18.1 presents the proposed route in the context of the current surface water drainage network and EPA sub-catchment delineation (EPA, 2021). Active EPA monitoring stations are also presented in Figure 18.2.

18.4.3 Hydrological Drainage Features along the Project Alignment

As indicated in Section 18.4.2 above, there are a number of surface water features (some with tributaries) within the overall study area of which the main identified features, from north to south, include the following:

- Ballyboghil River;
- Turvey Stream;
- Staffordstown Stream;
- Broadmeadow River and its tributaries;
- Ward River;
- Gaybrook River;

- Gaybrook Stream (North);
- Sluice River;
- Cuckoo Stream;
- Mayne River;
- Santry River;
- Tolka River;
- Royal Canal;
- River Liffey;
- St Stephen's Green ponds (and connectivity with the Grand Canal);
- Grand Canal (at Grand Parade);
- Poddle River;
- Dodder River; and
- Other named/unnamed streams and ditches along the proposed Project alignment.

Table 18.10 below presents surface water features crossed by or in the vicinity of the proposed Project alignment (presented from north to south).

There are a number of historical watercourses across Dublin which have been culverted or infilled. While the proposed Project crosses some of these (see Diagram 18.3 below and Figures 18.3 and 18.4), there will be no interaction with the proposed Project. These watercourses will be located typically at a maximum depth of 3m below the existing surface and are sealed entities. The average tunnel depth for the proposed Project across Dublin is 8m to 10m below existing ground level to the crown (top) of the tunnel and therefore will not disturb or affect any of these historical watercourses.

Table 18.10 Surface Water Features Crossed by/in vicinity of the Proposed Route (North to South)

Ref.	Station /Main Construction Compound Name	Main water feature Ref.	EPA Code	Vicinity of station	Other water features	EPA Code	Vicinity of station	Station ref. (General)
AZ1	P&R Facility	Staffordstown Stream[6]	08S15	Immediate north	Lissenhall Great Stream	-	Immediate north	Estuary
		Broadmeadow River	08B02	Immediate south				
AZ1	Seatown	Ward River	08W01	West-northwest	Seapoint Stream	08S20	Northeast	Seatown-Estuary (Ward River, Broadmeadow River, Staffordstown Stream)
		Broadmeadow River	08B02	North	Greenfields Stream	08G16	Southeast/ northeast	
		Malahide Estuary	-	Northeast	Unnamed stream	-	Southeast	
AZ1	Swords Central	Swords Glebe	08S17	West	Greenfields Stream	08G16	Northeast	Swords Central-Seatown
		Ward River	08W01	Northwest				
		Gaybrook River and Gaybrook Stream (North)	08G08	South				
AZ1, AZ2	Fosterstown	Gaybrook River and Gaybrook Stream (North)	08G08	North/East	Unnamed stream	-	East	Fosterstown-Swords Central
		Swords Glebe	08S17	North	Unnamed stream	-	East	
		Sluice River	09S07	South				
AZ2	Dublin Airport	Sluice River	09S07	North	Marshallstown Stream	09M35	Northeast	Dublin Airport-Fosterstown (Sluice River)
		Cuckoo Stream	09C07	South-southeast	Unnamed stream	-		
AZ2, AZ3	Dardistown	Mayne River	09M03	East	Unnamed stream	-	North	Dardistown-Dublin Airport (Cuckoo Stream)
		Cuckoo Stream	09C07	Northeast				
AZ3	Northwood	Santry River	09S01	North	Ballymun Stream	09B98	East	Northwood-Dardistown (Santry River, Mayne River)
					Northwood drainage		West	

[6] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

Ref.	Station /Main Construction Compound Name	Main water feature Ref.	EPA Code	Vicinity of station	Other water features	EPA Code	Vicinity of station	Station ref. (General)
AZ3	Ballymun Village	Santry River	09S01	North-northeast	Ballymun Stream	09B98	North-northeast	Ballymun Village-Northwood West
AZ4	Collins Avenue Junction (DCU)	-	-	-	Bachelors Stream	09B14	West-southwest	Collins Avenue (DCU)-Ballymun
					Wad River (culverted)		East-southeast	
						-		
AZ4	Griffith Park West	Tolka River	09T01	Immediate south	Botanic Gardens	-	West-southwest	Griffith Park - Collins Avenue (DCU)
					Bachelors Stream	09B14	West-northwest	
					Claremont Stream	09C11	West-southwest	
					Wad River (culverted)	-	East	
AZ4	Glasnevin (Whitworth)	Royal Canal	-	Immediate south	-	-	-	Glasnevin (Whitworth)-Griffith Park (Royal Canal, Tolka River)
		Tolka River	09T01	North				
AZ4	Mater	Royal Canal	-	North	-	-	-	Mater-Glasnevin (Whitworth)
		River Liffey	09L01	South				
AZ4	O'Connell Street	River Liffey	09L01	South	-	-	-	O'Connell Street-Mater
AZ4	Tara Street	River Liffey	09L01	Immediate north	Stein River (culverted)	-	West-northwest	Tara Street-O'Connell Street
					Gallows Stream (culverted)		East	(River Liffey)
AZ4	St Stephen's Green	River Dodder	09D01	East	St Stephen's Green (park drainage for pond features)			St Stephen's Green-Tara Street
						-	Immediate west	
					Stein River (culverted)		East	

Ref.	Station /Main Construction Compound Name	Main water feature Ref.	EPA Code	Vicinity of station	Other water features	EPA Code	Vicinity of station	Station ref. (General)
					Gallows Stream (culverted)			
		River Poddle	09P03	West			Southwest - south	
		River Liffey	09L01	North		-		
AZ4	Charlemont	River Dodder	09D01	East-southeast	Ranelagh Gardens, Swan River (mostly culverted);		South-southwest	Charlemont-St Stephen's Green
						-		
					Stein River (culverted)		North	
		River Poddle	09P03	West-northwest				
		Grand Canal	-	Immediate north		-		

A review was undertaken of the EPA document 'Water Quality in Ireland, 2013 to 2018 ' (EPA 2019). This long-term dataset, together with field data assessment and information on fisheries, is considered below for the subdivisions into the geographical reference areas AZ1-AZ4.

18.1.1.1 AZ1 - Northern Section

18.4.3.1.1 Broadmeadow River and Ward River Confluence

The Broadmeadow River (08B02) flows into the Broadmeadow Estuary at Swords, towards the northern end of the proposed route. According to EPA biological (Q-Value) monitoring, the Broadmeadow was in poor condition throughout in 2017, indicating the river is of low water quality in areas with Station ref. RS08B020800 (Bridge near Waterworks, upstream of confluence with Ward River) assigned a Q-Value of Q3 for 2017. In 2018, Station ref: 0500 (Milltown Bridge, upstream) remained at 'Poor' (Q-3) conditions while Station ref: 0600 (WSW of Fieldstown House, upstream) improved slightly to 'Moderate' ecological conditions (Q3 to Q4).

According to the kick sampling carried out by the biodiversity specialists (see Chapter 15 (Biodiversity) of the EIAR), Q/kick-sampling provided a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. This is a lower Q-value than the EPA value. However, the EPA is a long-term dataset which is a more robust dataset. Therefore, the EPA evaluation is considered to be a better representation as it is determined on more sampling events over time.

The Ward River (08W01) is a tributary of the Broadmeadow River and flows into the Broadmeadow Estuary at Swords, County Dublin. During the latest EPA monitoring event (2017), Station ref. 0070 in the upper reaches of the Ward River improved from 'Poor' (Q3, 2014) to 'Moderate' (Q3 to Q4) ecological condition. The previous improvement at Killeek Bridge (Station ref. 0300) to 'Good' (Q4, 2014) ecological conditions has been maintained to 2017. Station ref. 0610 (Br d/s Scotchstone Br, upstream of confluence with Broadmeadow) remains at 'Poor' (Q3) ecological condition (2008-2017). According to the kick sampling carried out by the biodiversity specialists, Q/kick-sampling provided a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition, refer to Chapter 15 (Biodiversity).

In the context of water quality and ecological status, according to the IFI (2018), the Broadmeadow system supports a small population of Atlantic salmon in its lower reaches and a resident Brown trout population. Furthermore, the Ward system in the Lissenhall area supports Atlantic Salmon in addition to resident Brown trout populations. (Please refer to Chapter 15 (Biodiversity) for further details on the habitat assessment of Natura Sites 2000).

Baseline groundwater quality collected for area AZ1 – Northern Section over three monitoring rounds (2018 to 2019) included sampling of major and minor watercourses. The reported water quality results are consistent with an urban to agricultural setting with no significant issues or variation in values recorded for either of the three sampling events in 2018 to 2019. (Refer to Appendix A18.1 to A18.3 for detailed surface water quality results for the sampling points located within area AZ1).

The proposed alignment crosses directly over both the Broadmeadow River and Ward River to the west of the existing Lissenhall Bridge and Balheary Bridge. The proposed crossing is via a viaduct which spans the floodplain. The design of the viaduct span is based upon an understanding of the conveyance for the 100-year period flood event with the recommended allowance for effects of climate change in accordance with OPW requirements. Section 50 (of the Arterial Drainage Act 1945) approvals have been obtained from OPW for this crossing. Furthermore, downstream of the Viaduct, the track section enters an open cut and fall below the existing ground level. A reinforced concrete floodwall with stone cladding up to 0.85m in height is provided to prevent the ingress of flood water in the open track section. Both the wall and viaduct have been designed to accommodate the 0.1% AEP (1000-year flood event) design flow.

18.4.3.1.2 Other Named and Unnamed Streams and Ditches along the Alignment

There are a number of unnamed streams and ditches which may contain flowing or standing water depending on the conditions of the watercourse during the field sampling event. These are noted to the north and south of the Broadmeadow River in particular. The features appear to form part of local field drainage systems which drain the surrounding land to the west and generally lie beyond the study area. There are a number of drainage ditches piped beneath the R132 road in Swords which generally flow in an easterly direction taking surface water drainage from the wider Swords area. Some of these ditches are generally dry in summer months (June to August) except during periods of pronounced rainfall. Where access was not available, these watercourses are considered within this assessment through downstream sampling within the water body.

An assessment of the culverted surface water features (as above) impacted by the construction at specific sites, including at the R132, was undertaken and the findings summarised in Appendix A18.5 (Flood Risk Assessment). This report demonstrates that the design of these features and the overall proposed Project will ensure no measurable impact on the receiving waterbodies.

According to the IFI (2018), the Staffordstown Stream system to the north of the proposed Estuary Station is exceptional among most urban river systems in the area in supporting Atlantic salmon (listed under Annex II and V of the EU Habitats Directive) and Sea trout in addition to resident Brown trout populations. However, according to the biological kick sampling carried out by the ecologists, the findings provided a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition, refer to Chapter 15 (Biodiversity). The Staffordstown Stream is not presently monitored by the EPA for biological quality. The Staffordstown Stream is not crossed by the proposed alignment; however, it is proposed to discharge treated (water to be discharged through soil and grit traps) and attenuated surface water from the Park and Ride Facility at Estuary to this watercourse. The Turvey Stream is located north of the proposed Project alignment and the Park and Ride Facility. The Turvey is not crossed and will not be discharged to during the operational phase of the Project.

18.4.3.2 AZ2 - Airport Section

18.4.3.2.1 Sluice River and Tributaries

The Sluice River crosses the reference area AZ2 approximately 160m north of Dublin Airport and flows eastwards towards the Baldoyle Estuary and enters the Irish Sea at Portmarnock. Tributaries of the Sluice River include the Forrest Little Stream, Wad Stream as well as the smaller Kealy's Stream. All of these streams occur within the grounds of Dublin Airport.

The Sluice River is not presently monitored by the EPA for biological quality. However, according to the IFI (2018), the Sluice River system supports a resident population of Brown trout. Historically, as part of the consultation process for the Dublin Airport Terminal 2 EIS, the Eastern Regional Fisheries Board had identified the Sluice River as a salmonid river system (Ove ARUP, 2006). In order to be classified as a salmonid river, the EPA quality class would need to be Class B, Q3 TO Q4 (Slightly polluted) to Class A, Q4 (Unpolluted). As part of the baseline monitoring process for the Dublin Airport EIS, Kealy's Stream was also evaluated as having a Class C Q3, Q2 to Q3 (Moderately polluted) – this stream is currently not monitored by the EPA). Biological sampling undertaken at the proposed Project crossing point gave a Q-Value of Q2-3, i.e. 'Poor Status' under WFD status and 'Moderately Polluted, Unsatisfactory' under ecological pollution status and condition. Refer to Chapter 15 (Biodiversity) for further data.

The proposed alignment crosses over the Sluice River as an incline immediately north of the Naul Road L2040 and the Forrest Little Stream farther to the north, again as an incline alignment. A number of heavily overgrown road and field drains (which can often contain stagnant water as observed by AWN during sampling events) in the vicinity will likely drain ultimately to the Sluice River. The Sluice River channel has been previously culverted at road crossings including at the R132 Swords Bypass and farther east at the Cloghran Lissenhall M1 Motorway. The Sluice River and its tributaries are incorporated into three catchments along the proposed Project alignment – C2, D1 and D2 (refer Figure 18.12).

18.4.3.2.2 Cuckoo Stream

The Cuckoo Stream emanates within the grounds of Dublin Airport and flows eastwards towards the confluence with the River Mayne which ultimately discharges to Baldoyle Estuary. This feature receives drainage water from the wider airport grounds and is culverted at the R132 and farther east at the Airport M1 Motorway before flowing as predominantly open channel to the confluence with the River Mayne at Balgriffin Road.

The EPA biological status for 2013 to 2018 for this water feature is 'Poor'. According to the biological kick sampling carried out by the ecologists at this watercourse, the results classified the watercourse as a Q-Value of Q1, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. This is a slightly lower value than that provided by the EPA.

The proposed Project will be in tunnel below the course of the Cuckoo Stream at Dublin Airport.

Overall, baseline surface water quality collected for area AZ2 – Airport Section over three rounds completed in 2018-2019 included sampling of major and minor watercourses that either cross or are located within the vicinity of the proposed Project alignment. Similar to the observations above, the reported water quality results are consistent with an urban to agricultural setting with no significant issues or variation in values recorded for either of the three sampling events undertaken. (Refer to Appendix A18.1 to A18.3 for detailed surface water quality results and further discussion on same for the sampling points located within area AZ2).

18.4.3.3 AZ3 - Dardistown to Northwood

18.4.3.3.1 Mayne River

The Mayne River rises near Ballystruan south of Dublin Airport. It flows in an easterly direction immediately south of the long-term car park and Dardistown Cemetery and is culverted below the R132 and the Airport M1 Motorway. This river flows through mainly agricultural and recreational land north of the R132 Northern Cross Route Extension before its confluence with its tributary, the Cuckoo Stream, and ultimately discharges to Baldoyle Estuary and the Irish Sea at Mayne Bridge between Baldoyle and Portmarnock.

The EPA monitoring station for the Mayne River is the RS09M030500 (Wellfield Bridge) located at Hole-in-the-Wall Road Bridge and down-gradient of the Mayne confluence with the Cuckoo Stream. According to the most recent quality results obtained by the EPA (i.e. to 2019), ecological conditions at Wellfield Bridge (0500) remain 'Poor' (Q2-3) with an impoverished pollution-tolerant fauna evident in low numbers. This quality rating has remained unchanged since 2013. The EPA monitoring station for the Mayne River is the RS09M030500 (Wellfield Bridge). According to the IFI (2018), while the Cuckoo Stream and Mayne Rivers are a non-salmonid system, the IFI is currently assessing the viability of a salmonid re-introduction programme. According to the kick sampling collected by The biodiversity specialists within the Mayne River, sampling undertaken at the Project crossing point gave a Q-Value of Q1, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition.

The proposed Project passes to the west of the Mayne River at surface level before returning to tunnel alignment at Portal 2 to the north-east and immediately south of Collinstown Lane (L2015). There is however an existing watercourse (tributary) flowing from beyond the Naul Road/South Parallel Road farther to the west (refer to Appendix A18.5) which, together with other small drainage ditches, feeds into the Mayne River farther to the east.

A number of (heavily) overgrown access lane and field-drains are also found in the general area near the Mayne River at the proposed Dardistown depot. These features can often contain both flowing and stagnant water based on field observations by AWN at the time of monitoring, and under sufficient head will ultimately drain to the Mayne River. The tunnel alignment in this area (immediately north of Portal 2) also crosses a heavily overgrown ditch at Collinstown Lane (L2015) which was observed to contain some standing to very low flowing surface water during field monitoring.

18.4.3.3.2 Santry River

The Santry River rises near Harristown to the east of the R122. The river flows in a south-easterly direction through Sillogue Park Public Golf Course before being culverted to the immediate west of the M50 interchange with the Naul Road/Ballymun Road at Ballymun. It continues in a south-easterly direction as predominantly open channel flowing through Santry Demesne, Clonshaugh, Coolock and Raheny before discharging to Dublin Bay (via North Bull Island) near Watermill Road.

According to EPA biological (Q-Value) monitoring, the ecological conditions at Station ref. RS09S010300 i.e. Clonshaugh Road Bridge remain 'Poor' (Q2 to Q3) to 2019, declining very slightly on 2016 (Q3) results. The Santry River is non salmonid according to the IFI, (2018). The biodiversity specialists collected kick samples at this watercourse where the proposed Project crossed this waterbody. Q/kick-sampling gave a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. This is in line with the EPA classification for the Santry River.

The proposed Project crosses directly over the Santry River to the immediate east of the M50 interchange with the Naul Road/Ballymun Road at incline alignment, and north (300m) of the Northwood Portal and Northwood Station.

Overall, baseline groundwater quality collected for area AZ3 – Dardistown to Northwood over three rounds completed between 2018 to 2019 included sampling of major and minor watercourses that either cross or are located within the vicinity of the proposed Project alignment. Similar to the observations above, the reported water quality results are consistent with an urban setting with no significant issues or variation in values recorded for either of the three sampling events undertaken. (Refer to Appendix A18.1 to A18.3 for further surface water quality results and discussion for the sampling points located within area AZ3).

18.4.3.4 AZ4 - Northwood to Charlemont

18.4.3.4.1 Tolka River

The Tolka River rises in County Meath in an area 12km northwest of Dunboyne. The river flows in a south-easterly direction along with a number of tributaries, through agricultural land until it reaches the Fingal County Council (FCC) boundary at Clonee. From here, it flows east to south-east through Mulhuddart and Blanchardstown into Finglas and continues to flow through the urban areas of the Tolka Valley Park, Botanic Gardens, Griffith Park and Fairview Park before discharging to the Irish Sea at the Tolka Estuary near East Wall Road.

According to the current EPA biological (Q-Value) monitoring, the ecological conditions at Station reference RS09T011100, i.e. Tolka River at Violet Hill Drive, Finglas is 'Poor' 2019 (Q3). In July 2019, the uppermost station (RS09T010300) declined to 'Poor' (Q3) ecological conditions from 'Moderate' conditions in 2016 (Q3 TO Q4) and was dominated by pollution tolerant taxa. In contrast, Station RS09T010600 (Dunboyne Road Bridge D/S Clonee) improved to 'Moderate' while the assessed quality for Station reference RS09T010800 (Mulhuddart Bridge), RS09T011000 (Abbotstown Bridge) and RS09T011100 (Violet Hill Drive, Finglas) all remained 'Poor'. The biodiversity specialists collected Q/kick-samples at the proposed Project crossing point. These samples classified the waterbody with a Q-Value of Q2-3, i.e. 'Poor Status' under WFD status and 'Moderately Polluted, Unsatisfactory' under ecological pollution status and condition.

According to the IFI (2018), the Tolka River can support Atlantic salmon, Lamprey and Brown trout populations in addition to other fish species and provides a particularly important nursery function for salmonid species throughout. (Salmon were recorded in the Glasnevin area in 2011.)

The proposed route crosses beneath the Tolka River at St Mobhi Road, east of the Botanical Gardens, in tunnel.

18.4.3.4.2 Other Named and Unnamed Water Features along the Alignment

The Wad River and Wad Diversion pass to the east of both proposed stations at DCU (Collins Avenue) and Griffith Park farther south. The Wad Diversion is a flow diversion from the Wad River to the Tolka River. It is understood the diversion alignment consists of three large pipes (an old 900mm diameter pipe, a 1,200mm diameter pipe and 1,400mm diameter pipe). There is also likely to be a large underground chamber to accommodate this diversion. It appears to be a significant piece of flood alleviation infrastructure in the area that will likely be impacted by the construction of Griffith Park West station but also by proposed works for the station at DCU Collins Avenue Junction.

An assessment of the utilities impacted by the construction at specific sites (including the Wad River and Diversion) was undertaken and the findings summarised in Chapter 5 (MetroLink Construction Phase) Appendix A5.11 (Water Management), as discussed above under Section 18.4.3.1.

18.4.3.4.3 Royal Canal

The Royal Canal is a man-made waterway between the River Shannon in Longford and the River Liffey in Dublin. This water feature is generally navigable between the River Shannon and Dublin and is of important tourist and amenity value. The canal is also a proposed Natural Heritage Area (pNHA), site code: 002103 (NPWS, 2020). Proposed NHAs (pNHAs), which were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. These sites are of significance for wildlife and habitats. The importance of these designations are further discussed in Chapter 15 (Biodiversity) of this EIAR.

Canals are required to achieve good ecological potential rather than good ecological status, because they are artificial water bodies. Ecological potential can be maximum, good, moderate, poor or bad (EPA, 2019). Together with the Grand Canal (see below) the recent EPA assessment of the canals using macro-invertebrates indicates good biological conditions in the Royal Canal. (Note: For both the Royal Canal and Grand Canal, approximately 41% of sites (17) are classified at maximum ecological potential, and 48.8% (20) are achieving good potential. Furthermore, the majority of sites (95%) for both canals were compliant with the physico-chemical and microbiological water quality standards – see also details under Grand Canal below).

The results for the Royal Canal were positive and the feature was classified as 'Good' in terms of macrophyte assessment (refer to Grand Canal for overall ecological potential assessed to date). However, 35 out of the 38 total sites [for both the Royal Canal and Grand Canal] had to be downgraded from maximum to good due to the presence of the invasive aquatic plant Nuttall's pondweed. When assessed for hydro-morphology, generally all Royal Canal sites were at maximum ecological potential. No kick sampling was carried out on this watercourse as the proposed Project will be tunnelled under this watercourse.

According to the IFI (2018), both the Royal Canal and the Grand Canal support significant populations of coarse fish including a range of other freshwater aquatic species, plus all associated floral and faunal components in adjacent habitats.

The proposed route crosses beneath the Royal Canal to the immediate west of Prospect Road south-west of Hart's Corner, Glasnevin, in tunnel.

18.4.3.4.4 River Liffey

The River Liffey rises in the Wicklow Mountains approximately 20km to the south of Dublin and flows to the west of Naas in Kildare through Dublin City and ultimately discharges into Dublin Bay at Dublin Port.

According to EPA monitoring, the water quality in the River Liffey in 2019 was generally similar to 2016 i.e. generally satisfactory.

Ecological conditions were reported by the EPA to be satisfactory (Q4) at the majority (14) of the 16 stations surveyed on the River Liffey in 2019. Satisfactory ecological conditions were maintained in the upper reaches (Station ref. RS09L010100, RS09L010200, RS09L010250). Station ref. RS09L010400 and RS09L010500 (Ballymore Eustace) improved for the first time since 1991 and 2010, respectively. At both stations RS09L010700 (Kilcullen) and RS09L010850 (Connell Ford) 'High' (Q5, Q4 to Q5) ecological conditions were noted, despite obvious signs of nutrient enrichment (and excess filamentous algae), which represented an improvement since 2016. Similarly, Station reference RS09L011200 (Castlekeely Ford (RHS)) improved from 'Moderate' to 'Good'. However, the EPA advised a note of caution regarding this particular recovery as there were still signs of nutrient pressure with significant amounts of filamentous algae. In contrast, the macro-invertebrate community indicated a decline at both station RS09L012100 (Lucan) which dropped from 'Good' (Q4, 2016) to 'Moderate' (Q3 to Q4, 2019) and Station reference RS09L012360 (0.2km d/s Chapelizod Bridge (Lynch's Lane)) which dropped to 'Poor' (Q3) ecological conditions. Sewage fungus and *Chironomus sp*. were found at this particular site. The River Liffey at Islandbridge (RS09L012400) located >3.5km to the west of the proposed route is classified as Q3, 'Moderately Polluted'. No kick sampling was carried out on this watercourse as the proposed Project will be tunnelled under this watercourse.

According to the IFI (2018), the River Liffey system supports a regionally significant population of Atlantic salmon. The Liffey Estuary also serves as the natural linkage for species such as Salmon, Sea trout and Eels migrating between freshwater and ocean environments, providing the necessary habitat for their transition. Previous surveys in Dublin City area of the River Liffey have recorded Eel and River Lamprey.

The proposed route crosses beneath the River Liffey in Dublin City Centre at George's Quay to the south and Eden Quay to the north, in tunnel.

18.4.3.4.5 St Stephen's Green Ponds

Communication with the OPW (January 2021) confirms that the ponds (lakes) in St Stephen's Green are connected via a 300mm (12") diameter cast iron watermain to Grand Canal (Portobello Basin) below Lower Mount Street. Review of OPW data also indicates that the main fountain within the Green is fed by a hydrant, with manholes present within the grassed areas and 'drain lines' (laid c. 1851) from the lakes running across the eastern extent of the Green towards the south-eastern corner near the junction with Earlsfort Terrace and Leeson Street (this may suggest that the eastern part of the Green was also historically the wetter part of the overall Green perimeter). The OPW has confirmed the presence of two outflows from the Green, namely at the east side to Mount Street and on the north side of the park to a DCC main.

Communication with the OPW (27/05/2021) confirms there is no data on water quality for the ponds at St Stephen's Green. However, given the virtually stagnant conditions observed to date the shallow depth of the water and the significant waterfowl population (mostly mallard duck) at these features, the water is likely to have high bacterial and organic loading from faecal material. The ponds are therefore described as artificial or 'highly modified habitats' with low species diversity.

With regard to the St Stephen's Green ponds, the proposed route crosses beneath St Stephen's Green East in Dublin City Centre, in tunnel and cut and cover station.

18.4.3.4.6 Grand Canal (at Grand Parade)

The Grand Canal is a 132km long man-made waterway, the main line of which is between the River Shannon at Shannon Harbour in County Offaly and the River Liffey in Dublin. There are three branch lines: the Barrow Line (45km) which runs south from Lowtown in County Kildare to join the River Barrow in Athy; the Naas Branch, which is navigable to Naas Harbour (2 miles); and the Kilbeggan Branch. The proposed alignment crosses beneath the Grand Canal at Grand Parade (location of the proposed Charlemont Station).

Together with the Royal Canal (see above) the recent EPA (2019) assessment of the canals using macro-invertebrates indicates good biological conditions in the Grand Canal. The only sites failing to reach the water quality standard are both located at the Grand Canal Basin in Dublin: one is failing because of high levels of faecal coliforms and the other because of high levels of ammonia.

The results for the Grand Canal were positive and the feature was classified as Good in terms of macrophyte assessment. However, 35 out of the 38 total sites (for both the Grand Canal and Royal Canal) had to be downgraded from maximum to good due to the presence of the invasive aquatic plant Nuttall's pondweed. (Refer also to Royal Canal above for detail on aquatic species according to IFI, 2018.) When assessed for hydro-morphology, generally all Grand Canal sites were at maximum ecological potential. No biological kick sampling was carried out on this watercourse as the proposed Project will be tunnelled under this feature.

According to the EPA (2019) Report on Water Quality in Ireland, 2013 to 2018 overall, the ecological potential of both canal systems has remained unchanged since the 2013 to 2015 period with 13 of the 14 sampling points in the Grand Canal and Royal Canal systems achieving good ecological potential.

The proposed route crosses beneath the Grand Canal at the R111 road, Grand Parade in Ranelagh, in tunnel.

18.4.3.4.7 River Dodder

The River Dodder has its source in the Dublin Mountains. Steep elevations dominate in the upper reaches of this surface water feature as its course descends rapidly towards Old Bawn in the south-west of County Dublin. The river is located in a sloped valley along the majority of its middle and upper reaches which is less pronounced in its lower sections as it flows through Dublin eventually discharging via the River Liffey to Dublin Bay.

According to the EPA Report on Water Quality in Ireland, 2013 to 2018, 'Satisfactory' ecological conditions continue in the upper reaches (Station ref. RS09D010010 1.3km upstream Reservoir, RS09D011000 at Ballsbridge) with the diversity of pollution-sensitive macro-invertebrates indicating a return to 'High' ecological conditions upstream of the Reservoir (Station ref. RS09D010010). The EPA acknowledged the improvement to 'Good' (Q4) ecological conditions as noted for Old Bawn Bridge (Station ref. RS09D010300) in August 2019, after a decline in 2016. Station reference RS09D010620

(Bridge on Springfield Ave) also improved slightly to 'Moderate' (Q3 to Q4) quality, while the lowest station at Beavor Row, Footbridge (RS09D010900) remained at 'Moderate' (Q3 to Q4).

According to the IFI (2018), the River Dodder is also exceptional among most urban rivers in the area in supporting Atlantic salmon and Sea trout in addition to resident Brown trout. The sections from Herbert Park in Ballsbridge to Beaver Row in Donnybrook are regarded as prolific trout fishery waters. Fishery habitat is regarded as particularly good for all salmonid life stages throughout the Dodder system. No biological kick sampling was carried out on this watercourse as the proposed Project does not cross it or discharge to it, therefore it cannot alter the existing condition of the watercourse. However, there is an indirect link to the River Dodder via the Swan River which discharges into the River Dodder.

18.4.3.4.8 Other Named/Unnamed Water Features along the Alignment

The Grand Canal Drainage Tunnel (constructed c. 1978) runs beneath the R111 road immediately south of the Grand Canal, including at Grand Parade (near the proposed Charlemont Station). This is a combined 3,600mm diameter concrete surface water and foul sewer buried beneath the R111 road by the canal. The drainage tunnel extends from Dolphin's Barn and discharges to Grand Canal Dock with eventual outfall to the River Liffey. The tunnel also receives surface water from the nearby (predominantly culverted) Swan River via a c. 5' 6" diameter spur tunnel to this culverted watercourse (i.e. the Swan River storm relief sewer).

The Stein River is a culverted watercourse that is traversed by the proposed Project including at the proposed station locations for Tara Street and St Stephen's Green (at the junction with Earlsfort Terrace). The Gallows Stream is also a culverted, historical watercourse which flows to the east of both St Stephen's Green and Tara Stations but is not directly traversed by the tunnel alignment. The orientation of the Gallows Stream is observed to cross beneath Trinity College (see further detail below) and the invert of the ~3m wide culvert is approximately 3m below ground level. Similar to the Wad River and the Swan River, the Stein River and Gallows Stream are not included in the EPA (2022) river networks dataset, due largely to the features flowing underground. It is noted that the tunnel will not impact either of these culverted watercourses as the tunnel crown alignment is at an average depth of 6m below existing ground level, therefore, beneath these culverted features. The assumed maximum depth of these culverts is 3m below the existing surface level.

Overall, baseline surface water quality collected for area AZ4 – Northwood to Charlemont over three rounds undertaken between 2018-2019 included sampling of major and minor watercourses that either cross or are located within the vicinity of the proposed Project alignment. Similar to the observations above, the reported water quality results are consistent with an urban to agricultural setting with no significant issues or variation in values recorded for either of the three sampling events completed. (Refer to Appendix A18.1 to A18.3 for further surface water quality results and discussion for the sampling points located within area AZ4.)

18.4.4 Historical Rivers and Hidden Rivers

There are a number of historical watercourses running through Dublin City in particular, most of which are culverted or partially culverted, for example the Swan River flowing from west of the proposed Charlemont Station but not intercepted by this station location. Diagram 18.3 below presents a view of the historical rivers within Dublin City and environs; the watercourses (green linear features) are shown in the context of the proposed alignment. Diagram 18.4 presents an additional map of the rivers of Dublin north of the River Liffey with the townlands shown from the Santry River in the north to the Royal Canal in the south.

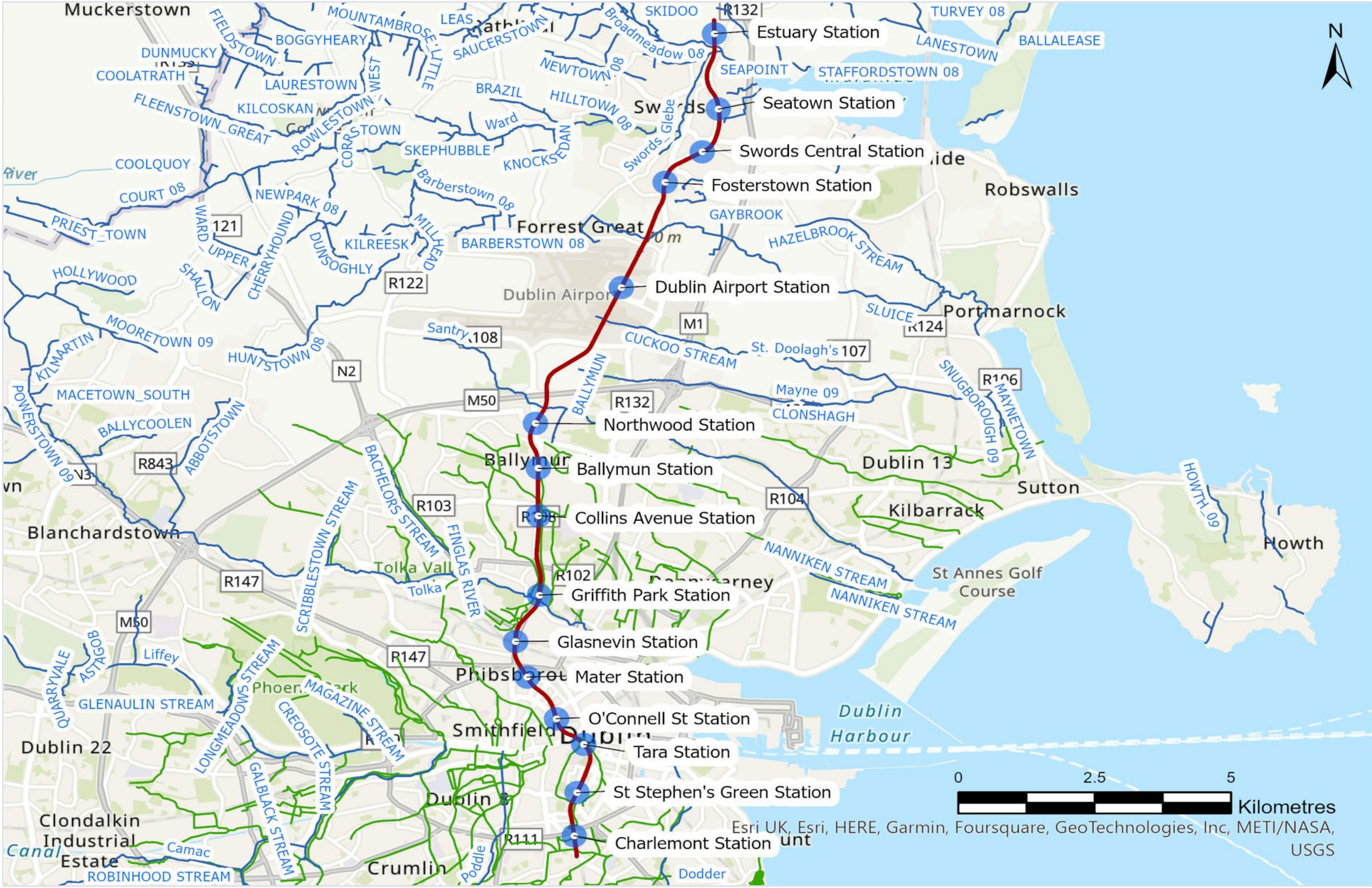

Diagram 18.3 Historical Rivers – Dublin City & Environs

Note: Historical rivers in green; EPA (2020) rivers in blue. (Source: Jacobs GIS, ESRi)

Diagram 18.4 Historical Rivers – Dublin (Santry to Royal Canal)

(Source: Environmental Impact Statement for Old Metro North, RPA, 2008; Sweeney, 1991)

The proposed alignment (indicated as blue in Diagram 18.4) for this area has been superimposed to add context to the image in terms of the Project and the surface water features in the vicinity of same. Diagram 18.4 indicates that the proposed tunnel alignment crosses at depth below key watercourses including (from south to north) the Tolka River, Claremont Stream, Hampstead Stream, Wad Diversion, Wad River, and the Santry River. Table 18.10 below indicates the approximate depth of the crown of the tunnel beneath the riverbeds crossed. The hidden rivers are not included as these are historically sealed entities (i.e. culverted) from the urban city development. The assumed maximum depth of these culverts is 3m below the existing surface.

For example, investigations undertaken in October/November 2021 in Trinity College Dublin (TCD) uncovered an old existing culvert - foundations of the 1875 Anatomy Building annex and a culverted stream with limestone wall surviving on western side. The depth of the (~3m wide) culvert is approximately 3m below ground level and full of large limestone blocks and water. According to The Rivers of Dublin (Sweeney, 1991), this culvert is historically shown to discharge to/or form part of the Gallows Stream which flows beneath the eastern part of TCD and to the east of the proposed Tara Station. This watercourse then discharges into the River Liffey.

18.4.5 Surface Watercourses and Groundwater Interaction

Chapter 19 (Hydrogeology), Section 19.4.14, provides an assessment of the groundwater baseflow contribution to rivers within the area of the proposed Project. Although variability will occur, in general, as these aquifers are classified as 'Poorly Productive' (following GSI's aquifer classification), they provide little groundwater for water supply or for baseflow to surface water bodies.

Table 18.11 below summarises the key hydrological attributes along the proposed alignment and includes a brief description of the setting of that respective watercourse in terms of local hydrogeology and potential for connectivity with the underlying water-bearing overburden strata and, or bedrock.

In summary, based on a review of the local hydrogeological setting for each of the features identified, the main watercourses crossed by the proposed Project where there is potential hydraulic connectivity as baseflow with water-bearing strata and, or the underlying bedrock, include the Broadmeadow River, Ward River, Sluice River, Forrest Little Stream and the River Liffey, with potential for connectivity also at the Tolka River.

Table 18.11 Depth to Crown of Tunnel beneath Hydrological Features with Geological Context

Ref.	Waterbody Name	Location with regard to Proposed Route	Approx. Chainage	Geology at/near Feature Crossing Point	Depth from riverbed to crown (top) of tunnel (approx. metres)	Summary Description/Comments
AZ1	Turvey Stream	North of P&R Facility	NE of ch:1+000	QBR over QTR/CMUP bedrock	Not crossed	This waterbody is located to the north/north-east of the route. Watercourse likely set in (undifferentiated) alluvium/low permeable limestone tills, poorly drained.
	Staffordstown Stream[7]	North of P&R Facility	NE of ch:1+000	QBR over QTR/CMUP bedrock	Not crossed	This waterbody is located to the north/north-east of the route with proposed treated and attenuated surface water discharged to it from the P&R Facility. Watercourse likely set in (undifferentiated) alluvium/low permeable limestone tills, poorly drained.
	Lissenhall Great Stream	North/north-east of P&R Facility	NE of ch:1+000	QBR over QTR/CMUP bedrock	Not crossed	Tributary of the Staffordstown Stream; east of proposed Project, >250m NE of [above ground] tracks. Watercourse likely set in [relatively thin] low permeable limestone tills, poorly drained subsoils.
	Broadmeadow River	Between Estuary and Seatown stations	1+540	QBR over QTR/CMUP bedrock	Crossed over Ground - culverted	Proposed alignment crosses directly over both the Broadmeadow River and Ward River to the west of the existing Lissenhall Bridge and Balheary Bridge; crossing is above ground level i,e a spanning viaduct. Watercourse likely set in/connected to (undifferentiated) alluvium over boulder clay (1.00-6.00mBGL).
	Ward River	Between Estuary and Seatown stations	1+640	QBR over QTR/CMUP bedrock	Crossed over Ground - culverted	See above comment on proposed Ward River crossing. Watercourse shown as set in (Made Ground -undefined) (GSI, 2020) however the feature is underlain by/connected to alluvium and gravels near the confluence with the Broadmeadow River.
	Seapoint Stream	North-east of Seatown	2+540	Qx over QBR/CMUP bedrock	Not crossed	Minor watercourse is not crossed directly by proposed route. Watercourse is likely fully culverted from Mantua to Malahide Estuary discharge point. Geological setting indicated by GSI as predominantly made ground overlying Irish Sea Till derived from Limestones.
	Greenfields Stream	East of Seatown station	3+040	Qx over QBR/CMUP bedrock	Not crossed	Watercourse is not crossed directly by proposed route; headwaters likely culverted. This stream flows directly to Malahide Estuary. Geological setting

[7] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

Ref.	Waterbody Name	Location with regard to Proposed Route	Approx. Chainage	Geology at/near Feature Crossing Point	Depth from riverbed to crown (top) of tunnel (approx. metres)	Summary Description/Comments
						indicated by GSI as predominantly made ground overlying low permeable Till derived from Limestones.
	Swords Glebe	West of Swords Central station	3+840	Qx over QBL/CMLO bedrock	Not crossed	Tributary of the Ward River and is not crossed directly by the proposed route. Geological setting is predominantly low permeable Tills with occasional superficial lacustrine deposits.
	Gaybrook River	East of Fosterstown and Swords Central Stations	4+780	Qx over QBL/CMLO bedrock	Not crossed	Feature is not crossed directly by the proposed route. Geological setting at watercourse near station is predominantly low permeable Till (black boulder clay) derived from Limestones.
	Gaybrook Stream (North)	East Swords Central Station	5+146	Qx over QBL/CMLO bedrock	Crossed over Ground – culverted.	Feature is crossed directly by the proposed route via cut and cover tunnel. Geological setting at watercourse near station is predominantly low permeable Till (black boulder clay) derived from Limestones.
	Sluice River/Forrest Little Stream	Between Fosterstown and Dublin Airport stations	5+960/5+770	Qx over QBL/CMUP bedrock	Crossed over ground - culverted	The Sluice River and its tributary Forrest Little Stream (to the north of the Sluice) are both crossed directly by the proposed route, north of the Naul Road. Geological setting (with connectivity) at both watercourses is alluvium and gravels underlain by predominantly [regional] low permeable Till (black boulder clay) derived from Limestones.
AZ2	Marshallstown Stream/Commons East	Between Fosterstown and Dublin Airport stations	5+740	Qx over QBL/CMUP bedrock	Not crossed	Tributaries of the Sluice River; both are not crossed directly by the proposed route.
	Cuckoo Stream	South-east of Dublin Airport	7+770	Qx over QBL/CTO bedrock	Not crossed	The open section is not crossed directly by the proposed route however the tunnel alignment may cross beneath culverted sections of this watercourse within the airport grounds. Geological setting is low permeable Tills.
AZ3	Mayne River	Between Dublin Airport and	8+960	Qx over QBL/CTO bedrock	Channel will be diverted	Headwaters of the Mayne River are directly crossed by proposed depot footprint and surface track alignment. Geological setting is low permeable Tills.

Ref.	Waterbody Name	Location with regard to Proposed Route	Approx. Chainage	Geology at/near Feature Crossing Point	Depth from riverbed to crown (top) of tunnel (approx. metres)	Summary Description/Comments
		Dardistown stations				
	Santry River	Between Dardistown and Northwood stations	9+980	Qx over QBR & QBL/CLU bedrock	Crossed over ground	Proposed route crosses directly over the Santry River to the immediate east of the M50 interchange with the Naul Road/Ballymun Road at incline alignment. Geological setting is low permeable Tills.
AZ4	Bachelors Stream	West/south-west of Collins Avenue Junction (DCU)	13+160	Qx over QBR/CLU bedrock	Not crossed	Tributary of the Tolka River and is not crossed directly by the proposed route. Geological setting is alluvium over low permeable Tills.
	Tolka River	Between Griffith Park and Glasnevin stations	13+920	QBR/CLU bedrock	6m	The proposed route crosses beneath the Tolka River at St Mobhi Road in tunnel. Geological setting is alluvium (connectivity) underlain by [possibly thin sequence] low permeable Tills.
	Royal Canal	Between Glasnevin and Mater Hospital stations	14+950	Qx over QBR/CLU bedrock	Canal feature is an historically sealed entity	The proposed route crosses beneath the Royal Canal in tunnel. Geological setting is low permeable Tills (thick sequence).
	River Liffey	Between O'Connell Street and Tara stations	17+200	Qx over QAG/CLU bedrock	8m	The proposed route crosses beneath the River Liffey in tunnel. Geological setting is predominantly alluvium with variable permeability which sits upon the Calp Limestone.
	Grand Canal	Between St Stephen's Green and Charlemont stations	19+250	Qx over QBR/CLU bedrock	Canal feature is an historicall	The proposed route crosses beneath the Grand Canal in tunnel. Geological setting is low permeable Tills.

Ref.	Waterbody Name	Location with regard to Proposed Route	Approx. Chainage	Geology at/near Feature Crossing Point	Depth from riverbed to crown (top) of tunnel (approx. metres)	Summary Description/Comments
					y sealed entity	
	River Dodder	East of Charlemont station	19+340	Qx over QBR/CLU bedrock	Not crossed	The Dodder is not crossed directly by the proposed route. Geological setting is alluvium and low permeable Tills.
	River Poddle	West of Charlemont station	19+720	Qx over QBR/CLU bedrock	Not crossed	The Poddle is not crossed directly by the proposed route. Geological setting is low permeable Tills.

18.4.6 Special Areas of Conservation and Special Protection Areas

There are 24 Special Areas of Conservation (SAC), or Special Protection Areas (SPA) designated under European directives located within c. 15km of the proposed Project. These are discussed in more detail in Chapter 15 (Biodiversity) in terms of distance to the proposed Project, reasons for designation and zone of influences. These European sites are valued as being of International Importance.

European Sites in the vicinity of the proposed Project are detailed in the Natura Impact Statement (NIS) for the proposed Project, completed and presented by Scott Cawley (2020) under separate cover. Ten of these designated sites (Malahide Estuary SAC and SPA, North Dublin Bay SAC, North Bull Island SPA, Baldoyle Bay SAC and SPA, South Dublin Bay SAC, South Dublin Bay and River Tolka Estuary SPA, Rogerstown Estuary SAC and SPA) are also RAMSAR sites, under the Ramsar Convention (Ramsar site 833, 406, 413, 832 and 412, respectively). Malahide Estuary SAC and SPA, North Dublin Bay SAC and North Bull Island SPA are marine protected areas (MPA) under the OSPAR Convention - i.e. Malahide Estuary MPA (O-IE-0002967) and North Dublin Bay MPA (O-IE-0002968).

The proposed Project does not overlap directly with any European site however, there is an indirect pathway through the watercourses. The nearest European site is Malahide Estuary SAC, which is located c. 380m downstream of the proposed crossing point on the Broadmeadow River. This is followed by Malahide Estuary SPA, which is located c. 765m downstream of the proposed crossing point on the Broadmeadow River. Staffordstown Stream which also flows into Broadmeadow Water which is a transitional waterbody. These European Sites are located within this transitional waterbody.

Baldoyle Bay SAC and Baldoyle Bay SPA are located c. 8.4km downstream of the proposed crossing point on the Sluice River. The Cuckoo Stream and Mayne River, which are both crossed by the proposed Project, also flow into the Mayne transitional waterbody within which these European sites are located.

There are four European sites located in Dublin Bay that are downstream of five proposed watercourse crossing points of the proposed Project, i.e. on the Santry River, Tolka River, Royal Canal, River Liffey and Grand Canal. These European sites are: North Dublin Bay SAC, South Dublin Bay SAC, North Bull Island SPA and South Dublin Bay and River Tolka SPA.

The Rye Water Valley/Carton SAC is located within the same groundwater catchment as the proposed underground section of the alignment of the proposed Project. However, this SAC site is located upgradient from the project alignment and is located approx. 13km west of the project area.

18.4.6.1 Natural Heritage Areas and Proposed Natural Heritage Areas

NHAs are designations under Section 16 of the Wildlife Acts to protect habitats, species or geology of national importance.

In addition to NHAs there are pNHAs, which are also sites of significance for wildlife and habitats and were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. PNHAs are offered protection in the interim period under the county or city development plans which requires that planning authorities give due regard to their protection in planning policies and decisions.

Many of the pNHA sites, and some of the NHAs, in Ireland overlap with the boundaries of European sites.

The proposed Project is located near to:

- Malahide Estuary pNHA, which are located downstream of the proposed crossing points at the Broadmeadow River, Ward River and Staffordstown stream;
- Baldoyle Bay pNHA, which are located downstream of the proposed crossing points at the Sluice River, Cuckoo stream and Mayne River;
- Santry Demesne pNHA, which is located downstream of the proposed crossing point at the Santry River;

- Royal Canal pNHA, which is at a proposed crossing point; and
- Grand Canal pNHA, which is at a proposed crossing point.

18.4.7 Water Body Status and WFD Risk Score

The key water features listed in Section 18.4.3 above and located along or within close proximity to the proposed Project are classified according to their most recent WFD River Body Status The status and risk score are established based on a number of key characteristics including biotic sampling (such as kick sampling) and water quality sampling undertaken by the relevant bodies. The results of the sampling and analysis of trended data are used to determine the status and risk of the particular waterbody.

The EPA has classified the status and risk score of the natural streams of interest for the period 2013 to 2018 based on the WFD guidance. The available results are summarised in Table 18.12 below.

Table 18.12 Water Body Status and WFD Risk Score (EPA, 2022)

Geographical Reference	Water Surface body	EU Water Body Code	EPA Status/Period for Classification	WFD Risk Score
AZ1	Broadmeadow River	IE_EA_08B020800 (Broadmeadow)	Poor/2013 to 2018	At risk
	Ward River	IE_EA_08W010610 (Ward)	Poor/2013 to 2018	At risk
AZ2	Sluice River	IE_EA_09S071100	Poor/2013 to 2018	Under review
AZ3	Mayne River	IE_EA_09M030500	Poor/2013 to 2018	At risk
	Santry River	IE_EA_09S010300	Poor/2013 to 2018	At risk
AZ4	Tolka River	IE_EA_09T011150	Poor to Moderate/2013 to 2018	At risk
	River Liffey	IE_EA_09L012360 (River Liffey Lower) IE_EA_09L010400 (River Liffey Upper)	Moderate/2013 to 2018	At risk

18.4.7.1 Areas for Action for the River Basin Management Plan for Ireland 2018 – 2021

The River Basin Management Plan (RBMP) for Ireland 2018 – 2021 sets out measures and priorities aimed at ensuring its implementation over four years will achieve objectives of the EU Water Framework Directive (Waters and Communities, 2020). To support these objectives the catchment characterisation work undertaken by the EPA has informed criteria for prioritisation for this cycle of river basin management planning, these are:

- Ensure full compliance with relevant existing EU legislation;
- Prevent deterioration of ecological status;
- Meet the specific water-related objectives required for protected areas;
- Specifically protect and restore our high-status objective water bodies;
- Prioritise catchment areas for action that facilitates: (i) the targeting of water bodies where evidence suggests they could achieve status improvements during this cycle, and (ii) the progression of pilots in sub-catchments with more complex issues that require multi-disciplinary and cross-agency approaches; and
- Work to improve our knowledge and understanding of hydro-morphology and barriers as pressures impacting on water quality, including the identification of the scale of these issues; build the expertise necessary to address these issues.

The creation of the Local Authority Waters Programme the expansion of the initial programme in 2018 under the current RBMP and is a shared service working with Local Authorities and state agencies to develop and implement RBMPs in Ireland, as required under the EU Water Framework Directive.

Water bodies identified as being 'At Risk' of not achieving their environmental objectives need to have targeted measures implemented to achieve objectives under this Plan. The manner and the timeframe in which these targeted measures are implemented need to be prioritised to take account of the finite resources available and of the time and resources needed to develop appropriate measures.

During the development of this Plan, a prioritisation exercise was undertaken by the local authorities, the EPA and other stakeholders to identify those water bodies that require immediate action within this plan cycle to 2021. During the catchment characterisation, the EPA identified those water bodies either 'At Risk' of not achieving their objectives or 'Under Review'. The outcome of this prioritisation process was the selection of 190 Areas for Action across the 5 Local Authority regions. Within these 190 areas, a total of 726 water bodies were selected for initial actions during this RBMP cycle. There are 832 water bodies identified as being 'At Risk' of not achieving their environmental objectives under this Plan that have not been included in the Areas for Action. For most of these water bodies, targeted actions will be undertaken in the third cycle RBMP from 2022-2027. The draft 3rd cycle RBMP has been reviewed in the context of ensuring mitigation measures comply with current and expected future measures required to be implemented for protection of water body status within the context of the proposed Project.

For the proposed Project, there are a number of water bodies that fall into the Moderate to Poor/At Risk status for waterbodies, and where there are areas for action identified within the 2nd RBMP/draft 3rd RBMP. Refer to Table 18.15 below. These include the following relevant to the proposed Project:

- AZ1 - Northern Section: Broadmeadow River, Ward River;
- AZ2 - Airport Section: No Rivers Identified for Action;
- AZ3 - Dardistown to Northwood: Mayne River, Santry River; and
- AZ4 - Northwood to Charlemont: Dodder River, Tolka River, River Liffey [tunnelled section].

These rivers are highlighted in the *draft* 3rd RBMP for restoration as their objective.

The proposed Project has considered the qualitative, quantitative and hydromorphological effect on all waterbody status.

18.4.8 Flooding Characteristics

A baseline assessment of flooding (Stages 1, 2 and 3) is included in JL's *Surface water drainage & Flood Impact Assessment*, Report (2021) & *Swords to Charlemont Flood Risk Assessment (2022)*. The Office of Public Works (OPW, 2021) on-line mapping database www.floodinfo.ie was reviewed (May 2021) in order to obtain information on historical flooding events along and in the vicinity of the proposed metro route corridor. The desk study also included a review of available CFRAM Flood Data (www.cfram.ie), and other relevant sources, such as EPA (2021) catchment studies (www.catchments.ie/) and flow and level data (www.epa.ie/hydronet).

The proposed Project will result in an increase in the area of impermeable surfaces due to the construction of the track bed, new stations, P&R, depot and other associated infrastructure. To ensure no associated increase in flood risk, the proposed Project developed an overarching Drainage Strategy to ensure the implementation of Sustainable Drainage Measures (SuDS). These measures, which will be further developed through detailed design, are in line with CIRIA SuDS manual C753 (2015), Great Dublin Regional Code of Practice and associated GDSDS Technical Documents and Fingal CC Blue/Green infrastructure for Development Guidance Note. The proposed measures are designed to ensure no increase in existing runoff rates throughout the proposed new development as consequence of the works.

As necessary, additional stormwater infrastructure has been incorporated into the proposed Project to runoff will not compromise the existing system. This is to ensure no change in the risk of flooding arising from surface water sources.

Figure 18.3 shows the present day 'high probability' river flood extents (Annual Exceedance Probability, AEP) 10% or 1 in 10-year flood event) and the location of past flood events. The proposed metro alignment and works areas are also indicated along with the WFD sub-catchment boundaries and the principal watercourses and respective catchment area.

The summary outputs from the Stage 1 and Stage 2 flood assessments for fluvial and coastal flooding are presented in Table 18.13 below. The locations of the watercourses listed are presented in Diagram 18.5 below.

This hierarchy of assessment ensures that flood risk is taken into account at all levels of the planning system but also that the right level of detail is considered. This avoids the need for detailed and costly assessments prior to making strategic decisions.

In terms of the Flood Risk Assessment and Management Study the scope of this work incorporates three stages:

- **Stage 1: Flood Risk Identification** - to identify whether there may be any flooding or plan issues related to a plan area or proposed development site that may warrant further investigation;
- **Stage 2: Initial Flood Risk Assessment** - to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. The extent of the risk of flooding should be assessed which may involve preparing indicative flood zone maps. Where existing river or coastal models exist, these should be used broadly to assess the extent of the risk of flooding and potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures; and,
- **Stage 3: Detailed Flood Risk Assessment** - to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model of the river or coastal cell across a wide enough area to appreciate the catchment wide impacts and hydrological processes involved.

As described in the FRM guidelines flood risk is a combination of the likelihood of flooding and the potential consequences arising. This is normally expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

The likelihood of flooding is normally expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in 100 years, i.e. it has a 1% chance of occurring in any one year. Therefore:

- 100-year flood = 1% Annual Exceedance Probability (AEP).
- 1000-year flood = 0.1% AEP.

In the FRM Guidelines, the likelihood of a flood occurring is established through the identification of Flood Zones which indicate a high, moderate, or low risk of flooding from fluvial or tidal sources, as defined as follows:

- *Flood Zone A* - Where the probability of flooding is highest (greater than 1% AEP or 1 in 100 for river flooding and 0.5% AEP or 1 in 200 for coastal flooding) and where a wide range of receptors would be vulnerable;
- *Flood Zone B* - Where the probability of flooding is moderate (between 0.1% AEP or 1 in 1000 and 1% AEP or 1 in 100 for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200 for coastal flooding); and
- *Flood Zone C* - Where the probability of flooding is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding).

For the purposes of this Flood Risk Assessment (Stage 2 & 3), the potential impact of climate change on flood risk to the proposed development has been made relative to the MRFS (Mid-Range Future

Scenarios) scenario as specified in *Document Circular PL 2/2014* issued by the Department of Housing, Local Government and Heritage.

Table 18.13 Coastal and Fluvial Flood Risk - Stage 1 Flood Risk Assessment (FRA) Summary

Watercourse[8]	Project Chainage	Dominant Flood Risk Source	Comments	Stage 3 FRA Required
Staffordstown Stream[9]	-	Fluvial	Not impacted by proposed Project, no further assessment required.	×
Un-named Watercourse	Ch. 1+000	Fluvial	Small ditch system; diversion required as part of P&R Facility development.	✓
Broadmeadow & Ward	1+536.2 (Broadmeadow) 1+633.9 (Ward)	Fluvial	proposed Project crosses an area of flood risk at grade. Mitigation required to protect project.	✓
Gaybrook River	4+400	Fluvial	Record of historic flooding recorded at Pinnock Hill Roundabout.	×
Gaybrook Stream North	5+146	Fluvial	proposed Project crosses Gaybrook Stream North. Appropriately sized bridge/culvert required to manage flood risk.	×
Sluice	5+762 5+963	Fluvial	proposed Project crosses Sluice River. Appropriately sized bridge/culvert required to manage flood risk.	✓
Cuckoo Stream	7+760	Fluvial	No impact, track is in tunnel	×
Mayne River System	8+900 (ditch)	Fluvial	Diversion of Mayne River (Turnapin Stream) required due to construction of proposed Dardistown Depot.	✓
Santry River	9+960	Fluvial	Localised diversion required at culvert outlet to accommodate proposed track alignment.	×

[8] *See Diagram 18.5 below for locations*

[9] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

Watercourse[8]	Project Chainage	Dominant Flood Risk Source	Comments	Stage 3 FRA Required
Wad River Diversion	8+320 – 13+905	Fluvial	Culverted watercourse, no impact.	×
Tolka River	13+905	Fluvial	No impact, track is in tunnel.	×
River Liffey	17+200	Coastal	No impact to track, however Tara Station is potentially at risk from coastal flooding which could have wider effects for the project.	×
Stein River	17+200 – 18+700	Fluvial	Culverted watercourse, no impact.	×

Diagram 18.5 Watercourses Crossed by the proposed Project

(see Table 18.13 above for details)

An overview of the some of the historical flooding characteristics along identified key watercourses crossed by/in the vicinity of the proposed Project, and where surface water discharges are proposed, is presented in the sub-sections below. Unless stated, the reported findings are based on the OPW CFRAM programme which is the most recent and accurate source for flood risk information in Ireland. Outputs from the CFRAM programme are published for general use on www.floodinfo.ie.

18.1.1.1 AZ1 - Northern Section

The OPW database indicates a record of a series of flood incidents in the Dublin Area on 9 and 10 August 2008 after extremely heavy rainfall[10]. Specific reference to such events at the Broadmeadow River and Ward River, within AZ1, is provided as follows.

18.4.8.1.1 Broadmeadow River

The river recorded a water level of 1.62m (above Datum) at the OPW automatic recording hydrometric station (Station No. 08008) on the morning of 10 August 2008, which is the third highest water level recorded compared to the annual maximum series for the station (for the period 1978-2006). A flood event in the river at the Broadmeadow station (No. 0808) is also recorded for 26 August 1986 (following Hurricane Charlie) for which a measured flow of 7.46 m^3/sec is recorded at a water stage level of 0.67m on 28 August 1986.

The Stage 1 Flood Risk Assessment indicated that the proposed Project is at risk of fluvial flooding where it crosses the Broadmeadow and Ward Rivers at Lissenhall (Swords). The proposed Project can be split into two sections in this location:

- Section 1 (Ch. 1+500 and Ch. 1+760) where the proposed Project crosses the Broadmeadow and Ward Rivers on and embankment and viaduct.
- Section 2 (Ch. 1+760 and Ch. 2+200) where the proposed Project comprises an open cut section of track running parallel to the Ward River.

The Eastern CFRAM study outputs for the Broadmeadow and Ward Rivers were compared against the proposed Project. As shown in Figure 5.1, the proposed Project passes through lands that are at risk of flooding in the 10%, 1% and 0.1% AEP floods.

Peak water levels from the Eastern CFRAM study are compared against the proposed track levels for the proposed Project. The predicted flood levels between Ch. 1+490 and Ch. 1+760 have been obtained from the OPW CFRAM Study maps for the 10%, 1% and 0.1% AEP flood events and have been compared against the minimum top of rail level for the proposed Project in this section. The proposed Project is not at risk of flooding in the 0.1% AEP flood at the proposed crossing of the Broadmeadow and Ward Rivers as the level of the track significantly exceeds the design flood level (e.g. flood level is 5.62mOD for 0.1% AEP while the proposed minimum top of rail is 7.70mOD, therefore 2.08 metre difference). The proposed Project does however traverse a significant area of floodplain and mitigation will be required to ensure no increase in flood risk as a consequence of the works.

The proposed works comprise the construction of a 216.61m viaduct which comprises 13 spans between Ch. 1+500 and Ch. 1+760 crossing Broadmeadow and Ward Rivers. These spans range from 19.05m to 28.10m in width, refer to Figure 7.6 and drawing 'ML1-JAI-SGN-SC01_XX-DR-Y-00002' in Appendix A18.5 (Flood Risk Assessment). The minimum soffit level for the viaduct is 5.90mOD.

Design measures include the following:

- Downstream of the Viaduct, the track section enters an open cut and fall below the existing ground level. A reinforced concrete floodwall with stone cladding up to 0.85m in height is provided to prevent the ingress of flood water in the open track section. Both the wall and viaduct have been designed to accommodate the 0.1% AEP design flow.
- The proposed viaduct was designed in accordance with the Hydraulic Design contained in Section 50 consent guidance from the OPW.

[10] *76.2mm rainfall was recorded at Dublin Airport on 09/08/2008*

- The bridge must be capable of passing a fluvial flood flow with a 1% annual exceedance probability (AEP) or 1 in 100-year flow with climate change without significantly changing the hydraulic characteristics of the watercourse.
- A bridge must be capable of operating under the above design conditions while maintaining a freeboard of at least 300mm.
- If the land potentially affected includes dwellings and infrastructure, it must be demonstrated that those dwellings and/or infrastructure are not adversely affected by constructing the bridge or culvert.
- The use of piers is minimized, in order to maintain the characteristics of the existing channel.
- Bridges are designed to operate with a freeboard between the flood level and the bridge deck.
- The encroachment of bridges abutments into the channel are minimized.
- The bridge abutments and piers are parallel with the existing direction of flow.
- The number of barrels for culverts is minimized to reduce the likelihood of debris blockage.

Also refer to Chapter 5 (MetroLink Construction Phase) & Chapter 6 (MetroLink Operations & Maintenance) of this EIAR for further details on the proposed Viaduct as well as the Structures Book of the RO.

18.4.8.1.2 Ward River

The inclement rainfall discussed on the above dates also led to a flood event (09/08/2008) on the Ward River approximately 300m upstream of the confluence with the Broadmeadow River. Historically, other flood events include the Ward River at North Street/Watery Lane in Swords on 14 and 15 November 2002 following rainfall in the area of up to 50mm. The Ward River overflowed into the park adjacent to North Street and flooded between North Street and Watery Lane.

According to the Flood Risk Assessment (Appendix A18.5*)*, the proposed Project crosses the Broadmeadow and Ward Rivers prior to passing beneath the R125/R132. Flood risk to this area was assessed as part of the FEM (Finite Element Method) FRAM Study which included the production of a 1-D and 2-D flood model of Broadmeadow and Ward Rivers. Refer to Design measures mentioned above. This model was used to assess the flood risk impacts of the proposed Project where it crosses the two watercourses. The model outputs, findings and design mitigation measures are further discussed in the Flood Risk Assessment Report. The findings are included in Section 18.3.8 below on the impact assessment and proposed mitigation measures are included in Section 18.5 on mitigation measures.

The Stage 3 Flood Risk Assessment for Broadmeadow and Ward Rivers concluded that the proposed Project is not at risk of fluvial flooding up to and including the 0.1% AEP flood event. The Proposed Viaduct also provides 0.5m freeboard for the 0.1% AEP flood. The proposed floodwall downstream of the viaduct also protect the open cut section of the track from flooding.

There is no change in fluvial flood risk as a result of the construction of the proposed viaduct and floodwall between Ch. 1+500 and Ch. 1+760.

Fluvial flood risk is the dominant source of flooding from the Broadmeadow and Ward Rivers at the proposed Project. The design of the proposed Project to accommodate the 0.1% AEP fluvial flow means that it is also sufficient to contain the 0.1% AEP coastal event. Furthermore, the 0.1% AEP coastal flood level is 2m lower that the 0.1% fluvial peak flood level.

18.4.8.2 Summary Overview with Regard to Above Ground Structures

18.4.8.2.1 P&R Facility

The Project alignment runs through the 10% AEP flood extent for the Staffordstown Stream. South of P&R Facility, the route crosses both the Broadmeadow River and Ward River, passing through the 10% AEP flood extent for both. The floodplain of both rivers is particularly extensive with low-lying land to the northeast and flood risk areas in Saucerstown, Oldtown, Newtown and Holybanks. The proposed route also passes ~500m upgradient of an area that is at risk from coastal flooding (1% AEP flood extent) along the Ward and Broadmeadow rivers (OPW, 2021).

The proposed location for the P&R Facility is not within the modelled flood plain and analysis of the local topography backs up the flood risk model. The maximum flood level predicted by the existing flood model at node 5La2004 is 4.74mOD. A topographic survey of the site shows the lowest site level being +5.60mOD. The site therefore sits above the predicted flood level for 0.1% AEP flood event. From the current flood modelling and record of historic flooding it is predicted that the site is not at risk of flooding and P&R Facility section will not, therefore, reduce existing floodplain storage.

The works associated with the P&R require diversion of ditches at the head of the catchment to ensure drainage largely, of just the P&R site. A ditch channel form and associated culverts have been designed to convey a 0.1% AEP design flow of 0.5m^3/s, with a freeboard allowance. The proposed ditches will therefore not pose a fluvial flood risk to the proposed Project.

The development will introduce new impermeable surfaces to a current greenfield site. Increased run-off due to new impermeable areas could increase flood risk. However, this increased run-off will be attenuated through the new proposed drainage system. The new drainage network has been designed using the latest SuDS guidance to limit run-off to the larger of existing greenfield run-off rate or 2.0l/s. A suitable design for stream diversion was required to maintain existing site drainage (refer to JL's report *Surface water drainage & Flood Impact Assessment*, Report, 2021). The proposed viaduct only resulted in a 0.01m increase in the 0.1% AEP flood level for the proposed Project. This is considered to be acceptable within the bounds of model tolerance so has been progressed as part of the proposed Project design. The principles that are applied to the design of the viaduct are referred in JL's *Surface water drainage & Flood Impact Assessment*, Report, 2021 and in Section 18.2.2 above.

The viaduct design is presented in greater detail on the following drawings: Broadmeadow and Ward River Viaduct Preliminary Design - General Arrangement; Broadmeadow and Ward River Viaduct Preliminary Design -Cross Sections; and Broadmeadow and Ward River Viaduct Preliminary Design - Abutment.

A Stage 3 Detailed Flood Risk Assessment was required for this location. The Stage 3 Assessment identified and designed suitable flood mitigation measures to ensure the proposed works are flood resilient and to ensure there is no increase in flood risk elsewhere (refer to Appendix A18.5). Furthermore, this area has been spilt into individual catchments with associated SuDS techniques to manage surface water drainage system appropriately.

18.4.8.2.2 Seatown and Swords Central

The proposed stations for both Seatown and Swords Central are situated along the R132 and both stations are located c. 1.8km north-east from the Ward River and its flood extents. South of the Swords station, a section of the proposed route is liable to 0.1% flooding from a tributary of the Gaybrook River (Gaybrook Stream North). Alongside the Ward River, there is substantial flood risk adjacent to its banks through Ward Valley Park with areas of flood risk extending along its banks right through to its confluence with the Broadmeadow River.

To develop the design for the proposed Project in this location, the FEM FRAM model of the Ward and Broadmeadow River was updated to include the proposed Project. Initially, the proposed Project was represented as a solid embankment that would not be overtopped in a 0.1% AEP flood with bridge crossings of the Broadmeadow River and Ward River.

Based on the Stage 2 FRA model, construction of an embankment across the floodplain for the proposed Project resulted in a 0.45m increase in the 0.1% AEP flood level and brought new properties into the floodplain. This would not be compliant with the requirements of the Justification Test meaning mitigation was required as part of the project design. The Proposed Scheme is not at risk of flooding in the 0.1% AEP flood at the proposed crossing of the Broadmeadow and Ward Rivers as the level of the track significantly exceeds the design flood level. The Proposed Scheme does however traverse a significant area of floodplain and mitigation will be required to ensure no increase in flood risk as a consequence of the works. As the Justification Test was not passed certain mitigation measures will be implemented to ensure no flooding to the alignment and no increased flooding to surrounding areas.

Mitigation measures such as the use of SuDS techniques with a pump and attenuation tanks to attenuate the worst-case scenario (winter storm event).

The proposed Project has a significant footprint within the flood plain and across the river. The new footprint within the flood plain would cause a reduction in flood plain volume which could potentially cause an increased flood risk elsewhere. Additionally, any structures built within the flood plain or river channel could restrict flow and cause increased flood risk elsewhere.

Existing flood models show the proposed Project line would cross the fluvial flood risk zone associated with the Broadmeadow River and Ward River. The proposed line crosses within the 10% AEP flood zone associated with a high risk of flooding. Additionally, there is a recorded history of flooding within this area.

Furthermore, this area (Seatown and Swords Central Station) has been spilt into individual catchments with associated SuDS techniques to manage the surface water drainage system appropriately (Appendix A18.5*)*.

A Stage 3 Detailed Flood Risk Assessment was not required for this location.

18.4.8.2.3 Pinnock Hill

The proposed Project crosses the Broadmeadow River and Ward River prior to passing beneath the R125/R132. Flood risk to this area was assessed as part of the FEM FRAM Study which included the production of a 1-D/2-D flood model of the Pinnock Hill area. This model was used to assess the flood risk impacts of the proposed Project where it crosses the Pinnock Hill site.

There is a history of flooding at this location with surface water flooding reported in 2002, 2004 and 2005 affecting the R132 at Pinnock Hill Roundabout, that would be in close proximity to the proposed Project. Reports state flooding was due to 'under capacity of the surface water drainage network' (OPW, 2021).

The available CFRAM maps show the 10%, 1% and 0.1% AEP flood extent where the proposed Project crosses Pinnock Hill (Appendix A18.5). The proposed Project alignment will be constructed within the modelled floodplain for the Gaybrook Stream (North). The proposed development in this location will be constructed in a cut and cover tunnel. Therefore, there will be no impact on the existing floodplain storage volume. The proposed track location is within the 0.1% AEP flood risk zone (low risk). The nearest location with high flood risk is the industrial estate to the east.

From site investigation it is considered the CFRAM model results are not accurate (*Appendix A18.5*). The CFRAM model assumes all flow for the Gaybrook Stream North passes under the R132 road and continues along the project route. The proposed Project crosses lands at risk of flooding in the 0.1% AEP flood extent associated with the Gaybrook Stream North. However, a 900mm culvert intercepts the stream north-west of the R132 and diverts water to the Ward River catchment. The proposed Project runs parallel to the R132 in open cut and cover sections, prior to passing beneath the Gaybrook Stream North. Based on the visual inspection, it was estimated that 95% of flows from Gaybrook Stream North watercourse are being diverted to the new route with a small sweetening flow is conveyed in the existing culvert crossing underneath the R132. The CFRAM mapping therefore overestimates the extent of flooding from the Gaybrook Stream North as it does not include the 900mm diversion culvert that conveys most of the flows to the Ward River.

Owing to the extent of the track that is covered in the this reach and the diversion of the Gaybrook Stream North into a 900mm culvert, it is therefore considered that there is no risk of fluvial flooding from Gaybrook Stream North to the proposed Project. Therefore, a Stage 3 Flood Risk Assessment is not required to confirm the extent of the flood risk associated with the proposed Project established at this location. The proposed Project will have no impact on flows along the Gaybrook Stream North as all existing culverts are maintained and not modified as part of the works (Appendix A18.5 Flood Risk Assessment).

18.4.8.2.4 Fosterstown

A review of the flood risk potential for the proposed route between the Fosterstown and Dublin Airport stations indicates that while neither station is prone to any flooding, the route does cut across the Sluice River as mentioned in Section 18.3.1.2 above. However, this watercourse is generally contained within its banks within the study area with the exception of some slight out of bank flooding upstream of the R132.

Existing flood modelling shows flood flows are retained within the river channel at the intersection between the proposed Project alignment and the Sluice River. It is considered with an appropriately designed culvert the alignment will not reduce floodplain volume and therefore will not cause increased flood risk elsewhere due to this mechanism. Suitable culvert design was designed to allow conveyance of flood flows preventing an increase in flood risk upstream.

Existing flood modelling shows the proposed crossing of the Sluice River will not reduce floodplain storage volume.

Furthermore, this area has been spilt into individual catchments with associated SuDS techniques to manage surface water drainage system appropriately (Appendix A18.5).

18.4.8.2.5 Sluice River

This watercourse receives surface water runoff from Dublin Airport via a network of ditches and the floodplains of this river do not have any significant flood storage capacity. There is anecdotal evidence from local residents that flooding has occurred in the past along some sections of the Sluice River, but no quantitative flood data exist. Consultation with the OPW has confirmed that the Sluice River can be subject to localised flooding. A flood event in the Sluice River at Kinsaley Hall (Station 0805) is recorded for 26 August 1986 (following Hurricane Charlie) in which a water stage level of 1.18m above Poolbeg Datum (+6.471mOD) is noted; a measured flow of 0.455m3/sec at stage level 0.369m is also recorded for 28 August 1986.

The proposed Project crosses the Sluice River at Ch. 5+693 and one of its tributaries at Ch. 5+762. The CFRAM mapping for the Sluice River (www.floodinfo.ie) shows that the watercourse has little natural floodplain. The Stage 3 Flood Risk Assessment for Sluice River and its tributary concluded that the proposed Project is not at risk of fluvial flooding up to the 0.1% AEP flood event. There is no change in fluvial flood as a result of the construction of the proposed culverts across either watercourse up to and including the 0.1% AEP flood. Therefore, there is little to no risk of flooding at this section.

18.4.9 AZ2 - Airport Section

With regard to the geographical area AZ2, the following is referenced with regard to flooding.

18.4.9.1 Summary Overview with Regard to Above/Below Ground Structures

18.4.9.1.1 Fosterstown

See comments regarding the Sluice River under Section 18.4.8.1 above.

18.4.9.1.2 Dublin Airport

It is understood that this area (i.e. general footprint of the airport) is unlikely to be susceptible to flooding as there are no rivers nearby. However, the Cuckoo Stream flows to the south-east of the airport and discharges from within the airport boundary downgradient to the Mayne River. There are a number of localised fluvial flood risk areas located along the Cuckoo Stream (up-gradient of the Mayne River) in the vicinity of Toberbunny (i.e. at ALSAA sports grounds), however none of these is local to the proposed Project.

Therefore, there is little to no risk of flooding at this section of the Project.

Furthermore, this area contains associated SuDS techniques to manage the surface water drainage system appropriately (Appendix A18.5*).*

18.4.9.2 AZ3 Dardistown to Northwood

With regard to the geographical area AZ3, the following is referenced with regard to flooding.

18.4.9.2.1 Mayne River

According to a review of OPW data, the Mayne River has a small catchment area and is subject to widely varying flows. The watercourse can run very low in periods of continuous dry weather and is subject to localised flooding especially near culverted sections (for example near the Northern Cross road). The river has been canalised in sections in the past along its channel in urban areas and has been widened and deepened in other areas. The floodplains of this watercourse do not have any significant flood storage capacity. The OPW national flood hazard mapping database indicates historical flood events at the Mayne River at the M50 Motorway flyover at the Old Airport Road in November 2002; this location has also been recorded as a 'recurring' in terms of flooding potential.

18.4.9.2.2 Santry River

The OPW Flood Hazard Database indicates flooding was noted in the catchment of the Santry River on the 14 November 2002. The culvert on the Santry River at the Old Swords Road was unable to take the quantity of water in the river and overflowed, with water flowing from the Old Swords Road into Santry Close which was under ~0.45m of water. This culvert overflowed again on 20-21 October 2002 and 28 October 2004. This information was also listed in an EPA report in 2005, but no additional information on the flood levels or flooding status was recorded in the report. The EPA monitoring station is located in Coolock, outside the study area. OPW information for the same period confirms that areas of localised flooding of this river occurred within the study area including at the M50 Motorway Ballymun Exit and within Santry Demesne.

As shown Appendix A18.5, the proposed Project passes the M50 and then crosses over a culverted section of the Santry River. The Santry River does flood a significant area, including the M50, but this will not impact the proposed Project as it passes the M50 on a Viaduct so will be elevated (67.55m) above any potential flooding from the Santry River. Furthermore, the proposed Project passes over a culverted section of the Santry River. No flooding is predicted in this location and there are no works proposed to modify the hydraulic capacity of the Santry River culvert.

18.4.9.3 Summary Overview with Regard to Above Ground Structures:

18.4.9.3.1 Dardistown Depot and Station

The flood extent of a tributary of the Mayne River is located within the proposed depot at Dardistown. This tributary runs through the lands in which the Dardistown Station is located. The flood extent of the 10%, 1% and 0.1% AEP is also extending into the proposed location of the Dardistown Station. There are planned works at this part of the proposed Project which include the diversion of the existing tributary/section upstream of the Mayne River to allow for construction works.

The existing flood modelling shows that the depot site does not sit within a flood risk zone and the historic flood record does not show recorded flooding at this site.

The Dardistown Local Area Plan includes the proposed MetroLink Depot and also includes a number of objectives in relation to diversion of the Turnapin Stream, namely:

- CP031 - A 15m riparian corridor shall be maintained along both sides of the Turnapin Stream in order to protect and manage this existing watercourse.
- CP035 - The eastern regional fisheries board shall be consulted in relation to any working in relation to diverting or crossing of a river/stream.

In addition to the above policies the following is taken from the Water Quantity section of the Local Area Plan:

'Culverting of watercourses shall generally not be permitted in accordance with the Fingal Development Plan 2011-2017 which seeks to restrict the use of culverts on watercourses in the county. Section 50 of the Arterial Drainage Act 1945 requires that, any proposal to construct or alter any bridge over a watercourse must be submitted to the Office of Public Works for their approval. Any such proposal must be previously agreed with both the Water Services and Transportation departments. It is important to note that drainage ditches (whether dry or not) are considered watercourses under the 1977 and 1990 water pollutions act'.

The proposed Project emerges from the tunnel section at Dardistown, to the south of Dublin Airport. This location has been proposed as the site of the main train depot. The area has been zoned for employment in the Local Development Plan and will comprise sidings, storage, cleaning and other operational facilities. Within the section, the Turnapin Stream, which is a tributary of the Mayne River is diverted to accommodate the new depot. The proposed diversion includes a 15m wide riparian buffer, in accordance with the Local Development Plan, to improve connectivity between the river and floodplain.

The proposed Project emerges from the tunnel section at Dardistown, to the south of Dublin Airport. This location has been proposed as the site of the main train depot. The area has been zoned for employment in the Local Development Plan and will comprise sidings, storage, cleaning and other operational facilities. Within the section, the Turnapin Stream, which is a tributary of the Mayne River is diverted to accommodate the new depot. The proposed diversion includes a 15m wide riparian buffer, in accordance with the Local Development Plan, to improve connectivity between the river and floodplain.

The impacts to and arising from the proposed Project are assessed against the Medium Range Future Scenario (MRFS) for climate change. The proposed new viaduct over Broadmeadow and Ward Rivers, culverts over Sluice River and its tributary and the diversions of a tributary of Staffordstown watercourse and Turnapin watercourse also allow for the effects of future climate change. All new drainage is designed to accommodate the effects of the medium range future climate change scenario.

A detailed design for diversion of the Turnapin Stream has been developed and is presented with the Depot Design Report. The design of the diversion in tandem with the Dardistown Depot will ensure no change in flood risk at the site or increase in off-site flooding.

A Stage 3 Detailed Flood Risk Assessment was required for this location. The Stage 3 Assessment identified and designed suitable flood mitigation measures to ensure the proposed works are flood resilient and to ensure there is no increase in flood risk elsewhere (Appendix A18.5).

The Stage 3 Flood Risk Assessment for the proposed diversion of the Turnapin watercourse concluded that the proposed Project is not at risk of fluvial flooding up to the 0.1% AEP flood event. There is no change in fluvial flood risk in the area of interest as a result of the construction of the proposed diversion as the channel has been designed to contain all flows up to and including the 0.1% AEP flood.

Furthermore, this area has been spilt into individual catchments with associated SuDS techniques to manage surface water drainage system appropriately (Appendix A18.5).

18.4.9.3.2 Northwood Station

The Santry River runs along the M50 and crosses the proposed metro route between Dardistown Depot and Northwood Station. Although there is no immediate flood risk to the proposed route, there is a small area of flood risk (10% AEP) along the proposed route at the M50/Naul Road intersection. This point at the Santry River is also fed by a tributary culverted below the Naul Road and which joins the Santry River to the east. It should also be noted that there is a 0.1% AEP flood risk to the M50 Motorway in this area.

According to the available CFRAM mapping for the Santry River (www.floodinfo.ie), the watercourse has a moderate level of natural floodplain.

A Stage 3 Detailed Flood Risk Assessment was not required for this location. Furthermore, this area has been spilt into individual catchments with associated SuDS techniques to manage surface water drainage system appropriately (*Appendix A18.5).*

18.4.9.4 AZ4-Northwood to Charlemont

With regard to the geographical area AZ4, the following is referenced with regard to flooding.

18.4.9.4.1 South of the proposed of Northwood Station

The proposed Project is entirely in tunnel which means there is no direct risk of flooding to the line. In terms of the station entrances, these will be covered with a canopy to avoid rainwater falling directly onto the entrance. Furthermore, the station entrances will be equipped with drainage around the plaza and station entrances would be designed to stop water ponding or draining into the entrance. The majority of stations south of the Northwood Station are situated on existing hardstanding areas with an existing surface water drainage system. Therefore, there is no risk to flooding to the stations and the tunnel as it is beneath the surface.

All station drainage is designed to ensure that there is no net increase in runoff as a consequence of the proposed Project.

18.4.9.4.2 Tolka River

A Flood Study report was commissioned by DCC, in association with FCC, Meath County Council (MCC) and the OPW in 2002. This report has since been incorporated into the Greater Dublin Strategic Drainage Study (2005). Historically, a major flood occurred on the Tolka River in December 1954. Other major floods for which records are available include those of 28 October 1880, 25-26 August 1986 (Hurricane Charlie), 6 of November 2000, November 2002 and October 2011. The flood event in the Tolka River at Drumcondra (Station 0919) on 26 August 1986 (following Hurricane Charlie) recorded a water stage level of 8.418m above Poolbeg Datum (+0.00mOD) and a discharge of 19.55 m^3/sec at stage level 7.50m on 27 August 1986 (an estimated flow at high water level was provided at 53.0 m^3/sec). The principal areas affected by the flood in November 2002 were the areas to both sides of the river between Glasnevin Bridge and Luke Kelly Bridge. These areas are just outside the study area. Other areas affected included Botanic Avenue and Richmond Road. These areas are unaffected by the proposed Project.

18.4.9.4.3 River Liffey

Historical records from the OPW do not provide any evidence that part of the proposed Project study area has been affected in the past by flooding of the River Liffey. Flooding events have been recorded by the OPW on the Camac River (a tributary of the River Liffey) for example at Chapelizod, Islandbridge and Kilmainham but these areas are located outside the study area.

18.4.9.4.4 St Stephen's Green/Grand Canal

Heavy rainfall led to flooding in multiple locations in south Dublin City in June 1963. A number of defence assets have since been put in place. No flood events in the vicinity of St Stephen's Green East or farther south on the Grand Canal near the proposed alignment have been recorded by the OPW.

18.4.9.4.5 River Dodder

Historical records from the OPW provide evidence of historical flooding events at the River Dodder including at Anglesea Road in December 1958 and November 1965, and near Ballsbridge in October 1987, October 2011 (at Herbert Cottages and Bath Avenue). The River Dodder flows to the east and north-east of the proposed route.

18.4.9.5 Summary Overview with regard to Below Ground Structures:

18.4.9.5.1 Griffith Park and Glasnevin stations

According to the OPW (2020) the Tolka River does not have an official associated 1% AEP area presently, as the area is under review. There have been a number of historical flood events along this river including where a section of the proposed route passes under the Tolka River. However, neither station is likely to be affected by any reviewed flood extent and the stations are underground and the proposed metro route lies in tunnel at this particular point.

18.4.9.5.2 Tara Street

The proposed route between O'Connell Street station and Tara Station passes through Dublin City centre and crosses the River Liffey. There is no fluvial flood risk within this reach however, there is a high coastal flood risk in the general Docklands area and low-lying lands at Ormond Quay. In the context of the River Liffey there is a 0.5% AEP coastal flood risk to Tara Station entrance which is at surface. The station itself is below ground. To ensure that Tara Station is sufficiently resilient to flooding, the proposed design will make the provision for the addition of demountable defences across each entrance to the station, refer to Figure 7.19. The demountable and the station building will be designed to prevent flooding up to a level of 4.35mAOD. This equates to the 0.1% AEP coastal flood level with HEFS allowance for climate change.

18.4.9.5.3 South of the proposed Northwood Station

The proposed Project is entirely in tunnel which means there is no direct risk of flooding to the line.

18.4.9.5.4 Flood Risk for Temporary Construction Compounds

Table 18.14 below describes all construction and contractor compound sites (including bulk fuel storage areas) in the context of flooding potential to these areas.

Table 18.14 Summary of all Construction and Contractor Compound Sites (including bulk fuel storage areas) - Flooding Potential

Ref. Area	Site Reference	Construction Site Type	Reference Watercourse	Flooding Potential Y/N	Comments
AZ1	Estuary Station and logistics site	Main Construction Compound	Staffordstown_08	No	Low probability 0.1% AEP flooding on the north boundary of the compound
AZ1	Seatown West	Satellite Construction Compound	Ward	No	Low probability 0.1% AEP flooding to the west outside the boundary of the compound
AZ1	Estuary Court	Satellite Construction Compound	Ward	No	Ward River is 450m to west of site. No risk of flooding
AZ1	Estuary Station	Station Construction site	Broadmeadow 08	No	1% AEP flooding from the Broadmeadow River to the south outside the boundary of the site

Ref. Area	Site Reference	Construction Site Type	Reference Watercourse	Flooding Potential Y/N	Comments
AZ1	Swords Central	Station Construction site and lorry holding area	Gaybrook Stream North	No	No risk of flooding. Site 100m from stream.
AZ1	Pinnock Hill Roundabout	Main Construction site	Gaybrook Stream North and Gaybrook River	No	Low probability 0.1% AEP flooding on site. Very low risk of flooding during use of compound.
AZ1	Swords Satellite construction and logistics site	Medium Construction Compound	Gaybrook Stream North and Gaybrook River	No	Low probability 0.1% AEP flooding on site. Very low risk of flooding during use of compound.
AZ1	Footbridge installation site	Small Construction Compound	Ward	No	No risk of flooding. Site 350m from stream.
AZ1	Seatown Station	Main Construction site	Ward	No	No risk of flooding. Site 550m from river.
AZ1	Woodie's	Satellite Construction Compound	Ward	No	No risk of flooding. Site 550m from river.
AZ1	Mantua Park	Satellite Construction Site	Ward	No	No risk of flooding. Site 450m from river.
AZ1	North Dublin Corporate Park (NDC)	Satellite Construction Compound	Ward	No	No risk of flooding. Site 650m from river.
AZ1	Chapel Lane	Satellite Compound Site	Ward	No	No risk of flooding. Site 500m from river.
AZ1	Pavilion's Shopping Centre	Satellite Construction Site	Swords Glebe	No	No risk of flooding. Site 550m from river.
AZ1	Fosterstown Station	Main Construction Site	Gaybrook River	No	No risk of flooding. Site 300m from river
AZ1	Nevinstown Lane	Satellite Construction Site	Gaybrook River	No	No risk of flooding. Site 200m from river
AZ1	Boland	Satellite Construction Site	Sluice	No	No risk of flooding. Site 450m from river
AZ2	North Portal (North Section)	Satellite Construction Site	Sluice	No	No risk of flooding. OPW map shows no flooding from Sluice River to the north of the site

Ref. Area	Site Reference	Construction Site Type	Reference Watercourse	Flooding Potential Y/N	Comments
AZ3	Northwood Station construction site	Main Construction site	Santry	No	No risk of flooding. Site 350m from river
AZ3	Dublin Airport South Portal	Main Construction site	Mayne_09	No	No risk of flooding. Site 150m from river
AZ3	Dardistown Station and Depot	Main Construction Site	Mayne_09	No	No risk of flooding. Site 400m from river
AZ3	M50 Viaduct (Central Section & St Anne's)	Satellite Construction Site	Santry	No	No risk of flooding. Site 200m from river
AZ3	Northwood Station and Portal	Main Construction Site	Santry	No	No risk of flooding. Site 150m from river
AZ3	Northwood Station Logistics Site	Satellite Construction Compound	Santry	No	No risk of flooding. Site 100m from river
AZ4	Ballymun Station	Main Construction Site	Santry	No	No risk of flooding. Site 1,200m from river
AZ4	Albert College Park Intervention Shaft	Main Construction Site	Tolka	No	No risk of flooding. Site 1,200m from river
AZ4	Collins Avenue Station	Main Construction Site	Tolka	No	No risk of flooding. Site 1,700m from river
AZ4	Griffith Park Station	Main Construction Site	Tolka	No	No risk of flooding. Assessment from OPW National Flood Hazard Mapping. Updated Floodinfo map is under review. Site 25m from river.
AZ4	Mater Station	Main Construction Site	Liffey	No	No risk of flooding. Site 1,400m from river
AZ4	O'Connell Street Station	Main Construction Site	Liffey	No	No risk of flooding. Site 400m from river
AZ4	Tara Station	Main Construction Site	Liffey	No	Low Probability 0.1% AEP tidal flooding at construction site. Very low risk of flooding during construction. No risk of fluvial flooding. Site 80m from river.
AZ4	St Stephen's Green Station	Main Construction Site	Liffey	No	No risk of flooding. Site 1,000m from river

Ref. Area	Site Reference	Construction Site Type	Reference Watercourse	Flooding Potential Y/N	Comments
AZ4	Dublin Airport Station	Main Construction Site	Cuckoo Stream	No	No risk of flooding. Site 700m from stream.
AZ4	Albert College Park Ventilation Shaft	Main Construction Site	Tolka	No	No risk of flooding. Site 1,000m from river
AZ4	Glasnevin Station	Main Construction Site	Tolka	No	No risk of flooding. Site 950m from river
AZ4	Charlemont Station	Main Construction Site	Liffey	No	No risk of flooding. Site 1,700m from river

The following can be summarised on the potential sources of flooding along the Project:

18.4.9.5.5 Pluvial Flooding

As current, there is a risk of temporary pluvial flooding along the entire MetroLink Project. This is a function of the capacity of the existing surface water network, which is typically designed to contain a 20% AEP storm. It is beyond the scope of the proposed Project to increase the capacity of the existing surface water network.

The proposed Project will result in the creation of additional impermeable surfaces for the proposed track, stations and other infrastructure. A comprehensive programme of SuDS measures have been implemented to ensure that there is no change in existing runoff rates as a consequence of the proposed Project. This will ensure no increase in the risk of pluvial flooding.

18.4.9.5.6 Fluvial Flooding

The proposed Project is at risk of fluvial flooding from the proposed diversion of a tributary of Staffordstown Stream, Broadmeadow and Ward Rivers, Sluice River and a tributary and the proposed diversion of the Turnapin Stream.

A new viaduct has been proposed over Broadmeadow and Ward Rivers. Qualitative and quantitative analysis completed for a Stage 3 Assessment carried out shows that the proposed viaduct will not impact on flood levels for the Broadmeadow and Ward Rivers. The planned viaduct makes sufficient provision to maintain floodplain flows.

New culverts have been proposed over Sluice River and its tributary. Qualitative and quantitative analysis completed for a Stage 3 Assessment carried out show that the proposed culverts will not impact on flood levels for the Sluice River and its tributary. This is because both culverts have been overdesigned for 0.1% AEP flood.

Two watercourse diversions have been proposed to allow for the construction of the proposed P&R at Lissenhall and Depot at Dardistown. A tributary of the Staffordstown Stream (Lissenhall) and the Turnapin Stream (Dardistown) will be diverted. Qualitative and quantitative analysis completed for a Stage 3 Assessment carried out shows that the diversions have been designed so their banks will not be overtopped by the 0.1% AEP flood.

18.4.9.5.7 Coastal Flooding

The proposed Project (proposed Tara Station) is at risk of coastal flooding from the River Liffey with the effects of climate change.

It is not possible to raise the street level of the Tara Station entrances to allow for the effects of climate change. Tara Station will therefore be designed to be resilient to including, including the provision of demountable flood defence for the 0.1% AEP flood with the HEFS scenario for climate change.

Qualitative and quantitative analysis completed for a Stage 3 Assessment carried out shows that the proposed Tara Station will not impact on flood levels for the River Liffey. The proposed development at Tara Station is shown to displace less than 1% of the total flood volume on the floodplain and hence, the impact on both fluvial and coastal flood extents is deemed to be negligible.

18.4.9.5.8 Climate Change

Climate change will result in an increased risk of flooding to the proposed Project due to:

- Increased river flows.
- Increased rainfall depths and intensity.
- Increased sea levels.

Increased rainfalls depths and intensities will increase the risk of pluvial flooding from the existing surface water drainage network. New drainage measures which are installed as part of the proposed Project, including any SuDS, are designed to allow for future climate change.

Refer to Appendix A18.5 for further information on each stage of flood risk assessment (Stage 1 to Stage 3) carried out along the Project alignment.

18.4.10 Summary Description of Hydrology Attributes along the Proposed Route

Based on the TII criteria for rating the importance of hydrological features (criteria outlined in Table 18.2), the importance of the baseline hydrological features along the proposed route are rated in Table 18.15 below. The assigned importance of each attribute is based on a summary description of the characteristics of that watercourse as well as the assessment of the feature on the basis of habitat assessment, flood risk, fisheries use and distance hydrologically upstream from an SAC/SPA.

The fishery and habitat resource of the hydrological attributes included in the table below are addressed in detail in Chapter 15 (Biodiversity).

Table 18.15 Summary Description of Hydrology Attributes along the Proposed Route

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
AZ1	Staffordstown Stream[11]	North of P&R Facility	Poor	At Risk	N/A	This river is located to the north of the route with proposed treated and attenuated surface water discharge to it from the P&R Facility at Estuary via a connection with the Lissenhall Great tributary at design catchment A1. The start of the proposed route runs through the 10% AEP flood extent for the Staffordstown Stream. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to	*0.23km to Malahide Estuary SAC and 0.49km to Malahide Estuary SPA*	***Importance: Extremely High***[12] *Ecological Importance*[13]*:* *Habitat - Local Importance (Higher Value)* *Atlantic salmon – National importance*

[11] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

[12] The hydrological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (National Roads Authority, 2009) and based on the ecological evaluation set by the ecologist. In addition, the distance to the Natura Sites, presence of important habitats, EPA WFD status and risk score was used to determine the hydrological importance of an attribute. For example, if a waterbody discharges into a Natura Site within 1km of the proposed Project, it is conservatively considered as *'Extremely High'.*

[13] The ecological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (National Roads Authority, 2009) and advice on how to determine the importance of an ecological feature provided in CIEEM guidelines (CIEEM, 2018). Refer to Chapter 15 (Biodiversity) for full details on these valuations.

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						Chapter 15 (Biodiversity) for further details. The Turvey system supports Atlantic salmon (listed under Annex II and V of the EU Habitats Directive) and Sea trout in addition to resident Brown trout (both Salmo trutta) populations.		
AZ1	Lissenhall Great Stream	North of P&R Facility	Poor	At Risk	N/A	Tributary of the Staffordstown Stream which will receive treated and attenuated surface water discharge from the P&R Facility at design catchment A1. The stream was recorded as dry during all baseline monitoring events.	*Not directly hydrologically connected to Malahide Natura Site.*	***Importance: Medium*** *Ecological Importance:* *Local Importance (Low value)*
AZ1	Broadmeadow River	Between Estuary and Seatown stations	Poor	At Risk	Moderately Polluted	Proposed alignment crosses directly over both the Broadmeadow River and Ward River to the west of the existing Lissenhall Bridge and Balheary Bridge; crossing is via a viaduct. Proposed to receive treated and attenuated surface water at design catchment A2. Historically flooding has occurred in the area including a significant flooding event in August 2008 after extremely heavy rainfall. The floodplain of both the Broadmeadow and Ward rivers is particularly extensive with low-lying land to the northeast and flood risk areas up-gradient. Baseline water quality sampling in 2019 indicated no significant water quality issues.	*0.38km to Malahide Estuary SAC and 0.76km to Malahide Estuary SPA*	***Importance: Extremely High*** *Ecological Importance:* *Habitat - Local Importance (Higher Value)* *European eel – International importance*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						The river is classified as Moderately Polluted including up-gradient of the 2019 baseline sampling point (station 0800 i.e. Q3 for 2017). The quality trends are consistent with these classifications for the last number of years. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. The Broadmeadow system supports a small population of Atlantic salmon in its lower reaches and a resident Brown trout population.		*Atlantic salmon – National importance* *All other fish species – Local Importance (Higher Value)*
AZ1	Ward River	Between Estuary and Seatown stations	Poor	At Risk	Moderately Polluted	See above comment on proposed Ward River crossing. Proposed to receive treated and attenuated surface water at design catchment B. Historically flooding has occurred in the area including a significant flooding event in August 2008 after extremely heavy rainfall. The floodplain of both the Ward and Broadmeadow rivers is particularly extensive with low-lying land to the northeast and flood risk areas up-gradient. Alongside the Ward River, there is substantial flood risk adjacent to its banks through Ward	*0.23km to Malahide Estuary SAC and 0.49km to Malahide Estuary SPA*	***Importance: Extremely high*** *Ecological Importance:* *Habitat - Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						Valley Park with areas of flood risk extending along its banks right through to its confluence with the Broadmeadow River. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q3, i.e. 'Poor Status' under WFD status and 'Moderately Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (75mg/l) and Kjeldahl Nitrogen (12mg/l). The river is classified as Moderately Polluted, including near the 2019 baseline sampling point (station 0610 i.e. Q3 for 2017). The quality trends are consistent with these classifications for the last number of years. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. The Ward system in the Lissenhall area supports Atlantic salmon in addition to resident Brown trout populations and		*European eel – International importance* *Atlantic salmon – National importance* *All other fish species – Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						an eel population of international importance.		
AZ1	Greenfields Stream	East of Seatown station	Poor	Under review	N/A	Watercourse is not crossed directly by proposed route. This stream flows directly to Malahide Estuary and is proposed to receive treated and attenuated surface water from drainage catchment C1. The stream was recorded as affected by tidal surge up the discharge culvert during all baseline monitoring events. No aquatic habitats recorded at this location. This waterbody is mostly culverted.	*0.23km to Malahide Estuary SAC and 0.49km to Malahide Estuary SPA*	***Importance: Extremely High*** *Ecological Importance:* *Habitat - Local Importance (Low value)*
AZ1	Gaybrook	East of Swords Central station	Poor	Under review	N/A	Feature is not crossed directly by the proposed Project. However, Gaybrook Stream North is crossed directly. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (97mg/l). South of the Swords station, a section of the proposed route is liable to 0.1% flooding from a tributary of the Gaybrook River.	*0.23km to Malahide Estuary SAC and 0.49km to Malahide Estuary SPA*	***Importance: Extremely High*** *Ecological Importance:* *Habitat - Local Importance (Higher Value)*
AZ1	Swords Glebe	West of Swords Central station	Poor	At Risk	N/A	Tributary of the Ward River and is not crossed directly by the proposed route. Baseline water quality sampling in 2019 indicated no significant water quality issues.	*Not directly hydrologically connect to the*	***Importance: Medium*** *Ecological Importance:*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						There is substantial flood risk adjacent to the banks of the Ward River through Ward Valley Park with areas of flood risk extending along its banks right through to its confluence with the Broadmeadow River. The flooding risk also extends to the Swords Glebe.	*Malahide Natura Site*	*Habitat - Local Importance (Higher value)*
AZ2	Sluice River	Between Fosterstown and Dublin Airport stations	Poor	Under review	N/A	The Sluice River and its tributary Forrest Little are both crossed directly by the proposed route, north of the Naul Road. The Sluice is proposed to receive treated and attenuated surface water from drainage catchment C2, D1 and D2. This river and its tributaries drain the northern area by Dublin Airport and the Swords urban area. This water course can be subject to localised flooding according to the OPW. However, there are no significant flood events near the immediate study area. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q2-3, i.e. 'Poor Status' under WFD status and 'Moderately Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (69mg/l) and only minor exceedances of SWTV (Surface Water Threshold Value) for zinc and ortho- phosphate.	*8.4km to Baldoyle Bay SAC and Baldoyle Bay SPA*	*Importance: High* *Ecological Importance:* *Habitat - Local Importance (Higher Value)* *Brown trout – Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						The Sluice River is not presently monitored by the EPA for biological quality. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. The Sluice system supports a resident population of Brown trout.		
AZ2	Marshallstown Stream	Between Fosterstown and Dublin Airport stations	Poor	Under review	N/A	Tributary of the Sluice River and is not crossed directly by the proposed route. Not sampled for baseline water quality due to access constraints. No kick sampling was undertaken by the ecologist for this waterbody.	*Not directly hydrologically linked to Baldoyle Natura Site.*	***Importance: Medium*** *Ecological Importance:* *Habitat - Local Importance (Higher value)*
AZ2	Cuckoo Stream	South-east of Dublin Airport	Poor	At Risk	N/A	The open section is not crossed directly by the proposed route however the tunnel alignment may cross beneath culverted sections of this watercourse within the airport grounds. There are a number of localised fluvial flood risk areas located along the Cuckoo Stream (up-gradient of the Mayne River) in the vicinity of	*Not directly hydrologically linked to Baldoyle Natura Site.*	***Importance: Medium*** *Ecological Importance:* *Habitat - Local Importance*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						Toberbunny however none of these is local to the proposed route. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q1, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated potassium (17mg/l), elevated sulphate (88mg/l) and only minor exceedances of SWTV for zinc. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. The Cuckoo and Mayne Rivers are a non-salmonid system, however IFI is currently assessing the viability of a salmonid reintroduction programme.		*(Higher Value)*
AZ3	Mayne River	Between Dublin Airport and Dardistown stations	Poor	At Risk	Moderately Polluted	The proposed Project will involve the permanent diversion of a tributary to the Mayne River along the northern and eastern extents of the proposed Dardistown Depot.	*8.4km to Baldoyle Bay SAC and Baldoyle Bay SPA*	***Importance: Medium*** *Ecological Importance:*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						The Mayne River is proposed to receive treated and attenuated surface water from drainage catchment E1. Historically, flooding has occurred in the area including at the M50 flyover at the Old Airport Road in November 2002; this area is recorded as a 'recurring' in terms of flooding potential. The flood extent of a tributary of the Mayne River approximates the proposed Dardistown Depot and proposed permanent water course diversion works. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q1, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated potassium (10mg/l), sulphate (93mg/l) and total suspended solids (221mg/l). The biological quality trends are consistent with this classification from 2013. However, the only EPA station on this river is located ~5km east and down-gradient of the proposed route (and baseline sampling point). Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat		*Habitat - Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. The Cuckoo and Mayne Rivers are a non-salmonid system, however IFI is currently assessing the viability of a salmonid reintroduction programme.		
AZ3	Santry River	Between Dardistown and Northwood stations	Poor	At Risk	Moderately Polluted	The proposed route crosses directly over the Santry River to the immediate east of the M50 interchange with the Naul Road/Ballymun Road at incline alignment. The Santry River is proposed to receive treated and attenuated surface water from drainage catchment F. Historically, flooding has occurred in the area with significant flood events reported including November 2002. Although there seems to be no flood risk to either of these two proposed route locations, there is a small area of flood risk (10% AEP) along the proposed route at the M50/Naul Road intersection. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q2, i.e. 'Bad Status' under WFD status and 'Seriously Polluted, Unsatisfactory' under ecological pollution status and condition.	*5km to North Dublin Bay SAC and North Bull Island SPA*	***Importance: Medium*** *Ecological Importance:* *Habitat - Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						Baseline water quality sampling in 2019 indicated no significant water quality issues other than minor exceedance of SWTV for zinc and elevated sulphate (94mg/l). This river is presently classified as Moderately Polluted for Clonshaugh Road Bridge (>3km east of the proposed route and baseline sampling point). The quality value has declined when compared with the classification from 2010-2016. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to Chapter 15 (Biodiversity) for further details. According to the IFI, The Santry is non-salmonid.		
AZ4	Bachelors Stream	West/south-west of Collins Avenue Junction (DCU)	Poor	At Risk	N/A	Tributary of the Tolka River and is not crossed directly by the proposed Project. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (147mg/l) and only minor exceedances of SWTV for ortho phosphate.	*Not directly connected to the Dublin Bay or Tolka River Natura Sites.*	***Importance: Medium*** *Ecological Importance:* *Habitat - Local Importance (Higher value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
AZ4	Tolka River	Between Griffith Park and Glasnevin stations	Poor to Moderate	At Risk	Moderately Polluted	The proposed route crosses beneath the Tolka River at St Mobhi Road in tunnel. Historically, flooding has occurred in different areas in close proximity to the proposed route including significant flood events in October 2011 at Botanic Gardens. The flood mapping for the Tolka is currently under review by the OPW. Q/kick-sampling undertaken at the metro crossing point gave a Q-Value of Q2-3, i.e. 'Poor Status' under WFD status and 'Moderately Polluted, Unsatisfactory' under ecological pollution status and condition. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (67mg/l). This river does not have WFD status assigned in the stretch between Violet Hill and Tolka Estuary (which crosses the proposal route). However, upstream (>1km from the 2019 baseline sampling point) at Violet Hill the river is classified as Moderately Polluted (Q3). The current value is consistent with classifications provided since 2007. Watercourse is classified as the habitat type depositing/lowland rivers (FW2), which is a relatively uncommon habitat in the surrounding area, somewhat species rich and contains a different species assemblage to those of the common habitats present. Refer to	*5km to North Dublin Bay SAC and 2.1km to South Dublin Bay and River Tolka Estuary SPA*	*Importance: Very High* *Ecological Importance:* *Habitat - Local Importance (Higher Value)* *European eel – International importance* *Atlantic salmon and Lamprey species – National importance* *All other fish species – Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						Chapter 15 (Biodiversity) for further details. According to the IFI, the Tolka River supports Atlantic salmon, Lamprey and Brown trout populations in addition to other fish species and provides a particularly important nursery function for salmonid species throughout. Salmon were recorded in the Glasnevin area in 2011.		
AZ4	Royal Canal	Between Glasnevin and Mater Hospital stations	-	-	Good	The proposed route crosses beneath the Royal Canal in tunnel. Data from the OPW indicate no historical information of flooding at the Royal Canal. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated sulphate (54mg/l). The current water quality of the canal is classified as Good in terms of macrophyte assessment. Watercourse is located within the boundaries of the nationally designated site the Royal Canal proposed Natural Heritage Area. Refer to Chapter 15 (Biodiversity) for further details.	*5km to North Dublin Bay SAC and North Bull Island SPA, 2km to South Dublin Bay SAC and 2.1km to South Dublin Bay and River Tolka Estuary SPA*	*Importance: Very High* *Ecological Importance:* *National Importance*
AZ4	River Liffey	Between O'Connell Street and Tara stations	Moderate	At Risk	Satisfactory (Moderately Polluted upstream)	The proposed route crosses beneath the River Liffey in tunnel. OPW flood data show that areas outside the proposed metro route corridor are liable to flooding (for example upstream at Chapelizod, Islandbridge and Kilmainham). No areas	*5km to North Dublin Bay SAC and North Bull Island SPA, 2km to South Dublin*	*Importance: Very High* *Ecological Importance:*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						within the proposed route corridor recorded any historical floods. However, in the context of the River Liffey there is a 0.5% AEP coastal flood risk to Tara Station. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated potassium (94mg/l) and sulphate (620mg/l) at the downstream tidal reaches of the river. According to EPA monitoring, the water quality in the River Liffey in 2019 was generally similar to 2016 i.e. generally satisfactory. The River Liffey at Islandbridge >3.5km to the west of the proposed route (and baseline sampling points) is classified as classified as Q3, 'Moderately Polluted'. Watercourse is classified as tidal rivers (CW2) habitat type and corresponds to the Annex I habitat estuaries (1130) and is therefore a habitat of high conservation concern. Refer to Chapter 15 (Biodiversity) for further details. According to the IFI, The Liffey system supports a regionally significant population of Atlantic salmon. The Liffey estuary serves as the natural linkage for species such as Salmon, Sea trout and Eels migrating between freshwater and ocean environments, providing the necessary habitat for their transition. Previous surveys in Dublin city area of	*Bay SAC and 2.1km to South Dublin Bay and River Tolka Estuary SPA*	*Habitat - National Importance* *European eel – International importance* *Atlantic salmon – National importance* *Sea trout – Local Importance (Higher Value)*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						the Liffey have recorded Eel and river lamprey.		
AZ4	Grand Canal	Between St Stephen's Green and Charlemont stations	-	-	Good	The proposed route crosses beneath the Grand Canal in tunnel. Data from the OPW indicate no historical information of flooding at the Royal Canal. The current water quality of the canal is classified as Good in terms of macrophyte assessment. Watercourse is located within the boundaries of the nationally designated site the Grand Canal proposed Natural Heritage Area. Refer to Chapter 15 (Biodiversity) for further details.	*5km to North Dublin Bay SAC and North Bull Island SPA, 2km to South Dublin Bay SAC and 2.1km to South Dublin Bay and River Tolka Estuary SPA*	*Importance: Very High* *Ecological Importance:* *National Importance*
AZ4	River Dodder	East of Charlemont station	Moderate	At Risk	Slightly polluted	The Dodder is not crossed directly by the proposed route. According to EPA monitoring, the water quality in the River Dodder in 2019 at Beaver Row (station 0900) was generally similar to 2016 i.e. generally unsatisfactory. Baseline water quality sampling in 2019 indicated no significant water quality issues other than elevated potassium (68mg/l) and sulphate (413mg/l) at the downstream tidal reaches of the river near Grand Canal basin. The EPA station (0900) is >500m upstream of the baseline monitoring point. According to the IFI, the River Dodder is also exceptional among most urban rivers in the area in supporting Atlantic salmon and Sea trout in addition to	*5km to North Dublin Bay SAC and North Bull Island SPA, 2km to South Dublin Bay SAC and 2.1km to South Dublin Bay and River Tolka Estuary SPA*	*Importance: Very High* *Ecological Importance:* *Habitat present – Local Importance (Higher Value)* *European eel – International importance*

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Current WFD Risk Score	EPA Ecological value (latest)	Summary Description/Comments	Distance to nearest Natura Site 2000 (km)	Importance of Attribute
						resident Brown trout. The sections from Herbert Park in Ballsbridge to Beaver Row in Donnybrook and from Milltown to Rathfarnham are regarded as prolific trout fishery waters. Fishery habitat is regarded as particularly good for all salmonid life stages throughout the Dodder system.		*Atlantic salmon – National importance* *All other fish species – Local Importance (Higher Value)*
AZ4	River Poddle	West of Charlemont station	Poor	At Risk	Moderately Polluted	The Poddle is not crossed directly by the proposed route. No baseline sampling was undertaken on this water feature.	*Not directly connected to the Dublin Bay or Tolka River Natura Sites.*	***Importance: Medium*** *Ecological Importance:* *Habitat – Local Importance (Higher Value)*

18.5 Predicted Impacts

18.5.1 Introduction

A detailed description of the proposed Project (Construction and Operation) is provided in Chapter 4 (Description of the MetroLink Project), Chapter 5 (MetroLink Construction Phase) and Chapter 6 (MetroLink Operations & Maintenance). This section outlines the characteristics of the proposed Project in relation to the existing hydrological environment and assesses the predicted impacts.

The Impact Assessment follows the EPA Guidelines for the EIAR process as outlined in Section 18.3 of this EIA Chapter and in Chapter 2 (Methodology in Preparation of the EIAR). The predicted impact on the attributes (as described in Table 18.15 above) is described with and without mitigation.

The design includes measures to manage stormwater flow and reduce potential for accidental discharge to surface water as a result of the proposed Project. Both design and mitigation measures are outlined in Section 18.6 below.

In summary, unattenuated runoff and unmitigated releases to surface waters during construction could have temporary impacts on water quality and quantity impacts on the hydrological environment. However, for the proposed Project, Construction Phase management includes mitigation measures (outlined in the Outline Construction and Environmental Management Plan (CEMP) Appendix A5.1 of this EIAR) to protect receiving waters (groundwater and surface water) and ensure continued conveyance of natural surface watercourses. Furthermore, there are no proposed discharges of waters from the Construction Phase directly into a nearby watercourse. Therefore, the only source during construction is an accidental spillage and/or discharge which is mitigated against in the outline CEMP.

During operation, the proposed Project has a low potential for surface water quality impact or conveyance and flood risk. There is limited potential for accidental releases: the vehicles are electric and there is minimal bulk chemical storage. The design incorporates specific design measures to manage risks to the environment such as:

- Chemicals required for maintenance works are stored within bunds, primarily within the Dardistown Depot;
- Stormwater drainage is designed in accordance with Sustainable Drainage Systems (SuDS) and is collected and discharged to stormwater sewer or open river sections following appropriate attenuation and treatment; and
- Interceptors (oil separators) are included in maintenance yards and carparking areas.

There is only a limited potential for collection of drainage water from within the tunnel (which will be an enclosed, watertight system) for example at the interface with stations, and this will be discharged to the public wastewater sewer. All culverts, diversions, bridges and discharge points are designed to facilitate natural conveyance of streams and rivers. There will be no operational phase dewatering and therefore no impact on baseflows of streams/rivers.

The elements of the proposed Project that will interact with the hydrological environment fundamentally are those activities that have the capacity to change the surface water regime in terms of local flow patterns and water quality. The potential impacts, if not adequately addressed in design or mitigation measures, during construction and operation of the proposed Project on the character of the receiving surface waters are described below.

18.5.1.1 Construction Phase

- Potential impact to surface watercourses (flow and water quality) which are crossed, culverted or diverted;
- Potential impacts (flow) due to increase in surface runoff from temporary construction compounds;

- Potential for accidental discharge-related pollution (water quality - sediment loading within run-off and/or accidental release during construction of hydrocarbons and alkaline water from cement works, grouting) entering watercourses; and
- Potential for faecal contamination discharging to surface water arising from inadequate treatment of on-site toilets and washing facilities.

18.5.1.2 Operational Phase

- Potential for increase in flooding and water quality impacts due to increase in runoff from new hardstand areas such as the Dardistown Depot and the P&R Facility facility;
- Potential impact to surface water quality resulting from track drainage discharge to the surrounding hydrological environment;
- Potential for increase in flooding risk due to inadequate culvert/viaducts design or encroachment on flood plains;
- Potential impact to stream/river morphology as a result of stormwater discharges to identified water features; and
- Potential impact on habitats of ecological importance within watercourses crossed by/downstream of the proposed Project, e.g. Malahide Estuary SAC.

18.5.2 Do Nothing Impact Assessment

In the event of the proposed Project not being constructed, there would be no resulting impacts on the hydrology within the vicinity of the proposed Project. However, changes in the existing hydrological baseline will occur as a result of land use zoning on current land use. Much of the farmland in north County Dublin along the corridor is designated for development which would result in an increase in impermeable areas. This increase in hardstanding areas would be mitigated by requiring developers to maintain green field runoff rates as a result there would be no overall change to flooding but the trend in change of land use will result in local changes to recharge and hydrological flow patterns.

18.5.3 Construction Phase Impact Assessment

Activities associated with the Construction Phase can interact with hydrological receptors by changing the water regime that a receptor is dependent upon. Potential impacts are outlined in this section with a summary of the impact assessment for each potential impact presented in Section 18.5.3.4 and Tables 18.16 and 18.17 below.

Mitigation measures are described in Section 18.6 below and residual impacts, i.e. post mitigation measures, are outlined in Section 18.7 below.

The following are considered in the Construction Phase impact assessment:

- Surface water crossings, culverts and diversions;
- ESB High Voltage cable installations;
- Flooding during the Construction Phase;
- Discharges during the Construction Phase;
- Discharge from construction compounds and construction work areas;
- Construction of football pitches; and
- Potential discharge of microplastics.

18.1.1.1 Surface Water Crossings, Culverts or Diversions

All proposed watercourse culverts, crossing and diversions will be designed in accordance with *Section 50 of the Arterial Drainage Act, 1945*, as amended and compliance will be required from OPW and IFI. This will ensure continued conveyance of existing flows without any upgradient or downgradient impacts on flow or water quality. The following summarises the main crossings, culverts and diversions along the proposed Project.

18.5.3.1.1 AZ1 – P&R Facility

There are a number of ditches coming from Staffordstown that require diverting around the Park & Ride Facility building area. The existing stream/ditch system will be diverted as follows.

Western Stream/Ditch:

- Diverted via open channel (intercepting ditch) to the north side of the proposed Park & Ride Facility site with 500mm diameter concrete pipes under the new Estuary Station access roads;
- Diverted below the Estuary Station Turnback area and tracks via a 500mm diameter concrete pipe and from there fed into new attenuation ponds north-east of the Park & Ride Facility structure; and
- Diverted within the site along the eastern boundary of the Park & Ride Facility structure with an outfall into the existing watercourse adjacent to the R132.

The proposed diversion of the existing ditches would mainly comprise up to 300mm to 500mm diameter concrete piped surface water culverts, excavated to gradient and bedded/surrounded in approved bedding material. In addition, open/intercepting channels and attenuation ponds also form part of this diverted surface water system, in order to re-direct the existing ditches around to the north-east and south of the Park & Ride Facility building. The impact of this diversion, if not adequately designed with adequate mitigation measures during construction, is *Moderate to Significant Impact* due to the potential impact on water quality and river morphology.

When the planned earthworks progress far enough, some or all of the culvert diversion works would be included with the pre-earthworks site drainage measures. It is likely that additional temporary piped culverts or open channels would be constructed to accommodate completion of permanent culvert diversions and necessary haul roads within the Estuary Station site.

The permanent culvert works will involve either temporary diversion and culverting for the watercourse or constructing a temporary dam upstream of the works and pumping the water to the downstream side of the works. Method statements will be agreed with OPW prior to the commencement of any construction works. The potential impact of this feature, if not adequately designed with supplementary mitigation measures, is *Moderate to Significant Impact* due to the potential impact on water quality and river morphology.

Further construction details on the culverted section are described Appendix A5.10 Watercourse Diversions. The contractor will be required to use a detailed designed culvert in regard to OPW requirements (i.e. Section 50) and to maintain current and future watercourse flow including to facilitate climate change flows.

18.5.3.1.2 AZ1 - Northern Section

The proposed viaduct over the Broadmeadow River and Ward River will comprise a 13-span concrete piled structure with twin concrete bridge deck beams taking one track each. Temporary construction of 'bailey' bridges crossing the two watercourses will be required for access of construction traffic. As part of the Flood Risk Assessment for the Broadmeadow and Ward River Crossings, a requirement was identified for Metrolink to construct a viaduct on an approximate 260m length on the southern approach to the Ward River to ensure no upstream flooding arising from the proposed Project.

Temporary modular type temporary bridges, which are assembled on site will be used to span over rivers to provide access for construction traffic and site personnel. These temporary bridges would likely be lifted in one operation but can also be pre-assembled, launched or slid into position over the channel or rivers. The bridge decks can be sealed to provide built-in protection to minimise risk of siltation or other unwanted material from entering or seeping from the temporary bridge deck into the rivers.

Given the proximity of the proposed spread foundations to support the bridge spans, it is proposed that a cofferdam method would be adopted to reduce the risk of grout or concrete spillage entering the watercourses. Constructing a cellular cofferdam is done by driving sheet piles in a circular pattern, and then repeating this process adjacent to the original to form a series of circular cells. Each of these cells connects to one another and forms a tight seal that prevents water from entering.

Subject to prevailing ground conditions, temporary foundations for temporary bridge crossings would be constructed to ensure minimal disturbance of the watercourse shoreline or bank. The standard temporary foundation construction for river crossings is usually formed as part of the temporary haul road construction and river crossing approaches. The potential impact of this feature, if not adequately designed with adequate mitigation measures, is Moderate to Significant Impact due to the potential impact on water quality and river morphology.

Foundations can be excavated with the use of sheet piling to protect the works from flooding and the watercourse from being contaminated. The ground or haul road would likely involve a building up of material to form the temporary road surface and approach. The use of precast beam components placed in shallow excavations on compacted granular base material will form combined temporary bridge seating and abutments.

Temporary in-river construction works will be required as part of this construction work. The design of the bridge span is based upon a modelled prediction of water conveyance for the 100-year period flood event with the recommended allowance for climate change in accordance with OPW requirements. As such, there is no likely impact on up-gradient or down-gradient potential for flooding. Diagram 18.6 and Diagram 18.7 below present the proposed construction design.

The construction works start with the foundations. Temporary excavations will be required below the base of the foundation. Blinding concrete will be spread with a thickness of about 10cm.

Once the surface is ready, the formwork and reinforcement are installed. After that, the pouring of the concrete of the foundations is done. Any waterproofing or protection of the footings will be provided before the required earthworks that will provide a covering on the foundation of about 1m.

After that, the piers and the lintel are constructed. The bearings will be installed using non-shrinkable mortar to define the levels properly.

The precast beams will be erected by girders and the top slab of each span will be cast in situ. The remaining tasks to provide drainage, earthing and bonding and trackworks will be done in later stages.

As part of these works, it is proposed that a watermain diversion is needed to allow for the construction of this viaduct structure. It is proposed that this diversion will involve horizontal directional drilling (HDD) to install the new watermain. This method is assigned a 'low significance' rating as it involves horizontal drilling underneath the waterbody and into the subsoil and/or weathered rock (to unknown depths) for subsequent pipe installation purposes. Similarly, with the appropriate design measures set out in this EIAR report and that approval of the methodology from the IFI is need prior to any construction works – this significance during construction would be 'Imperceptible'. During the operation phase, the significance is 'Imperceptible'.

These construction works are considered to be Temporary in duration as construction works typically will not last longer than one year, individually.

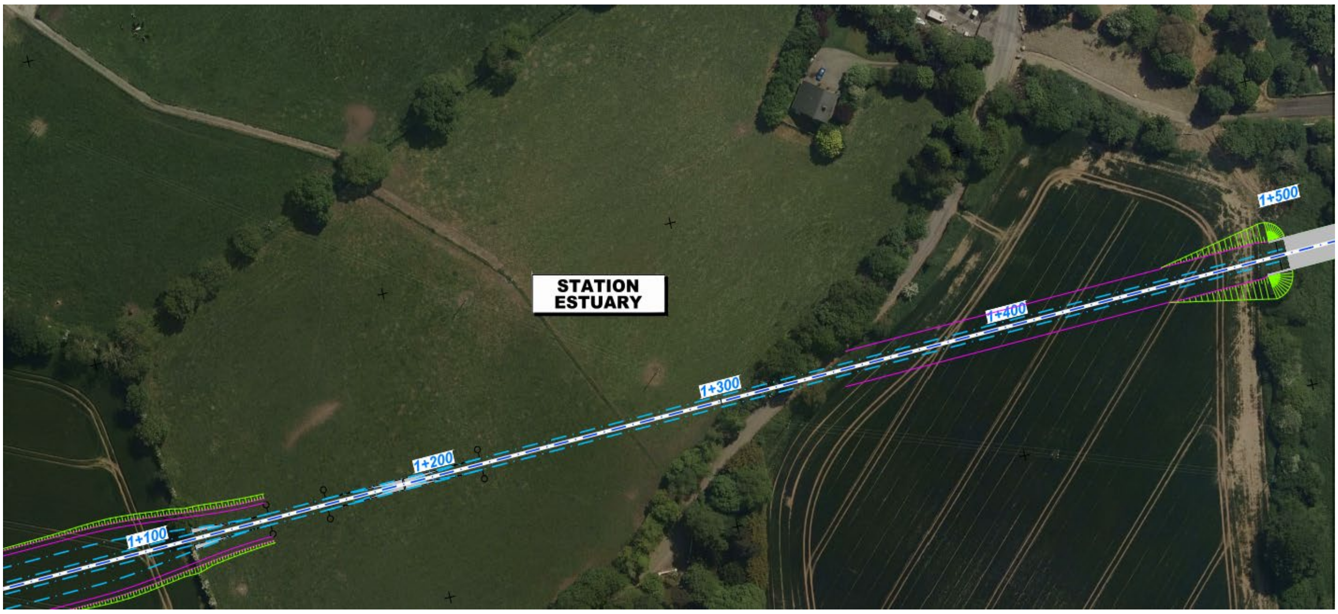

Diagram 18.6 Construction of Viaduct over Broadmeadow River and Ward River (Part I)

Diagram 18.7 Construction of Viaduct over Broadmeadow River and Ward River (Part II)

18.5.3.1.3 AZ2 – Airport section

At chainages Ch. 5+963 and Ch. 5+762 the proposed Project crosses the Sluice River necessitating the construction of a box culvert with provision for mammal crossing at chainage 5+963, as presented in Diagram 18.8 below. A farm accommodation culvert underpass is also required at Ch. 5+762.

The culvert to be constructed at Ch. 5+963 is up to 26m long, 2.5m high and 2.0m wide internally incorporating a mammal shelf.

The culvert to be constructed at Ch. 5+762 is up to 50m long, 6.6m high and 5.8m wide internally incorporating a mammal shelf in a 2.0m wide stream, and a 3.6m wide underpass roadway at a level of +42.3m. The road and stream are divided by a 2.0m wide internal reinforced concrete wall.

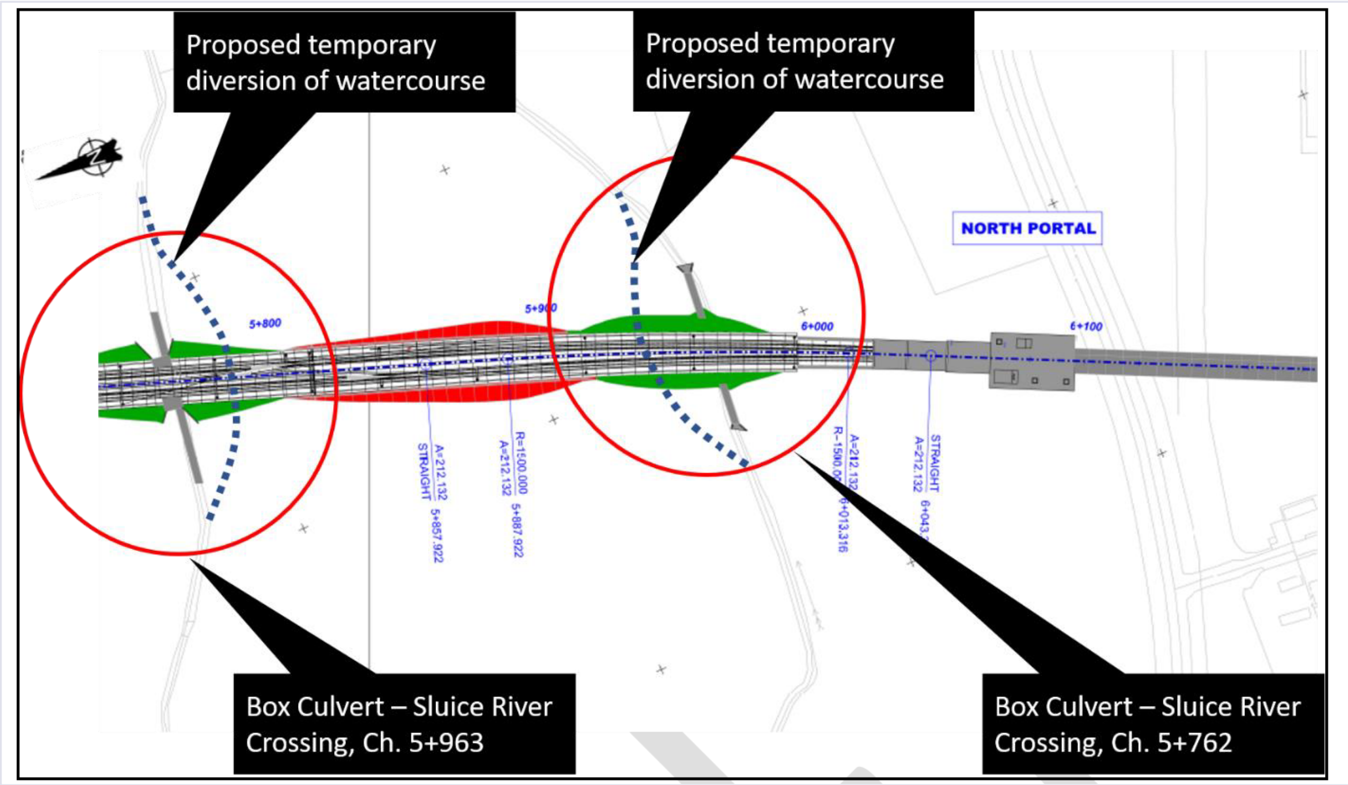

Diagram 18.8 Proposed Culvert Works – Sluice River Crossings

Diagram 18.8 above also indicates the proposed temporary river diversions to be established prior to commencing the installation of the permanent box culvert structures, which would be subject to a Section 50 application and prior approval by the OPW. Local Authority approval may also be required.

Electrical power will be provided from the national grid (Electricity Supply Board Networks Ltd - ESBN) at 110kV (kilovolt) alternating current (AC), which will feed two high voltage (HV) bulk connection (multi-purpose connection) substations, which will be Gas Insulation Switchgear (GIS) transmission power substations. The new electrical substations will be constructed at the DANP and at the Dardistown Depot. Other works required include the installation of a number of new transmission cables and minor works at two existing utility transmission substations at Newbury and Belcamp.

As described above, one of two GIS transmission power substations will be located near the DANP which will transform the incoming high voltage power supplied by ESBN to medium voltage power to operate the proposed Project.

The substation compound will be located immediately north of the Naul Road and east of the DANP and will include both the ESBN substation, MetroLink substation and associated transformers. An underground power line will connect the MetroLink substation to the alignment. An access road to the GIS transmission power substation will be provided from the Naul Road.

These construction works are considered to be Temporary in duration as these construction works typically will not last longer than one year, individually.

18.5.3.1.4 AZ3 – Dardistown to Northwood

The Santry River crosses immediately north of the proposed Northwood Station; the watercourse passes west to east as an existing culverted feature beneath the Naul Road, with an additional culverted tributary also crossing beneath the Naul Road. In order to accommodate the proposed Project, some minor alterations are proposed to the Santry River immediately downstream of the proposed Project's crossing. These works will comprise minor alterations to straighten the channel, including the addition of scour protection, immediately downstream of the culvert outlet. The effect of these works will be to reduce hydraulic losses at the culvert outlet, resulting in a marginal increase in culvert capacity.

The proposed Dardistown Depot is located at the head of the Mayne River system. Diversion of the Turnapin Stream which is a tributary of the Mayne River will be required to maintain local drainage routes.

The main vehicular access to the site is via Collinstown Lane (also known as the Old Airport Road) to the northwest of the depot. The access road will be raised slightly above existing ground level due to the provision of a culvert over a tributary to the River Mayne. The depot access road will also serve as an access to the HV ESB substation that will serve the proposed Project. The main electricity supply to the depot will be provided by ESBN via a 110/20kV substation located outside, but close to, the depot. The 20kV incoming and outgoing lines of the 20kV ring will be connected to the E building (Electrical Building) and the 20kV switchgear.

These construction works are considered to be *Temporary* in duration as these construction works typically will not last longer than one year, individually.

Further general construction methodologies on culverts and watercourse diversion protocols are discussed Appendix A5.10 Watercourse Diversions.

18.5.3.1.5 AZ4 – Northwood to Charlemont

As the proposed Project alignment is completely underground in this section of the Project, there are no waterbody crossings for this section. The alignment will be tunnelled beneath the watercourses and culverted historical/hidden watercourses that traverse the alignment in area AZ4. Refer to Table 18.10 under Section 18.4.5 above for the depth of the tunnel below the crossed riverbeds in the context of geological environment.

The Royal Canal is a man-made waterway between the River Shannon in Longford and the River Liffey in Dublin. This water feature is generally navigable between the River Shannon and Dublin and is of important tourist and amenity value. The proposed Project alignment crosses beneath the Royal Canal to the immediate west of Prospect Road south-west of Hart's Corner, Glasnevin, in tunnel.

The construction of Glasnevin Station will temporarily affect the Royal Canal, with a working area to be created in the canal basin, resulting in the closure and temporary draining of this section of the canal. This closure has been agreed with the IFI and other relevant parties, refer to EIAR Chapter 4 (Description of the MetroLink Project), EIAR Chapter 8 (Consultation) and Appendix A8.16. Secant piling will be required as part of the interchange works in order to reinforce the canal wall and as part of the construction of new retaining walls that will be built along with new platforms to allow for the interchange with the Iarnród Eireann rail services.

The maximum duration of time that the canal will be closed is predicted to be 24 months (Short-Term). However, subject to further consultation and agreement with Waterways Ireland, it was stated that the canal would be drained to install sheet piles for 3 months only and again when the works are completed another 2 months were required to reinstate and remove the sheet piles and other associated structures. The canal retaining wall will be strengthened and the functioning of the canal will remain unchanged.

As such, there is a short-term significant effect on the Royal Canal based on the proposed design measures during the Construction Phase. The design of the tunnel and station will ensure that there will be no impact on this amenity during the Construction Phase of the proposed Project. This is due to the detailed outline CEMP (Appendix A5.1) for this part of the site which details design measures during the Construction Phase.

18.5.3.1.6 Summary of Impact Assessment

There will be eight water crossings for the proposed Project. All crossings are located in areas AZ1 to AZ3. AZ4 is below ground in tunnel and therefore below the waterbodies identified and assessed in this section (refer to Table 18.10 above).

A summary table of the impact assessment for culverts, crossings and diversion during construction is presented in Table 18.17 under Section 18.5.3.4 below.

A summary of the impact assessment for each potential discharge is presented in Section 18.5.3.4 and Table 18.18.

Mitigation measures are described in Section 18.6 below and residual impacts, i.e. post mitigation measures, are outlined in Section 18.7 below.

18.1.1.2 ESB Connections - Surface Water Crossings

It is the policy of ESB that, in so far as possible, high voltage underground cables shall only be installed under public roads. One of the key advantages of laying cables under roadways is that there is usually no permanent impact on the environment additional to that caused by the presence of the roadway. When an underground cable is laid under an existing roadway the potential for impact is normally only a short-term impact during the Construction Phase.

However, in certain situations high voltage cables cannot be installed in existing roadways and have to be installed across waterbodies and drainage ditches. The crossing of streams and rivers shall be carried out by open trench method or trenchless methods. The open trench method crossing of streams and rivers can be carried out by 'damming and fluming' or 'damming and pumping'.

The method adopted shall be implemented only with the approval of Inland Fisheries Ireland (IFI) prior to the commencement of any construction works. Where applicable, the construction shall take place outside the salmon spawning period from October to April unless otherwise agreed with IFI.

A detailed description of the proposed Grid Connections route is presented in the MetroLink/ESBN Construction Methodology of HV Cable Routes (Appendix A18.4). The local receiving environment for the proposed Grid Connections is dominated by existing roads as the majority of the works will take place within the footprint on existing roads. The proposed Grid Connections alignment will potentially cross several watercourses including the Dunbro Stream, Barberstown Stream, Cuckoo Stream and Mayne River.

All design measures set out in the MetroLink/ESBN Construction Methodology of HV Cable Routes (Appendix A18.4) shall be implemented during the installation of underground cables which cross waterbodies and/or drainage ditches.

Electrical power will be provided from the national grid at 110kV AC, which will feed two HV bulk connection (multi-purpose connection) substations, which will be GIS transmission power substations. The new electrical substations will be constructed at the DANP and at the Dardistown Depot. Other works required include the installation of a number of new transmission cables and minor works at two existing utility transmission substations at Newbury and Belcamp.

As described above, one of two GIS transmission power substations will be located near the DANP which will transform the incoming HV power supplied by ESBN to MV power to operate the proposed Project.

The substation compound will be located immediately north of the Naul Road and east of the DANP and will include both the ESBN substation, MetroLink substation and associated transformers. An underground power line will connect the MetroLink substation to the alignment. An access road to the GIS transmission power substation will be provided from the Naul Road.

The main electricity supply to the depot will be provided by ESBN via a 110/20kV substation located outside, but close to, the depot. The 20kV incoming and outgoing lines of the 20kV ring will be connected to the E building (Electrical Building) and the 20kV switchgear. Refer to Chapter 4 to Chapter 6 of the EIAR for further detail on the MetroLink Grid Connections.

18.5.3.1.7 Summary of Impact Assessment

There will be multiple water crossings for the proposed Project to facilitate the installation of high voltage underground cables. As previously mentioned, these will be installed in roadways where possible. However, due to the scale of the proposed Project, it is envisaged that there will be installations within nearby watercourses.

As referenced, the options provided by MetroLink/ESBN Construction Methodology of HV Cable Routes (Appendix A18.4) are as follows:

- Option 1 – Open Trench (Damming and Fluming)
- Option 2 – Open Trench (Damming and Pumping)
- Option 3 – Trenchless Installation

However, based on the three methods described in Appendix A18.4 the following can be concluded:

- Options 1 and 2: These involve in-stream works and will have a 'higher significance' than the third option presented. However, with the design measures set out in the report and that approval of the methodology from the IFI is needed prior to any construction works – this significance during construction would be 'Not Significant'. During the operation phase, the impact significance is 'Imperceptible'.
- Option 3 above: The third option will have a 'lower significance' rating applied as it involves horizontal drilling underneath the waterbody and into the subsoil and/or weathered rock (to unknown depths) for subsequent pipe installation purposes. Similarly, to Option 1, with the design measures set out in the report and that approval of the methodology from the IFI is need prior to any construction works – this significance during construction would be 'Imperceptible'. During the operation phase, the significance is 'Imperceptible'.

In terms of the GIS substation buildings, these are designed as self-contained buildings with bunds. All equipment and materials shall be new and of the highest quality and shall be capable of withstanding the electrical and atmospheric environmental conditions on site over the anticipated GIS switchgear life. Therefore, the significance during construction would be 'Temporary' and 'Not Significant'. During the operation phase, the impact significance is 'Permanent' and 'Imperceptible'.

18.5.3.2 Flooding during the Construction Phase

Construction sites can have an impact on the damage a flood event can cause, both to the wider environment and the site itself. During construction, drainage is altered, and land use is changed. This alters the dynamics of any flood water in terms of capacity, attenuation, runoff and quality. Poor planning and preparation for flood events can have a significant impact and cause increased damage to the environment, surrounding areas as well as damage to structures on and off site and cause programme delays.

Sites are typically cleared of all structures and vegetation at the start of the works. Increasing the capacity for flood waters to pick up sediment and reducing attenuation of the area. Additionally, any stockpiles can increase the sediment within the water greatly. Sediment rich flood waters can cause erosion of riverbanks, they can block gullies, pipes and other drainage systems resulting in increased flood risk and cause damage to the aquatic environment by settling in ecosystems. Flood waters can also pick-up pollutants as they pass through a construction site. A flood event may cause excavations, boxes, shafts and tunnels to fill with water. These structures are able to collect a significant quantity of water which will be contaminated and need treatment prior to disposal. This will also have a significant impact on the programme as time will be needed to treat and pump out the water and return the site to safe work conditions.

The planning and mitigation for flooding events as part of the outline CEMP is important in minimising these impacts. Poor planning and preparation for a flood event can have significant impact. With good planning and preparation, a construction site may not increase the impact the damage of a flood event could have and potentially have a positive impact. Potential impacts if not adequately managed are outlined below:

18.5.3.3 Discharges during the Construction Phase

During construction of below ground structures, temporary dewatering will be required where the phreatic (natural) water table is encountered. This occurrence is more frequent in the northern section of the route as well as during the early stages of below ground station construction. The potential impact of dewatering on surface waters is considered in detail in Chapter 19 (Hydrogeology) of this EIAR. Section 19.5.3 in Chapter 19 (Hydrogeology) provides detailed information on anticipated dewatering volumes from the construction of deep excavations as well as the modelled zone of influence of [temporary] dewatering activities beyond the point of pumping and in the context of potential receptors including hydrological attributes.

As assessed in Chapter 19 (Hydrogeology), generally there is no likely impact from dewatering on long-term baseflow in any rivers due to the clayey nature of the soil in which most of the identified rivers along the proposed route flow. However, the River Tolka for example is set in QBR clays/upper weathered rock so there is a slight potential for a temporary impact close to where significant dewatering may occur during construction. As such, within area AZ4, the predicted impact from dewatering is considered Temporary, Imperceptible to Not Significant based primarily on proximity to the Tolka River (open channel ~90m from dewatering site), Wad River Diversion (~30m), River Liffey (~140m), historical, subterranean watercourses i.e. Stein River and Gallows River (near Tara station) both of which ultimately discharge to the River Liffey in this area.

All water discharges from construction areas are likely to be high in sediment, with potentially elevated alkalinity where cement works are on-going. The construction design incorporates attenuation (acceptable rates as approved by the relevant Local Authorities) and treatment prior to approved discharge to the respective defined sewer. The outline CEMP refers to detailed mitigation measures to be implemented during the Construction Phase with attention to stormwater discharges /other water discharges (Section 6.4 of the outline CEMP), biodiversity (Section 6.7 of the outline CEMP) and the management of soil (Section 6.5 of the outline CEMP). Furthermore, a Soil Management and Pollution Prevention Plan will be undertaken as part of the approved site CEMP prior to the commencement of any construction works. This CEMP document will be constructed by the works Contractor. The outline CEMP is a 'live' document and will go through a number of iterations before works commence and during the Construction Phase itself. The outline CEMP provided with this application set out the minimum requirements and standards which must be met during the construction stage and includes any relevant mitigation measures outlined in this EIAR. It will be updated by the Contractor to address any subsequent planning conditions relevant to the proposed development. Measures for management of run-off and pumped water are included in Mitigation Measures, Section 18.6, sub-section 18.6.1 below.

Water discharges from the construction areas will be to sewers following effective treatment and attenuation and on the basis of a temporary permit/consent as issued by the relevant Local Authority. The contractor will be required to provide a Water Management Plan for disposal of construction run-off water for approval. Monitoring of the discharge will be in accordance with Local Authority discharge requirements and any discharge water which exceeds approved discharge limits will be re-circulated at the site and treated or will be disposed offsite to an appropriate disposal facility. Based on the typical nature of construction related water, it is likely that discharge water will require [recorded] daily inspection and monitoring for key parameters including pH, suspended solids and mineral oils. Where discharge is not possible, then all contained contaminated water and/or firewater will be tankered off-site to a licensed facility for disposal or treatment.

The most significant works areas are primarily associated with the tunnel bore launch locations, namely:

- Immediately south of Collinstown Lane (Old Airport Road) and Dublin Airport. This TBM launch site allows tunnelling northwards towards the proposed deep station at Dublin Airport; and

- Adjacent to the proposed Northwood Station to the west of the R108 and south of St Margaret's Road. This TBM launch site allows tunnelling southwards towards Ballymun Station and to the proposed Charlemont Station in the suburb of Ranelagh.

18.5.3.4 Discharge from Construction Compounds and Construction Work Areas

Runoff from construction compounds and construction areas pose a risk to receiving waters if not adequately mitigated. A strict Soil and Water Quality Management Plan (as described in the outline CEMP and described below in Section 18.6 mitigation including defined and effective set-back distances from the respective water course) will be required to be adhered to by the contractor. Management of excess soil will be managed through a Spoil Management Plan.

Project features all have the potential to impact on surface water and groundwater quality during the Construction Phase. Sources of water for discharge off site include primarily groundwater from dewatering of the R132 cuts, TBM Portal sites, station boxes, intervention shafts and discharge from the TBM process itself, but also localised surface water run-off.

A number of surface water features will be crossed by the proposed Project, as discussed above. These include the Broadmeadow River, Ward River, Sluice River (and Forrest Little Stream), and the Mayne River, Santry River, Tolka River, Royal Canal, River Liffey and the Grand Canal. There are no proposed discharges to nearby watercourses. All water from the Construction Phase will be discharged to sewer where appropriate. After consultation with IW, it is apparent that discharge to sewer is optimum where treated water will discharge under appropriate permit prior to the commencement of the construction works (refer Table 18.4.7 below).

All [combined surface water and groundwater] water discharges from construction site areas are initially likely to be high in sediment, with potentially elevated alkalinity where cement works are on-going and will require adequate attenuation and treatment prior to approved discharge to the respective defined sewer.

Run-off associated with on-site dampening activities where diaphragm walls are installed (for example at Griffith Park (Tolka River) and within the city centre at Tara Street (River Liffey)) poses a potential impact on local water quality. In relation to the O'Connell Street station, there is limited potential impact (effect) to the hydrological environment. In the scenario of during the Construction Phase with or without Hammersons, there is little impact to the surrounding hydrological environment for both scenarios. Without Hammersons, there will be less excavated material however, once construction is commenced on Hammerson, the works Contractor will need to abide by the project-specific CEMP to ensure the protection of the surrounding environment.

Ineffective management of material at batching/bentonite plants also represent potential impact on water quality through run-off effects. The requirement for a Spoil/Excavated Material Management Plan alongside a Pollution Prevention Plan as part of overall soil and water quality management forms a key part of the outline CEMP for the Project. In brief, the contractor will be required to undertake all works in accordance with the outline CEMP which will cover *inter alia* environmental control measures specifically related to water, Soils & Geology and biodiversity hence affording protection of the hydrogeological environment and its related attributes.

Faecal contamination of subsoils and groundwater arising from inadequate treatment of on-site toilets and washing facilities (grey water) is also a potential impact on the water environment if not properly managed. As outlined below this will be mitigated by providing on site welfare facilities for the workforce which may be connected to the sewerage system or tankered away.

Table 18.16 below presents the construction and contractor compound sites and bulk fuel storage with subsoil storage involved in the proposed Project. Furthermore, the table provides a summary of the construction and compound sites along the full route together with the planned discharge point (surface water/storm sewer) and the estimated daily rate of discharge to that receiving feature. None of the planned construction or compound sites are located immediately within areas which have potential for fluvial or coastal flooding.

Table 18.16 Summary of all Construction and Contractor Compound Sites and Bulk Fuel Storage with Subsoil Storage

Ref. Area	Site Reference	Construction Site Type	Bulk Fuel Storage Type	Subsoil Storage (Y/N)	Flooding Potential Y/N	Inferred Nearest Watercourse
	Estuary Station construction and logistics site	Main	Fuel/Gas	Yes	Low probability 0.1% AEP flooding on the north boundary of the compound. 1% AEP flooding from the Broadmeadow River to the south outside the boundary of the site.	Staffordstown_08 and Broadmeadow 08
AZ1	Estuary Court	Satellite	Fuel/Gas	Yes	Ward River is 450m to west of site. No risk of flooding.	Ward
	Seatown Construction Site	Satellite	Fuel/Gas	Yes	Low probability 0.1% AEP flooding to the west outside the boundary of the compound	Ward
	Fingallians footbridge site	Satellite (Ancillary)	No	No	No risk of flooding. Site 350m from stream.	Ward
	Seatown Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 550m from river.	Ward
	Fingal County Council	Satellite	No	No	No risk of flooding. Site 500m from river.	Ward
	Woodies	Satellite	No	No	No risk of flooding. Site 550m from river.	Ward
	Mantua Park	Satellite	No	No	No risk of flooding. Site 450m from river.	Ward
	North Dublin Corporate Park	Satellite	Fuel/Gas	Yes	No risk of flooding. Site 650m from river.	Ward
	Chapel Lane	Satellite	No	No	No risk of flooding. Site 500m from river.	Ward
	Pavilions Shopping Centre	Satellite	No	No	No risk of flooding. Site 550m from river.	Swords Glebe
	Swords Central	Main	Fuel/Gas	Yes	No risk of flooding. Site 100m from stream.	Gaybrook Stream North
	Pinnock Hill Roundabout Satellite Site	Satellite	No	Yes	Low probability 0.1% AEP flooding on site. Very low risk of flooding during use of compound.	Gaybrook River and Gaybrook Stream North

Ref. Area	Site Reference	Construction Site Type	Bulk Fuel Storage Type	Subsoil Storage (Y/N)	Flooding Potential Y/N	Inferred Nearest Watercourse
	Pinnock Hill Roundabout Lorry Holding Area	Logistic	No	No	Low probability 0.1% AEP flooding on site. Very low risk of flooding during use of compound.	Gaybrook River and Gaybrook Stream North
	Swords Central Footbridge Construction (Swords Satellite construction and logistics site)	Satellite	No	No	Low probability 0.1% AEP flooding on site. Very low risk of flooding during use of compound.	Gaybrook Stream North
	Nevinstown Lane construction site	Satellite	No	No	No risk of flooding. Site 200m from river	Gaybrook River
	Fosterstown Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 300m from river	Gaybrook River
	North Portal (North Section)	Satellite	No	Yes	No risk of flooding. OPW map shows no flooding from Sluice River to the north of the site	Sluice
AZ2	Dublin Airport North Portal	Main	Fuel/Gas	Yes	No risk of flooding. OPW map shows no flooding from Sluice River to the north of the site	Sluice
	Boland construction site	Satellite	Fuel/Gas	Yes	No risk of flooding. Site 450m from river	Sluice
	Dublin Airport Station	Main	Fuel/Gas	Yes	No risk of flooding. OPW map shows no flooding within Dublin Airport.	Sluice
	Dublin Airport South Portal	Main	Fuel/Gas	Yes	No risk of flooding. Site 150m from river	Mayne_09
AZ3	Dardistown Station and Depot	Main	Fuel/Gas	Yes	No risk of flooding. Site 400m from river	Mayne_09
	Northwood Station and Portal	Main	Fuel/Gas	Yes	No risk of flooding. Site 350m from river	Santry
	Northwood Logistics Yard	Logistics	No	No	No risk of flooding. Site 150m from river	Santry

Ref. Area	Site Reference	Construction Site Type	Bulk Fuel Storage Type	Subsoil Storage (Y/N)	Flooding Potential Y/N	Inferred Nearest Watercourse
	M50 Viaduct	Construction Site	Fuel/Gas	Yes	No risk of flooding. Site 200m from river	Santry
	Ballymun Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 1.00km from river	Mayne
AZ4	Collins Avenue	Main	Fuel/Gas	Yes	No risk of flooding. Site 1.20m from river	Tolka
	Collins Avenue – Additional Area	Logistics	No	No	No risk of flooding. Site 1.50km from river	Tolka
	Albert College Vent Shaft	Main	Fuel/Gas	Yes	No risk of flooding. Site 110m from river	Tolka
	Griffith Park	Main	Fuel/Gas	Yes	No risk of flooding. Site 50m from river	Tolka
	Glasnevin Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 890m from river	Tolka
	Mater Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 1.20km from river	Tolka
	Mater Station – Additional Area	Additional	No	No	No risk of flooding. Site 1.10km from river	Tolka
	O'Connell Street	Main	Fuel/Gas	Yes	No risk of flooding. Site 430m from river	Liffey
	Tara Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 125m from river	Liffey
	St Stephens Green Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 1.80km from river	Dodder
	Charlemont Station	Main	Fuel/Gas	Yes	No risk of flooding. Site 1.70km from river	Dodder

Note – Risk of flooding to the construction compound is based on the available flood models and distance to the nearest watercourse.

18.5.3.5 Summary of Impact Assessment

Without mitigation, impact on flow, river morphology and water quality in receiving waters as a result of construction is considered *Temporary* following (TII, 2009) and *Slight to Significant,* based on the EPA guidelines for impact assessment. However, with appropriate measures in place the resulting impact is considered *Temporary,* and *Imperceptible to Not Significant* in terms of significance. The impact is based on the attribute rating and the potential for the temporary construction works (silt run-off, potential leaks from construction vehicles and instream disruption of flows) to impact on the attribute. A conservative approach has been taken based on the distance of proposed construction works upstream of any European designated habitat. None of the watercourses is designated a protected salmonid river (as per the Salmonid Regulations), however some rivers have been noted as having salmon fisheries by the IFI and as such the potential for impact on the habitat quality due to silt run-off has been considered in the assigned impact rating.

Route development and station construction will entail temporary dewatering which will require collection, treatment and attenuation prior to off-site discharge. Discharge to sewer will be undertaken by consent from Irish Water or the Local Authority as appropriate prior to the commencement of construction works. The estimated rate of discharge will decrease once sealing and containment at the excavation areas has been completed below the phreatic water table. Mitigation measures are provided below. It is anticipated that dewatering activities will be required at the majority of sites. For sites where volumes and discharge rates are expected to be high, then these could provide an additional valuable source of supply for general site use such as dust suppression, general cleaning and surface washdown. Also, and where practical, surplus water from sites being actively dewatered, should be transported to sites where dewatering is not being carried out in order to minimise requirements for water at these locations.

Design mitigation measures also include the use of adequate containment measures for chemicals stored within construction compounds and maintenance yards, use of petrol/oil interceptors in maintenance yards and car parking areas, and the proper water management and use of environmentally friendly herbicides. These design mitigation measures are discussed in detail in Section 18.6 below. Implementation of a construction-based Sediment Erosion and Pollution Control Plan (as described in Appendix A5.1 outline CEMP) and a programme of continuous monitoring (such as a maintenance schedule and site-specific procedures will be established by the Contractor for silt and pollution control measures during the construction period) will minimise the potential for accidental discharge to receiving waters/discharge points.

A summary of Construction Phase impacts for watercourse crossing, culverts, and diversions (with and without mitigation and design measures) is provided in Table 18.17 below.

Table 18.17 Impact Assessment of Proposed Watercourse Crossings, Culverts and Diversions

Ref. Area	Approx. Chainage	Surface Watercourse	WFD Catchment	Summary of Works Proposed	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact – with design and mitigation measures
AZ1	1+000	A number of ditches coming from Staffordstown Stream[14] *Attribute Rating – Extremely High*	Ballough [Stream]_SC_010	Diversions of a number of ditches coming from the waterbody.	*Temporary, Significant impact*	*Temporary, Not Significant impact*

[14] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

Ref. Area	Approx. Chainage	Surface Watercourse	WFD Catchment	Summary of Works Proposed	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact – with design and mitigation measures
AZ1	1+500 to 1+760	Broadmeadow River *Attribute Rating – Extremely High*	Broadmeadow_SC_010	Viaduct crossing -spanning both rivers.	*Temporary, Significant impact*	*Temporary, Not Significant impact*
AZ1	1+500 to 1+760	Ward River *Attribute Rating – Extremely High*	Broadmeadow_SC_010		*Temporary, Significant impact*	*Temporary, Not Significant impact*
AZ1	Crossing the alignment and culverted. FRA have found it was previously diverted as part of R132 Swords Bypass Project	Gaybrook Stream (North) - Upstream of Gaybrook River *Attribute Rating – Extremely High*	Broadmeadow_SC_010	Crossing, cut and cover tunnel at Pinnock Hill Roundabout	*Temporary, Significant impact*	*Temporary, Not Significant impact*
AZ1	5+764	Forest Little Stream *Attribute Rating – Medium*	Mayne_SC_010	New culvert on existing stream to convey it beneath the proposed Project	*Temporary, Moderate impact*	*Temporary, Imperceptible to Not significant impact*
AZ1	5+963	Sluice River *Attribute Rating – High*	Mayne_SC_010	New culvert on existing stream to convey it beneath the proposed Project	*Temporary, Moderate to significant impact*	*Temporary, Imperceptible to Not significant impact*
AZ3	8+648	Mayne River - at Dardistown *Attribute Rating – Medium*	Mayne_SC_010	Diversion of the Turnapin Stream to the north of the proposed Dardistown Depot, reconnecting to the Mayne downstream of the line. Culverts where the diverted	*Temporary, Moderate to significant impact*	*Temporary, Imperceptible to Not significant impact*

Ref. Area	Approx. Chainage	Surface Watercourse	WFD Catchment	Summary of Works Proposed	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact – with design and mitigation measures
				stream passes beneath access roads/the proposed Project		
AZ3	9+98	Santry River (at M50 Viaduct) *Attribute Rating – Medium*	Mayne_SC_010	The proposed Project passes over existing culvert. Existing culvert crossing is maintained. Localised channel realignment proposed downstream of outlet to reduce outlet losses.	*Temporary, Moderate impact*	*Temporary, Imperceptible to Not significant impact*

Table 18.18 below presents a summary of the construction and compound sites along the proposed Project together with the planned discharge point (surface water/storm sewer) for treated/attenuated water and the estimated daily rate of discharge to that receiving feature. The estimated outflows (m^3/day) are based on modelled volumes of water as anticipated from each of the work areas listed. The impact assessment is based on assessment of the any accidental discharges during construction on the most likely receiving watercourse and attribute rating i.e. whether direct or indirect through drainage.

Table 18.18 Summary of Construction Discharge from Excavated Stations and Associated Work Areas

Ref. Area	Site Reference	Approx. Chainage	Construction Site Type	Estimated Discharge (m^3/day) prior to any grouting	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact - with design and mitigation measures
AZ1	Estuary Station	1+250	Station Excavation (Station at grade)	93.3	*Temporary, Significant impact*	*Temporary, Not Significant impact*
	Balheary Park to Malahide Roundabout	2+253 to 3+460	Excavation of long section of retained cut and cut & cover	229.8	*Temporary, Significant impact*	*Temporary, Not Significant impact*
	Seatown Station	2+800 to 2+890	Station Excavation	33.7	*Temporary, Significant impact*	*Temporary, Not Significant impact*
	Malahide Roundabout to Pinnock Hill Roundabout	3+520 to 4+400	Excavation of long section of predominantly retained open cut track	58.8	*Temporary, Significant impact*	*Temporary, Not Significant impact*
	Pinnock Hill to North Portal	4+400 to 6+040	Excavation of long section of predominantly	111.3	*Temporary, Significant impact*	*Temporary, Not Significant impact*

Ref. Area	Site Reference	Approx. Chainage	Construction Site Type	Estimated Discharge (m^3/day) prior to any grouting	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact - with design and mitigation measures
			retained open cut track			
	Swords Central Station	3+830	Station Excavation	37.9	*Temporary, Significant impact*	*Temporary, Not Significant impact*
	Fosterstown Station	4+780	Station Excavation	28.5	*Temporary, Significant impact*	*Temporary, Not Significant impact*
AZ2	Dublin Airport North Portal	6+040	Deep Excavation/TBM tunnel	37.2	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ2	Dublin Airport Station	7+050	Station -Deep Excavation, D-walls	54.4	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ2	Dublin Airport South Portal	8+440	Deep Excavation/TBM tunnel	141.7	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ3	Dardistown (Future station)	8+840	Station Excavation – retained cut and piling	61.3	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ3	Dardistown Depot	9+040	Excavation (various cut/fill)	38.9	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ3	M50 Viaduct	9+700	Viaduct	40.6	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
AZ3	Northwood Portal	10+040	Deep Excavation/TBM tunnel	40.6	*Temporary, slight impact on channel flow and morphology*	*Temporary, imperceptible impact on channel flow and morphology*
AZ3	Northwood Station	10+340	Station -Deep Excavation, D-walls	146.9	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*

Ref. Area	Site Reference	Approx. Chainage	Construction Site Type	Estimated Discharge (m^3/day) prior to any grouting	Magnitude of Impact - without design and mitigation measures	Magnitude of Impact - with design and mitigation measures
AZ4	Ballymun Station	11+260	Station -Deep Excavation, D-walls	90.7	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
	Dublin City University (DCU) Collins Avenue Station	12+220	Station -Deep Excavation, D-walls	76.0	*Temporary, Moderate impact.*	*Temporary, Imperceptible to Not Significant impact.*
	Albert College Park Intervention & Ventilation Shaft	12+800	Deep Excavation	58.8	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	Griffith Park Station	13+800	Station -Deep Excavation, D-walls	113.2	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	Glasnevin Station	14+850	Station -Deep Excavation, D-walls	79.5	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	Mater Station	15+640	Station -Deep Excavation, D-walls	76.9	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	O'Connell Street Station	16+660	Station -Deep Excavation, D-walls	67.4	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	Tara Station	17+400	Station -Deep Excavation, D-walls	82.0	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	St Stephens Green Station	18+480	Station -Deep Excavation, D-walls	76.0	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*
	Charlemont Station	19+360	Station -Deep Excavation, D-walls	79.5	*Temporary, Moderate impact.*	*Temporary, Not Significant impact.*

Discharge rates indicated above were estimated using groundwater flow modelling (refer Chapter 19, Section 19.5.3.4). The models were calibrated against inputs from field works (recent pumping tests, field assessments) in order to allow validation and confidence in modelled discharge volumes per day.

Typically, the estimated and conservative rate of discharge based on modelling of outflows undertaken for each of the deep excavations in particular will decrease once sealing/containment at the excavation area (through deep-set walls/piles with application of toe-grouting within the base) has been completed below the natural water table.

18.5.3.6 Construction of Football Pitches

As part of the proposed Project, it is necessary to relocate football pitches during the Construction Phase. For example, a football pitch in Balheary Park will have to be relocated to facilitate the construction of the part of the proposed Project alignment. The type of pitches will include natural grass pitches and synthetic turf pitches (3G/4G). Each type of pitch has a specific type of construction methodology.

Localised interventions typically consist of:

- Minor pitch repair works,
- Weed and pest control,
- Surface levelling,
- Replacement of damaged areas particularly at goal mouths,
- Re-surfacing post drainage/service works,
- Fertiliser applications to improve soil and feed growth,
- Aeration to counter compaction and improve drainage,
- Scarification to remove thatch accumulation,
- Overseeding, and
- Localised sand amelioration or top dressing.

Not all of the above works may be necessary and even those that are required may not be required for the full extent of the pitch.

The works required to construct an all-weather/3G pitch consist of:

- Site clearance, including where relevant tree and bush removal including stumps, spray off area for proposed pitch and run off areas;
- Strip topsoil and dispose of off-site;
- Cut and fill to form base for new pitch and set levels to ensure positive drainage;
- Install primary drainage network to collect pitch drainage and outfall pipes to discharge location;
- Install secondary drainage network to drain pitch;
- Lay stone sub-base and geotextiles to required thickness and levels;
- Install floodlighting ducting and bases at this stage, if pitch is being floodlit;
- Install kerbs to pitch edges;
- Lay blinding stone layer and roll;
- Lay shock pad layers – depth and type of material depends on proposed sports usage;
- Lay artificial surfacing;
- Once the artificial carpet is laid, silica sand will be installed (which gives it the weight), followed by SBR rubber and brush into place; and
- Install fencing.

There is typically a 16-week construction period associated with this type of pitch. These construction works are therefore considered to be *Temporary* in duration as they will not last longer than one year individually.

The potential impacts in regard to hydrology associated with the construction and movement of football pitches are as follows:

- Increased sediment loading in run-off.

- Surface water runoff during the Construction Phase may contain increased silt levels or become polluted from construction activities. Runoff containing large amounts of silt can cause damage to surface water systems and receiving watercourses. Silt water can arise from dewatering excavations, exposed ground, stockpiles and access roads.
- During the Construction Phase at this site there is potential for an increase in run-off due to the compaction of soils. This will reduce the infiltration capacity and increase the rate and volume of direct surface run-off. The potential impact of this is a possible increase in surface water run-off

and sediment loading which could potentially impact local drainage. Site investigations classified the subsoils as 'inert'.
- Any surface water run-off collecting in excavations will likely contain a high sediment load. This will be diverted to settlement tanks/bags and will not be allowed to directly discharge directly to the existing drainage system.

▪ Accidental spills and leaks.

- As with all construction projects there is potential for water (rainfall and/or groundwater) to become contaminated with pollutants associated with construction activity. Contaminated water which arises from construction sites can pose a significant short-term risk to groundwater quality for the duration of the construction if contaminated water is allowed percolate to the aquifer. The potential main contaminants include:
- During construction of the development, there is a risk of accidental pollution incidences from the following sources.
- Suspended solids (muddy water with increase turbidity) – arising from excavation and ground disturbance.
- Cement/concrete (increase turbidity and pH) – arising from construction materials.
- Hydrocarbons (ecotoxic) – accidental spillages from construction plant or onsite storage.
- Wastewater (nutrient and microbial rich) – arising from accidental discharge from on-site toilets and washrooms.
- Machinery activities on site during the Construction Phase may result in contamination of runoff/surface water. Potential impacts could arise from accidental spillage of fuels, oils and paints, which could impact surface water if allowed to infiltrate to runoff to surface water systems and/or receiving watercourses. However, implementation of the design and mitigation measures detailed throughout this report will ensure that this does not occur.

▪ Increased run-off.

18.5.3.6.1 Summary of Assessment

These pitches will be constructed away from any watercourses with appropriate buffer zones as per design measures set out in the construction methodology.

Without mitigation, impact on flow, river morphology and water quality in nearby waters as a result of construction is considered *Temporary* following (TII, 2009) and *Slight to Significant,* based on the EPA guidelines for impact assessment. However, with appropriate design measures in place the resulting impact is considered *Temporary,* and *Imperceptible* in terms of significance. The impact is based on the attribute rating and the potential for the temporary construction works (silt run-off and potential leaks from construction vehicles) to impact on the attribute.

Design mitigation measures are discussed in detail in Section 18.6 below. Implementation of a construction-based Sediment Erosion and Pollution Control Plan (as described in the outline CEMP) and a programme of continuous monitoring (such as a maintenance schedule and site-specific procedures will be established by the Contractor for silt and pollution control measures during the construction period) will minimise the potential for accidental discharge to nearby watercourses.

18.5.3.7 Microplastics & Potential for Discharge

Road traffic is a source of a diversity of environmental relevant compounds, ranging from microplastics (mainly tyre wear and road particles) to a variety of organic micropollutants. These pollutants can reach the water environment mainly via runoff and airborne drift.

Microplastics are defined as small plastic particles (< 5mm), which are insoluble and slowly degradable. This also includes plastic particles from biogenic origin and rubber particles. Microplastics are released from a large variety of sources, including littering, households (laundry, beauty products), paints and industry. Microplastics are also released from traffic and roads, including the wear of tyres (rubber particles), brakes, asphalt, road marking and vehicle parts. Tyre wear is deemed to be the largest source of microplastics emissions from traffic and roads, while microplastic emissions from road markings, brakes and asphalt are estimated to be a factor of 10 lower than microplastic emissions from tyres.

Runoff will infiltrate in the verge and most pollutants will remain in the subsoil (except for pollutants with high solubility which can be transported to groundwater). Runoff can also be treated in storm water treatment systems and the effluent is then discharged in surface water. This can be a direct discharge or via a sewer connected to a wastewater treatment plant. Pollutants will also be transported from the road via drift (the airborne route of splash and spray from the road). Research indicates that the pollutants will be deposited within a few hundred metres (or closer) from the road and can thus directly impact surface water bodies.

18.5.3.7.1 Summary of Assessment

During the Construction Phase of the proposed Project, there will be some potential for microplastics entering watercourses as there will be additional traffic movements which could lead to further wear and tear of rubber tyres. However, it is important to note that microplastics are present in all watercourses and it is difficult to implement a strong design measure.

The impact on water quality in nearby waters as a result of construction is considered *Temporary* following (TII, 2009) and *Not Significant,* based on the EPA guidelines for impact assessment.

18.5.3.8 Water Framework Assessment

In terms of the Construction Phase, this assessment has considered the current water status of all relevant water bodies (Section 18.4.9 above), and potential impacts have been considered (Section 18.5.3 above). With mitigation measures in place, it is concluded there will be no degradation of the current water body (chemically, ecological and quantity) or any impact on its potential to meet the requirements and/or objectives in the second RBMP 2018-2021 (RBMP) and *draft* third RBMP 2022-2027.

There are no discharges of water during the Construction Phase to any open waterbody/watercourse. There are appropriately designed mitigation and design measures which will be implemented during the Construction Phase to protect the hydrological environment. There is a potential of accidental discharges during the Construction Phase, however these are temporary short-lived events that will not impact on the water status of waterbodies long-term and as such will not impact on trends in water quality and over all status assessment.

There will be limited impact on the surrounding hydrological environment from the activity of dewatering, which will reduce for all excavations including retained cuts/cut and cover section as the features become sealed including with bottom grouting at the deep station box excavations). Once the piling is complete, the extent (influence) of dewatering is very limited with the zone of influence being small. Therefore, the impact on the hydrology of the water body is negligible. Also, there is limited dewatering required for the northern section as the track and station are above ground structures. As such the proposed Project will not have an impact on the quantitative aspects in consideration of water body status.

The outline CEMP and project-specific CEMP which the works Contractor will develop will implement strict mitigation measures to ensure the protection of the hydrological environment during construction which will ensure that there will be no negative impact on the quantitative or qualitative or morphology of the nearby watercourses.

Overall, the potential effects on the WFD status to the waterbodies are considered *Neutral, Imperceptible to Not Significant and Temporary.*

18.5.4 Operational Phase Impact Assessment

Activities associated with the Operational Phase can interact with hydrological receptors by changing the water regime that a receptor is dependent upon. Potential impacts are outlined in this section with a summary of the impact assessment for each potential impact presented in Section 18.5.4.4 and Table 18.22 below.

Mitigation measures are described in Section 18.6 below and residual impacts, i.e. post mitigation measures, are outlined in Section 18.7 below.

The following are considered in the Operational Phase impact assessment:

- Surface water crossings, culverts and diversions;
- Discharge to watercourses; and,
- Potential discharge of microplastics.

18.1.1.1 Surface Water Crossings, Culverts or Diversions

This section discusses the potential impacts to identified surface watercourses which are planned to be permanently crossed, culverted or diverted as a result of the proposed Project, i.e. operational phase impacts.

Culverting and crossing of watercourses can have a negative impact (if not adequately designed) on river water bodies by impacting on river flow velocity (up-gradient and/or down-gradient) or the fishery/ecological value assigned to that water feature. Inappropriate sizing and design of culverts and surface water crossings can also impact on the value of that waterbody as a habitat for fishery by altering sedimentation and river morphology. Table 18.9 presents the proposed watercourse crossing locations.

The Broadmeadow River and Ward River will be crossed by a long-spanning viaduct. Table 18.18 below presents the finding of a modelling study to confirm the completed structure will have no impact on the natural flow regime including consideration of future climate change effects.

As outlined in Appendix A18.5, two design approaches have been applied to the track drainage for the proposed Project based on system requirements, namely:

- Surface Water Systems – which are designed to convey and discharge the greater of rainfall generated surface water flows or firewater flows.
- Tunnelled Systems – which are designed to convey and discharge firewater flows only.

Tunnelled systems are only required to carry firewater flows as the design includes transverse grated channels that are located immediately upstream of the tunnel portals, to stop surface water (rainfall) flows entering the tunnel.

There are six different cross section types that are proposed for the drainage design. Drainage design details are provided in Appendix A18.5 Flood Risk Assessment.

18.5.4.1 Overall Design Criteria

The following criteria is applicable to all sections of the drainage design. Any deviations of this criteria are noted in the appropriate sections below.

- All track drainage is directed to the centre of the track, where a main channel is located to convey the flow to the assigned discharge point. In most cases the slope of the channel will follow the gradient of the track. When the track grade is flat, for example at stations, the channel will have a built-in minimum slope to achieve a minimum velocity of 0.5m/s.
- For surface water drainage systems, the central drainage channel is 1m wide and up to 1m deep. An enlarged channel section is used to maximise potential online storage and reduce the required size of the attenuation tanks or ponds that are required prior to discharge. In tunnel sections, the channel is 1m wide and up to 1m deep. For all sections, the central channel will be formed in-situ.

- No more than 80% of the potential channel capacity is used to convey 1% AEP plus climate change design storm. The 'spare' 20% is to allow for potential uncertainty in the runoff calculations and to mitigate the impact of over-design events on the track drainage.
- At pumped discharge points, the central channels are joined in a main collector pipe or channel, which directs the water towards the pumping well.
- The drainage at track crossover locations is achieved with PVC drainage pipes of the same capacity as the main drainage channel (rectangular shape) through the crossing. This pipe continues to run along the crossing to discharge in the next breaking load box.
- The maximum design flow of all surface water elements is 80% of capacity. This makes reference to the design of the drainage channel along the centre of the railway line. This means that the channel is in effect 20% larger than it needs to be to allow for modelling uncertainty and reduces the risk of failure during operation.
- The channel will be covered for security safety purposes with a grate and breaking load boxes will be placed for inspection. These boxes will also help to create the attenuation effect along the channel and protect the waterbody's morphology.
- At stations and pumped discharge points, the central channels are joined in a main collector pipe or channel, which directs the water towards a pumping well. A group of four pumps will be installed inside the well, two in duty and two in standby, to pump the water up a rising main to a reception manhole and then on to the approved outfall point.

Discharge of the track drainage to the surface water network was not considered at it was assumed that the existing drainage networks would not have the capacity to receive it. The EPA Maps (https://gis.epa.ie/EPAMaps/) and OSi mapping were therefore used to identify potential watercourses that could be used to receive the surface water runoff from each catchment.

The required volume of the attenuation storage for each catchment was based on the surface water runoff rate from the catchment for the design storm and as noted the permitted greenfield outflow rate to the receiving watercourse.

Attenuation storage for each catchment was sized to contain the 1% AEP storm plus 20% for climate change plus 300mm freeboard allowance.

All track drainage is designed to ensure that there is no net increase in runoff as a consequence of the proposed Project.

All culverts are designed with inlet and outlet structures that include headwall, wingwalls and a buried concrete apron or amour stone to resist local scour of the stream bed at the inlet and outlet. Pipe culverts and box section inverts will all be buried beneath existing riverbed levels by depths of 150mm in respect to pipes and 300mm in respect of the box sections in fishery watercourses. All watercourses which are non-fishery waters will be culverted using a standard nominal 1,200mm or 900mm diameter concrete pipe or equivalent. Under *Section 50 of the Arterial Drainage Acts 1945 and 1995*, culverting of streams by new, upgraded or extended culverts/bridges requires approval from the OPW. This allows the OPW to assess the potential impact of the particular proposal in relation to flooding. This minimum size of culvert proposed for the subject development meets OPW requirements with specific regard to hydraulic capacity, blockage potential and maintenance. Section 50 applications will be prepared following approval of the RO and prior to the commencement of construction works.

All culverts are designed to prevent permanent impact to the river morphology although a short-term local impact may occur during installation of these structures. The potential for permanent impact is prevented by ensuring the width of the river is not significantly exceeded or constricted by the culvert or crossing and that reasonable conveyance above and below the structure are minimised. Therefore, there is no potential impact to the water quality and flow to the waterbodies.

In all fishery sensitive watercourses, the proposed culvert will be embedded into the channel to a depth of 300mm for box sections and a minimum of 150mm for pipe culverts (depending on hydraulic size requirements). Suitable local granular material will be placed to back fill the embedded culvert and sizing and design will be undertaken in consultation with IFI.

All culverts are designed to allow for both aquatic species and mammal migration, as well as to maintain the existing riverbed as far as possible in accordance with *'Guidelines for the Crossing of Watercourses during the Construction or National Road Schemes' (NRA, 2008).*

18.5.4.2 Area AZ1 – Northern Section

18.5.4.2.1 Broadmeadow and Ward River Crossing

The proposed Project requires one significant crossing which is located in the northern section of the route. From the proposed station at Estuary, the route is planned to cross over both the Broadmeadow and Ward rivers, up-gradient of the confluence of both watercourses. The crossing will be a 260m long, spanning viaduct running along the western side of the R132 road adjacent to the pitches at Balheary Park (ch:1+500 to 1+760).

The Broadmeadow/Ward Viaduct has a 0.25% slope and will be provided with a PVC pipe of maximum 300mm diameter anchored to the bottom of the viaduct deck structure. Transversal slopes will redirect surface water to the centre of the track where two capture pits per span will reduce the amount of runoff flowing along the deck (Appendix A18.5). The vehicles are electrically operated so there is limited potential for contaminated run-off along the viaduct's deck structure.

Substantial modelling has been undertaken to design the viaduct to avoid the structure impacting on the flow characteristics of the Broadmeadow and Ward Rivers. The design of the viaduct span is based upon understanding of the conveyance for the 100-year period flood event with the recommended allowance for effects of climate change in accordance with OPW requirements. Section 50 approvals have been obtained from OPW for this crossing. No significant impact is predicted on either the up-gradient or down-gradient potential for flooding or water quality during operation.

The location and design of the proposed viaduct is shown in Diagram 18.9 below.

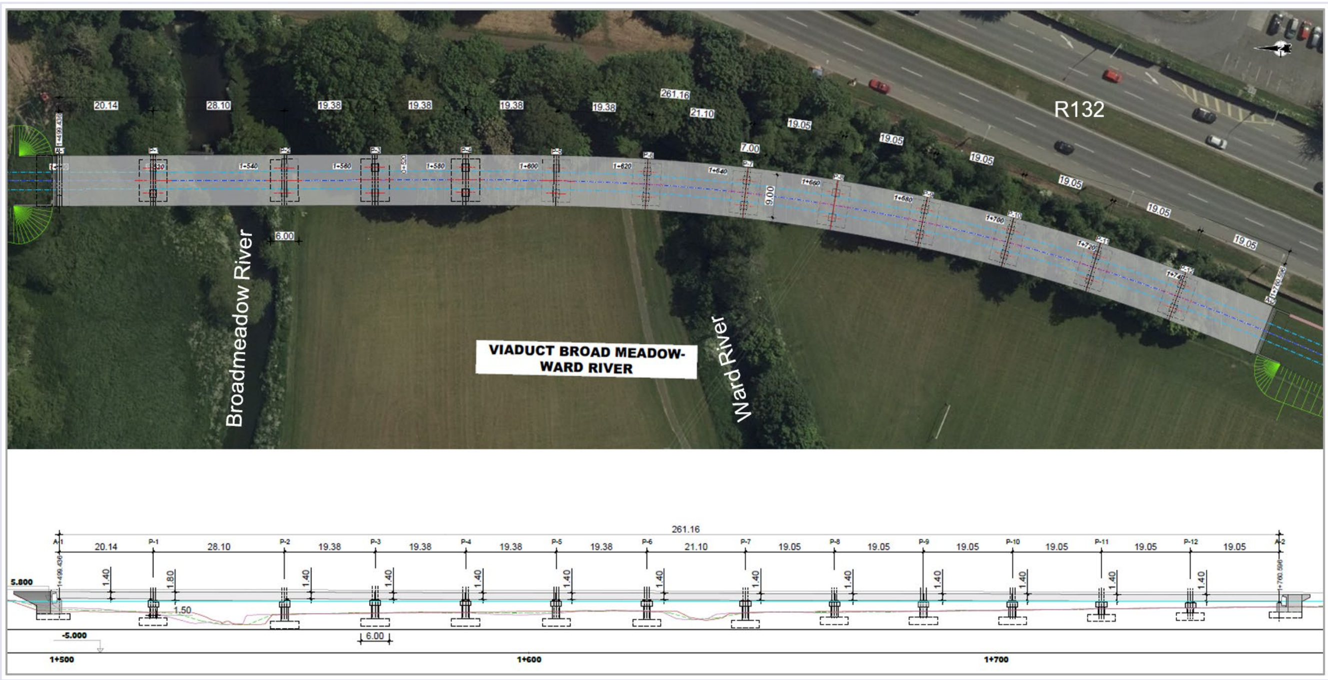

Diagram 18.9 Viaduct over Broadmeadow River and Ward River - Location and Design

A FEM FRAM model of the Ward and Broadmeadow River was undertaken and confirmed the suitability of the viaduct design. This is detailed in Jacobs's report ref Appendix A18.5.

Table 18.19 Broadmeadow and Ward Mitigation – Modelling Results for the Viaduct Structure

Scenario	0.1% AEP Flood Level (mOD) Upstream of the proposed Project	Difference from Existing Situation
Existing Situation	5.37	-
Viaduct (as Diagram 18.9 & 18.10)	5.38	+0.01

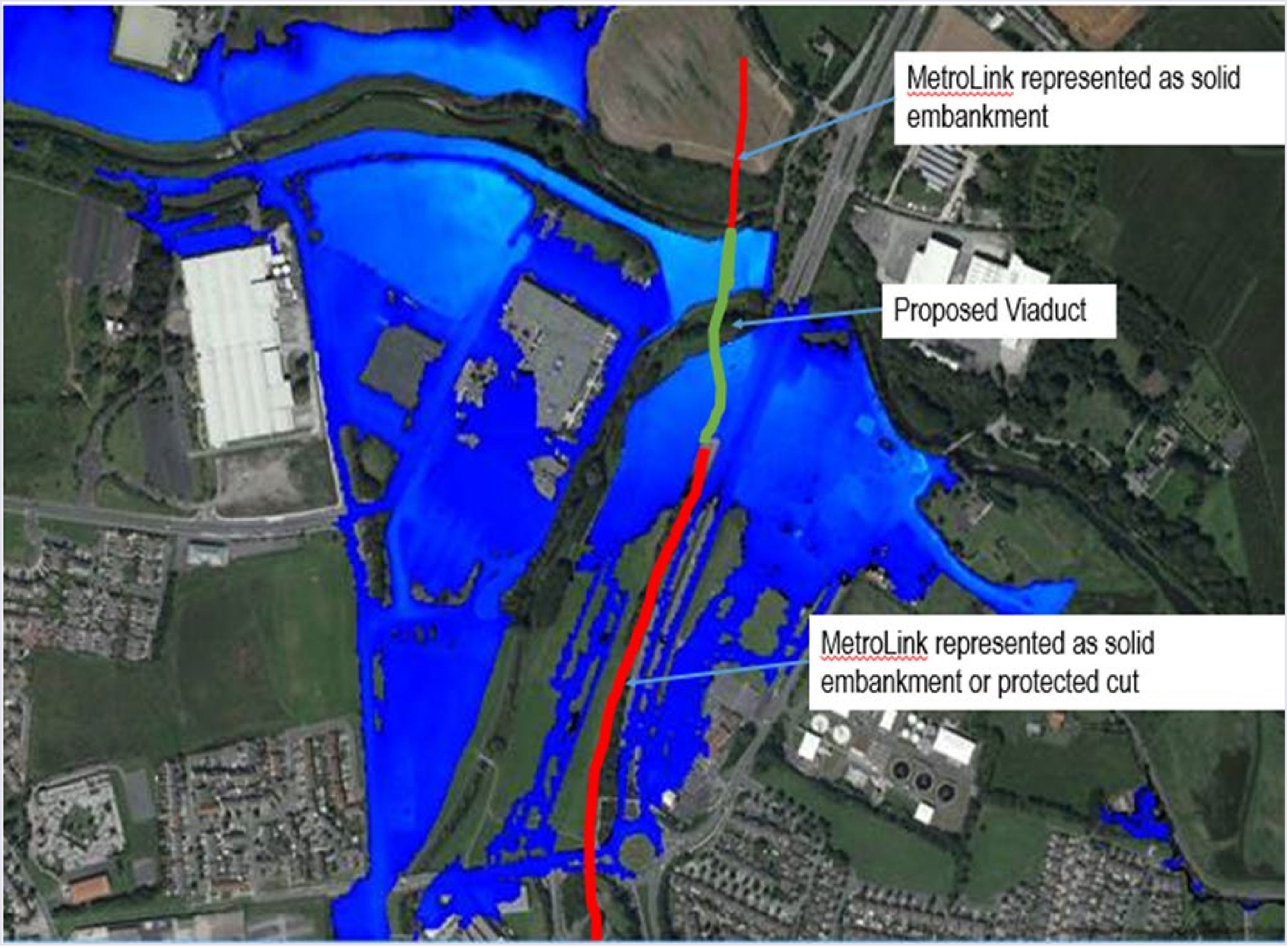

Diagram 18.10 Viaduct over Broadmeadow River and Ward River with 0.1% AEP Flood Event from Associated Rivers

The addition of up to 15 no. 1.5m Box Culverts to the south of the Ward River to allow flows to pass through the proposed Project embankment had little impact on reducing upstream flood levels. It was not considered realistic to have more than 15 no. Box Culverts, so this option was discounted. The negative impact on the hydromorphology of the river and the instream works to install the box culverts was considered too great when compared to the little impact on reducing upstream flood levels.

18.5.4.3 Area AZ2 – Airport Section

In this area AZ2, owing to the flat gradient for much of this section of the track, the central drain depth was designed to 0.50m to 0.75m depth to achieve minimum flow velocities. A sensitivity analysis was undertaken using the model to verify the channel dimensions and found the worst-case design storm for the track to be 1% AEP 15-, 60-, 120- and 180-minute winter storms.

As noted, the track outfall was located at Ch. 6+022.2. Downstream of the track outfall, a series of 450mm diameter pipes and 3 no. orifices were designed to attenuate the 1% AEP (plus climate change) design storm to the greenfield rate prior to discharge to the Sluice River.

Based on the IH 124 Method, the permitted greenfield discharge is capped at 2l/s. A Hydro-Brake® was added to the model to cap outflows from the pond to this permitted greenfield rate. All flows are attenuated online within the pipe network for this catchment as an open pond would not be acceptable so close to Dublin Airport.

The total maximum outflow from the drainage system of 2l/s or 0.002m^3/s compares to a QMED or 50% AEP flow in the Sluice River of 1.21m^3/s. This discharge will therefore have a negligible impact flood levels in the Sluice River.

The track outfall will be located at Ch, 10+251, where a pumping station is located. After the pump, a 350mm diameter pipe discharges into a Stormtech® tank (or similar accepted system). The size of the tank was determined using a sensitivity analysis which showed the 60-minute winter storm to be the worst-case design storm.

18.5.4.4 AZ3 – Santry River

The proposed Project will pass over a culverted section of the Santry River. No flooding is predicted in this location and no works are proposed to modify the hydraulic capacity of the Santry River culvert itself. In order to accommodate the alignment of the proposed Project, some minor alterations are proposed to the Santry River immediately downstream of the culvert outlet to straighten the channel and provide scour protection. The effect of these works will be to reduce hydraulic losses at the culvert outlet, resulting in a marginal increase in culvert capacity.

It is therefore proposed that no changes are made to the existing culverts on site.

In order to accommodate the proposed Project, some minor alterations are proposed to the Santry River immediately downstream of the proposed Project's crossing. These works will comprise minor alterations to straighten the channel, including the addition of scour protection, immediately downstream of the culvert outlet. The effect of these works will be to reduce hydraulic losses at the culvert outlet, resulting in a marginal increase in culvert capacity (report Appendix A18.5).

- To contain the 1% AEP (plus climate change) design storm, the tank has a total volume of 200m^3. A freeboard allowance is provided by a 600mm minimum depth from ground level to the top of the tank chambers.
- The tank discharges to two (2) no. 150mm diameter pipes to discharge to the Santry River. Based on the IH 124 Method, the permitted greenfield discharge is capped at 2 l/s. A Hydro-Brake® was added to the model at the outlet of the tank to cap outflows from the tank to this permitted greenfield rate.

An outline of the works proposed on the Santry River is presented in Chapter 5 (MetroLink Construction Phase), Appendix A5.10 Watercourse Diversion.

Table 18.20 below summarises the preliminary sizing of watercourse crossing culverts for the proposed Project. Section 50 applications will be sought from the OPW at the RO order application stage.

Table 18.20 Water Course Crossing Culverts

Geographical Ref. Section	Approx. Chainage & proposed works	Watercourse
AZ1	5+764 – 36m long (19.90m centre section with road crossing)	Forest Little Stream *Attribute Rating – Medium*
AZ1	5+963	Sluice River *Attribute Rating – High*

Geographical Ref. Section	Approx. Chainage & proposed works	Watercourse
AZ3	9+980 Santry River – maintenance of existing culvert. Slight adjustment to channel just to the east.	Santry River *Attribute Rating – Medium*

No major river re-alignment and culverting works will be required for the proposed Project.

Minor stream and ditch re-alignments, for example at Dardistown Depot (and future station) are presented in Table 18.21 below. Methodologies for re-alignment works will be required to be approved with IFI to ensure the design incorporates adequate morphology in order to promote ecology and maintain the fishery habitat. Following initial disturbance, the design will ensure on-going conveyance of flow for the 100-year period flood event with recommended allowance for climate change effects in accordance with OPW requirements. As stated, above Section 50 approvals will also be obtained from OPW. As such there is no likely impact on up-gradient or down-gradient potential for flooding or water quality during the operational phase.

Table 18.21 Minor Watercourse Diversions

Geographical Ref. Section	Approx. Chainage	Surface Watercourse	Diversion Channel Length (m) & Other Details
AZ1	1+100	Unnamed Ditch System which is part of the Lissenhall Great Stream catchment *Attribute Rating – Medium*	Approx. 440m of unnamed watercourse/ditch to be diverted to accommodate P&R and associated access roads. Diversion to incorporate offline swales/detention basins for runoff attenuation
AZ3	8+640	Turnapin Stream *Attribute Rating – Medium*	Approx. 400m of watercourse to be diverted with culverted crossings of access roads (2 No.) and the proposed Project alignment. Design in development and will be progressed through Stage 3 FRA
AZ3	9+980	Santry River *Attribute Rating – Medium*	Slight adjustment to channel just to the east of existing culvert

At Dardistown there is a planned re-alignment of the upper headwaters of the Mayne River as shown in Diagram 18.11 and Diagram 18.12 below.

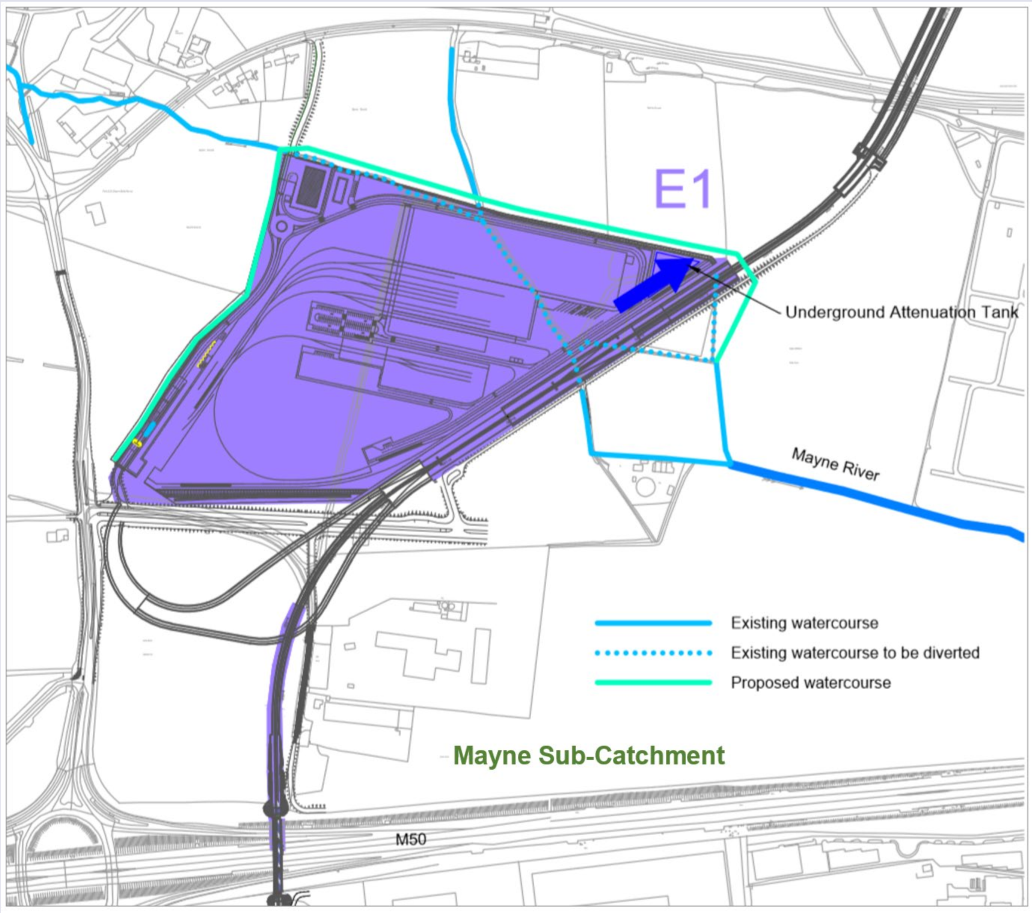

Diagram 18.11 Dardistown Depot and Proposed Water Course Diversion

A diversion of the Mayne River was identified as a requirement for the construction of the Dardistown Depot. This is the preferred option as the naturalised channel will provide benefits to reduction in flood risk over the culvert or concrete channel options. The preferred option is shown in Diagram 18.12 below.

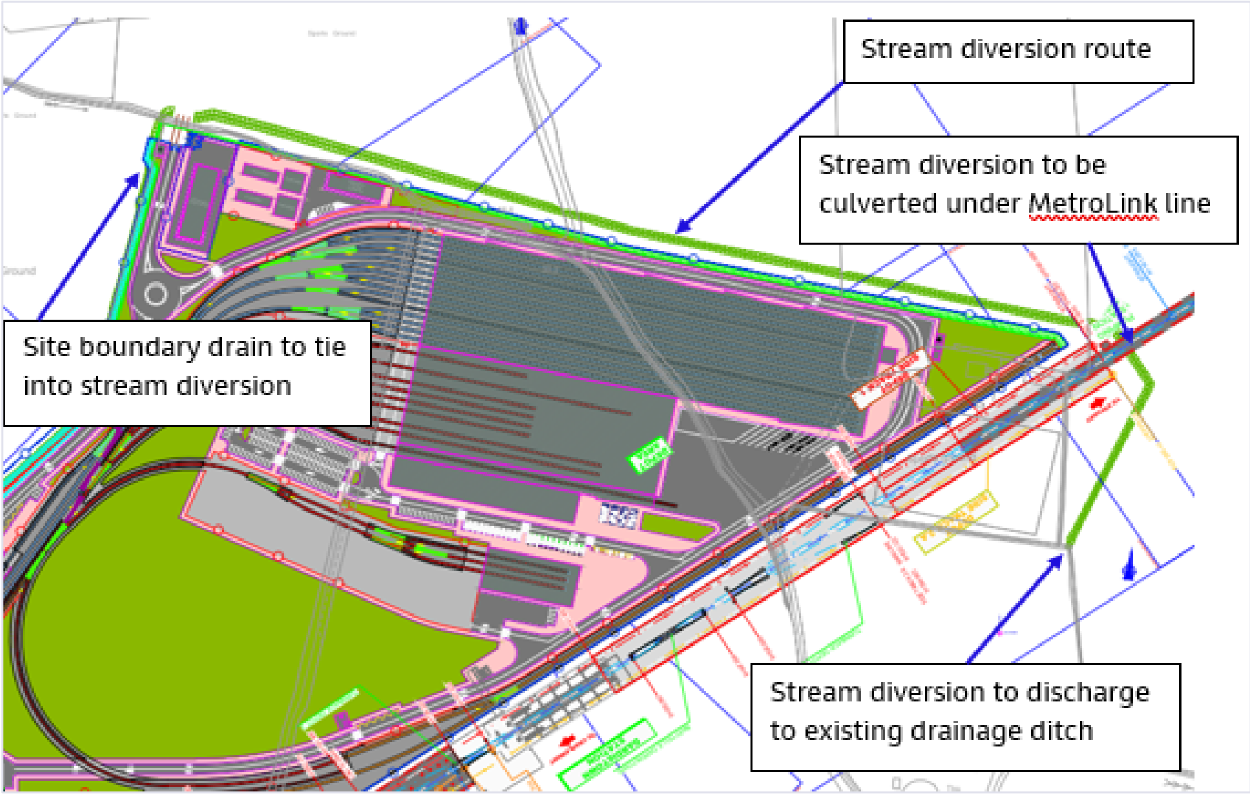

Diagram 18.12 Dardistown Depot and Proposed Water Course Diversion - Preferred Option

The diagrams above indicate the separate sections of the watercourse to be diverted together with the proposed new alignment of the same to ensure continuity of flow towards the Mayne River from the main head water tributary flowing from farther to the west.

18.5.4.5 Summary of Impact Assessment - Surface Water Crossings, Culverts or Diversions

The construction impact of these crossings, culverts and diversions are discussed above in Section 18.5.3.4 and Table 18.17. As all watercourse crossings, culverts and diversions will be designed appropriately to ensure there is no measurable impact on the surrounding hydrological environment, the following impact assessment can be concluded for all of these works.

Following EPA EIA guidelines, significant impacts could occur on watercourses with an attribute significance of Medium to High (refer to Table 18.15 above) if the design did not incorporate adequate conveyance for current and future flow conditions or crossings or culverting/diversions removed high quality habitats. With the design measures planned for the proposed development the impact is assessed as Long-term and the significance is Imperceptible.

Stream diversions and culverts are not proposed on any locally sensitive salmonid streams. None of the proposed diversions/culverts represents a significant transfer of surface water flow between drainage basins. The impact is assessed as Long-term and the significant imperceptible.

18.5.4.6 Discharges to Watercourses

The proposed Project will include eight main drain outfalls to receiving watercourses either directly or indirectly through existing storm water sewers. These are presented in Table 18.21 below. The drainage outfalls to rivers and streams are point discharges and have the potential - if not adequately designed and mitigated - to change the current flow regime and water quality in the existing surface watercourses.

During the Operational Phase of the proposed Project, the potential for any accidental discharge is low as the only potential chemical source is accidental release from storage areas for maintenance chemicals, incorrect use of herbicides and/or discharges from individual vehicles in above ground park and ride areas (which will be mitigated through interceptors). To minimise any impact to receiving water flows, the design incorporates effective attenuation to greenfield run-off rates for new hardstanding areas following the Institute of Hydrology Report Number 124 (IH 124) Methodology. The proposed attenuation storage volumes are sized to accommodate any potential increase in surface water run-off rates up to the 100-year return period storm event with an allowance for climate change effects.

The alignment was divided into catchment areas based on the longitudinal slope of tracks, catchment size, local topography and nearby viable discharge points. Prior to discharge to the receiving watercourse, surface flow from each defined catchment is effectively attenuated to match the existing greenfield run-off rate (1% AEP, with climate change correction). This means that:

- Attenuation storage is provided for areas where the track results in the creation of new impermeable surfaces in areas that are currently permeable (i.e. greenfield); and
- Attenuation storage is not provided for areas where the track crosses which are currently impermeable.

The design calculations for the proposed attenuation are presented in Appendix A18.5.

All outfall structures have been designed with an outlet structure that includes headwall, wingwalls and a bed apron to prevent local scouring of the banks and the channel bed. This, together with management of flow to mimic current runoff rates, will ensure no measurable impact on river morphology, existing surface water flow hydraulics or the potential for an increase in the risk of flooding.

Selected receiving watercourses for each defined catchment for the proposed Project were chosen with the intention of minimising the transfer of surface water flows across 'natural' sub-catchment boundaries to minimise potential for increasing flood risk or impact on water body status.

The use of SuDS is predicated on managing the pollutant load. The proposed development makes either provision for, or is actively considering for inclusion, several SuDS measures including:

- Green Roofs – good removal capability of atmospherically deposited urban pollutants;
- Swales/Filter Strips – polluting suspended solids treated through filtration and sedimentation;
- Permeable surfaces – treating polluting suspended solids similar to Swales/Filter Strips;
- Infiltration Basins - effective at pollutant removal via filtering through the soils;
- Retention Ponds - good removal capability of urban pollutants;
- Petrol/Oil Separators – at all outfall points to receiving watercourses; and
- Other Infrastructure – catch pits and gullies provided with sediment traps with access for maintenance cleaning. Inlet covers shall be provided with a sand trap to prevent accumulation of sand in curb inlet catch basins.

Green roofs will be present on a number of buildings along the alignment. For example, above ground stations like Swords Central, Estuary, Seatown and Fosterstown.

As noted, firewater at the Metro Stations and Dardistown Depot is separated from surface water and discharged into the existing wastewater collection system.

Dardistown Depot will have facilities that are not present at the other MetroLink Stations such as vehicle cleaning areas which will be provided with automatic Train Washing Plant (AWP) that will also include a water treatment and recycling system to reduce water consumption and pollution. The treatment installation will be sized to suit the designed water flow rates and the recycled water volume will be at least 80% of the total water used. The basic treatment installation will be as follows:

- underground settling tanks;
- hydrocarbon separator with coalescent filter;
- sand (or pressure) filter; and
- biological treatment.

In addition, to the vehicle cleaning areas, there will be rolling stock maintenance areas. The drainage design includes measures to ensure that pollutant loads will be treated at source.

Dardistown Depot will be serviced with potable water supply distribution system comprising a ring main to distribute water to the various buildings connected to the public water supply network. The demand will be based on requirements for welfare (drinking water, canteens, and sanitation), industrial water used on site, and fire-fighting.

Two different sewerage systems will be provided, one to collect industrial water from the automatic train washing plant and the workshop and the other to collect domestic wastewater from the canteen facilities, showers, and toilets. The industrial wastewater will be collected and treated in the Water Treatment Plant (oil/sand/grease trap and hydrocarbon interceptor) located in the south-east corner of the site. The treated water from the plant and the domestic wastewater will be discharged to the public sewer.

The drainage proposals for each of the defined catchment areas for the development, showing the natural sub-WFD sub-catchments, are presented as Figure 18.9 to Figure 18.14.

An example of the attenuation system across the proposed Project is one located at the Park & Ride Facility. The attenuation pond discharges to the Broadmeadow River. Refer to Diagram 18.13 below. Based on the IH 124 Method, the permitted greenfield discharge is capped at 8.64 l/s. A Hydro-Brake® was added to the model to cap outflows from the pond to this permitted greenfield rate which is incorporated as part of the design. The total maximum outflow from the pond of 8.64 l/s or 0.01 m3/s compares to a QMED or 50% AEP flow in the Broadmeadow River of 22.05 m3/s. This discharge will therefore have an imperceptible impact on flood levels in the Broadmeadow River.

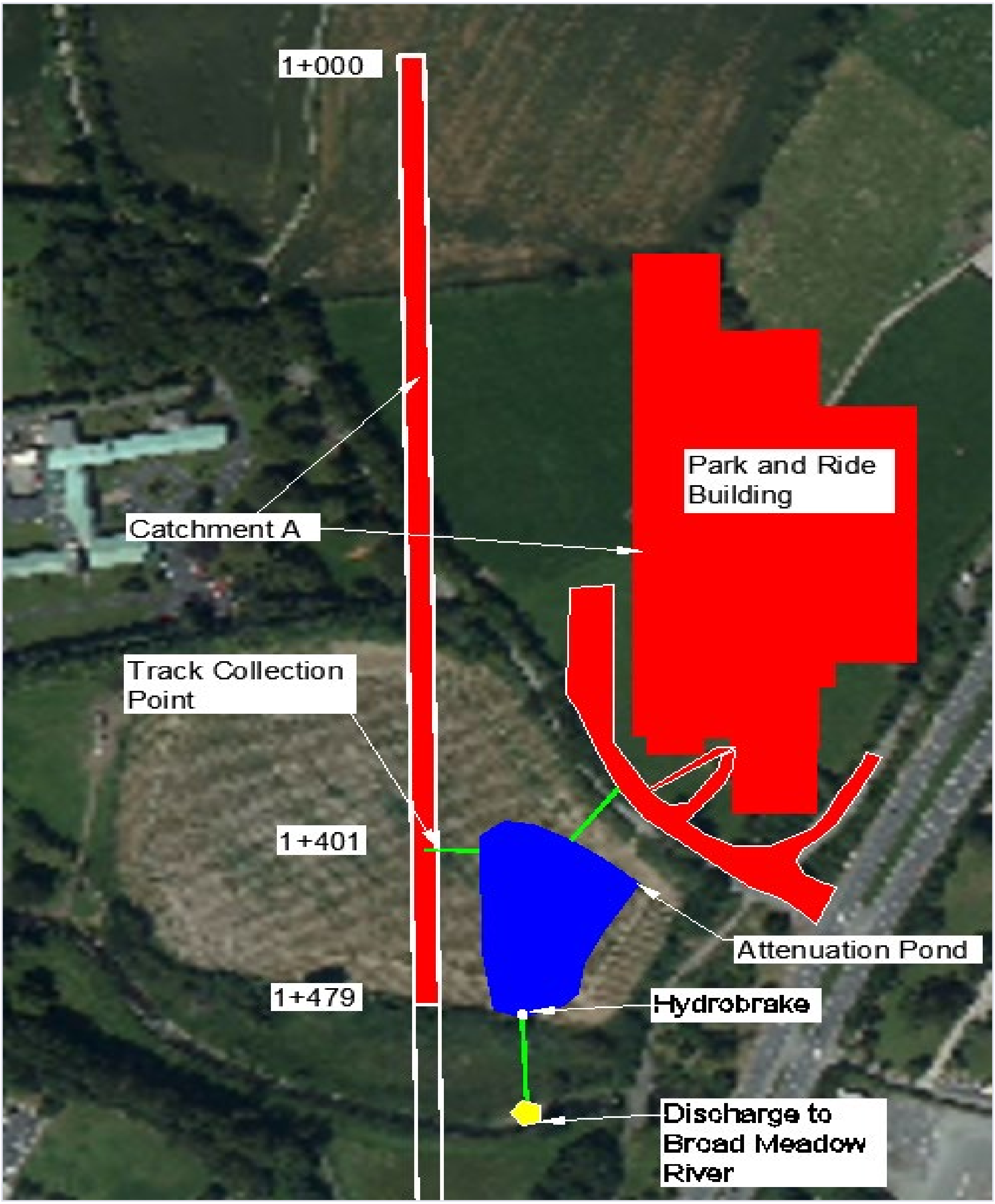

Diagram 18.13 Attenuation and drainage type at Catchment A – P&R Facility.

A summary of the design catchment drainage system and proposed attenuation included in the design is presented below in Table 18.22.

Table 18.22 Summary of Design Catchment Drainage System and Attenuation

Ref. Area	Design Catchment	Start Chainage	End Chainage	Collection Point /Outfall Chainage	Discharge Recipient (WFD Sub-catchment)	Catchment Up-Gradient (Approx. Km²)	Drainage System	Drainage System & Attenuation Type (size m³)	Greenfield Mean Annual Maximum Flood Run-off in receiving watercourse (m³/sec)
AZ1	A1 (Swords Western Distributor Road) (ES-1 Catchment)	N/A	N/A	N/A	Unnamed Watercourse (Ballough [Stream]_SC_10)	0.098	Gravity	Gravity. Attenuation Pond with hydrobrake to manage discharge rates at greenfield runoff rates.	QMED = 0.3m³/s in Staffordstown Stream
AZ1	A2 + Estuary Station Parking	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (2,650m³)	QMED = 21.5m³/s; Mean Flow = 1.1m³/s (A2 catchment)
AZ1	A2 + Estuary Station Parking (ES-2 catchment)	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (500m³)	
AZ1	A2 + Estuary Station Parking (ES-3 catchment)	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (280m³)	
AZ1	A2 + Estuary Station Parking (ES-4 catchment)	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (280m³)	
AZ1	A2 + Estuary Station Parking (ES-5 catchment)	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (200m³)	
AZ1	A2 + Estuary Station Parking (ES-6 catchment)	1+000	1+479	1+401	Broadmeadow River (Broadmeadow_SC_10)	105.915	Gravity	Gravity. Wetland Pond with hydrobrake to control discharge rates at greenfield rates (200m³)	

Ref. Area	Design Catchment	Start Chainage	End Chainage	Collection Point /Outfall Chainage	Discharge Recipient (WFD Sub-catchment)	Catchment Up-Gradient (Approx. Km²)	Drainage System	Drainage System & Attenuation Type (size m³)	Greenfield Mean Annual Maximum Flood Run-off in receiving watercourse (m³/sec)
AZ1	B + Existing Road	1+479	2+804	2+277	Ward River (Broadmeadow_SC_10)	59.83	Gravity and Pump	Gravity & Pump system. Two Stormtech tanks with hydrobrake to control discharge rates (total 500m³)	QMED = 11.4m³/s; Mean Flow = 0.6m³/s
AZ1	C1	2+804	5+200	2+900	Unnamed Watercourse (Mayne_SC_10)	0.1292	Gravity and Pump	Gravity & Pump system. One Stormtech tank with hydrobrake to manage discharge rates at greenfield rates (1,650m³)	3.5l/s (0.0035m³/s)
AZ2	C2-D1	5+200	5+880	5+200 2+604	Sluice River (Mayne_SC_10)	0.3023	Gravity and Pump	Gravity & Pump system. Pipes + Orifices	QMED = 0.2m³/s
AZ2	D2	5+880	6+022	6+022	Sluice River (Mayne_SC_10)	2.994	Gravity	Gravity system. Pipes + Orifices	QMED = 0.2m³/s
AZ3	E1 + Depot	8+650	9+700	8+650	Sluice River (Mayne_SC_10)	1.902	Gravity and Pump	Gravity & Pump system. One underground Attenuation Tank (Stormtech) with hydrobrake to manage discharge rates at greenfield rates (200m³)	QMED = 0.35m³/s
AZ3	E2	9+700	10+075	10+075	Santry River (Mayne_SC_10)	5.085	Gravity	Gravity system. One underground Attenuation Tank (Stormtech) with hydrobrake to manage discharge rates at greenfield rates (200m³)	QMED = 0.7m³/s

Note: The catchment areas were obtained using Google Earth based on available WFD sub-catchment boundaries, DAA-LAP SFRA (report presents the boundaries of the internal catchments within Dublin Airport) and ground level information available on Google Earth. The procedure included drawing the catchment following the WFD/DAA boundaries and/or following the highest point between two adjacent catchments, from the beginning of the main catchment to the proposed discharge point.

The proposed Project incorporates two tunnels, the Airport Tunnel and the City Tunnel from Northwood West Station to the southern extent of the development south of Charlemont Station. The tunnelled sections will not receive any rainfall and are designed as water-tight structures. Any drainage within the tunnels will be collected internally and gravitated to sumps where it will be collected and discharged by pumping externally into the public foul drainage system (subject to agreement with Irish Water).

There will be 11 underground stations, one in the Airport Tunnel and ten along the City Tunnel. During the operational phase, there will be negligible water discharge arising from track drainage which will be collected and pumped to public storm water (i.e. separate or combined) sewer if there is no watercourse available. Therefore, all stormwater network discharges to watercourses preferably, and to the combined existing network if not possible.

There will be no public toilets at the stations or on the trains and wastewater arising from welfare facilities for the staff at the stations and Dardistown Depot will be discharged to foul sewer. Therefore, the potential for any surface water contamination is negligible. However, toilets will be available for the public at the main interchange stations and wastewater conveyed to foul sewer

18.5.4.7 Summary of Impact Assessment - Discharges to Watercourses

Table 18.23 below presents the discharge points during the Operational Phase of the proposed Project and the assessment impact with and without mitigation. All stormwater network discharges are released to watercourses preferably, and to the combined existing network if not feasible.

Table 18.23 Summary of Operational Stage Discharge Points - Impact Assessment without and with Mitigation Measures

Ref. Area	Outfall Ref. /Location	Outfall Chainage	Receiving Watercourse/ Attribute significance	WFD Sub-Catchment	Impact (without design measures) [15]	Impact (with design measures)
AZ1	**A1** (Swords Western Distributor Road) *Attenuation pond with Xm³ volume. Hydrobrake to control flow to greenfield rates.*	N/A	Unnamed Watercourse *Attribute Rating – High* *Note: No reported history of flooding*	Ballough [Stream]_SC_ 10	*Temporary Moderate impact.*	*Long-term Imperceptible impact*
AZ1	**A2** + Estuary Station Parking *Wetland pond with 2,650m³ volume. Hydrobrake to control flow as well as interceptor along drainage system.*	1+401	Broadmeadow River *Attribute Rating – Extremely High* *Note: Extensive floodplain at confluence of Broadmeadow/Ward*	Broadmeadow _SC_ 10	*Temporary Significant impact.*	*Long-term Imperceptible impact*

[15] The Impact Assessment without design mitigation measures assumes that the attenuation pond, interceptor and other measures in place fail during the operational phase. However, these mitigation measures are a part of the design of the proposed Project. The majority of the failures would result in increased flows to the receiving waterbody. Dardistown Depot is the only location where bulk fuel storage is present and failure of design measures would result in potentially high volume of contamination entering the waterbody.

Ref. Area	Outfall Ref. /Location	Outfall Chainage	Receiving Watercourse/ Attribute significance	WFD Sub-Catchment	Impact (without design measures) [15]	Impact (with design measures)
AZ1	**B** + Existing Road Chainage 2+277 *Two attenuation tanks with a total volume of 500m³. Hydrobrake to control flow to greenfield rates.*	2+277	Ward River *Attribute Rating – Extremely High* *Note: Extensive floodplain at confluence of Broadmeadow/Ward*	Broadmeadow _SC_ 10	*Temporary Significant impact.*	*Long-term Imperceptible impact*
AZ1	**C1** *One attenuation tank with a total volume of 1,650m³. Hydrobrake to control flow to greenfield rates.*	2+900	Unnamed Watercourse *Attribute Rating – Medium* *Note: No reported history of flooding*	Mayne_SC_10	*Temporary Moderate impact.*	*Long-term Imperceptible impact*
AZ2	**C2-D1** *Gravity and pump system. Run-off rates controlled to greenfield rates.*	2+604 5+200	Sluice River *Attribute Rating –High*	Mayne_SC_10	*Temporary Significant impact.*	*Long-term Imperceptible impact*
AZ2	**D2** *Gravity system. Run-off rates controlled to greenfield rates.*	6+022	Sluice River *Attribute Rating –High* *Note: Little natural floodplain, flows contained in-bank*	Mayne_SC_10	*Temporary Significant impact.*	*Long-term Imperceptible impact*
AZ3	**E1** + Depot *Gravity & Pump system. One underground Attenuation Tank (200m³).* *Hydrobrake to control flow to greenfield rates. Interceptor located along the drainage system. Bulk fuel storage present at this location.*	8+650	Mayne River *Attribute Rating – Medium* *Note: Little natural floodplain, flows contained in-bank*	Mayne_SC_10	*Temporary Significant impact.*	*Long-term Imperceptible impact*
AZ3	**E2** *Gravity system. One Attenuation Tank*	10+075	Santry River	Mayne_SC_10	*Temporary Moderate impact.*	*Long-term Imperceptible impact*

Ref. Area	Outfall Ref. /Location	Outfall Chainage	Receiving Watercourse/ Attribute significance	WFD Sub-Catchment	Impact (without design measures) [15]	Impact (with design measures)
	(200 m³) with hydrobrake to manage discharge rates at greenfield rates.		*Attribute Rating – Medium* *Note: No reported history of flooding at this location.*			

Based on the significance as per EPA EIA guidelines for impact assessment, the potential operational phase impact (without adequate design measures) for discharged water, the potential for impact on flooding and hydro-morphology is considered Temporary, Moderate to Significant. However, with appropriate design measures in place, based on best available technology to maintain runoff at greenfield rates, the resulting impact is considered as Long-term, Imperceptible. Design measures include adequate attenuation to mimic the current flow regime in the receiving water course, the avoidance of water transfer outside of any sub-catchment boundary, and good practice in the design of all outfall structures.

Following a failure in drainage design measures, the potential for impact on surface water quality is considered Slight and with the proposed drainage design (including pollution control measures) in place the resulting impact on water quality impact is considered Imperceptible to Not significant. Design measures (such as bunding, double skinned tanks and petrol interceptor along drainage system) include use of adequate containment measures for chemicals and fuel storage within maintenance yards, petrol/oil interceptors in maintenance yards and car parking areas, and proper management and use of herbicides. These design measures will reduce the potential of discharge of contaminates off-site to the surrounding environment. Apart from oil storage in maintenance yards there is no bulk chemical storage required during operation.

Table 18.23 above presents a summary of the potential impact magnitude during the Operational Phase.

18.5.4.8 Microplastics & Potential for Discharge

There is a potential of microplastics being generated during the operational phase of the proposed Project. The origin of the microplastics are as follows:

- Brakes on the Metro; and
- Vehicles within all parking and maintenance areas.

18.5.4.8.1 Summary of Assessment

The impact on water quality in nearby waters as a result of construction is considered *Long-Term* and *Not Significant,* based on the EPA guidelines for impact assessment. During the operational phase of the proposed Project, there will be a minor increased potential of microplastics entering watercourses as there will be additional traffic movements which could lead to further wearing of tyres. However, microplastics are present in all watercourses and it is difficult to implement a strong design measure to eliminate the discharge of these pollutants.

18.5.4.9 Water Framework Assessment

In terms of the operation phase, this assessment has considered the current water status of all relevant water bodies (Section 18.4.9 above), and potential impacts have been considered (Section 18.5.4 above). With mitigation measures in place, it is concluded there will be no degradation of the current water body status (chemically, ecological and quantitative) or its potential to meet the requirements and/or objectives and measures in the second [current] RBMP 2018-2021 (RBMP) and draft third RBMP 2022-2027. There are limited discharges of water during the operational phase to any open waterbody/watercourse and no long-term groundwater dewatering for the Project. The discharges will be adequately treated via SuDS measures, hydrobrake (or equivalent) and oil/water interceptor to ensure there is no long-term negative impact to the WFD water quality status of the receiving watercourse. The SuDS and proposed measures have been designed in detail with the ultimate aim of protecting the hydrological (& hydrogeological) environment. The SuDS and project design measures will be maintained correctly as per specifications to ensure long-term/on-going integrity of same.

There is no dewatering associated with the operational phase, hence there is no impact on the hydrological environment in terms of baseflow.

Furthermore, there is limited volume of chemicals and fuel storage for this development as the MetroLink is powered by electricity.

Overall, the potential effects on the water body status to the waterbodies through which the proposed Project will operate are considered *Neutral, Imperceptible* to *Not Significant* and *Permanent*.

18.6 Mitigation Measures

This section presents the proposed mitigation measures for hydrology. Mitigation measures follow the principles of avoidance, reduction and remediation. As set out in Section 18.2.1 appropriate measures have been incorporated into the design of the proposed Project to avoid impacts where possible. As such, this section summarises any additional mitigation included in the construction and operation of the proposed Project in order to protect the receiving water environment. These measures should be read in conjunction with measures outlined in Chapter 15 (Biodiversity), Chapter 19 (Hydrogeology), and Chapter 20 (Soils & Geology).

18.6.1 Mitigation During Construction

Stringent mitigation measures are proposed and include for the management of the water regime within the vicinity of the Project as well as control of potential polluting activities associated with the Construction Phase. These are discussed below and include standard and enhanced mitigation measures employed for the protection of the hydrological environment in line with the requirements of the Water Framework Directive.

18.6.1.1 Management of Run-off Quality

The contractor will be required to operate in compliance with a Construction Environmental Management Plan (CEMP). The project-specific Outline CEMP (CEMP) for the project is included in EIAR Appendix A5.1. This document includes specific measures which will be implemented in order to protect the water environment which are summarised below. A more detailed and site-specific CEMP will be developed by the works Contractor. The outline CEMP is a living document and will go through a number of iterations before works commence and during the Construction Phase itself. The outline CEMP provided with this application set out the minimum requirements and standards which must be met during the construction stage and includes any relevant mitigation measures outlined in this EIAR. It will be updated by the Contractor to address any subsequent planning conditions relevant to the proposed development. Measures for management of run-off and pumped water are included in Mitigation Measures, Section 18.6, sub-section 18.6.1 below.

The outline CEMP includes specific reference to the following documents: CIRIA publications, including C532: Control of water pollution from construction sites (CIRIA, 2001), C648: Control of water pollution from linear construction projects: technical guidance (CIRIA, 2006a) and C649: Control of water pollution from linear construction projects: site guide (CIRIA, 2006b). The following shall also apply with regard to contractor responsibility:

- The contractor will produce a Water Management Plan that includes, the objectives and information described in EIAR Appendix A5.1 which includes detail on the following:

- The activities requiring water and the anticipated peak water demand for each site;
- Where the water for each site will be sourced;
- Strategies for minimising water use;
- Strategies for conserving water;
- Treatment of wastewater; and
- Means of disposal of wastewater.

- A Sediment Erosion and Pollution Control Plan will be implemented for all construction works. This includes measures to manage soil and silt-laden water on site, accidental leaks/spills to ground and water quality monitoring to ensure compliance with environmental quality standards specified in the relevant legislation (i.e. *European Communities (Environmental Objectives (Surface Waters)) Regulations, 2009 (S.I. No. 272 of 2009 and amendments), and the European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988).* As part of the outline CEMP, the plan for erosion and sediment control also deals specifically with the potential impacts of the material deposition areas included for the Construction Phase of the project.
- All construction staff will be suitably trained to respond to accidental discharge/leaks and appropriate spill management kits will be in place to allow rapid response on site. An Incident Response Plan will be in place detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous substances or wastes, logging of non-compliance incidents and any such risks that could lead to a pollution incident at any point along the proposed alignment.
- Site-specific constructability reports prepared for the Project will clearly specify how water emanating from site activities will be managed from source to final approved discharge point. Under no circumstances will treated water be discharged to a water course without the respective water quality meeting the statutory limits as set under the relevant EU Environmental Objectives for surface water.
- As with any below ground construction, pumping will be required to manage both stormwater collection and/or any inflows of groundwater into the cut section/station box within each site boundary. Water will be pumped through a temporary construction site attenuation tank/Siltbuster or equivalent, prior to discharging through a series of treatment tanks with storage (i.e. typically 900m^3 attenuation volume equivalent to one day's discharge where a conservative inflow of ~10l/sec is assumed) as required. There will be regular checks on the treatment system as well as continuous monitoring equipment to measure, but not limited to, pH, temperature, conductivity, Total Suspended Solids and Totals Dissolved Solids. All treated water will be discharged to the nearby sewer.
- Under no circumstances will treated water be discharged to a watercourse without the respective water quality meeting the statutory limits as set under the relevant EU Environmental Objectives for surface water.
- The provision of boundary treatments such as silt fencing and berms will be installed prior to the commencement of any construction works in order to enhance the protection of identified water features (for example Broadmeadow River, Ward River and Santry River) during the full Construction Phase. A silt fence along the relevant boundary line of the construction works area in the context of the identified surface water feature will be required, this will be constructed of a suitable geotextile membrane to ensure water can pass through, but that silt will be retained. Typically, an interceptor trench will be required in front of this silt fence. The silt fence should be capable of preventing 425micron and above sediment from passing through. It should also be resistant to damage during deformation resulting from loading by entrapped sediment and repaired/replaced as necessary by the contractor as part of the on-going monitoring programme.
- Temporary stockpiles are required during the proposed Project works and these will be located outside of the buffer zone; leachate generation will be prohibited. Refuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated and controlled area away the buffer zone(s) applied. On-going consultation with IFI and NPWS will be undertaken prior to and during these works. Furthermore, temporary stockpiles of excavated material will be managed on a site-per-site basis and designated areas will be suitably sized and isolated from open excavations as well as identified [storm/combined] sewers in the area.
- If any potentially contaminated material is encountered, it will need to be segregated from clean/inert material, tested and classified as either non-hazardous or hazardous in accordance

with the EPA publication entitled 'Waste Classification: List of Waste & Determining if Waste is Hazardous or Non-Hazardous' using the HazWasteOnline application (or similar approved classification method). The material will then need to be classified as clean, inert, non-hazardous or hazardous in accordance with the EC Council Decision 2003/33/EC, which establishes the criteria for the acceptance of waste at landfills.

- If it is not possible to immediately remove contaminated material, then it will be stored on, and ensure necessary bunding or containment is in place around stockpiles or storage. The time frame between excavation and removal of all [natural or contaminated] excavated material will be recorded and kept to an absolute minimum.
- All excavated material will, where possible, be reused within the project for the construction of embankments, in backfill, for bunding and landscaping requirements (such as Dardistown Depot, viaduct embankments). The overall approach to spoil management shall be in accordance with the Eastern-Midlands Region Waste Management Plan for 2015-2021 (EMWR 2015) as well as the County Council Development Plans. This plan shall include the application of the Waste Hierarchy and highlight potential methods and sites for reuse, recovery, recycling and disposal of the excavated material with the aim of minimising disposal as waste.
- The appointed contractor will ensure acceptability of the material for reuse for the proposed Project with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the appropriate earthworks specification(s). These excavated soil materials will be stockpiled using an appropriate method to minimise the impacts of weathering. Care will be taken in reworking this material to minimise dust generation, groundwater infiltration and generation of runoff.
- Excavated contaminated soils will be segregated and stored in an area where there is no possibility of runoff generation or infiltration to ground or surface water drainage. Care will be taken to ensure no cross-contamination with clean soils elsewhere throughout the site.
- Surplus suitable material excavated that is not required elsewhere for the proposed Project, shall be used for other projects where possible, subject to appropriate approvals/notifications.
- Earthwork's haulage will be along agreed predetermined routes along existing national, regional and local routes (outlined in the STMP, Appendix A9.4 of this EIAR). Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition.
- Protection measures will be put in place to ensure that all hydrocarbons used during the Construction Phase are appropriately handled, stored and disposed of in accordance with the TII document '*Guidelines for the crossing of watercourses during the construction of National Road Schemes', (NRA, 2008)*. All chemical and fuel refilling locations will be contained within effectively bunded areas and set back a minimum of 10m from water courses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner to prevent pollution or alternatively discharged to foul sewer in agreement with Irish Water. Some construction work areas will need temporary site connections to foul sewer (for office and welfare facilities) or in some cases this will be collected on site and disposed of appropriately. It is likely that any 'grey water' from site works will be collected and prior assessed for potential re-use, requiring appropriate cleaning and storage tanks.

18.6.1.2 Management of Discharges

Prior to commencement of construction, the contractor will prepare method statements for discharge of construction water discharges. Further discussions will take place with the relevant authority to determine the required permit licence agreements to permit the discharge of water during the Construction Phase to either sewer or to ground. Where applicable, it is proposed that all water will be discharged to sewer. A treatment train and monitoring will be undertaken to meet the requirements of the permit licence operation. The monitoring program will be set by the Local Authority and will be abided by the works Contractor.

The design of each treatment train will depend on the activity at each construction compound as outlined in Diagram 18.14 below. Stormwater and any dewatering will be collected and stored (if required) prior to discharge to the site-specific treatment plant. There will be no direct discharge to any identified water course without adequate attenuation and discharge will be controlled by a hydrobrake to mimic greenfield runoff rates as per Appendix A18.5.

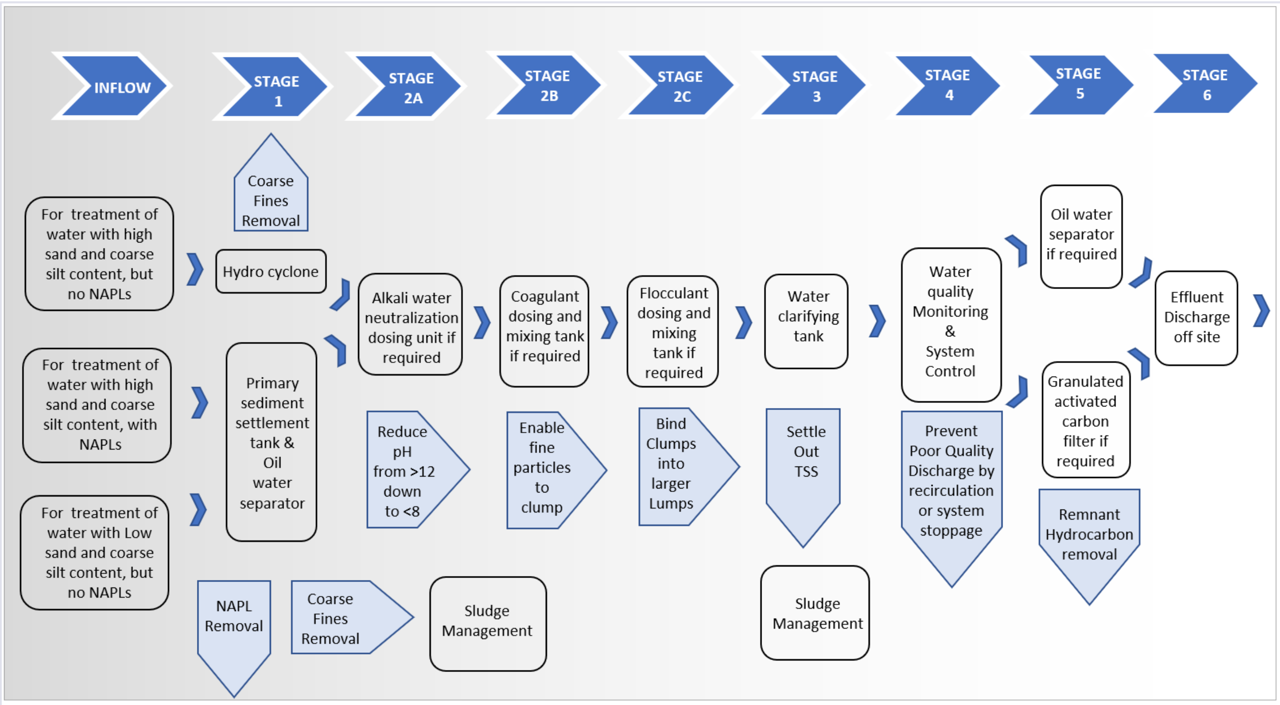

Diagram 18.14: Treatment Train Schematic for Water

Where excavations include significant placement of concrete and/or bentonite, there is potential for alkaline discharges to occur. When this concreting is being carried out, the discharge water will require additional treatment including pH neutralisation. A continuous pH monitor will be installed on the discharged water from the treatment plant. It is proposed that discharge water pumped out during the concrete works where it exceeds a pH of 6-9 pH units is either re-circulated for further treatment, removed off site for appropriate treatment and disposal, or treated on site and discharged into the foul sewer, with due permission from Irish Water.

Where used, any sedimentation system and/or pond capacity and treatment plant will allow adequate settlement of suspended sediment. However, daily visual inspection will be undertaken by the contractor at the outfall(s) to ensure adequate internal settlement is occurring. Where the visual assessment highlights elevated suspended sediments higher than expected, the water will be re-circulated for further treatment. Samples will be taken at regular intervals and suspended solid levels checked and recorded for inspection.

Detailed monitoring requirements will depend on discharge permit agreements put in place prior to any works commencing. The installation of continuous monitoring equipment may be required as part of the temporary discharge permit and/or licence. This would include the installation field monitoring probes connected to telemetry system to continuously monitor parameters such as temperature, pH, TOC (Total Organic Carbon), total suspended solids (TSS), total dissolved solids (TDS) and EC (Electrical Conductivity).

The use and management of concrete in or close to identified watercourses will be carefully controlled to avoid spillage potential. Where on-site batching is proposed, for example at the north of the development at Estuary, this activity will be carried out at a significant safe distance from the nearby watercourses. Washout from such mixing plants will be carried out only in a designated contained and impermeable area and washing out of associated vehicles will only be authorised in designated contained areas.

18.6.1.3 Management of Flood Risk

In terms of managing the potential for flood risk, the following will apply.

- Construction compounds will not be set up on lands designated as Flood Zone A or B in accordance with the OPW 'Planning System and Flood Risk Management Guidelines' (2009).
- The flood risk on a construction site can be mitigated through the design, land use, methodology, attenuation, drainage and programming of construction activities. This can be done through alternations to the permanent design, methodologies used for construction, changing the construction sequence, site layout and use during construction and programming high risk activities during specific periods of the year.
- The design of all sites during construction must take into account the flood risk of the site and mitigate any increase in risk of harm. Every site will be unique due to the factors listed above and a specific assessment is needed to determine what level of mitigation is needed. Below are general factors to be considered in planning, designing and operating the site during construction:

- Minimise areas of open ground or stockpiles of soil: exposed ground increases the sediment content of flood waters which can cause environmental damage and clog drainage networks. This can be done through minimizing topsoil removal and covering haul road with tarmac.
- Drainage: All areas of site should have an appropriate drainage with sufficient capacity. Drainage should discharge to a controlled location following necessary settlement or treatment.
- Attenuation: Construction sites tend to have less attenuation of water than its previous use and have contents that pollute. In some cases, it may be necessary to have capacity to attenuate a flood event and to treat flood waters before discharge from site. This can be using features such as settlement lagoons or tanks.
- Water Treatment: Where the water leaving site is contaminated it may be necessary to treat the water prior to discharging. This treatment system must have capacity to ensure drainage and/or attenuation is not overrun during storm events.

- The following responsibilities shall apply to the contractor.

- Obtaining updated modelled water levels from the OPW as well as updated information on the required standard of protection for flood defences.
- The contractor shall ensure that flood risk is managed safely throughout the construction period and that all designs comply with the flood risk assessed in the EIAR and include provision of a safe refuge for flood events.
- A flood risk compliance procedure will be included in the water quality management plan/flood protection plan. This will take a risk-based precautionary approach, using the source-pathway-receptor concept, and will apply to temporary and permanent works.
- Temporary mitigation measures shall be employed to mitigate the risk of flooding to structures on a construction site. These can be installed for the duration of the works or at time where flood risk has increased.
- Sheet piling and cofferdams: shall be required at the piers situated adjacent the Broadmeadow and Ward Rivers and anywhere where construction activities are to occur on or near flood zones.
- Sandbags: used for temporary flood protection typically a short-term measure.
- Mobile and inflatable barriers.
- Existing flood defences shall be monitored for stability for surface construction, tunnelling, dewatering, filtration and river works.
- Materials on a construction site are a significant risk to the environment and should be managed for flood events. Materials carried away may also come into contact with structures, causing them damage. The flood risk for materials can be mitigated by:
- Keep materials on site in a flood barriered area or at higher levels, such as raised ground or platforms.
- Keep materials away from flood plains and flood risk areas.
- Only bring materials onto site when needed.
- Keep onsite material storage to a minimum, such as daily requirement, with larger quantities kept off site.
- Only remove existing ground and topsoil when work requires.

- Remove materials offsite prior to a forecasted flood event.
- Keep materials in watertight containers where possible.
- Anchor down materials that may float away.
- Ensure site hoarding can contain materials that may float away.
- Covering of storage areas for material which has been stockpiled, to prevent silt runoff.

- Flood protection and mitigation measures set out in the pre-construction works need to be supported in the Construction Phase to be effective. This is done by monitoring the EPA alerts and guidance, monitoring weather and monitoring water levels of nearby watercourses. This is particularly important for sites located on or near flood plains, such as Broadmeadow Viaduct and the nearby Broadmeadow River and Ward Rivers. The monitoring will give advance warning allowing for temporary flood protection to be deployed and material mitigation measures to be adopted.
- If a flood event during construction occurs, safety and mitigation measures need to be in place to allow for a response. These measures will add to the protection of structures, workforce and responders.
- Drainage, silt and water management is to be inspected during a flood event. Site fencing should be secured, and any access points closed. This will prevent buoyant materials and equipment from being washed away from the site causing damage to the environment. It will also prevent items being carried into the site and impacting construction works.
- Site utilities and isolations points should be situated in areas that are easily accessible and protected from flood waters. In the event of a flood, utilities should be isolated, particularly generators and mains connections, to reduce the dangers. If utilities and conduits are sufficiently protected and not impacted by flood waters, they can remain operational.
- Plant and equipment should be relocated during a flood event. The plant and equipment should be moved to areas that are protected through barriers or elevated above the flood waters. Plant and equipment should be isolated from their connections and if they hold significant fluids and hazardous materials, such as Silt Busters and Water Treatment plants, they should be sealed and emptied where possible.
- Implementing the necessary measures will reduce the impact of the flood on the site and the impact that the site has on the local environment.
- If flood waters only partially impact the site, construction activities may be able to continue. The continuation of works should consider that waters may rise further and ensure safe access and egress.
- If a flood event occurs during construction, the correct procedures and legislation need to be followed during site clean-up and reinstatement.
- Flood waters carry germs, bacteria and diseases that are hazardous to health and environment and may be further contaminated by sewage or materials and chemicals during the flood event.
- PPE that provides adequate protection for dealing with contaminated waters should be stocked on site. This will provide sufficient protection to workers when dealing with flood clean-up. Suitable and sufficient procedures should also be in place, such as method statements and risk assessments, to further protect the workforce carrying out clean-up works.
- Any flood waters that have collected on site will also need to be suitably and sufficiently managed. Due to their contaminated nature, they may not be able to be discharge without further settlement or treatment. Any discharge into a sewer will require a discharge permit from the Local Authority. The permit will stipulate that the water achieves specific quality standards. It may also refuse discharge, resulting in water being treated and removed offsite for further treatment or disposal. If disposed of via the usual methods, it is important to ensure that any additional treatment is given as the water on site may be of a different quality than that usual treated and may not achieve the quality standards for discharge with the usual treatment. There are no discharges of water during the Construction Phase to any watercourses.

Overall, the Project is susceptible to flooding during the Construction Phase. Start of Route to Seatown crosses the Broadmeadow and Ward Rivers and their flood plains. These sections will need to make use of:

- Heights of sheet piles extended for sheet piles excavations
- Raised capping beam for retained cuttings

- Permanent flood mitigation measures programmed to be done in advance
- The use of sheet piles and cofferdams for protection of viaduct piers
- Inflatable barriers to protect haul roads
- Plant and materials not to be left on the flood plain.

Shafts and box structures are exposed to unexpected flood events through burst watermains and surface water flooding. The flood risk to these structures can be mitigated through the construction of an upstand wall and material mitigation.

Retained cut and cover structures can mitigate their flood risk through the use a raised capping beam and material mitigation.

Earthworks structures such as open cuts and embankments have a flood risk from surface water flooding. This can be mitigated against through the use of material mitigation and inflatable barriers.

Although flood mitigation measures have an upfront cost and can increase the duration of the works through their installation time or resequencing, the measures can avoid the penalties of a flood event.

18.6.1.4 Management of Fire Water

In terms of managing the firewater, the following will apply:

- In the event of an emergency tankering contaminated water from each site to an approved facility for disposal. The management of the potential water that is contaminated with fire products will be detailed in the project-specific CEMP.

18.6.2 Mitigation During Operation

18.6.2.1 Water Quality Mitigation

The potential for impact on water quality as a result of stormwater discharge is low during operation. The vehicles are electrically operated so limited potential for contaminated run-off along the rail link as a result of minimal use of lubricants and chemical for operational maintenance. There is also limited requirement for bulk chemical storage. Measures included in the design to protect water quality are outlined in Section 18.2.1 Project Description. There are no further mitigation measures required. Due to the size and type of development, it is envisaged that the Dardistown Depot will discharge storm water/or nearby watercourse and to sewer, subject to licence from Irish Water.

A programme of regular inspection of operational design discharges will be undertaken as part of the long-term operation and maintenance programme.

18.6.2.2 Flood Risk Mitigation

The project design incorporates specific measures to ensure that the project will not be impacted by flooding or result in any off-site flooding as a result of the construction (see section 18.2.2). No further mitigation measures are required.

18.1.1.1 Management of Fire Water

In terms of managing potential firewater, the following will apply.

- In the case of fire in the above ground structures, any water contaminated by firefighting operations will be contained within a fit-for-purpose attenuation pond/tank (for example P&R and Dardistown Depot) discharged safely in agreement with the EPA, Irish Water and any other relevant stakeholders.
- In the case that a fire breaks out in an underground station or along the track, the drainage system will be designed with an automatic shut off valve. This shut off valve will be activated in the event

of a fire. The firewater will then be contained within the drainage system prior to pumping it out for appropriate disposal off-site.

- Apply measures to prevent fire from occurring through removing or reducing the cause including measures to respond and manage an outbreak of fire, and measures to mitigate the impact of the response activities.
- A fire detection system will be installed and will include public announcements and video analytics.
- A Fire Safety Strategy prepared for tunnels will be drawn up in line with best practice specifications.
- Inspection and maintenance of drainage.

18.7 Residual Impacts

The residual impacts are those that would occur after the mitigation measures, as presented in Section 18.6 above, have taken effect. The following is a summary of the residual impacts associated with the hydrological environment:

- There is no increased flood risk as a result of the proposed Project. However, the proposed Project will result in new discharge points to existing watercourses. Although there will be some small conveyancing of water from one [track] sub-catchment to another (i.e. at proposed drainage catchment areas A1, A2, B, C1, C2-D1, E1 and E2) there is no overall net change to the discharge pattern or rate of discharge to receiving waters. The increase in run-off as a result of increased hardstanding will be managed by attenuation to greenfield run-off rates as included in the design for areas which were previously undeveloped, as such there is no overall increase in the rate of discharge. As expected for any significant development of this type there is a requirement for some modifications to natural land drainage. Where modifications such as culverting or re-alignment has been necessary, this has been designed to ensure good conveyance of flow with the aim of minimising all culvert lengths. The significance of the residual impact on river and stream flow is considered as Imperceptible to Slight and of Permanent duration.
- No significant local impacts to river or stream morphology are expected, based on the design measures included in the project for bridges, culverts, channel re-alignments and stormwater outfalls. These will minimise the potential for scouring and impact on the existing surface water flow regime in those receiving watercourses. Overall, the significance of the residual impact on river morphology is considered to be Slight to Imperceptible and of Permanent duration.
- There is potential for accidental spillages to result in water quality changes to receiving waters. However, as the trains are electrically operated, the potential for contamination is considered to be low. Maintenance and car parking areas will have oil/petrol interceptors included in their design to manage accidental discharges locally. The significance of the residual impact in this regard is considered to be Imperceptible and of Permanent duration.

There are no protected wetlands within the zone of influence of the proposed Project alignment or planned stormwater discharge points. There is also no potential for impact on down-gradient ecological sensitive receptors based on the low potential for water contamination during operation, and the mitigation measures incorporated in the proposed design (construction and operation), and the distance and dilution to these receptors. The significance of the residual impact in this regard is considered to be Imperceptible and of Permanent duration.

A summary of the likely significant residual impacts of the proposed Project on hydrology is tabulated below (Table 18.24) with associated mitigation measures. The residual impacts are based on the baseline assessment (refer to Table 18.15 above), implementation of the design and enhanced mitigation measures and the sensitivity of the waterbody.

Table 18.24 Summary of Potential Likely Significant Impacts and Residual Effects of the proposed Project on Hydrology

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
AZ1	Staffordstown Stream[16]	North of P&R Facility	Poor	*Importance: Extremely High*[17] *Ecological Importance*[18]*:* *Habitat - Local Importance (Higher Value)* *Atlantic salmon – National importance*	Construction – This river is not crossed by the proposed alignment however, it is located close to the lands where the P&R Facility will be constructed. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Increased flood risk if discharge is not attenuated.	Significant	Construction – The contractor will be required to operate in compliance with the project-specific CEMP and the outline Construction Environmental Management Plan (CEMP) refer to Section 18.6 of this report. This includes mitigating against silt-laden waters and monitoring discharge points.	Not Significant
					Operation – It is proposed to discharge treated (water to be discharged through soil and grit traps) and attenuated surface water from the Park & Ride Facility at Estuary to this watercourse.	Significant	Operation – The P&R Facility will be designed with attenuation measures, hydrobrake and a petrol interceptor to contain any localised spills of contaminates.	Imperceptible

[16] *Note: The Staffordstown Stream is often incorrectly referred to as the Turvey River*

[17] The hydrological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (National Roads Authority, 2009) and based on the ecological evaluation set by the ecologist. In addition, the distance to the Natura Sites, presence of important habitats, EPA WFD status and risk score was used to determine the hydrological importance of an attribute. For example, if a waterbody discharges into a Natura Site within 1km of the proposed Project, it is conservatively considered as *'Extremely High'*.

[18] The ecological importance of an attribute has been determined with regard to the examples set out in the TII guidelines (National Roads Authority, 2009) and advice on how to determine the importance of an ecological feature provided in CIEEM guidelines (CIEEM, 2018). Refer to Chapter 15 (Biodiversity) for full details on these valuations.

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
AZ1	Lissenhall Great Stream	North of P&R Facility	Poor	*Importance: Medium* *Ecological Importance:* *Local Importance (Low value)*	Construction – Diversion of unnamed ditch which is part of the Lissenhall Great Stream catchment. There will be instream works and approx. 440m will be diverted to accommodate the P&R Facility. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Another potential impact is the changing of the hydrological environment with increase flood risk.	Significant	Construction – The contractor will be required to operate in compliance with a CEMP. Also, any instream works will be agreed with the IFI before any works commence.	Imperceptible
					Operation – Once, diverted there is no potential of water being discharged from the P&R. However, with the increase in hardstanding area, there is a potential of increase flooding.	Significant	Operation – As part of the design of the diversion, the installation of swales/detention basins for runoff attenuation	Imperceptible
AZ1	Broadmeadow River	Between Estuary and Seatown stations	Poor	*Importance: Extremely High* *Ecological Importance:*	Construction – The proposed viaduct will cross this waterbody. Without appropriate design or mitigation measures, the potential impacts include deterioration in water quality, change in river morphology and loss of habitat.	Moderate to Significant	Construction – The design of the viaduct and the construction methodologies ensures that there is no measurable impact on the Broadmeadow River. This is provided	Not Significant

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
				Habitat - Local Importance (Higher Value) *European eel – International importance* *Atlantic salmon – National importance* *All other fish species – Local Importance (Higher Value)*	Temporary in-river construction works will be required as part of this construction work.		via project-specific CEMP, detailed design of the viaduct structure, attenuation, and treatment of construction water.	
					Operation – With the increase in hardstanding, there is a potential flood risk downstream if the increase run-off is not appropriately attenuated.	Significant	Operation – As part of the design, the viaduct will be serviced by the proposed track drainage system and will be attenuated to greenfield rates to ensure no increase in run-off rates. Therefore, minimising off-site flooding.	Imperceptible
AZ1	Ward River	Between Estuary and Seatown stations	Poor	***Importance: Extremely high*** *Ecological Importance:* *Habitat - Local Importance*	Construction – The proposed viaduct will cross this waterbody. Without appropriate design or mitigation measures, the potential impacts include deterioration in water quality, change in river morphology and loss of habitat. Temporary in-river construction works will be required as part of this construction work.	Moderate to Significant	Construction – The design of the viaduct and the construction methodologies ensures that there is no measurable impact on the Ward River. This is provided via project-specific CEMP, detailed design of the	Not Significant

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
				(Higher Value) *European eel – International importance* *Atlantic salmon – National importance* *All other fish species – Local Importance (Higher Value)*			viaduct structure, attenuation, and treatment of construction water.	
					Operation – With the increase in hardstanding, there is a potential flood risk downstream if the increase run-off is not appropriately attenuated.	Significant	Operation – As part of the design, the viaduct will be serviced by the proposed track drainage system and will be attenuated to greenfield rates to ensure no increase in run-off rates. Therefore, minimising off-site flooding.	Imperceptible
AZ1	Greenfields Stream	East of Seatown station	Poor	***Importance: Extremely High*** *Ecological Importance:* *Habitat - Local Importance (Low value)*	Construction – No construction activities located close to this waterbody.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route; headwaters likely culverted.	-	-	-

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
AZ1	Gaybrook River	East of Fosterstown and Swords Central stations	Poor	*Importance: Extremely High* *Ecological Importance:* *Habitat - Local Importance (Higher Value)*	Construction – No construction activities located within or at this waterbody.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route.	-	-	-
AZ1	Gaybrook Stream North	East of Swords Central station	Poor	*Importance: Extremely High* *Ecological Importance:* *Habitat - Local Importance (Higher Value)*	Construction – proposed Project crosses this waterbody via cut and cover tunnel. Appropriately designed to manage flood risk. The alignment crosses a culverted section of this waterbody. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Increased flood risk if discharge is not attenuated. There will be associated instream works as a new culvert will be constructed as part of the proposed Project.	Significant	Construction – The contractor will be required to operate in compliance with a CEMP. Also, any instream works will be agreed with the IFI before any works commence.	Not Significant

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
					Operation – The proposed Project alignment will be constructed within the modelled floodplain for the Gaybrook Stream (North). The proposed development in this location will be constructed in a cut and cover tunnel. Therefore, there will be no impact on the existing floodplain storage volume. The proposed track location is within the 0.1% AEP flood risk zone (low risk). Owing to the extent of the track that is covered in the this reach and the diversion of the Gaybrook Stream North into a 900mm culvert, it is therefore considered that there is no risk of fluvial flooding from Gaybrook Stream North to the proposed Project.	Significant	Operation – The design of the cut and cover tunnel will be adequate to sufficiently manage any potential flood risk. It is also noted that localised drainage improvements have been completed in this location to reduce the existing risk of flooding (i.e. presence of the 900mm culvert).	Imperceptible
AZ1	Swords Glebe	West of Swords Central station	Poor	*Importance: Medium* *Ecological Importance:* *Habitat - Local Importance (Higher value)*	Construction – No construction activities located close to this waterbody. Waterbody is a tributary to the Ward River.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route.	-	-	-

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
AZ2	Sluice River	Between Fosterstown and Dublin Airport stations	Poor	*Importance: High* *Ecological Importance:* *Habitat - Local Importance (Higher Value)* *Brown trout – Local Importance (Higher Value)*	Construction – A box culvert is proposed to be constructed as part of this project. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Increased flood risk if discharge is not attenuated. There will be associated instream works for the proposed culvert will be constructed as part of the proposed Project.	Moderate	Construction – The contractor will be required to operate in compliance with a CEMP. Also, any instream works will be agreed with the IFI before any works commence.	Imperceptible
					Operation – The Sluice River will receive water from the proposed drainage system along the route. The potential impacts associated with the discharge of water into a watercourse is increase downstream flooding and impacting on water quality.	Significant	Operation – The design of the culvert will be adequate to sufficiently carry water from this waterbody and will not impact on the river's morphology. The discharge of treated water will be attenuated to greenfield rates and will be removed of any potential contaminates.	Imperceptible

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
AZ2	Marshallstown Stream	Between Fosterstown and Dublin Airport stations	Poor	*Importance: Medium* *Ecological Importance:* *Habitat - Local Importance (Higher value)*	Construction – No construction activities located close to this waterbody. Waterbody is a tributary to the Sluice River.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route.	-	-	-
AZ2	Cuckoo Stream	South-east of Dublin Airport	Poor	*Importance: Medium* *Ecological Importance:* *Habitat - Local Importance (Higher Value)*	Construction – No construction activities located close to this waterbody.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route. The tunnel alignment will cross beneath this waterbody.	-	-	-
AZ3	Mayne River	Between Dublin Airport and Dardistown stations	Poor	*Importance: Medium* *Ecological Importance:* *Habitat - Local Importance*	Construction – Channel will be diverted for the construction of the Dardistown Depot. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species.	Moderate to Significant	Construction – The contractor will be required to operate in compliance with a project-specific detailed CEMP. Also, any instream works will be agreed with the IFI before any works commence.	Imperceptible to Not significant impact

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
				(Higher Value)	Operation – As the watercourse diversion will be designed appropriately to ensure there is no measurable impact on the surrounding hydrological environment. In terms of the increase hardstanding associated Dardistown Depot, there is a potential impact of increased flooding. Furthermore, the Depot will contain bulk fuel which could enter the nearby waterbody and impact on the water quality.	Significant	Operation – The increased run-off will be attenuated to greenfield run-off rates to ensure no off-site flooding. Bulk fuels will be stored on hardstanding areas within appropriately designed bunds. Therefore, any spill or leak will be fully contained.	Imperceptible
AZ3	Santry River	Between Dardistown and Northwood stations	Poor	***Importance: Medium*** *Ecological Importance:* *Habitat - Local Importance (Higher Value)*	Construction – Existing culvert is maintained, and localised channel realignment proposed at this waterbody. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Accidental leaks from chemicals and fuels associated with construction sites.	Moderate	Construction – The contractor will be required to operate in compliance with a project-specific detailed CEMP. Also, any instream works will be agreed with the IFI before any works commence.	Imperceptible to Not Significant
					Operation – As the watercourse diversion and culvert will be designed appropriately to ensure there is no	Significant	Operation – The increased run-off will be attenuated to greenfield run-off rates	Imperceptible

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
					measurable impact on the surrounding hydrological environment. Discharge of operational water from Northwood station and track drainage systems. The potential impacts associated with the discharging of water is increased run-off and contaminates entering the waterbody which will impact on the water quality of the river.		to ensure no off-site flooding. Furthermore, the proposed drainage system will contain petrol interceptors to ensure fuels are contained.	
AZ4	Bachelors Stream	West/south-west of Collins Avenue Junction (DCU)	Poor	*Importance: Medium* *Ecological Importance:* *Habitat - Local Importance (Higher value)*	Construction – No construction activities located close to this waterbody.	-	-	-
					Operation – Watercourse is not crossed directly by proposed route. The tunnel alignment will cross beneath this waterbody.	-	-	-
AZ4	Tolka River	Between Griffith Park and Glasnevin stations	Poor to Moderate	*Importance: Very High* *Ecological Importance:* *Habitat - Local*	Construction – No construction activities located close to this waterbody. However, as it is a major river, it will receive treated water from construction sites within the catchment.	Significant	Construction – The contractor will be required to operate in compliance with a project-specific detailed CEMP. All construction sites will be installed with water treatment	Imperceptible

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
				Importance (Higher Value) *European eel – International importance* *Atlantic salmon and Lamprey species – National importance* *All other fish species – Local Importance (Higher Value)*	The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Accidental leaks from chemicals and fuels associated with construction sites.		systems and will be monitored weekly to ensure no impact to the surrounding hydrological environment.	
					Operation – The proposed route crosses beneath the Tolka River at St Mobhi Road in tunnel approx. 6m beneath the river. Geological setting is alluvium (connectivity) underlain by [possibly thin sequence] low permeable Tills. However, this major river will receive water from nearby stations. The potential impacts are increase run-off, increase in contaminates and changes to the river morphology.	Significant	Operation – All water will be attenuated to greenfield run-off rates and the proposed drainage systems will contain petrol interceptors to ensure that any contaminates are contained.	Imperceptible
AZ4	Royal Canal	Between Glasnevin and Mater Hospital stations	-	*Importance: Very High* *Ecological Importance:* *National Importance*	Construction – The Glasnevin station will temporarily affect the Royal Canal, with a working area to be created in the canal basin, resulting in the closure and temporary draining of this section of the canal. The potential impacts are the discharge of construction water to the waterbody which could cause	Significant	Construction – The contractor will be required to operate in compliance with a project-specific detailed CEMP. All construction sites will be installed with water treatment systems and will be	Imperceptible to Not Significant

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
					deterioration in surface water quality and associated potential risk to aquatic species. Accidental leaks from chemicals and fuels associated with construction sites. Furthermore, the loss of amenity value as it will be close for approx. 6 months during the Construction Phase.		monitored weekly to ensure no impact to the surrounding hydrological environment.	
					Operation – There are no potential impacts associated with the proposed Project on the Royal Canal.	-	-	-
AZ4	River Liffey	Between O'Connell Street and Tara stations	Moderate	*Importance: Very High* *Ecological Importance:* *Habitat - National Importance* *European eel – International importance* *Atlantic salmon –*	Construction – No construction activities located close to this waterbody. However, as it is a major river, it will receive treated water from construction sites within the catchment. The potential impacts are the discharge of construction water to the waterbody which could cause deterioration in surface water quality and associated potential risk to aquatic species. Accidental leaks from chemicals and fuels associated with construction sites.	Significant	Construction – The contractor will be required to operate in compliance with a project-specific detailed CEMP. All construction sites will be installed with water treatment systems and will be monitored daily to weekly (site inspections & water sampling) to ensure no impact to the surrounding hydrological environment.	Imperceptible

Ref.	Waterbody Name	Location with regard to Proposed Route	Current WFD Status	Importance of Attribute	Impacts with the Potential to result in Likely Significant Impacts	Potential Impact Significance	Design & Mitigation Measures	Residual Impact
				National importance *Sea trout – Local Importance (Higher Value)*	Operation – The proposed route crosses beneath the River Liffey in tunnel, approx. 8m below the river. Geological setting is predominantly alluvium with variable permeability which sits upon the Calp Limestone. However, this major river will receive water from nearby stations. The potential impacts are increase run-off, increase in contaminates and changes to the river morphology.	Significant	Operation – All water will be attenuated to greenfield run-off rates and the proposed drainage systems will contain petrol interceptors to ensure that any contaminates are contained.	Imperceptible

18.8 Difficulties Encountered

Items of note with regard to the collection of specific data or assessing impact potential are presented below.

18.8.1 Surface water sampling

Surface water sampling was carried out in summer and winter months, respectively to gain a greater understanding of water quality between seasons. However, during summer months some waterbodies were noted as dry, and no water samples could be collected. These locations (waterbodies) can be found in the surface water monitoring field sheets in Appendix A18.1 to A18.3. Therefore, there were no water quality results for this sampling round. For example, the Ballymun Stream (SW13) was dry during the sampling round 1 in 2018. However, surface water sampling was mainly carried to gather water quality data to ensure that there was no impact during the Construction Phase. There is no discharge of construction water to open waterbodies as all arising from the Construction Phase will be discharged to the nearest sewer. Therefore, the absence of this surface water quality does not affect our assessment as there is no discharge during construction to any open watercourses. All construction water will be discharged to sewer.

Furthermore, rivers that are mapped by the EPA were culverted and difficult to sample in the field. For example, the Sluice River (SW19) is partially culverted and was difficult to sample.

In general, there were access constraints trying to sample the selected waterbodies along the project alignment and pre-determined sample locations were slightly moved due to these constraints.

18.8.2 Online Data Compilation

While the EPA online data base is a beneficial source of data, there are still many waterbodies (rivers and streams) that are not sampled at all. Therefore, there is no long-term data set that can be used when assessing these hydrological features.

18.9 References

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18.10 Glossary of Terms

Acronym	Meaning
Base flow	That part of the stream discharge that is not attributable to direct runoff from precipitation or melting snow; it is usually sustained by groundwater discharge.
Baseline monitoring	The establishment and operation of a designed surveillance system for continuous or periodic measurements and recording of existing and changing conditions that will be compared with future observations.
Discharge area	An area in which water is discharged to the land surface, surface water, or atmosphere.
Electrical Conductivity	Measure of the ability of material to conduct an electrical current. For water samples, it depends on the concentration and type of ionic constituents in the water and temperature of the water; and it is expressed in siemens per meter.
Hydrobrake	A device that manages low, moderate and high flows to deliver low-impact drainage from single sites to large networks.
Phreatic Water	Natural water table where all pores and fractures are saturated with water.
River Morphology	Shapes of river channels and how they change in shape and direction